XESS® User's Guide

Version 5.0

Applied Information Systems
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1

Introducing the XESS Spreadsheet

The Best Spreadsheet for
Business, Technology, and Personal Use

Overview

The XESS spreadsheet application is designed specifically for users who want familiar spreadsheet functionality with ease-of-use right on their X Windows platform — without any emulators! By using the intuitive XESS user interface, you can easily access its powerful computational, reporting, and graphing tools. You need only a few keystrokes or mouse clicks to analyze your data and then present the results with graphs ranging from simple line plots to 3D surfaces. You can create nice reports just as easily. And you can just as easily publish them as web pages.

The XESS spreadsheet provides a flexible and comfortable visual environment in which to handle simple or complex calculations and data manipulations — and anything in between. It calculates a full range of mathematical, statistical, matrix and string functions — all with the ease of a familiar spreadsheet format with point-and-click screen displays and pull-down menus.

XESS 5.0 is fully compatible with previous versions of itself.. References to XESS throughout this document refer to any version of the XESS spreadsheet. Things which are applicable to a specific version of the XESS spreadsheet (e.g. XESS SE, XESS V5) are qualified as such. The XESS spreadsheet is highly compatible with other spreadsheets such as Excel and Lotus.

The XESS product line includes spreadsheet products for most Linux, UNIX, OpenVMS, and Windows NT systems. Other products are available which provide additional capabilities, including a developers SDK for tightly integrating with other applications, the xsBasic Macro and Scripting facility, and various industry-specific applications.

Computational Functions

XESS supports all arithmetic, Boolean, and logical operators available in the C programming language, plus special XESS matrix functions which allow matrix, vector, Fourier transform, and similar operations to be entered and recalculated as simply as other spreadsheet functions.

Other features of XESS calculations include:

- lots of room for your data and calculations — XESS supports up to 10,000,000 rows, 4095 columns, and 4095 sheets in a workbook.
- constraint expressions that indicate when a cell value is outside predetermined or calculated boundaries.
- goal-seeking to calculate the value of an independent variable needed to achieve a desired objective.
- sorting data rows in ascending or descending order, numerically or alphabetically.
- powerful Find and Replace tools that quickly identify occurrences of data that meet specified criteria and optionally replace with different values.
- broad range of mathematical, statistical, and financial functions.
- extracting data based on certain criteria to create internal data aggregates.
- multi-variable, multi-rule solver.

Output Formats

You can save XESS files in the native XESS formats or in other common spreadsheet formats such as the WKS ,WK1, WK3, or XLS formats used by many spreadsheet programs. The XESS format has the advantage that it can be easily mailed among systems without the need for any filtering.

XESS directly creates print files in two formats for printing later or incorporating into other documents: ASCII or PostScript. This gives you the freedom to use the format best suited for your application. Filters are provided which support print preview and printing to non-PostScript printers (e.g. PCL).

The PostScript output format gives you flexibility of producing WYSIWYG output, with the printed output matching the chosen font styles and sizes, graphs, and images on the display. The PostScript Files created by the XESS Print operation are widely accepted into other documents.

You can also produce output in LaTeX or HTML formats for use in other applications or for display using browser technology.

You can create area, bar, stacked bar, line, scatter, X-Y, polar, histogram, pie, high-low, box, control, contour and surface graphs of the data in your spreadsheets, with user-selected formats, colors, scaling, axis characteristics, labeling, and annotation.

Using XESS

XESS is an X Window System compatible spreadsheet that runs under X11 release 5 or later on a wide variety of computers and operating systems. While many of the supported systems are Unix variants, Unix is not a requirement for XESS. XESS is supported on a number of X Windows platforms based on other operating systems (e.g. OpenVMS on VAX and Alpha AXP systems).

XESS was designed in accordance with Open Software Foundation, Inc. style guidelines for OSF/Motif software applications. Therefore, the look and feel of XESS should be familiar and intuitive to anyone who has used OSF/Motif applications before.

In fact, OSF/Motif conventions — such as pull-down menus, scroll bars, list boxes, pop-up dialog boxes, buttons to click on and off, and multiple windows — should look familiar to anyone who has used a windows type program, including those that operate on Apple or IBM-compatible personal computers.

XESS is designed to be easy to learn and easy to use:

- Operations are grouped by function in clear, concise, pull-down menus. Making a menu selection is as easy as clicking a selection or pressing a single key or key combination on your keyboard.
- Frequently used pull-down or pop-up menus (e.g. the **Cell Formats** list box) can be separated from the activation menu button so that they remain on-screen until you explicitly close the window or exit the application.
- The look and feel of operations is consistent throughout the program. When you see how one dialog box works, you understand how all dialog boxes work. The interface is as invisible as possible; all you need to concentrate on is the work to be done, not how to get it done.
- If XEss needs more information to carry out an operation, it prompts you with messages, pop-up dialog boxes, and list boxes. At every step, it is clear what you need to do to complete the task.
- If you make a mistake, XEss tells you. Whereas some spreadsheets beep unintelligible warnings, XEss gives error messages in descriptive terms that actually help you solve the problem.
- An Undo feature lets you restore the sheet and recover from mistakes. Multiple levels of Undo are supported.
- A Redo feature lets you *undo* the last undo.
- Help for XEss operations and functions is only a keystroke away — including a comprehensive Help Search facility.

Major Features of XEss

XEss disproves the old theory that sophisticated programs have to be difficult to use. XEss is feature-rich, but it makes these features accessible with convenient menus and dialog boxes. Here is a sampling of what you can expect from XEss in major functional areas:

Accessing Workbooks

- Create or open any number of XEss workbooks in a given session, limited only by the room on your screen and your system's memory. Of course, you can open, save and rename existing XEss workbooks.
- Open native workbook/spreadsheet files from Excel and Lotus and import data from text files arranged in tabular

format or with values separated by commas or user-specified delimiters.

- Dynamically link XEss workbook cells to cells in other XEss workbooks *(saved on disk or opened concurrently)*. You can even establish links in an XEss workbook which point to specific cells in Excel and Lotus files residing on disk.
- Use any of six convenient methods for moving around the spreadsheet: the keyboard, the mouse, the scroll bars, the sheet tabs, and the **Go To** and **Find** operations.
- Use keyboard and one-character mnemonics to access frequently used menu selections, streamlining your work.
- Create multiple views of your workbook data, each in a separate window. Move intuitively among the views (windows) while performing spreadsheet operations such as selections.
- Lock title rows and columns that stay in view as you scroll through a large spreadsheet or between sheets in a workbook.

Manipulating the Workbook

- Copy and move formulas and values anywhere within the workbook with automatic formula adjustment, and easily cut/copy/paste data to and from other X Windows programs visible on your display as well as within the workbook.
- Select cells and ranges with simple mouse or keyboard actions, or with the **Select Range** and **Select All** operations.
- Clear the contents of a cell, range of cells or the entire active sheet with a few simple actions. Delete rows and columns at any time, including the data they contain. All formulas automatically adjust accordingly.
- Assign and use names rather than cell coordinates for cells and ranges. Once assigned, you can use these names anywhere a traditional cell reference is accepted.
- **Undo** multiple levels of any of the above with a single keystroke or mouse click. **Redo** the last Undo.

Interacting with Other Applications

- Import, export, and paste data to and from other XEss workbooks, transferring data and formatting.

- Import formatted data from other programs, such as spreadsheet applications, tabular text reports, web pages,, and user-defined delimited files. Export data to other programs in ASCII, WKS, WK1, WK3, XLS, LaTeX, PostScript, HTML tables, tab-separated value, comma-separated value formats, or user-defined delimiter.
- Establish dynamic (live) links with specific cells in Excel and Lotus workbook/spreadsheet files saved on disk such that each linked cell value is automatically retrieved when the XEss workbook is first opened and with each XEss calculation.

Functions and Tools

- Use the **Go To** operation to position to a specific point in the workbook or use the **Find** operation to locate cells containing desired values or meeting specific criteria.
- Use the **Replace** operation to selectively or globally modify cell contents in a workbook which meet specified criteria.
- **Sort** rows of data in ascending or descending order, naming the primary column on which to sort, and if necessary, naming secondary columns to use when any of the values are equivalent.
- Use the **Transpose** tool to transpose blocks of data (switch rows to columns) with various options.
- Assign or remove cell protection to cells and ranges. When enabled for the workbook, you may select from three levels of cell protection —relaxed **(min)** which restricts some operations to rigid **(max)** which prohibits any user-made changes to the contents of protected cells. (Cells can still be changed upon recalculation.) Completely remove cell protection easily with the **Unprotect** operation.

Defining the Appearance of the Spreadsheet and Display

- Set defaults for language, currency, decimal point, and thousands separator from your workstation's Locale setting.
- Select default characteristics that affect the entire workbook, such as the size and position of the spreadsheet, display colors, cell format and fonts, and column width.
- Assign different characteristics to selected sheets and cells or ranges, such as bold type for the totals row, a date format for a column of dates, or a wider column to accommodate large values.

- Completely hide rows and columns.
- Assign colors, patterns, and font characteristics (point size, family, etc.) to specific cells or cell ranges on a sheet in a workbook.
- Change the alignment and orientation of cell contents at will: left-justified, right-justified, centered, or center-across-selection — horizontally, vertically, up, down.
- You can also select from many cell formats, including scientific notation, U.S. and International currency, date/time formats and others.
- Change grid line colors or remove altogether.
- Add **Cell Notes** and **Cell Borders** to specific cells or cell ranges on a sheet in a workbook.
- Include external graphical images in a wide variety of formats in your XESS spreadsheet or use the **Overlay Editor** to create graphical overlays which can be anchored to a location on the display or to a cell.
- Tailor the display using **Display Options** to further customize the XESS appearance such as removing row/column buttons.
- Set your own personal preferences for session and workbook defaults.

XESS Calculations and Functions

- Take advantage of natural, double-precision calculation, constraint-checking, and user-definable recalculation options.
- Use the **sum button** on the tool bar to insert quick calculations.
- Add criteria to calculations to check for valid results (**constraint checking**).
- Support all the arithmetic, conditional, and boolean operators available in the C programming language.
- Provide a wide variety of mathematical, statistical, conditional, string, and logical functions, designed specifically for scientific and engineering needs.
- Use special **matrix functions** that permit matrix, vector and Fourier transform operations.

- Perform iterative calculations.
- Perform "goal-seeking", deriving the value of an independent variable required to reach a stated objective for another cell.

Creating Graphs and Reports

- Create print files in ASCII and PostScript formats, to be printed later or imported into other programs that recognize these formats. Filters convert the PostScript output for printing on non-PostScript printers (e.g. PCL, HPGL).
- Use numerous page layout options to create nicely formatted reports and **preview** before printing.
- Create area, bar, stacked bar, line, scatter, X-Y, polar, pie, histogram, high-low, box, control, contour, and surface graphs of the data in your spreadsheets. You can customize the graph to suit your application, defining such options as axis labeling and scaling, colors, line and marker patterns, titles, legends, and annotation.

About this Manual

With the differences noted, the same manuals are used for all XEss systems. This book is one in a set of XEss Manuals:

- **Getting Started with XEss**, a basic guide for new users, tells you how to get XEss up and running, and includes a hands-on tutorial that introduces you to its basic features.
- This book, the **XEss User's Guide**, provides detailed information about using all XEss features and functions, including advanced features that are not discussed in the **Getting Started** book.

Manual Organization

The **XEss User's Guide** is addressed to users with differing levels of experience. It includes chapters on subjects of varying complexity, from basic spreadsheet concepts to using C-callable programming routines to establish real-time data links with other programs.

This guide is divided into thirteen chapters, several appendices, and a glossary of terms you may encounter while using XESS:

Chapter 1. Introducing the XESS Spreadsheet
provides an overview of system features and benefits.

Chapter 2. Basics
describes the basic skills you need in order to use XESS, such as using the mouse, using pull-down menus and pop-up dialog boxes and starting and ending an XESS session.

Chapter 3. Accessing Workbooks
explains how to create a spreadsheet or load an existing one, then name and save the spreadsheet. Also covered in this chapter is how to load multiple sheets simultaneously.

Chapter 4. Entering Data
explains how to enter data into cells, what are the valid contents of cells, and how to enable cell protection.

Chapter 5. Manipulating the Spreadsheet
explains how to move around the sheet, select cells and ranges, and make changes such as moving, copying, and deleting cells. This chapter is centered around the Edit and View menus.

Chapter 6. Calculations
describes how XESS performs calculations, how to change calculation options such as automatic recalculation, iteration limits, and constraint-checking. Plus it explains the anatomy of XESS formulas.

Chapter 7. Built-in Functions
introduces the mathematical, statistical, logical and other functions you can use in formulas.

Chapter 8. Defining the Appearance of the Workbook
explains how to set column width, cell format, and other appearance options such as cell fonts and colors.

Chapter 9. XESS Tools
discusses tools such as goal seek, sort, and extract.

Chapter 10. Interacting with Other Applications
explains how to transfer data to and from other X Windows applications.

Chapter 11. Printing the Spreadsheet
explains how to customize page layout options and direct your output to a printer, file, or third-party product such as a PostScript previewer.

Chapter 12. Graphs
describes the various types of graphs and the options that affect them.

Chapter 13. Graph Tutorial
explains how to create line, area, bar, stacked bar, histogram, pie, hi-lo,box, control, polar, contour, and surface graphs, plus how to print graphs.

Appendix A. Function Reference
provides detailed descriptions of the individual functions.

Appendix B. XESS Resources
describes how to set defaults for various aspects of the spreadsheet and its appearance.

Appendix C. Error Messages
explains XESS error messages that appear in the Message Line area and directly in the cells themselves.

Appendix D. Internationalization
provides detailed description of how to tailor XESS for use in various locales and languages.

Glossary defines terms used in describing the spreadsheet

2

Basics

This chapter introduces you to some of the basic procedures involved in using XESS. It tells you how to:

- start an XESS session
- end an XESS session
- access sample spreadsheets
- use areas of the XESS display
- use the mouse or keyboard to operate XESS
- use XESS menus to activate operations
- get on-screen help
- use Xess in a non-English environment

Most XESS operations can be performed with either the keyboard or with the mouse (or similar pointing device). This document assumes that your workstation is equipped with a mouse and that mouse actions are used.

Starting an XESS Session

To start XESS from your operating system prompt,

Type: **xess** or **xess5**
Press: **[Enter]**

(On some keyboards, the **[Enter]** key is labeled **[Return]**.) On some systems, Xess may be started using a desktop icon.

XESS can also be invoked using one of the command-line options. To display the available command-line options, at the operating system prompt:

Type: **xess -h**
Press: **[Enter]**

The following text is displayed:

xess [options] [filename]

Options:

-cols c -c c	display "c" columns
-rows r -r r	display "r" rows
-size r c -s r c	display "r" rows and "c" columns
-position x y -pos x y -p x y	initialize upper left corner to "x,y"
-connect {a | r | l}	accept, refuse, or lock connections
-xsname text -xsn text	set connection name of this instance
-class class	set class name of instance (Xess5)
-verbose	show diagnostic messages at startup
-help -h	display this text and exit
-version -v	display current version number

If you have any trouble starting XESS it may not be installed on your workstation. Consult the XESS Installation Procedures, a separate document provided with your XESS distribution.

Ending an XESS Session

To end an XESS session: select **Exit** from the **File** menu. If you have made changes to any of the active workbooks, XESS displays the **Warning** dialog box as shown in Figure 2-1.

— **To save the changed version**, click the **Save** button. XESS saves the new version (possibly overwriting a previous version) and ends the session.

— **To discard your changes** and preserve the workbook on disk, click **Discard**. XESS discards the version on screen and ends the session.

— **To cancel the Exit operation**, click the **Cancel** button. XESS returns you to the active workspace without saving or discarding anything.

Figure 2-1 Warning Dialog Box

Spreadsheet Examples

The XESS distribution contains a sub-directory with examples of XESS workbooks. In this directory, a summary of files available is found in the workbook, **Examples.xs5**.

Using the Mouse

A mouse is a hand-operated pointing device that sends signals to your computer. For operations that can be performed with either the keyboard or the mouse, the mouse offers many advantages, such as an intuitive, point-and-click way of working and greater mobility when moving around large spreadsheets.

To move the mouse pointer (which usually appears on screen as an arrow), move the mouse across your desktop or mouse pad. To move the mouse pointer further than your mouse area allows, lift the mouse off the surface and reposition it.

The mouse has two or three buttons. Most XESS operations require only the left button (MB1). The right mouse button (MB3) is used

to activate a short-cut dialog. On a three-button mouse, the middle button (MB2) is the paste operation. On a two-button mouse, you simulate MB2 by simultaneously clicking MB1 and MB3.

Technique	Action
Point	Move the mouse pointer to a specific area of the screen.
Click	Quickly press and release the left button.
Double-click	Quickly press and release the left button twice.
Hold down	Hold down the left button while you perform some action, such as moving the mouse.
Drag	Press the left button and hold it down while you move the pointer.
Release	Release the left button after dragging.
Select	Hold down the left left mouse button and drag it over the area to be selected.
Paste	Click the middle mouse button to copy a selection to a new location.

Table 2-1 Mouse Actions

Using the Keyboard

The mouse provides a convenient and intuitive way to move around the XESS display and menus. As you become more familiar with XESS you may wish to use shortcuts that make routine operations much faster.

XESS provides two faster methods for many operations:

- **keyboard accelerators** execute menu selections with simple key combinations, whether or not the menu is displayed.

  A keyboard accelerator is a key or key combination that invokes a menu selection without displaying the menu. Not every menu selection has a keyboard accelerator. Those that do are marked with the accelerator key or key combination on the menu.

- **mnemonics** execute menu selections with a single keystroke while that menu is displayed.

  A mnemonic is a single character that provides a shortcut for making selections from the keyboard. Mnemonics are usually the first character of a command and are always marked on the menu with an underscore. While a menu is displayed, simply press the mnemonic character.

Keyboard Accelerators

A keyboard accelerator is a key or key combination that invokes a menu action without displaying the menu. Not every menu item has a keyboard accelerator. Those that do are marked with the accelerator key or key combination on the menu. They can be used when a spreadsheet view has focus as the active window and you are not in the middle of entering or editing the contents of a cell.

Many keyboard accelerators are formed by holding down the **Ctrl** key or the **Meta** key while pressing another key. This type of action is documented as **Meta + key** or **Ctrl + key** where **key** is the name of the key that is pressed. The **[Meta]** key on your keyboard may be labeled **[ALT]**, **[Compose]**, **[Meta]**, or be represented with a diamond. Some systems make a distinction between **[Meta]** keys on the left and the right of the space bar.

The definition of keyboard accelerators can be changed by modifying the XESS resources defined in Appendix B. The ones documented below are the default set.

XESS Keyboard Accelerators and special function keys are:

Key	Action
Delete or **Backspace**	Clear Cell or Range
Ctrl + a	Select All
Ctrl + b	Bold Font
Ctrl + c	Insert Column
Ctrl + d	Data Fill
Ctrl + f	Copy Formula
Ctrl + g	Go to
Ctrl + i	Italic Font
Ctrl + m	Move
Ctrl + n	Normal Font
Ctrl + o	Open Sheet
Ctrl + p	Repeat
Ctrl + r	Insert Row
Ctrl + s	Save
Ctrl + t	Insert Sheet

Ctrl + u	Undo
Ctrl + v	Copy Value
Ctrl + C	Delete Column
Ctrl + D	Redo
Ctrl + F	Format Range
Ctrl + I	Bold-Italic Font
Ctrl + R	Delete Row
Ctrl + T	Delete Sheet
Ctrl + V	Create new view
Ctrl + Space	Select
Ctrl + Meta + Space	Reselect
Meta + a	Automatic Alignment
Meta + c	Center Alignment
Meta + i	Center-over-selection Alignment
Meta + l	Left Alignment
Meta + p	Print Sheet
Meta + q	Quit
Meta + C	Close Sheet
Meta + N	New Sheet
Meta + R	Right Alignment
F2	Edit Cell
F3	Replace
Meta + F3	Replace Next Cell
F4	Toggle absolute/relative cell reference
F6	Find
F7	Find Next
F8	Find Previous
F9	Recalculate
F10	Shift focus to the menu bar
F11	Cancel Edit
Esc	Cancel Edit
Left Arrow	Move left one cell
Right Arrow	Move right one cell
Up Arrow	Move up one cell
Down Arrow	Move down one cell
Tab	Move to next unprotected cell
Ctrl + Tab	Move to previous unprotected cell
Ctrl + Left Arrow	Page left
Ctrl + Right Arrow	Page right
Ctrl + Up Arrow,	Page up
Ctrl + Down Arrow	Page down
Next Page/Page Down	Page down
Prev Page/Page Up	Page up
Home	Top of sheet -- cell A1
End	Last non-empty row
Ctrl + End	Right-most non-empty column

Shift + any motion	Select while moving cursor
Meta + arrow key	Advance to next "break" in data in the specified direction

Table 2-2 Keyboard Accelerators and Special Function Keys

Mnemonics

A mnemonic is a single character that provides a shortcut for making selections from the keyboard. Mnemonics are usually the first character of a menu item and are always marked on the menu with an underline. While a pull-down menu is displayed, simply press the mnemonic character. Pressing the mnemonic character has the same effect as selecting the menu choice with the mouse or the arrow keys.

To display a pull-down menu using mnemonics:

1) Press **[F10]** to shift keyboard focus to the menu bar (the File option will be highlighted by a square).
2) Type the underlined letter in the option you wish to select.
3) Repeat for each level of the menu structure until the final selection is made.

   OR

1) Press **[Meta]** and the underlined letter at the same time.

Mnemonics are a keyboard alternative to using the mouse or cursor to access menus. For tear-off menus, mnemonics can be used when the menu has focus.

Primary Spreadsheet Window

The primary Xess display has several distinct areas:

- menu bar
- toolbar
- edit line
- spreadsheet data area
- select all button
- row and column borders
- scroll bars
- sheet tabs and sheet tab scroll buttons
- message line

You can control which of these are actually being displayed by using the **Display Options** dialog from the **Options** menu.

There is a primary Xess display for each open workbook.

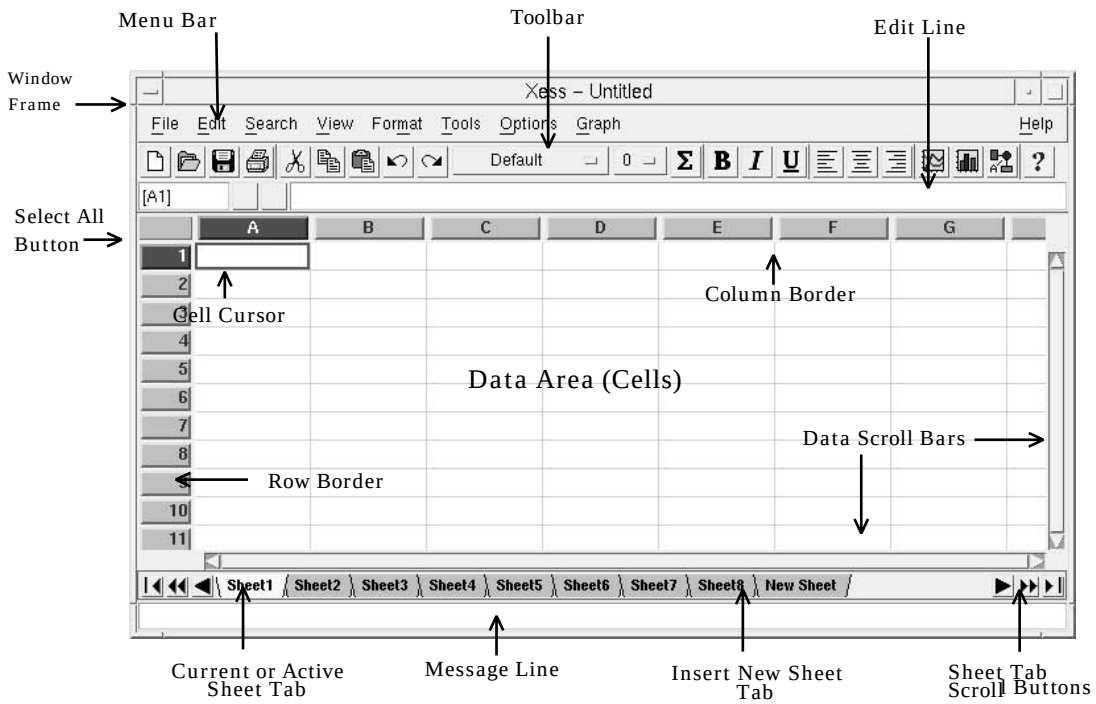

Figure 2-2 XESS Primary Display

Main Menu Bar

The main menu bar stretches across the top of the primary XESS display area, beginning with the word **File** and ending with the word **Help.** The words in the menu bar do not directly carry out commands; they are **buttons** that display pull-down menus organized in functional groups containing commands for XESS operations. If you open multiple workbooks within the same XESS session, each workbook will be attached to its own main menu.

- The **File** menu contains operations that read or write files to disk or other devices, link external graphical images to specific cells, and print.
- The **Edit** menu contains operations that modify cells in the spreadsheet.

- The **Search** menu contains operations for locating cells based on their values, and for replacing values.
- The **View** menu contains operations associated with navigation and creating new views.
- The **Format** menu has operations for changing the cell format and appearance for a cell or a group of cells and Cell Notes.
- The **Tools** menu includes special functions such as Sort, Transpose, Goal Seek, and Overlay Editor.
- The **Options** menu contains operations that define default options for spreadsheet functions, appearance, and locale settings.
- The **Graph** menu contains operations for defining the appearance of a graphic display of spreadsheet data and displaying a graph.
- The optional **Connections** menu contains operations for managing interactions with applications developed with the Software Developers Kit.
- The optional **Macro** menu contains operations associated with the xsBasic Macro and Scripting Language.
- The **Help** menu gives you access to on-line help.

These menu functions are explained in detail in other chapters of this **User's Guide**.

Toolbar

The Toolbar is a set of icons below the main menu as shown in Figure 2-3 . Each icon is a push button which provides a short-cut to the associated operation positioned from left to right as follows:

- New Workbook
- Open File
- Save File
- Print As
- Cut to Clipboard
- Copy to Clipboard
- Paste from Clipboard
- Undo

- Redo
- Cell Format Type
- Cell Decimal Places
- Summation
- Bold toggle
- Italic toggle
- Underline toggle
- Left alignment
- Center alignment
- Right alignment
- Line graph
- Bar graph
- Overlay Editor
- Help on...

Figure 2-3 Tool Bar

To display or remove the toolbar:

1) Select **Display Options** from the **Options** menu to display the dialog box.
2) Click the **Toolbar** check button *on* to display the toolbar shown in Figure 2-3 or *off* to remove.
3) Click **Apply** or **OK** to complete the operation.

Edit Line

The Edit Line is used for:

- viewing the full contents of the current cell, and
- entering and editing cell contents

It contains the current cell indicator, followed by two check boxes used for **accept** and **cancel** when edit mode is active, followed by the cell contents. The cell contents field is a scrollable field.

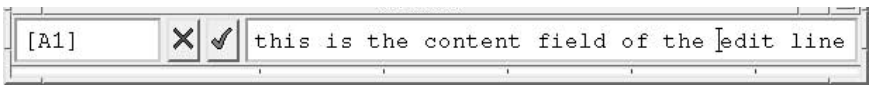

Figure 2-4 Edit Line

Data Area

The data area is a rectangular grid defined by a sheet reference (identified by a name on the sheet tab), columns (identified by letters) and rows (identified by numbers). Each block within this grid is a cell, which is where you enter data and formulas. Each data element in the grid has a unique location whose address is defined by the name convention, `Sheet!RC` (e.g. Sheet1!A1).

For sheets larger than the window, XESS shows only part of the sheet on screen at a time. To access other areas, you can scroll through the sheet using the **scroll bars** or the arrow keys on your keyboard. All components of the Data Area may be selectively removed from the display. from the Display Options dialog. Refer to Figure 2-2 to see each component described below.

Column Border

A horizontal row of letters that identify each column of cells in the sheet. The first 26 columns are labeled with single letters (A to Z); the remaining columns are labeled with double and triple letters (AA to FAN). The column of the current selection is highlighted in reverse video or a different color, depending on your monitor.

Row Border

A vertical column of numbers (1 to the maximum row allowed) that identify each row of cells in the sheet. The row of the current selection is highlighted in reverse video or a different color, depending on your monitor.

Select All Button

A push button at the intersection of the row and column borders (in the upper left section of the XESS display) selects all cells in the in the current sheet in a workbook. For example, if your maximum row number were 60,000, then the selection would be: A1..FAN60000.

Sheet Border and Sheet Tabs

A horizontal row of sheet tabs at the bottom of the Data Area (above the Message Line) that have sheet tab scrolling buttons on the far left and far right. One view always contains one active sheet. The tab of the **active sheet** is typically highlighted in some manner. Mouse button 3 (MB3) over a sheet tab displays a pop-up menu of operations on sheets.

To display multiple sheets within a workbook at the same time, you must create a view for each sheet and set each view to the desired active sheet.

Sheet Tab Scroll Buttons

To the left and right of the Sheet Tabs below the Data Area (just above the Message Line) are scrolling buttons which allows you to easily scroll the Sheet Tabs when the number of tabs exceeds the width of the window. In the figure below these are the three buttons on the far left and far right equating to reverse and forward tab scrolling respectively.

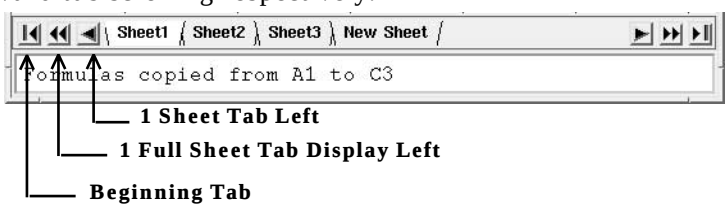

Figure 2-5 Sheet Scroll Buttons

Message Line

The message line is displayed at the bottom of the primary display. It is used to display status and error messages about a current operation or calculation condition.

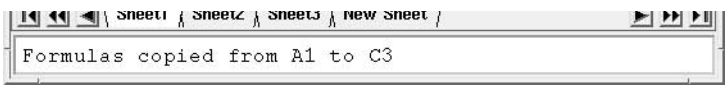

Figure 2-6 Message Line

Multiple Views

The primary XESS display for a workbook contains all of the elements shown in Figure 2-2. In addition, you may create multiple secondary windows of the spreadsheet data area to

display other areas of the current sheet or of other sheets in the current workbook. Secondary windows contain only the spreadsheet data, sheet tabs, and scrolling bars. They do not have a menu bar, toolbar, edit line, or message line.

Each secondary window can be sized, navigated, and manipulated independently using the main menu bar along with standard scrolling and window management facilities.

To create a secondary data window:

1) Select **Create New View** from the **View** menu.

To remove a secondary data window:

1) Select **Cancel** from the view window.

Display Options Dialog

By using the **Display Options** dialog of the **Options** menu, you can control which components are displayed.

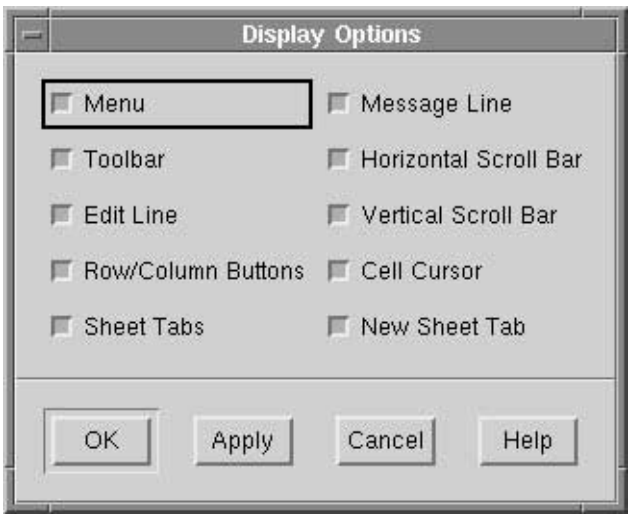

Figure 2-7 Display Options Dialog Box

How to Use Menus

The main menu bar is usually visible across the top of the primary XESS display area. There is a separate primary display area and menu bar for each concurrently open workbook.

When secondary data windows are displayed within the same workbook, the menu bar is not attached to each window; however, any operation invoked through the menu bar is applied to the window(s) containing the current cell. For

more information on this topic, refer to the topic, ***Multiple Views****, in the section,* ***Data Area****.*

. . . . . .

To view a pull-down menu from the menu bar:

1) Move the mouse pointer to the desired menu title.
2) Press the left mouse button.

OR

1) Press **[F10]** on the keyboard.
2) Use the arrow keys to move the highlight to the desired menu title.

OR

1) Press **[F10]**.
2) Type the underlined character in the menu selection you desire.

To select a menu action:

1) Display the pull-down menu from the menu bar.
2) Move the highlight to the desired menu selection.
3) Release the mouse button.

Menu selections can result in any of three actions:

- A menu selection can directly activate an operation such as **Edit Cell**, **Select All**, or **Exit**.
- A menu selection can lead to a cascading submenu that contains additional related operations or options. For instance, the **Copy** selection has a submenu that contains the selections **Copy Formulas** and **Copy Values.** The **Font Style** selection has a sub-menu that contains the selections **Default**, **Normal**, **Bold**, **Italic**, and **Bold-Italic**. Selections that have sub-menus are always marked with a right-arrow.
- A menu selection can display a pop-up **dialog box** for you to specify further information about the menu selection. For instance, the **Go To** selection from the **View** menu displays a dialog box for you to specify the destination of the **Go To** operation.

To display a submenu:

1) Display a pull-down main menu from the menu bar.
2) Move the highlight to a menu selection with an arrow next to it.

3) Move the mouse to the right to display the submenu.

To select a submenu item:

1) Pressing the left mouse button, move the highlight to the desired selection.

2) Release the mouse button.

*To avoid making a menu selection when you have displayed a menu, drag the pointer off the menu and release the mouse button. Keyboard users press the **[Esc]** or **[F11]** key.*

Mouse Button 3 Popup Menu

With a single mouse click you can access a popup menu allowing you to quickly invoke frequently used operations which effect selected cells. When you click the right mouse button (MB3) or its equivalent, a popup dialog box is displayed which contains most of the Edit and Format operations.

To invoke the short-cut menu:

1) Select the cells to be effected.

2) Hold down MB3 and traverse as needed to the desired operation and release.

To disable MB3 popup, change the resource `*popupMenu` in the Xess5 resource file to `False`.

If you are in the middle of editing data in a cell and click MB3, some operations will be greyed out.

Tear-off Menus

Most of the menus within the XESS Spreadsheet have the TearOff attribute, indicated by a dashed line at the top of the menu. When the line is selected, the menu is made into a separate window and acts much like a dialog box. It does not disappear after a selection is made.

When you are through using a tear-off menu, it may be dismissed. On the Motif Window Manager (mwm), **to cancel (close) a tear-off menu**, double-click the top left button of the tear-off window frame.

How to Use Dialog Boxes

XESS uses dialog boxes to accept user entries that define certain operations, such as formatting, sorting, and printing. Dialog boxes accept information by using:

- **check buttons** — square buttons that are clicked on and off to activate any number of selections that are not mutually exclusive.
- **option buttons** — rectangular button containing the current state of an option menu followed by a bar indicator; when clicked it displays the option menu.
- **list boxes** — boxes that present lists of information or choices, with scroll bars that work just like the scroll bars on the main XESS window.
- **slider** — bars that can be moved to change a parameter setting. Similar to a scroll bar.
- **data entry lines or boxes** — lines and boxes that contain information you type, such as a file name or cell location.
- **push buttons** — buttons that you click to activate your selection or cancel an operation, such as **Start, OK, Apply,** or **Cancel**. A **Help** button provides on-screen help describing dialog box functions.

Check Button

To activate a check button:

1) Move the mouse pointer to the desired selection.
2) Click the left button. The button will appear in reverse video or a different color, depending on your monitor.

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Keyboard users: Press the space bar to display button options or change on/off state.

. . . . . .

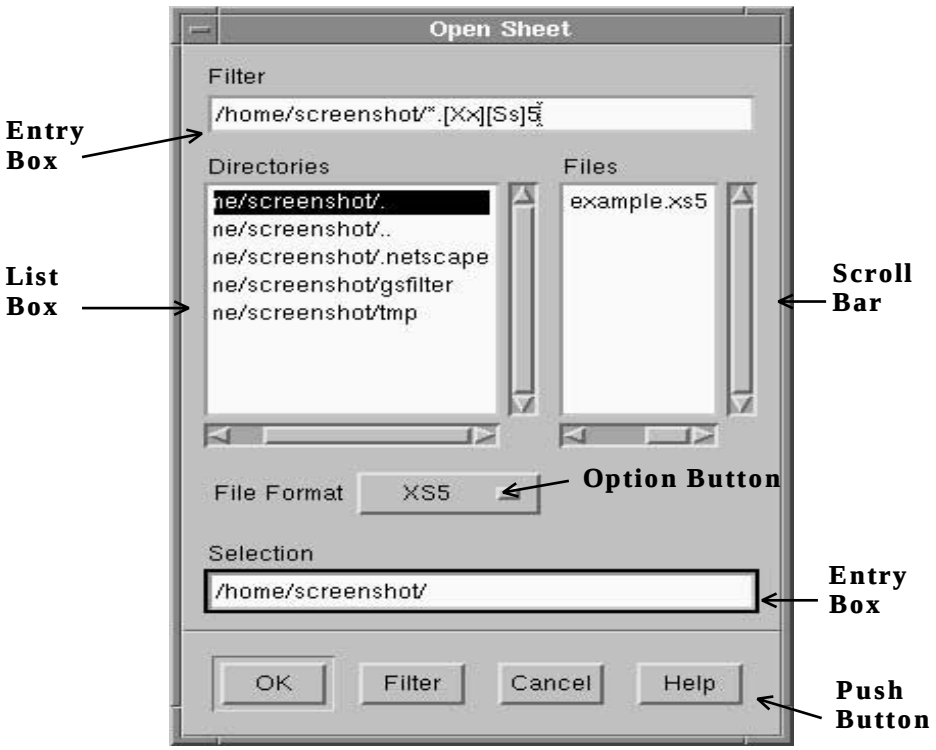

Figure 2-8 Example XESS Dialog Box 1

Option Button

To activate an option button:

1) Move the mouse pointer to the desired button.
2) Click the left button to display the option menu. While holding down the left mouse button move the pointer to the desired selection and release.

Slider Bar

To change the slider bar:

1) Move the mouse pointer onto the slider bar.
2) Drag the mouse to the right or left until the desired parameter is displayed above the slider.

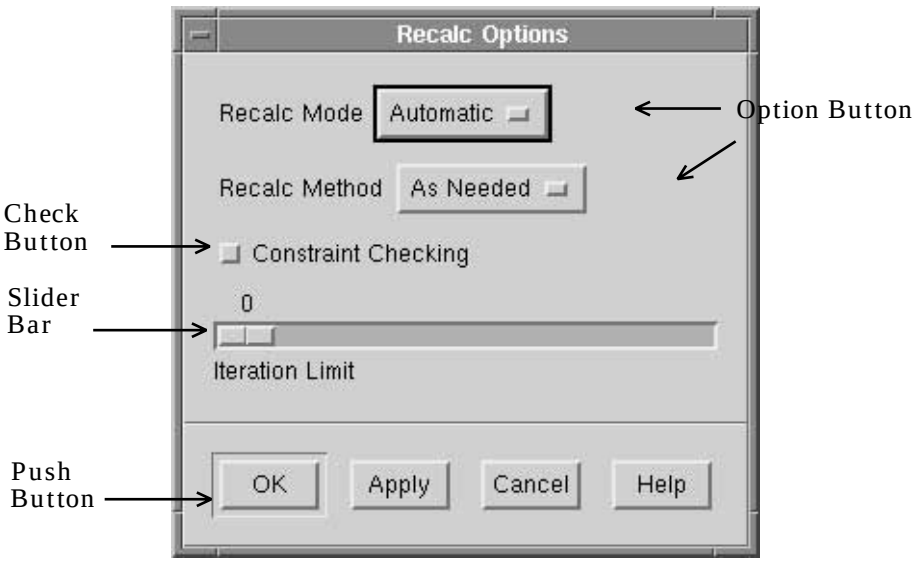

Figure 2-9 Example XESS Dialog Box 2

Data Entry Line or Box

To use a data entry line or box:

1) Move the mouse pointer to the desired location on the line.
2) Click the left button. The vertical bar cursor will blink, indicating that XESS is ready to accept text in that space.
3) Use the keyboard and numeric keypad to enter the information.

OK and Apply Buttons

To confirm and activate your entries:

1) Move the mouse pointer to the **OK** button at the bottom of the dialog box.
2) Click the left mouse button.

By clicking **OK** you *activate* your choices and dismiss the dialog box.

OR

1) Move the mouse pointer to the **Apply** button at the bottom of the dialog box.

2) Click the left mouse button.

By clicking **Apply** you *activate* your choices and keep the dialog box open. With the **Apply** button, you are able to quickly readjust or add more settings without having to reopen the dialog box.

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*Any applied spreadsheet action which is destructive to the data can be reversed using **Undo**. Ten (10) levels of **Undo** are supported by default. You can reverse the most recent Undo with **Redo**.*

. . . . . .

Cancel Button

To cancel your entries and return to the display:

1) Move the mouse pointer to the **Cancel** button at the bottom of the dialog box.

2) Click the left mouse button.

. . . . . .

*Note: **Cancel** does not undo changes that have already been applied.*

. . . . . .

Reset Button

Sets the fields in the dialog back to their default values. These values are derived from the user template file (if one is present), from the resource file, or from the standard default values.

Help Button

Each dialog box contains a Help button which is context-sensitive. It invokes on-line Help displaying the topic related to the dialog box. Once the XESS Help dialog box is open, you may select any other topic of interest from the Topic Index.

File Selection Dialog

All XESS operations which involve file input or output such as Opening, Saving, and Printing a workbook use the Motif standard File Selection Dialog with slight variations.

The **File Selection** dialog box displays an alphabetical list of all the files in the selected directory whose names meet the criteria in your **Filter.** The current directory name is displayed at the top of

the **Directories** list. If the lists are large, all the names may not fit in the boxes.

a) To move the selection highlight, use the up and down arrow keys, or move the mouse pointer to the desired name and click.

b) To scroll through the list of file names, click the up and down arrows along the right side of the list box, or drag the scroll box.

c) To jump to a specific alphabetical section of the list, type the first character(s) of the name of the file you are looking for in front of the asterisk (*). The dialog box then starts the display at the first file name starting with those characters.

To select a different directory, double-click on the directory name in the **Directories** list. XESS then displays the names of files in that directory in the **Files** list. Double-click on the second file in the **Directories** list change to the next-higher directory level.

To select a workbook, double-click on the workbook name, or click the name once and then click **OK** to complete the operation.

To cancel the operation after viewing the dialog box, click **Cancel**.

Window Frame and the Window Manager

The menu bar, edit line, data area and message line are all contained within a window frame. Window frames do more than enclose the Xess display area. They contain icons and menus that let you manipulate the size and position of windows on the screen.

You can have several windows open at once, move from window to window, change the size and position of windows on screen, and shuffle the order in which windows overlap one another. If several windows are open at once, all of them are active, but keyboard and mouse actions can address only one current window. In X Window System terminology, that window has the input focus.

The window frame and functions are not controlled by XESS but rather by your system's window manager program. The exact method for manipulating windows depends on the window manager program you are using. Xess should work with any X11 compliant window manager.

The following instructions assume that you are using the OSF/Motif Window Manager (`mwm`) from the Open Software

Foundation, Inc. Other window managers have different window frames and use different mouse and keyboard sequences to perform comparable actions.

OSF/Motif Window Manager windows usually contain the following functional elements:

- a **window menu** icon, located in the top left corner of the window frame
- a **minimize** icon, located in the top right corner of the window frame, that reduces a normal-sized window to an icon
- a **maximize** icon, located in the top right corner of the window frame, that enlarges a normal-sized window to fill the computer screen or reduces a full-screen window to normal size
- a **resize border,** located at the borders, that permits you to change the dimensions of the window

The Window Manager provides several options for manipulating windows with the keyboard, mouse and built-in shortcuts.

Current Window

To make a window current:

1) Move the mouse pointer into the window, or
2) Move the mouse pointer into the window and click the left mouse button.

Window Sizing

To enlarge the spreadsheet to fill the entire display:

1) Move the mouse pointer to the larger box icon at the upper far right of the window frame.
2) Click the left mouse button.

OR

1) Click the window menu icon at the top left of the window frame.
2) Select **Maximize** from the window menu.

To return a maximized spreadsheet to normal size:

1) Move the mouse pointer to the maximize button at the upper right corner of the window frame.

2) Click the left mouse button.

OR

1) Click the window menu icon at the top left of the window frame.
2) Select **Restore** from the window menu.

To change the dimensions of the window:

1) Position the mouse pointer in the window border. The pointer will change shape.
2) Press and hold the left mouse button. Drag the mouse until the fine cross-lines indicate the desired dimension.
3) Release the mouse button.

OR

1) Click on the window menu icon at the top left of the window frame.
2) Select **Size** from the window menu.
3) Press the left mouse button and drag the mouse until the cross-lines indicate the desired dimension.
4) Release the mouse button.

Iconifying (Minimizing)

To reduce the window to an icon:

1) Move the mouse pointer to the smaller box icon at the upper right of the window frame.
2) Click the left mouse button.

OR

1) Click the window menu icon at the top left of the window frame.
2) Select **Minimize** from the window menu.

To restore a spreadsheet that has been turned into an icon:

1) Move the mouse pointer to the icon.
2) Click the left mouse button.
3) Select **Restore**.

OR

1) Move the mouse pointer to the icon.
2) Double click the left mouse button.

Moving a Window

To move the window:

1) Move the mouse pointer to the title bar.
2) Press the mouse button. While holding the mouse button down, move the mouse to reposition the window.
3) Release the mouse button.

OR

1) Click the window menu icon at the top left of the window frame.
2) Select **Move** from the window menu.
3) Press the left mouse button and drag the mouse until the cross-lines indicate the desired position.
4) Release the mouse button.

To move the current window behind another window:

1) Click the window menu icon at the top left of the window frame.
2) Select **Lower** from the window menu.

To close the window and remove it from the workspace:

1) Display the **File** menu from the menu bar.
2) Select **Quit** from the File menu.

Keyboard shortcuts can be used to perform these functions. The keystrokes are marked beside the selection on the menus.

User Preferences

This dialog allows you to set personal display and operation attributes that are not tied to any specific workbook. These settings are shown in Figure 2-10. Settings are not saved in the workbook; instead they are saved in an Xess preference file in your default file directory. (On UNIX and Linux systems, the `.xesspref.rc` is a hidden file.) Preference changes are remembered from one session to another.

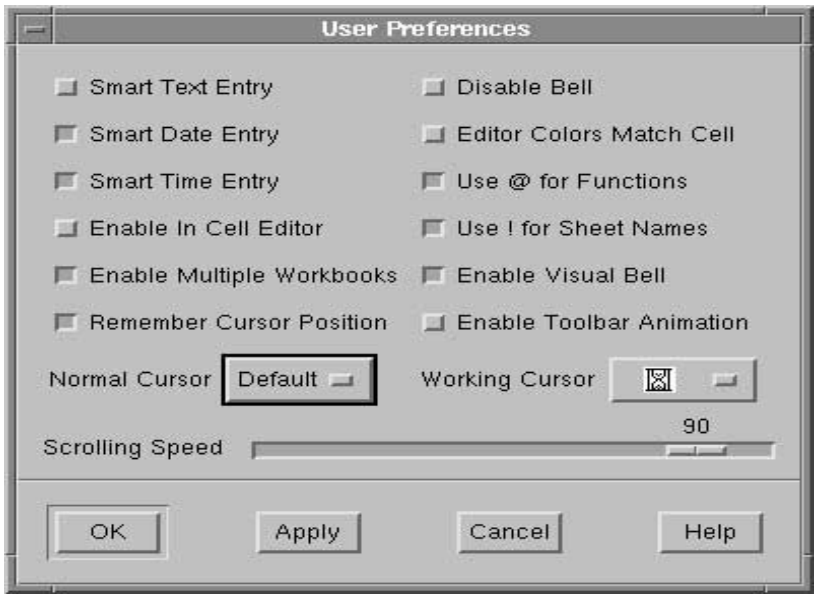

Figure 2-10 User Preferences dialog box

Smart Text Entry

When **Smart Text Entry** is enabled, it allows the entry of numeric and special data as text strings without them being processed as a formula. A typical use would be for entry of telephone numbers or social security numbers:

1-919-942-7801
561-042-563

See the section **Entering Text** for details.

Smart Date and Smart Time Entry

When **Smart Date Entry** or **Smart Time Entry** is enabled, Xess will recognize most dates and time entered without having to prepend the (/) when entering dates and times. Refer to Table 4-2 and the surrounding discussion for more details.

Enable In Cell Editor

When **Enable In Cell Editor** is selected, you can enter and edit data directly in the cell.

Enable Multiple Workbooks

When **Enable Multiple Workbooks** is selected, you can open more than one workbook in the same Xess session. Each workbook has its own primary window and menu bar.

Remember Cursor Position

When **Remember Cursor Position** is enabled, the active cell location is remembered for each sheet in a workbook. When you tab from sheet to sheet the cursor location may be different. When this option is disabled, the location of the cell cursor on the current sheet will be maintained when tabbing to different sheets.

Disable Bell

When **Disable Bell** is specified, the audible bell in the workstation is not used for error messages and similar actions.

Editor Colors Match Cell

When **Editor Colors Match Cell** is set, the within-cell editor uses the same colors as the current settings for the cell.

Use @ for Functions

When **Use @ for Functions** is set, the **@** character is displayed before each function name. Function names may be entered with or without the initial **@**.

Use ! for Sheet Names

If **Use ! for Sheet Names** is set, then the exclamation point is used to separate sheet names from cell names in cell references. Otherwise, a period is used to separate the names.

Enable Visual Bell

When **Enable Visual Bell** is set, a visual equivalent to the bell is flashed when the audible bell would be used. This is a flashing border around the accept/reject icons on the edit line or around the current dialog.

Enable Toolbar Animation

When **Enable Toolbar Animation** is set, a border is only shown around a Toolbar icons when the cursor is over the icon.

Normal Cursor

Normal Cursor provides a selection of cursor styles for use in the spreadsheet for normal operation.

Working Cursor

Working Cursor provides a slection of cursor styles to use to indicate that the spreadsheet is busy.

Scrolling Speed

Scrolling Speed controls how fast the spreadsheet scrolls when using the mouse. Smaller values causes the display to scroll slower. The impact of this value depends on your specific hardware and software.

How XEss Handles Errors

When the syntax of a formula is incorrect or a calculation cannot be performed, XEss generates an error message. If you make a mistake, XEss tells you by giving you an error message in descriptive terms that actually helps you solve the problem. The types of errors are described below. A complete list of XEss error messages and their explanations can be found in the **XEss User's Guide Appendix C**, **Error Messages.**

Calculation Errors

When XEss encounters a computational error, a descriptive message is displayed on the **Message Line**. In addition, the word **Error** followed by the message appears highlighted in the affected cells. If there are multiple errors flagged in the body of the sheet, the message on the message line represents the *first* calculation error encountered.

For example, if you try to invert a 3 x 2 matrix, XEss highlights the cell where the formula was entered, and displays the message, "**Error - @INVERT, matrix must be square**" in the cell containing the invalid formula. In addition, the message, "**Cell xx:Error - @INVERT must be square**" appears on the Message Line.

Syntax Errors

If you attempt to enter an expression which is syntactically incorrect, XEss displays an informational message on the **Message Line**, *while placing the text edit cursor in the expression where the error was detected*.

XEss will not allow a syntactically incorrect expression to be entered.

For example, if you enter the formula @DATE(1/10), XEss displays the message, "**ERROR: not enough arguments to function",** on

the Message Line and the cursor is positioned to the right of the 0 on the Edit Line. You must correct or erase the invalid expression.

Operational Errors

When you request XESS to perform an invalid operation, the condition is flagged by the **XESS Message** dialog box which immediately pops up with a message describing the error. You must click **Cancel** to dismiss the dialog box.

For example, if you enter an invalid cell address in a dialog box which requires that data to continue, XESS displays the **XESS Message** dialog box (Figure 2-11) which contains the message, **ERROR: - illegal range specification.** You must press **Cancel** to remove the box and continue.

Figure 2-11 XESS Message Dialog

How to Get Help

XESS is designed to be easy to learn, using a familiar spreadsheet format and self-explanatory menus and messages. However, you may encounter situations where you need help. Accordingly, you can take advantage of

- descriptive error messages, which provide information to help you correct the error, and
- on-line help, which displays a concise summary of specific functions at the touch of a button.

Error Messages

Have you ever wasted time doing detective work, trying to find the source of a problem while a spreadsheet program beeps warnings at you? If so, you will appreciate the XESS difference. XESS error messages do more than notify you of a problem; they describe the nature of the problem and provide clues to resolving it. For example:

This message ...	Means ...
Error: Goal Seek - variable cell must be a constant	The cell which changes during Goal Seek must not contain a formula.

Xess displays error messages on the Message Line at the bottom of the primary spreadsheet display. A full list of XESS error messages and values and what they mean is contained in **Appendix C.**

Using On-Line Help

There are several types of on-line help:

- **Help>Index** is a complete help system with a multi-level list of topics, "hot" links to related topics, and a keyword search facility.
- **Help** buttons in each dialog link provide information on the function and options of the dialog.
- **Tips** are displayed in pop-up windows when the mouse cursor is placed over a toolbar button.
- **Help on** gives information about the elements of the display.

To select a help topic:

1) Select **Index...** from the **Help** menu. XESS displays the **XESS Help** dialog as shown in Figure 2-12. Click on a topic in the **Help Topics** list that is shown with a page icon to view the help on that topic. When you click on a topic shown with a closed-book icon, the "book is opened" and topics within that book are shown and the closed-book icon is replaced with an opened-book icon. Clicking on this icon "closes the book".

2) In the **Xess Help** dialog box you will be able to read about the topic you selected. If necessary, use the scroll bars to view all the information about the topic.

3) Any keywords or phrases that are highlighted in the help text are links to other on-line help topics. Simply click on these keywords to go directly to the corresponding help topic. To return back to where your were, click the **Back** button.

4) Use the **Search** option of the **Help** dialog to locate topics which relate to the keywords you specify. Words that *must* be found in the topic should be preceded by a plus (**+**) character; those that *must not*, by a minus (**-**). The result of the search operation is a list of topics displayed in the **Search Help File** dialog. Click on these topics to view the

related help. The topics that best match your query are displayed first in the list.

5) Click **Cancel** to dismiss the **XESS Help** dialog box.

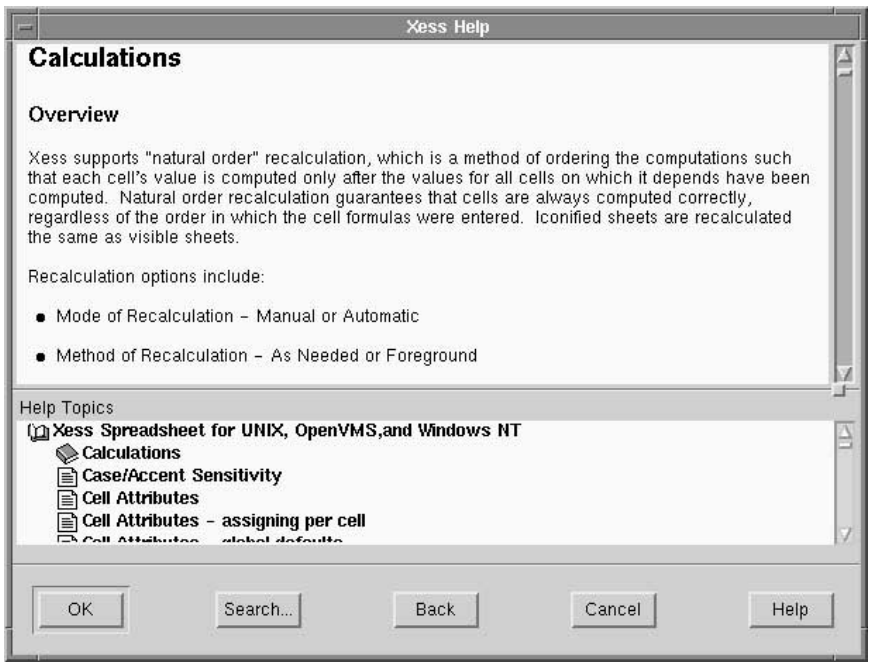

Figure 2-12 Help Dialog Box

Through the Help menu, you can get information on:

- general system functions and menus,
- the current window,
- special keys and mnemonics,
- all the subjects available in the Help index, and
- using the Help facility.

The Help dialog can be resized to display more of the help at one time. The relative size of the help area versus the help topics area can be adjusted by dragging the indicator between the scroll bars.

You can also get context sensitive help while performing an operation that uses a dialog box.

To get help from a dialog box:

1) Select an XESS operation, for example, select **Save As** from the **File** menu.

2) XESS displays the **Open Sheet** dialog box as shown in Figure 2-8.

3) Click **Help**. XESS displays the **Help** dialog box as shown in Figure 2-12. The dialog box contains information about opening workbooks. Use the scroll bars to view all the information.

4) Click **Cancel** to dismiss the XESS Help dialog box and resume the **Save** operation.

The help file is in HTML which makes it possible to access on-line help outside XESS with a standard HTML browser such as that provided with Netscape.

Help is also available using the **Help on** feature or the **[?]** toolbar icon. First click **Help on** or **[?]**, and then click on the feature of interest. XESS then displays a pop-up description of the feature. These pop-up features**, tips**, are automatically displayed when the cursor is over a toolbar icon.

Internationalization

Locale and Language Support

You can switch among locales of single-byte ISO 8859-1, -2, -5, -7, -9, -11 (and other) languages and multi-byte languages (e.g. Chinese) while using a single XESS executable image. Language-specific resources, messages, and on-line help files are dynamically accessed by the same binary executable. In addition to the Locale setting, you will need to define fonts and character set to match the language.

Workbook Data

When it starts, XESS retrieves workstation locale settings for currency, decimal point, thousands separator, and date formats. If locale settings are not available, the initial defaults are retrieved from the XESS resource file. In either case, the settings are accessible from the **Local Defaults** dialog underneath the **Options** menu and are applied globally within the session.

These locale settings are used to define applicable cell formats and the character used as decimal point when entering numeric data into a cell or when formatting relevant cell data.

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You can use the `-nolocale` *to have Xess ignore locale setting and use the defaults or those defined in the Xess resource file.*

. . . . . .

Locale Defaults

When you create a new workbook, the **Locale Defaults** are retrieved from your workstation's locale settings and the Xess resource file. When you select **Locale Defaults**, the **Locale** dialog box as shown in Figure 2-13 is displayed.

The **Locale** settings serve as the defaults used for Cell Formats and data entry (with respect to the decimal point). You can change the settings in the **Locale** dialog, and they will be saved in workbook files and loaded with them. If you wish to permanently change the Locale defaults, you must change them in your template file, `xess_template.xs5`, in the Xess resource file, or in your workstation's locale settings.

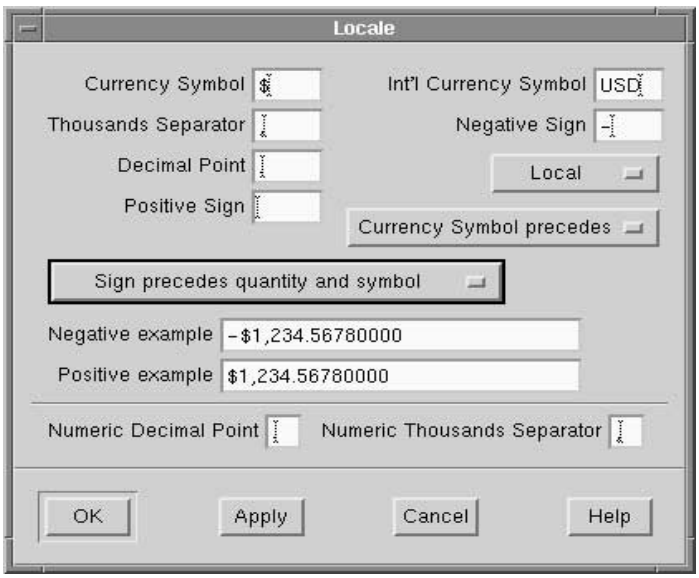

Figure 2-13 Locale dialog box

User Interface

In addition to locale and language support within the workbook data, you have easy access to the following user interface components which can be translated into other languages:

1) Messages
2) On-line Help
3) Names of the days of the week and the months
4) Menus and Buttons

3

Accessing Workbooks

This chapter describes how to create new workbooks and access existing ones. One or more sheets that work together make a workbook. Workbooks are saved in a single XEss file of type .xs5.

Building a New Workbook

When you start XEss, it displays a blank spreadsheet ready for you to enter data.

If you are already working in a spreadsheet workbook and want to clear all cells and start again with an empty workbook:

1) Display the **File** menu from the menu bar.
2) Select **Close** from the File menu.
3) Display the **File** menu again and then select **New.**

If you are working in a workbook and want to begin working in a different workbook:

1) Display the **File** menu from the menu bar.
2) Select **Open...** and XEss will display the **Open Sheet** dialog box for selecting the name of the workbook you wish to use. If you have set **User Preferences** to single-workbook mode and have made changes to the current workbook, XEss will first ask if you want to save the changes before loading the new workbook. In multiple-workbook mode, the new workbook is displayed in a new primary window.

Loading an Existing Workbook

XEss saves workbooks in specialized files, usually with the file type **.xs5** attached to the end of the file name. One of these files contains the entire definition of all the sheets in a workbook, including formats, graphs, and overlays.

The **.xs5** file format consists entirely of printable characters. This makes it easy for you to copy XEss files from one system to another regardless of the operating system or file structure. It also means that XEss files can be mailed among systems without additional processing.

XEss can also access spreadsheets and workbooks in several other popular formats: **.xs**, **.xs3**, and **.xs4** sheets compatible with previous versions of XEss; and **.wk1, .wks, .wk3** (wk3/wk4)**,** and **.xls** sheets compatible with most other spreadsheet systems.

You can get an existing workbook, view it, change it, recalculate it, and then save it (overwriting the original version) or exit without affecting the original version. You can load and use workbooks from other spreadsheet programs or load data from text files in a variety of formats.

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For more information about loading data from text files, refer to ***Interacting with Other Applications****.*

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To load an existing XEss, WK*, or XLS workbook:

1) Select **Open...** from the **File** menu. XEss displays the **Open Sheet** dialog box as shown in Figure 3-1.

2) Select the type of spreadsheet file you wish to read: **XS5, XS4, XS3**, **XS**, **WK1**, **WKS**, **WK3**, or **XLS** . Note that the WK3 filter can also be used to load WK4 files.

3) Click the **Selection** entry box and type the name of the file you wish to use, or select a file by highlighting its name in the **Files** list using the mouse.

   Adjacent to the **Files** list is the **Directories** list. The files shown in the **Files** list are those files found in the directory whose name is highlighted in the **Directories** list.

   The dialog box displays an alphabetical list of all files whose names meet the criteria in your **File Filter**. If the list is large, all the document names may not fit in the box.

a) To move the selection highlight, use the up and down arrow keys, or move the mouse pointer to the desired name and click.

b) To scroll through the list of document names, click the up and down arrows along the right side of the list box or drag the scroll box.

c) To jump to a specific alphabetical section of the list, type the first character(s) of the name of the document you are looking for in front of the asterisk (*). The dialog box then displays the first file name beginning with these characters.

4) To select a file, double-click on the file name, or click the name once and then click the **OK** button. XESS opens the workbook with the same window size and position that were in effect when the file was last saved.

5) To select a different directory, double-click on the directory name in the **Directories** list. XESS then displays the names of files in that directory in the **Files** list. (The **..** entry allows you to change to the next highest level of the directory structures.)

6) To avoid opening a file after viewing the dialog box, click **Cancel**.

*If you do not find the file name you are looking for, check the **File Format** and the **File Filter** in the dialog box to make sure you are searching in the correct disk or disk directory and for the desired spreadsheet type.*

The File Filter

The **File** Filter controls which files are presented in the dialog box **Files** list or the **Directories** list. For most operations, XESS automatically displays all files with the **.xs5** extension, the typical extension for XESS files.

XESS changes the default filter to match the file format you requested. For example, if you set **File Format** to WKS, the **File Filter** appears as ***.wks** and the **Files** list includes all files with names ending in **.wks**.

On Linux and UNIX systems, the default extension allows filenames in upper, lower, or mixed case, similar to the following: .[Xx][Ss]5. On OpenVMS and Windows NT, the same extension is displayed as .xs5 —but is not case sensitive.

You can change the file filter to display only certain groups of files. This is especially useful when you have many files on the disk and the list is cumbersome to search. For example, you can change the file filter to display:

- files in a specified directory or sub-directory,
- files whose names have a character match to designated characters, or
- files with a specified extension.

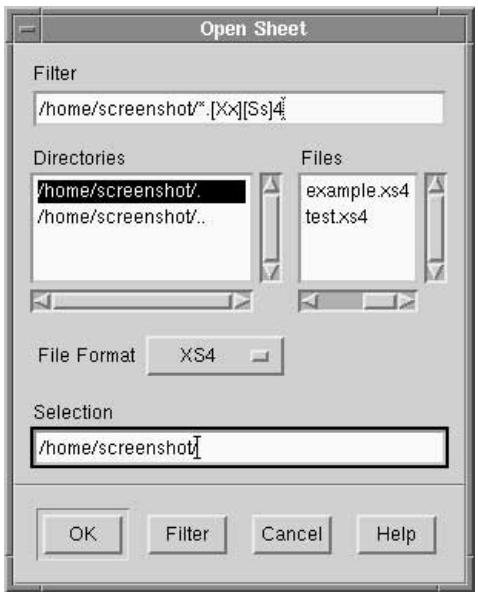

Figure 3-1 Open Sheet Dialog Box

One way **to change the file filter** is to double-click on a different directory. Alternatively, you can change the file filter by doing the following:

1) While the dialog box is displayed, click on the text of the **File Filter**. XESS displays a blinking cursor in the File Filter area.

2) Using the keyboard, type the desired file filter. You can use the asterisk (*) as a wildcard. For instance, the file filter ***.xs5** tells XESS to display files with the **.xs5** extension, no matter what characters precede the extension. The file filter **test*.xs** tells XESS to display all files whose names begin with **test** and end with the **.xs** extension.

3) Press **[Enter]** or click on the **Filter** button**.** XESS displays file names that meet the criteria specified in the new file filter.

Loading a Recent Workbook

The names of the most-recent four workbooks are remembered from one session to another. These names are displayed on the **File** menu. To open one of these files, just click on its name.

Loading a Workbook in a Different Format

XESS lets you load and save files stored in the popular WKS ,WK1, WK3, WK4, and XLS spreadsheet formats using the **Open...** and **Save...** operations. When opening WK* and XLS files, XESS loads the entire workbook along with its default characteristics such as column width and format. XESS automatically determines the proper file format for loading a file by examining its contents.

Note that there are differences between spreadsheet programs, so you may have to modify certain formulas or cells to get the spreadsheet to work properly in XESS. You can load most spreadsheets without any difficulty, but those with complex interactions that use macros or certain functions may require some modification.

If you have problems opening a file in one of these formats, make sure that file was copied in binary mode from its source system. Unlike XESS, these formats can be corrupted if transferred in text modes. Also make sure what application produced the file. Problems are often caused by non-spreadsheet applications writing invalid files that by chance will load on some version of some spreadsheet product. If you still have problems, please report them to AIS support.

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Loading an XLS or WK file into XESS, formulas which contain functions that exist in the source spreadsheet product but not in XESS will generate a formula error indicating that the function does not exist. Formulas containing ambiguous function references are converted to text strings in XESS for manual intervention.*

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In addition, with the **Import...** operation, you can load tabular data from text files in several formats which include comma-separated values (CSV), tab-separated values (TSV), user-defined delimiter, and HTML tables.. For more information about importing data from other programs, refer to **Interacting with Other Applications.**.

Saving the Workbook

The **Save** and **Save As...** operations are used to save your workbook to a file on disk. When a workbook is saved, all of its current characteristics, including window size, window location, and scrolling position within the file are preserved as a snapshot.

*Refer to the next section, **Naming the Workbook,** for details about the conventions governing file names.*

To save a workbook that has not yet been named:

1) Select **Save As...** from the **File** menu. XEss displays the **Save Sheet** dialog box as shown in Figure 3-2.
2) Select the type of spreadsheet file you wish to create: **XS5**, **XS4**, **XS3**, **WK1**, **WK3**, **WKS**, **XLS**, or **XLS V4**.
3) Enter the name of your file in the Selection area of the dialog. Alternatively, use the Files display, select a file name there, and modify to get the new file name.
4) Click **OK** or press **[Enter]**. To cancel the operation, click **Cancel**.

To save a workbook that has already been named:

1) Display the **File** menu from the menu bar.
2) Select **Save** from the File menu. XEss saves the sheet using the current name and displays a message on the Message Line.

The **Save** and **Save As...** operations do not remove your workbook from memory, so you can continue to make changes to it after saving. You should, in fact, save your work periodically during a session to minimize the risk of losing work if the computer system is interrupted for any reason.

If you **Save** the current workbook, it will have the same file name as the file already on your disk. The old version of this file is renamed to have a tilda character (**~**) at the end of the name before the workbook is saved with the file name.

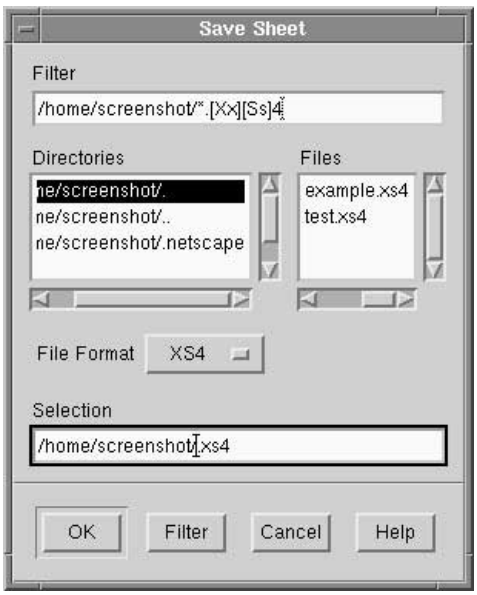

Figure 3-2 Save Sheet Dialog Box

Saving a Workbook in a Different Format

XESS lets you save workbook files stored in the popular WKS, WK1, WK3, and XLS formats using the **Save** and **Save As...** operations. The **Save** operation for **WK*** and **XLS** format files writes the workbook to a file along with its default characteristics such as column width and cell format.

When saving an XLS or WK* file from XESS, formula which contain functions that exist in XESS but not in Excel or Lotus are converted to text strings when XESS creates the XLS or WK* file.

In addition, with the **Export...** operation, you can save tabular data into text files in several formats which include comma-separated values (CSV), tab-separated values (TSV), user-defined separators, LaTeX (TEX), and Hypertext Markup Language (HTML). For more information about exporting data to other programs, refer to **Interacting with Other Applications.**

Naming the Workbook File

XESS stores spreadsheet workbooks by names with extensions. The name identifies the workbook for your purposes; the file extension helps you identify the file type for different operations.

File names for XESS files usually end in **.xs5**. Xess determines the type of contents by examining the data in the file.

You should use names that are descriptive or mnemonic, so you can easily identify the file from a directory listing, possibly weeks or months after you have last used the file. If you have several files that are similar, you can differentiate between them by adding dates or code numbers, for example, MFG_391 or TEST91.

Follow these conventions in assigning file names:

- File names follow the conventions for the host file system. They can usually be at least eight characters long and can consist of both letters and numbers. (Some systems support names as long as 127 characters.)
- Be careful when using upper-case and lower-case letters. Some systems are case sensitive; others, case insensitive. For example, under some systems (e.g. OpenVMS, Windows NT), **USRTEST.XS5** is considered identical to **usrtest.xs5**. On other systems, including UNIX and its derivatives, the previous names represent different files.
- Do not use spaces in a file name. You can use an underline character (_) or hyphen (-) to simulate spaces, for example, ekg-200 or EKG_200. While some systems support the space character in filenames, its use makes it harder to share files among systems and over the net.
- Unless you have a specific reason to change the file extension (transferring the file to a different program, for example), let XESS assign the default file extension.

Copying, Moving, Renaming, or Deleting Files

XESS workbooks and related files are stored as simple text files. Therefore, you can copy, move, rename, mail, or delete XESS files using the file management commands of your operating system. XESS provides no additional functions for copying, moving, renaming or deleting files.

Opening Multiple Workbooks

Multiple workbooks can be open at the same time -- just open the second workbook without closing the first one. Each workbook has its own primary window. References between two open workbooks are recalculated automatically when the source value is changed.

4

Entering Data

XEss gives you many options for entering data into cells, using both the keyboard and mouse. To reference a cell in a formula, you can type its cell address, or you can point and click with the mouse to select the cell address, or you can type the cell name. You can define the format of cells and allow designated cells to accept only certain types of input, or restrict access completely to certain cells.

This section describes how to enter data in your spreadsheet and how to enable cell protection. For more information about editing cells, moving and copying data, and manipulating spreadsheets, refer to **Manipulating the Spreadsheet.** For more information about using formulas to calculate values, refer to **Calculations.**

About Cells

XEss spreadsheets are a computerized version of a ledger pad, with information stored in a row-by-column table of **cells.** A group of sheets which work together and are saved in a single disk file is called a workbook.

A cell is the intersection of a row and column within a sheet in a workbook. Cells can contain numeric or text constants, dates and time, formulas, images, and graphs. Constants and calculated values are visible on screen, but the formulas that produce those values are generally invisible.

Formulas are viewed and changed directly in the cell if in-cell edit is enabled or in the Edit Line otherwise; they appear only when the cell is highlighted. The current cell is typically outlined in red in the body of the sheet; in addition the row and column button of the current cell is a different color from the other row/column buttons. This is the cell that will be affected by your next action.

Each cell is identified by an address that contains the column and row coordinates of a specific sheet in the workbook. For instance, the address of the first cell in the workbook is typically `Sheet1!A1`; the cell in column D, row 4 of Sheet 10 has the cell address `Sheet10!D4`. With 4096 columns, 10 million rows, and 4095 sheets an XESS workbook may contains more than 167 trillion cells. However, the actual size of your workbook is limited by the memory capacity of your computer system, which is far less than the theoretical capacity of the workbook. (Set the resource value `*maximumRowNumber` to enable the use of very large sheets.)

The amount of information in each cell and the nature of the entries themselves determine how many cell entries you can make before you run out of memory. There is a good reason, though, for Xess to provide a spreadsheet grid larger than you can ever fill; it gives you the flexibility to develop long, narrow sheets or wide ones with few rows. The **Workbook Statistics** tool lets you monitor the actual size of a workbook.

Cell Range

A **cell range** is a rectangular group of cells that are grouped so that operations or formulas act on several cells at once. Ranges are identified by the cell addresses of two opposite corners, usually the top left and bottom right corners.

Ranges can also be be 3-dimensional by referencing cells on more than one sheet in a workbook. For example, `Sheet1!A1..Sheet10!C5` creates a rectangular group which cuts through the third dimension of a workbook.

Input Mode and Edit Mode

XESS has two modes of operation for entering data, input mode and edit mode.

Input Mode

Input Mode allows you to enter data into a blank cell or retype the contents of a cell.

To enter input mode, press any alphanumeric key on your keyboard. You can then enter text, numeric values or formulas. Depending on user preferences, the enter values are initially shown in either the Edit Line or the cell itself.

XESS stays in input mode until you press **[Enter]**, move the cell cursor to another cell location by using the up or down arrow keys, or click the **accept** or **reject** indicators left of the Edit Line.

Edit Mode

Edit Mode allows you to modify the contents of a cell without retyping the entire contents. Use the mouse or the arrow keys to position the cell cursor to the cell to be edited.

To enter edit mode, either use the mouse to position the cursor in the **current cell contents** in the Edit Line, choose **Edit Cell** from the **Edit** menu, or use the **[F2]** key. You may edit either in the Edit Line or within the cell itself.

Use the **Delete** or **[Backspace]** key to erase and enter the correct entry. Use the left and right arrow keys to move within the cell.

After making your changes, click the **accept** or **reject** buttons, press **[Enter]**, or use the up or down arrow keys to complete the edit. You can cancel Edit Mode by pressing the **[esc]** key or by clicking the **reject** button.

In both input mode and edit mode, data entered from the keyboard appears in the line in the Edit Line of the main view of the current sheet. When you complete the entry with **[Enter]** or its equivalent**,** XESS inserts the new value into the current cell. In input mode, you can also use any arrow key to complete the entry and move one cell in the direction of the arrow.

You can change the current cell by:

- pressing an arrow key to complete an entry in input mode. The cursor moves one cell in the arrow direction.
- pressing the up or down arrow key to complete an entry in edit mode. Xess accepts the entry and moves the cursor one cell in the arrow direction.

Cell entries often look different on the input/edit lines than they do in the cells. For example, if a cell contains a formula that produces a value, the input/edit lines show the formula, not the value. If a cell is formatted for scientific notation or a special date format, it appears in the cell in its special format but appears on the input/edit lines just as you typed it.

- In **input mode**, any input beginning with **+ - . , @ =** or a digit **0 - 9** is assumed to be a formula, unless the cell is already formatted to be text, a date, or time. If **Smart Date** or **Smart Time** entry is enabled in **User Preferences**, the input is examined to determine if it matches one of the standard date or time formats and is processed accordingly. Otherwise the entry is assumed to be text. In **edit mode**, XEss does not differentiate between formula and text entries except that formula always begin with the **=** character.
- In **input mode**, an entry is completed by pressing **[Enter]** or any arrow key. In **edit mode**, the **left** and **right** arrow keys move the position of the character cursor within the current value for the cell.
- In **input mode**, you cannot use the arrow keys to move the text cursor. In **edit mode**, you can use the arrow keys to move over characters without deleting them. In either mode you can use the mouse to reposition the text cursor. Characters can then be inserted or deleted at the text cursor.
- In **input mode**, cell and range references are appended to the characters already entered. In **edit mode**, cell and range references are inserted into the string at the cursor location

When you are modifying the Edit Line, various editing options are usually available:

left and **right**	Move the character cursor a single character.
Ctrl + left	Moves the character cursor a word left.
Ctrl + right	Moves the character cursor a word right.
Meta + left	Moves to the beginning of the line.
Meta + right	Moves to the end of the line.
Shift	With one of the above, selects characters to be deleted or replaced.

Cell Contents

XEss accepts several basic types of cell entries: text, constant numeric values, dates or times, formulas that calculate a value, graphs, and images. Calculated values may be single numbers or strings, or they can be arrays or tables of values.

Text Entries	Text entries are useful for labeling columns and rows, for including comments about data values being calculated, and for

using XESS to manage textual information, such as names, addresses or whatever your application may require.

Numeric Values

If a cell entry begins with a digit from 0 - 9, XESS treats the entry as a numeric entry. XESS also recognizes the following symbols as indicators of numeric entries:

+ - . (and **,** in some locales)

You can format numeric values to be displayed in many ways, including fixed formats, scientific notation, currency, fractions, and hex.

Dates and Times

XESS provides special, built-in features for displaying date entries in the format you choose. Date and time entries begin with the the slash (*/*). Example date and time formats include:

24-Oct-99
24-Oct
10/24
4-Jul-1776
11/23/1963
24.10.91
2001-10-24
14:27

Dates and times can also be entered without the initial slash. In this mode, both the day and year must be entered or the cell must already be formatted as date.

Formulas

Formulas establish and calculate mathematical relationships between spreadsheet elements. XESS formulas can calculate with numbers, text, logical values, cell references, and other formulas. For example, you can easily calculate the sum of a series of cells, the total of values in a column, or the absolute value of another cell entry.

Graphs

Graphs can be inserted into cells. The anchor cell becomes the upper left corner of the embedded graph. Graph objects in cells can be moved with the Copy Formulas operation.

Entering Text

A text entry is usually used for descriptive information, such as a column heading, a row label, or an explanatory comment. You can also make text entries of names, addresses, or other non-numeric information your application requires.

XESS treats text and numeric entries differently, so you differentiate between text and numeric values when entering cell contents.

To enter most text into a cell, just type the text string as you want it to appear. If the text you wish to enter would normally be considered a formula or a date, then you must precede the actual text with the ' (apostrophe) character.

If you make an entry that is not text but which returns an error when treated as a formula, XESS inserts an error message but remains in input mode.

Character Sets

XESS will accommodate the characters in the various ISO 8859 code pages, including 8859-1 (ISO Latin 1). Languages that require multi-byte characters (e.g. Chinese) are supported by specifying appropriate locale resources and using the required input method. In addition, collating options for extended (accented) characters in European languages can be set in the **Workbook Defaults** dialog box. This setting affects **Sort**, **Find**, **Extract**, **Replace**, and string comparisons.

Treating Numeric Entries as Text

Note that some numeric entries, such as phone numbers, should really be treated as text. For example, if you enter the phone number 555-1212 in a cell, XESS will display the number -657, the difference of 555 and 1,212. However, if you start the string with the apostrophe ('555-1212, for example), XESS treats the phone number as text and does not calculate it.

If **Smart Text Entry** is set in the **User Preferences** dialog, then cells formatted as **Text** assume that their input will also be text strings (and not numbers or formulas), unless the initial character entered is:

=	number or formula
/	date or time
//g	graph
//r	repeating character

\	escaped character
’	string

This ensures that values entered are treated as text. A typical use of this feature would be to enter postal codes and to keep the leading zeros:

01754

In this mode, if you change the format of a non-empty cell to Text, Xess displays the underlying contents of the cell. For example, a formula would be displayed rather than the result of its evaluation.

Repeating Characters

You can automatically repeat one or more characters to fill the cell by starting the character string with the characters slash-slash-r (**//r**). For instance, to fill a cell with hyphens:

Type: **//r-**

This feature can be useful for drawing lines to demarcate areas of your spreadsheet when printed. Another way is to fill a cell with hyphens and plus signs:

Type: **//r-+**

However, if you wish to enter a character string that begins with a slash (/), you must be sure to begin the entry with the special text-indicator characters ’ (apostrophe).

Entering Text Wider than One Cell

Text entries can be up to 4095 bytes long, so it is possible to make an entry that exceeds the current width of a column. If you make an entry longer than it can be displayed in the column, XESS continues to display the text into adjacent empty cells to the right, until it reaches an occupied cell. XESS stores all of the text string you entered into a single cell, but only displays the number of characters that will fit over adjacent empty cells.

If you change the alignment of the data in the cell, the text will overflow or be truncated as needed on the left, the right, or both.

You can format the entire column with the **Snap Column Width to Contents** option to adjust the column width to contain the entire string.

Text Wrapping

If the cell has the **wrap** attribute, the text will be divided between words to fit within the current cell width. The cell contents are displayed on successive lines extending downward to accommodate the entire cell contents. This downward display will be truncated by a non-empty cell. You can adjust the row height to accommodate the multiple lines of text fully displayed. The **Snap Row Height to Contents** option forces a best-fit row height.

To edit an entry that is displayed over more than one cell, position the cell cursor to the cell actually containing the value. XEss displays the full entry in the Edit Line.

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XEss lets you change the width of columns to accommodate entries up to 255 characters long. For more information, refer to ***Defining the Appearance of the Workbook.***

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Entering Special Characters

Special characters can be entered as text by using the back-slash convention (\). (This technique is compatible with Standard C escape codes.) The most common use of this is to explicitly force a new line in a text cell by entering **\n**. Other useful ones are \" which allows the quotes character within a string and \\ which allows the back-slash character.

Many systems support the use of the **Compose** key to enter characters not found on the current keyboard. For example, **Compose** followed by **n** followed by **~** might produce **ñ**.

Entering Numeric Values

Follow these conventions for entering numeric values:

- To enter a positive number, use the number keys to type the number, with or without a **+** indicator. If you do not type a plus (**+**), XEss assumes the number is positive.
- To enter a negative number, type a minus sign (**−**) and the number. Do not use parentheses to indicate negatives. However, if you change the numeric format to Dollars or Comma, XEss displays negative numbers in parentheses.
- Do not use spaces, commas, or currency symbols when entering numbers. If you wish, you can display these items with the value by choosing the appropriate cell format or by creating a custom format. In **locales which use comma**

rather than period as the decimal point, commas may be used as a decimal point when entering numbers. In these locales, semi-colon (**;**) is used in formulas to separate items in a list, rather than comma (**,**).

- Be careful not to substitute a lower case **L** for the numeral **1** or an upper case **O** for the numeral **0**.
- You can use scientific notation to enter a number, with the convention that the letter **e** separates the fraction from the base 10 exponent. 1.23e3 is the equivalent of 1230.

Entering Numeric Values Wider than the Cell

If the numeric value of a cell fits within the cell size and format, XESS displays it in full. Otherwise, XESS displays as much of the value as it can with a large solid line at the edge of the cell to show that it has been truncated. This is usually on the left edge of the cell, but can be on the right edge or on both edges, depending on the alignment of the cell.

Changing the Numeric Format

You can choose from a variety of formats for displaying numbers. The display formats do not change the number itself, the way the number is stored internally, or the way it is used in calculations. Formatting just changes the way XESS displays numbers.

XESS offers four methods for changing the format of cell contents:

- To change the default formatting for the entire sheet, use the **Cell Defaults...** dialog box, available from the Options menu on the menu bar.
- To change formatting for a selected cell or range of cells, use the **Cell Format...** dialog box from the Format menu.
- To change formatting for a selected cell or range of cells, use the format icon button on the **toolbar.**
- To change formatting for a selected cell or range of cells, select the cell(s) to be affected and press **MB3** (the right mouse button) to display the short-cut popup menu and select **Cell Format...** .

All operations offer the format choices in Table 4-1 which follows:

Format	Definition
Percent	Display the number as a percentage, multiplying it by 100. For example, the value .1 is displayed as 10.00%.
Currency	Displays the number using the relevant currency settings from the workstation's Locale.
Custom...	Displays the number using the combination of specification from the Custom dialog which allows you to override all settings defined by Locale.
Comma	Displays the number with comma delimiters, as in 1,000,000. Negative values are displayed in parentheses.
Dollars	Displays the number with a leading **$** sign and with comma delimiters, as in $1,000,000. Negative values are displayed in parentheses.
Scientific	Displays the number in scientific notation (exponent form) with N significant digits.
Fixed	Displays the number using a fixed number of decimal places, specified by N.
General	Displays the number in fixed format or scientific notation, whichever fits. Trailing zeros are not displayed.
Fraction	Displays the non-integer part of a number as a fraction instead of decimal.
HH:MM	Displays the fractional portion of a date/time value in the format 06:15.
HH:MM:SS	Displays the fractional portion of a date/time value in the format 06:15:30.
MM/DD/YY	Displays the integer portion of a date/time value in the format 08/01/99.
DD-MMM-YY	Displays the integer portion of a date/time value as a Gregorian date, in the format 08-Aug-91.
DD-MMM	Displays the integer portion of a date/time value in the format 08-Aug.
MMM-YY	Displays the integer portion of a date/time value in the format Aug-99.
YY-MM-DD	Displays the integer portion of a date/time value in the format 99-08-01.
YYYY-MM-DD	Displays the integer portion of a date/time value in the format 2000-01-01.
DD.MM.YY	Displays the integer portion of a date/time value in the format 01.08.99.
Hidden	Cell contents are not displayed.
Hex	Displays the integer portion of the number in base 16 with a leading **0x** indicator. For example, the value 30.5 would be displayed as 0x1e.
Logic	Displays 0 as **0**, displays 1 as **1**, and displays all other values as **?** .
Degrees	Displays as degrees, minutes, seconds -- determined by digits setting.
Text	Displays the characters which were entered to create the cell rather than the resulting value of the cell.
User Defined...	Displays using a user-specified pattern and rules.

Table 4-1 XESS Formats

In the **Cell Format** dialog box there is an additional choice for **Default**. Default displays the number in the manner defined by

the default format governing the entire workbook. (This default is set by the **Cell Default** operation from the **Options** menu.) When **Default** is chosen, the **Decimal Places** value is taken from the **Cell Defaults** dialog, not the **Cell Format** dialog.

The @TEXT function provides a higher-level of user control of formatting.

For more information about cell formats and instructions for changing cell formats, refer to **Defining the Appearance of the Workbook.**

Entering Dates and Times

If the Smart Date Entry or Smart Time Entry is enabled in the Users Preferences dialog, XEss will recognize most of the dates and times in Table 4-2 entered in their standard format and convert them to **@DATE** or **@TIME** functions. You do not need the explicit date prefix (/). For dates such as dd-mmm and mmm-yy, you still need to enter a leading slash (/) or set the format of the cell to a date or time format before entering the value.

If Smart Date Entry or Smart Time Entry is *not* enabled, then for XEss to interpret the entry as a date or time, you must begin all date and time entries by typing a slash (/) before the desired value. Type a **/** followed by the date or time in any of the date/time formats. The dates and times entered with this method are also converted to the equivalent references to **@DATE** and **@TIME.**

Date/Time	Entered as	Generates
19 July 1990	/07/19/90	@DATE(1990,7,19)
27 September 1991	/27-sep-91	@DATE(1991,9,27)
01 August 1999	/01-Aug	@DATE(1999,8,1)
01 Aug 2003	/Aug-2003	@DATE(2003,8,1)
21 May 1621	/1621-05-21	@DATE(1621,5,21)
21 May 1621	/21.05.1621	@DATE(1621,5,21)
12:30	/12:30	@TIME(12,30,0)

Table 4-2 XEss Dates and Times

XEss supports dates from 1 January 100 through 31 December 3999. The transition from the Julian calendar to the Gregorian calendar is implemented in 1582 when 15 October immediately follows 4 October, as it was decreed by Pope Gregory XIII.

Using Date Functions to Enter Dates

Another way to enter dates is to use one of the XESS date functions. You can use the **Format** dialog box from the Edit menu to choose how the date should appear in the cell.

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For more information on Date and Time Functions, please refer to the chapter, ***Built-in Functions,*** *and also the* ***Function Reference*** *in* ***Appendix A****.*

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XESS internally stores date and time information using the same convention as other popular spreadsheet programs:

Dates are represented as an integer equal to the number of days before or since December 30, 1899 (or January 1, 1904 in the 1904 date system).

Times are represented as fractions of a day, starting at midnight. For example, 6:00 am is stored as .25 (a quarter of a 24-hour day).

Using this convention, date and time values may be used together. For example, the date/time value 2.25 corresponds to 6:00:00 AM, January 1, 1900.

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You can use date values in calculations. For example, subtracting 05-Oct-1999 from 10-Oct-1999 yields a value of 5 days.

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Entering the Current Date or Time

The **Insert Current Date** and **Insert Current Time** operations on the Edit menu set the cell to the date or time at that moment. This differs from using the @NOW function which changes value each time it is recalculated.

Entering Sequences of Values Quickly

The **Data Fill** Tool provides an efficient method for entering values which follow a pattern, such as the months, times, or numeric series. Simply enter the first few items in the sequence, select the entire range (including those just entered), and use the Tool>Data Fill operations (**Ctrl+d**).

Entering Formulas

Formulas are the backbone of the XESS spreadsheet, defining relationships between the values in other cells. For example, formulas can be used to sum a column of numbers, compute an

average, determine a minimum or maximum value, or round the results of a calculation. Formulas must begin with an equal (=) sign as shown in this example:

=A1+B2-C4/(E1+E2)

Whereas constant entries remain the same until you change them, cells defined by formulas are automatically changed to reflect changes in referenced cells -- even where there are complex interdependencies among cells.

Once entered in a cell, formulas are hidden behind the scenes, performing their work in the background and displaying only the result of their calculation. To view the formula in a cell, move the cell cursor to the cell. XEss displays the formula in the Edit Line. You can edit the formula or values in cells by selecting the **Edit Cell** option from the Edit menu or by positioning into the cell contents in the Edit Line with the mouse.

Point-and-Click Entry

During formula entry, instead of typing cell coordinates into the formula, you may simply move the mouse cursor to the desired cell coordinate and click the left mouse button. The cell coordinate will be pasted into the formula. You must begin the formula as usual with the equal (=) sign then click on the desired cell coordinate. You may then enter another operator followed by subsequent point-and-click operations. When the formula is complete, press **[Enter]** to complete the entry.

If you type a *non-formula* cell value intended for the current cell and then click the mouse in a *different* cell, the data will be accepted into the current cell before the current cell is moved to the new mouse location. If you type/edit a formula, and click the mouse on different cell, XEss will treat this as true formula point/click mode and adjust the formula in the edit line with the cell address.

Built-in Functions

XEss also provides a wide array of functions that perform specific tasks. Functions can be used alone or in combination with formulas and other functions. XEss was designed for demanding users, so it provides many highly specialized functions for business, engineering, scientific, and statistical applications. For more information about functions, refer to chapter, ***Built-in Functions,*** and also the ***Function Reference*** in the Appendix.

Entering Graphs

In addition to displaying graphs in separate graph windows, you may embed graphs directly into cells in the sheet. There are two mechanisms provided:

To embed a graph in the sheet using the menus:

1) Position the cursor cell where you want the top left corner of the graph to be.
2) Select **Insert in Sheet...** from the Graph menu.
3) Select the desired graph from the **Choose Graph** dialog box.
4) Click OK or Apply to complete the operation.

To embed a graph in the sheet from the edit line:

1) Position the cell cursor in the cell where you want the top left corner of the graph to be.
2) Move the mouse pointer to the edit line and type the string **//gn** where n is the number assigned to the graph when you first saved it in the Graph Editor. (One way to determine the graph number is to select Edit Graph from the Graph menu.)
3) Press **[Enter]** or click the accept button in the Edit Line to complete the entry.

Entering Images

You can store a link to an XPM, XBM, BMP, ICO, PBM, PNG, JPG, or PCX graphics image in a cell. The image is visible on the display and in printed output, a link to the associated file is saved in the sheet, and the image is restored from this file when the spreadsheet is loaded. These image types are also recognized in the <IMG> tag and the background in the HTML Help browser.

To insert a link to an image into a cell:

1) Place the cursor on the cell to contain the image.
2) Select **Link...** from the **File** menu.
3) In the **Link Image** dialog, select the image type and filename. Press **OK**.

Foreground and background cell color settings affect XBM images.

Cell Notes

Cell notes allow you to attach textual information with a cell which is displayed when the mouse cursor points within the cell. The text of the cell note is displayed in a pop-up area. When the mouse is moved, the pop-up is no longer displayed. Cells which contain notes are displayed with a small dot in the upper right corner, the same color as the cell cursor.

To enter a note in a cell or to modify an existing note:

1) Place the cell cursor in the desired cell.
2) Choose **Cell Note...** from the **Format** menu.
3) Enter or edit the text of the note in the dialog box.
4) Click **OK**.

To delete a note from a cell:

1) Place the cell cursor in the desired cell.
2) Choose **Delete Cell Note** from the **Edit** menu.

Cell notes are saved in the spreadsheet file. Printing of Cell Notes is controlled by the **Page Options** dialog.

Cell notes can be copied along with other cell values and attributes. This is controlled by the **Copy Options** dialog.

Protecting Cells from Modification

Cell protection is used to prevent modification of certain cells while allowing others to be modified. (Cells will still be changed by recalculation).

Xess provides a global setting **Cell Protection** in the **Workbook Defaults** dialog which controls whether or not protection is enabled and, if so, the level of cell protection being enforced for the entire workbook:

- **Off**
- **Max**
- **Mid**
- **Min**

Off means that protection is disabled or not enforced. **Max** does not allow any modification, manipulation, or movement of protected cells by the user, except through recalculation. The **Mid** and **Min** settings relax the stringency of the protection checking.

For example, clearing an unprotected range within a protected workbook is allowed in both. The **Min** setting also allows relocation and reordering of data in protected workbooks.

Like color, font, format, etc. each cell has a protection attribute: Default, Protected, or Unprotected. The protection attribute of cells or ranges are set via the **Tools->Cell Protection** menu. It may be set to:

- **Default**
- **Unprotect**
- **Protect**

The default value of the protection attribute is defined by the **Protection** field in **Cell Defaults** dialog. Cell protection is controlled by three operations:

- **Cell Protection** in the **Workbook Defaults** dialog box turns cell protection on and specifies the level of protection to be enforced for cells that have been designated as protected.
- The **Protection** option menu in the **Cell Defaults** dialog box applies the selected protection option to all cells in the sheet.
- The **Cell Protection** option from the **Tools** menu **protects**, **unprotects,** or assigns the cell **protection default** to selected cells, overriding the setting in **Cell Defaults**. **However, cell protection must first be enabled in the Sheet Defaults dialog box for this setting to have any effect**.

To enable or disable cell protection for the entire workbook:

1) Select **Workbook Defaults** from the **Options** menu to display the **Workbook Defaults** dialog box as shown in Figure 8-1.
2) Select the type of **Cell Protection** desired.
3) Apply your selection by clicking **OK** or **Apply**.

To set default cell protection for the entire workbook:

1) Select **Cell Defaults** from the **Options** menu to display the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Move the pointer to the **Protection** option button. While holding down the left mouse button to display the options, point to desired option and release.

3) Move the pointer to the **Recalc Mode** option button. While holding down the left mouse button to display the options point to desired option and release.

To apply cell protection to a selected cell or range:

1) Select the cell or range to be protected.

2) Select **Cell Protection** from the **Tools** menu.

3) Select **Protect** from the cascade menu.

To remove cell protection from a selected cell or range:

1) Select the cell or range of cells for which protection should be removed.

2) Select **Cell Protection** from the **Tools** menu.

3) Select **Unprotect** from the cascade menu.

To apply the default cell protection to a selected cell or range:

1) Select the cell or range to be protected.

2) Select **Cell Protection** from the **Tools** menu.

3) Select **Default** from the cascade menu.

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Cells are protected by default. If Cell Protection is on, then all cells will be protected until changed.
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Correcting Entry Errors

If you make a mistake in a cell, it is very easy to edit the cell and change its contents or formula. But what if you accidentally erase the wrong data or overwrite some cell with a Copy or Move? XEss allows you to easily recover from your mistakes using the **Undo** option from the Edit menu. The **Undo** operation allows you to undo the most recent operations performed on the workbook. The menu is updated so you can now undo the next-most-recent operation.

The Undo option is context-sensitive and the menu reflects which operation is to be removed. For example, if the last operation were

Copy Formulas the menu would read **Undo Copy**. To Undo the Copy Formulas operation, select **Undo Copy** from the Edit menu.

If you accidentally **Undo** too many levels, use the **Redo** operation to redo the operation that was undone.

By default, you can undo 10 previous operations. This is can be changed in the resource file.

Importing Data from Other Programs

XEss lets you copy data from other programs -- spreadsheets, database management programs and word processing programs -- and bring this data into an XEss workbook.

Using the **Import...** operation from the File menu, XEss lets you import columns of values in text format from a data file into a designated range of cells in an active XEss sheet at the current cursor location.

The **Import Data** dialog provides you with several options for importing data. The **Text** file format assumes that the data is aligned in columns with **white space** (tabs and spaces) separating the data values. XEss uses an algorithm to attempt to determine how to parse the data. This algorithm is controlled by the **Import/Export Options...** dialog on the Options menu.

The **Tab Separated Values** (TSV) and **Comma Separated Values** (CSV) formats allow you to load text files with values separated by tabs or commas. **User Delimited** uses a delimiter character that you specify.

For the **Import/TSV** operation, tabs contained in the file being imported are used as the only delimiters and the text is formatted appropriately in the sheet.

For the **Import/CSV** operation, commas contained in the file being imported are used as the only delimiters and the text is formatted appropriately inside the sheet.

For the **Import HyperText Markup Language** (HTML), the contents of web pages are parsed and loaded into cells of the spreadsheet below and to the right of the current cursor. Elements of tables are placed in separate cells.

You can also export the displayed contents of an XEss sheet as ASCII text to other programs such as text editors.

For more information about Import and Export, refer to **Interacting with other Applications. Lotus** and **Excel** files can be opened directly with the **File Open** operation

5

Manipulating the Spreadsheet

Once you have created an XESS spreadsheet, you can change it to reflect new information, to change how the information is displayed, to fine-tune the underlying logic and calculations, or to explore what-if scenarios.

This chapter explains how to:

- select cells and cell ranges.
- change the view to different areas of the spreadsheet.
- move cell values and formulas from one location to another.
- duplicate cell contents in other cells.
- clear the contents of a cell or range of cells.
- clear the entire sheet.

Moving Around the Spreadsheet

XESS gives you many options for moving around the spreadsheet. You can use:

- the mouse or the keyboard arrow keys to move the cell cursor,
- the data scroll bars to scroll to another view of the sheet,
- the sheet tabs to select a different sheet in the workbook,

- the **End** key to go to the last row used in the current column of the current sheet,
- the **Go To** operation to move to a designated cell address,
- the **Find** operation to move to a cell with a specified content,
- the **Create View** operation to permit multiple windows in the same workbook, or
- the **Top** and **Bottom** operations for moving within a view.

Moving with the Keyboard

You can use the keyboard **arrow keys** to move the cell cursor to a desired cell. Each time you press an arrow key, the cell cursor moves one row or column in the direction of the arrow. Press the appropriate arrow key until the target cell is highlighted by the cell cursor. This is the cell that will be affected by your next action, such as editing, formatting, copying, deleting, or pasting.

Because the spreadsheet window can show only part of a large sheet, you may need to scroll through the sheet to view other sections. The arrow keys can be used to scroll to the remote areas of the sheet as described below.

To move the view to the right:

1) Hold down the right arrow key and watch the sheet scroll to the right.
2) Release the arrow key once you reached the desired view area.

Similarly, use the down, up, and left arrow keys to move the view other areas of the sheet.

The **Ctrl** key plus the **arrow keys** allow you to move the cell cursor around the sheet a page at a time. Hold down the **Ctrl** key while using the **arrow keys** to move an entire window (page) in any direction. Your keyboard may also have specific keys for moving a page at a time. These are usually labeled **PageUp** and **PageDown** or **PrevScreen** and **LastScreen.**

The **Meta** key plus the **arrow keys** advance the cursor to the next "break" in the current row or column. (On many keyboards, **Meta** is labeled **ALT**.) For example, **Meta+Down** advances to the last entry in the current column -- the one with an empty cell below it. A subsequent **Meta+Down** might take you to the absolute last row available.

Moving with the Mouse

You can move about your XESS sheet using the mouse or other pointer device. To position the cursor to a different cell in the current view, just click on the desired cell with the left mouse button. You can also scroll to a different area of the sheet using the mouse.

To move the view to the right:

1) First position the cell cursor somewhere in the rightmost column that is displayed.
2) Press the left mouse button and drag the mouse (still holding down the left mouse button) a little to the right and watch the sheet scroll to the right.
3) Release the left mouse button once you reach the desired view area.

To move the view down:

1) First position the cell cursor somewhere in the last displayed row of the sheet.
2) Press the left mouse button and drag the mouse (still holding down the left mouse button) a little towards the bottom and watch the sheet scroll down.
3) Release the left mouse button once you reach the desired view area.

Similarly, follow the steps above to scroll towards the left and top of the sheet.

Moving with the Scroll Bars

Scroll bars, which appear on the bottom and right edges of the spreadsheet area, allow you to scroll through the sheet just as though it were printed on a continuous roll of paper. On a scroll bar, a slider bar indicates:

- the size of your sheet view relative to the total area used by the sheet, and
- the current position of the sheet view in relation to the total area used by the sheet.

Each view has its own scroll bars. If the slider fills the entire scroll bar, then the current view displays the entire sheet.

To move the view left or right one column at a time:

1) Move the mouse pointer to the arrow at the left or right of the horizontal scroll bar.
2) Click the left mouse button.

To move the view up or down one row at a time:

1) Move the mouse pointer to the arrow at the top or bottom of the vertical scroll bar.
2) Click the left mouse button.

To move the view one screen at a time:

1) Move the mouse pointer to an empty area at either end of the scroll bar.
2) Click the left mouse button.

To move the view anywhere in the sheet:

1) Move the mouse pointer into the slider.
2) Press the left mouse button and drag the slider until the view reaches the desired location.
3) Release the mouse button.

To move the view to the top or bottom of the used portion of the sheet:

1) Move the mouse pointer into the slider.
2) To move to the **top**, press the **Ctrl** and click the up arrow on the elevator bar at the same time.
3) To move to the **bottom**, press the **Ctrl** and click the down arrow on the elevator bar at the same time.

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*The **Go To** operation allows you to jump to a designated cell address. **Top** positions you in cell A1. **Bottom** positions you in the highest number cell defined by *maximumRowNumber (e.g. A65535). The **Find** command allows you to jump to a cell whose value meets your search criteria.*

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Moving with the Go To Dialog

XEss lets you move to a designated cell address anywhere in the workbook. This feature is particularly useful in large sheets that are cumbersome to scroll through. Even in moderate-sized sheets,

the **Go To** feature is often the fastest way to get to your destination.

To Go To a designated cell:

1) Select **Go To...** from the **View** menu. XESS displays the **Goto Cell** dialog box as shown in Figure 5-1.

2) In the **Enter Cell Address** entry box, type the address of the cell to which the cursor should move. Named ranges may be used for the cell address.

3) Click **OK** to carry out the command and dismiss the dialog box. Click **Apply** to carry out the command and leave the dialog box open. Click **Cancel** to cancel the operation.

If the cell is not currently visible, XESS changes the view so that the requested cell is in the displayed area of the sheet.

The **Go To** dialog can reference sheet names and named ranges. You can select from the list of named ranges displayed in the dialog window. This allows you to move the cell cursor to a cell anywhere on any sheet in the workbook.

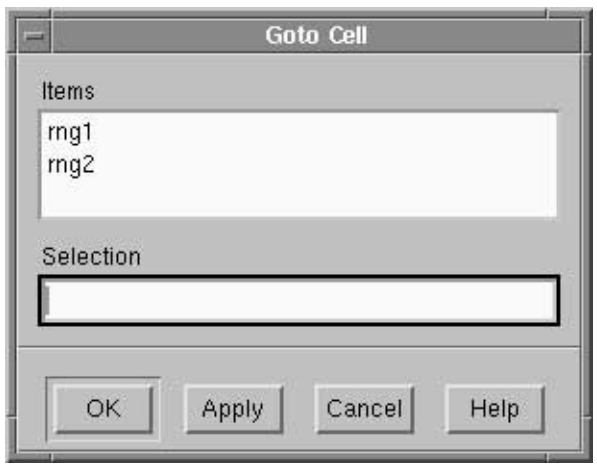

Figure 5-1 Goto Cell Dialog Box

Moving with the Find Tool

The **Find** tool lets you quickly locate a specific character string or numeric value. The power of the **Find** tool lies in its ability to accept expressions. XESS is not limited to just locating a specified string. It can find numeric values that meet certain logical or calculated conditions and can find strings that match specified patterns.

For example, you can search for cells whose values are greater than 100 and less than 150, or for cells whose values are less than the average of the three preceding cells. This facility is extremely useful for spotting patterns in large, complex data sets.

You can tell XEss which part of the workbook to search, whether to search by row or by column, and whether to search for text characters or numeric values.

To use the Find tool:

1) Select **Find...** from the **Search** menu or press the **[F6]** key. XEss displays the **Find** dialog box as shown in Figure 5-2.

2) In the **Find** dialog box, make the following entries to carry out the Find operation:

   Search Range — Specify the range of cells in which XEss should search, by entering two corner coordinates (e.g. A1..Z55). The default range is the entire sheet. If a range was selected when you invoked the **Find** operation, the default is this selected range.

   Target — Specify the string or value as it would appear formatted in the cell. To find a numeric value that meets certain criteria, enter an expression in Target. For example, to find values less than 20, specify the Filter as **#<20** and do a numeric search. *Target criteria is explained in more detail in the following section.*

3) By default, XEss searches row by row. Change the selection box to **Search by Column** to start searching column by column.

4) Select the type of cell values you would like to search: **Cell Formulas**, **Formula Values**, **Text Constant Cells**, **Numeric Constant Cells**, or **Cell Notes**.

5) Select **Text Comparison**, **Regular Expression**, or **Numeric Comparison** to indicate whether the Find operation does character comparisons, regular expressions, or evaluates numeric and logical expressions. These are described in detail in following sections.

6) For **Text Comparison** and **Regular Expressions** searching:

a) Use the **Ignore case** toggle button to determine whether or not upper/lower case is taken into consideration with the Find operation. If you wish to find both upper and lower case occurrences of alphabetic characters, click the toggle button *on* to **Ignore case.** Otherwise, if this toggle button is off, the Find operation will be case sensitive.

b) Use the **Ignore accents** toggle button to determine whether or not accents used in the extended ISO 8859 character pages are taken into consideration with the Find operation. If you wish to find both unaccented and accented occurrences of the same alphabetic character, click the toggle button *on* to **Ignore accents**. Otherwise, if this toggle button is off, the Find operation will differentiate between accented and unaccented characters.

c) Use the **Match whole word** to require that parts of words do not satisfy the search.

7) To start the search, select **Apply** or **OK.** Select **Find Next** (**[F7]**) and **Find Previous** (**[F8]**) on the **Search** menu to find additional cells meeting the search requirements.

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*The initial settings for the **Ignore case** and **Ignore accents** toggles are determined by the respective collating settings for case and accents in the Workbook Defaults dialog. Once you override either setting from the Find dialog, it will be remembered with subsequent Find operations within the same session.*

. . . . . .

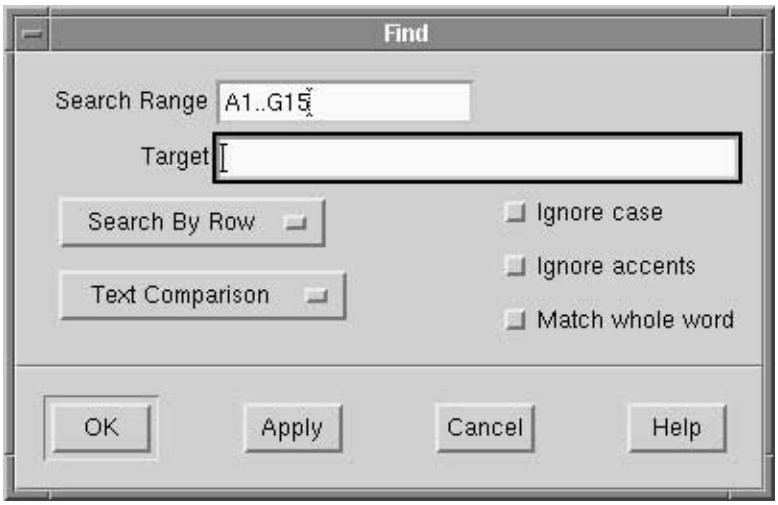

Figure 5-2 Find Dialog Box

Find Next

To find the next occurrence of the value or string being searched, select **Find Next** button from the **Search** menu. Alternatively, press **F7** key to repeat the search. The **Find** operation (described above) must precede the **Find Next** operation.

Find Previous

To find the previous value that was searched, select **Find Previous** from the **Search** menu. Alternatively, press **F8** key to search the previous value.

Target Criteria

To find a character string, type the string inside the Target entry box as it would appear when formatted in the cell.

For example:

Doe, John

To find a character string that matches a pattern, select **Regular Expression** and enter the desired pattern in the Target area.

For example:

A[B-Z]

This finds a cell containing an A followed by another letter other than an A.

To find a numeric value, either a constant or a calculated value, type the value exactly as it would appear formatted in the cell.

For example:

$1,000,000

To find numeric values that meet certain criteria, enter the target with a constraint expression. **#** is used to represent the current cell being examined. Select **Numeric Comparison**. For example:

- To find values less than 20, specify the target as:

  #<20

- To find values greater than or equal to 50, the rule is:

  #>=50

- To find cells whose values are less than 600 and whose neighboring cells in the same column have values less than 500, specify the target as:

  #<600 && #{0,-1}<500 && #{0,1}<500

- To find the cell containing the date August 22, 1991, specify the target as:

  #==@DATE(1991,8,22)

- To find cells with non-default background color, use:

  @CELL("BackgroundColor",#)!=0

How XESS Evaluates Target Criteria

XESS follows these rules when finding a target string:

- XESS begins the search at the top left corner of the selected range. Subsequent searches with **Find Next** and **Find Previous** start at the current cell.
- You can use regular expressions to define text (non-numeric) searches. Regular expressions specify a set of strings of characters. In a regular expression, a character normally matches with the same character in the matching string. A few characters have special meanings:

  . A period matches any character (e.g. **A.C** matches "ABC" or "AXC").

  ^ Matches only at the beginning of a field (e.g. **^ABC** matches "ABC" but not "AABC").

$** Matches only at the end of a field (e.g. **ABC$ matches "AABC" but not "ABCD").

[x-y] Matches any character between the character **x** and the character **y** (e.g. **[0-5]$** finds fields ending in the characters **0** through **5**).

[xyz] Matches any character in the list **xyz** (e.g. **[05]$** finds fields ending in either a **0** or a **5**). This form and the one above can be combined. **[27-9]$** will find fields ending with the characters **2**, **7**, **8**, or **9**.

\ Uses the next character as its actual value rather than with special meaning (e.g. \\, \$).

\< Match the beginning of a word.

\> Match the end of a word.

***** Match 0 or more of the expression to the left.

+ Match 1 or more of the expression to the left.

\(... **\)** Match the expression with the delimiters. Useful when you want to add a closure operator to the right of it.

These methods can be combined. Thus, the filter **[brc]at** finds "bat," "rat" and "cat."

- By default, XESS looks for your search string in any part of a cell entry. If you search for the word "Test," XESS locates cells containing the strings "Test1," "Test2," "TestFinal," and so on.
- When conducting a text search, XESS formats the cell entry before searching. For example, XESS would recognize the dollar sign ($) and commas in numbers formatted in the **Dollars** format, rather than the generic manner in which they were entered.

Creating Multiple Views

XESS allows you to create multiple secondary windows to the same workbook. These windows can be navigated independently of each other. Each view is a *transient* window which means it is always positioned on top of the main XESS window. Each secondary window can be moved and resized—but not iconified.

Secondary windows do not include a menu bar. However, any menu or operation selected from the main menu on the primary

window is applied to any secondary window which has the current or selected cell(s) in view.

To create a secondary window of the spreadsheet data:

1) Select **Create New View** from the **View** menu.

To remove a secondary window:

1) Click **Cancel** on the window to be removed.

Setting and Clearing View Titles

XESS provides utilities to set view titles that remain on screen when you scroll through the sheet:

- The **Lock View Titles** option on the **View** menu establishes rows at the top of the sheet for column headings and columns on the left as row headings. The title rows scroll with the view from left to right but remain in the same position at the top of the sheet as you scroll up and down.

  The title columns scroll with the view as you move up and down but remain in the same position at the left of the sheet as you scroll right and left.

  Row and column titles must be entered before the view titles are locked. After view titles are set, the cursor no longer moves into the title area.

- The **Unlock View Titles** option removes title status from all existing title rows and columns.

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*For more information about title rows and columns, see **Defining the Appearance of the Workbook.***

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Edit Menu

Most of the operations that manipulate cells in the sheet are done with Edit menu selections. To use this menu, select **Edit** from the menu bar. (*Mouse button 3 popup menu may be used as a short-cut access to most Edit operations.)*

Undo	Undoes the last operation performed on the workbook. The Undo operation is context-sensitive and removes the most recent operation.
Redo	Performs again the operation that was just canceled with **Undo**.

Repeat	Performs again the operation that was just done.
Cut to Clipboard	Copies the selected cells to the Clipboard and removes them from the sheet.
Copy to Clipboard	Copies the selected cells to the Clipboard.
Paste from Clipboard	Copies the Clipboard to the cells beginning at the cell cursor.
Edit Cell	Switches into Edit Mode so that you can edit the contents of the current cell.
Select All	Highlights (selects) the entire sheet for use by the next operation.
Select...	Highlights a range of cells to be affected by a subsequent operation.
Reselect	Selects the most recent selection.
Named Range...	Defines and manipulates named ranges.
Set Sheet Name...	Changes the name of the current sheet.
Move	Moves a selected cell or range of cells (including all data values, formulas, formatting and cell references) to a designated location, overwriting existing data in the destination range.
Copy	Duplicates the contents of a cell block and writes them one or more times into a specified area of the workbook.
Clear	Erases all data values and formulas in a selected cell or range of cells. The cells and their formatting are retained.
Insert	Inserts a row, a column, or a page break into the sheet at the present position of the cursor or inserts a sheet before the current sheet.
Delete	Removes rows, columns, page breaks, or sheets from the workbook. When a row or column of cells is deleted, they no longer exist and other cells shift up and left to replace them.

Insert *and* ***Delete*** *are discussed in* ***Defining the Appearance of the Workbook***

Mouse Button 3 (MB3) Popup Menu

Most of the operations available from the **Edit** menu may also be accessed via the mouse button 3 (MB3) popup menu. Simply hold down the right mouse button or equivalent and traverse the choice of operations to the one desired and release.

If you happen to click MB3 during an edit operation, some selections will be greyed out.

*You may disable the MB3 functionality by setting the resource, *popupMenu, in the Xess5 resource file to False.*

Undo

If you make a mistake in a cell, it is very easy to edit the cell and change its contents or formula. But what if you accidentally erase the wrong data or accidentally overwrite some cell with a Copy or Move? XESS allows you to easily recover from your mistakes using the **Undo** option from the Edit menu.

The **Undo** operation allows you to undo the most recent operations performed on the workbook. Undo is context-sensitive. For example, if the last operation were **Copy Formulas,** the menu would read **Undo Copy**.

If there is not a command that can be undone, the **Undo** option will appear dim on the **Edit** menu and you can not select it.

*Note: if **Undo** results in restoring cells to the empty state, some of their cell attributes may not be restored.*

Redo

If you **Undo** too many operations, **Redo** lets you perform again the operation that was just undone. This is particularly useful if you have undone too many actions.

Repeat

Applies the previous operation to the current selection.

Selecting Cells and Ranges

Some edit actions affect only one cell at a time, such as changing the value of a cell. Others actions affect blocks of cells, known as

cell ranges. The copy, move, clear and format operations, for example, can affect one cell or a group of cells.

Before you do an operation that manipulates cell contents, you must select which cell(s) you wish to affect. For example:

- To clear the contents of cells A1 through A5, you must first select the range A1 through A5. When you initiate the **Clear** operation from the Edit menu, XESS clears the contents of each cell in the range.
- To copy the values of cells A1 through E5, you must first select the range A1 through E5. XESS prompts you to specify the destination.

XESS offers five options for selecting cells:

- using the mouse to highlight the desired cell(s),
- using the select button to select all cells in the sheet.
- using the **Select...** operation to specify the cell(s) by address,
- using the **Select All** option or
- using the **shift key** with the arrow keys.

In each case, XESS highlights the selection. If no range or cell is selected, most XESS operations apply to the current cell.

Most operations affect all the cells in the selected range (for example: **Clear**, **Cell Color**, or **Copy**). Certain operations restrict the ranges that they use. For example, if you have 10 rows of numbers each in columns A and B and select all of both columns (using the column buttons) to define a graph, the graph operation will only use the 10 data points and ignore the thousands of empty cells.

Selecting Ranges Using the Mouse

To select a cell using the mouse:

1) Move the mouse pointer to the desired cell.
2) Click the left mouse button and drag the mouse pointer just outside of the cell boundary, and then back in.
3) Release the mouse button. The selected cell will be highlighted.

If there is not an explicit selection of a cell or range, most operations affect the current cell, the one where the cell cursor is positioned.

To edit the contents of the current cell, use **Edit Cell,** or place the mouse cursor in the Edit Line and click the left mouse button.

If you wish to move, copy or clear cell contents, click once on the cell, then select the appropriate function from the Edit menu.

To select a range of cells using the mouse:

1) Move the mouse pointer to one corner of the range.
2) Press the left mouse button and drag the mouse (still holding down the left mouse button) to the opposite corner of the range.
3) Release the mouse button. The selected range will be highlighted.

To select a row using the mouse:

1) Move the mouse pointer to the row border. For example, move the mouse pointer to the number of the row you wish to select.
2) Press the left mouse button to select the whole row.
3) Drag the mouse pointer up or down if you wish to select several contiguous rows.
4) Release the mouse button. The selected row(s) will be highlighted.

To select a column using the mouse:

1) Move the mouse pointer to the column border. For example, move the mouse pointer to the letter of the column you wish to select.
2) Press the left mouse button to select the column.
3) Drag the mouse pointer to the left or right if you wish to select several contiguous columns.
4) Release the mouse button. The selected column(s) will be highlighted.

To extend a selection with the mouse:

Use the **Shift** key with the left mouse button to extend or reduce a selection. The current selection will be adjusted so that the newly-selected cell becomes one of the corners of the selection. **Shift** and click on a sheet tab to extend the current selection to multiple sheets within the workbook.

Multiple views of the workbook can be used when extending selections. For example, select the top elements in one view and shift-click the bottom cell in another view. The selection is extended as if it were all in a single view.

To select the entire sheet with the mouse:

Use either the **Select All** option of the Edit menu or click on the push button at the top of the row numbers and to the left of the column names. This selects the entire sheet.

Selecting Ranges Using the Select Operations

For large or remote ranges, using the keyboard or mouse to highlight the range can be cumbersome. It is much easier to select the range by specifying the cell addresses of two opposite corners of the range. The **Select...** operation (from the Edit menu) displays a dialog box for that purpose. The **Select Range** dialog works for any XEss operation.

To select a cell using the Select Range operation:

1) Choose **Select...** from the **Edit** menu. XEss displays the **Select Range** dialog box as shown in Figure 5-3.
2) In the **Selection** entry box, type the cell address or range in the dialog box. For example, type in B17. Named ranges can also be used.
3) Apply your selection by clicking **OK** or **Apply** or by typing **[Enter]**.

To select a range of cells using the Select operation:

1) Choose **Select...** from the Edit menu. XEss displays a the **Select Range** dialog box as shown in Figure 5-3.
2) In the **Selection** entry box, type the addresses of two cells in opposite corners of the desired range, separated by two periods (**. .**). For example, to select a range from A14 to B27, type A14..B27. Named ranges can also be used.

3) Apply your selection by clicking **OK** or **Apply** or by typing **[Enter]**.

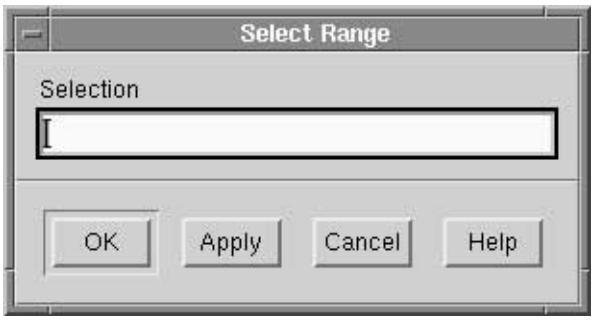

Figure 5-3 Select Range Dialog Box

To select all cells using the Select All command, choose **Select All** from the **Edit** menu. XEss selects the range which covers all cells in the sheet.

*If you are working in edit mode or input mode, XEss assumes that **Select All** is meant to be an insertion into the content of the current cell. Therefore, XEss does not leave the selection highlighted for subsequent action; it inserts the range address into the edit line text at the current cursor position.*

Selecting Ranges Using the Keyboard

To select a single cell using the keyboard:

1) Using the arrow keys, move the cell cursor to the desired cell.

2) Hold the **Shift key** and move the cursor to an adjacent cell and back to the desired cell. The desired cell will be highlighted.

If you wish to edit the contents of the cell, press the accelerator key for Edit Cell (usually **[F2]**) to enter edit mode. You can then use the keyboard to change cell contents.

To select a range of cells using the keyboard:

1) Using the arrow keys, move the cursor to one corner of the range.

2) Hold down the **Shift key**.

3) Use the arrow keys to move the cursor to the diagonally opposite corner of the range and then release the **Shift key**.

4) If this is the selection of a destination for a move or copy, type **[Enter]** to complete the operation.

To select all cells using the keyboard, press **Ctrl+a**. This is the accelerator for **Select All**.

To enter a selection into the Edit Line: press **[Enter]** after making the selection with the arrow keys and Shift.

Deselecting Cells and Ranges

You can cancel a selection by deselecting cells and ranges using the keyboard or mouse.

To cancel a selection using the mouse, click the left mouse button on any cell.

To cancel a selection using the keyboard, move the cursor without depressing the **Shift key**.

XEss will de-select the current cell or range.

Note: Any motion such as the arrow keys (without Shift), scrolling, Go To, Top, and Bottom also cancels the selection.

Reselecting a Range of Cells

Use the **Reselect** option to select the cells that were most-recently selected. The selected range is highlighted and the cell cursor is positioned within the range.

Specifying Cells and Ranges in Dialog Boxes

Some XEss dialog boxes have entry fields where you can specify a cell name or a range of cells.

To specify a cell in a dialog box:

Enter the address of the cell. For example: A1.

OR

Use the mouse to point to the cell, and then click the left mouse button (This moves the cell cursor.). Now position the mouse over the dialog entry and press the middle mouse button (MB2). XEss pastes the cell name into the dialog as a relative reference. To paste an absolute reference, hold the **Ctrl** key when you press the middle mouse button.

To specify a range in a dialog box:

Type the addresses of opposite corners of the range, separated by two periods (**..**). For example: A1..E5.

OR

Use the mouse or keyboard to highlight the range of cells. Now position the mouse over the dialog entry and click the middle mouse button (MB2). XESS pastes the cell range into the dialog as a relative reference. To paste it as an absolute reference, hold the **Ctrl** key when you click the middle mouse button.

*If you have previously assigned a name to a cell or cell range using the **Named Range** dialog, you can specify cells and ranges by this name rather than by pointing or by coordinates.*

Named Ranges

Individual cells and rectangular ranges of cells may be referred to by their standard address coordinates (A5..D25, for example) or by pre-assigned names. Using names can help clarify your logic making it easier to share among users, and easier to update long after it was originally designed. The **Named Range** option lets you assign a name to any cell or range. Once defined, names can be used anywhere standard cell or range references are used including cell formulas.

The following guidelines apply to named ranges:

- XESS differentiates between upper and lower-case letters in range names. For example, XESS would consider "Range1" and "range1" to be different names.
- Names must begin with an uppercase or lower-case alphabetic character. The rest of the name may include any combination of alphabetic characters, numeric characters, dollar signs(**$**), and underscores (_) . If the name does not satisfy this rule, it must be enclosed within single quotes (**'**).
- When an area containing a named range or cell is moved, XESS automatically updates the definition of the name to reflect the new location.
- Named cells and ranges can have relative or absolute addresses. When cells containing references to named cells with absolute addresses are moved, the references are not updated.

- When cells containing a reference to a named cell or range are copied, XESS converts the reference to an appropriately translated standard reference.
- If you redefine a name, all instances of that name in the workbook are updated as soon as the workbook is recalculated.
- If you remove a name definition, all references to that name in the workbook are converted to appropriate standard references.
- Named ranges can reference three-dimensional ranges by qualifying the upper left cell with the front sheet name and qualifying the bottom right cell with the back sheet name.

To name a cell or range:

1) Select the cell or range to be named.
2) Select **Named Range...** from the **Edit** menu. XESS displays the **Named Range** dialog box as show in Figure 5-4.
3) In the **Selection** entry box, the current cell or range is displayed. Click on the entry box before the equal (=) sign and enter a name.
4) Click **Set** or press **[Enter]**. Click **Cancel** to dismiss the dialog box.

To clear the name from a cell or range:

1) Select **Named Range...** from the **Edit** menu. XESS displays the **Named Range** dialog box as shown in Figure 5-4.
2) Click on an entry in the **Named Range List** box. XESS displays your choice in the **Selection** entry box.
3) Click **Clear**.

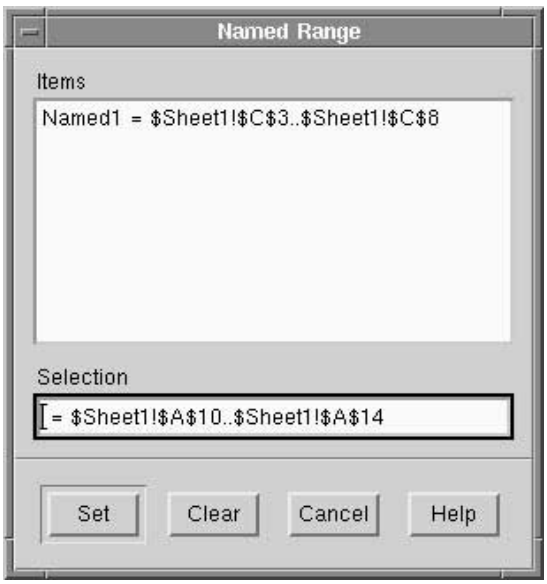

Figure 5-4 Named Range Dialog Box

Copying Data

XESS provides considerable flexibility in copying data from one part of the sheet to another, and for copying data from one XESS sheet to another within the same workbook. You can copy cell formulas or values — either for one cell or for a range of cells — and place these formulas or values into a designated cell or range of cells.

The most common ways to copy data are:

- With the mouse
- Through the Clipboard
- With the Copy menu
- With the Transpose tool

You can also copy between workbooks using either the mouse or the Clipboard.

Copying with the Mouse

One of the easiest and most powerful ways to copy cells uses just the mouse. **Select** the cell you want to copy by holding the left mouse button while dragging the mouse through the desired

range. Then position the mouse pointer to the upper left cell where you want the result and click the middle mouse button to do a **paste**. (On a two-button mouse, click both buttons at the same time.) XESS performs a Copy Formulas operation, copying the cell values and attributes, but not the cell notes.

Selection-Paste can be used within the current sheet, between XESS workbooks, and between XESS and other applications. If XESS is unable to exchange cell information with the other application, the current values are passed as text.

Selection-Paste is the standard convention for most X applications including terminal windows, text editors, and utility applications. This makes it easy to do things like selecting a file directory listing in a terminal window and pasting it directly into a sheet where the data might be sorted and graphed.

Using the Clipboard

To copy using the clipboard, select the range to be copied. Then **Copy to Clipboard** using either the **Edit** menu or the toolbar copy icon. Now position the cell cursor to the upper left corner of the target range and paste the result by using the **Paste from Clipboard** on the **Edit** menu, using the paste icon on the toolbar, or clicking the middle mouse button.

Items copied to the clipboard may be pasted into several different locations by using repeated paste operations. The clipboard holds its contents until the next cut or copy to the clipboard.

Using the Copy Menu

To copy formulas, use the **Copy Formulas** operation from the Edit menu. **To copy values**, use the **Copy Values** operation from the Edit menu,

Copy Formulas	Copies formulas from a selected cell or cell range into a selected cell or range, overwriting existing data in the destination range. XESS changes cell references to reflect the new location, unless the cell references are absolute (marked with a dollar sign, **$**), which indicates that they should not change.
Copy Values	Copies values from an active cell or cell range into a designated cell or range, overwriting existing data in the destination range. When copying cells that contain formulas, XESS copies the present value of the cell, not the formula,

and enters it into the destination cell or range as a constant.

For Copy Formulas and Copy Values, XEss follows these rules for distributing the copies to the destination cell or range:

- If you specify one source cell and one destination cell, XEss copies the original and places the contents in the destination cell. The original cell is unchanged.
- If you specify one source cell and more than one destination cell, XEss duplicates the original cell in each cell of the target range.
- If you specify a range of cells to copy and specify an equivalent destination range (one with an equivalent number of rows and columns), XEss copies each cell in the origin range into its counterpart cell in the destination range.
- If you specify a source range that spans only one row but a destination range that spans several rows, XEss repeats the data in each row. (Note: The source and destination ranges must have the same number of columns.)
- If you specify a source range that spans only one column but a destination range that spans several columns, XEss repeats the data in each column. (Note: The source and destination ranges must have the same number of rows.)
- If you specify a destination range that contains fewer cells than the source range, XEss returns the message **illegal source/destination**, and nothing is copied.
- If you specify a destination range with a different number of rows and columns from the source range, XEss returns the message **illegal combination of source/destination range**, and nothing is copied.
- In order for cell attributes to be copied, the cell must not be empty.

Note: You can make multiple copies of cells or cell ranges in one operation, simply by making the destination range larger than the source destination.

Copying Formulas

The **Copy Formulas** operation duplicates a cell or range of cells (along with all formatting) and places these formulas in a new location, overwriting existing data in the destination range. XEss

automatically translates relative cell references in the copied formulas to reflect their new locations. For example, if cell A10 contains the formula **=@SUM(A1..A9)** and is copied to cell B10, then B10 will contain the formula **=@SUM(B1..B9)**.

. . . . . .

*To create an absolute cell reference -- one that XEDIT will not translate if the cell contents are copied -- insert a dollar sign (**$**) before each component of the cell reference (e.g., $A$1). You can use the **[F4]** key to insert the $ into formulas. For more information, refer to **Absolute and Relative Cell References** in the **Calculations** chapter.*

. . . . . .

To copy formulas from one cell or range to another:

1) Select a cell or range of cells whose formulas or values are to be copied. For example, select A1 through A10.

2) Select **Copy** from the **Edit** menu, **MB3** popup, or press **Ctrl+f**, and display its submenu.

3) Select **Copy Formulas** from the Copy submenu. XEDIT displays the **Copying formulas from A1..A10, select destination Range/Address...** in the Message Line.

4) Using the mouse, click on a cell or select a range to which the formulas should be copied. For example, click on cell E1 to copy the formulas to cells E1 through E10, or select the range E1..G1 to copy three columns of the formulas in cells E1 through G10. XEDIT copies the formulas and their values from the source range to the destination range, overwriting any existing data.

Alternatively, use the the **Select Range** dialog box from the Edit menu to select a destination range.

Remember that copying with the mouse is usually an easier operation.

Copy Formulas can be use to copy cells with repeating characters or graphs that are stored in the sheet.

Copying Values

The **Copy Values** operation copies the current value of a cell or range of cells to a new location. When copying a cell that contains a formula, XEDIT copies the calculated result of that formula, not the original formula. The value is copied to the new location and treated thereafter as a constant value.

If you have used formulas to build part of your sheet and no longer need the formulas themselves, converting the formulas to values can save memory and reduce recalculation times.

To copy values from one part of the workbook to another:

1) Select a cell or range of cells whose values are to be copied. For example select A1 through A10.

2) Press **Ctrl+v** or: Select **Copy** from the **Edit** menu or **MB3** popup and and select **Copy Values** from the Copy submenu.

3) XEss displays **copying values from A1..A10, select destination Range/Address...** in the Message Line. Using the mouse, click on a cell or select a range to which the values should be copied. For example, click on cell C1 to copy the values to cells C1 through C10, or select the range E1..G1 to copy three columns of the values in cells E1 through G10. XEss copies the values from the source range to the destination range, overwriting any existing data.

Alternatively, use the the **Select Range** dialog box from the Edit menu to select a destination range.

Copying Large Blocks of Data

When you need to handle a large block of data which exceeds the screen boundary, instead of using the mouse to select the data, use the **Select** operation from the **Edit** menu in conjunction with the Copy operations.

To copy a large block of data using the Select operation:

1) Select **Select...** from the **Edit** menu or **MB3 popup** menu to display the **Select Range** dialog box.

2) Enter the range you wish to copy and click **OK** or **Apply**.

3) Select the desired **Copy** operation from the **Edit** menu or **MB3 popup** menu.

4) To complete the operation, identify the beginning target cell by scrolling to the location and clicking in the cell.

   -OR-

   Select the **Go To...** operation from the **View** menu. Enter the target cell address and click **OK** or **Apply**.

To copy a single cell to a large block of cells using the Select operation:

1) Select the cell to be copied with the mouse.
2) Select the desired **Copy** operation from the **Edit** menu or **MB3 popup** menu.
3) Select **Select...** from the **Edit** menu or **MB3 popup** menu to display the Select Range dialog.
4) Enter the target range and click **OK** or **Apply**. *This will cause the target area to be selected only.*
5) Press **[Enter]** to complete the copy operation.

Tailoring Copy Options

You can control which attributes of a cell are copied by using the **Copy Options** dialog of the **Options** menu (Figure 5-5). This dialog contains settings which determine which of the attributes are copied with the **Copy Values** and **Copy Formulas** operations. They are not used by the Selection-Paste operation used for copying with just the mouse.

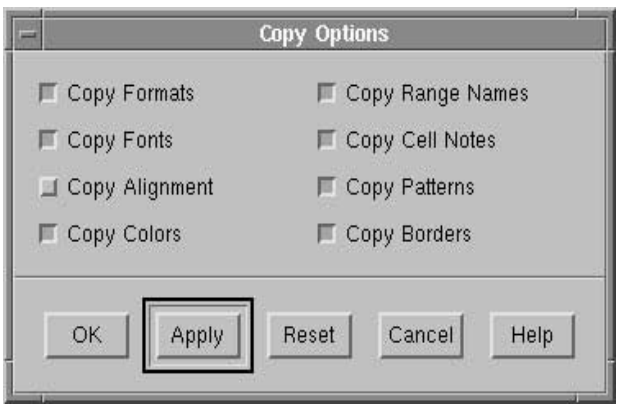

Figure 5-5 Copy Options Dialog Box

Transpose Tool

The **Transpose** operation on the **Tools** menu allows copy and move operations where the row and column orientation of the result is reversed from that of the source. For example, the transpose of the range A4..A10 into C3 places the results into the range C3..I3.

The **Transpose** command can copy the **values**, copy the **formulas**, or **move** the formulas. With **Transpose>Move** and **Transpose>Formulas**, the cell references are updated appropriately.

Moving Data

The **Move** operation moves a cell or range of cells to a new location, along with all formulas. XEss clears the source cells and overwrites any existing data in the destination cells. Like the **Copy Formulas** operation, all cell references are updated to reflect the new cell/range location.

To move data in a cell or range of cells:

1) Select a cell or range of cells to be moved. For example, select A1 through A10.

2) Select **Move** from the **Edit** menu, **MB3** popup, or press **Ctrl+m**. XEss displays **moving from A1..A10, select destination Range/Address...** in the Message Line. Using the mouse, click on the cell to which the values should be moved. For example, click on cell A17 to move the contents to cells A17 through A26. XEss clears the original cell location and overwrites any existing data in the destination range with values and formulas from the source.

Alternatively, use the the **Select Range** dialog box from the Edit menu to select a destination cell.

Cells can also be moved by doing a **Cut to Clipboard** followed by a **Paste from Clipboard** at the appropriate destination.

Effects of Moving Cells

- When you move a cell that is referenced by a formula, XEss automatically updates the formula for the new location, even if the cell reference is absolute.
- When you move a cell in the middle of a range that is referenced by a formula, the formula still references the original range. However, if you move a corner cell of the range, XEss extends or contracts the range to match the new locations of the cells that were in the range.
- If you move a cell range that has been named, or one referenced in a formula, XEss automatically updates the definition of the range name or the formula reference to reflect the new location.
- If you move part of a cell range that has been named or referenced in a formula, it can cause problems. XEss updates range names and references only when you move one or more corner cells of the range. If you move cells in the interior of the range, XEss will not change the range name or any references to it.

*Note: If you make a mistake when copying or moving data, you can use **Undo** from the Edit menu to restore the workbook to its state prior to the copy or move.*

Copying or Moving Data from one Workbook to Another

With XESS, you can have many workbooks active at the same time. Cells can be copied between workbooks using either the mouse select-paste operation or by using the clipboard.

You cannot move data from one workbook to another using the **Move** operation. You can accomplish the same effect, however, with **Cut to Clipboard** followed by **Paste from Clipboard.**

You can also paste data to and from other X Windows application. For more information, see **Interacting with Other Applications.**

Removing Data -- Clear

XESS provides several methods for removing data and formatting from the workbook:

- The **Clear** operation from the Edit menu or MB3 popup clears all data from a designated cell or range of cells and makes the cells empty.
- The **Delete** operation from the Edit menu or MB3 deletes the current rows or columns and all data contained in the rows or columns.
- The **Cut to Clipboard** clears the cells in the selection after they are copied to the clipboard.

Clearing Cells

To erase data in cells:

1) Select a cell or range of cells to be cleared.
2) Select **Clear** from the **Edit** menu or **MB3** popup, or press **Delete**. XESS makes the selected cells be empty.

Deleting Rows and Columns

The **Delete** operations deletes rows and columns from the sheet, along with all formulas and values in the deleted cells. XESS reassigns addresses for the remaining rows and columns and adjusts formulas in other cells as needed so that cell dependencies are preserved. If the deleted rows or columns were included in

named or referenced ranges, XESS contracts those ranges accordingly.

To delete a row:

1) Use the mouse to select the row(s) you wish to delete. Place the mouse pointer over the number which identifies the row, and click the left mouse button. To select more than one row, place the mouse pointer over the number, drag the mouse (holding down the left mouse button) to the desired ending number, and release the left mouse button.

2) Select **Delete** from the **Edit** menu or **MB3** popup to display its submenu.

3) Select **Delete Row** from the Delete submenu. XESS deletes the row(s) and all data contained in that row. XESS re-addresses the remaining rows and rewrites cell references where necessary to be consistent with the new row numbering.

To delete a column:

1) Use the mouse to select the column(s) you wish to delete. Place the mouse pointer over the letter which identifies the column, and click the left mouse button. To select more than one column, place the mouse pointer over the letter, drag the mouse (holding down the left mouse button) to the desired ending letter, and release the left mouse button.

2) Select **Delete** from the **Edit** menu or **MB3** popup to display its submenu.

3) Select **Delete Column**, from the Delete submenu. XESS deletes the column(s) and all data contained in that column. XESS re-addresses the remaining columns and rewrites cell references where necessary to be consistent with the new column lettering.

Starting a New Workbook

The **New** option from the File menu creates a new workbook. Any workbooks already open remain open. The new workbook will have its own primary window with menus, toolbars, etc.

Closing the Current Workbook

The **Close** option from the Edit menu completes processing of the current workbook.

To close the current workbook:

1) Select **Close** from the **File** menu. If you made changes to the workbook, XEss displays the **Warning!!!** dialog box as shown in Figure 5-6.

   a) **To save the changed version**, click the **Save** button. XEss saves the new version (possibly overwriting a previous version).

   b) **To discard your changes** and preserve the workbook on disk, click **Discard**. XEss discards the version on screen.

   c) **To cancel the Close operation**, click **Cancel**. XEss returns to the active sheet.

Figure 5-6 Warning Dialog Box

6

Calculations

This chapter explains XESS calculations, including:

- how XESS calculates.
- how to change calculation options such as automatic recalculation and iteration limit.
- elements of formulas.

How XESS Calculates

XESS uses **natural order** recalculation, which is a method of ordering the computations such that each cell's value is computed only after the values for all cells on which it depends have been computed. Natural order recalculation guarantees that cells are always computed correctly, regardless of the order in which the cell formulas were entered. Iconified sheets are recalculated the same as visible sheets.

XESS supports several recalculation options:

- Mode (Manual or Automatic)
- Method (Foreground or As Needed)
- Iteration Limit
- Constraint Checking

All four options are set in the **Recalc Options** dialog box.

Mode of Recalculation

Xess supports two modes of recalculation: **Manual** and **Automatic**. When **Manual** is set, formulas are only recomputed when an explicit recalculation operation is requested. When **Automatic** is set, any action which causes the contents of a cell to change automatically triggers recalculation of any formulas depending on the changed cell.

Method of Recalculation

Automatic recalculation supports two methods of recalculations: **Foreground** and **As Needed**.

Foreground

When **Foreground** is set, Xess enforces **minimal** recalculation, which means that only the cells in the workbook which are potentially affected by an operation which you perform (such as editing a cell, or moving a range of cell) are recalculated. This feature minimizes the work performed during recalculation and thus speeds up your computations. Minimal recalculation is in effect whenever the recalculation mode in the **Recalc Options** dialog is set to **Automatic** and the method is set to **Foreground**.

As Needed

When **As Needed** is set Xess enforces **frugal** recalculation, which further reduces the number of cells that need to be computed. The performance gain in recalculation can be significant, depending on the size and complexity of the sheet. Frugal recalculation is in effect whenever the recalculation mode in the **Recalc Options** dialog is set to **Automatic** and method is set to **As Needed**. Note that **As Needed** does not support Constraint Checking and Iterative Recalculation options.

Iterative Calculations

Normally, a formula in a given cell should not depend on that cell itself, either directly or indirectly. Such a condition is called a **cyclic dependency**. When cyclic dependencies exist, the rule for natural order recalculation as described above does not make sense. When you enter a formula which creates a cyclic dependency, the message *"**Cycle!**"* is displayed in the cell.

In some cases cyclic dependencies are useful in that they can represent **iterative** calculations, which XESS supports. Iterative calculation is useful when two or more cells mutually depend on each other such that each time they are recalculated, their values become closer and closer to the desired answer.

When the **Iteration Limit** field in the Recalc Options dialog box is set to a non-zero value and **Method** is set to **Foreground**, iterative calculation is enabled. In this mode, XESS will make multiple recalculation passes, still preserving the natural order and minimal recalculation rules described above, until either the iteration limit has been reached or, if constraint checking is enabled, until all constraints are satisfied. The @INIT function helps perform iterative calculations.

Constraint-Checking

XESS formulas may contain conditional expression which establish conditions under which a formula operates or boundaries for valid results of the formula. When calculating the workbook, XESS only performs constraint checking when it is explicitly enabled in the **Recalc Options** dialog on the **Options** menu.

Precision and Accuracy

XESS performs all calculations in double-precision floating point binary numbers. This allows numbers to be represented with up to 15 significant decimal digits. This works well for integer values, but you need to use care when working with fractional values.

A simple example of the problem with fractions is to enter the value 0.01 into 100 cells and then sum the values and subtract 1. The result is not 0. Rather, it has small value in the 16th decimal place. The reason for this round-off error is that the decimal value .01 cannot be exactly represented as a binary fraction -- just as the value 2/3 cannot be exactly represented as a decimal number. This behavior is well known and well understood in scientific and statistical computing, but can cause surprise when first using spreadsheet products to work with currencies. This behavior is found in all popular spreadsheet products.

Calculations with logical operators -- **!** (logical NOT), **&&** (logical AND), **||** (logical OR), and **?:** (conditional) -- consider a non-zero value to be True and a zero value to be False. Integer operators -- **~** (complement), **&** (bitwise AND), **|** (bitwise OR), **^** (bitwise EXCLUSIVE-OR), and **%** (modulus) convert their operands to 32-bit integers before performing the operation.

XESS Formulas

Formulas are the backbone of spreadsheets, establishing and calculating mathematical relationships between spreadsheet elements. Whereas numeric entries remain the same until you change them, cells defined by formulas are automatically changed

to reflect changes in referenced cells -- even where there are complex interdependencies among cells.

XESS formulas can calculate with numbers, text, logical values, cell references, and other formulas. For example, you can easily calculate the sum of a series of cells, the total of values in a column, a minimum or maximum value within a range, the rounded result of another formula, or the absolute value of a cell entry. Formulas can express complex interdependencies among cells, and they can define constraints on the calculation, such as limits on acceptable values or specific conditions under which a calculation should take place.

Once entered in a cell, formulas are hidden behind the scenes, perform their work in the background, and display only the result of their calculation. To view the formula in a cell, simply select the cell.

XESS displays the formula in the Edit Line just below the main menu bar. You can edit the formula or values in cells at any time.

. . . . . .

Note: You cannot enter or change formulas in cells that have been protected with the cell protection feature. For more information about cell protection, refer to the chapter, ***Entering Data****.*

. . . . . .

XESS also provides a wide variety of functions that perform certain tasks. Functions can be used alone or in conjunction with formulas and other functions. XESS provides many specialized functions in addition to those that are usually found in typical financial spreadsheets. For more information about functions, refer to **XESS Built-in Functions**.

Formula Syntax

The general form of an Xess formula is:

= expression ; constraint expression //comment

where **expression** defines the calculations needed to generate the cell's value, **constraint expression** places limits on acceptable values or the circumstances under which the calculation should take place, and **comment** is any text you want to attach to the cell.

The expression part of XESS formulas look just like algebraic formulas; they contain values and operators that define the relationships between values.

XESS uses the following conventions for formulas:

- A formula must begin with an equal (=) sign. If the first character you type is one of the following, an equal sign is automatically inserted for you:

  0 1 2 3 4 5 6 7 8 9 . + - @ =

- A formula may have as many as 4095 bytes (or characters for most languages). You can enter spaces if you wish, but XEss automatically removes them.

To change a formula in a cell, move the mouse pointer to the cell and choose the **Edit Cell** operation from the Edit menu or position the cursor in the formula display in the Edit Line.

Formula Values

Formulas can contain any or all of the following types of values:

- Numbers, such as 123, -123, 12.3
- Addresses of single cells, such as A1, D5, Sheet3!Z100
- Addresses of cell ranges such as B12..G29, A1..D5
- Absolute cell references denoted with dollar signs before the fixed coordinate ($A$1, $A1, or A$1), which will not be updated when the referencing cell is moved or copied.
- User-defined cell names or cell range names, such as TOTALS or PROJECT1
- XEss functions, such as @SUM or @RADIANS, with their arguments
- Text surrounded by double quotation marks, such as "The sum is " or "Total"
- Matrices of numeric constants enclosed in braces such as:
  {1,1,2,3,5,8} which is a 6-element matrix.
  Two dimensional matrix constants use multiple braces.
  {{1,2,3}{4,5,6}} or {{1,2,3;4,5,6}} is the matrix:

1	2	3
4	5	6

Formula Operators

XEss supports all the arithmetic, boolean and logical operators available in the C programming language. It does not support the C address operators or the operators that have side effects, such as

++. XESS provides two operators, exponentiation (**) and percent (%), that are not available in the C language.

XESS Formulas can contain the following operators to define relationship between values.

Operator	Precedence	Definition
%	14	Unary percent
**	13	Exponentiation
+	12	Unary plus
-	12	Unary minus
~	12	Bitwise complment (integer)
!	12	Logical not
*	11	Multiplication
/	11	Division
%	11	Remainder (integer)
+	10	Addition
-	10	Subtraction
<<	9	Shift left (integer)
>>	9	Shift right (integer)
<	8	Less Than
>	8	Greater Than
<=	8	Less Than or Equal
>=	8	Greater Than or Equal
==	7	Equal
!=	7	Not Equal
&	6	Bitwise And (integer) or String Concatenation
^	5	Bitwise Exclusive Or (integer)
|	4	Bitwise Or (integer)
&&	3	Logical And
||	2	Logical Or
?:	1	Conditional

Table 6-1 XESS Operators

In formulas with more than one operator, XESS calculates operators in the order of precedence presented above, with highest precedence first. That is, AND/OR/NOT relationships are considered after equal/unequal relationships, and subtraction/

addition are considered after multiplication/division. Operators at the same precedence level are evaluated from left to right.

To change the precedence of operators, enclose highest priority operations in parentheses.

Here are some special notes about XEES operators:

- The operators marked "(integer)" on the table above automatically convert their operands to integers.
- The **&** operator performs double duty: as a bit-wise "and" if the operands are numbers or as a string concatenation operator joining two strings together if the operands are text.
- The **%** operator also performs double duty: as the "percent" operator when appended to a number or numeric expression, or as the C-style "modulus" operator when applied between two integer expressions.
- Operators that define equality/inequality relationships (such as **==** and **<**) can be used to compare text strings lexically (alphabetically).
- In comparing mixed strings lexically, XEES considers string operands to be lower than numeric operands.
- The conditional operator returns its second operand if its first operand evaluates "True" (non-zero) and returns its third operand if it evaluates "False," (zero).
- In formulas with conditional operators, the second and third operands may be any type XEES supports, including ranges. For example, the expression

  @SUM(A1?B1..C20:C10..D15)

  returns the sum of B1..C20 if A1 evaluates to non-zero; otherwise it returns the sum of C10..D15.
- XEES accepts most arithmetic operators used in other spreadsheets, but there are a few differences in syntax and precedence.

Case and Accent Sensitivity in String Comparisons

Case sensitivity and the effect of accented characters with respect to string comparisons in @IF, @HLOOKUP, @REGEX, @VLOOKUP, @XHLOOKUP, and @XVLOOKUP are controlled by options in the Workbook Defaults dialog box. (@EXACT and @FIND ignore these options.)

Empty Cells and Trailing Spaces

Xess lets you control whether spaces pad the shorter of two strings when doing a comparison. This is controlled by an option in the **Workbook Defaults** dialog. When XLS sheets are opened, this option is set True. When other formats are opened, it is set False.

If this option is set to True, empty cells will compare equal to blank strings and to 0 numeric values.

Referencing Other Cells in Formulas

The real power of XEss lies in its ability to calculate relationships among different cells in the workbook. These references can be to cells in the current sheet, in other sheets in the current workbook, or to cells in other workbooks, including those produced by Excel and Lotus.

XEss provides several ways within a formula to reference other cells. You can:

- type the row/column coordinates, or address, in the formula.
- use the mouse or keyboard to highlight the cell or range of cells you wish to reference in the formula.
- type the assigned name of a cell or range of cells in the formula.
- use @XVALUE to reference values in other workbooks.
- use workbook-qualified cells and ranges to reference values in other workbooks.

To reference a cell by address:

Type the row and column coordinates of the cell in the formula. For example, to reference Row 5 in Column D, type D5

OR

While entering a formula, move the mouse pointer to the cell to be referenced and click once. In **input mode**, XEss inserts the cell reference after the last character entered. In **edit mode**, XEss inserts the cell reference at the cursor location in the Edit Line.

To reference a contiguous group of cells by address:

Type the row and column coordinates of two cells in opposite corners of the block to be referenced, with two periods (**..**) between the coordinates. For example, to reference the first five columns and the first five rows of the sheet, type A1..E5.

OR

Move the mouse pointer to one corner of the block or range to be referenced. Press the left mouse button and drag the mouse to the opposite corner, then release the mouse button. In **input mode**, XESS inserts the cell reference after the last character typed. In **edit mode**, XESS inserts the cell reference at the cursor location.

To reference a cell or range by name:

Type the pre-assigned name of the cell or cell block into the formula.

*To assign a name to a cell or range of cells, use the **Named Range** utility in the Edit menu. For more information about named ranges, refer to the chapter, **Manipulating the Spreadsheet**.*

Cell Referencing in XESS

XESS differentiates between relative, absolute, and indirect references.

Relative Reference

XESS tracks the referenced cell by considering its position relative to the formula cell, not by its address. For example, if the formula in cell A1 references cell B2, XESS remembers that the referenced cell is one row down and one column right. If you copy the formula in cell A1 to another location (e.g. D17), the formula will reference the cell one row down and one column right of the new location (e.g. E18).

Absolute Reference

Absolute references remain the same, no matter where you move or copy the original formula. For example, if the formula in cell A1 references cell B2, and you copy the formula in cell A1 to another location (e.g. D17), the formula still references cell B2. To specify an absolute cell address, insert a dollar sign (**$**) before the address coordinate to be fixed, or before both coordinates if the row and column coordinates are to be fixed. For example: $B$2.

To specify all or part of a cell address to be absolute, insert a dollar sign ($) before the address coordinate to remain fixed For example:

- $B$5 makes the complete address absolute.
- $B5 makes the B coordinate absolute, the row coordinate relative

- B$5 makes the column coordinate relative, the 5 absolute.

Cell ranges are also relative, so when you move a cell range, references in formulas within that range are updated to reflect their new location.

To specify an absolute range reference, insert dollar signs (**$**) before the coordinates in the formula. For example, to make the range A1..D5 absolute, type the reference as $A$1..$D$5.

To specify part of a cell range to be absolute, insert dollar signs only before the coordinates to remain absolute. For example, $A1..$D5 will fix the column coordinates of cell references but adjust the row coordinates to reflect the new location.

You can use the **[F4]** key when editing a cell to toggle through the addressing modes in a reference.

Indirect Reference

The current cell is identified in any expression with the symbol (**#)**. References to other cells are made with offset values enclosed in braces (**{}**) and following the **#**. Offset references tell XEDIT where to look, in relation to the current cell, for the cell to use as the argument or value .

The format is as follows:

#{column offset,row offset}

- If you include only one value in the offset, XEDIT assumes that it is a column offset. For example, the offset reference #{-1} tells XEDIT to look to the column just left of the current cell.
- The offset values may be constants or expressions.

Examples:

#{0,-1}	refers to the cell above the current cell.
#{-2}	refers to the cell two columns left of the current cell.
#{1}	refers to the cell to the right of the current cell.
#{0,1}	refers to the cell below the current cell.

@CSUM(C4..C100,#{-1} == "Joe") calculates the sum of all the values in the range C4..C100 for which the cell in the column to the left contains the string "Joe."

@CCOUNT(C4..C100,# > #{0,-1}) counts all the cells in the range C4..C100 whose value is greater than the contents of the cell immediately above.

@XVALUE("master.xs5",#) returns the value of the same cell reference in which this function is stored from the sheet indicated.

#{-1}+2 adds 2 to the cell value from the cell to the left.

Sheet Names in Formulas

Sheet names may be used to indicate which sheet contains the cell or range of cells needed. By default, sheet names are of the form:

```
Sheet1, Sheet2,...Sheetn
```

The alternate form of sheet names is the same as column names:

```
A,B,C...FAM
```

The style of names used for new sheets is specified in the **Workbook Defaults** dialog and is controlled by the `*defaultSheetNameFormat` resource with values of **N** (numeric) or **A** (alphabetic). Sheets can also be given user-defined names.

Sheet names are separated from cell specifications by either a period (**.**) or an exclamation point (**!**).

The upper left cell in the first sheet is:

```
Sheet1.A1    or   A.A1
Sheet1!A1    or   A!A1
```

If an explicit sheet name is not specified, the cell reference is assumed to be on the current sheet.

Sheet names (like column names) are case insensitive. `Sheet1` is the same as `SHEET1` and `sheet1`.

One or both of the cells which define the boundaries for a range may be qualified with a sheet name. Thus:

`Sheet3.A1..Sheet9.A1` or `C.A1..I.A1`

defines a range of 7 cells, drilling through the sheets.

`Sheet3!A1..A5` or `C.A1..A5`

defines a 5 cell range on Sheet3, which may not be the current sheet. By varying the sheet name, the column, and the row you can reference 3-dimensional ranges. For example:

`Sheet1.A1..Sheet10.E10` or `A.A1..J.E10`

defines a cubic solid containing 500 cells (10 sheets * 5 columns * 10 rows).

Just as row and column references may be relative or absolute, so can sheet names. Place a dollar sign (**$**) before the sheet name to

prevent it from changing when formulas are are copied from one sheet to another.

Referencing Cells in Other Workbooks

Cells in other workbooks can be referenced directly in formulas. These other workbooks can be in any of the spreadsheet file formats: Xess, Excel, or Lotus.

External cell references have the filename of the workbook enclosed in quotes and followed by two colons (**::**):

```
"book2.xs5"::Sheet1!A4
"/home/test/olddata.xls"::Sheet4.C1..C17
"part-table.xs5"::namedrange
```

If the referenced workbook is not active, the values of the cells are retrieved from the file on disk. If the referenced workbook file is opened by Xess, then the values dynamically change and the referencing workbook is recalculated as required.

Constraint Expression

Constraints are limitations or conditions placed on the variables in your workbook. They are expressed as algebraic statements appended to formulas. You can attach a constraint expression to any formula, by typing a semicolon (;) and the constraint conditions after the formula.

Constraint expressions establish conditions under which a formula operates or boundaries for valid results of the formula. Constraint expressions may be simple equality/inequality relationships, or they can be arbitrary formulas. Any valid XESS expression which returns a numeric value is also a valid constraint expression. However, unlike the expression that defines a cell value, a constraint expression can reference the cell in which it resides, using the symbol #.

For example, the formula

=A1 + A2 ; #>2 && #<=B5 || #==C7

means, "the value of the current cell is the sum of cells A1 and A2, and that value must be either greater than 2 and less than or equal to the value of cell B5, or equal to the value of cell C7."

Constraint expressions are used in several other contexts within XESS, including the Find and Extract Tools, and the conditional statistical functions.

The benefit of constraint expressions is maximized when combined with indirect reference support (#) as illustrated in the above example.

Explicit Dependency

There may be instances where you need to force a recalculation when certain cell values changes, when there is no implicit dependency in the formula that would trigger an automatic recalculation. This option is indicated by appending a backslash (\) to the end of the dependent formula. For example, the formula

@SUM(A1..A20)\D50

instructs XEDIT to recalculate @SUM(A1..A20) whenever the contents of D50 change.

This feature is particularly important when you have a constraint expression containing an offset reference that produces a cell reference outside the cell range referenced in a dependent formula. Under these circumstances, Automatic Recalculation would not necessarily be triggered. Take for instance, the example from above:

@CCOUNT(C4..C100,# > #{0,-1}) counts all the cells in the range C4..C100 whose value is greater than the contents of the cell immediately above.

In order for C4 to be evaluated, it must be compared to C3 - which is not part of the explicit range, C4..C100. Without indicating an explicit dependency, C4 would never be evaluated properly. So, in this case, we could indicate the dependency as follows:

@CCOUNT(C4..C100,# > #{0,-1})\C3..C99

which tells XEDIT to recalculate whenever any cell in the range C3..C99 changes.

Changing Calculation Options

The **Recalc Options** dialog box allows you to change certain features about XEDIT calculations defined as:

- Recalculation Mode
- Recalculation Method
- Iteration Limit
- Constraint Checking

To change or view the calculation options using the Recalc Options dialog box:

1) Select **Recalc Options** from the **Options** menu to display the **Recalc Options** dialog box as shown in Figure 6-1.

2) Change any of the options. (Each option is described in detail later in the chapter.)

3) Apply your selection by clicking **OK** or **Apply**.

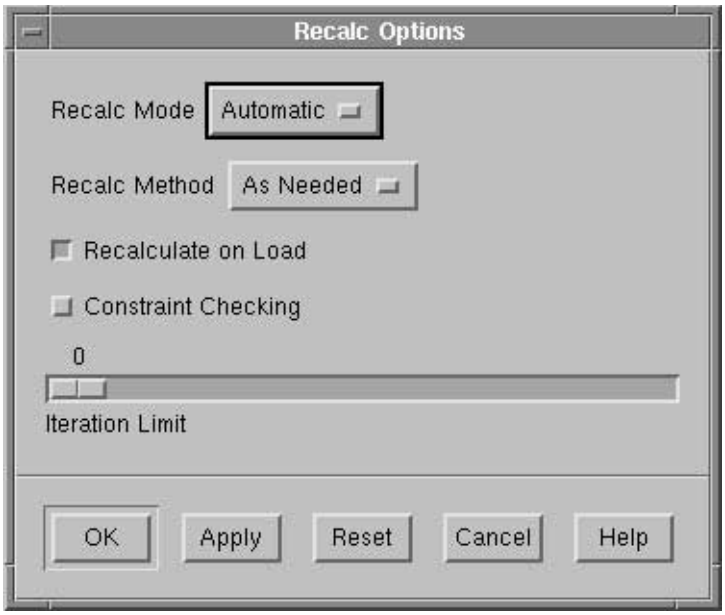

Figure 6-1 Recalc Options Dialog Box

Setting Recalculation Method

Recalc Method defines how XESS will proceed with recalculation. There are two options: **As Needed** and **Foreground**.

As Needed means that recalculation is highly optimized to recompute the minimum number of cells when updating the workbook. This can result in significant performance improvement for certain types of workbooks, particularly on very large workbooks.

. . . . . .

As Needed *does not support Constraint Checking and Iteration Limits.*

. . . . . .

Foreground means that minimal recalculation is performed, similar to other spreadsheets.

To change recalculation method:

1) Select **Recalc Options** from the **Options** menu. XEss displays the **Recalc Options** dialog box as shown in Figure 6-1.

2) Move the pointer to the **Recalc Method** option button. While holding down the left mouse button to display the options point to the desired option and release.

3) Apply your selection by clicking **OK** or **Apply**.

Controlling Automatic Recalculation

XEss lets you decide whether or not to recalculate the workbook after you make changes that affect other cells or whenever the file is initially loaded. XEss automatically recalculates the formulas in both cases if **Recalculation Mode** is set to **Automatic**.

However, this can be time-consuming for large workbooks, especially those with graphs that are automatically recalculated as well. If recalculation is taking too much time, you can turn automatic recalculation off. XEss will only recalculate upon explicit request.

Disabling Automatic Recalculation

To turn automatic recalculation off:

1) Select **Recalc Options** from the **Options** menu. XEss displays the **Recalc Options** dialog box as show in Figure 6-1.

2) Move the pointer to the **Recalc Mode** option button. While holding down the left mouse button to display the options point to desired option and release.

3) Apply your selection by clicking **OK** or **Apply**.

Manual Recalculation

To manually recalculate a workbook, select **Recalculate** from the **Tools** menu or press **[F9]** on the keyboard.

Enabling Constraint-Checking

When calculating the formulas, XEss ignores constraint expressions unless constraint-checking is turned on for the workbook.

To turn constraint-checking on:

1) Select **Recalc Options** from the **Options** menu. XESS displays the **Recalc Options** dialog box as show in Figure 6-1.

2) Click the **Constraint Checking** check button on.

3) Apply your selection by clicking **OK** or **Apply**.

Setting Iteration Limits

When the **Iteration Limit** field on the Recalc Options dialog is set to a non-zero value, iterative calculation is enabled for all formulas in the workbook. In this mode, XESS will make multiple recalculation passes, still preserving the natural order and minimal recalculation rules, until either the iteration limit has been reached or, if constraint checking is enabled, until all constraints are satisfied, whichever comes first.

To set iteration limit:

1) Select **Recalc Options** from the **Options** menu. XESS displays the **Recalc Options** dialog box as show in Figure 6-1.

2) Move the **Iteration Limit** slider bar to the desired number.

3) Apply your selection by clicking **OK** or **Apply**.

Highlighting Special Calculated Results

XESS provides a mechanism for flagging certain calculation results such as errors, negative values, and constraint conditions that are not met. Highlight Options are explained in detail in the chapter, ***Defining the Appearance of the Workbook.***

7

Functions

XESS functions are predefined formulas supplied with the program. They offer a shortcut approach to accomplishing the work of long, complex formulas. Mathematical and statistical functions are often used to sum a column of numbers, compute an average, determine a minimum or maximum value, or round the results of a formula.

Other functions are used for more specialized purposes such as computing the future value of an investment or the product of multiplying one cell range by another range. Some functions perform calculations that arithmetic operators cannot handle such as text-string manipulations.

XESS functions fall into the following categories:

- Mathematical
- Statistical
- Conditional Statistical
- String
- Logic
- Digital Logic
- Financial
- Date and Time
- Miscellaneous

Using XESS Built-in Functions

You enter a function in a cell in the same way you enter a formula or any other entry, with a few additional guidelines.

- Function names must either start with the "at" sign (**@**) or be immediately followed by a left parenthesis (**(**). Function names are abbreviations that indicate what the function does. For instance, **@ABS** computes the absolute value, **@ROUND** rounds to the specified number of places, and **@AVERAGE** computes the average of a list of arguments.

  You can select in the User Preferences dialog whether the the initial **@** is displayed in formulas.

- After typing the function name, enter arguments enclosed in parentheses. Most functions use one or more arguments to define the task to be performed. For example, the **@AVG** function averages the value of two or more arguments. The **@LENGTH** function returns the length of an argument that is a character string.

- Use only the arguments required by the function, in the exact order specified in the function syntax. If you enter other arguments or enter them in the wrong order, XESS will misinterpret their meaning or return an error message.

- All the function names in this chapter are typed in uppercase letters, but you may enter them in upper or lower-case.

Arguments

Arguments specify the values the function should use in its calculations. The number of arguments, their types, and their formats varies from one function to another. Arguments are usually numeric values, cell or range references, or string values. Most functions have at least one argument; a few have none.

The following chart shows different types of arguments used in XESS functions.

Argument	Example
Numeric value	123
Address of a cell	A10
Address of a range	F9..F99
Name of a cell or range	BUDGET1, where BUDGET1 is the range D9..K9
String value	"Quarterly Report"
Matrix constant	{1,1,2,3,5,8,13,21}

Using Operators with Functions

The result of an @ function depends on the order in which XEss handles the calculations. Please see **Calculations** for more information on operators and their precedence

Explicit Dependencies

Certain formulas, particularly those useing relative cell references, make it difficult to detect all the cells whose values might affect the value of the functions. XEss provides a special construct to force a recalculation, referred to as an **explicit dependency**. For example,

```
=@CCOUNT(C3..C100,#>#{-1} )
```

would not recalculate when the values in column B change. To make the formula recalculate when these values change, make the formula be:

```
=@CCOUNT(C3..C100,#>#{-1} )\B3..B10
```

Matrix and Table Results

Certain functions return arrays (or tables) of values. They may be used as arguments to other functions in formulas. When the final value of a cell formula is an array, the values of its elements are stored in a group of adjacent cells. These adjacent cells are set to constant formulas with explicit dependencies on the anchor cell.

For example, an matrix function in cell B2 might produce the formula `=1.3459\B2` in cell B3. This formula indicates that the cell currently contains the constant 1.3459 but that its value depends on the contents of cell B2, its anchor cell.

This notion of explicit dependencies is important for recalculation. It guarantees that any cell that references B3 will not be recalculated until after cell B2 is recalculated. This ensures that data generated by the formulas is always current.

Quick-Reference Guide to Built-in Functions

These functions are grouped by general type of function performed.

Mathematical Functions

Mathematical Functions perform calculations such as determining absolute value, finding the integer portion of a number, or establishing the value of a constant. Although you could accomplish these tasks with a formula, using a function saves time and trouble.

XEss also provides a full range of trigonometric functions as well as ones for matrix arithmetic and manipulation.

Mathematical functions perform calculations with numeric values as arguments, returning numeric values.

Function	Returns
@ABS(*X*)	The absolute value of *X*
@ACOS(*X*)	The arc cosine of *X*
@ACOSH(*X*)	The hyperbolic arc cosine of *X*
@ACOT(*X*)	The arc cotangent of *X*
@ACOTH(*X*)	The hyperbolic arc cotangent of *X*
@ACSC(*X*)	The arc cosecant of *X*
@ACSCH(*X*)	The hyperbolic arc cosecant of *X*
@ASEC(*X*)	The arc secant of *X*
@ASECH(*X*)	The hyperbolic arc secant of *X*
@ASIN(*X*)	The arc sine of *X*
@ASINH(*X*)	The hyperbolic arc sine of *X*
@ATAN(*X*)	The 2-quadrant arc tangent of *X*
@ATAN2(*X*,*Y*)	The 4-quadrant arc tangent of *Y*/*X*
@ATANH(*X*)	The hyperbolic arc tangent of *X*
@BESSELI(*X*,*N*)	The Bessel function of order In(x).
@BESSELJ(*X*,*N*)	The Bessel function of order Jn(x).
@BESSELK(*X*,*N*)	The Bessel function of order Kn(x).
@BESSELY(*X*,*N*)	The Bessel function of order **Y**n(x).
@BETA(*Z*,*W*)	The beta function of z and w
@BETAI(*A*,*B*,*X*)	The incomplete beta function

@CEIL(*X*)	The smallest integer greater than or equal to *X*
@COMPLEX(A,B[,S])	The complex number defined by the coefficients a and b of the form "a + bi" or "a + bj",
@COS(*X*)	The cosine of *X*
@COSH(*X*)	The hyperbolic cosine of *X*
@COT(*X*)	The cotangent of *X*
@COTH(*X*)	The hyperbolic cotangent of *X*
@CSC(*X*)	The cosecant of X
@CSCH(*X*)	The hyperbolic cosecant of X
@DEGREES(*X*)	Converts the angle expressed in radians to degrees (180/π**X*)
@DELTA(*X,Y*)	Returns 1 if numbers are equal
@DET(*M*)	The determinant of the matrix range *M*, which must be a square matrix
@DFT(*R*)	The Discrete Fourier Transform of the range *R*
@DOT(*R1,R2*)	The dot product of the vectors *R1* and *R2*
@EIGEN(*M*)	The eigenvalues of the matrix *M*
@EVEN(*X*)	The next larger even integer
@EXP(*X*)	e raised to the *X* power
@FACT(*N*)	The value of *N!*
@FACTDOUBLE(*N*)	The value of *N * (N-2) * (N-4) ...*
@FFT(*R*)	The Discrete Fourier Transform of the range *R* using a fast Fourier Transform algorithm
@FLOOR(*X*)	The largest integer less than or equal to *X*
@FRAC(*X*)	The fractional portion of *X*
@GAMMA(*X*)	The value of the gamma function evaluated at *X*
@GCD(*X*,...)	Greatest Common Divisor of all the numeric values in the argument list
@GRAND	A 12th-degree binomial approximation to a Gaussian random number with zero mean and unit variance
@IMABS(A)	The absolute value (modulus) of the complex number A.

@IMAGINARY(A)	The imaginary coefficient of the complex number A.
@IMARGUMENT(A)	The argument (or amplitude) of the complex number A.
@IMCONJUGATE(A)	The conjugate of the complex number A.
@IMCOS(A)	The cosine of the complex number A.
@IMDIV(A,B)	The quotient of A divided by B.
@IMEXP(A)	The exponetial of the complex number A.
@IMLN(A)	The natural logarithm of the complex number A.
@IMLOG10(A)	The common logarithm (base 10) of the complex number A.
@IMLOG2(A)	The logarithm base 2 of the complex number A.
@IMPOWER(A, X)	The complex number A raised to the power X.
@IMPRODUCT(...)	The product of the complex arguments
@IMREAL(A)	The real componnent of the complex number A.
@IMSIN(A)	The sine of the complex number A.
@IMSQRT(A)	The square root of the complex number A.
@IMSUB(A, B)	The difference between the complex numbers A and B.
@IMSUM(...)	The sum of the complex arguments
@INT(*X*)	The integer portion of *X*
@INVDFT(*R*)	The inverse of the Discrete Fourier Transform of the range *R*
@INVERT(*M*)	The inverse of matrix *M*
@INVFFT(*R*)	The inverse of the Discrete Fourier Transform of the range *R* using a fast Fourier Transform algorithm
@LCM(*X*,...)	Lowest Common Multiple of all the numeric values in the argument list
@LN(*X*)	The natural log (base e) of *X*
@LNGAMMA(*X*)	The log base e of the gamma function evaluated at *X*
@LOG(*X*)	The log base 10 of *X* (included for compatibility with WKS/WK1)
@LOG10(*X*)	The log base 10 of *X*

@LOG2(*X*)	The log base 2 of *X*
@MADD(*M1*,*M2*)	The result of adding matrix *M2* to matrix *M1*
@MMUL(*M1*,*M2*)	The product of multiplying matrix *M2* by matrix *M1*
@MOD(*X*,*Y*)	The remainder of *X* / *Y*
@MODULUS(*X*,*Y*)	The modulus of *X* / *Y*
@MSUB(*M1*,*M2*)	The result of subtracting matrix *M2* from matrix *M1*
@ODD(*X*)	The next larger odd integer
@PI	The value of π
@POLY(*X*,...)	The value of an *N*th-degree polynomial in *X*
@PRODUCT(*X*,...)	The product of all the numeric values in the argument list.
@RADIANS(*X*)	Converts the angle expressed in degrees to radians (π/180**X*)
@RAND	A uniform random number on the interval 0,1
@ROUND(*X*,*n*)	*X* rounded to *n* decimal places (-15 to 15)
@ROUNDDOWN(*X*,*n*)	*X* rounded towards zero at *n* decimal places (-15 to 15)
@ROUNDUP(*X*,*n*)	*X* rounded away from zero at *n* decimal places (-15 to 15)
@SEC(*X*)	The secant of *X*
@SECH(*X*)	The hyperbolic secant of *X*
@SIGMOID(*X*)	The value of the sigmoid function 1/(1 + exp(-*X*))
@SIGN(*X*)	The sign of *X* as (-1, 0, 1).
@SIN(*X*)	The sine of *X*
@SINH(*X*)	The hyperbolic sine of *X*
@SQRT(*X*)	The positive square root of *X*
@SQRTPI(*X*)	The positive square root of *X* * π
@SUMPRODUCT(*R1*,*R2*)	The dot product of the vectors *R1* and *R2*, where *R1* and *R2* are of equal dimension
@TAN(*X*)	The tangent of *X*
@TANH(*X*)	The hyperbolic tangent of *X*

@TRANSPOSE(*M*)	The transpose of matrix *M*.
@TRUNC(*X,N*)	Returns the value of X truncated to N decimal places
@VECLEN(...)	The square root of the sum of squares of its arguments

Statistical Functions

Statistical Functions perform descriptive statistics such as calculating means, minimums, maximums, and averages.

XEES also provides more sophisticated statistical test functions that perform operations on a group of values expressed as a list of arguments. These include the F-test, T-tests, correlation coefficient, deviations, and all common averages.

Statistical functions return numeric values.

Function	**Returns**
@AVERAGE(...)	Average (mean) of its arguments
@AVG(...)	Average (mean) of its arguments
@CORR(*R1,R2*)	Pearson's product-moment correlation coefficient for the paired data in ranges *R1* and *R2*
@COUNT(...)	A count of its non-blank arguments
@F(*M,N,F*)	The integral of Snedecor's F-distribution with *M* and *N* degrees of freedom from minus infinity to *F*
@ERF(*L[,U]*)	Error function integrated between 0 and *L;* if *U* specified, between *L* and *U*.
@ERFC(*L*)	Complementary error function integrated between *L* and infinity.
@FORECAST(...)	Predicted *Y* values for given *X*
@FREQUENCY(*R,B*)	Returns a frequency distribution for values *R* with a set of intervals *B*.
@FTEST(*R1,R2*)	The significance level (alpha) of the two-sided F-test on the variances of the data specified by ranges *R1* and *R2*
@GMEAN(...)	The geometric mean of its arguments
@HMEAN(...)	The harmonic mean of its arguments
@LARGE(*R,N*)	The *N*th largest value in range *R*.
@LINCOEF(*X,Y*)	The least squares coefficients for the straight line fit

@LINFIT(*X,Y*)	The straight line least squares fit. This function is equivalent to @POLYFIT(*X,Y,1*)
@LLS(*A,Y*)	The linear least squares solution X to the over-determined system of equations *AX=Y*
@MAX(...)	The maximum of its arguments
@MEAN(...)	The arithmetic mean of its arguments
@MEDIAN(...)	Median (middle value) of the arguments
@MIN(...)	The minimum of its arguments
@MODE(...)	The mode, or most frequently occurring value
@MSQ(...)	The mean of the squares of its arguments
@PERCENTILE(*R,N*)	The value from the range *R* which is at the *N*th percentile in *R*.
@PERCENTRANK(*R,N*)	The percentile rank of the number *N* among the values in range *R*.
@PERMUT(*S,T*)	The number of *T* objects that can be chosen from the set *S*, where order is significant.
@PLS(*X,Y,d*)	Analyzes the least squares polynomial model
@POLYCOEF(*X,Y,d*)	The least squares coefficients for the polynomial fit
@POLYFIT(*X,Y,d*)	The least squares polynomial fit, given a vector of independent variables (*X*), dependent variables (*Y*), and the degree (*d*) of polynomial.
@PTTEST(*R1,R2*)	The significance level (alpha) of the two-sided T-test for the paired samples contained in ranges *R1* and *R2*
@PURECOUNT(...)	Returns the number of cells containing numeric values.
@QUARTILE(*R,Q*)	The quartile *Q* of the data in range *R*.
@RANK(*E,R[,O]*)	The rank of a numeric argument *E* in the range *R*.
@RMS(...)	The root of the mean of squares of its arguments
@SMALL(*R,N*)	The *N*th smallest number in range *R*.
@SSE(...)	The sum squared error of its arguments.
@SSQ(...)	The sum of squares of its arguments

@STD(...)	The population standard deviation (N weighting) of its arguments
@STDS(...)	The sample standard deviation (N-1 weighting) of its arguments
@SUM(...)	The sum of its arguments
@SUMNEGATIVE(...)	The sum of its negative arguments
@SUMPOSITIVE(...)	The sum of its positive arguments
@SUMSQ(...)	The sum of the squares of its arguments
@SUMXMY2(RX,RY)	The sum of the squares of the differences between ranges RX and RY
@SUMX2MY2(RX,RY)	The sum of the differences between the squares of the elements of RX and RY
@SUMXPY2(RX,RY)	The sum of the squares of the addition of elements of ranges RX and RY
@T(*N*,*T*)	The integral of Student's T-distribution with *N* degrees of freedom from minus infinity to *T*
@TREND(*NX*,*KX*,*KY*)	The y values for new x values given existing x and y values.
@TTEST(*R*,*X*)	The significance level (alpha) of the two-sided single population T-test for the population samples contained in range R
@TTEST2EV(*R1*,*R2*)	The significance level (alpha) of the two-sided dual population T-test for ranges *R1* and *R2*, where the population variances are equal
@TTEST2UV(*R1*,*R2*)	The significance level (alpha) of the two-sided dual population T-test for ranges *R1* and *R2*, where the population variances are not equal
@VAR(...)	The sample variance (N weighting) of its arguments
@VARS(...)	The sample variance (N-1 weighting) of its arguments
@VSUM(...)	The "visual sum" of its arguments, using precision and rounding of formatted cell values

Conditional Statistical Functions

Conditional Statistical Functions operate much like statistical aggregation functions, except that the last argument is a constraint expression that XEss evaluates for each cell in the argument list. Only cells that meet constraint criteria are included in the calculation. The constraint expression may be any XEss expression that evaluates to a numeric result.

Conditional Statistical Functions return a numeric value.

For more information on constraint expressions, please see **Calculations**.

Function	Returns
@CAVG(...,*C*)	Conditional average
@CCOUNT(...,*C*)	Conditional count
@CMAX(...,*C*)	Conditional maximum
@CMIN(...,*C*)	Conditional minimum
@CSTD(...,*C*)	Conditional sample standard deviation (N weighting)
@CSTDS(...,*C*)	Conditional sample standard deviation (N-1 weighting)
@CSUM(...,*C*)	Conditional sum
@CVAR(...,*C*)	Conditional population variance (N weighting)
@CVARS(...,*C*)	Conditional population variance (N-1 weighting)

String Functions

String Functions manipulate and evaluate character strings. For example, string functions can return the length of a string, find the first occurrence of a string in a range, change a string from upper to lower-case and vice versa, or replace one string with another.

String functions return strings or numeric values.

Function	**Returns**
@CHAR(*N*)	The character represented by the code *N*
@CLEAN(*S*)	The string formed by removing all non-printing characters from the string *S*
@CODE(*S*)	The integer value of the first byte in string *S*

@EXACT(*S1*,*S2*) Returns 1 if string *S1* exactly matches string *S2*, otherwise returns 0

@FIND(*S1*,*S2*,*N*) The index of the first occurrence of *S1* in *S2*

@FORMAT(*F*,*N*,*X*) The string formed by formatting the value *X* using format code F and precision *N*

@HEXTONUM(*S*) The numeric value for the hexadecimal interpretation of *S*

@LEFT(*S*,*N*) The string composed of the leftmost *N* characters of *S*

@LENGTH(*S*) The number of characters in *S*

@LOWER(*S*) *S* converted to lower case

@MID(*S*,*N1*,*N2*) The string of length N2 that starts at position N1 in S

@NUMTOHEX(*X*) The hexadecimal representation of the integer portion of *X*

@OCCUR(*S1*,*S2*) Returns the number of times string S2 occurs in string S1

@PROPER(*S*) The string *S* with the first letter of each word capitalized

@REGEX(*S1*,*S2*) Returns true (1) if string *S1* exactly matches string *S2*; otherwise returns false (0). Allows "wildcard" comparisons by interpreting *S1* as a regular expression.

@REPEAT(*S*,*N*) The string *S* repeated *N* times

@REPLACE(*S1*,*N1*,*N2*,*S2*) The string formed by replacing the *N2* characters starting at position *N1* in *S1* with string *S2*

@REVERSE(*S*) The reverse order of characters in *S*.

@RIGHT(*S*,*N*) The string composed of the rightmost *N* characters of *S*

@SETSTRING(S,N,F) Returns a string of length N with the string S aligned within (left, right, center)

@STRCAT(...) The concatenation of all its arguments

@STRING(*X*,*N*) The string representing the numeric value of *X*, to *N* decimal places

@STRLEN(...) The total length of all strings in its arguments

@SUBSTITUTE(S,OLD,NEW,N)	Replaces the Nth occurrence of string OLD in string S with string NEW.
@TRIM(*S*)	The string formed by removing spaces from beginning and end of the string *S*
@UPPER(*S*)	The string *S* converted to upper case
@VALUE(*S*)	The numeric value represented by the string *S*; otherwise 0 if *S* does not represent a number
@VERIFY(*S1,S2*)	Returns the number of the first character in string S1 not in string S2

Logic Functions

Logic Functions return one value if an argument meets certain criteria, another value if it does not. Logic functions are used as an adjunct to conditional statements.

Logic functions return the value 1, 0, or a value.

Function	**Returns**
@FALSE	The logical value 0
@FILEEXISTS(*S*)	1 if file *S* can be opened for reading; otherwise 0
@IF(*X,T,F*)	The value of *T* if *X* evaluates to on-zero, or *F* if *X* evaluates to zero
@ISERROR(*X*)	Returns 1 if *X* contains an error, otherwise 0.
@ISEVEN(*X*)	1 if integer part of *X* is even; otherwise 0.
@ISNUMBER(*X*)	1 if *X* is a numeric value; otherwise 0
@ISODD(*X*)	1 if integer part of *X* is odd; otherwise 0.
@ISSTRING(*X*)	1 if *X* is a string value; otherwise 0
@TRUE	The logical value 1

Digital Logic Functions

Digital Logic Functions perform digital logic operations such as AND, OR, NOT, etc.

Digital logic functions return the values 0, 1, or -1 (for unknown). Any argument value whose integer portion is not equal to 0 or 1 is considered unknown. Unknown input values *may* cause unknown output values. For example, @OR(1,27) returns 1, while @OR(0,27) returns -1.

Function	Returns
@AND(...)	0 if any arguments are 0; 1 if all arguments are 1; otherwise -1
@NAND(...)	0 if all arguments are 1; 1 if any arguments are 0; otherwise -1
@NOR(...)	0 if any arguments are 1; 1 if all arguments are 0; otherwise -1
@NOT(*X*)	0 if *X*=1; 1 if *X*=0; otherwise -1
@OR(...)	0 if all arguments are 0; 1 if any arguments are 1; otherwise -1
@XOR(...)	-1 if any of the arguments are not 0 or 1; otherwise 0 if the total number of arguments with the value 1 is even; 1 if the total number of arguments with the value 1 is odd.

Financial Functions

Financial Functions perform common financial calculations, such as calculating the future value of an annuity at a given interest rate, straight-line depreciation, double-declining depreciation, or the payment term for a given investment. The financial functions in Xess cover annuities, cash flows, assets, bonds, and Treasury Bills.

Financial functions are most useful for solving cash flow calculations where you know all but one variable. For example, if you know the present value of an investment, interest rate, and periodic payment, you can use the **@FV** function to calculate the future value of the investment. If you know the future value and other variables, but need to know the present value, you can use the **@PV** function.

Many financial functions require specifying a **Day Count Basis**. A Day Count Basis indicates the way in which the days in a month and the days in a year are to be counted. Most of the financial functions in securities involve 4 different Day Count Basis: 30/360, actual/actual, actual/360 and actual/365.

30/360 Day Count Basis assumes 30-day months and 360-day years (12 months x 30 days). Xess also follows the "End-of-Month" rule which assumes that a security pays interest on the last day of the month and will always make its interest on the last day of the month. Special rules are followed when calculating the days between two dates on 30/360 Day Count Basis.

For example, let Start_Date = D1/M1/Y1, End_Date = D2/M2/Y2.

1) If D1=31, XESS uses 30 for D1.

2) If D2=31, XESS uses 31, unless D1=30 or D1=31. In this case, XESS uses 30.

3) If D1 is the last day of February (D1=28 or 29 in a leap year), XESS uses 30 for D1.

4) If D2 is the last day of February (D2=28 or 29 in a leap year) and D1 is also the last day of February, XESS uses 30 for D2.

Financial functions use the following arguments:

interest rate	The interest rate to be used in the calculations. The rate may be specified as annual, monthly or quarterly, but it must agree with the increment you use for periods. By default the interest rate is an annual rate.
present value	The present value of an investment, representing the amount already received from or committed to an investment.
period	The number of periods over which the loan, investment or depreciation is to be calculated. The periods may be defined in months, quarters or years, but must agree with the increment used to define interest rate.
future value	The future value of an investment, given a certain present value, interest rate, and number of periods.
cost	The original cost of a depreciable capital asset.
salvage value	The remaining value of a capital asset after the depreciation period has expired.
allowable life	The allowable life of a depreciable item.
yield	The interest rate that will make the present value of the expected future cash flows equal to the price of the financial instrument.
price	The present value of the expected future cash flows where the discount rate is equal to the yield of the financial instrument.
coupon rate	The annual coupon rate of a security.
frequency	The number of coupon payments in a year.
basis	The day count basis to be used in calculation.

Functions related fixed income securities usually require special dates as arguments: *issue date, settlement date, first coupon date, last coupon date, maturity date* of a security. When specified, the following constraints should be followed:

issue > settlement > maturity
issue > first coupon > maturity
issue > last coupon > maturity

Function **Returns**

@ACCRINT(*I,Ft,S,R,P,F[,B]*)
Accrued interest for a security that pays periodic interest.

@ACCRINTM(*I,S,R,P[,B]*)
Accrued interest for a security that pays interest at maturity

@COUPDAYBS(*S,M,F[,B]*)
The number of days between the beginning of the coupon period to the settlement date.

@COUPDAYS(*S,M,F[,B]*)
The number of days in the coupon period that the settlement date is in.

@COUPDAYSNC(*S,M,F[,B]*)
The number of days between the settlement date and the next coupon date.

@COUPNCD(*S,M,F[,B]*)
The next coupon date after the settlement date.

@COUPNUM(*S,M,F[,B]*)
The number of coupon payments between the settlement date and maturity date.

@COUPPCD(*S,M,F[,B]*)
The previous (most recent) coupon date before the settlement date.

@CTERM(*R,FV,PV*) The number of compounding periods for an investment

@CUMIPMT(*R,NP,PV,S,E,T*)
The cumulative interest on a loan between start period *S* and end period *E*.

@CUMPRINC(*R,NP,PV,S,E,T*)
The cumulative principal paid on a loan between start period *S* and end period *E*..

@DB(*C,S,L,P[,M]*) Fixed-declining depreciation allowance

@DDB(*C,S,L,N*) Double-declining depreciation allowance

@DISC(*S,M,P,R[,B]*) The discount rate for a security.

@DOLLARDE(*FD,F*) Converts a dollar amount expressed as a fraction form into a decimal form.

@DOLLARFR(*DD,F*) Converts a dollar amount expressed as a decimal form into a fraction form.

@DURATION(*S,M,R,Y,F[,B]*)
The Macauley duration of a security assuming $100 face value.

@EFFECT(*NR,NP*) Returns the effective annual interest rate.

@FV(*P,R,N*) Future value of an annuity

@FVSCHEDULE(*P,S*)
The future value of an initial investment after compounding a series of interest rates.

@INTRATE(*S,M,I,R[,B]*)
The interest rate for a fully invested security.

@IPMT(*R,P,NP,PV,FV[,T]*)
The interest payment for a specific period for an investment based on periodic, constant payments and a constant interest rate.

@IRR(*G,F*) The internal rate of return on an investment. See also @XIRR and @MIRR.

@MDURATION(*S,M,R,Y,F[,B]*)
The modified Macauley duration of a security assuming $100 face value.

@MIRR(*CF,FR,RR*) The modified internal rate of return for a series of periodic cash flows.

@NOMINAL(*ER,NP*) The nominal annual interest rate.

@NPV(*R,CF*) The present value of a series of future cash flows at given the rate *R* and the cash flow *CF* range

@ODDFPRICE(*S,M,I,FC,R,Y,RD,F[,B]*)
The price per $100 face value of a security with an odd (short or long) first period.

@ODDFYIELD(*S,M,I,FC,R,PR,RD,F[,B]*)
The yield per $100 face value of a security with an odd (short or long) first period.

@ODDLPRICE(*S,M,LC,R,Y,RD,F[,B]*)
The price per $100 face value of a security with an odd (short or long) last period.

@ODDLYIELD(*S,M,LC,R,PR,RD,F[,B]*)
The yield per $100 face value of a security with an odd (short or long) first period.

@PMT(*PV,R,N*) The periodic payment for a loan

@PPMT(*R,P,NP,PV,FV,T*)
The payment on the principal for a specific period for an investment based on periodic, constant payments and a constant interest rate.

@PRICE(*S,M,R,Y,RD,F[,B]*)
The price per $100 face value of a security that pays periodic interest

@PRICEDISC(S,M,D,RD[,B])
The price per $100 face value of a discounted security.

@PRICEMAT(*S,M,I,R,Y[,B]*)
The price per $100 face value of a security that pays interest at maturity

@PV(*P,R,N*) The present value of an annuity

@RATE(*FV,PV,N*) The interest rate required to reach future value *FV*

@RECEIVED(*S,M,I,D,[,B]*)
The amount received at maturity for a fully vested security

@SLN(*C,S,L*) The straight-line depreciation allowance

@SYD(*C,S,L,N*) The "sum-of-years-digits" depreciation allowance

@TBILLEQ(*S,M,D*) The bond-equivalent yield (BEY) for a Treasury Bill.

@TBILLPRICE(*S,M,D*)
The price per $100 face value for a Treasury bill.

@TBILLYIELD(*S,M,D*)
The yield on a Treasury bill.

@TERM(*P,R,FV*) The number of payment periods for an investment

@VDB(*C,S,L,S,E*) Fixed-declining depreciation allowance between two periods

@XIRR(*G,V,D*) Internal rate of return for a series of cash flows with variable intervals

@XNPV(*R,V,D*) Returns the net present value for a series of cash flows with variable intervals.

@YIELD(*S,M,R,PR,RD,F[,B]*)
Yield of security paying periodic interest

@YIELDDISC(*S,M,PR,RD[,B]*)
The annual yield for a discounted security

@YIELDMAT(*S,M,I,R,PR[,B]*)
Annual yield of a security which pays interest at maturity

Date and Time Functions

Date and Time Functions return values corresponding to the specified date, month, year, hour, minute or second. You can also use date/time functions to enter the current system time and date in a cell. These functions open up many possibilities for managing accounts receivable and calculating test times.

XEss internally stores date and time information using the same conventions as other popular spreadsheet programs:

Dates are represented as an integer equal to the number of days before or since December 30, 1899 (or January 1, 1904 for the 1904 date system).

Times are represented as fractions of a day, starting at midnight. For example, 6:00 AM is stored as .25 (a quarter of a 24-hour day).

Using this convention, date and time values may be used together. For example, the date/time value 2.25 corresponds to 6:00:00 AM, January 1, 1900.

Function	Returns
@DATE(*Y,M,D*)	The date value for year *Y*, month *M*, and day *D*
@DATEVALUE(*S*)	The corresponding date value for a given string *S*
@DAY(*DT*)	The day number in the date/time value *DT*
@DAYS360(*S,E*)	The number of days between two dates, based on a 30/360 day count system.

@EDATE(*S,M*) The date/time value representing number of months (*M*) before or after start date (*S*).

@EOMONTH(*S,M*) The date/time value representing the last day of the month *M* months after *S*, if *M* is positive, or *M* months before if *M* is negative

@HOUR(*DT*) The hour value (0-23) of date/time value *DT*

@MINUTE(*DT*) The minute value (0-59) of date/time value *DT*

@MONTH(*DT*) The number of the month in date/time value *DT*

@NETWORKDAYS(*S,E[,H]*) The number of whole working days, starting at *S* and going to *E*, excluding weekends and holidays.

@NOW The date/time value of the current system date and time

@SECOND(*DT*) The seconds value (0-59) of the date/time value *DT*

@TIME The time value for hour H, minute M, and second *S*

@TIMEVALUE(*S*) The corresponding time value for a given string value *S*

@TODAY The date value of the current system date

@WEEKDAY(*D*) The integer representing the day of the week on which the day *D* falls. 1 is Sunday, 7 is Saturday.

@WORKDAY(*S,D[,H]*) The day that is *D* working days *after S*, if *D* is positive, or *before S*, if *D* is negative, excluding weekends and all holidays specified as dates in range *H*

@YEAR(*DT*) The year value of date/time value *DT*

@YEARFRAC(*S,E[,B]*) The portion of the year represented by the number of days between start date (*S*) and end date (*E*).

Miscellaneous Functions

Miscellaneous Functions perform a variety of calculations, such as returning a reference to specific cells or ranges or returning the Nth argument from a list of arguments.

Function	Returns
@@(*S*)	Reference to the cell or range *S*
@ALARM(*X*,*S*)	If *X* evaluates non-zero, string (*S*) is evaluated as an expression and displayed in the message line, and the terminal beeps. If *X* evaluates to zero, *S* is not evaluated and the return value is zero.
@ANNOTATE(*Text*,*X*,*Y*[,*H*[,*V*]])	Generates a dynamic graph annotation text, given the text (*Text*), coordinates (*X*,*Y*) and the justification values (*H*,*V*)
@CELL(*S*,*C*)	The value of property S for cell C
@CELLPOINTER(*S*)	The value of property S for current cell
@CELLREF(*N1*,*N2*)	A reference to the cell in column *N1* and row *N2*
@CHOOSE(*N*,...)	The Nth argument from the list
@COL(*C*)	The column address of the cell referenced by *C*
@COLS(*R*)	The number of columns in the specified range *R*
@COORD(SH,C,R,F)	The string cell address equivalent to sheet SH, column C, row R using format F.
@DOLLAR(*X*,*N*)	Formats the number X using the Dollars format with N decimal places
@ENVIRON(*S*)	The value of the environmental variable in string S
@ERR	Returns an error indicator
@HLOOKUP(*X*,*S*,*R*)	The value of the cell in range *S* that is *R* number of rows beneath *X*
@INDEX(A,C,R[,S])	Returns the element of the range or array A indexed by column C, row R, and sheet S
@INFO(*S*)	Returns the information item S for the current workbook and environment
@INIT(*X1*,*X2*)	Returns X1 on the first recalculation pass and X2 on susequent recalculation passes when performing iterative calculations

@INTERP2D(*R1,R2,N*)
The interpolation value for a 2 dimensional vector

@INTERP3D(*R,X,Y*) The interpolation value for a 3 dimensional vector.

@MATCH(*V,R[,T]*) The relative position in range *R* of value *V* based on positioning criteria *T*.

@MESSAGE(*X,S*) The string *S* is displayed on the status line and the terminal beeps, if *X* evaluates non-zero

@N(*R*) The numeric value of the top left cell in range *R*

@RANGENAME(*R*) Returns the name of the first range containing the cell R

@RANGEREF(*N1,N2,N3,N4*)
A reference to the range defined by coordinates *N1* through *N4*

@ROMAN(*X[,N]*) Returns the Roman numeral for the value X and simplification N

@ROW(*C*) The row address of the cell referenced by *C*

@ROWS(*R*) The number of rows in the specified range *R*

@S(*R*) The string value of the top left cell in range *R*

@SALARM(*X,S*) Silent alarm. The same as **@ALARM** with no terminal beep.

@SHEET(*R*) The number of the sheet for the top left cell in range *R*

@SHEETS(*R*) The number of sheets in range *R*

@TEXT(*X,S*) Formats the number X using the format pattern string S

@VLOOKUP(*X,S,C*) The value of the cell in range *S* that is *C* number of columns to the right of X.

@XHLOOKUP(F,*X,R,N*)
In the workbook file F, the value of the cell N rows below the cell in range R that matches the value X.

@XVALUE(*F,R*) In the workbook file F, the value of cell R.

@XVLOOKUP(F,*X,R,N*)
In the workbook file F, the value of the cell N columns to the right of the cell in range R that matches the value X.

8

Defining the Appearance of the Workbook

XESS gives you considerable control over the appearance of the workbook, letting you change many characteristics such as the cell format, font family, type, size, and colors. This allows you to customize the entire XESS work environment to suit your application and personal preferences.

Additionally, what you see on the display is essentially what you get when the sheet is printed to a PostScript printer which supports colors and fonts.

This chapter explains how to define the appearance of the XESS workbook and its spreadsheet elements such as rows, columns and cells.

Spreadsheet Appearance

In determining how to display and print the body of the spreadsheet, XESS relies on:

- start-up defaults
- workbook defaults and sheet attributes
- cell defaults
- individual cell attributes
- highlight options
- row/column specifications
- view title specifications

Start-up Defaults

Whenever you invoke XESS, it looks for an optional **X resource file** which contains application defaults that control the spreadsheet appearance and environment.

While XESS maintains a set of "fallback" definitions internally, you may wish to change the local resources (start-up defaults) to suit your preferences. Start-up defaults which can be changed that affect the spreadsheet appearance include:

- Workbook Defaults
- Sheet Attributes
- Cell Defaults
- Cell Border Defaults
- Locale Defaults
- Highlight Options
- Color Palette
- XESS Aesthetics

See the appendix ***XESS Resources*** for more about resources.

Workbook Defaults and Sheet Attributes

Workbook Defaults define the options which apply to the overall display, processing, and printing of the sheets in a workbook. **Sheet Attributes** allow modification of some attributes on a sheet-by-sheet basis. These defaults can be changed for specific cell ranges using the Format menu items.

You may save a **workbook template** of these settings which are then used as the default whenever you create a new workbook. Simply set the desired options and save the workbook with the name `xess_template.xs5` in your login/home directory.

Default Workbook Options

Cell Defaults and **Workbook Defaults** are global definitions that affect the entire workbook, defining such attributes as cell format, font, and alignment. By changing the default options, you can affect all cells in the workbook..

Default characteristics are viewed and changed using the **Cell Defaults** dialog box and the **Workbook Defaults** dialog box available from the **Options** menu.

Changing Workbook Defaults

To change default workbook settings:

1) Select **Workbook Defaults** from the **Options** menu. XESS displays the **Workbook Defaults** dialog box as shown in Figure 8-1.
2) Change any of the values.
3) Apply your selection by clicking **OK** or **Apply**.

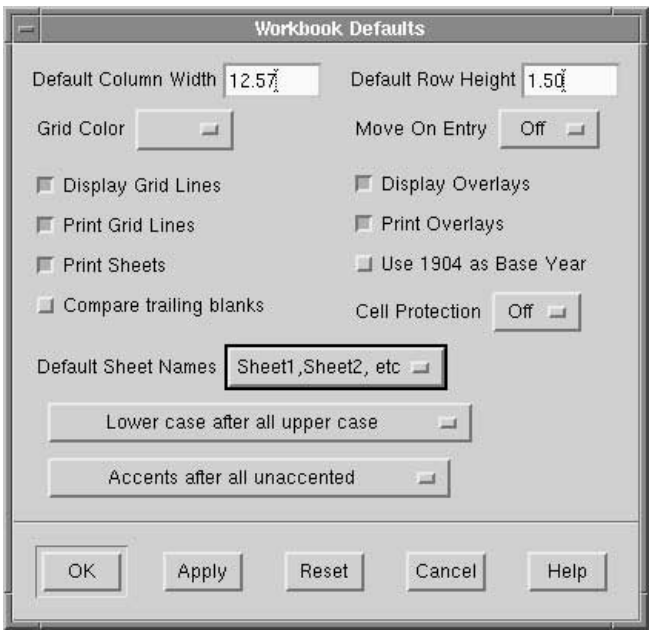

Figure 8-1 Workbook Defaults Dialog Box

Changing Sheet Attributes

Sheet attributes are initially set to the values specified in **Workbook Defaults**. Certain sheet attributes can be over-ridden on a sheet-by-sheet basis using the **Sheet Attributes** dialog box.

To change sheet attributes:

Select **Sheet Attributes** from the **Options** menu. XESS displays the **Sheet Attributes** dialog box as shown in Figure 8-2.

1) Change any of the values.
2) Apply your selection by clicking **OK** or **Apply**.

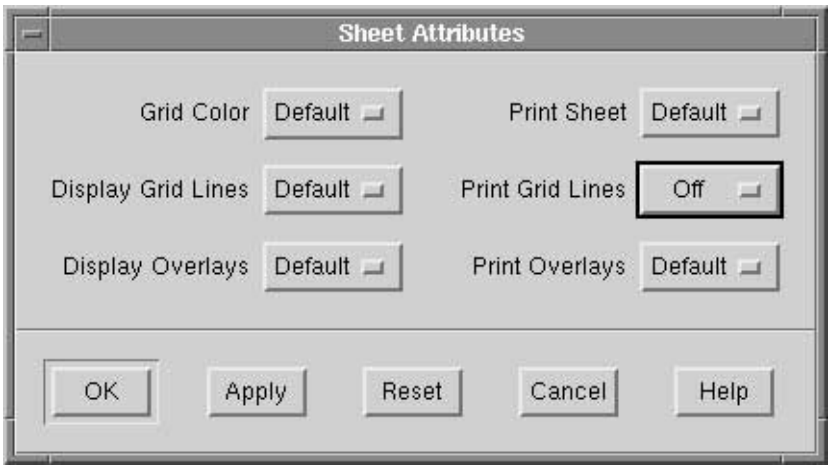

Figure 8-2 Sheet Attributes Dialog Box

Cell Defaults

Cell Defaults define the general appearance of the cells in the workbook. They are set globally — that is, they affect all the cells in all the sheets in the workbook.

The Cell Defaults that you can set include:

- Cell format (see Table 4-1 for a list of formats)
- Cell font family, size, style, and color
- Orientation and alignment
- Underlining and strikethrough
- Automatic text wrapping
- Colors and patterns used to display values

These defaults change all cells, rows, or columns in the workbook that are not already explicitly assigned attributes.

Workbook Defaults versus Individual Cell Attributes

Cell Attributes affect selected cells, rows, or columns, which are then treated as exceptions to the settings defined by the Sheet Defaults and the Cell Defaults. Cell attributes are set using the **Format** menu.

As an alternative to using the Format menu, you can change individual cell formats and attributes using the **toolbar** or the **mouse button 3 (MB3) popup menu**.

When you apply formats to specific cells, you do not interfere with the global defaults or the appearance of other cells in the workbook

Cell Border Defaults Dialog

The Cell Border Defaults dialog lets you set the default styles and colors to be used for cell boarders. These defaults are used by the **Cell Border** dialog.

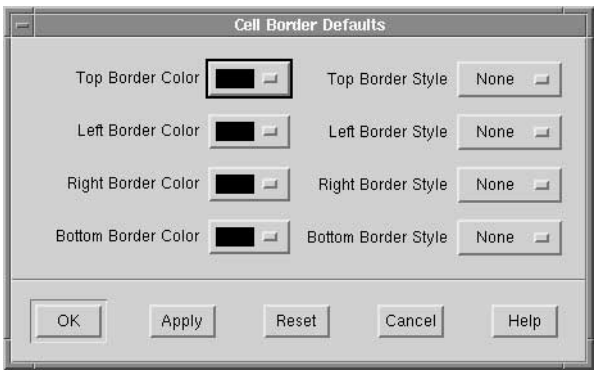

Figure 8-3 Cell Border Defaults Dialog

Highlight Options

Highlight Options affect those cells whose calculation results fall into any of three categories:

- Errors
- Negative Values
- Constraint conditions which are not met

You may choose distinct background and foreground colors to flag these results for all cells in the workbook. These colors override any colors already in the cells.

Row and Column Specifications

You can override or apply the default **Row Height** and **Column Width** in selected rows or columns by using the corresponding actions under the **Format** menu or **MB3** popup. These row/column actions include:

- Reset to default row height or column width
- Set a specific row height or column width
- Best-fit mechanism for row height or column width

View Titles

You can specify an area of the spreadsheet view which is constantly displayed - independent of scrolling. This is referred to as *view title locking* and allows you to define column and/or row labels which never scroll out of view. View locking and unlocking are controlled from the **View** menu.

Changing Cell Defaults

To change Cell Default settings:

Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

1) Change the desired options.

2) Apply your selection by clicking **OK** or **Apply**.

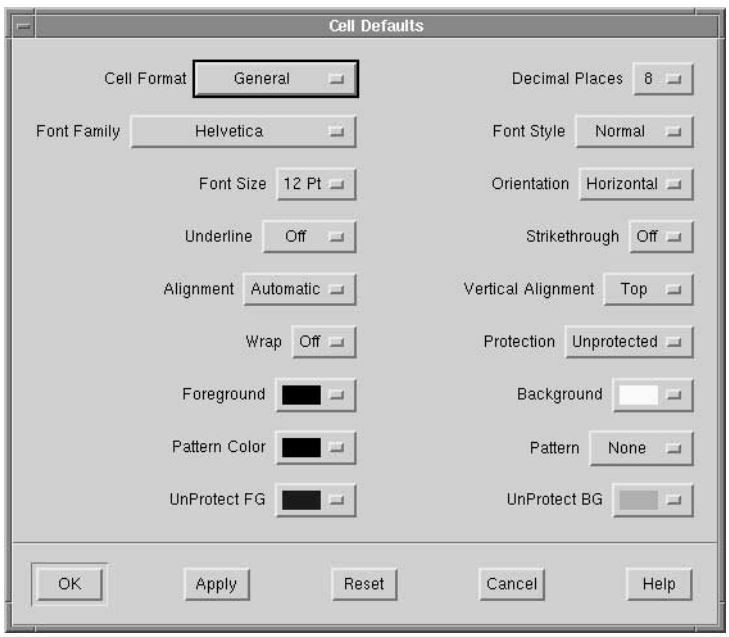

Figure 8-4 Cell Defaults Dialog Box

Cell Formats

XESS lets you define how the cell contents are displayed in the cell. This includes the type of format category (such as *fixed* or *date)* and number of decimal places when applicable. The default for the whole sheet is changed in the **Cell Defaults** dialog box from the

Options menu. However, you can control the format used in an individual cell or range of cells by using the **Cell Format** dialog box from the **Format** menu, **Toolbar**, or **Mouse Button 3 (MB3) Popup** menu

You can only choose one format; when you make a selection, XESS automatically turns off the previous selection. See Table 4-1 for a list of the formatting selections.

To change default Cell Format:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-1
2) Click the **Cell Format** and/or **Decimal Places** option button to select the desired format.
3) Apply your selection by clicking **OK** or **Apply**.

To change the Cell Format for individual cells using the menu:

1) Select a cell or range of cells to be affected.
2) Select **Cell Format** from the **Format** menu or **MB3 popup** menu. XESS displays the **Cell Format** dialog box as shown in Figure 8-5.
3) Click the **Cell Format** and/or **Decimal Places** option button to select the desired format.
4) Apply your selection by clicking **OK** or **Apply**

You can also click on the Format and Decimals icon buttons on the toolbar.

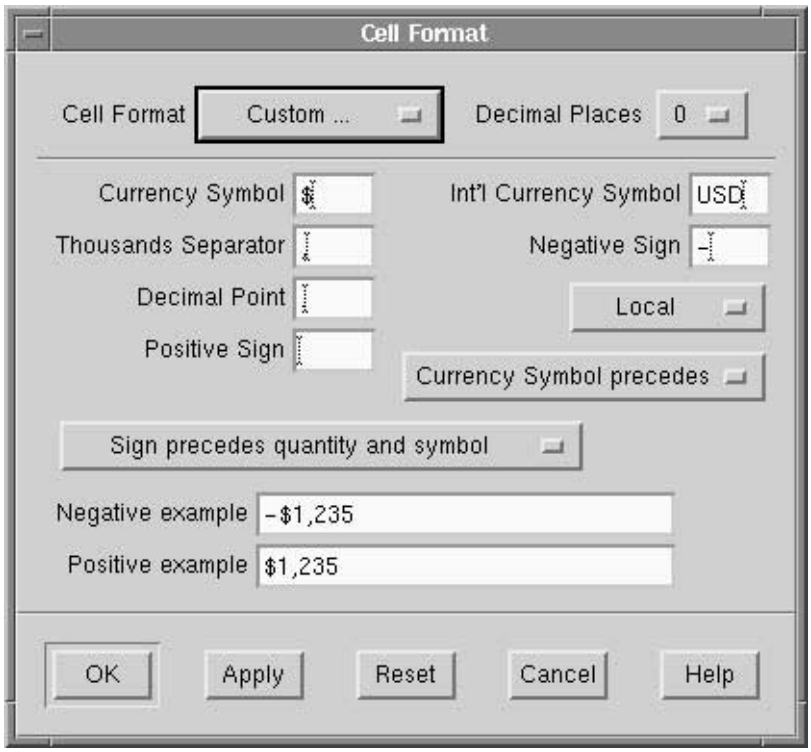

Figure 8-5 Cell Format Dialog Box

Decimal Places

XESS lets you define how many decimal places to display, but stores and uses the full, double-precision value for calculations. Decimal places are considered part of the Format specification. Please refer to the section, **Formatting Cells**, for more details.

When the Cell Format selected is Default, the number of decimal places is defined by the Cell Defaults dialog, not by the Toolbar or the Cell Format dialog.

Custom Formats

You can define multiple **Custom Formats**. These formats complement the single locale-specific Currency format defined in the **Locale** dialog on the **Options** menu. Custom formats let you easily control many aspects of how a numeric value is displayed. You can define as many Custom Formats as you need for you application. Custom Formats are saved with the workbook.

While primarily designed for defining multiple currencies in the same workbook, this feature also gives you control over how negative numbers are displayed, what characters are used for the decimal point and thousands separator, and where these are displayed relative to each other.

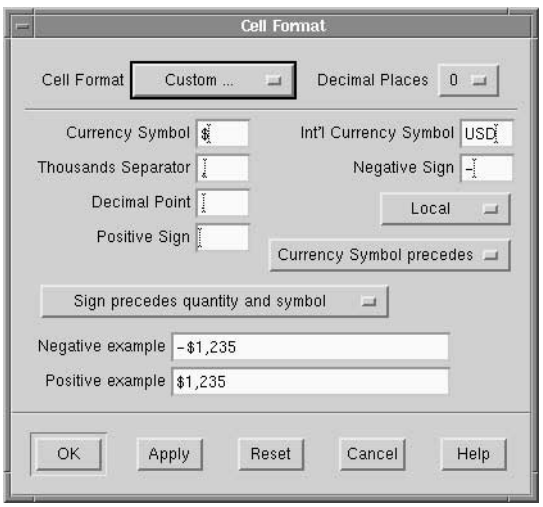

Figure 8-6 Custom Format Dialog

User Defined Formats

User Defined formats provide the most control and customization of the way values are displayed in cells.

By using a picture prototype, you can format the value of cells in sophisticated ways. You can choose from a selection of format definitions based on the current value of the cell and you can control the foreground color of the result.

The @TEXT function uses a subset of these definitions, ignoring those that affect color.

The format string may contain any of the following operators. These operators are replaced with the appropriate values in the result string.

Numbers:

#	Ouput significant digits
0	Ouput significant digits or zeros
.	Output the decimal point
,	Output a comma separator
%	Output number as percent including percent character

Text and Insertion:

@	Output the value if it is text; otherwise, output nothing.
"..."	Ouput the text between the quotes

Dates and Times

yy	Output the last two digits of the year
yyy	Output the last two digits of the year if it meets the rule for this workbook; otherwise output all 4 digits of the year.
yyyy	Output all four digits of the year.
m	If seen after an h or hh operator, output the minutes in 1-digit format if the minutes are less than 10, or in 2-digit format if the minutes are between 10 and 59. If seen at any other time, output the month in 1-digit format if the month is less than 10, or in 2-digit format if the month is between 10 and 12.
mm	If seen after an h or hh operator or before an s or ss operator, then output the minutes in 2-digit format. If seen at any other time, output the month in 2-digit format.
[m]	Elapsed time in minutes.
mmm	Output the month abbreviation.
mmmm	Output the full month name.
d	Output the day in 1-digit format if the day is less than 10, or in 2-digit format if the day is between 10 and 31.
dd	Output the day in 2-digit format.

ddd	Output the abbreviation of the day of the week.
dddd	Output the full name of the day of the week.
h	Output the hour in 1-digit format if the hour is less than 10, or in 2-digit format if the hour is between 10 and 23.
[h]	Elapsed time in hours
hh	Output the hour in 2-digit format.
s	Output the second in 1-digit format if the second is less than 10, or in 2-digit format if the second is between 10 and 59.
ss	Output the second in 2-digit format.
[s]	Elapsed time in seconds
a/p	Output **a** if the hour is between 0 and 11, or **p** if the hour is between 12 and 23. If this format specifier is present, the hour will always be displayed using the 12-hour clock (0-12).
am/pm	Output **am** if the hour is between 0 and 11, or **pm** if the hour is between 12 and 23. If this format specifier is present, the hour will always be displayed using the 12-hour clock (0-12).
A/P	Output **A** if the hour is between 0 and 11, or **P** if the hour is between 12 and 23. If this format specifier is present, the hour will always be displayed using the 12-hour clock (0-12).
AM/PM	Output **AM** if the hour is between 0 and 11, or **PM** if the hour is between 12 and 23. If this format specifier is present, the hour will always be displayed using the 12-hour clock (0-12).
\	Escape the normal meaning of the next character and write it as an immediate literal to the output string.

Spaces (blanks) in the format string are preserved in the result string.

Examples:

```
@TEXT(@NOW, "dddd\, mmmm d")
        returns   "Monday, October 19"
```

Conditional Definitions

You can define different formats to be used based on the value being formatted. This is done by specifying a list of condition and format pairs separated by semi-colons. For example:

```
[>0]#0.00+;[<0]#0.00-;#
```

places a trailing plus or minus character following the value, has at least one digit before the decimal point, and displays 0 values as blank.

When formatting a value, the conditionals are evaluated from the left, comparing the value against the simple test conditions. The first test that is true determines the format to be used. The comparisons must be against constants. A single format may have many conditionals.

Because the comparisons with zero are so common, you may omit them when there are no other comparisons. Based on the number of formats specified, the default comparisons are:

```
[all]
[>=0] ; [<0]
[>0]  ; [<0] ; [=0]
[>0]  ; [<0] ; [=0] ; [text]
```

If only a single format is given, it is used for all values specified. In this case only, a minus character is inserted before negative values in numeric formats. The `[all]` and `[text]` items above cannot be specified directly; they are applied internally by default.

Color in Formats

User defined formats allow you to control the foreground (or font) color of the cell, possibly dependent on the value of the cell being formatted. The color names or codes are placed within square brackets, separate from the test conditions. A typical use of this is to highlight values in a certain range.

```
[>=1000][Color 3]#;[>=500][Color 5]#;
                   [>0][Color 4]#;"ERROR"
```

The color numbers shown correspond to the XESS color palette. Color names, such as [Blue], use colors predefined on your system. Depending on your system, these names may be case sensitive.

```
#;[Red]-#;#
```

Fonts

XESS allows you to select fonts to define the appearance of the spreadsheet on the display in addition to the default type of printed output. These fonts are defined by three font characteristics: family, style, and size. The default font settings for the whole workbook are modified with the **Cell Defaults** dialog box from the **Options** menu. However, you can control the font characteristics for the individual cell or range of cells by using the **Font Family**, **Font Style**, and **Font Size** options from the **Format** or **MB3 popup** menus.

XESS allows you to assign font characteristics which consist of family, style, and size.

Standard Font Families

The following families are supported:

- Courier
- Helvetica
- Souvenir
- Times-Roman
- Lubalin Graph
- Avant Garde
- New Century Schoolbook
- Symbol (Σψμβol)

Additional or alternative fonts can be defined using the resource file.

Font Style

The following styles are supported.

- Normal
- **Bold**
- *Italic*
- ***Bold-Italic***

Font Size

The following sizes are supported:

- 8 Pt
- 10 Pt
- 12 Pt
- 14 Pt
- 18 Pt
- 24 Pt

Additional font sizes can be defined using the resource file.

User-defined Fonts

In addition to the standard fonts defined in XESS, you may specify up to seven (7) other font families of choice. These user-defined fonts must be specified in the resource file using the resources defined in **Appendix B**.

Changing Fonts

To change the default Font characteristics:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Click the **Font Family** option button and select the desired font family.

3) Click the **Font Style** option button and select the desired font style.

4) Click the **Font Size** option button and select the desired font style.

5) Apply your selection by clicking **OK** or **Apply**.

To change the Font characteristics for individual cells:

1) Select a cell or range of cells to be affected.

2) **To change font family**, select **Font Family** from the **Format** menu or **MB3 popup** menu to display a cascading menu of available choices. Choose a font family or choose **default** to use the default setting from **Cell Defaults**.

3) **To change font style**, select **Font Style** from the **Format** menu or **MB3 popup** menu to display a cascading menu of available choices. Choose a font style or choose **default** to use the default setting from **Cell Defaults**.

4) **To change font size**, select **Font Size** from the **Format** menu or **MB3 popup** menu to display a cascading menu of available choices. Choose a font size or choose **default** to use the default setting from **Cell Defaults**.

Underlining Cell Contents

XESS allows you to underline (single or double) the *contents* of one or more cells. The default for the whole sheet is changed in the **Cell Defaults** dialog box from the **Options** menu. However, you can set the underline option for an individual cell or range of cells by using the **Underline** option from the **Format** menu, **Toolbar** underline toggle button, and **MB3 popup** menu.

To change the default Underline specification:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Click the **Underline** option button and select one of:

   On to enable single underline
   Off to disable underlining
   Double to enable double underline

3) Apply your selection by clicking **OK** or **Apply**.

To change the Underline setting for individual cells:

1) Select a cell or range of cells to be affected.

2) Select **Underline** from the **Format** menu or **MB3 popup** menu to display a cascading menu of choices. Choose one of:

   Default to use the cell default setting
   On to enable single underline
   Off to disable underlining
   Double to enable double underline

. . . . . .
Alternatively, you can click the underline toggle button icon on the toolbar to cycle through Off/Single/Double options.
. . . . . .

Strikethrough

Text in a cell can be displayed with strikethrough -- a single line drawn through the middle of the characters in the cells.

To change the default Strikethrough specification:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Click the **Strikethrough** option button and select one of:

   On to make strikethrough the default
   Off to disable strikethrough

3) Apply your selection by clicking **OK** or **Apply**.

To change the Strikethrough setting for individual cells:

1) Select a cell or range of cells to be affected.

2) Select **Strikethrough** from the **Format** menu or **MB3 popup** menu to display a cascading menu of choices. Choose one of:

Default to use the cell default setting
On to set strikethrough attribute
Off to clear strikethrough attribute

Aligning Cell Contents

Horizontal Alignment

XESS allows you to indicate the horizontal alignment (justification) of one or more cells. This specification applies to both text and numeric cell entries and indicates whether the contents will be left-alilgned, right-aligned, or centered within the column boundary. The default for the whole sheet is changed in the **Cell Defaults** dialog box from the **Options** menu. However, you can set the alignment for an individual cell or range of cells by using the **Justification** option from the **Format** menu, **Toolbar** icon buttons, or **MB3 popup** menu.

To change the default Alignment specification:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Click the **Alignment** option button and select one of the following:

Automatic	Text is left aligned; numerics are right-aligned
Right	Text and numerics are right-aligned
Left	Text and numerics are left-aligned.
Center	Text and numerics are centered.

3) Apply your selection by clicking **OK** or **Apply**.

To change the Alignment setting for individual cells:

1) Select a cell or range of cells to be affected.

2) Click the desired alignment icon button on the **Toolbar**.
- OR -

Select **Alignment** from the **Format** menu or **MB3 popup** menu to display a cascading menu of choices. Choose an explicit setting or choose **default** to use the default setting from **Cell Defaults**.

One additional option, **Center Selection**, allows text to be centered over a group of cells.

To use Center Selection:

1) Enter the text in the left-most cell of the group of cells.
2) Select the group of cells over which to center the text.
3) Select the columns to be centered over.
4) Select **Alignment>Center Selection**.

Vertical Alignment

XESS allows you to indicate the vertical alignment (justification) of one or more cells. This specification applies to both text and numeric cell entries and indicates whether the contents will be aligned with the top of the cell, the bottom of the cell, or centered vertically within the cell. The default for the whole sheet is changed in the **Cell Defaults** dialog box from the **Options** menu. However, you can set the vertical alignment for an individual cell or range of cells by using the **Vertical Alignment** option from the **Format** menu or **MB3 popup** menu.

To change the default Vertical Alignment specification:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.
2) Click the **Vertical Alignment** option button and select one of the following:

Top	Contents aligned with the top of cell
Bottom	Contents aligned with bottom of cell
Center	Contents are vertically centered.

3) Apply your selection by clicking **OK** or **Apply**.

To change the Vertical Alignment setting for individual cells:

1) Select a cell or range of cells to be affected.
2) Click the desired alignment icon button on the **Toolbar**.
   OR -
   Select **Vertical Alignment** from the **Format** menu or **MB3 popup** menu to display a cascading menu of choices. Choose an explicit setting or choose **Default** to use the default setting from **Cell Defaults**.

Orientation

The orientation of text, numbers, and computed values in a cell is controlled by the **Orientation** option of the **Format** menu. The cell content can have an orientation of **Horizontal**, **Vertical**, or rotated 90 degrees in either direction from the horizontal. Rotated **Up** means reading from bottom to top; **Down**, top to bottom.

Wrapping Text Within Cell Boundary

XESS allows you to wrap text in a cell which would normally overflow into the adjacent cell or be truncated if the adjacent cell is not empty. Wrapped text is displayed on subsequent lines within the cell, aliasing over adjacent cells as needed and allowed.

The default for the whole sheet is changed in the **Cell Defaults** dialog box from the **Options** menu. However, you can set the wrap option for an individual cell or range of cells by using the **Wrap** option from the **Format** menu or **MB3 popup** menu.

To change the default Wrap specification for all cells:

1) Select **Cell Defaults** from the **Options** menu . XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Click the **Wrap** option button and select one of:

   On to enable text wrapping
   Off to disable text wrapping

3) Apply your selection by clicking **OK** or **Apply**.

To change the Wrap setting for individual cells:

1) Select a cell or range of cells to be affected.

2) Select **Wrap** from the **Format** menu or **MB3 popup** menu to display a cascading menu of choices. Choose an **On**/**Off** setting or choose **default** to use the default setting from **Cell Defaults**.

Colors and Patterns

XESS allows you to specify background and foreground colors for both protected and unprotected cells. The default for the whole sheet is changed in the **Cell Defaults** dialog box from the **Options** menu. However, you can set color for an individual cell or range of cells by using the **Cell Color** option from the **Format** menu or **MB3 popup** menu.

Palette

The color palette displayed whenever you choose to assign or change the color may consists of up to 63 colors. The default colors and the size of the color palette displayed in XESS are defined in the XESS resource file and can be modified.

Assigning cell colors

To change the default Color specification:

1) Select **Cell Defaults** from the **Options** menu. XESS displays the **Cell Defaults** dialog box as shown in Figure 8-4.

2) Click the **Foreground** option button and select a color for the text or numbers displayed in all *protected* cells.

3) Click the **Background** option button and select a color for the background in all *protected* cells.

4) Click the **Pattern** option button and select a background pattern, if desired. If a pattern is specified, click the **Pattern Color** option button and select the color of the pattern foreground.

5) Click the **UnProtect FG** option button and select a color for the text or numbers displayed in all *unprotected* cells.

6) Click the **UnProtect BG** option button and select a color for the background in all *unprotected* cells.

7) Apply your selection by clicking **OK** or **Apply**.

If Check Protection is set to OFF in Sheet Default, UnProtect FG and UnProtect BG have essentially no visible impact.

To change the Color setting for individual cells:

1) Select a cell or range of cells to be affected.

2) Select **Cell Color** from the **Format** menu or **MB3 popup** menu. XESS displays the **Cell Colors** dialog box as shown in Figure 8-7

3) Click the **Foreground** option button and select a color for the text or numbers displayed in the selected cell(s).

4) Click the **Background** option button and select a color for the background in the selected cells. (This can be used for either Protected or UnProtected cells.)

5) Apply your selection by clicking **OK** or **Apply**.

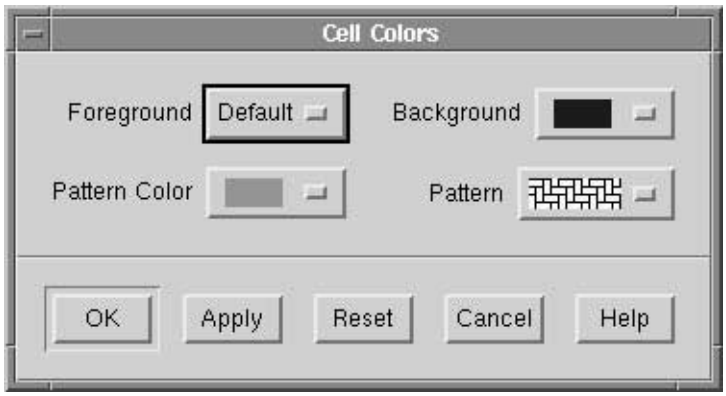

Figure 8-7 Cell Colors Dialog Box

Cell Borders

You can place horizontal and vertical borders around a cell or range of cells. These borders are visible on the display and in printed output and are saved with the sheet. Cell borders can be any of the colors in the color palette and any of a variety of styles.

There are two typical ways to use cell borders. The first places borders around each cell. The second places a single border around a group of cells.

To place borders on each cell in a range of cells:

1) Select the range of cells. If nothing is selected, the current cell is affected.
2) Choose **Cell Borders...** from the **Format** menu.
3) In the **Cell Borders** dialog, choose the color and border style for the left, right, top, and bottom borders. The default border style is no border. Click **OK**.

To place an outline border around a range of cells:

1) Select the range of cells. If nothing is selected, the current cell is affected.
2) Choose **Cell Borders...** from the **Format** menu.
3) In the **Cell Borders** dialog, choose the color and border style for the outline. Click **OK**.

Figure 8-8 Cell Borders Dialog Box

Highlight Options

You may set background and foreground colors to distinguish any/all of the following calculation results:

- errors
- negative values
- constraint conditions which are not met.

These colors are applied to the entire sheet and override those selected by **Cell Colors** for individual cells.

To set the highlight options:

1) Select **Highlight Options** from the **Options** menu. XESS displays the **Highlight Options** dialog box as shown in Figure 8-5.

2) Click the check button beside the option to activate or deactivate the feature for any or all of the three conditions.

3) Set the **background** and/or **foreground** color for each condition by pointing to the designated option button and holding down the left mouse button. Position the mouse on the color of choice and release.

4) Apply your selection by clicking **OK** or **Apply**

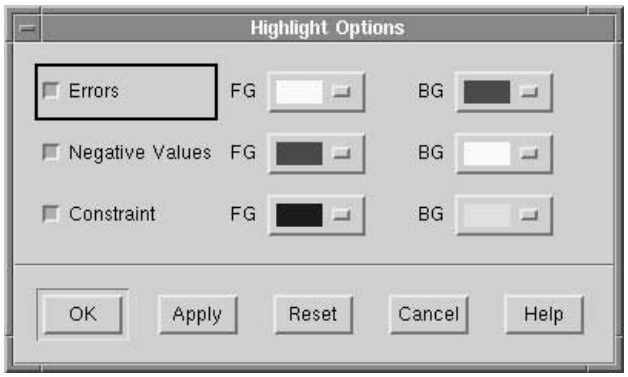

Figure 8-9 Highlight Options Dialog Box

Row and Column Attributes

This section describes how to:

- change column width,
- change row height,
- insert rows and columns,
- insert cells in rows and columns,
- delete rows and columns,
- delete cells in rows and columns
- hide rows and columns, and
- create row and column titles

Column Width

By default, XESS creates columns that are twelve (12) positions wide. As mentioned earlier in this chapter, you can use the **Workbook Defaults** dialog box to change this default for the workbook, creating a uniform set of columns of some user-specified width. You can also set individual columns to be wider or narrower than the default by using the **Column Width** option under the **Format** menu or **MB3** popup or by simply **dragging** the column border with the mouse.

Setting Column Width with Menus

To change the default column width:

1) Select **Workbook Defaults** from the **Options** menu. XESS displays the **Workbook Defaults** dialog box.

2) Enter a number from 1.00 to 255.00 in the **Default Column Width** entry box.

3) Apply your entry by clicking **OK** or **Apply**.

To explicitly set the width of selected columns:

1) Select the column(s) you wish to change.

2) Select **Column Width** from the **Format** menu or **MB3 popup** menu which displays its cascading submenus.

3) Select **Column Width...** from the submenus. XESS displays the **Column Width** dialog box.

4) In the **Selection** entry box, enter the desired column width (1 - 255).

5) Apply your entry by clicking **OK** or **Apply**.

To restore the original default column width to selected columns:

1) Select the column(s) you wish to reset to the default.

2) Select **Column Width** from the **Format** menu or **MB3 popup** which displays its cascading submenus.

3) Select **Default Column Width** from the submenu.

Best Fit Column Width

XESS provides a *snap-to* mechanism which forces the column width to best fit the cell contents. This provides a dependable mechanism to ensure no text is being truncated and that wasted space is minimized. This is particularly useful when combined with the Text Wrap feature.

These two features together allow you to define a column width to achieve optimal page layout and force long text strings to wrap within the column bounds rather than be truncated or overflow into the adjacent cell. Then you can use the snap-to mechanism to adjust the row height to accommodate the wrapped text.

To snap column width to best fit cell contents:

1) Select the column(s) you wish to adjust.

2) Select **Column Width** from the **Format** menu or **MB3** popup which displays its cascading submenus.

3) Select **Snap Width to Contents** from the submenu.

Dragging the Column Border

You may change the column width dynamically, by dragging the right column border to the desired width. If you drag the border to the left past the beginning of the column, then the column is hidden.

Content Exceeds Column Width

When the contents of a cell containing a **non-numeric** entry exceeds the column width, one of two things will occur. If the adjacent cell to the right is empty, the displayed content will overflow into the adjacent cell. If the cell the the right is not empty, the displayed content will appear truncated. *You may want to use the **Wrap** option to force the long string to wrap at the cell boundary.*

When the column width of a cell is too narrow to display a **numeric** entry completely, XESS alerts you to this condition by showing a **bold cell border** in the truncated cell. If truncation occurs to the left, the left cell border is highlighted. If the truncation occurs to the right, the right cell border is highlighted. (Cell Alignment determines whether the truncation occurs on the left or the right.)

Row Height

By default, XESS creates rows that are "one unit" in height. A unit is defined to be the space needed to store a numeric zero. As mentioned earlier in this chapter, you can use the **Workbook Defaults** dialog box to change this default for the workbook, creating a uniform set of rows of some user-specified height.

You can also set individual rows to be wider or narrower than the default by using the **Row Height** option under the **Format** menu or by simply dragging the row border with the mouse.

Setting the Row Height Using Menus

To change the default row height:

1) Select **Workbook Defaults** from the **Options** menu. XESS displays the **Workbook Defaults** dialog box as shown in Figure 8-1.
2) Enter a number in the **Default Row Height** entry box.
3) Apply your entry by clicking **OK** or **Apply**.

To explicitly set the height of selected rows:

1) Select the rows(s) you wish to change.

2) Select **Row Height** from the **Format** menu or **MB3** popup which displays its cascading submenus.

3) Select **Row Height...** from the submenus. XESS displays the **Row Height** dialog box.

4) In the **Selection** entry box, enter the desired row height.

5) Apply your entry by clicking **OK** or **Apply**.

To apply the default row height to selected rows:

1) Select the row(s) you wish to adjust.

2) Select **Row Height** from the **Format** menu or **MB3** popup which displays its cascading submenus.

3) Select **Default Row Height** from the submenu.

Best Fit Row Height

XESS provides a *snap-to* mechanism which forces the row height to best fit the cell contents.

To snap row height to best fit cell contents:

1) Select the row(s) you wish to adjust.

2) Select **Row Height** from the **Format** menu or **MB3** popup which displays its cascading submenus.

3) Select **Snap Height to Contents** from the submenu.

Dragging the Row Border

You may change the row height dynamically, by dragging the lower row border to the desired width within the maximum height allowed. If you drag the bottom border up past the top of the row, then the row is hidden.

Content Exceeds Row Height

If font size or multiple lines of text in the same cell cause the cell content to exceed the row height, one of two things will occur. If the first line in the cell is too tall, the displayed contents will overflow above into adjacent empty cells; additional lines overflow down into adjacent cells. (This is sometimes referred to as *aliasing*.) If the adjacent cell is not empty, the displayed content will appear truncated. You may want to use the **Snap-to** option to force the row height to accommodate the tall text or multiple lines of text in the same cell.

Inserting Rows and Columns

While creating or changing sheets, you may need to add new rows or columns. XEss makes this very easy to do with the **Insert** operation from the Edit menu. The Insert operation creates new, empty row(s) or column(s) at the current location in the sheet. Existing rows and columns are re-indexed to take the additional rows and columns into account. XEss updates all cell references in formulas to match the new row or column addresses.

To insert new, empty rows:

1) Move the cell cursor to the row above which you would like to insert an empty row. To insert more than one row, select a range containing the number of rows you wish to insert starting at that position.
2) Select **Insert** from the **Edit** menu or **MB3** popup to display its cascading submenu.
3) Select **Insert Row** from the **Insert** submenu.

To insert new, empty columns:

1) Move the cursor one column to the right of where you want to insert an empty column. To insert more than one column, select a range containing the number of columns you wish to insert starting at that position.
2) Select **Insert** from the **Edit** menu or **MB3** popup to display its cascading submenu.
3) Select **Insert Column** from the **Insert** submenu.

Inserting Cells by Row or by Column

Sometimes it is convenient to insert a block of new cells into the sheet with other cells being moved right or down to make room for the new cells.

To insert cells by row:

1) Select the range where the new cells will be inserted.
2) Click **Insert Cells by Row** on the Edit menu. A block of empty cells are inserted and previous values are moved down.

To insert cells by column:

1) Select the range where the new cells will be inserted.

2) Click **Insert Cells by Column** on the Edit menu. A block of empty cells are inserted and previous values are moved right.

Deleting Rows and Columns

XESS lets you delete rows and columns that you no longer need, along with any data in those columns. The **Delete** operation in the Edit menu deletes the current row or column and causes the remaining rows or columns to be re-indexed to reflect the deletion. XESS updates all cell references in formulas accordingly.

If you delete a row or column, the data in the deleted row or column is lost, but all dependencies in the sheet are preserved. The ranges which span the deleted row are contracted to prevent inclusion of unwanted cells.

To delete a row(s):

1) Select the row(s) to be deleted.
2) Select **Delete** from the **Edit** menu or **MB3** popup to display its cascading submenu.
3) Select **Delete Row** from the **Delete** submenu.

To delete a column(s):

1) Select the column(s) to be deleted.
2) Select **Delete** from the **Edit** menu or **MB3** popup to display its submenu.
3) Select **Delete Column** from the **Delete** submenu.

Deleting Cells by Row or by Column

A block of cells can be deleted with other cells being moved up or left to "fill in" the empty space.

To delete cells by row:

1) Select the range of cells to be deleted.
2) Click **Delete Cells by Row** on the Edit menu. The selected cells will be deleted and the cells below them will be moved up to fill the space.

To delete cells by column:

1) Select the range of cells to be deleted.

2) Click **Delete Cells by Column** on the Edit menu. The selected cells will be deleted and the cells to the right of them will be moved left to fill the space.

Hiding Rows and Columns

You can completely hide rows and columns. With this new feature, you are able to eliminate them from the display while they remain accessible behind the scenes. For instance, if you hide column B, you see A,C,D,E... on the display. Column B and its contents still exists; it is just not visible on the displayed and printed output.

To hide a range of columns using the Hide Columns operation:

1) Select the column or columns to be hidden.
2) Choose **Column Width...** from the **Format** menu. Xess displays the list of options.
3) Choose **Hide Column**.

To unhide a range of columns using the Unhide Columns operation:

1) Select a range of columns which includes the ones hidden.
2) Choose **Column Width...** from the **Format** menu. Xess displays the list of options.
3) Choose **Unhide Column**.

If you have hidden rows/columns at the edge of the sheet, position the cursor in the first row or column that is not hidden and then unhide. For example, the column A is hidden, place the cursor in column B and Unhide Column to restore A.

Rows and Columns can also be hidden by dragging their button borders.

Creating View Titles

Users often reserve the top rows of a sheet for descriptive column headings and the leftmost columns for descriptive row titles. However, when you scroll right or down in a large sheet, you can no longer view these headings, just the row and column indices (AA, 125, etc.).

XESS supports three variations of view titles: row headings, column heading, row and column headings. The text for view titles is entered before the view is protected with the **Lock View**

Titles operation. After view titles are set, the cursor will no longer move into that area. When you lock a view title, XESS changes the applicable border color from to designate the locked area.

Column View Titles

When the cell cursor is in column A, the **Lock View Titles** option from the **View** menu establishes a number of protected rows from the row above the cell cursor to the top of the sheet for view titles. The view title scrolls with the view from left to right but remains in the same position at the top of the sheet as you scroll up and down.

To create column view titles:

1) Use your usual method (keyboard, mouse, or import operations) to enter text for column titles.
2) Move the cursor to the row immediately below the last row to be included in the Column View Title. For example, if column headings occupy Rows 1 through 4, move the cursor to Row 5.
3) Select **Lock View Titles** from the **View** menu.

All rows above the cell cursor are highlighted and protected as a title area.

Row View Titles

When the cell cursor is in Row 1, the **Lock View Titles** option from the **View** menu establishes one or more protected columns beginning with the column to the left of the cell cursor to the left edge of the sheet to serve as view titles. The view title scrolls with the view as you scroll up and down but remains in the same position at the left of the sheet as you scroll right and left.

To create row view titles:

1) Use your usual method (keyboard, mouse, or import operations) to enter text for row headings.
2) Move the cursor to the column immediately to the right of the rightmost column to be included in the Row View Title. For example, if row headings occupy Columns A and B, move the cursor to Column C.
3) Select **Lock View Titles** from the **View** menu.

All columns to the left of the cell cursor are highlighted and protected as a title area.

Row and Column View Title

When the cell cursor is in the body of the sheet the **Lock View Titles** option from the **View** menu establishes one or more protected rows and columns above and to the left of the current cursor position to serve as view title.

To create both title rows and title columns:

1) Use your usual method (keyboard, mouse, or import operations) to enter text for row and column headings.
2) Move the cursor to the row immediately below and to the column to the right of the desired title area.
3) Select **Lock View Titles** from the **View** menu.

All columns and rows above and to the left of the cell cursor are highlighted and protected as a title area. When you scroll down, the column view titles will remain onscreen; when you scroll right the row view titles will remain onscreen.

Unlocking and Relocking View Titles

To unlock any view title, select **Unlock View Titles** from the **View** menu. The cell which was the anchor for the view title becomes the upper-left corner of the display. Later, the most recent view title can be re-enabled using the **Relock View Title**.

9

XESS Tools

XESS tools, available from the **Tools** menu, perform special tasks, including:

- **Recalculate** - forces recalculation of the workbook.
- **Cell Protection** - sets and clears cell protection.
- **Transpose** -swaps row and column orientation of cells
- **Data Fill** - completes entry of patterns of values
- **Goal Seek** - varies the value of an independent variable in order to achieve a desired result in another variable.
- **Solver** - multi-variable, multi-rule solutions to complex systems.
- **Sort** - sorts data in ascending or descending order.
- **Extract** - extracting data from internal databases.
- **Overlay** - editor for free-form drawing and illustration.
- **Workbook Statstics** -- memory use information

These are powerful features that give you control over the spreadsheet beyond the logic embedded in cells. For instance, you can create what-if scenarios, asking XESS what value is required to achieve a certain outcome. You can quickly identify patterns in research data, and sort the data by criteria you select. You can visualize your data in the manner most useful to you, then discard

the new view or save it under a new name, preserving the original workbook intact.

Recalculate

Forces a recalculation of the workbook.

Cell Protection

Sets or clears the cell protection for the specified range of cells.

Transpose

It is often useful to be able to swap the row and column orientation of a set of cells. The **Transpose** tool performs this operation. For example, assume the following data is selected:

	A	B	C
1	One	Two	Three
2	10	20	30

in A1..C3 and the **Transpose>Copy Values** places the result beginning at cell A5. The result would be:

	A	B
5	**One**	**10**
6	**Two**	**20**
7	**Three**	**30**

The **Transpose** tool works in ways similar to the **Copy** and **Move** commands on the **Edit** menu. With **Transpose>Move** and **Transpose>Copy Formulas**, the cell and range references are adjusted appropriately.

Data Fill

The **Data Fill** tool provides a convenient way to assign values to a a range of cells by extending a pattern or completing a series. For example, `Monday, Tuesday` would extend with `Wednesday, Thursday` and `15-Jan, 15-Apr` would extend with `15-Jul, 15-Oct, 15-Jan`.

To use Data Fill:

1) Enter the values for the first cells in range. (Enough cells to define the pattern)

2) Select the range to contain the sequence of values, including the cells containing the initial pattern.

3) Select **Data Fill** from the **Tools** menu (or **Ctrl+d**). The pattern of values will be extended to the entire selection.

Goal Seek

In many types of analysis, even in simple budget preparation, you may need to vary a cell value until a chosen cell reaches a target value. In XESS this process is called goal-seeking and is accomplished using an iterative technique.

Using this method, XESS usually finds the desired value in two or three iterations for linear relationships, more for higher-order dependencies.

To perform Goal Seek:

1) Select **Goal Seek** from the **Tools** menu. XESS displays the **Goal Seek** dialog box as shown in Figure 9-1.

2) Enter the following specifications in the entry boxes:

   Variable Cell The name or address of the cell value to change.

   Target Cell The name or address of the cell containing the target value.

   New Value The value to be reached.

3) Click **Start** to begin the search. XESS performs the calculation and displays the results on screen, with the Goal Seek dialog box still displayed. If necessary, you can move the Goal Seek dialog box to view the results of the goal seek operation.

4) Click **Cancel** to exit the Goal Seek dialog.

Note: If the value of the target cell does not respond to changes in the variable cell, XESS stops goal seek, delivers an error message, and restores the sheet to its original values.

Figure 9-1 Goal Seek Dialog Box

*Note: If the target value is not reached in ten (10) iterations, goal seek pauses and enables the **Continue** button allowing you to choose whether or not to continue with the goal seek operation.*

Solver

While the Goal Seek tool is adequate for many simple problems, the Solver tool is designed for complex problems with many variables and many constraint rules. The target cell may be solved for a maximum, a minimum, or a specific value. Some problems have many solutions, others have none.

Constraints are rules that must be met in order to have a valid solution to the problem. They restrict the posible values a cell may have and define the relationships among cells which must be maintained in the solution. Example constraints are:

```
A3 > 20
revenue > expenses
```

To use the Solver:

1) Select **Solver...** from the Tools menu. XESS displays the Solver dialog box.

2) Enter the following specifications in the entry boxes:

   Target Cell The name or address of the cell that is the target of the solution.

   Seek to: The goal to be reached - min, max, or specific value.

Variable Cell(s)
The names or addresses of the cells whose values will be changed when searching for a solution.

Constraint(s): The current constraints for this problem. You can click on an existing constraint and then Delete it.

Add Constraint:
Enter a new constraint rule here and then click Add.

3) Click **Start** to start the solver. XESS performs the calculations and displays the intermediate results on the cells, with the Solver dialog box still displayed. You can modify your constraints and restart the Solver.

4) Click **Cancel** when finished with the Solver dialog.

Sort

XESS can sort the rows of a range into ascending or descending order based on the values in specified columns. Before sorting a range of cells, consider these rules that XESS follows for sorting:

- Cells containing text (labels) or text-valued formulas are sorted in lexical order (alphabetical order following the same sorting conventions as a dictionary). Cells containing numeric formulas or constants are sorted by the numeric value of the cell.
- When sorting a mixed range of numeric and string values, XESS assigns the following priority order to different cell types:
  - — cells containing text values are less than those with numeric values.
  - — numeric values are ordered from largest-magnitude negative to largest-magnitude positive.
  - — empty cells are considered highest-ranking for ascending sorts and lowest-ranking for descending sorts. This places empty cells at the bottom of the results.
- For alphabetic sorts, the output of the sort will reflect case and accent mark sensitivity according to the setting of the case and accent collating option.
- XESS does not modify range references within the sorted range. This avoids the risk of cells in the referenced range becoming non-contiguous.

- When the sort includes named cells, Xess updates the definition of the named cell to reflect its new location. Named ranges are not changed.
- XESS keeps track of what it moves and where -- and updates cell references throughout the workbook to reflect the changes that occurred while sorting. However, XESS lets you choose not to update cell references, if you wish.

Note: If you specified that Xess not update cell references during the sort:

- *Cell and range references are changed only in a linear fashion, calculated by the distance that the cell moves.*
- *The definitions of named cells and ranges are unchanged.*
- *References to named cells and ranges are changed to standard references such as A1..A5.*

To sort a range of cells:

1) Select **Sort...** from the **Tools** menu. XESS displays the **Sort** dialog box for you to enter the specifications of the sort. See Figure 9-2.

2) Make the following entries in the Sort dialog box:

Range	Type the addresses of opposite corners of the range to be sorted, separated by one or two periods (e.g. A1..D5) or use the mouse to select the range and paste it in with the middle mouse button. If you selected a range before choosing the Sort operation, XESS enters this range by default.
Key 1	Enter the address of a cell in the column on which to base the sort. For example, to sort by the contents of column B starting at row 2, enter **B2**. If you enter a range, XESS uses the leftmost column of the range.
Key 2 **Key 3** **Key 4** **Key 5**	Enter the address of a cell on which to sort if two or more values in the primary column are the same. If you enter a range, XESS uses the leftmost column of the range.

3) Click on the check button labeled **Descending** to sort the column values in descending order. By default, XESS sorts in ascending order.

4) Click off the check button labeled **Update References** if you do not want to update cell references once the sort is complete. By default XESS updates all cell references.

5) Select **Exclude Header Row** if you want to prevent the top row of the selection range from being sorted.

6) You can change the collating sequence with respect to upper/lower case and accented/unaccented characters by selecting one from each of the corresponding list box selections as follows:

Case	Accented Characters
Lower case after all upper case	Accents after all unaccented
Lower case after corresponding upper	Accents after corresponding unaccented
Lower case with corresponding upper (case ignored)	Accents with corresponding unaccented (accents ignored)

7) Click **OK** or **Apply** to proceed. XESS sorts the cells and displays the results. **Apply** leaves the Sort dialog displayed on the screen.

*Use the **Undo Sort** operation from the Edit menu, MB3 popup, or the X icon on the toolbar to cancel the most recent sort operation. All cells are returned to their unsorted locations.*

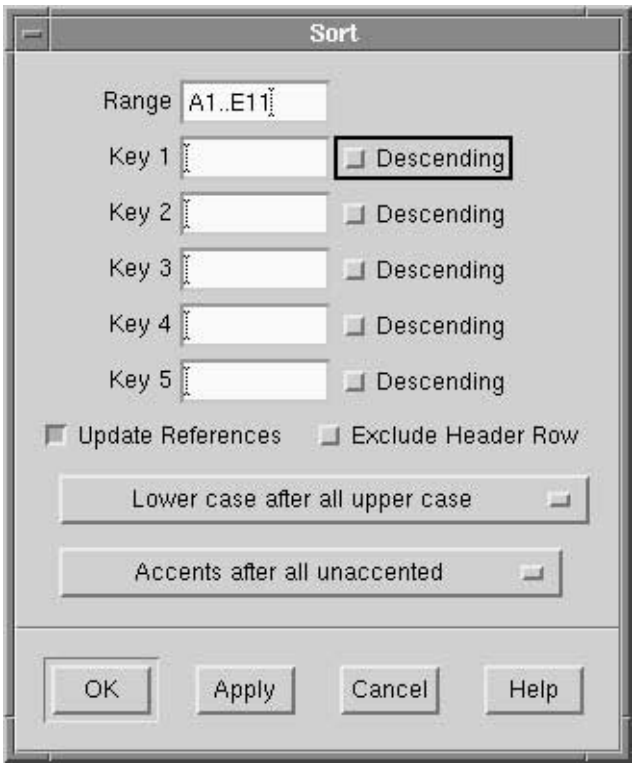

Figure 9-2 Sort Dialog Box

Extract

Extract is a facility for managing internal databases. Internal databases consist of records stored as rows. Extract allows you to selectively retrieve a set of records based on a selection criteria.

To Extract a range of cells:

1) Select **Extract** from the **Tools** menu. Xess displays the **Extract** dialog box as shown in Figure 9-3.

2) Enter the following specifications:

Source Range Enter the range of records from which extract will be performed.

Key Specify the key column cell address on which you want to base the extract. This column represents "#" in a constraint expression specified in Filter.

Destination Enter the beginning cell address the extracted records will be placed.

Filter Specify the string or value as it would appear formatted in the cell. To find a numeric value that meets a certain criteria, enter the Filter with a constraint expression. For example to extract values less than 20, specify the Filter as #<20.

a) **To extract a character string**, type the string inside the Filter entry box as it would appear when formatted in the cell. Example:

Doe, John

b) **To extract a numeric value**, either a constant or a calculated value, type the value exactly as it would appear formatted in the cell. Example:

$1,000,000

c) **To extract numeric values that meet certain criteria**, enter the target with a constraint expression. # is used to represent the current cell being examined. Select **Numeric Search**. For example:

(1) To find values less than 20, specify the target as

#<20

(2) To find values greater than or equal to 50, specify the target as

#>=50

(3) To find cells whose values are less than 600 and whose neighboring cells in the same column have values less than 500, specify the target as:

#<600 && #{0,-1}<500 && #{0,1}<500

(4) To find the cell containing the date August 22, 1991, specify the target as:

#==@DATE(1991,8,22)

3) Click on the check button labeled **Numeric Comparison** if you are using a numeric find pattern.

4) Use the **Ignore case** toggle button to determine whether or not upper/lower case is taken into consideration with the Extract operation. If you wish to find both upper and lower

case occurrences of alphabetic characters, click the toggle button *on* to **Ignore case.** Otherwise, if this toggle button is off, the Extract operation will be case sensitive.

5) Use the **Ignore accents** toggle button to determine whether or not accents used in the extended character set are taken into consideration with the Extract operation. If you wish to find both unaccented and accented occurrences of the same alphabetic character, click the toggle button *on* to **Ignore accents**. Otherwise, if this toggle button is off, the Extract operation will differentiate between accented and unaccented characters.

6) Click **OK** or **Apply** to begin.. Xess will extract the data and place it in the destination range. **Apply** leaves the Extract dialog displayed on the screen.

7) Click **Cancel** to quit Extract.

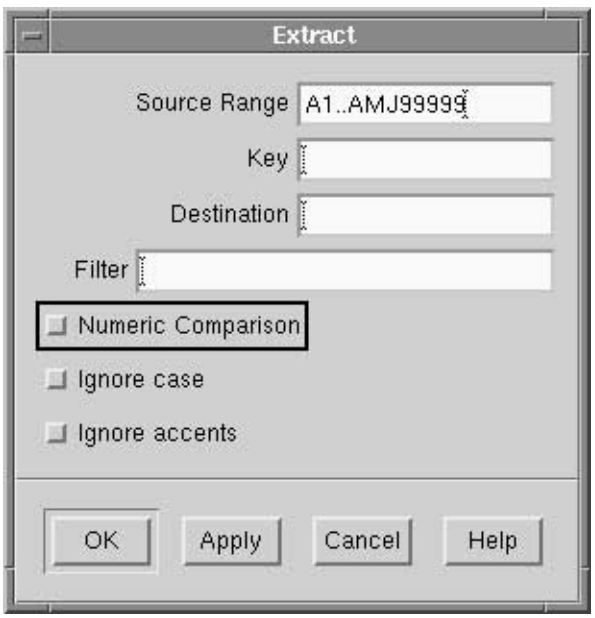

Figure 9-3 Extract Dialog Box

Use the Undo Extract operation from the Edit menu, MB3 popup, or the X icon on the toolbar to cancel the most recent extract operation. All cells are returned to their original state before the extract.

Overlay Editor Drawing Tool

The **Overlay Editor** is invoked from either the toolbar icon or by the **Overlay...** on the **Tools** menu and appears as shown in Figure 9-4. It provides the ability to draw on the face of a sheet with figures, lines, and text. These items are saved with the sheet and are displayed on top of cell contents.

Figure 9-4 Overlay Editor

The **Overlay Editor** dialog contains eight icons and several selection options. Clicking on an icon places you in a drawing mode. (These icons have tips associated with them.) The icon for the currently selected action is displayed in reverse video.

The icons have the following meanings:

Send Object to Back	**Select Object**
Draw Line	**Draw Text**
Draw Hollow Rectangle	**Draw Filled Rectangle**
Draw Hollow Oval	**Draw Filled Oval**

The selection options control colors, patterns, and fonts. The **Foreground Color** is used to draw text, lines, and outlines. The **Background Color** is used to draw the background of filled objects. The **Pattern Color** is used to draw the foreground of fill patterns. The **Font Family**, **Font Style**, and **Font Size** control drawing text objects.

Overlay Attachment defines how the object is attached to the sheet and when it is visible:

- Objects attached with **View Window** maintain a constant position relative to the upper left corner of the spreadsheet data area, even when the sheet is scrolled.
- Objects attached with **Nearest Cell** maintain a constant position relative to the nearest cell. These objects scroll with the sheet and reflect changes in the size of cells above and to the left of their anchor cell.
- Objects attached with **Sheet Origin** maintain a constant position relative to cell A1. They scroll with the sheet.

Creating Overlay Objects - Drawing on the Sheet

To draw an overlay item on the sheet:

1) Click on the icon for the desired item in the **Overlay Editor** and select the desired settings for colors, patterns and fonts.
2) Press **MB1** (left mouse button) at the desired starting point on the display, drag until the desired line, rectangle, or oval is drawn, and release the mouse button.
3) Additional items of the same type may be drawn without re-selecting the operation.

. . . . . .
*To convert rectangles and ovals into squares and circles, press the **[Shift]** while drawing or resizing the object.*
. . . . . .

To enter text on the sheet:

1) Select **Draw Text**.
2) Click the left mouse button at the desired starting location in the sheet for the text
3) Begin typing the text string.
4) Press **[Enter]** when done.

Modifying Overlay Objects

Attributes of overlay objects can be modified in several ways.

To change the shape of an object:

1) Click the **Selection Icon** in the **Overlay Editor**.
2) Click on the object in the sheet view. The selected object is now displayed with selection points at its edges/corners.

3) Position the mouse over a selection point until the mouse pointer changes shape. Hold the left mouse button down while positioned over this point and drag the mouse to reshape the object.

4) Release the mouse button. Additional selections can now be made.

To modify object attributes:

1) Click the **Selection Icon** in the **Overlay Editor**.

2) Click on the object in the sheet view. The selected object is now displayed with selection points at its edges/corners.

3) Select the appropriate attributes (e.g. color, font) for the object and click **Apply**. The object now has the new attributes.

To move a Text object:

1) Click the **Selection Icon** in the **Overlay Editor**.

2) Click on the text object in the sheet view. The selected text object is now displayed with an anchor point before its left-most character.

3) Use the left mouse button to drag the text object to the desired location.

4) Release the mouse button.

Deleting Overlay Objects

To delete an overlay object from a sheet:

1) Click the **Selection Icon** in the **Overlay Editor**.

2) Click on the object in the sheet view. The selected object is now displayed with selection points at its edges/corners.

3) Click **Delete** in the **Overlay Editor**.

Workbook Statistics

The **Workbook Statistics** dialog displays the number and size of various components of the current workbook.

10

Interacting with Other Applications

XESS interacts with other applications in two distinctly different ways:

- importing and exchanging static data between XESS and other programs, and
- establishing connections for dynamic, real-time data exchange between XESS and other programs.

Static Data Exchange

XESS Import and Paste operations let you import data from other programs, such as spreadsheets and tabular text reports. This data is static, meaning that it is inserted into the current XESS workbook but is no longer affected by calculations and manipulations that take place in the source program.

Similarly, you can use Export and Paste operations to export static data to other programs. This data can be used by the other program but is no longer affected by calculations and manipulations that take place in XESS.

Dynamic Data Exchange

The most powerful feature of XESS is its ability to handle real-time data transfer with other programs, even those running under different machine architectures, different

operating systems -- even in different countries. With this facility, you can have XESS accept, process and display information from other programs in real-time, continually updating the screen as you watch. You can also have XESS transfer data to other programs in real-time.

The Import, Export, and Paste operations are used for transferring static data. Dynamic connections are established with special XESS connection routines that you program into the external application.

This chapter explains how to use XESS in partnership with other X Windows applications, including how to:

- import static data from other programs
- export static data to other programs
- import static data from other XESS workbooks
- import dynamic data from other XESS workbooks
- export static data to other XESS workbooks
- establish connections with other X Windows programs for dynamic data exchange.

Importing Data into an XESS Workbook

XESS can load spreadsheet files stored in WKS, WK1, WK3/WK4, and XLS formats, plus spreadsheet files stored in XESS formats. These operations handle formulas, values, formatting, and global settings. You can also save XESS workbooks in WKS, WK1, WK3, XLS or XESS formats for use in applications that recognize those formats.

XESS can also import values in text files and HTML files and export XESS spreadsheet data as files to be used by other programs.

Import operations are an efficient way to bring information into XESS without the risk of error associated with retyping everything. Obviously, there are many occasions when it makes sense to import data from other programs, for example:

- You can load, revise and use a sample budget created by another department using a different spreadsheet program. You do not have to recreate the workbook in XESS; just specify the alternate file type in the **Open Sheet** dialog box. XESS loads the data into XESS and notifies you if there are any problems with the foreign sheet format.

- You can paste a directory listing of files from a terminal window into XESS, sort by file size, and graph filenames versus file sizes.
- You can use XESS to manipulate and display numbers produced in a large table by a simulation program.
- You can capture information from electronic mail, such as price lists for lab equipment, and use them in XESS to create a purchase requisition.
- You can import tables of numbers and labels from a document, and use them in XESS just as if you had typed them on the Input line.
- You can import tabular data from HTML files for easy integration with web applications.

Loading WK* and XLS Files

XESS loads and saves WKS/WK1/WK3/WK4 and XLS format spreadsheets just as it does its own formats. Use the **Open...** and **Save...** operations and specify the desired file type for the spreadsheet.

When opening WK*/XLS files, XESS loads the entire WK* or XLS file including its formulas and formatting. Note that there are differences between spreadsheet programs, so you may have to modify certain formulas or cells to get the spreadsheet to work properly in XESS.

You can open most spreadsheet files without difficulty, but those with complex interactions that use macros or certain functions may require some modification. Here are some principal differences between typical WK* and XLS spreadsheet programs and XESS:

- XESS stores all internal values as double-precision floating point numbers, whereas some spreadsheets store some numbers as 16-bit integers. XESS converts integers to double-precision floating point numbers as they are imported.
- Some spreadsheets have built-in functions that are not present in XESS. If XESS encounters an ambiguous function, it stores the text of the function in the cell as a text entry. You can then use XESS Edit features to modify the formula to work under XESS.
- Some spreadsheets support cell formats that XESS does not recognize. If XESS encounters an unfamiliar cell format while

importing a file, it assigns the default cell format and default number of decimal places.

- Some spreadsheets use blank cells to hold a format for empty cells, whereas XESS uses the Format Range function for this task. When importing WK* files, XESS ignores blank cells.

To load an existing WK*/XLS file:

1) Select **Open...** from the **File** menu and display its submenu.
2) Click the **File Format** option button and select **WKS, WK1, WK3,** or **XLS.**
3) Click on the **Selection** entry box and type the name of the file you wish to open, or select a file by highlighting its name in the **Files** list.
4) To select a different directory, double-click on the directory name in the **Directories** list. XESS then displays the names of files in that directory in the **Files** list.
5) Click **OK** to complete the operation and load the file.

To load only part of a WK*/XLS file, create a temporary workbook that contains only the desired data, and import the temporary workbook instead of the full original.

To load the data into an existing XESS workbook with other data, open both workbooks and then copy the desired data from one XESS workbook to the target workbook.

Importing Data from Other XESS Spreadsheets

Of course, an XESS spreadsheet can import data stored in XESS format, using either of two options:

- the **Import/Cells** operation, which imports data that has been stored in an intermediate file by a prior **Export/Cells** operation. This operation does not require that two workbooks be active.
- using the **Paste** operation, which transfers data between two active workbooks. The workbooks may be open in the same instance of Xess or in different instances of Xess, possibly running on different machines and using the same display.

Both methods transfer formats, fonts and formulas. For each method, XESS updates cell references as appropriate. However, if the exported range contained references to cells outside the range, it may have errors when imported into another spreadsheet.

Importing Data Using the Import Cells Operation

The Import/Cells operation imports an XESS-format file that was created with a prior Export/Cells operation. The default file extension for cells format is **.xc4**. For more information about exporting cells, see **Exporting Data in XESS Format,** later in this chapter.

To import data using the Import/Cells operation:

1) Select **Import...** from the **File** menu. XESS displays the **Import Data** dialog box similar to the one shown in Figure 10-2.
2) Click the **File Format** option button and select **Cells**.
3) Click on the **Selection** entry box and type the name of the file you wish to import, or select a file by highlighting its name in the **Files** list.
4) To select a different directory, double-click on the directory name in the **Directories** list. XESS then displays the names of files in that directory in the **Files** list.
5) Click **OK** to complete the Import operation.

Importing Data Using the Mouse Paste Operation

The Mouse Paste operation is a mouse action for which no menu selection is needed. The Paste operation is similar to the Copy Formulas operation. Cell values and formulas are copied from one location to another location, transferring all formatting except column width and row height, overwriting existing data in the destination location, and automatically updating cell references.

To paste formulas/values from one XESS workbook to another:

1) Make the source workbook active.
2) Select the cell or range to be copied.
3) Make the destination workbook active.
4) Move the mouse pointer to the destination cell or the upper left corner of the destination range.
5) Click the **mouse paste** button (usually the middle button).

You can also use the Mouse Paste operation to copy values from other windows displayed on your workstation. The applications associated with these windows need not be aware of XESS; they only need to support the X Windows standard for data

interchange. Similarly, XESS data can be selected and pasted into the windows of other applications.

Importing Data from Files

With the **Import/Text** operation, XESS lets you import columns of text or numbers from any text file into a designated range of cells in an active XESS sheet. XESS looks for patterns of **white space** running through the data file to determine where to divide the input values into cells. The parameters used in this determination are controlled by **Import/Export Options** dialog. The default filename extension for importing text is **.txt**.

. . . . . .

Note: You can also paste text into an XESS workbook from other programs with a simple mouse operation. For more information, refer to ***Manipulating a Spreadsheet.***

. . . . . .

During the Import/Text operation, XESS tries to convert values to numbers. If a value cannot be converted to a valid numeric value, XESS converts it to a text value. The converted values are placed in the destination range starting at the current cell or at the top left cell of the selected range.

Setting Import/Export Options

XESS gives you additional control on importing, exporting, or pasting text into the spreadsheet using the **Import/Export Options** dialog window. These options determine how the contents of the text file is parsed and placed in cells.

To change import options:

1) Select **Import/Export Options...** from the Options menu to display the **Import/Export Options** dialog box as shown in Figure 10-1.

2) Select from the following options:

Use UNIX quote escape
Use the UNIX method of representing quote characters (**"**) within quoted strings by using the back-slash character (**\"**). Otherwise, use two quote characters to represent a single character in the string (**""**).

Treat leading 0s as text
Treat leading zeros as text characters.

Modify cell formats
Change the formats of the target cells to correspond to the data type of the value from the smart recognition.

Smart number recognition
Allows formatted numeric values to import as values with formatting (e.g. $123,456.78 or (1,234.56)).

Smart date recognition
Allows date values to import as values with formatting rather than strings (e.g. 1-Jan-2000).

Smart time recognition
Allows time values to import as values with formatting rather than strings (e.g. 7:00pm or 12:45).

Preserve formats for export
Preserves formatting of cells when exporting into delimited files.

User-defined Delimiter
Specifies the character used to separate successive fields when importing and exporting files with the **User Delimited** File Format.

Escape HTML tags
Escape HTML tags in the text values of cells so that they will be displayed as text by the browser. Otherwise treat the HTML tags as commands to be interpreted by the browser.

Write Graphs with Page
When exporting HTML, save graphs inserted on the sheet as image files and save links to these files in the HTML file. This makes the HTML be a snapshot of the sheet, including graphs.

One Word Per Column
When set, each word on a line is stored in successive cells in a row. When cleared, text files are separated into columns based on whitespace in the file. The amount of whitespace is determined by the following option.

Whitespace Threshold
This option allows you to indicate what percent of all lines must have a blank in the exact same location for that location to be recognized as a field delimiter on import. The extreme cases (0 and 100) have the following properties:

0 The import creates only one column; the entire text of a line goes into a cell.

100 In order for a column to be defined, a blank must be in the same relative position in every row.

Reset to Defaults Restore default settings.

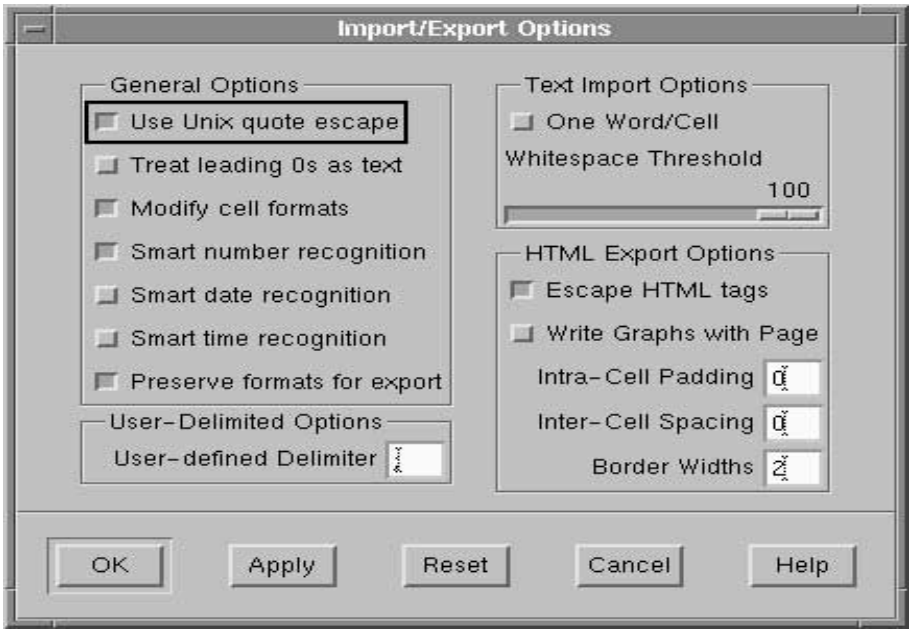

Figure 10-1 Import/Export Options Dialog Box

Importing Text Files

To import a text file into the spreadsheet:

1) Optionally, select the range of cells into which the numbers will be read. If you do not select a range, XESS imports the data starting at the current cell.

2) Select **Import...** from the **File** menu. XESS displays an **Import Data** dialog box similar to Figure 10-2.

3) Click the **File Format** option button to select **Text**.

4) Click on the **Selection** entry box and type the name of the spreadsheet you wish to import, or select a spreadsheet by highlighting its name in the **Files** list. XESS imports the text file, modifying just the cells affected by the import.

5) To select a different directory, double-click on the directory name in the **Directories** list. XESS then displays the names of files in that directory in the **Files** list.

6) Click **OK** to complete the Import operation.

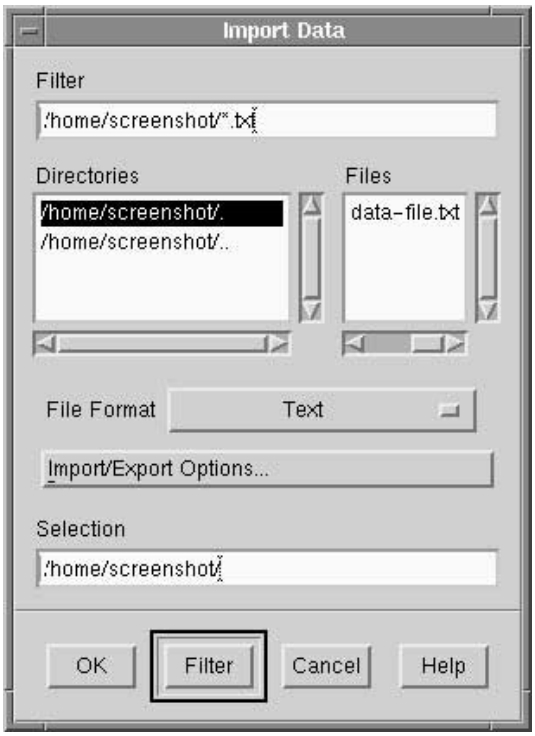

Figure 10-2 Import Data Dialog Box

Importing delimited text and HTML files

The **Tab Separated Values** (TSV)**, Comma Separated Values** (CSV), and **User Delimited** (UD) Import operations allow you to load text files with values separated by tabs, commas, or a user-specified delimiting character.

For **Import/TSV**, tabs contained in the records being imported are used as the **only** delimiters and the text is formatted appropriately inside the spreadsheet.

For **Import/CSV**, commas contained in the records being imported are used as the **only** delimiters and the text is formatted appropriately inside the spreadsheet.

For **Import/UD**, the user-specified delimiter character separates fields within the input records.

For **HyperText Markup Languate/HTML**, the structure of the HTML page and its tables determine which values are placed in which cells.

The default filename extension for TSV, CSV, UD, and HTML files are **.tsv**, **.csv**, **.dat**, and **.html** respectively.

To Import a TSV, CSV, UD, or HTML file into a spreadsheet:

1) Select **Import** from the **File** menu. XESS displays the **Import** dialog box similar to the one shown in Figure 10-2.
2) Select the appropriate File Format.
3) Click on the **Selection** entry box and type the name of the spreadsheet you wish to import, or select a spreadsheet by highlighting its name in the **Files** list.
4) Select a file in the same way you would select an XESS file: double-click on the file name, or click the name once and then click **OK**. XESS imports the file, beginning at the current cell cursor location. Each line or record in the input file is placed in a row in the sheet, beginning at the column of the current cell cursor.
5) To select a different directory, double-click on the directory name in the **Directories** list. XESS then displays the names of files in that directory in the **Files** list

Exporting Data from XESS to other Programs

XESS provides several options for exporting data from XESS to be used by other applications:

- You can save data (formulas and values) in WKS, WK1, WK3, XLS Version 4, and XLS formats for use by spreadsheet programs that recognize these files types.
- You can export a range of cells from the spreadsheet to be later imported into another XESS spreadsheet. This operation has the same effect as cut-and-paste between XESS spreadsheets. It uses an intermediate file so it does not require both spreadsheets to be active simultaneously.
- You can paste data (formulas and values) in XESS format to other active XESS spreadsheets.
- You can export data (string and numeric values, but not formulas) in text format. There are three options available for exporting text. One is called TSV (tab separated values) format, where the cell values are separated by tabs. A second is called CSV (commas separated values) format, where the cell values are separated by commas. The third allows a user-defined delimitor (separator character). These options allow external software to process data accurately.

- You can export HTML tables which can be incorporated into other HTML documents or used standalone with any standard HTML browser.
- You can export data in LaTeX tabular format.

Saving Data in WK* and XLS Formats

The Save operation for WKS/WK1/WK3 and XLS files writes the entire spreadsheet to an intermediate file, along with its default characteristics such as column width and cell format. For example, when columns are set to a width other than the sheet default, XEss writes a record to allow the other spreadsheet to set the new width.

Because there are differences between spreadsheet programs, you may have to modify certain formulas or cells to get the spreadsheet to work properly in the other spreadsheet. Here are some principal differences:

- Some spreadsheets do not recognize font characteristics such as bold, italic or bold-italic fonts, so these font formats are lost during the Export.
- XEss stores all internal values as double-precision floating point numbers. No integer values are exported.
- Other spreadsheets will not recognize functions that are unique to XEss, such as the conditional functions.
- XEss does not export empty cells that have not been assigned a format. These cells will assume the default format in the other spreadsheet.
- Many other spreadsheets prohibit text from extending beyond the left margin of a cell, which commonly happens with long right-aligned or centered strings. The strings and alignment will be transferred correctly but may be displayed differently in the other spreadsheet.

To save an XEss spreadsheet in WK* or XLS format:

1) Select **Save As...** from the **File** menu. XEss displays the **Save Sheet** dialog box as shown in Figure 3-2.
2) Select **WKS/WK1/WK3/XLS** for the File Format.
3) In the **Selection** entry box, enter a name for the output file.
4) Click **OK** or press **[Enter]**. XEss creates a spreadsheet file in the specified format. You can import this file into another spreadsheet program in a separate operation.

Remember that XESS exports the entire spreadsheet during the export operation.

To export only part of a spreadsheet, create a temporary spreadsheet that contains only the desired data, and export this file instead of the full original.

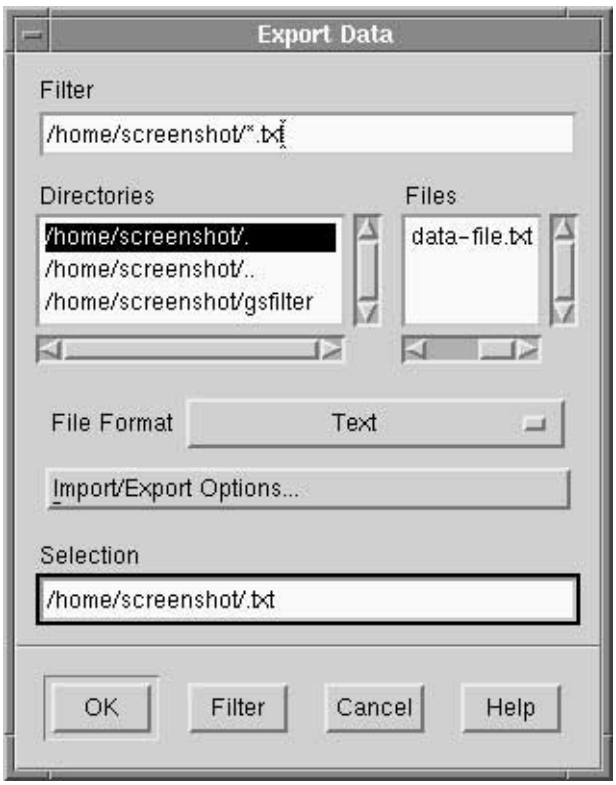

Figure 10-3 Export Data Dialog Box

Exporting Data in XESS Format

Of course, an XESS spreadsheet can export data (formulas and values) stored in XESS format, using either of two options:

- using the **Export/Cells** operation, which exports a range of data or the entire spreadsheet to an intermediate file. The file may be later imported to another spreadsheet using the **Import/Cells** operation.

- using the Paste operation, which transfers a selected range of data between two active spreadsheets.

Both methods transfer formats, fonts and formulas. For both methods, XEss updates cell references as appropriate. However, if the exported range contained references to cells outside the range, it will create error messages when imported into another spreadsheet.

Exporting Data using the Export Cells Operation

The Export/Cells operation creates an export file of the data in a selected range. This file (with the extension **.xc4**) can be imported into another XEss spreadsheet using the Import/Cells operation described earlier in this chapter.

To export data using the Export/Cells operation:

1) Select **Export** from the **File** menu. XEss displays the **Export Data** dialog box as shown in Figure 10-3.
2) Select **Cells** for the File Format.
3) In the **Selection** entry box, enter a name for the export file.
4) Click **OK** or press **[Enter]**. XEss creates the export file in the specified format. You can import this file into another spreadsheet program in a separate operation.

You can also export XEss formulas and values to another active spreadsheet using the Paste operation, which involves only a few simple mouse actions. For more information about pasting data, see ***Importing Data using the Paste Operation,*** *earlier in this chapter.*

Exporting Data in Text Format

With the **Export/Text** operation, XEss lets you export cell values in a selected range in text format with either tabs separating values (**TSV**) , with commas separating values (**CSV**), or a user-defined character separating values.

You can also paste text into an XEss spreadsheet from other programs with a simple mouse operation. See the section **Manipulating the Spreadsheet**.

To export XEss data in text format:

1) Select **Export** from the **File** menu and display its submenu. XEss displays the **Export Data** dialog box as shown in Figure 10-3.

2) Select the File Format and Options.

3) In the **Selection** entry box, enter the name for the file.

4) Click **OK** or press **[Enter]**. XESS creates the export file in the specified format. You can import this file into another spreadsheet program in a separate operation. Click **Cancel** to cancel the operation.

XESS exports the selected data to an intermediate text file. You can import the text file into another program later with a separate operation.

Exporting HTML Tables

XESS can create tables in the format of HyperText Markup Language (HTML). These tables can be accessed directly by web browsers and other similar tools or merged into other HTML documents.

XESS will create an HTML document which includes a table element comprised of the cells from the selected range. To ensure that the HTML table elements approximate their order in the spreadsheet, empty cells are treated as empty data elements in the table. Note also that if a cell element overflows into an adjacent cell, it is necessary to include the root cell into the range selected.

To create an HTML table:

1) Select the cells from the spreadsheet you wish have in the HTML table.

2) Select **Export** from the **File** menu to display the Export Data dialog box.

3) Click on the File Format list box and select **H**yper**T**ext **M**arkup **L**anguage.

4) Specify the file name to be used and click OK to complete the operation.

5) If you wish to view the file immediately using a web browser such as Netscape, select **Open File...** from the browser's File menu and specify the name of the file created in step 4.

You may include HTML elements directly into spreadsheet cells. These elements will be passed through, as text, to the HTML file and ultimately processed by the browser. For example, a cell could contain the anchor element, <A ...>, which anchors some text to a hypertext link, or <CAPTION> which can be used to label the

table of data. Users can also create a table of links which then point to different table documents.

You may edit the HTML file and enter a title, through the <TITLE>...</TITLE> tags within the <HEADER> elements using the text editor of choice. Also, you may delete the <HTML>, <HEAD> and <BODY> tags if you wish to include the table into another HTML document.

11

Printing the Spreadsheet

This chapter explains how to route your XESS spreadsheet to a printer, third-party product, or to a file in one of the following formats:

- **PostScript** format, suitable for any application or printer that accepts encapsulated PostScript files. Filters convert PostScript output for printers that use other formats such as PCL and for Print Preview
- **ASCII Text** format, widely compatible for most text editors and other applications, and suitable for even the simplest dot-matrix printers.

Printing in PostScript Format

The primary XESS print format is PostScript, which gives you the greatest number of options for controlling the appearance of the printed output. Many programs, such as document management programs, can incorporate encapsulated PostScript files. However, not all printers can support PostScript formatting options such as fonts and page orientation; check the manual for your printer to determine its capabilities for handling fonts, proportional spacing and other PostScript extras.

Most parameters for PostScript printing are defined with the **Page Options** dialog box. Other appearance attributes are defined in **Workbook Defaults, Sheet Attributes**, **Cell Defaults**, **Headers and Footers** and in individual cell **Formats.**

PostScript Fonts and XESS

PostScript Fonts are used by XESS to define the appearance of the workbook in printed output. These fonts are defined by three font characteristics: family, style, and size. These correspond to those used for displaying cells on the display.

Font Family

XESS lets you choose a Font Family for Cell Defaults and allows you to override the default on a cell-by-cell basis. The most popular font families are supported.

Font Style

Font style is typically defined as normal, **bold**, *italic*, or ***bold-italic.*** XESS lets you choose a Font Style for Cell Defaults and allows you to override the default on a cell-by-cell basis.

Font Size

Type size is entered in points, on a scale of 72 points per inch. As a guide, remember that standard typewriter Courier is 12-point type. Most type you read in newspapers and magazines is 9, 10, or 11 point type. XESS allows you to select from several font sizes.

Proportional Spacing

Typewriters typically used fixed-width spacing, that is, the I occupies the same amount of space as the M and W. The XESS PostScript fonts, except Courier, use proportional spacing. In order to correctly calculate line widths when each character occupies a different amount of space, XESS refers to the Adobe Font Metric files on your system.

Printing in ASCII Text Format

XESS can print in plain text ASCII format, a widely-compatible format that can be printed on simple printers, included as text in other documents or used by other programs. When printing in ASCII format, XESS makes no attempt to break the text into pages, maintain margins, or print bold and italic type. *Layout options specified in the Page Options dialog are ignored*. However you may specify horizontal and vertical pitch for the printed text from the Printer Options dialog box.

Defining the Appearance of the Output

What you see on the display is essentially what will be printed to a PostScript printer which supports color and/or fonts. XESS provides several mechanism to customize the appearance.

Using the **Page Options** dialog box, you can customize the page layout features such as:

- page size
- page margins
- column and row titles
- pagination

Using the **Cell Defaults** dialog box or the **Format** operation, you can define for each cell:

- font characteristics
- underlines
- color

Furthermore, whether or not the grid is printed and its color is defined in the **Workbook Defaults** and **Cell Attributes** dialog boxes.

This chapter focuses on page and printer characteristics. For a more detailed discussion of the spreadsheet contents, please refer to the chapter, ***Defining the Appearance of the Workbook.***

Changing Page Layout Options

XESS allows you to customize the page layout for PostScript output. The Page Options dialog box is provided to change a number of options which effect the page layout. Default start-up values for each option are defined in the XESS resource file and may be modified. For more details on changing the default start-up values, please refer to the topic in this chapter, **Modifying Start-up Defaults**.

To change Page Options:

1) Select **Page Options** from the **Options** menu or the **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Change any or all of the following

   a) Page Size
   b) Orientation
   c) Page Height and Page Width
   d) Margins (Top, Bottom, Left, Right)
   e) Fit to Page

f) Centering
g) Shrink/Expand
h) Row Titles
i) Column Titles
j) Expand Graph to Page (On/Off)
k) Page Header and Page Footer (On/Off)
l) Borders (On/Off)
m) Print Cell Notes

3) Apply your selection by clicking **OK** or **Apply**.

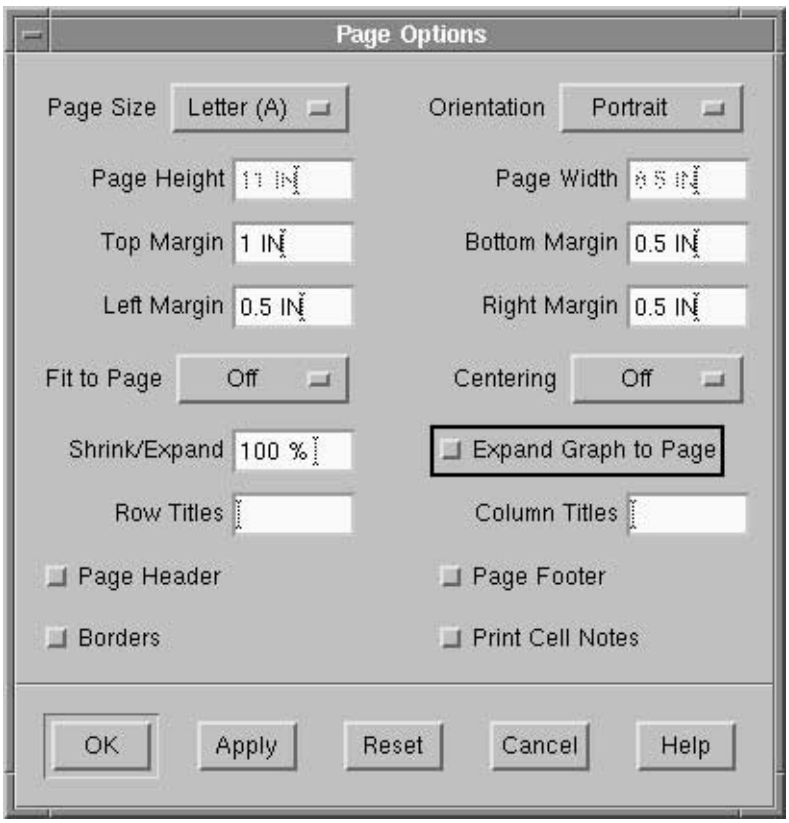

Figure 11-1 Page Options Dialog Box

Changing the Page Size

The **Page Size** option allows you to specify which page type to use. You may choose from a list of standard pre-defined page types or specify a custom size. The actual height and width associated with the selection is displayed in the **Page Height** and **Page Width** boxes.

If you select **Other**, then the **Page Height** and **Page Width** boxes become open for data entry. You may enter either in inches (IN) or centimeters (CM). Whichever is entered is converted automatically to your default setting.

To change the page size:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the left mouse button over the **Page Size** option button to display the options. Holding the left mouse button down move to the desired selection and release.

3) If you selected **Other** in the above step, enter the desired **Page Height** and **Page Width** the in the respective entry boxes.

4) Apply your selection by clicking **OK** or **Apply**.

Changing the Orientation

Orientation allows you to specify whether the output is rotated 90 degrees (**landscape**) or in normal **portrait** mode.

Orientation is independent of Page Size: this means when you select landscape and page size is set to Letter (A), the height and width dimensions are not switched when you change orientation from portrait to landscape—the printer simply knows to rotate the printed output.

To change the orientation:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the left mouse button over the **Orientation** option button to display the options. Holding the left mouse button down move to the desired selection and release.

3) Apply your selection by clicking **OK** or **Apply**.

Changing the Margins

Top Margin, Bottom Margin, Left Margin, and **Right Margin** allow you to specify how much white space there is on each of the four sides of each page printed. You may enter these specifications in units of either inches (IN) or centimeters (CM). However, if you enter in centimeters (CM), the number is automatically converted to inches.

To change the margins:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Enter the desired **top/bottom/left/right margin** specification(s) into the respective entry box(es).

3) Apply your selection by clicking **OK** or **Apply**.

Centering the Output on the Page

The **Centering** options allow you to specify whether centering is enabled, and if so, in what context. There are four choices:

Off	Disable option.
Horizontal	Center the page contents so that the left and right margins are equal.
Vertical	Center the page contents so that the top and bottom margins are equal.
Both	Center the page contents so that all four margins are equal

To center the page contents:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the left mouse button over the **Centering** option button to display the options. Holding the left mouse button down move to the desired selection and release.

3) Apply your selection by clicking **OK** or **Apply**.

Overriding Automatic Page Breaks

XESS provide two options which allow you to override the automatic page breaks which would otherwise be enforced.

Fit To Page

The **Fit-to-Page** options allow you to specify whether this option is enabled, and if so, forces the printed output to fit within the specified context. (The font size is ignored to reduce the character size as necessary to comply with the selected option.) There are four choices:

Off	Disable option.

Horizontal	Reduce the size of the selected print area to fit within the page width eliminating overflow.
Vertical	Reduce the size of a selected print area to fit within the page height eliminating page overflow.
Both	Reduce the size of the selected print area (width and height) to fit within the bounds of a single page.

To override the automatic page breaks:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the left mouse button over the **Fit to Page** option button to display the options. Holding the left mouse button down move to the desired selection and release.

3) Apply your selection by clicking **OK** or **Apply**.

Shrink/Expand

The **Shrink/Expand** option allows you to decrease or increase the size of the printed output - overriding the font size. The default is 100% which means that the option is not active. To reduce the size, change the percent to something less than 100%; to expand, change the percent to something more than 100%.

To shrink or expand the printed output:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Enter the desired adjustment factor into the **Shrink/Expand** entry box.

3) Apply your selection by clicking **OK** or **Apply**.

Setting Explicit Page Breaks

You may add and remove explicit **page breaks** (horizontal and vertical) within the body of the spreadsheet. The page breaks indicated in the sheet force a **new page** condition whenever XESS encounters the page break indicator during the **Print** operation.

To set a horizontal page break:

1) Position the cell cursor in the row which marks the first row on the page.

2) Select **Insert Page Break Row** from the **Edit** menu.

To set a vertical page break:

1) Position the cell cursor in the column which marks the first column of the page.

2) Select **Insert Page Break Column** from the Edit menu.

To remove a page break:

1) Position the cell cursor in the row below (**horizontal**) or in the column to the right (**vertical**) of the page break indicator.

2) Select **Delete Page Break *(Row or Column)*** from the **Edit** menu.

Expanding Graph to Page Size

The **Expand Graph to Page** allows you to force any graph printed from the Graph Editor to be expanded to fit the specified page size, complying with page and margin specifications.

To expand graph to page size:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the **Expand Graph to Page** check button ON to enable or OFF to disable.

3) Apply your selection by clicking **OK** or **Apply**.

Specifying Row and Column Titles

The **Row Titles** option allows you to specify repeating row labels to be used on a multi-page printout where the number of columns exceeds the page width.

The **Column Titles** option allows you to specify repeating column labels to be used on a multi-page printout where the number of rows exceeds the page length.

If you print only part of a spreadsheet, XEss only prints row and column titles for the selected range.

To print row and column titles:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Page Options** dialog box as shown in Figure 11-1.

2) Enter cell ranges for **Row Title** and/or **Column Title**.

3) Apply your selection by clicking **OK** or **Apply**.

Enabling Headers and Footers

The **Page Header** option allows you to specify whether or not an additional line is printed at the top of the page. By default, this line contains the sheet name, time, and date and is printed above the specified page boundary.

The **Page Footer** option allows you to specify whether or not an additional line is printed at the bottom of the page. By default, this line contains the page number and is printed below the specified page boundary.

The values for the headers and footers can be modified in the **Headers and Footers** dialog box.

To print headers and/or footers:

1) **Select Page Options from the Options menu** or **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the **Page Header** check button ON to enable or OFF to disable. Click the **Page Footer** check button ON to enable or OFF to disable.

3) Apply your selection by clicking **OK** or **Apply**.

Enabling Column and Row Borders

The **Borders** option allows you to specify whether or not the spreadsheet row and column border is printed along with the selected print area. If selected, it is printed on each page.

To print borders:

1) Select **Page Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Page Options** dialog box as shown in Figure 11-1.

2) Click the **Borders** check button ON to enable or OFF to disable.

3) Apply your selection by clicking **OK** or **Apply**.

Printing Cell Notes

To print the cell notes, check the **Print Cell Notes** option in the **Page Options** dialog.

Headers and Footers

You can specify user-defined Headers and Footers, text that appears on each printed page. There are the left, center, and right headers and the left, center, and right footers. These headers and footers are saved with an .xs5 file and take their initial values from resources or from the `xess_template.xs5` template file when you do a New workbook or when you load an .xs4 or .xs3 file.

You can specify the text, font family, font size, font style, and color of each of the headers and footers separately using the **Headers and Footers** dialog, accessed either either the Options menu or from the Print Dialog.

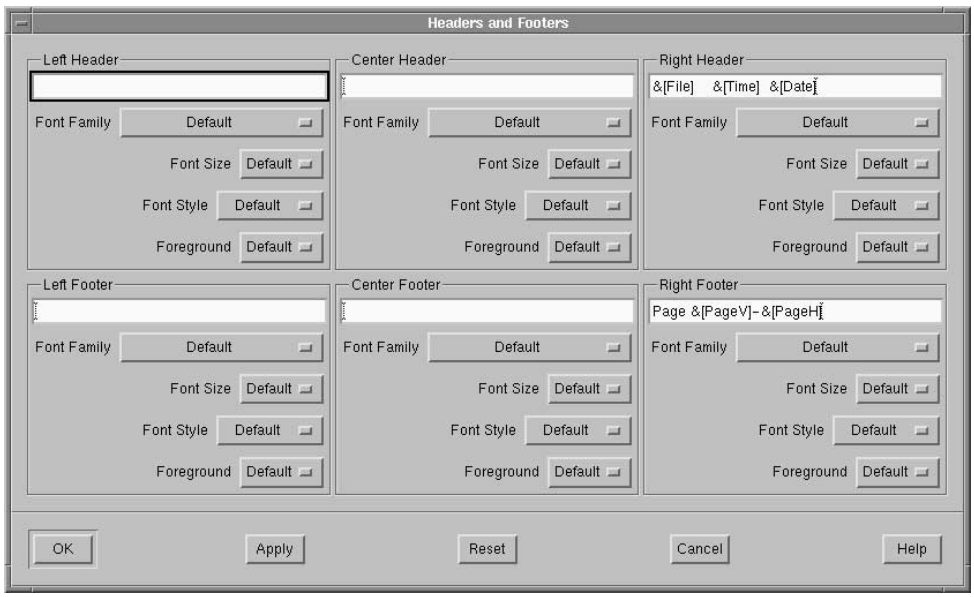

Figure 11-2 Headers and Footers Dialog Box

In the text string, special codes indicate where special values should be inserted into the prototype strings. These special values begin with the ampersand character (**&**) and are enclosed in square brackets (**[ ]**). Case is not significant for the []-enclosed escape codes. The optional date-spec, time-spec, and number-spec strings use the same picture formats as User Defined formats and the @TEXT function.

&[Cell=cell-spec] Insert the value from the given cell into the header/footer text. **cell-spec** can be either a specific cell or a single-cell named range. It can also be a cell on the current

worksheet that is being printed if you leave out the sheet specification. Example: `&[cell=A5]`

&[Date=date-spec] Insert the current date into the header/footer text. If "=date-spec" is omitted a default value will be used (`"dddd\, mmmm d\, yyyy"` which is the same as the date string in previous versions of Xess). Example: `&[date=dd-mmm-yyyy]`

&[File] Insert the current file name with its complete path into the header/footer text.

&[FileName] Insert the current file name with just the last part of the file name into the header/footer text.

&[Page=number-spec]
Insert the current page number as a running count of the pages printed. If "=number-spec" is omitted then the default value of "#0" will be used.

&[PageH=number-spec]
Insert the current horizontal page number into the header/footer text. If "=number-spec" is omitted then the default value of "#0" will be used.

&[Pages=number-spec]
This is recognized but not used.

&[PageV=number-spec]
Insert the current vertical page number into the header/footer text. If "=number-spec" is omitted then the default value of `"#0"` will be used.

&[Tab] Insert the current sheet tab name into the header/footer text.

&[Time=time-spec] Insert the current time of day into the header/footer text. If "=time-spec" is omitted then the default value of `"hh:mm:ss"` will be used instead. For example, `&[Time]`

&[User] Insert the current user name into the header/footer text.

Any HTML character entity for the Latin-1 character set is also recognized, such as `©` for inserting a Copyright symbol.

Defining Printers and Other Output Mechanisms

XESS provides a mechanism to define a number of output destinations. These definitions can be used to identify different printer locations, different print options, or third-party packages such as a PostScript previewer.

If you have selected Printer as your print destination in the Printer Options dialog box, you may choose from the list of printers shown in the Printer list box. When you select a printer, its associated print command is displayed in the Print Command display field which is the command XESS will use to complete the print operation. You can edit this command directly in the dialog for special needs.

To define multiple output destinations:

1) Edit the Xess resource file (e.g. Xess5) with an editor of choice. (You can use XESS if you prefer; import and export the resource file as text.)

2) Define the printers (or third-party product) using the *printers resource in the following format:

```
*printers:      Default:lpr %s\n\
                Name2:cmd2\n\
                Name3:cmd3\n\
                .
                Name32:cmd32
```

3) You may leave the modified resource file in your home directory or move it to the directory, /usr/lib/X11/app-defaults.

Other start-up resources related to printing and page layout are described at the end of this chapter in the section, ***Modifying Start-Up Defaults***.

Changing Printer Options

To print all or part of an XESS spreadsheet, you must ensure that the desired printer options are set. Although XESS defines default values for all printer options, you may want to change one or more of these options.

To change the printer options:

1) Select **Printer Options from th**e Options menu or the Print Sheet dialog box. XESS displays the **Printer Options** dialog box as shown in Figure 11-3.

2) Change any or all of the following:

   a) Printer Type
   b) Destination
   c) Horizontal Pitch
   d) Vertical Pitch
   e) Print Area
   f) Printers

3) Apply your selection by clicking **OK** or **Apply**.

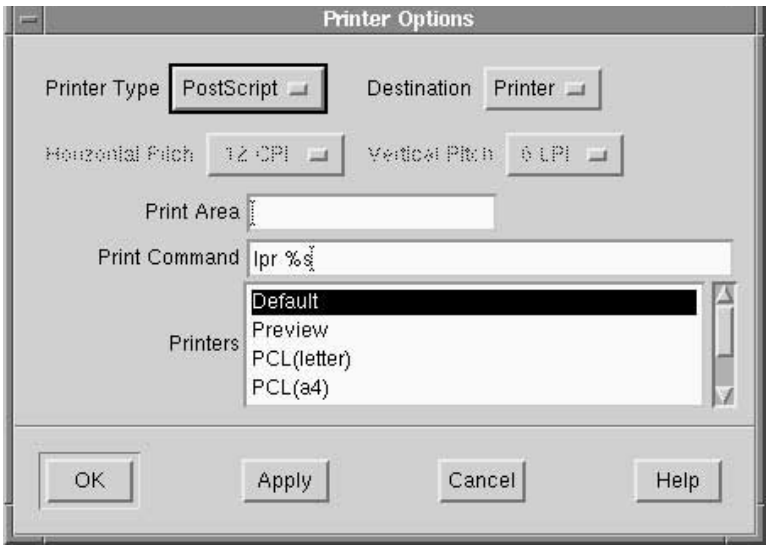

Figure 11-3 Printer Options Dialog Box

Selecting the Type of Output

The **Printer Type** option allows you to specify the format of the printed output. There are two choices:

PostScript	The printed output will be in standard PostScript format with all related options such as font and page characteristics enforced. Used with filters to other printer types and Preview.
Text	The printed output will be a basic ASCII text file.

To change the printer type:

1) Select **Printer Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Printer Options** dialog box as shown in Figure 11-3.

2) Click the left mouse button over the **Printer Type** option button to display the options. Holding the left mouse button down move to the desired selection and release.

3) Apply your selection by clicking **OK** or **Apply**.

Changing the Print Destination

The **Destination** option determines where the printed output will go. There are three choices:

Printer	The printed output will be directed to the current printer specification
File	The printed output will be directed to a file whose name is specified in the Print Sheet dialog box
Both	The printed output will be directed to both the current printer specification *and* a file

To change the print destination:

1) Select **Printer Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Printer Options** dialog box as shown in Figure 11-3.

2) Click the left mouse button over the **Destination** option button to display the options. Holding the left mouse button down move to the desired selection and release.

3) Apply your selection by clicking **OK** or **Apply**.

Changing Horizontal and Vertical Pitch for Text

These options are applicable only when Printer Type is set to Text.

The **Horizontal Pitch** option allows you to control the number of characters per inch (CPI) in the printed output. There are three choices:

- 10 CPI
- 12 CPI
- 16.5 CPI

The **Vertical Pitch** option allows you to control the number of lines per inch (LPI) in the printed output. There are three choices:

- 6 LPI
- 8 LPI
- 12 LPI

To change the horizontal or vertical pitch:

1) Select **Printer Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Printer Options** dialog box as shown in Figure 11-3.
2) Click the left mouse button over the **Horizontal** or **Vertical Pitch** option button to display the options. Holding the left mouse button down move to the desired selection and release.
3) Apply your selection by clicking **OK** or **Apply**.

What Gets Printed

XEss provides three methods for specifying what to print: **default print range**, **print range specification** (in the Printer Options dialog box), and **explicit mouse selection.** Explicit mouse selection takes precedence over the other two methods.

If you select a range whose cell entries overflow out of the selected range, XEss does not print the overflow portion.

When multiple pages are printed which are wider than the specified width of the page, the print order is left-to-right then down. If you select page footer to be printed, by default each physical segment is identified with the second page number qualifier (e.g. Page 1-0, Page 1-1, etc.)

Default Print Range

If a range was not explicitly selected and *no* Print Area is specified when you initiate the Print operation, XEss selects and prints the used portion of the spreadsheet.

Print Range Specification

The **Print Area** option allows you to specify a print range which is stored with the sheet. If you explicitly select an range to be printed in the sheet, this print range is ignored.

To specify or change the print range:

1) Select **Printer Options** from the **Options** menu or **Print Sheet** dialog box. XEss displays the **Printer Options** dialog box as shown in Figure 11-3.
2) Specify the range to print in the **Print Area** entry box.
3) Apply your selection by clicking **OK** or **Apply**.

Explicit Mouse Selection

Any cells which are explicitly selected when the Print operation is initiated will be printed, overriding any other method of specification.

Selecting a Printer

The **Printers** list box allows you to choose from a list of printer specifications which have been defined in the XESS resource file. When you choose a printer, the corresponding print command which will be used by XESS to complete the print function is displayed in the Print Command field. The selected print command can modified in the dialog for the current printing.

Instructions on defining these devices or print command variations to XESS are found in the section, **Defining Printers and Other Output Mechanisms**, in this chapter.

To select a different output destination:

1) Select **Printer Options** from the **Options** menu or **Print Sheet** dialog box. XESS displays the **Printer Options** dialog box as shown in Figure 11-3.
2) Select the printer specification of choice from the **Printers** selection box. (The command which the Print operation will use is displayed in the Print Command field. The command cannot be changed from this menu.)
3) Apply your selection by clicking **OK** or **Apply**.

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The current printer name is saved with the sheet. When the sheet is reloaded, the saved printer name will be compared to the list available. If there is a match the associated print command will be used. If there is no match, XESS will select the first choice in the list which should be your default print command.

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Printing your Spreadsheet

Once you have decided how you want to print your spreadsheet and where to print to, you are ready to print.

To print a spreadsheet the first time:

1) Select **Print As** from the **File** menu which displays the **Print Sheet** dialog box (Figure 11-4).
2) Ensure that **Page Options** and **Printer Options** are set accordingly.

3) If you chose **Destination** to be **File** or **Both** in the Printer Options dialog box you must specify the file name in the Selection area of the **Print Sheet** dialog box as shown in Figure 11-4.

4) Click **OK** or press **[Enter]** to complete the print operation. Click **Cancel** to dismiss the dialog box.

For subsequent printing, you may simply select Print from the File menu. The current printer and page options will be used.

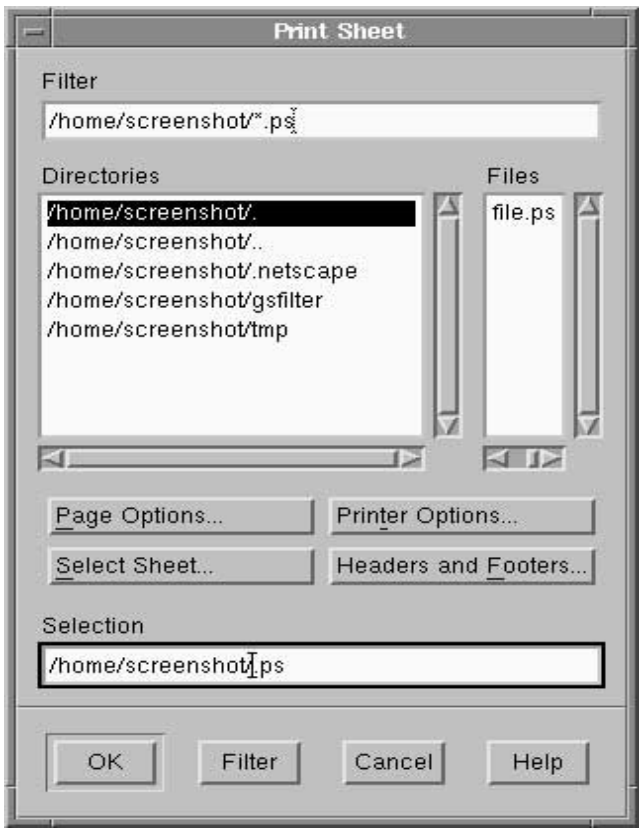

Figure 11-4 Print Sheet Dialog Box

Modifying Start-up Defaults

The XESS resource file contains default values for all options in both the Page Options and Printer Options dialog boxes. These values can be changed in the resource file to reflect user and or site preferences. When XESS is invoked it will reflect the new values in the resource file as the current settings in the corresponding dialog boxes. You may still elect to override the new defaults by changing the current setting in the dialog box.

Page Option Resources

The resources which refer to options in the Page Options dialog are defined in the appendix, ***XESS Resources.*** To modify the desired resources, follow the instructions outlined in that appendix for any of the Page Options resources.

Printer Options Resources

The resources which refer to options in the Printer Options dialog are defined in the appendix, ***XESS Resources.*** To modify the desired resources, follow the instructions outlined in that appendix for any of the Printer Options resources.

12

Graphs

This chapter explains how to create graphs and charts from the data in your XESS spreadsheets. It describes the various graph types and formatting options. A separate chapter provides a comprehensive graphing tutorial designed to step you through the graph making process with simple examples for all types of graphs.

XESS supports Line, Area, Bar, Stacked Bar, Histogram, Pie, Surface (3-D), Contour, Polar, High-Low, Box, and Control graphs. Variations of Line graphs include X-Y, scatter, and point plots. XESS also provides 3-D rotation of surface plots. XESS can display multiple graphs at the same time, either in separate windows or as cells in the sheet itself.

XESS offers considerable flexibility in defining how graphs and charts look. For instance, you can define how each axis should be scaled, labeled, and tick-marked. You can define whether or not legends, titles, and labels are printed, and, if so, in what font and color. You can choose your own line and marker styles, even shading variants for surface charts.

XESS stores the current graph definition with the workbook so you can change the data and redraw the graph, or change the graph definition to view different sets of data.

You can view graphs on screen while you continue to work on the workbook or save graphs as PostScript files to be printed later on a PostScript printer or included in other documents.

Creating a Graph

To create an XESS graph using menus:

1) Select a range of cells to be graphed. (If the selection is a single array, those values are assumed to be Y-values; X-values are automatically set to 1, 2, 3...)

2) Select **New Graph** from the **Graph** menu and display its submenu.

3) Select the desired graph type (Line Graph, Bar Graph, etc.) from the New Graph submenu.

To create a quick line or bar chart using the toolbar:

1) Select a range of cells to be graphed. (If the selection is a single array, those values are assumed to be Y-values; X-values are automatically set to 1, 2, 3...)

2) Click the graph icon on the **Toolbar** which may be displayed below the main menu.

The graph is drawn inside a separate Graph Edit window named **Untitled**. The appearance of the graph itself is determined by the selected options in the **New Graph Options** dialog box. You can name your graph as explained later in this chapter.

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Note: If you attempt to create a graph without selecting a range of data, XESS displays an empty graph window named "untitled" as shown in Figure 12-2 below. The menus inside the graph window can be used to select data ranges and an appropriate graph type can be generated. This approach may be necessary if you have non-contiguous data ranges.

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New Graph Options...

New Graph Options from the **Options** menu provides a mechanism for determining the default appearance of new graphs. This mechanism allows you to choose which graph attributes are automatically varied to produce a chart whose datasets are uniquely identified.

To set new graph options:

1) Select **New Graph Option** from the **Options** menu to display the New Graph Options dialog box as displayed in Figure 12-1.

2) Click the check button to enable or disable the specified graph attribute. When enabled, XESS will automatically

cycle through the supported values for the corresponding attribute, assigning a unique attribute value to each Y dataset.

3) Apply your selection by clicking **OK** or **Apply**.

Figure 12-1 New Graph Options Dialog Box

X-Y Data Organization

For 2-dimensional graphs, if you select a range and select a new graph type, if the range is taller than it is wide, XESS assumes by default that the X data values are in the left-most column, and the Y data values are in successive columns moving to the right. When the range is wider than it is tall, then the X data values are assumed by default to be in the upper-most row and each set of Y data values is assumed to occupy the successively lower rows.

This arrangement is not required. You can explicitly specify the X and Y ranges for each dataset in the graph. Pairs of X and Y ranges need to have the same number of cells. Each dataset can have a different number of data points.

X-Y-Z Data Organization

For 3-dimensional graphs, XESS by default assumes that the X data values are contained in the first row of the selected range, beginning in the second column of the selection. The Y data values are in the left-most column, beginning with the second row. The Z data varlues are assumed to be all the data to the right and below the X and Y coordinate row and column.

You can explicitly enter the X, Y, and Z data ranges in the **Data Set Options** dialog.

Redefining Graph Data Sets

Keep in mind that you do not have to use the range that you originally select. XESS allows you to easily change ranges using the **Data Set...** option of the Graph Edit menu discussed later in this chapter.

Graph Editor

Whenever you create a new graph or choose to modify an existing graph, XESS invokes its Graph Editor which is displayed in Figure 12-2. This window can be iconified independently of the main spreadsheet window.

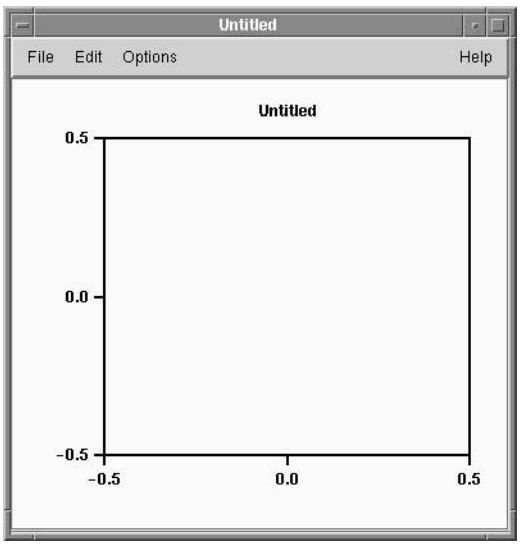

Figure 12-2 XESS Graph Edit Window

Each menu selection and associated dialog boxes are explained below.

File Menu

The File menu of the Graph Edit window consists of the following operations:

- Redraw
- Save
- Save As...
- Duplicate
- Export ...
- Delete
- Print
- Print As...
- Cancel

Redraw

The **Redraw** operation updates the current graph after you make changes to the data that affects the graph. XEss can also be made to automatically redraw the graph using the new values in the spreadsheet and after any graph parameters are applied. Please refer to the **General...** dialog on the **Options** menu, below.

Save

The **Save** operation of the **Graph Edit** window saves the changes to the current graph using the name that was already specified. If this graph is currently displayed in a **Graph View** window or has been placed in a cell on the main sheet, then these displays are updated to reflect the new graph parameters.

Save As...

The **Save As...** operation lets you save and name the graph you have created. Be sure to use descriptive names so you can tell your graphs apart. All XEss graphs are named **Untitled** by default.

To save a new graph:

1) Select **Save As...** from the graph window **File** menu. XEss displays a popup dialog box as shown in Figure 12-3.

2) Position the cursor inside the **Enter Graph Name** entry box and click the left mouse button to activate the text insertion cursor.

3) Enter an appropriate name for the graph.

4) Click **OK** or press **[Enter]** to name the graph and dismiss the dialog box.

5) Named graphs can be accessed by the other operations on the Graph menu of the main sheet. This allows graphs to be inserted in cells on the the sheet.

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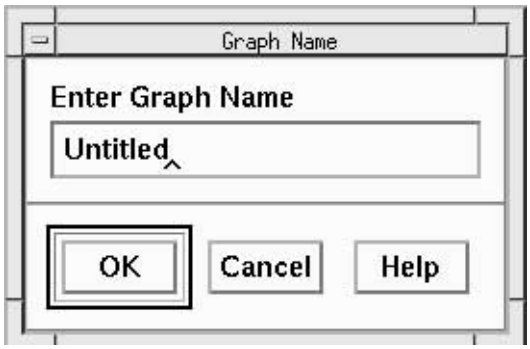

Figure 12-3 Graph Name Dialog Box

Once a desired number of graphs are created and saved, any one of them can be re-displayed by selecting the appropriate graph name from the options of the Graph menu of the main XESS window.

Duplicate

The **Duplicate** operation creates an identical copy of the current graph in a separate Graph Edit window. The current graph can be used as a template to create other graph types with the same or different data ranges. Use the **Save As...** operation as described above and assign descriptive names so you can tell them apart.

Export...

The **Export...** operation creates an image file of the graph. This file is in the selected image format (e.g. XPM, PNG).

Print

The **Print** operation enables you to output the graph in **PostScript** format to the current default file or printer. The options for this operation are controlled by the **Print As...** option.

Print As...

The **Print As...** operation lets you control various aspects of the printing of graphs from the Graph Edit window. It presents the **Print Graph** dialog which is equivalent to the **Print Sheet** dialog discussed in **Printing the Spreadsheet**.

Cancel

The **Cancel** operation dismisses the current Graph Edit window from the screen. You can redisplay this graph by selecting the appropriate graph option from the Graph menu from the main XESS window.

Edit Menu

The **Edit** menu of the Graph Edit window consists of the following operations:

- Data Sets...
- Rotate...

Data Sets...

The **Data Set Options** dialog box allows you to specify what ranges contain the data used in the graph and how you wish that data to be displayed. The Data Set Options dialog box includes the following sections:

- Data Set Selection
- Data Ranges
- Segment Type
- Line Type
- Marker types
- Fill Definition
- Shading
- Histogram
- Legends

To modify the Data Set Options for a graph:

1) Select **Data Sets...** from the graph window **Edit** menu. XEss displays the **Data Set Options** dialog box as shown in Figure 12-4.

2) The **Data Set** slider bar is used to specify which set of data on the graph you wish to modify. For example, each line on a line graph is a separate set of data. The **Disable** button excludes the current data set from the graph, but retains its definition.

3) The **Data Ranges** section contains nine entry boxes that allow you to specify the range of cells that contain the data to be plotted. If you create a graph from a selected block of cells, XEss automatically fills these entry boxes with the appropriate data ranges.

   a) In the **X Data** entry box, enter the range of cells, either a single column or a single row, containing the X coordinate of data points. For histograms this field is ignored.

   b) In the **Y Data** entry box, enter the range of cells , either a single column or a single row, containing the Y coordinate of data points.

For line or bar graphs, the number of Y data elements must match the number specified for the X Range.

c) In the **Z Range** entry box (which is used for a surface and contour plots) enter the range of cells, containing the Z coordinate of data points. This range must be a block whose dimensions must agree with the X and Y ranges in the following manner: the Z range should have the same number of columns as the X range and the same number of rows as the the Y range. The Z Range entry box is ignored for two-dimensional graphs.

d) The **Lo Data** and **Hi Data** entries specify the low and high Y values for graphs of financial trading data and the low and high extent for error bars.

e) The **Lo Var** and **Hi Var** entries are used for **Box** graphs and specify the low and high values for the bottoms and tops of boxes which are drawn around each current data point in a Box graph. The **Lo Var** entry is also used to specify the Y values for the variance plot in a **Control** graph.

f) The **Median** entry is used for Box graphs and specifies the Y values for the median values which are marked in a Box graph.

g) The **Annotation Data** entry box is used to specify annotations. Annotations are text that is dynamically displayed in the graph when the graph is drawn. To use them, you specify the coordinate in the graph where the text will be displayed. You can also indicate where the text will appear in relation to this coordinate. For example you could enter the following in cell B25:

(4,66,0.5,1.0)peak support time

XESS displays the text "peak support time" at position X=4 and Y=66 of the graph. This text is horizontally centered (0.5) and vertically above (1.0) position 4,66. Alignment of text in relation to the X,Y coordinate is specified in the following manner:

Horizontal Alignment

0 - default position
Positive values - left aligned
Negative values - right aligned
0.5 - centered

Vertical Alignment

0 - default position
Positive values - below point
Negative values - above point

The easiest way to enter annotations is with the @ANNOTATE function.

4) In the **Segment Type** entry, select whether points in this data set are connected by **Lines**, **Splines**, or **Bars**. Line segments connect the data points with straight lines; splines with smooth line segments (cubic splines); bars, with traditional bar charts. The **Histogram** indicator determines whether the actual data points are plotted directly or whether a plot is made of the frequency distribution of the data.

5) In the **Marker** area, select the style of marker to use to denote the data points. This option applies to Line, Scatter, high-low, and Polar graphs. XESS ignores this setting when creating other types of graphs. Select **None** to suppress displaying the actual data points. This produces a plot with just the line.

6) In the **Line Style** option, select the type of line to be used with this data set. Use **No Line** to produce X-Y or scatter plots of the data. The line types include solid ones and various combinations of dots and dashes.

   The **Line Width** option determines the thickness of the line used for this set of data. The **Line Color** option lets you select the color to be used when drawing the line and markers for this data.

7) The **Shading** option determines the representation of surface plots, contour plots, and bar charts.

   None applies no shading to the Graph. **Directed Light** applies shading that gives the appearance that the surface is lit from a single light source. **Light Source** indicates the location of the light source illuminating surface graphs. It is given as x,y,z values and defaults to 0, -1,1.

   Z Height shades the surface based on the values of the Z data, where minimum values are purple and maximum values are red. The height of each surface section is defined as the average of the Z values of its vertices.

8) The **Fill Style**, **Fill Color**, and **Fill Background Color** options determine the type of shading and pattern, if any, that is drawn between the line and the X axis. These also determine the color of the bars in a bar chart.

9) In the **Legend Text** entry box, type in a label for the data plotted with the line. If **Legends** is selected in the Graph Options dialog, then the Legend Text will appear to the right of the graph legend for this data set.

   Options are provided for setting the font, size, style and color of the legend text. In addition, the legend can be forced to multiple lines by embedding the new line indicator (\n) wherever you want to breakup the line.

10) Click **OK** to confirm your choices, dismiss the dialog box, and redraw the graph. Click **Apply** to confirm your choices, keep the dialog box open, and redraw the graph. Click **Cancel** to dismiss the dialog box.

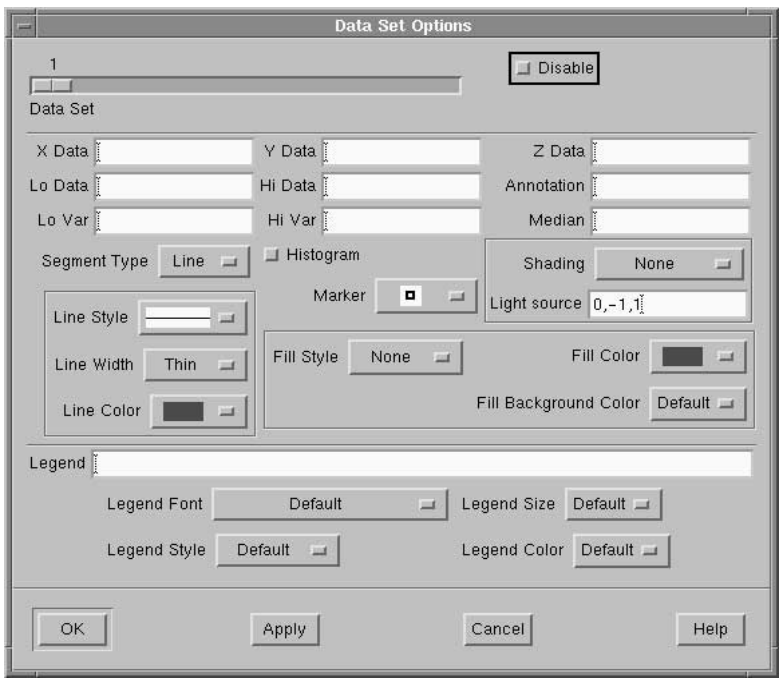

Figure 12-4 Data Set Options Dialog Box

Rotate...

The **Rotate...** option allows you to rotate surface graphs. When you draw other graph types, this button remains "greyed-out" or disabled. The Rotate Surface dialog box contains a simplified view of the surface graph axes.

To Rotate the Graph:

1) Select **Rotate...** from the graph window **Edit** menu. XESS displays the **Rotate Surface** dialog box as shown in Figure 12-5.

2) Position the mouse pointer anywhere in the box. Holding down the left mouse button, drag the mouse in the direction of desired rotation.

3) Release the mouse button when the desired rotation is achieved.

4) Click **OK** to redraw the rotated graph and dismiss the dialog box. Click **Apply** to redraw the rotated graph and keep the dialog box open. Click **Cancel** to cancel the operation.

OR

1) Enter the view angle directly into the **Theta** and **Phi** entry boxes.

Theta	The angle at which the surface rotates around the Z-Axis. Ranges from 0 to 89.
Phi	The angle at which you look down upon the surface. Ranges from 0 to -89.

2) Click **OK** to redraw the rotated graph and dismiss the dialog box. Click **Apply** to redraw the rotated graph and keep the dialog box open. Click **Cancel** to dismiss the dialog box.

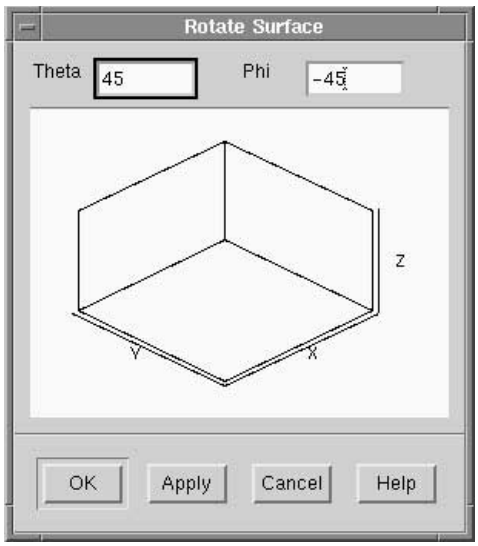

Figure 12-5 Rotate Surface Dialog Box

Options Menu

The **Options** menu of the graph window consists of the following options:

- General...
- X Axis...
- Y Axis...
- Aux. Y Axis...
- Z Axis...

General...

The **Graph Options** dialog box is used for changing the overall appearance and operation of the graph. The **Graph Options** dialog allows you to set:

- the graph type
- whether the graph redraws after recalculation
- whether to display legends
- whether to skew data series
- default font and colors for graph
- graph title text
- title display attributes

To set the Graph Options:

1) Select **General...** from the graph window **Options** menu. XESS displays the **Graph Options** dialog box as shown in Figure 12-6.

2) In the **Graph Type** area, click on the list box to choose the type of graph you wish to make. Keep in mind, that with the current data ranges selected, you may not be able to generate the desired graph type. XESS displays an appropriate error message if it is unable to create the desired graph type.

   Certain graph types can be combined by setting the graph type in the individual Data Set dialogs. For example, this allows you to mix scatter, line, and bar charts all on the same graph. Setting the type from the Graph Options dialog forces the type on all the contained data sets.

3) The **Redraw on Recalculation** setting controls whether this graph is automatically redrawn as the result of changes in the spreadsheet.

4) The **Defer Redraw** button controls whether changes made from the options of the Graph Edit window automatically cause the graph to redraw. This option is generally not needed. It should be used when making many changes to a very large graph on a relatively slow system. When the changes have been made, do an explicit Redraw of the graph.

5) Click on the check button labeled **Legend** to display a legend to the right of the graph. For line graphs, the legend displays the line and marker style for each data series along with the associated legend text. For bar graphs or histograms, the legend shows bar colors. For contour graphs, the legend shows colors and levels.

6) Click on the check button labeled **Skew Data** to improve the differentiation between data representation in Line, Scatter, High-Low, Box, and Control graphs when data points tend to obscure each other.

   In addition, the skewing option is also used to distinguish between Bar graphs and Stacked Bar graphs. For Stacked Bar graphs, skewing is ignored; for Bar graphs, skewing is always enforced. For both of these graphs, if the button setting is in conflict, an error dialog box pops up when the graph is drawn. To eliminate the error message popup, ensure that the Skew Data button is *off* for Stacked Bar graphs and *on* for Bar graphs.

7) The **Default Area** defines the default colors and fonts to use with this graph.

8) In the **Graph Title** area type in the text title of your graph. You may enter one or more lines of text for the graph title. XESS displays the first line of the graph title centered above the graph; subsequent lines are left aligned with the first line. You can format the text using the following special characters.

   ^ Starting a line with the caret character will center the line with respect to the previous line. Otherwise normal left alignment is used.

   { The left brace character begins a block of text.

   } The right brace character ends a block of text. Text blocks may contain other text blocks. Text blocks are typically used when multiple characters must be superscripted or subscripted.

   _ The underscore causes the next character or text block to be subscripted with respect to the preceding character.

   ^ Inside a line, the caret causes the next character or text block to be superscripted with respect to the preceding character.

   \ The backslash turns off the special properties of the following character so it can be printed out. The string \\ prints a single backslash.

9) The **Title Font** area lets you set set the font family, style, size, and color for the Graph Title.

10) Click **OK** to confirm your choices, dismiss the dialog box, and redraw the graph. Click **Apply** to confirm your choice,

keep the dialog box open, and redraw the graph. Click **Cancel** to dismiss the dialog box.

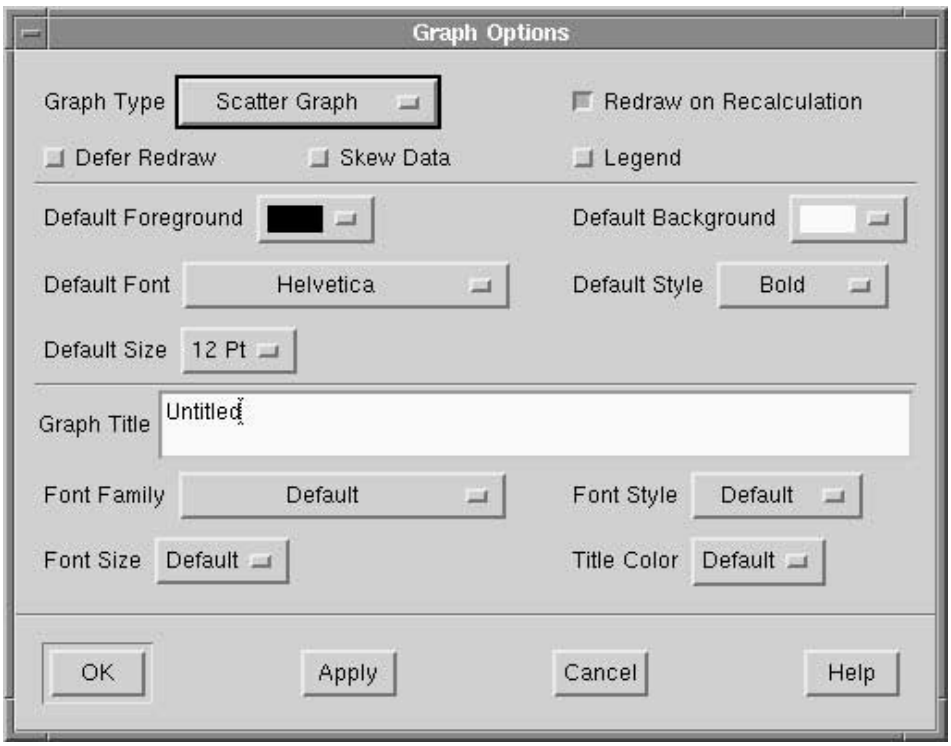

Figure 12-6 Graph Options Dialog Box

X Axis..., Y Axis..., Aux. Y Axis..., and Z Axis...

These dialog boxes are used to change the appearance of the respective axes to be displayed. Note that the Aux. Y Axis is used in Control graphs where two sets of Y data are plotted against the same X data.

To change Axis characteristics:

1) Select the appropriate axis (e.g. **X Axis...)** from the graph window Options menu. XESS displays the **Axis Options** dialog box as shown in Figure 12-7.

2) Click on the check button labeled **Auto Scale** if you want XESS to automatically define axis scaling, based on its evaluation of the data to be plotted. By default Auto Scale is

on. Click this button off to use the scale in the **Min** and **Max** entry boxes.

3) In the **Min** and **Max** areas, enter a low and high value for the axis values. The axis will be scaled to include these values, but with logical start and end points. If axes are formatted as date or time, you must enter the unformatted numeric values for Min and Min - instead of the formatted time or date representation. XESS ignores the maximum and minimum values entered here if **Auto Scale** is enabled.

4) Click on the check button labeled **Auto Ticks** if you want XESS to select the number of tick marks for the axis. By default, Auto Ticks is on.

5) In the **Major** and **Minor** areas, enter the number of tick marks to be placed on the given axis. XESS ignores this number if **Auto Ticks** is enabled. The axis will have the specified number of major ticks with corresponding labels and the specified number of minor ticks between pairs of major ticks.

6) Click on the check button labeled **Log Scale** if you want to plot the current set of data on a logarithmic scale, checking for data values less than or equal to zero. Leave this button off if you want XESS to plot data on a linear scale.

7) Set the **Ticks Out** button to cause tick marks to point away from the body of the graph. Otherwise, tick marks will point inward towards the graph itself.

8) Select **Exploded Axis** to have the axis and tick marks displayed slightly away from the graph area itself.

9) Set the **Axis Color** if you wish it to be a different color than the default foreground color for this graph.

10) Click on the **Grid Lines** button to display grid lines for this axis. These are drawn from each tick mark on the axis across the entire extent of the other axes. A cross-hatched grid can be drawn by activating this option for both the X and the Y axes. The color of this grid is controlled by the **Grid Color** selection. It defaults to the foreground color for this graph.

11) In the **Axis Label** area type in the text for the axis label. XESS centers the label along the axis, outside the graph area. Multiple lines of text may be entered. You can format the text using the following special characters.

^ Starting a line with a caret character will center the line with respect to the previous line. Otherwise normal left alignment is used.

{ The left brace character begins a block of text.

} The right brace character ends a block of text. Text blocks may contain other text blocks. Text blocks are typically used when multiple characters must be superscripted or subscripted.

_ The underscore causes the next character or text block to be subscripted with respect to the preceding character.

^ Inside a line, a caret character causes the next character or text block to be superscripted with respect to the preceding character.

\ The backslash turns off the special properties of the following character so it can be printed out. In addition, The string \\ prints a single backslash.

12) Select the font family, style, size, and color for the Axis Label using the list boxes provided.

13) Use the **Tick Style** section to define the font family, style, size, and color for the tick marks and tick labels.

14) Click **OK** to confirm your choices, dismiss the dialog box, and redraw the graph. Click **Apply** to confirm your choices, keep the dialog box open, and redraw the graph. Click **Cancel** to dismiss the dialog box.

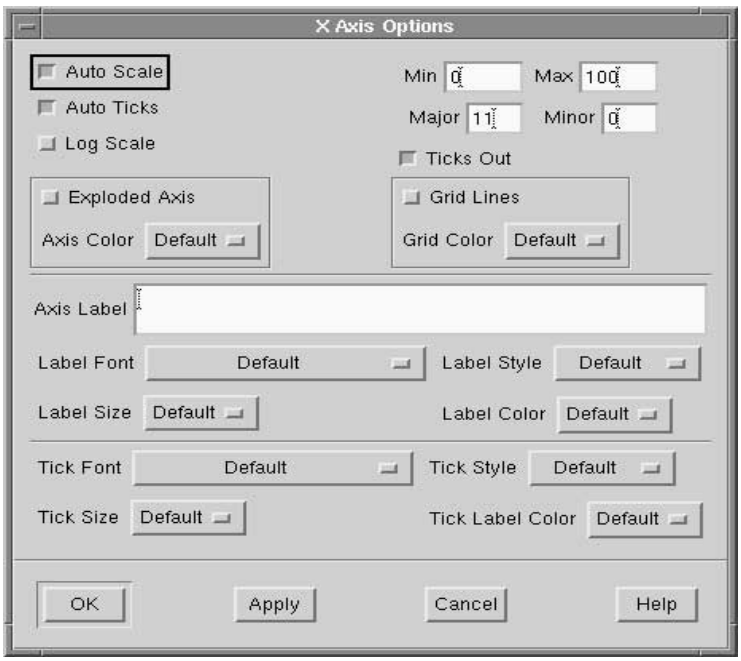

Figure 12-7 X Axis Options Dialog Box

*You may change initial default values associated with all of the graph dialog boxes. Refer to Appendix B, **XESS Resources,** for a complete list of graph resource definitions and accepted values.*

Using Existing Graphs

In addition to creating new graphs, the **Graph** menu contains several options for managing and using graphs. These include facilities to:

- Modify an existing graph
- View a graph without modification
- Place a graph on the worksheet itself
- Delete a graph

Modifying a Graph

To modify an existing graph:

1) Select **Edit Graph...** from the **Graph** menu and display the **Choose Graph** dialog box.

2) Select the desired graph form the listed graph items and click **OK**.

3) The Graph Edit window is displayed. All the options described under **Graph Editor** can be used now.

If the graph is stored on a sheet, you can double-click the graph to start the Graph Editor.

Viewing a Graph

You may often want to display graphs you have defined without needing to change the graph design. The Graph View window provides this facility in an efficient implementation with a limited number of options. Graph View requires less memory and fewer resources than does Graph Edit, but it does not have the same flexibility.

To view an existing graph:

1) Select **View Graph...** from the **Graph** menu and display the **Choose Graph** dialog box.

2) Select the desired graph form the listed graph items and click **OK**.

3) The Graph View window is displayed with the graph already drawn. If so specified, the graph will begin updating on recalculation.

4) Options available on the Graph View window are **Cancel**, **Redraw**, **Print**, and **Help**. **Print** uses the current settings for the print options.

5) Click **Cancel** to dismiss the Graph View window.

Placing a Graph in the Sheet

XESS lets you place graphs in the sheet itself. This is done by inserting the graph into an anchor cell in the sheet using the **Insert in Sheet...** option of the **Graph** menu. The graph will be inserted into the sheet with the upper left corner occupying the cell where the cursor is positioned. This cell will now contain the graph. It can be moved, copied, and deleted like other cells. Just remember that, like text that overflows into adjacent blank cells,

the graph is only in the upper left cell and overflows into adjoining cells for display.

To insert a graph into the sheet:

1) Define the graph and save it using the Graph Edit window.
2) Select **Insert in Sheet...** from the **Graph** menu on the sheet.
3) Position the cursor to the cell on the sheet where you want the graph.
4) Select the desired graph from the **Choose Graph** dialog box and click **OK**. The graph will be displayed in the sheet.

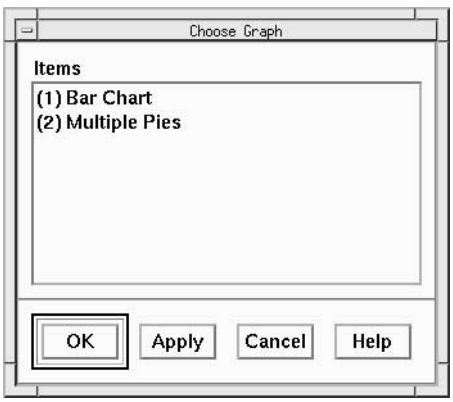

Figure 12-8 Choose Graph DIalog Box

It is likely that the graph is not the correct size to be displayed in the sheet. To adjust this size, edit the desired graph in a Graph Edit window. Resize the Graph Edit window as desired and then save the graph again. The graph in the sheet will adjust to the new size. Repeat this action until the desired size is obtained.

. . . . . .

Once you insert a graph in the sheet, any subsequent edit/save activity which results in changing the size of the graph may cause undesired changes to the spreadsheet layout. To ensure that the embedded graph size does not change unintentionally, click the expand button on the window frame to enlarge the graph edit window for editing, then click the shrink button to reinstate the original size. Then save the graph.

. . . . . .

Deleting a Graph

To delete an existing graph:

1) Select **Delete Graph...** from the **Graph** menu and display the **Choose Graph** dialog box.

2) Select the desired graph form the listed graph items and click **OK**.

Types of Graphs

XESS supports a variety of graph and chart types:

- Line and Scatter (including X-Y and point plots)
- Area
- Bar
- Stacked Bar
- Pie
- Surface
- Contour
- Polar
- Histogram
- High-Low
- Box
- Control

This section illustrates the graph types. Because of the large number of options that effect how a graph looks, it is impossible to show all the combinations and variations.

Line and Scatter Graphs

Line and scatter graphs are used to plot various types of X-Y data. In its simplest form, a line graph is nothing more than a set of data points on an X-Y grid, possibly connected by line segments.

Figure 12-9 illustrates a more-complicated line graph which shows a set of observed data values and a second set of data which shows a function fitted to this data. The raw data points are defined as the first data set with the **Line Style/None** connecting the points, producing an X-Y plot. The fitted curve is specified as Data Set 2 and has **Marker/None** and **Line Style/Solid** selected. All the scaling and tick marks were generated automatically.

On a color display, each line typically appears in a different color. You can also specify what type line connects the points (e.g. dotted, dashed, etc.). The **New Graph Options...** dialog on the Options menu of the main sheet controls how colors, line styles, and markers are initially defined for a new graph.

The data points to be graphed do not need to be spaced evenly on the X-axis. In fact, for scatter plots they do not even need to be in order. Line and spline segments will connect adjacent points in the value lists. You can also use the Skew Data button in the Graph Options dialog box to offset the data sets from each other. This helps in discriminating the data points of one data set from another.

A break in a line or spline segment is indicated by leaving an X-Y coordinate cell blank. This is usually done by inserting a blank line or column at the appropriate location.

The data for an X-axis or Y-axis can be either text or numeric. If the data are text, the text values become the labels for successive locations on the axis. A typical use is to show monthly values of some type in a trend.

If the cells in a range are formatted as dates or times, then the corresponding axis will be adjusted and displayed in appropriate units for the times and dates specified.

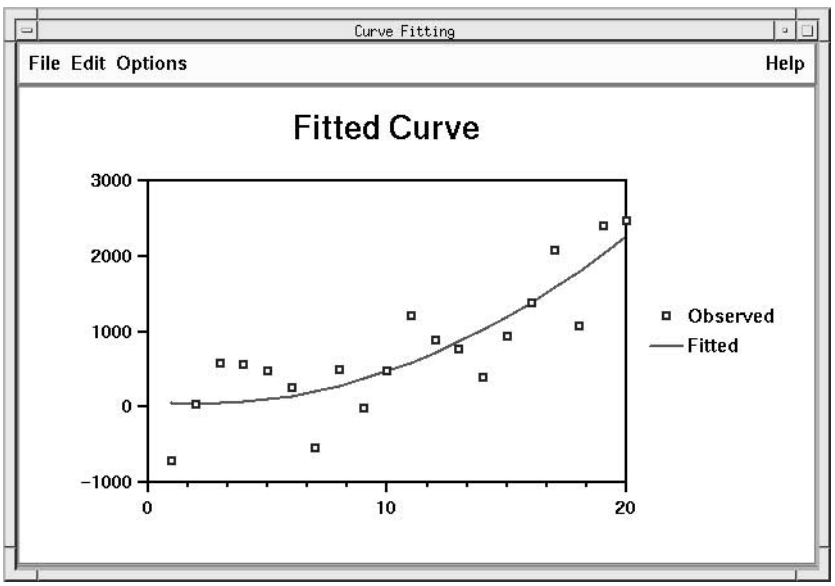

Figure 12-9 Line Graph of Observed Values and Fitted Curve

As is the case with all graphs, line plots can be printed as Encapsulated PostScript files. These files will print properly on either black and white or color systems.

Area Graphs

Area graphs are essentially the same as line graphs except that the Y values from each preceding data set are accumulated as each new Y data set is plotted. The resulting graph appears as a *stacked line graph* where the area below each line can be filled by a different color to distinguish each data set.

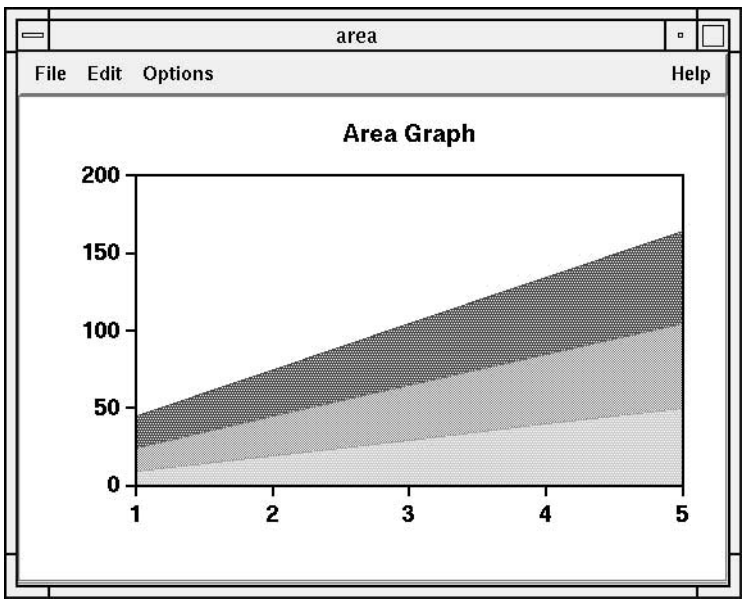

Figure 12-10Area Graph

Bar Graphs

Bar graphs plot data values much like a line graph except that a solid block is drawn between the Y value for the data and the X axis. The points associated with different sets of data are grouped/stacked side-by-side at their X-axis label to permit easy comparison between groups. Each set of data is represented by a different color or pattern. The skewing option is used to differentiate between Bar graphs and Stacked Bar graphs. For Bar graphs it is always enforced and thus the Skew Data button in the Graph Options menu should always be set *on*. If the Skew Data button is *off* for Bar graphs, an error message dialog pops up when the graph is drawn. To eliminate the message, simply click the Skew Data button *on*.

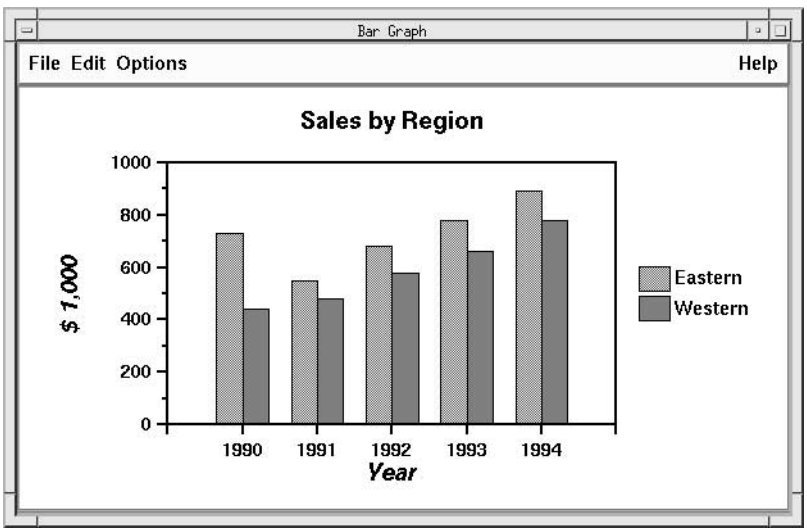

Figure 12-11Bar Graph

Stacked Bar Graph

Stacked Bar graphs are essentially the same as standard Bar graphs except that (like Area graphs) the Y values from each preceding data set are accumulated as each new Y data set is plotted. The resulting graph appears as bars stacked vertically rather than side-by-side. The bar segment for each data set can be filled by a different color to distinguish it from the ones above and below.

The skewing option is used to differentiate between Bar graphs and Stacked Bar graphs. For Stacked Bar graphs it is always ignored and thus the Skew Data button in the Graph Options menu should always be set *off*. If the Skew Data button is *on* for Stacked Bar graphs, an error message dialog pops up when the graph is drawn. To eliminate the message, simply click the Skew Data button *off*.

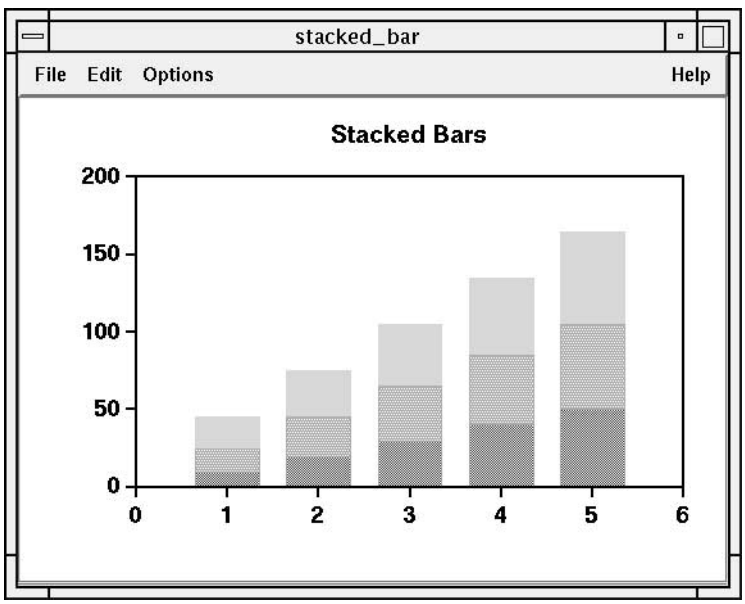

Figure 12-12 Stacked Bar Graph

Pie Charts

Pie charts show the percentage that each data item contributes to the sum of all the data items. The cells of the **X Range** specify the labels for the slices of the pie while those of the **Y Range** indicate the value of the item. The percentages are calculated automatically.

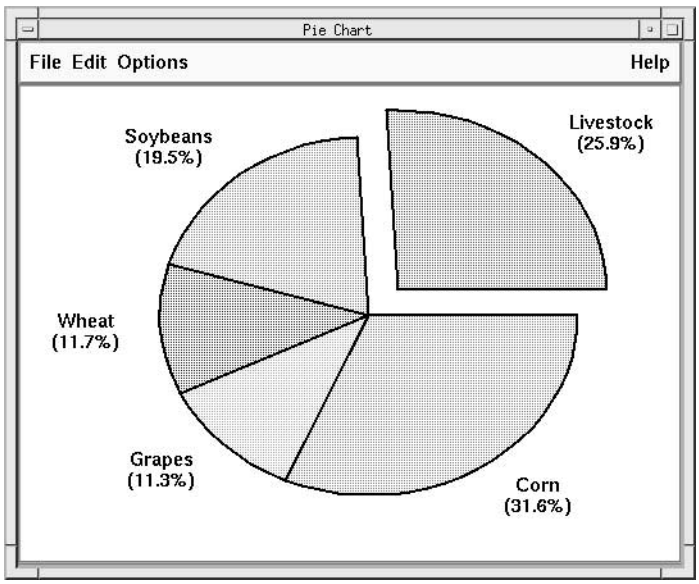

Figure 12-13 Pie Chart

Slices are removed (exploded) from the pie by placing a pair of blank cells before and after the affected cells.

Multiple data sets produce multiple pies in the same graph.

Surface Graphs

Surface graphs let you plot X-Y-Z data values and functions. On a surface plot, the X and Y values determine the reference coordinates for the Z values. XESS surface graphs are presented with perspective and shading. The shading can be either that of the surface when illuminated by light from a single point, or it can provide a color shading based on a Z value relative to the maximum and minimum Z values.

Surface graphs can be rotated using the **Rotate...** option of the Edit menu.

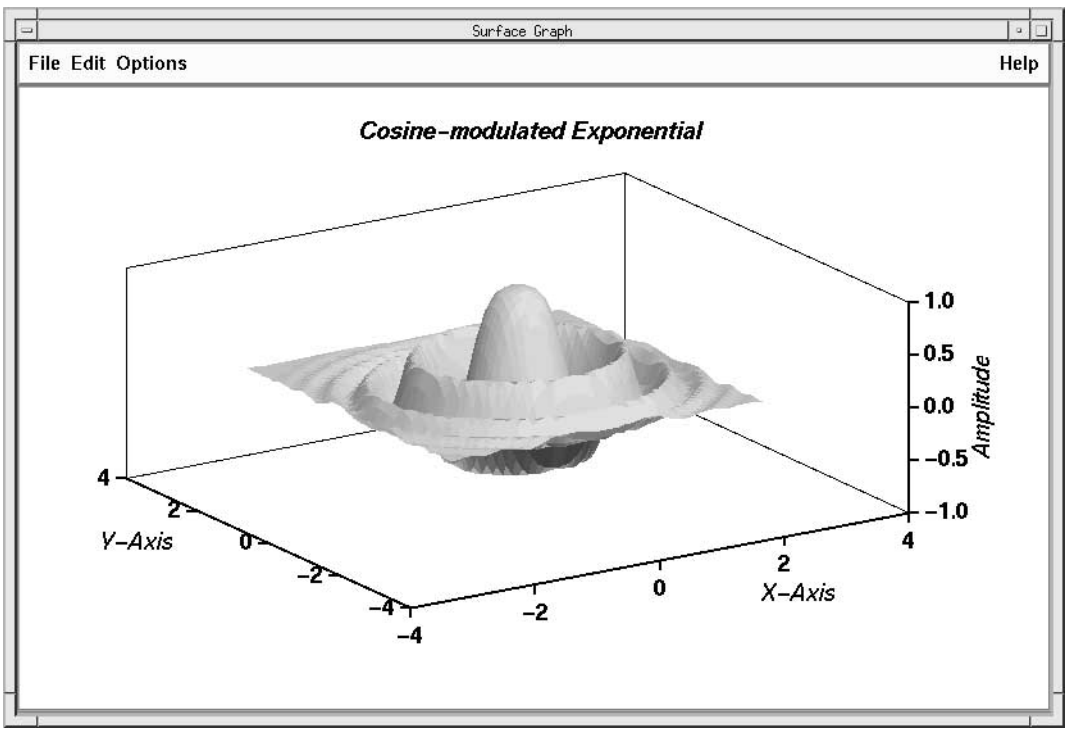

Figure 12-14 Surface Graph

Contour Graphs

A contour graph is a two-dimensional representation of a surface graph. This graph type is analogous to maps showing elevation. For example, you can change the Minimum and the Maximum scale for the X and the Y axis. You can also set exploded axis and outward ticks for the X and Y axes.

Just as you set the number of histogram bins, you can set the number of contour levels. This is done with the **Z-Axis Options** dialog box. Disable **Auto Ticks** and place the desired number of contour levels in the **Major** entry box.

You can also select the range over which the contours extend by first disabling **Auto Scale** and placing the desired range in the **Min** and **Max** entry box. You can also have logarithmically spaced contours by enabling **Log Scale** for the Z axis.

Outward Ticks, **Exploded Axis** and **Grid Lines** options have no effect on a contour graph.

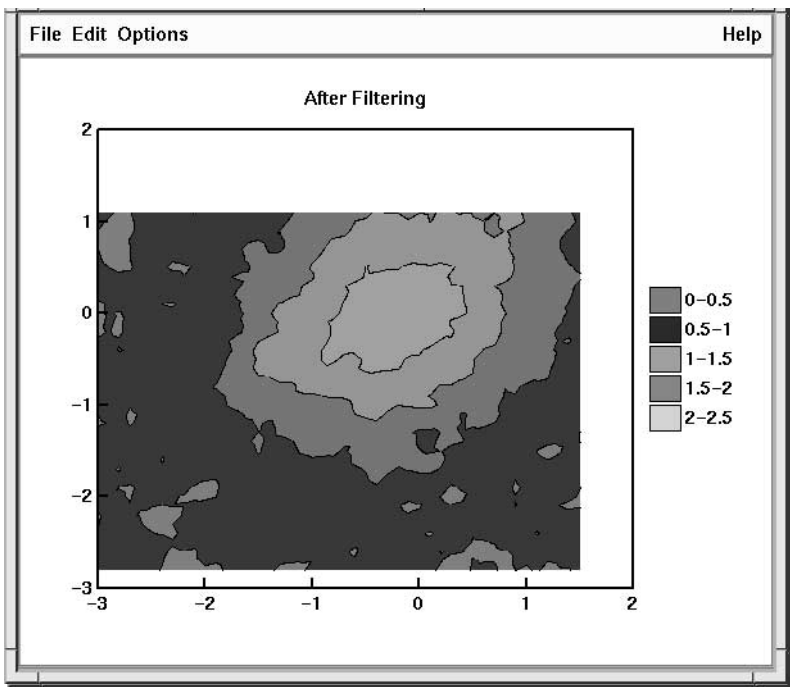

Figure 12-15 Contour Graph

Polar Graph

Polar Graphs provide graphs of a data with respect to a polar coordinate system rather than a Cartesian or rectangular coordinate system. A polar graph plots a point at some radial distance along a ray that creates a given angle with the positive X axis. For polar graphs, the angular measurement and radial components correspond to the X and Y coordinates in a line graph, respectively.

You can manipulate polar graphs just as you would line graphs, except you cannot display a label on the Y axis. If you annotate a polar graph, you must specify the annotation text in (X, Y) and not in (angle, radius) notation which is used for the data.

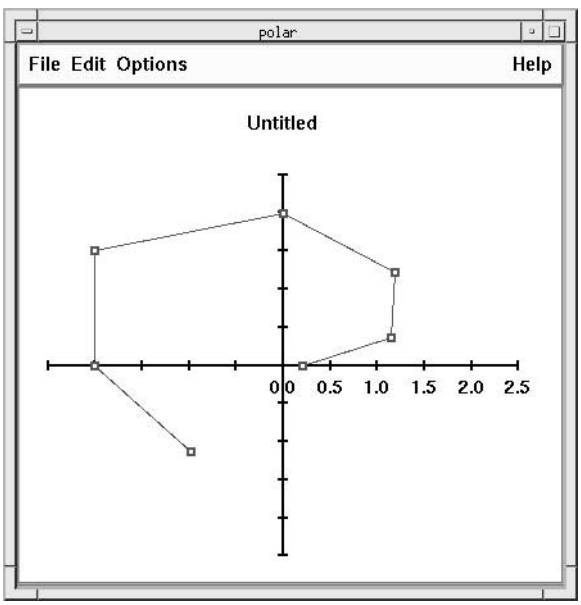

Figure 12-16 Polar Graph

Histograms

Histograms graph the distribution of a set of points. The range of the values specified by the **X Range** are divided in sub-ranges called bins. The count of the number of items within each sub-range is displayed. You indicate the number of bins by setting the number of tick marks for the X axis. You can also set the range of data using the **Max** and **Min** entry boxes in the X-Axis Options dialog box.

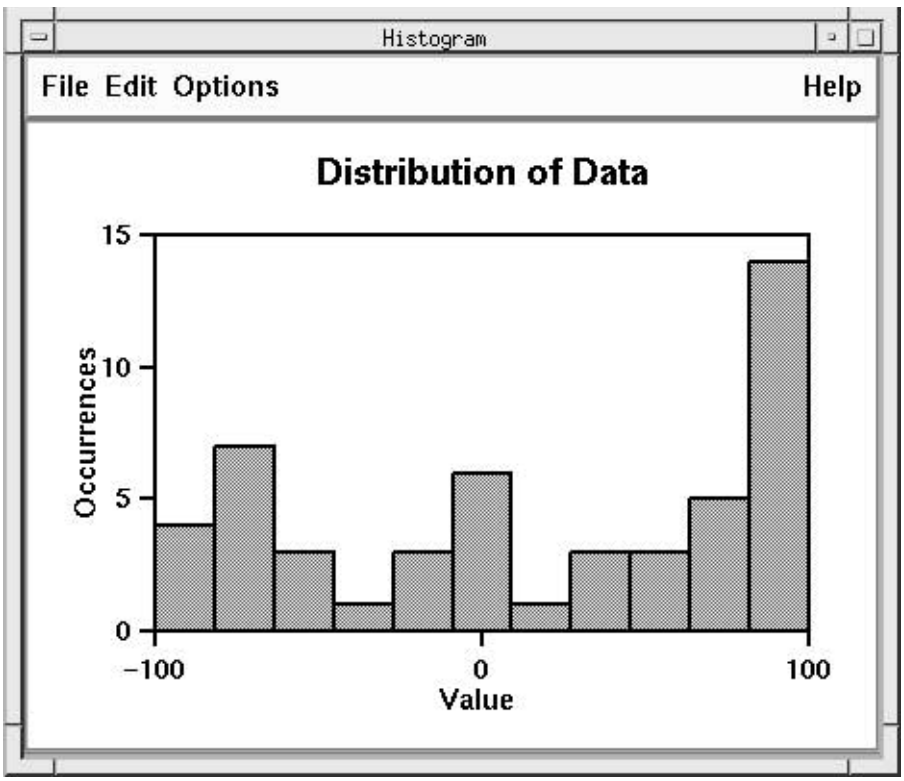

Figure 12-17 Histogram

High -Low Graphs

High-Low graphs display not only a Y-value for each X-value, but a range of Y-values for a given X-Value. High-Low graphs are typically used to display **error bars** or the **trading range** of a stock and its closing value for each period. The range of Y-values represent the low, standard (closing), and the high values for the given X value.

Just as with line and bar charts, high-low graphs can show multiple sets of data. You can use the Data Set Options dialog box to change the horizontal tick marks into boxes, circles, etc. You can also use the Skew Data button in the Graph Options dialog box to offset the data sets from each other. This helps in discriminating the data points from one data set to another. The vertical lines in each data set can also be connected with line segments or splines. You have the same flexibility in determining the look of the High-Low graph as you do with Line and Scatter graphs.

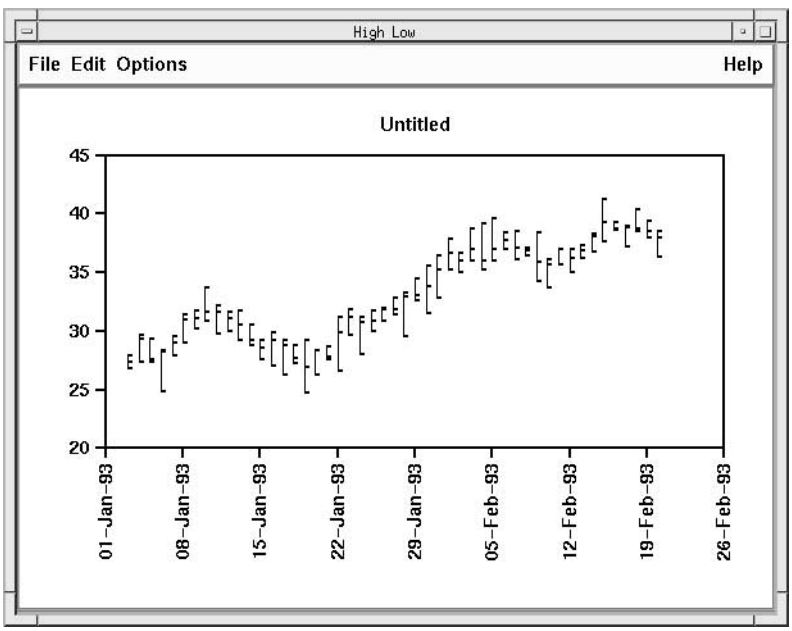

Figure 12-18 High-Low Graph

Box Graph

Box graphs display not only a Y-value for each X-value, but a set of Y-values for each X-value. Box graphs are typically used to display the upper and lower variances and perhaps the median point associated with each Y-value. This variance range is displayed as a rectangle.

You can use the Data Sets dialog box to mark the Y data with a specific marker type such as box or circle. This will cause the median data point to be marked with the same type of marker, but with a solid color.

As with Line and Bar graphs, Box graphs can show multiple set of data. You can use the Skew Data button in the Graph Options dialog box to offset the data sets from each other. This helps in discriminating the data points from one data set to another.

The vertical lines in each data set can also be connected with line segments or splines. You have the same flexibility in determining the look of the Box graph as you do with High-Low graphs. You may combine a Box graph with a High-Low graph by simply providing the High and Low Y-data ranges in the Data Sets dialog box.

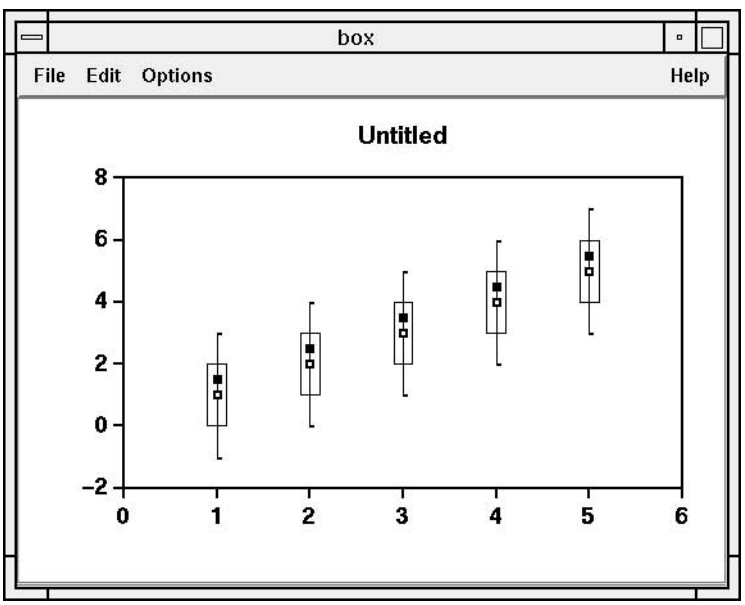

Figure 12-19 Box Graph

Control Graph

Like High-Low and Box graphs, Control graphs display two sets of Y-values for each X-value. Control graphs, however, display two different Y-values in separate plots which share the same X-axis but have different Y axes in the same graph display. Control graphs are typically used to display the mean and variance of the Y value over a range of X-values.

You can adjust the appearance of the separate plots in the Control graph exactly as you would with the Line, Bar, Scatter, Histogram, and Box graphs. The major difference is the presence of two different Y axes. The second set of Y values is defined in the "Lo Var" entry box of the Data Set Options dialog. The Aux. Y Axis Options dialog box is used to customize the Y axis for the second set of Y data. The options for this *auxiliary* Y axis operate the same as those for the X, Y, and Z axes.

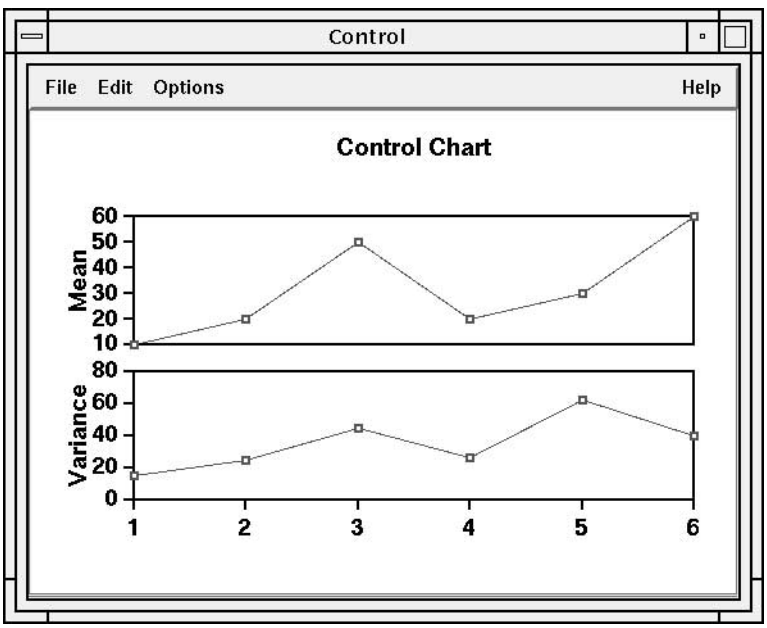

Figure 12-20 Control Graph

13

Graph Tutorial

This section is a comprehensive tutorial describing how to make various XESS graphs using simple examples. This tutorial assumes you already know how to enter data and use the spreadsheet. Go through the tutorial from start to finish, as later lessons refer back to an operation that was described and performed earlier.

Making Line Graphs

Drawing the line graph

To draw a simple line graph:

1) Enter the following numbers into columns A and B of a blank spreadsheet:

	A	B
1	1	1
2	2	4
3	3	9
4	4	16
5	5	25
6	6	36
7	7	49
8	8	64
9	9	81

2) Select the range **A1..B9**. The numbers in columns A and B should now be highlighted.

3) Select **New Graph** from the **Graph** menu and display its submenu.

4) Select **Line** from the New Graph submenu. Within a second or two, a new window containing a line graph will appear on your screen as shown in Figure 13-1.

. . . . . .

If you specify only a single dataset, the values are assumed to be Y-values with default X-values beginning with 1. In the example above, selecting B1..B9 instead of A1..B9 produces the same result.

. . . . . .

.

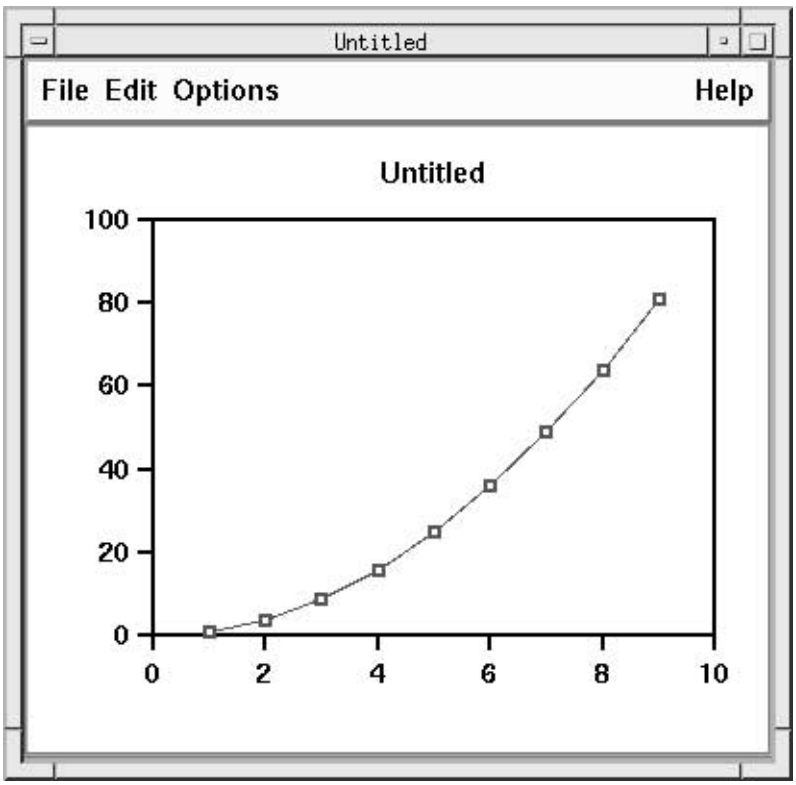

Figure 13-1 Line Graph 1

Redrawing the Graph

Suppose you typed in one of the data points incorrectly and you want to modify the spreadsheet and redraw the graph.

To redraw a graph using new data:

1) In the spreadsheet, go to cell **B4** and change the value from 16 to 47. Notice that the graph has changed to reflect the new value of the cell. You can disable this behavior in the **Options>General** dialog. If it is disabled, use the **File>Redraw** command to force a redraw.

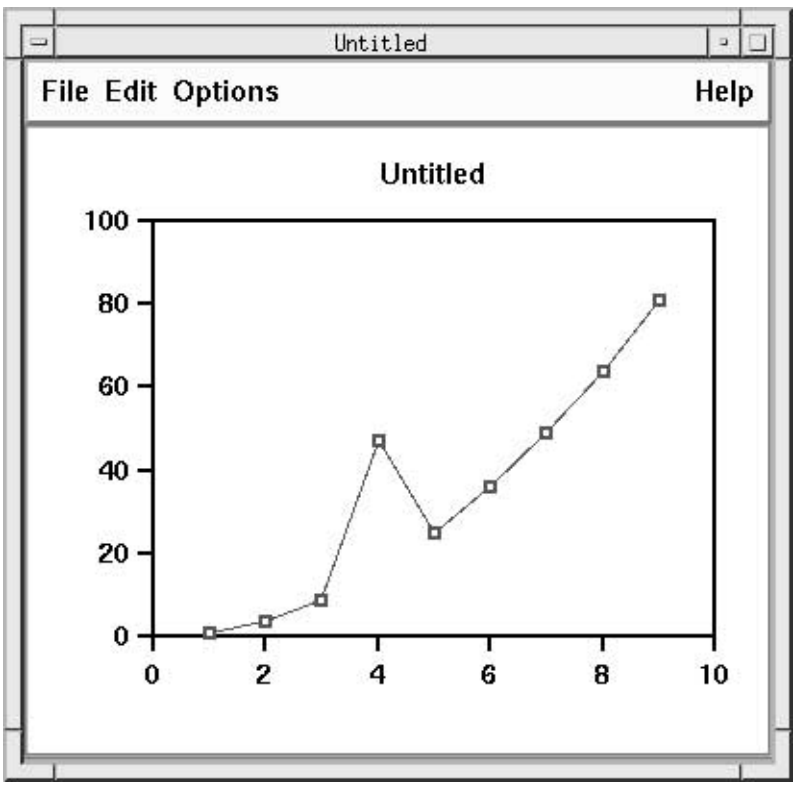

Figure 13-2 Line Graph 2

Duplicating the Graph

Now suppose that you want to change the look of your graph, but want to keep older versions. XESS allows you to duplicate your graph.

To duplicate a graph, select **Duplicate** from the graph window **File** menu. XEss displays another window with a copy of your graph.

Naming and Saving the Graphs

With two identical graphs on your screen, how do you tell them apart? Each graph window has a title across the top, but in both cases, the title is **Untitled**. Ideally, you would want to call each graph by its own name.

To save and name a graph:

1) Make sure the original graph is active.
2) Select **Save As...** from the graph window **File** menu. XEss displays a popup dialog box as shown in Figure 12-3.
3) In the **Enter graph name** entry box, type the name **my_1st_graph**.
4) Click **OK** or press **[Enter]** to name the graph and dismiss the dialog box.

Now that the graph window is named, follow the same steps to name your duplicate graph **my_1st_duplicate**.

Canceling and Recalling the Graph

At this point, your screen is probably crowded with windows, and it would be nice to get rid of some of the graph clutter.

To cancel a graph:

1) Make sure **my_1st_duplicate** graph is active.
2) Select **Cancel** from the graph window **File** menu. The duplicate graph will disappear.

Although the graph is not displayed, it has not completely disappeared.

To recall a canceled graph:

1) Select **Graph Edit...** from the **Graph** menu on the sheet.
2) Select **my_1st_duplicate** from the Chose Graph dialog. XEss once again displays the duplicate graph.

Deleting the Graph

XEss allows you to have up to 200 named graphs for one workbook. If you decide you no longer need one, you can delete it from the workbook.

To delete an existing graph:

1) Select **Delete Graph...** from the **Graph** menu on the sheet.
2) Select the graph you wish to delete from the graph selection window.

*Use caution when choosing **Delete** because XESS will not ask you "Do you really want to delete this graph?"*

Printing the Graph

You can send your graph to a printer or to a file. To print your graph, use the **Print As...** or **Print** options of the File menu on the Graph Edit window. For more information on printer options see **Printing the Spreadsheet**.

To print a graph:

1) Select **Print As...** from the graph window **File** menu to display the **Print Graph** dialog box.
2) Use the **Page Options** and **Printer Options** selections to control the destination and attributes of the print output.
3) Click **OK** to start the print operation.

Changing the Appearance of the Graph

One way to change the appearance of your graph is to use the **Data Set Options** dialog box.

To change the appearance of your graph:

1) Select **Data Sets...** from the graph window **Edit** menu. XESS displays a dialog box for the **Data Set Options** as shown in Figure 13-3. If the dialog box appears over your graph, rearrange the windows so you can see both the graph and the dialog box.
2) Click on the **Marker Type** list box, select **Circle,** and click **Apply**. The graph is redrawn with circles representing the data points.
3) Click on the **Line Style** list box, select **Dotted,** and click **Apply**. The graph is redrawn with a dotted line.
4) Click on the **Segment Type** list box, select **Spline,** and click **Apply**. The graph is redrawn with a cubic spline that smoothly connects the data points.

5) In the graph range area the X and Y range entry boxes are already filled in with the ranges **A1..A9** and **B1..B9** from when you first drew the graph. If you do not like these ranges and wish to use different ones, simply enter the new range in the appropriate box and click **Apply**.

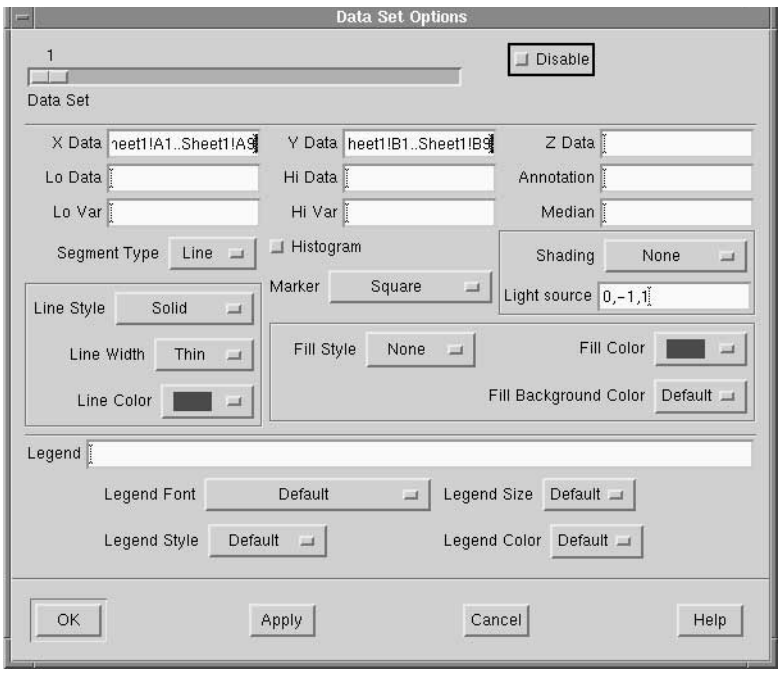

Figure 13-3 Data Set Options Dialog Box

Annotating the Graph

XESS allows you to specify a list of annotations. Annotations are strings that specify an (x,y) coordinate pair at which a label will be printed in the data area of the graph, and also how that label will appear in relation to the coordinate.

To place annotations in a graph:

1) Make the spreadsheet active. Enter the following lines in column A of the spreadsheet:

   In A12, enter (4,50,0.5,0)errant point
   in A13, enter (6,35,0.0,1.0)good point

2) In the **Data Sets** dialog box, enter **A12..A13** in the **Annotation** entry box and click **Apply**. The graph is redrawn with two text strings in the data area: the string **errant point** which is centered (0.5) and above (0.0) the point X=4 and Y=50; and the string **good point** which is left aligned (0.0) and below (1.0) the point X=6 and Y=35.

There is an XEss built-in function, **@ANNOTATE** that also allows you to specify your graph annotations. See **XEss Built-in Functions** for more information about @ANNOTATE.

Up to this point, you have changed the appearance of actual plotted data, but you might also want to add titles, legends, etc. To do this, use the selections from the graph window **Options** menu. You will use a few of these items in **Making a Bar Graph**, later in this section.

Multiple Data Sets

XEss allows you to plot up to 20 data sets in a Graph. Let's add to the line graph data you have already used.

Drawing the Graph

To draw a multiple line graph:

1) Add the following column of numbers (column C) to the spreadsheet you used in the last example. If you are just starting, enter all the columns of numbers.

	A	B	C
1	1	1	2
2	2	4	8
3	3	9	18
4	4	16	32
5	5	25	50
6	6	36	72
7	7	49	98
8	8	64	128
9	9	81	162

2) Select the range **A1..C9**. All three columns of data should now be highlighted.

3) Select **New Graph** from the **Graph** menu and display its submenu.

4) Select **Line** from the New Graph submenu. Within several seconds XESS displays a new window containing a line graph as shown in Figure 13-4.

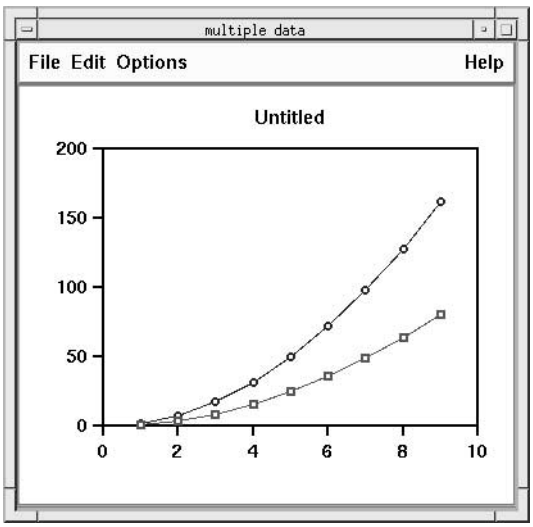

Figure 13-4 Multi-line Graph 1

Unlike **my_1st_graph**, this graph contains two lines of data. Use the **Save As...** operation from the graph window **File** menu to name this graph **multiple_data**.

Examining Data Sets

Using the **Data Sets** operation from the graph window **Edit** menu, you can change a data sets marker type, line segment, etc. You can also adjust the actual range of data that is being graphed.

To view multiple data sets:

1) Select **Data Sets** from the graph window **Edit** menu. XESS displays a dialog box for **Data Set 1**.

2) Click the slider bar to view **Data Set 2**, and then click it again to view **Data Set 1**.

3) Click the check button labeled **Disable**, and then click **Apply**. XESS redraws the graph with just the second data

set. You can Disable as many of the data sets as you want. This feature is nice if you want to examine just one data set or compare just a select few.

Adding a Legend

With several lines of data, it is often necessary to distinguish what each set represents. The use of a legend will provide this information. Incorporating legends is a two-step process as follows; order is not important:

Add legend text for each data set:

1) Select **Data Sets** from the graph window **Edit** menu. XESS displays the dialog box shown in Figure 12-4.
2) In the **Legend** entry box, enter **Data 1**.
3) Move the **Data Set** slider to the right to display a dialog box for **Data Set 2**.
4) In the **Legend** entry box, enter **Data 2**.
5) Click **OK** to confirm your choices for both data sets and dismiss the dialog box.

Enable legends:

1) Select **General...** from the graph window **Options** menu. XESS displays the **Graph Options** dialog box shown in Figure 12-6.
2) Click on the check button labeled **Legend**.
3) Click **OK** to confirm your choice and dismiss the dialog box. XESS redraws the graph and displays a legend to the right of the data area.

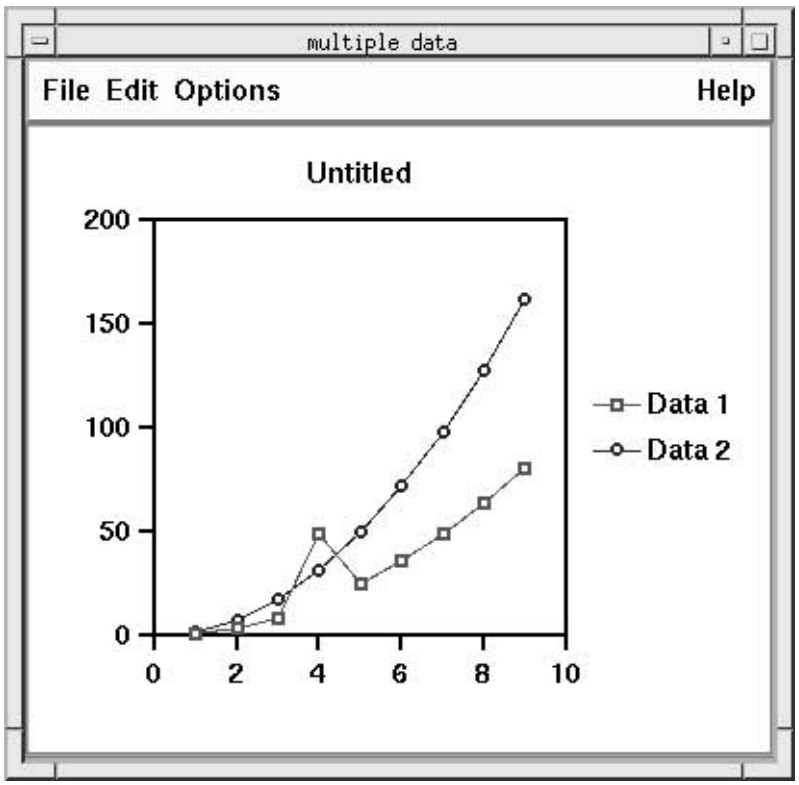

Figure 13-5 Multi-Line Graph 2 with Legend

Making Area Graphs

Making an area graph is similar to making a line graph except that the Y values are cumulative. The resulting graph appears as a *stacked line graph* where the area below each line can be filled by a different color or pattern to distinguish each data set. Area graphs are similar to Stacked Bar graphs.

Drawing the Graph

To Draw an Area Graph:

1) Select the range A1..C9 as shown in the following table:

	A	B	C
1	1	1	2
2	2	4	8
3	3	9	18
4	4	16	32
5	5	25	50
6	6	36	72
7	7	49	98
8	8	64	128
9	9	81	162

2) Select **New Graph** from the **Graph** menu to display its submenu.

3) Select **Area Graph** from the **New Graph** submenu. XEss displays a window containing the Area Graph shown in Figure 13-6.

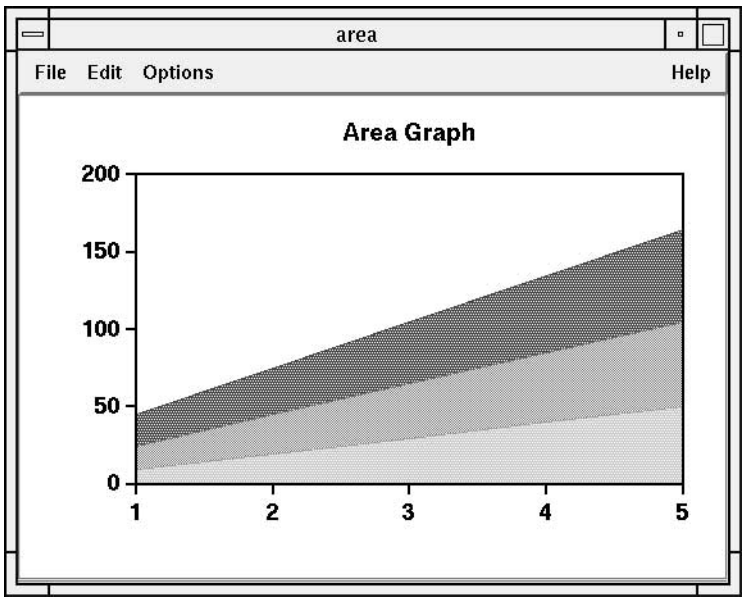

Figure 13-6 Area Graph

Making Bar Graphs

Making a Bar Graph is identical to making a Line Graph. The only thing you cannot do like a Line Graph is set a **Marker Type**. Stacked Bar Graphs are similar to Area Graphs.

Drawing the Graph

To Draw a Bar Graph:

1) Select the range of data previously used for the area graphs.

2) Select **New Graph** from the Graph menu and display its submenu.

3) Select **Bar Graph** instead of **Line Graph** from the New Graph submenu. XESS displays another new window with the bar graph shown in Figure 13-7.

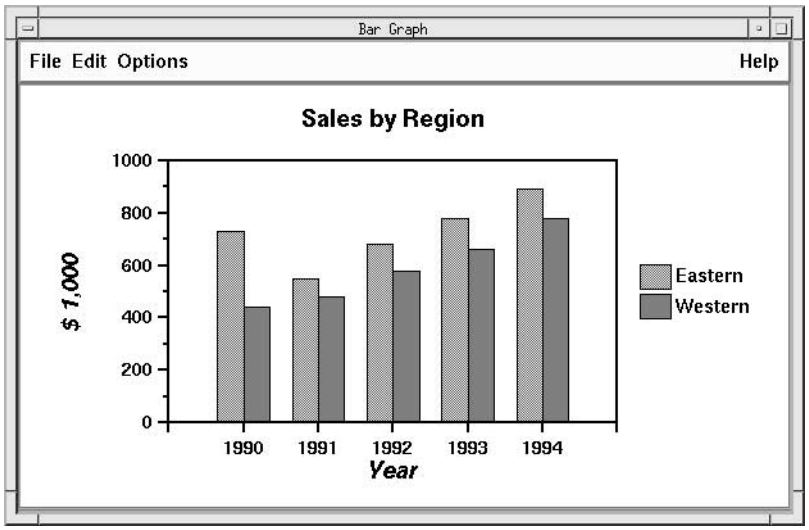

Figure 13-7 Bar Graph

Alternatively,

1) Make one of your line graph windows active.
2) Select **General...** from the graph window **Options** menu. XESS displays the **Graph Options** dialog box.
3) In the **Graph Type** select **Bar Graph**, and click **OK** or **Apply**. This will give you a bar graph as well.

To Draw a Stacked Bar Graph:

1) Select the range of data previously used for the area graphs.
2) Select **New Graph** from the Graph menu and display its submenu.
3) Select **Stacked Bar Graph** from the New Graph submenu. XESS displays another new window with the stacked bar graph shown in Figure 13-8.

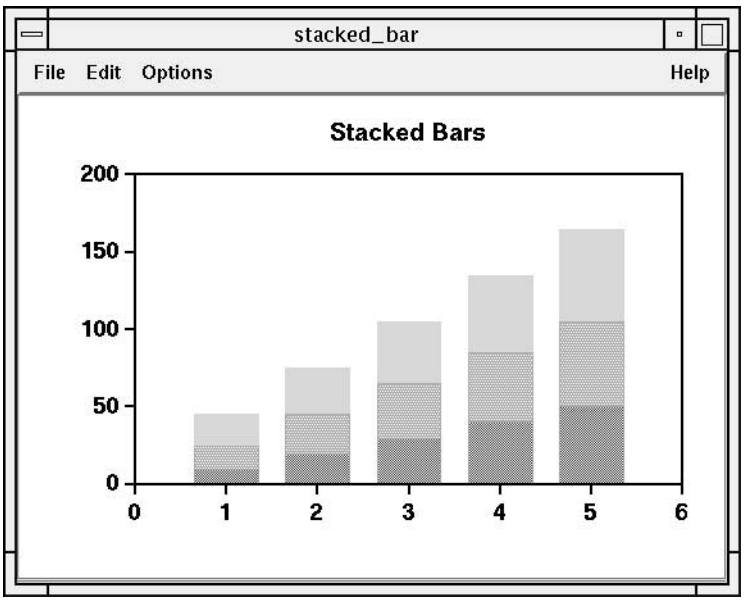

Figure 13-8 Stacked Bar Graph

Starting a New Sheet

You are completely finished with the workbook you have been using, so you will need to start a new one.

To start a new sheet:

1) Select **Close** from the **File** menu. XESS displays the **Warning** dialog box.

2) Click **OK** to save the current sheet. XESS now displays the **Save Sheet** dialog box.

3) In the **Selection** entry box type in the name **Lines.xs5**.

4) Click **OK** or press **[Enter]** to save the spreadsheet and dismiss the dialog box. XESS clears the workbook and is ready for the next one.

Using Text Labels in Bar Graphs

Sometimes bar graphs have text labels along the X axis.

To use text labels on the X axis:

1) Enter the following into columns A, B, and C of the new spreadsheet.

	A	B	C
1	cars	1000	3000
2	boats	2000	4000
3	trains	300	500
4	planes	4000	6000

2) Select the range **A1..C4**. The cells should now be highlighted.

3) Select **New Graph** from the **Graph** menu and display its submenu.

4) Select **Bar Graph** from the New Graph submenu. Within a few seconds, another window containing a bar graph will appear on your screen as shown in Figure 13-9.

This data might represent how far you traveled each of the past two years using cars, boats, trains, and planes, respectively. Selecting and plotting this data will produce a graph containing two interspersed bars (of different colors). A bar of each color will be centered over each text label, and will have a length proportional to the number of miles traveled using that mode of transportation over the past two years.

Note: You could also have text strings in the X data range of a line graph, but this occurs much less frequently than with bar graphs. In addition, you could also have text strings in the Y data ranges, though there is seldom a use for that.

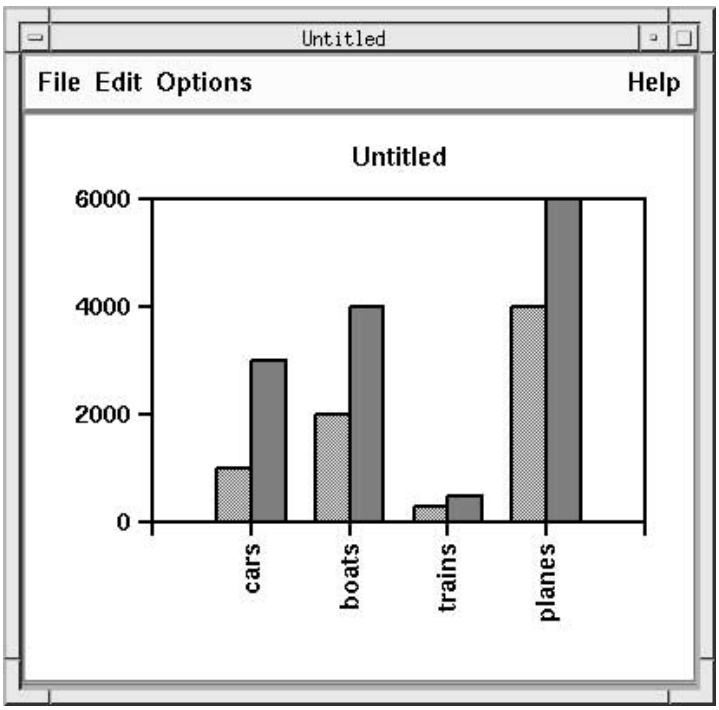

Figure 13-9 Bar Graph with Text Labels

Making Histograms

Histograms are used to gauge the relative frequencies of certain events.

Drawing the Graph

To draw a histogram:

1) Start a new workbook, saving the bar graph workbook as **bars**.

2) Enter the following data on used car prices into a spreadsheet:

	A	B	C	D
1	5640	4125	4183	3741
2	4557	4878	6251	5465
3	5294	4817	4759	5526
4	6739	5302	3739	5048
5	5172	6842	5604	4963
6	4438	4721	3886	4587
7	3410	4987	4206	5109
8	3878	6177	4118	5905
9	5003	6182	3462	5550
10	4485	5634	2873	4426

3) Select the range **A1..D10**. The cells should now be highlighted.

4) Select **New Graph** from the **Graph** menu and display its submenu.

5) Select **Histogram** from the New Graph submenu. XEss will bring up a window containing what looks like a bar graph. In Figure 13-10 you can see that there are ten bars over the interval from 2873 to 6842 and they have heights from 1 to 8. This graph shows the number of used cars that sell in a given price range. Notice that cars selling for $3,000 or $6,000 are rare, but prices between $4,000 and $5,000 are common.

Although the Histogram looks like a bar graph, it is not a bar graph. To create a bar graph, you need to give both X and Y coordinates to specify the position and height of each bar.

With histograms, you supply only the X range which can be a single row, single column, or block of data. XEss examines the data and determines the maximum and minimum values. Then it divides the data between the maximum and minimum into equal-sized "bins" and counts how many of the data values fall into each bin. The histogram is then made by drawing bars centered within each bin and having a height equal to the number of data values in each bin.

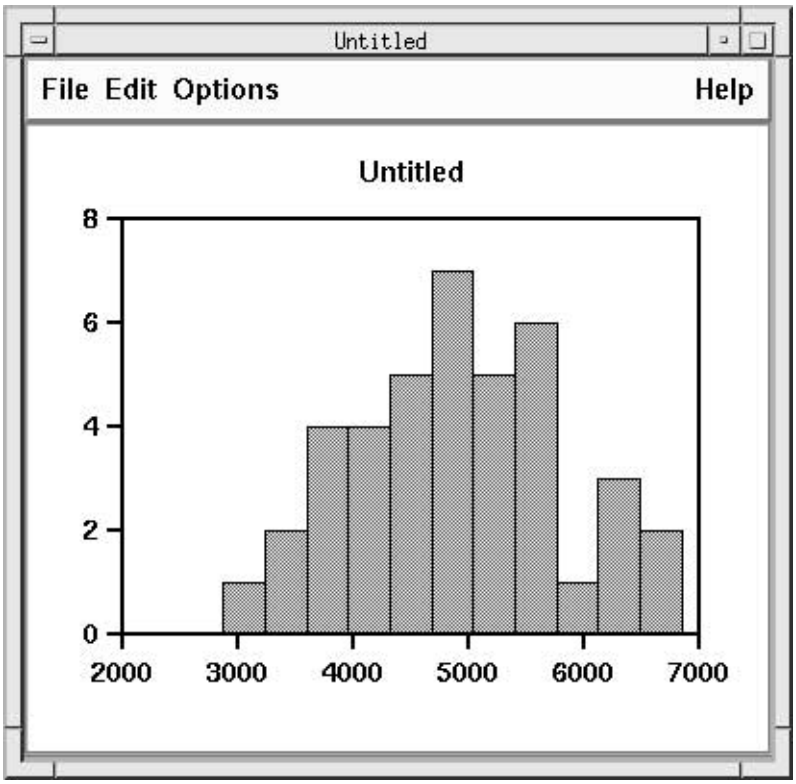

Figure 13-10 Histogram 1

Setting Maximum and Minimum Values

Now, the procedure described above is fine for a quick look at some data, but the bin intervals have odd values. For example, the first bin in the example above starts at 2,873 and ends at 3,270. Ideally, you would like to have regularly-spaced bins. This can be done by setting a maximum and minimum value in the **Min** and **Min** entry boxes of the **X-Axis Options** dialog box.

To set the Max and Min values:

1) Select **X Axis...** from the graph window **Options** menu. XESS displays the **X Axis Options** dialog box.

2) Click off the check button labeled **Auto Scale** to disable the option.

3) Enter **2000** in the **Min** entry box and **7000** in the **Max** entry box..

4) Enter 10 in the **Major** entry box to set the number of bins.

5) Click **Apply** to apply your choices, keep the dialog box open and redraw the histogram with bins beginning and ending at multiples of 500 as shown in Figure 13-11. The heights of some of the bars will change because the bin boundaries have moved and data items close to the bounds may move into an adjacent bin.

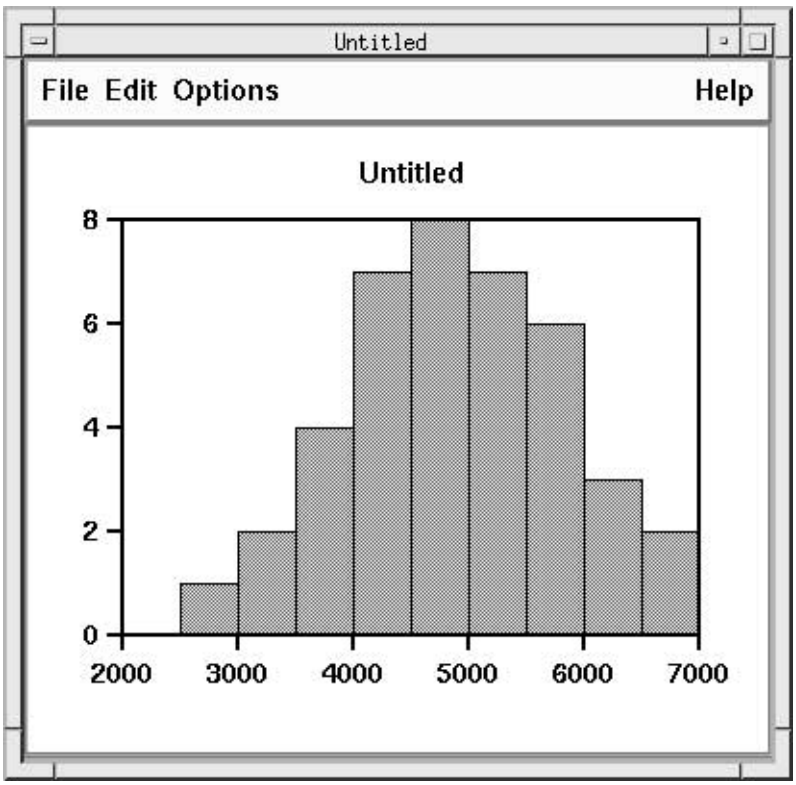

Figure 13-11 Histogram 2

Setting the Number of Bins

What if you want more bins? XEss allows you to define the number of bins in a histogram.

To define the number of bins:

1) In the **X Axis Options** dialog box (which should still be open) click off the check button labeled **Auto Ticks** to disable that option.

2) In the **Major** entry box enter the number **20**.

3) Click **OK** to confirm the number of bins, dismiss the dialog box and redraw the histogram with 20 bins that start and end on multiples of 250 as shown in Figure 13-12.

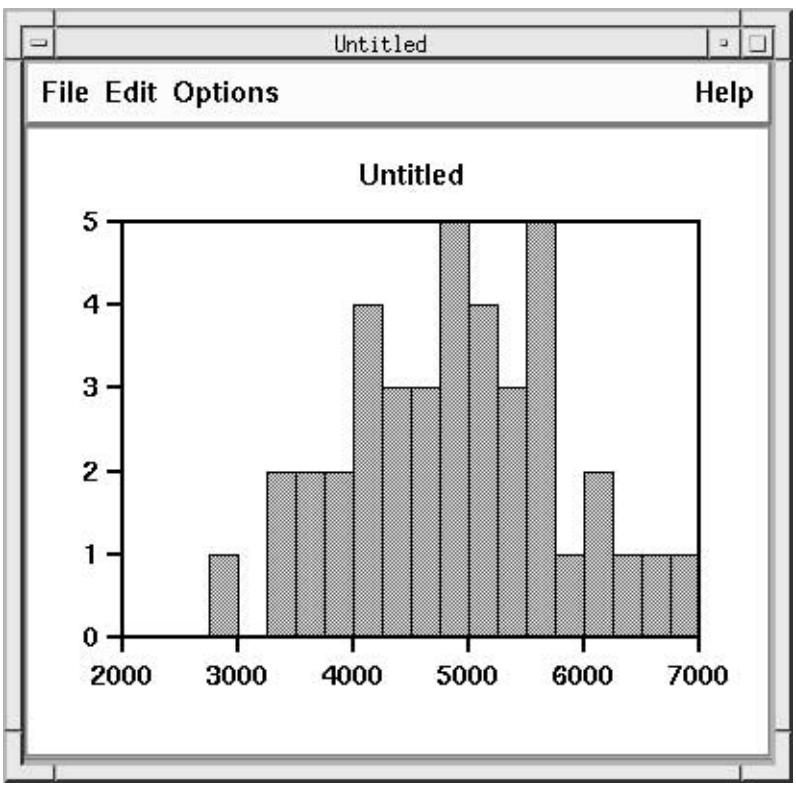

Figure 13-12 Histogram 3

Making Pie Charts

Drawing the Graph

To make the pie charts:

1) Start a new spreadsheet, saving the histogram workbook as **histograms**.

2) Enter the following data into the new spreadsheet:

	A	B
1	cars	10000
2	boats	2000
3	planes	6000
4	trains	1000
5	bicycles	600

3) Select the range **A1..B5**. The columns should now be highlighted.

4) Select **New Graph** from the **Graph** menu and display its submenu.

5) Select **Pie Graph** from the New Graph submenu. XESS will display a window containing a pie divided into 5 slices as shown in Figure 13-13. Each slice consumes a portion of the pie equal to the percentage of its data value out of the total of the values in column B. Each slice is also labeled with the text from column A and the percentage of the pie slice. The X data range (first column or row) contains the labels and the Y data range (second column or row) contains the sizes of the slices.

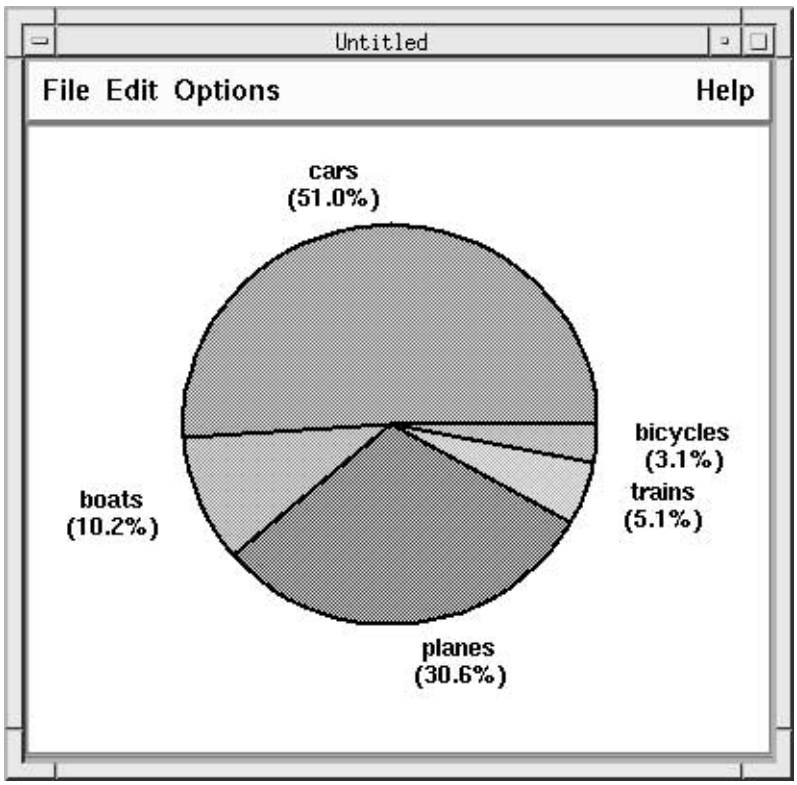

Figure 13-13 Pie Chart 1

Exploding Sections of the Pie

In order to accentuate certain data values, slices of the pie can be broken out. XESS allows you to do this in a manner similar to how you broke a line of data in a line graph.

To explode a slice of the pie:

1) Modify the data in your spreadsheet by inserting rows as follows:

	A	B
1	cars	10000
2	boats	2000
3		
4	planes	6000
5	trains	1000
6		
7	bicycles	600

2) Select the range **A1..B7**. The columns should now be highlighted.

3) Select **New Graph** and **Pie Graph** from the Graph menu. XESS will display a new pie chart showing that the pie slices for “planes” and “trains” have been exploded out of the pie as a contiguous piece as shown in Figure 13-14.

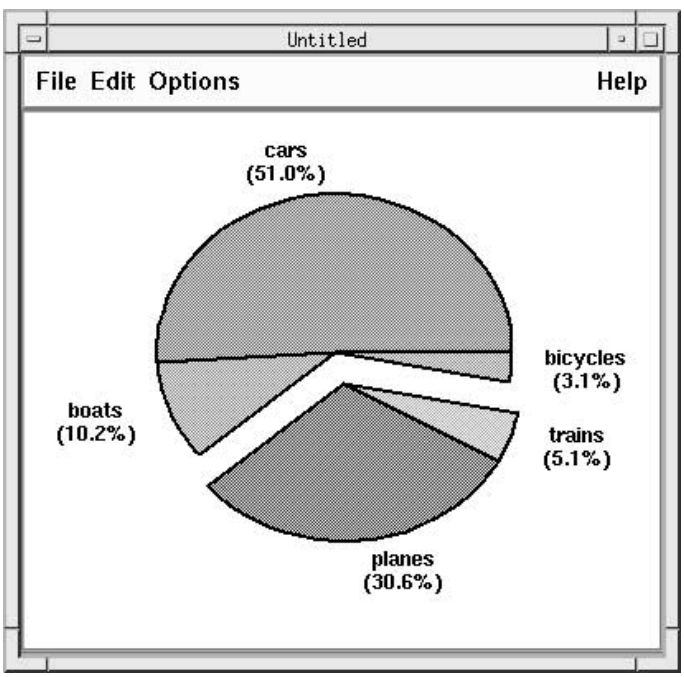

Figure 13-14 Pie Chart with Exploded Section

In general, just about any options you could use with bar graphs are usable with pie charts.

Making Surface Graphs

With surface graphs, you can display three-dimensional data on your two dimensional workstation screen. Each data point must be represented by three numbers, X, Y, and Z.

Drawing the Graph

To draw a surface graph:

1) Start a new spreadsheet, saving the pie chart workbook as **pies**.

2) Enter the following numbers in columns A through G as follows:

	A	B	C	D	E	F	G
1		1	2	3	4	5	6
2	1	2	3	4	5	6	7
3	2	3	4	5	6	7	8
4	3	4	5	6	7	8	9
5	4	5	6	7	8	9	10
6	5	6	7	8	9	10	11
7	6	7	8	9	10	11	1

3) Select the range **A1..G7**. The columns will now be highlighted.

4) Select **New Graph** from the **Graph** menu and display its submenu.

5) Select **Surface Graph** from the New Graph submenu. XESS displays a window containing a slanted plane divided into 25 squares as shown in Figure 13-15. The points at the corner of each square correspond to the data points in the spreadsheet, and XESS fills in the remaining space between them to create the surface you see in the graph window.

   The X coordinates of each point are listed in the first row in range B1..G1. The Y coordinates are in the first column in the range A2..A7. The Z coordinates for each point are listed in the data block B2..G7. Thus, the Z coordinate 7 in cell C6 is paired with the X coordinate 2 in cell C1 and the Y coordinate 6 in cell A6. XESS assumes the X coordinates of a selected block are along the upper row and the Y coordinates are along the left-most column.

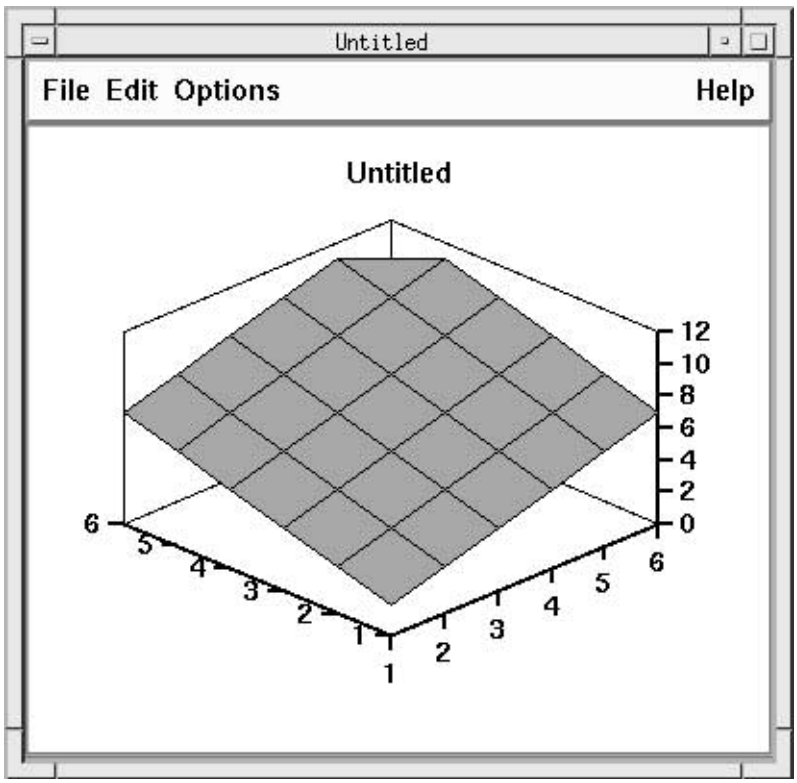

Figure 13-15 Surface Graph

XESS allows one surface to be displayed per window, so only the ranges displayed in the dialog box for **Data Set 1** affect the surface graph. You can also change **Line Style** and **Segment Type** of the lines on the surface graph. **Marker Type** and **Legend Text** have no effect since only one surface can be displayed at a time.

As an additional convenience, XESS does not force you to strictly order your data. For instance, if you swapped the contents of columns D and E in the example so that the X coordinates had the sequence 1,2,4,3,5,6 (the 4 and 3 are now out of order) then XESS would resort all the data before creating the surface graph.

Rotating the Graph

When a surface graph is displayed, **Rotate...** from the graph window **Edit** menu is enabled. Activating this option causes a dialog box to pop up which contains a simplified view of the surface graph axes.

To rotate a graph:

1) Select **Rotate...** from the graph window **Edit** menu. XESS displays the **Rotate Surface** dialog box shown in Figure 12-5.

2) Position the mouse pointer anywhere in the dialog box. By holding down the left mouse button you can swivel the axes back and forth and up or down.

3) Release the mouse button to lock the position of the axes.

4) Click **Apply** to redraw the surface graph with the new view orientation you just selected in the dialog box. An example rotation is shown in Figure 13-16.

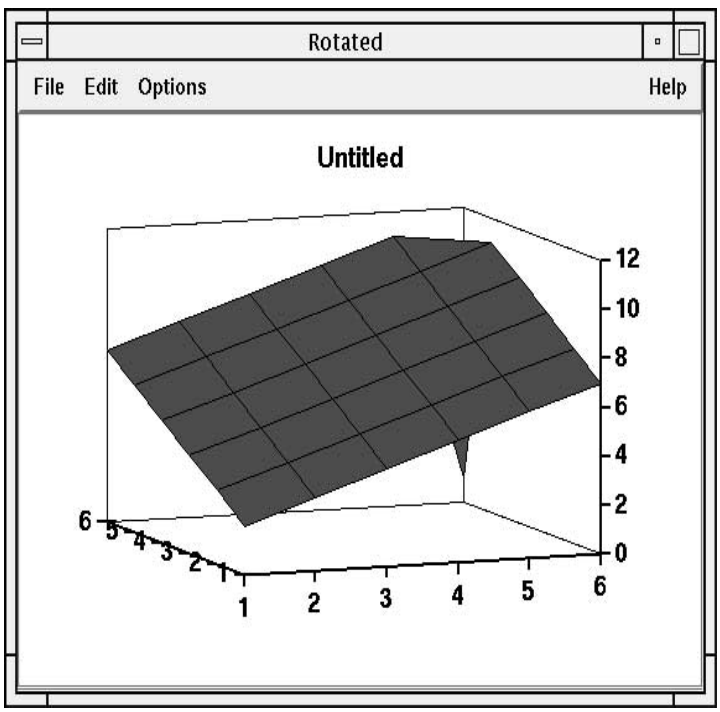

Figure 13-16 Rotated Surface Graph

Surface Graph Colors and Axes

You can change the coloring of the surface by using the **Data Set Options** dialog box accessed via the **Edit** menu**.** From this dialog box you may select one of the following shading options: **None**, **Z Height, Directed-Light.**

None disables shading; the surface will appear as a specified color.

Z Height shading colors higher points on the surface in warmer reddish tones while lower regions are given cooler bluish shades.

Directed-Light shading simulates how the surface would look if it were illuminated by a light. Surface regions that are facing away from the light will appear darker than those which are facing the light.

In addition to altering the appearance of the surface, you can also alter the appearance of the axes just as you did for line graphs.

Making Contour Graphs

A contour graph is a two-dimensional representation of a surface graph. Just as you set the number of histogram bins, you can set the number of contour levels. You can also select the range over which the contours extend. You can even have logarithmically-spaced contours. However, the **Grid Lines** options produce no effect on contour graphs.

Drawing the Graphs

To change a surface graph to a contour graph:

1) In your surface graph select **General...** from the **Options** menu. XESS displays the **Graph Options** dialog box.
2) Select **Graph Type** to be **Contour**.
3) Click **Apply** to redraw the surface graph as shown in Figure 13-17 and keep the dialog box open. Dark lines, or contours, divide the graph into regions of varying height.

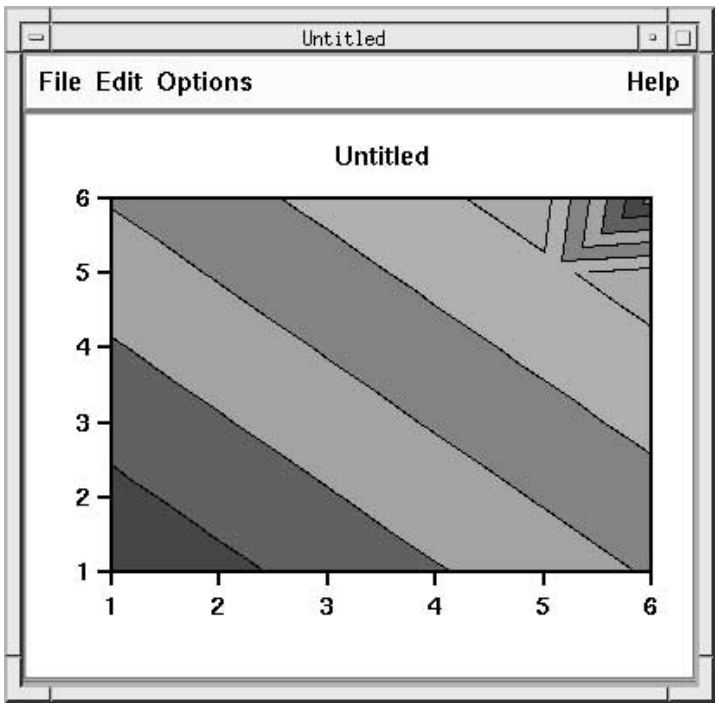

Figure 13-17 Contour Graph 1

Changing Coloring and Displaying a Legend

To further differentiate the regions:

1) In the **Shading** area, select **Z Height**.

2) Click **Apply** to redraw the graph and keep the dialog box open. The different contour levels are now shown in color with the higher regions being reddish and the lower ones being bluish.

To display a legend:

1) Click on the check button labeled **Legend**.

2) Click **OK** redraw the graph as shown in Figure 13-18 and dismiss the dialog box. XESS displays the contour colors and levels along the right side of the graph.

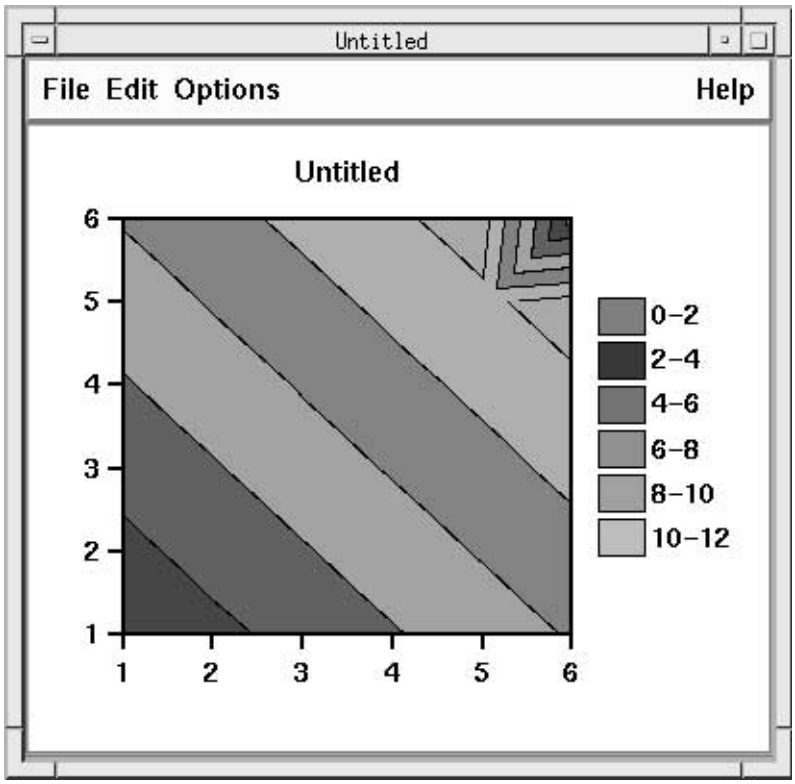

Figure 13-18 Contour Graph 2

Making Polar Graphs

A polar graph plots a point at some radial distance along a ray that creates a given angle with the positive X axis.

Drawing the Graph

To draw a polar graph:

1) Create a new spreadsheet, saving the contour workbook as **contours**.

2) Enter the following data into the new spreadsheet:

	A	B
1	0.157	1
2	0.314	2
3	0.471	3
4	0.628	4
5	0.786	5
6	0.942	5
7	1.100	4
8	1.257	3
9	1.414	2
10	1.571	1

3) Select the range **A1..B10**. The columns will now be highlighted.

4) Select **New Graph** from the **Graph** menu and display its submenu.

5) Select **Polar Graph** from the New Graph submenu. XEss displays a window containing one-quarter of a crudely-drawn four-leaf clover as shown in Figure 13-19.

   You may not understand the relationship between the numbers and the plot, but notice that you created the graph in the same way you made a line or bar chart. However, the X data in column A is actually the angle with respect to the positive X axis. A value of zero in this column would cause data to be plotted along the X axis, while a value of approximately $\pi/2$ (1.571...) would plot data along the Y axis. Values between 0 and $\pi/2$ plot data along rays between the X and Y axis.

   The distances along these rays at which the data points are placed are determined by the values in column B (which would be the column of Y data if this were a line graph). The data values in column A are an increasing sequence of angles with respect to the X axis, and the values in column B increase then decrease to move the plotted points away from and then closer to the graph origin. This creates the crude clover leaf.

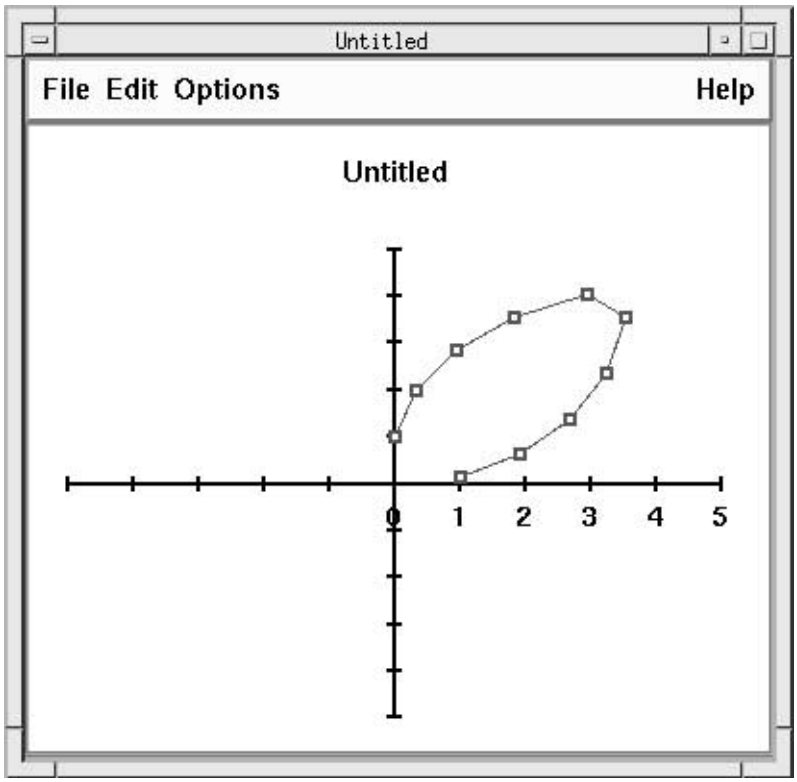

Figure 13-19 Polar Graph

For polar graphs, the angular measurement and radial components correspond to the X and Y coordinates in a line graph, respectively. With this perspective, you can manipulate polar graphs just as you would line graphs. In fact, all the options available with line graphs can be used with polar graphs except:

1) You can not display a label on the Y axis.

2) If you annotate a polar graph, you must specify the point at which the annotation text is printed in (X,Y) coordinates, not in the (angle,radius) notation that is used for the data.

Making High-Low Graphs

High-Low graphs display a high and low bound in addition to the actual data point. The display of high, low, and closing Dow-Jones averages in the Wall Street Journal is the High-Low graph most people are familiar with. In order to create such a graph, three values of Y data are needed for each X value (e.g. the low, the closing, and the high of the day's DJ average). Just as with line

and bar charts, high-low graphs can show multiple sets of data. Error bars may also be created from High-Low graphs.

Drawing the Graph

To draw the High- Low graph:

1) Start a new spreadsheet, saving the polar workbook as **polars**.

2) Enter the following data into the new Xess spreadsheet:

	A	B	C	D	E	F	G
1	1	2	3	4	5	6	7
2	28.1	28.6	30.7	31.5	31.8	33.0	32.2
3	27.5	28.6	29.3	30.1	31.2	32.2	30.7
4	25.3	27.5	27.8	29.2	29.2	31.3	30.5

3) Select the range **A1..G4**. The cells will now be highlighted.

4) Select **New Graph** from the **Graph** menu and display its submenu.

5) Select **Hi Lo Graph** from the New Graph submenu. XESS displays a window containing the high-low graph as shown in Figure 13-20.

   Unlike a line graph, this graph contains a series of isolated vertical lines each of which has a small horizontal tick. The horizontal ticks are placed according to the values in row 3 of the spreadsheet. The lower and upper bounds of each vertical line are determined by the data in rows 2 and 4, respectively. The horizontal location of each mark is set by the values in row 1. You could have created this high-low graph by arranging the data into columns.

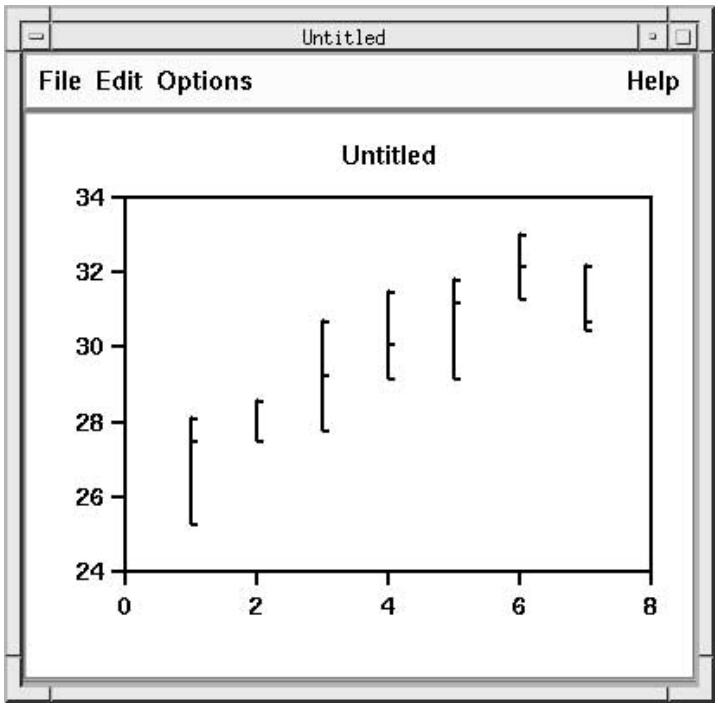

Figure 13-20 High-Low Graph

Making Box Graphs

Like High-Low graphs, Box graphs display a high and low bound in addition to the actual data point. However, Box graphs can also display an additional high and low bound by drawing a rectangle whose top and bottom edges reflect these two new bounds. Box graphs also let you specify a final range of Y data which is displayed using a *solid* marker having the same shape as the marker used for Y data values. In order to create such a graph, six values of Y data are needed for each X value. To continue the financial analogies, these six values could represent the low, the closing, and the high of the day's DJ average now augmented with the low variance, median price, and upper variance.

Drawing the Graph

To draw the Box graph:

1) Save the high-low workbook as **hilo**.

2) Create a new spreadsheet with the following data (*row 1 is optional*):

	A	B	C	D	E	F	G
1	x	ylo	y	yhi	varlo	median	varhi
2	1	-1	1	3	0	1.5	2
3	2	0	2	4	1	2.5	3
4	3	1	3	5	2	3.5	4
5	4	2	4	6	3	4.5	5
6	5	3	5	7	4	5.5	6

3) Select the range **A2..G6**. The cells will now be highlighted.

4) Select **New Graph** from the **Graph** menu to display its submenu.

5) Select **Box Graph** from the **New Graph** submenu. XESS displays a Box graph.

6) Use the **Data Sets...** dialog box to change the marker for the data set 1 to a square. The Box graph displayed is shown in Figure 13-21 . The top and bottom of the box represent the data values in the column headed by "yvarlo" and "yvarhi", respectively. The data in the "median" column is displayed using solid squares.

Unlike the High-Low graph in the previous section, this Box graph contains only a single data set. However, in addition to the High-Low graph markers, each data point now has a bounding box and a solid marker which represent the variances and median values stored in columns E, G, and F, respectively.

As with Line, Bar, and High-Low graphs, Box graphs can show multiple sets of data.

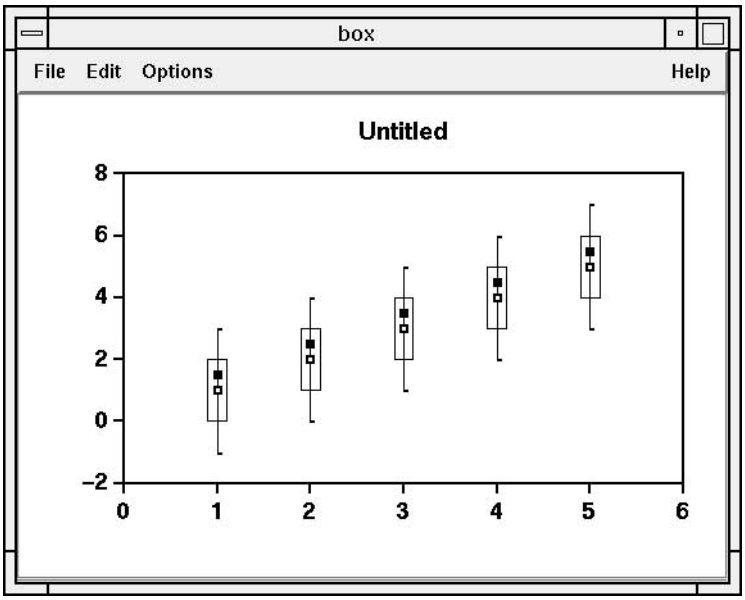

Figure 13-21Box Graph

Making Control Graphs

Like High-Low and Box graphs, Control graphs display multiple Y values for each X value. For the Control graph, two Y values are needed for each X value. However, the Control graph partitions the graph into two sub-graphs within the same window: the top one showing the relationship between X and the first set of Y values and the bottom one showing the second set of Y values. The Control graph is typically used in statistical applications where the top graph displays the mean value and the bottom graph shows the variance of some quantity.

Drawing the Graph

To draw a Control graph:

1) First, save the box graph as **box**.

2) Create a spreadsheet similar to the following (*row 1 is optional*):

	A	B	C
1		mean	variance
2	1	5	.2
3	2	4	.4
4	3	2	.3
5	4	1	.7
6	5	7	.1
7	6	9	.5

3) Select the range **A2..C7**. The cells will now be highlighted.

4) Select **New Graph** from the **Graph** menu to display its submenu.

5) Select **Control Graph** from the **New Graph** submenu. XEss displays a window containing a Control graph.

6) Select the **Y Axis** from the **Options** menu and set the axis label to "Mean".

7) Select **Aux. Y Axis** from the **Options** menu and set the axis label to "Variance".

The Control graph will be displayed as shown in Figure 13-22. The top and bottom sub-graphs represent the data values in the columns headed by "mean" and "variance", respectively.

. . . . . .

*The second set of Y values used for "variance" is specified in the **Lo Var** entry box of the **Data Set Options** dialog box.*

. . . . . .

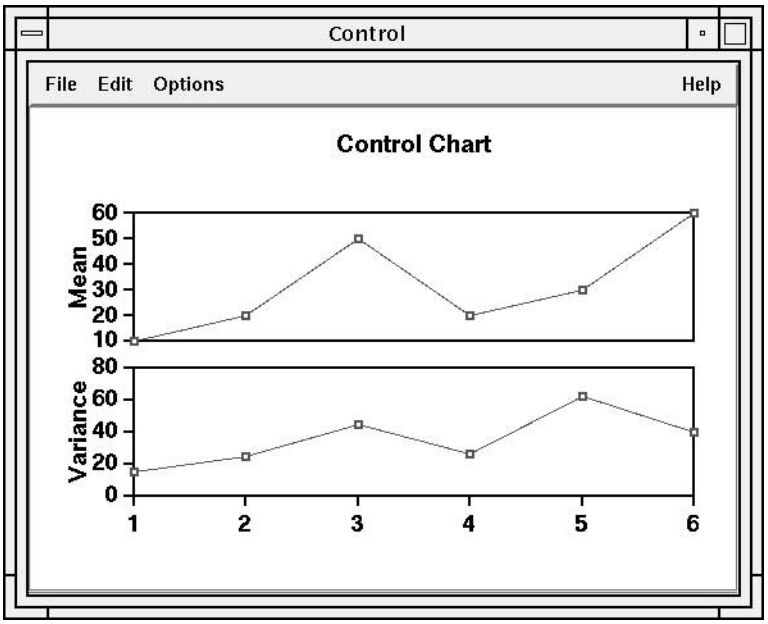

Figure 13-22 Control Graph

Appendix A

Function Reference

This appendix provides detailed description of all the functions found in XEES. They are arranged in alphabetical order.

Functions are shown with the initial **@** character, but it is not required when entering a formula. A setting in the User Preferences dialog determines whether it is displayed.

@@

Syntax: **@@(S)**

S = a string representing a cell, a range, or a named range

@@ returns a reference to the cell or range represented by *S*.

Example:

@@("B17") = 17, where B17 = 17

@SUM(**@@**("B2..B7")) = 24, where B2..B7 = 12, 1, 0, 4, and 7

@ABS

Syntax: **@ABS(X)**

X = a numeric value or cell reference containing a numeric value

@ABS returns the absolute (positive) value of X.

Examples:

@ABS(5) = 5

@ABS(-5) = 5

@ABS(52) = 52

@ABS(C15) = 10, where C15 = -10

@SQRT(**@ABS**(D4)) = 10, where D4 = -100

@ACCRINT

Syntax: **@ACCRINT(I, Ft, S, R, P, F [,B])**

I = The issue date.
Ft = The first interest date.
S = The settlement date.
R = The annual coupon rate.
P = The par value of the security.
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used,:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@ACCRINT returns the accrued interest for a security that pays periodic interest. Accrued interest is the amount the buyer must compensate the seller for the portion of the next coupon interest payment the seller has earned but will not receive from the issuer.

Example:

@ACCRINT(A1,A2,A3,A4,A5,A6,A7) = 35.3611, where A1=02/01/1993, A2=08/01/1993, A3=06/15/1993, A4=0.095, A5=1000, A6=2, and A7=0

@ACCRINTM

Syntax: **@ACCRINTM(I, S, R, P [,B])**

I = The issue date, a date/time value.
S = The settlement date, a date/time value.
R = The annual coupon rate.
P = The par value of the security.
B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@ACCRINTM returns the accrued interest for a security that pays interest at maturity.

Example:

@ACCRINTM(C6,C7,C8.C9,C10) = 39.3442, where C6 = 02/03/1992, C7 = 07/12/1992, C8 = 9%, C9 = 1000 and C10 = 1

@ACOS

Syntax: **@ACOS(X)**

X = a numeric value between -1 and 1.

@ACOS returns the arc cosine of angle *X*. The result is the angle (in radians) whose cosine is *X* and ranges from 0 to π. To convert the result from radians to degrees, use the **@DEGREES** function.

Examples:

@ACOS(1) = 0

@ACOS(R3) = 1.670963748, where R3 = -0.1

@DEGREES(**@ACOS**(0)) = 90

@ACOS(-20) = Error - @ACOS, domain is -1 <= x <= 1

@ACOSH

Syntax: **@ACOSH(X)**

X = a numeric value greater than or equal to 1.

@ACOSH returns the hyperbolic arc cosine of angle *X*. The result is the angle (in radians) whose hyperbolic cosine is *X*.

Examples:

@ACOSH(5) = 2.2924317

@ACOSH(F5) = 5.192926, where F5 = 90

@ACOSH(-1) = Error - @ACOSH, domain is x >= 1

@ACOT

Syntax: **@ACOT(X)**

X = a numeric value

@ACOT returns the arc cotangent of X.

Examples:

@ACOT(0) = 1.5707963

@ACOT(20) = 0.049958396

@ACOTH

Syntax: **@ACOTH(X)**

X = a numeric value

@ACOTH returns the hyperbolic arc cotangent of X.

Examples:

@ACOTH(40) = 0.02500521

@ACOTH(0) = Error - @ACOTH, domain is x > 1

@ACSC

Syntax: **@ACSC(X)**

X = a numeric value

@ACSC returns the arc cosecant of X.

@ACSC(1) = 1.5707963

@ACSC(0.5) = Error - @ACSC, domain is x >= 1

@ACSCH

Syntax: **@ACSCH(X)**

X = a numeric value

@ACSCH returns the hyperbolic arc cosecant of X.

Examples:

@ACSCH(1) = 0.88137359
@ACSCH(0) = Error: x must not be zero

@ALARM

Syntax: **@ALARM(X,S)**

X = an expression
S = a string (evaluated as an expression if *X* is non-zero)

@ALARM evaluates expression X. If *X* evaluates to non-zero, it beeps and returns the result of evaluating string *S* as an expression. If *X* evaluates to zero, *S* is not evaluated and the return value is zero.

Examples:

@ALARM(Pressure > 500, "@REMOTE_FN(Pressure)")
If "Pressure" exceeds 500, then the terminal beeps and REMOTE_FN is called with the value of "Pressure".

@AND

Syntax: **@AND(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@AND returns 1 if all arguments are 1; 0 if any argument is 0; otherwise -1 (unknown).

Examples:

A1=1, B1=1, C1=0, D1=0, E1=1 and A2=24
@AND(A1,B1) = 1
@AND(A1..E1) = 0
@AND(A1..A2) = -1

@ANNOTATE

Syntax: **@ANNOTATE(Text,X,Y[,H[,V]])**

Text = a string value of the annotation
X, Y = numeric values representing graph coordinates
H, V = numeric values representing justification

@ANNOTATE allows you specify a coordinate at which a label (*Text*) will be displayed in the data area of a 2-dimensional graph, and also how that label will appear in relation to the coordinate. *X* and *Y* represent the coordinates of the label on the graph.

H (horizontal justification) and *V* (vertical justification) are optional values that represent the text spacing offset of the label. If V is specified, H must also be specified; however, you may specify H without V.

This is a convenience function for creating strings of the form accepted by the XEss graph annotation mechanism. For more information on annotation see **Graphs**.

Examples:

@ANNOTATE("Average",5/2,12,1,0.5) = "(2.5,12,1.0,5)Average"

@ANNOTATE("Data Point",5,10)= "(5,10)Data Point"

@ANNOTATE("x^2",6,36,-1/4) = "(6,36,-0.25)x^2"

@ASEC

Syntax: **@ASEC(X)**

X = a numeric value

@ASEC returns the arc secant of X.

Examples:

@ASEC(1) = 0

@ASEC(1e+100) = 1.5707963

@ASEC(0) = Error: @ASEC, domain is abs(x) >= 1

@ASECH

Syntax: **@ASECH(X)**

X = a numeric value

@ASECH returns the hyperbolic arc secant of X.

Examples:

@ASECH(0.1) = 2.9932228

@ASECH(1000) = Error: @ASECH, domain is 0 < x < 1

@ASIN

Syntax: **@ASIN(X)**

X = a numeric value between -1 and 1.

@ASIN returns the arc sine of angle *X*. The result is the angle (in radians) whose sine is *X* and ranges from π/2 to -π/2. To convert the result from radians to degrees, use the **@DEGREES** function.

Examples:

@ASIN(0) = 0

@ASIN(A2) = 1.570796327, where A2 = 1

@DEGREES(**@ASIN**(V7)) = -11.536959, where V7 = -0.2

@ASIN(30) = Error - @ASIN, domain is -1 <= x <= 1

@ASINH

Syntax: **@ASINH(X)**

X = a numeric value

@ASINH returns the hyperbolic arc sine of angle *X*. The result is the angle (in radians) whose hyperbolic sine is *X*.

Examples:

@ASINH(1) = 0.88137359

@ASINH(L7) = -0.60282073, where L7 = -0.64

@ATAN

Syntax: **@ATAN(X)**

X = a numeric value expressed in radians.

@ATAN returns the 2-quadrant arc tangent of angle *X*. The result is the angle (in radians) whose tangent is *X* and ranges from -π/2 to π/2. To convert radians to degrees, use the **@DEGREES** function.

Examples:

@ATAN(.5) = 0.463647609

@ATAN(J44) = -0.785398163, where J44 = -1

@DEGREES(**@ATAN**(U6)) = 87.70939, where U6 = 25

@ATAN2

Syntax: **@ATAN2(X,Y)**

X = a numeric value
Y = a numeric value

@ATAN2 returns the 4-quadrant arc tangent of *Y*/*X*. At least one of the arguments must be non-zero. The result is the angle (in radians) and ranges between -π and π. To convert the result from radians to degrees, use the **@DEGREES** function.

Examples:

@ATAN2(1,1) = 0.78539816

@ATAN2(A1,A2) = -0.78539816, where A1 = 10 and A2 = -10

@ATAN2(D3,S5) = 1.5707963, where D3 = 0 and S5 = 1

@ATAN2(0,0) = Error - @ATAN2, one argument must be non-zero

@DEGREES(**@ATAN2**(1,3)) = 71.565

@ATANH

Syntax: **@ATANH(X)**

X = a numeric value between -1 and 1

@ATANH returns the hyperbolic arc tangent of angle *X*. The result is the angle (in radians) whose hyperbolic tangent is *X*.

Examples:

@ATANH(0) = 0

@ATANH(J20) = 1.127029, where J20 = 0.81

@ATANH(1) = Error - @ATANH, domain is -1 < x < 1

@AVERAGE

Syntax: **@AVERAGE(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@AVERAGE returns the average (arithmetic mean) of its arguments. Empty cells and strings are ignored. The function is given by:

$$\frac{\sum_{i=1}^{n} a_i}{n}$$

Examples:

@AVERAGE(A1,B9,J32,F16) = 21.125, where A1 = 12, B9 = 34.5, J32 = 22, F16 = 16

@AVERAGE(A1,A12..H13,111+32) = 135.67, where we don't really care what is at those variables, but which shows that you can use numbers, ranges, and expressions all together as arguments for @AVG.

@AVG

Syntax: **@AVG(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@AVG returns the average (arithmetic mean) of its arguments. Empty cells and strings are ignored. The function is given by:

$$\frac{\sum_{i=1}^{n} a_i}{n}$$

Examples:

@AVG(A1,B9,J32,F16) = 21.125, where A1 = 12, B9 = 34.5, J32 = 22, F16 = 16

@AVG(A1,A12..H13,111+32) = 135.67, where we don't really care what is at those variables, but which shows that you can use numbers, ranges, and expressions all together as arguments for @AVG.

@BESSELI

Syntax: **@BESSELI(x,n)**

X = a numeric value
N = an integer value

Computes the modified Bessel function of integer order In(x).

@BESSELJ

Syntax: **@BESSELJ(x,n)**

Computes the Bessel function of integer order Jn(x)

@BESSELK

Syntax: **@BESSELK(x,n)**

Computes the modified Bessel function of integer order Kn(x).

@BESSELY

Syntax: **@BESSELY(x,n)**

Computes the Bessel function of integer order Yn(x), also known as the Neumann function.

@BETA

Syntax: **@BETA (z, w)**

Returns the Beta function. z and w must be > 0.

@BETAI

Syntax: **@BETAI (a, b, x)**

Returns the Incomplete Beta function. a and b must be > 0. x must be 0 <= x <= 1.

@CAVG

Syntax: **@CAVG(argumentlist,C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CAVG returns the average (arithmetic mean) of those arguments which satisfy the constraint *C*. Empty cells and strings are ignored.

Examples:

@CAVG(A1..A5,#<6) = 2.333333, where A1..A5 are 2, 2, 3, 6, and 7

@CAVG(E1..E3,#>10) = Error - @CAVG, sample size less than 1, where E1 = 1, E2 = 5, and E3 = 0

@CAVG(B7..E10,#<#{-1}) = 15, where the average of the numbers in range B7..E10 which are less than the value of the cell to their left is 15.

@CCOUNT

Syntax: **@CCOUNT(argumentlist,C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CCOUNT returns a count of its non-empty arguments which satisfy the constraint *C*. Cells containing strings are counted.

Examples:

@CCOUNT(T2..T6, #==W2) = 1, where T2..T6 are 4, 7, 2, 8, 0 and W2 = 7

@CCOUNT(E1..E3,#>=0) = 3, where E1 = 1, E2 = 5, and E3 = 0

@CCOUNT(C4..C100,#>#{0,-1}) = 68, counts those cells in range C4..C100 whose value is greater than the contents of the cell immediately above

---

@CEIL

Syntax: **@CEIL(X)**

X = a numeric value

@CEIL returns the smallest integer that is greater than or equal to *X*.

Examples:

@CEIL(5.5) = 6
@CEIL(E3) = -9, where E3 = -9.99
@CEIL(C17) = 1, where C17 = 1

@CELL

Syntax: **@CELL (property, cell)**

Property = a string value
Cell = a cell reference

Return many useful things about a cell. Case is ignored in property names. The available property names are:

"Address"	The coordinates of the cell, as a string in A1 notation. For example, @CELL("address",C4) is equal to the string "$C$4". The sheet name is NOT included.
"BackGroundColor"	Index of background color
"Bold"	1 if Bold attribute; 0 otherwise
"BottomBorder"	Index of border style
"BottomBorderColor"	Index of border color
"Col"	The number of the column containing the cell. Equivalent to the @COL(cell) function.
"Contents"	Contents (value) of the cell
"Coord"	The fully-qualified coordinates of the cell, as a string. For example, @CELL("coord",C4) on Sheet1 would be equal to the string "$Sheet1!$C$4".
"FontFace"	Index number of font family
"FontSize"	In points. 0 indicates default value
"FontStyle"	Font Style 0 Standard 1 Italic 2 Bold 3 Bold Italic
"Halign"	Horizontal Alignment 0 Default 1 Left 2 Right 3 Center 4 Automatic
"Italic"	1 if Italic; 0 otherwise
"LeftBorder"	Index of border style
"LeftBorderColor"	Index of border color
"Orientation"	The orientation property 0 Default 1 Horizontal

	2 Vertical 3 Up 4 Down
"Pattern"	Background pattern index
"PatternColor"	Index of pattern foreground color
"Protect"	Cell protection attribute 0 Default 1 Off 2 On
"RightBorder"	Index of border style
"RightBorderColor"	Index of border color
"Rotation"	The amount of rotation for letters, in degrees (NOT the same as the orientation). So the cells using the Vertical orientation have the same rotation as cells using the Horizontal rotation, but cells using Up or Down orientation have either +90 or -90 rotation.
"Row"	The number of the row containing the cell. Equivalent to the @ROW(cell) function.
"Sheet"	The number of the sheet containing the cell. Equivalent to the @SHEET(cell) function.
"SheetName"	The name of the sheet containing the cell.
"StrikeThrough"	1 if strikethrough attribute; 0 otherwise.
"TextColor"	Index of color used for cell text.
"TopBorder"	Index of border style.
"TopBorderColor"	Index of border type
"Type"	b empty ("blank") l label (string constant) v anything else
"Underline"	Underline attribute 0 Default 1 None 2 Single underline 3 Double underline
"Valign"	Vertical alignment 0 Default 1 Top 2 Bottom 3 Center

"Wrap"	Word-wrap attribute 0 Default 1 Off 2 On

@CELLPOINTER

Syntax: **@CELLPOINTER (property)**

Property = a string value

Returns cell attribute information about the current cell (containing a formula using this function). The values for property are the same as for the @CELL function.

@CELLREF

Syntax: **@CELLREF(N1,N2)**

N1 = a numeric value
N2 = a numeric value

@CELLREF returns a reference to the cell whose column index is *N1* and whose row index is *N2*. Column indices start with 0, so the column index for column A is 0, B is 1, etc. Row indices are the same as the row number, and therefore start with 1.

Examples:

@CELLREF(3,1) = -80, where D1 = -80
@CELLREF(27,34) = 2400, where AA34 = 2400
@CELLREF(4,8) = 100.00, where E8 = 100.00

@CHAR

Syntax: **@CHAR(n)**

n = an ASCII code from 1 to 255

@CHAR returns the character represented by the integer code n.

Examples:

@CHAR(55) = "7"
@CHAR(C2) = "C", where C2 = 67
@CHAR(F5) = "£", where F5 = 163

@CHOOSE

Syntax: **@CHOOSE(N, argumentlist)**

N = a numeric value
argumentlist = any combination of numbers, strings, or cell addresses separated by commas.

@CHOOSE returns the *N*th argument from the argument list, starting with an index of 0. N should be less than the number of items in *argumentlist* - 1.

Examples:

@CHOOSE(2,D1,C22,F5,K1) = 54, where F5= 54

@CHOOSE(1,A9,D23,G12) = "Peaches", where D23 = "Peaches"

@CHOOSE(3,"nuts","rings","bolts","fittings") = "fittings"

@SUM(**@CHOOSE**(A1>B1,B1..B10,A1..A10)) sums either column A or column B.

@CLEAN

Syntax: **@CLEAN(S)**

S = a string value

@CLEAN returns the string formed by removing all non-printing characters from the string *S*.

Examples:

@CLEAN(A1) = "test", where *A1*=@STRCAT(A2,A3), A2="test" and A3=@CHAR(10)

@CMAX

Syntax: **@CMAX(argumentlist, C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CMAX returns the maximum value among its arguments which satisfy the constraint *C*. Empty cells and cells containing strings are not counted.

Examples:

@CMAX(A1..A6,#<@SUM(A11,A12)) = 56, where A1..A6 are 4, 56, 33, 100, 0, -1; A11=50 and A12=50

@CMAX(S3..S7,#<0) =-1, where S3..S7 = -1, -4, -99, -20, and -1.5

@CMAX(F1..F25,#<D1||#>D2) = 1.99, where the maximum of the values in range F1..F25; are less than D1 or greater than D2.

@CMIN

Syntax: **@CMIN(argumentlist,C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CMIN returns the minimum value among its arguments which satisfy the constraint *C*. Empty cells and cells containing strings are not counted.

Examples:

@CMIN(A1..A6,#<@SUM(A11,A12)) = -1, where A1..A6 are 4, 56, 33, 100, 0, -1 and A11=50 and A12=50

@CMIN(S3..S7,#<0) = -99, where S3..S7 = -1, -4, -99, -20, and -1.5

@=code(CMIN(F1..F25,#<D1||#>D2) = .99, where the minimum of the values in range F1..F25; are less than D1 or greater than D2.

@CODE

Syntax: **@CODE(S)**

S = a string value

@CODE returns the ASCII code for the first character in string *S*.

Examples:

@CODE("test") = 116

@CODE(H100) = 107, where H100 = "k"

@CODE(M10) = 56, where M10 = "89"

@COL

Syntax: **@COL(C)**

C = a cell or range. If *C* is omitted the current column will be returned.

@COL returns the column index of the cell referenced by *C*, or the left-most column if *C* is a range.

Examples:

@COL(A1) = 0

@COL(F10..G19) = 5

@COL = 25, where @COL is in cell Z20.

@COLS

Syntax: **@COLS(R)**

R = a range

@COLS returns the number of columns in the specified range.

Examples:

@COLS(*A*3..J17) = 10

@COMPLEX

Syntax: **@COMPLEX(a,b [,s])**

a = a number representing the real part of a complex number
b = a number representing the imaginary coefficient of a complex number.
s = a string containing "i" or "j"

@COMPLEX returns as a string the complex number defined by the coefficients a and b of the form "`a + bi`" or "`a + bj`", depending on the value of s, either "i" or "j".

Examples:

@COMPLEX(3,4) = "`3+4i`"
@COMPLEX(0,3) = "`3i`"
@COMPLEX(3-4) = "`3-4i`"

@COORD

Syntax: **@COORD (sheet, column, row [, flags])**

Sheet = sheet number (1 origin)
Column = column number (0 origin for column A)
Row = row number (1 origin)
Flags = an integer

Returns a string giving a cell specification. Sheet and row are 1-origin and column is 0-origin, to be consistent with other functions such as @CELLREF. The flags argument specifies which elements in the address string are absolute.

For example, the function reference =@COORD(1, 0, 1, flags) would return the following strings for the possible values of flags:

1 - $Sheet1!$A$1
2 - $Sheet1!A$1
3 - $Sheet1!$A1
4 - $Sheet1!A1
5 - Sheet1!$A$1
6 - Sheet1!A$1
7 - Sheet1!$A1
8 - Sheet1!A1

@CORR

Syntax: **@CORR(R1,R2)**

R1 = a range
R2 = a range

@CORR returns Pearson's product-moment correlation coefficient for the paired data in ranges *R1* and *R2*. *R1* and *R2* must have the same dimensions. The result is between -1 and 1. **@CORR** can be used to determine whether pairs of data are statistically related. The closer the correlation is to zero, the less likely that they are related. The function is given by:

$$\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)\left(y_i-\bar{y}\right)}{\sqrt{\left(\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2\right)\left(\sum_{i=1}^{n}\left(y_i-\bar{y}\right)^2\right)}}$$

Examples:

@CORR(A1..A4,B1..B4) = 0.44213546, where A1..A4 = .5, .98, .22, .1, and B1..B4 = .87, .6, .21, .49.

@CORR(H5..H9,K5..K9) = 0.92384914, where H5..H9 = 14, 35, 37, 0, 33, and K5..K9 = 67, 77, 94, 34, 99.

@CORR(F1..F9,G1..G15) = Error - @CORR, ranges must be same dimensions

---

@COS

Syntax: **@COS(X)**

X = a numeric value expressed in radians.

@COS returns the cosine of angle *X*. The result is between -1 and 1. To convert the argument from degrees to radians, use the **@RADIANS** function.

Examples:

@COS(-45) = 0.52532199

@COS(K24) = 0.5403023, where K24 = 1

@COS(@RADIANS(30)) = 0.866025

@COSH

Syntax: **@COSH(X)**

X = a numeric value

@COSH returns the hyperbolic cosine of angle *X*. The result is greater than or equal to 1.

Examples:

@COSH(1) = 1.543080635

@COSH(FF1) = 3.762195691, where FF2 = -2

@COSH(0) = 1

@COT

Syntax: **@COT(X)**

X = a numeric value

@COT returns the cotangent of X.

@COTH

Syntax: **@COTH(X)**

@COTH returns the hyperbolic cotangent of X.

@COUNT

Syntax: **@COUNT(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@COUNT returns a count of its non-empty arguments. Cells that contain strings are counted.

Examples:

@COUNT("Tom","Bob","Sue","Mary","Zack","Ann") = 6

@COUNT(D4..D8) = 3, where D4 is empty, D5 = 1, D6 is empty, D7 = 0, and D8 = 5

@COUNT(E5..J10) = 30, E5..J10 contains 36 cells, therefore 6 cells are empty

---

@COUPDAYBS

Syntax: **@COUPDAYSBS(S, M, F, [B])**

S = The settlement date
M = The maturity date
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used.

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@COUPDAYSBS returns the number of days between the beginning of the coupon period and the settlement date.

Examples:

@COUPDAYBS(@DATE(1993,2,15),@DATE(1994,12,20),2,0) = 55

@COUPDAYBS(@DATE(1993,2,15),@DATE(1994,12,20),2,1) = 57

@COUPDAYS

Syntax: **@COUPDAYS(S, M, F, [B])**

S = The settlement date
M = The maturity date
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used.

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@COUPDAYS returns the number of days in the coupon period that the settlement date is in.

Examples:

@COUPDAYS(@DATE(1993,2,15),@DATE(1994,12,20),2,0) = 180

@COUPDAYS(@DATE(1993,2,15),@DATE(1994,12,20),2,1) = 182

@COUPDAYSNC

Syntax: **@COUPDAYSNC(S, M, F, [B])**

S = The settlement date
M = The maturity date
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@COUPDAYSNC returns the number of days between the settlement date and the next coupon date.

Example:

@COUPDAYSNC(@DATE(1993,2,15),@DATE(1994,12,20),2,0) = 125

@COUPNCD

Syntax: **@COUPNCD(S, M, F, [B])**

S = The settlement date
M = The maturity date
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@COUPNCD returns the next coupon date after the settlement date.

Example:

@COUPNCD(@DATE(1993,2,15),@DATE(1994,12,20),2,0) = 34140 or 20-Jun-1993

@COUPNUM

Syntax: **@COUPNUM(S, M, F, [B])**

S = The settlement date
M = The maturity date
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@COUPNUM returns the number of coupon payments between the settlement date and the maturity date.

Example:

@COUPNUM(@DATE(1993,2,15),@DATE(1994,12,20),2,0) = 4

@COUPPCD

Syntax: **@COUPPCD(S, M, F, [B])**

S = The settlement date
M = The maturity date
F = The number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@COUPPCD returns the previous (most recent) coupon date before the settlement date.

Example:

@COUPPCD(@DATE(1993,2,15),@DATE(1994,12,20),2,0) = 33958

or 12/20/1992

@CSC

Syntax: **@CSC(X)**

X = a non-zero numeric value

@CSC returns the cosecant of X.

Examples:

@CSC(0.01) = 100.00167
@CSC(3) = 7.0861674
@CSC(4) = -1.3213487

@CSCH

Syntax: **@CSCH(X)**

X = a numeric value

@CSCH returns the hyperbolic cosecant of X.

Examples:

@CSC(1) = 0.85091813

@CSTD

Syntax: **@CSTD(argumentlist, C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CSTD returns the standard deviation (N weighting) of its arguments that satisfy the constraint *C*. Empty cells and cells containing strings are not counted.

Examples:

@CSTD(A1..A3,#<10) = 2.6246693, where A1..A3 are 1, 2, and 7
@CSTD(Y1..Y5,#>25) = 6.6833126, where Y1..Y5 = 22,24,29,34,45

@CSTDS

Syntax: **@CSTDS(argumentlist, C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CSTDS returns the sample standard deviation (N-1 weighting) of its arguments which satisfy the constraint *C*. Empty cells and cells containing strings are not counted.

Examples:

@CSTDS(A1..A3,#<10) = 3.2145503, where A1..A3 are 1, 2, and 7
@CSTDS(Y1..Y5,#>25) = 8.1853528, where Y1..Y5 = 22, 24, 29, 34, and 45

@CSUM

Syntax: **@CSUM(argumentlist, C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CSUM returns the sum of its arguments which satisfy the constraint *C*. Empty cells and cells containing strings are not counted.

Examples:

@CSUM(L1..L3,#<5) = 1.32, where L1 = 1.32, L2 = 5.45, L3 = 8.32

@CSUM(C5..C10,#>=D1/D10) = 150, where C5..C10 are 10, 20, 30, 40, 50, and D1 = 100 and D10 = 10

@CTERM

Syntax: **@CTERM(R, FV, PV)**

R = interest rate
FV = future value of the investment
PV = present value of the investment

@CTERM calculates the number of compounding periods required for an investment of PV to reach a value of FV at the given interest rate R. The formula is given by:

$$\frac{\ln\left(\frac{FV}{PV}\right)}{\ln\left(1+R\right)}$$

Examples:

@CTERM(0.085,1500,1000) = 4.97 (years, if the annual interest rate is 8.5%)

@CTERM(B5,D5,C5) = 11, where B5 = 10.5%, D5 = $300,000, and C5 = $100,000

@CTERM(.09,1900,1100) = 6.3

@CUMIPMT

Syntax: **@CUMIPMT(R, N, P, S, E, T)**

R = Rate, a numeric expression
N = Number of payments, an integer > 0
P = Present value
S = Starting period in calculation
E = Ending period in calculation
T = (Optional) timing of the payment
0 payment is made at the end of the period
1 payment is made at the beginning of the period

@CUMIPMT returns the cumulative interest paid between S (the start) and E (the end) on a loan.

Make sure that you are consistent about the units used for specifying R and N. For Example, for a 4-year loan with 10% annual interest rate, use 10%12 for R and 4*12 for N)

Example:

@CUMIPMT(9.5%/12,30*12,100000,1,12, 0) = 9473.61

@CUMPRINC

Syntax: **@CUMPRINC(R, N, P, S, E, T)**

R = Rate, a numeric expression
N = Number of payments, an integer > 0
P = Present value
S = Start of loan
E = End of loan
T = (Optional) timing of the payment
0 payment is made at the end of the period
1 payment is made at the beginning of the period

@CUMPRINC returns the cumulative principal paid between S (the start) and E (the end) on a loan.

Make sure that you are consistent about the units used for specifying R and N. For Example, for a 4-year loan with 10% annual interest rate, use 10%12 for R and 4*12 for N)

Example:

@CUMPRINC(9.5%/12,30*12,100000,1,12, 0) = 616.64

@CVAR

Syntax: **@CVAR(argumentlist, C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CVAR returns the population variance (N weighting) of its arguments which satisfy the constraint *C*. Blank cells and cells containing strings are not included.

Examples:

@CVAR(Y1..Y5,#<25) = 1, where Y1..Y5 = 22, 24, 29, 34, and 45

@CVAR(A1..A3,#<C2*E7) = 6.8888889, where A1..A3 are 1, 2, 7, and C2 = 5 and E7 = 2

@CVARS

Syntax: **@CVARS(argumentlist, C)**

argumentlist = any combination of cells or ranges
C = a constraint expression

@CVARS returns the sample variance (N-1 weighting) of its arguments which satisfy the constraint *C*. Empty cells and cells containing strings are not included.

Examples:

@CVARS(Y1..Y5,#<25) = 2, where Y1..Y5 = 22, 24, 29, 34, and 45

@CVARS(A1..A3,#<C2*E7) = 10.333333, where A1..A3 are 1, 2, 7, and C2 = 5 and E7 = 2

@DATE

Syntax: **@DATE(Y, M, D)**

Y = year
M = month
D = day

@DATE returns the date value corresponding to year *Y*, month *M*, and date *D*. If *Y* is between 0 and 99, it is assumed to be in the current century, unless modified in **Workbook Defaults**. . Otherwise, it represents the year from 100 to 3999.

Examples:

@DATE(66,4,6) = 24203, April 6, 1966

@DATE(366) = Error! wrong number or arguments

@DATEVALUE

Syntax: **@DATEVALUE(S)**

S = string value of a date

@DATEVALUE returns the corresponding date value for a given string *S*. It interprets the value of S as if it had been entered into a cell.

The year may be given as 2 or 4 digits. A two year digit assumes the current century.

In the above formats, the month (MMM) is case insensitive and may be either the standard 3 letter abbreviation or the full name of the month.

Examples:

@DATEVALUE("3/24/1954") = 19807

@DATEVALUE("3/24/54") = 19807

@DATEVALUE("4-July-1994") = 34519

@DATEVALUE("4-July") = 34519, where the year is omitted, and assuming the year is 1994.

@DATEVALUE("September-94") = 34578

@DATEVALUE("Sep-1994") = 34578

@DATEVALUE("SEP") = 34578, where the year is omitted, and assuming the year is 1994.

@DATEVALUE("06.04.66") = 24203

@DATEVALUE("06.04.1966") = 24203

CAUTION: When the year is defaulted, the value returned by @DATEVALUE will vary depending on the year.

@DAY

Syntax: **@DAY(DT)**

DT = a date/time value

@DAY returns the day of the month component of the date/time value *DT*.

Examples:

@DAY(24203) = 6 (24203 represents April 6, 1966)

@DAY(@TODAY) = 25, where TODAY = January 25, 1994

@DAY(366) = 31 (366 represents December 31, 1900)

@DAYS360

Syntax: **@DAYS360(S, E)**

S = Start date
E = End date

@DAYS360 returns the number of days between two dates, based on a 30/360 Day Count Basis (30-day-per-month, 360-day year.) Please refer to "Financial Functions" in Chapter 7 for more detail on 30//360 day count basis.

Examples:

@DAYS360(@DATE(1992,5,1),@DATE(1992,6,1)) = 30

@DAYS360(@DATE(1993,2,28),@DATE(1993,3,1)) =1

@DAYS360(@DATE(1992,2,28),@DATE(19923,1)) = 3 (1992 is a leap year.)

@DB

Syntax: **@DB(C, S, L, N, M)**

C = Initial cost of asset
S = Salvage value of asset
L = Number of periods over which the asset is depreciating (life)
N = Number of periods over which to calculate the depreciation
M = (Optional) Number of months in the first year. Assumed to be 12 if omitted.

@DB returns the fixed-declining real depreciation of an asset for a specified period.

Example:

@DB(40000,100,6,3,2) = 8323.1198

@DDB

Syntax: **@DDB(C, S, L, P)**

C = cost
S = salvage value
L = allowable life
P = the period for which the double declining depreciation allowance is being calculated

@DDB returns the double-declining depreciation allowance given cost *C*, salvage value *S*, allowable life *L*, and *N* number of depreciation periods. The function is given by:

$$\frac{bookvalue*2}{L}$$

where *bookvalue* is the current book value of the asset and *L* is the estimated life of the asset.

The double declining balance depreciation allowance for the P^{th} *depreciation period (*DDB_p*)* is calculated by the following iteration formula, where BV_i is the following iteration formula, where BV_i is the book value for the i^{th} depreciation period.

$BV_0 = C$

for *i=1* to *P* do
DDB_i = max(2(BV_i / *L*), 0)
BV_i = max(BV_{i-1} − DDB_i, *S*)

Examples:

@DDB(200,120,25,10) = 9.6

@DDB(F9,F5,10,6) = 524.29, where F5 = $1800.00 and F9 = $8000.00

@DDB(200,220,10,7) = error!, must have "cost" >= "salvage" >= 0

@DEGREES

Syntax: **@DEGREES(X)**

X = a numeric value

@DEGREES returns 180/π * *X*.

Examples:

@DEGREES(0.5) = 28.64789

@DEGREES(@PI) = 90

@DELTA

Syntax: **@DELTA (number1[,number2])**

Returns a 1 if number1 == number2, or 0 if number1 != number2. If number2 is not specified, it is assumed to be 0.

@DET

Syntax: **@DET(M)**

M = a range, which must contain an equal number of rows and columns.

@DET returns the determinant of the matrix specified by the range *M*, which must be square.

Examples:

Matrix A1..C3

	A	B	C
1	1	2	6
2	3	4	11
3	4	7	2

@DET(A1..C3) = 37

@DET(A1..B3) = Error - @DET, matrix must be square

@DFT

Syntax: **@DFT(R)**

R = a range representing a vector

@DFT generates the Discrete Fourier Transform of the given range *R*. *R* must represent a real vector (either its row or column dimension must be 1), or a complex vector (either its row or column dimension must be 2). The result is a complex vector.

Example:

Vector C1..C4	**C**
1	1.2
2	3.4
3	54.3
4	0.34

@DFT(C1..C4) =	59.2	0
	-53.1	3.06
	51.8	0
	-53.1	-3.06

@DISC

Syntax: **@DISC(S, M, P, R, B)**

S = Settlement date
M = Maturity date
P = Price per $100
R = Redemption value per $100
B = (Optional) The day count basis to be used.

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@DISC returns the discount rate of a security.

Examples:

@DISC(@DATE(1993,1,10), @DATE(1993,7,20),97.375,100,3) = 0.05016

@DISC(@DATE(1993,1,10), @DATE(1993,7,20),97.375,100) = 0.04974

@DOLLAR

Syntax: **@DOLLAR(X, P)**

X = Numeric value to be converted
P = Optional number of places, default of 2.

@DOLLAR returns as a string the value X formatted with the Dollars format rounded at P fractional digits. If P is less than 0, then the value is rounded at that many digits left of the decimal point.

Examples:

@DOLLAR(12345.678) = "$12,345.68 "
@DOLLAR(-12345.678) = "($12,345.68)"
@DOLLAR(12345.678,1) = "$12,345.7 "
@DOLLAR(12345.678,-2) = "$12,300 "

@DOLLARDE

Syntax: **@DOLLARDE(D, F)**

D = Dollars (in fractional form)
F = Fraction (denominator of fraction)

@DOLLARDE returns the amount in Dollar Decimal form of an amount expressed in fractional form.

Examples:

@DOLLARDE(1.02,8) = 1.025
@DOLLARDE(1.2,8) = 1.25
@DOLLARDE(10.16,32) = 10.5

@DOLLARFR

Syntax: **@DOLLARFR(D, F)**

D = Dollars (in decimal form)
F = Fraction (denominator of fraction)

@DOLLARFR returns the amount in Dollar Fractional form of an amount expressed in decimal form.

Examples:

@DOLLARFR(1.025,8) = 1.02

@DOLLARFR(1.25,8) = 1.2

@DOLLARFR(10.5,32) = 10.16

@DOT

Syntax: **@DOT(R1, R2)**

R1= a vector
R2 = a vector

@DOT returns the dot product of two vectors. *R1* must have the same number of rows and columns as *R2*, or *R1* and *R2* can be one-dimensional vectors of the same length.

Examples:

Matrix 1, A1..B2

	A	B
1	1	3
2	2	4

Matrix 2, C1..D2

	C	D
1	9	5
2	2	4

@DOT(A1..B2,C1..D2) =44

@DOT(A1..B1,C1..C2) = 15

@DOT(A1..B2,D1..D2) = Error - @DOT, incompatible range dimensions

---

@DURATION

Syntax: **@DURATION(S, M, C, Y, F [,B])**

S = Settlement date
M = Maturity date
C = Annual coupon rate
Y = Annual yield
F = Number of payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@DURATION returns the Macauley duration for an assumed par value of $100.

Example:

@DURATION(@DATE(1990,1,1),@DATE(1995,1,1),10%,8%,2,0) = 4.0954

@EDATE

Syntax: **@EDATE(S, M)**

S = Start date
M = Months

@EDATE returns a date/time value representing the date M months after S if M is positive, and M months previous to S if M is negative. The date returned will be on the same day of the month as S.

Examples:

@EDATE(@DATEVALUE("2/29/1992"),3) = 33753 or 05/29/1992

@EDATE(@DATEVALUE("2/29/1992"),12) = 34028 or 2/28/1993

@EDATE(@DATEVALUE("3/30/1993"),-6) = 33877 or 09/30/1992

@EFFECT

Syntax: **@EFFECT(R, P)**

R = Nominal rate
P = Number of compounding periods per year

@EFFECT returns the effective annual interest rate.

Example:

@EFFECT(6.75%,5) = 0.06935

@EIGEN

Syntax: **@EIGEN(M)**

M = a matrix

@EIGEN generates the eigenvalues of the matrix *M*, which must be square and symmetric.

Examples:

Matrix B9..C10

	B	C
9	0	1
10	1	2

@EIGEN(B9..C10) =

-0.414
2.4142

Matrix A1..B4

	A	B
1	.99	0
2	3	6.2
3	4.1	1.1
4	3.3	6.3

@EIGEN(A1..B4) = Error - @EIGEN, matrix must be square

Matrix T5..V7

	T	U	V
5	1	2	3
6	2	3	9
7	3	9	2

@EIGEN(T5..V7) =

0.02405
-6.6074
12.5833

@ELEMDIV

Syntax: **@ELEMDIV(M,V)**

M = a matrix or vector
V = a value, a matrix or vector

@ELEMDIV generates the element-by-element quotient of the matrix M divided by the value V. If V is a matrix or vector, each element in M is divided by the corresponding element of V. If V is a scalar value, each element of M is divided by the value V. If the dimensions of the matrices are incompatible, the function generates an error.

Examples:

Matrix B9..C10

	B	C
9	0	1
10	1	2

Matrix D9..E10

	D	E
9	3	5
10	4	8

@ELEMDIV(B9..C10,D9..E10) =

0.00	0.20
0.25	0.25

@ELEMDIV(D9..E10,3) =

1.00	1.67
1.33	2.67

@ELEMDIV(A1..B3,C1..G10) = Error!, incompatible matrix dimensions

---

@ELEMMUL

Syntax: **@ELEMMUL(M,V)**

M = a matrix or vector
V = a value, a matrix or vector

@ELEMMUL generates the element-by-element product of the matrix M by value V. If V is a matrix or vector, each element in M is multiplied by the corresponding element of V. If V is a scalar value, each element of M is multiplied times the value V. If the dimensions of the matrices are incompatible, the function generates an error.

Examples:

Matrix B9..C10

	B	**C**
9	0	1
10	1	2

Matrix D9..E10

	D	**E**
9	3	5
10	4	8

@ELEMMUL(B9..C10,D9..E10) =

0	5
4	16

@ELEMMUL(D9..E10,3) =

9	15
12	24

@ELEMMUL({1,2,3},5) =

5	**10**	15

@ELEMMUL(A1..B3,C1..G10) = Error!, incompatible matrix dimensions

---

@EOMONTH

Syntax **@EOMONTH(S,M)**

S = Start date, a date/time value
M = Months, an integer

Returns a date/time value representing the date M months after S, if M is positive, and M months before S, if M is negative. The date returned will be on the last day of the month.

Examples:

@EOMONTH(@DATEVALUE("7/7/1993"),-24)= 33450 or 7/31/1991

@EOMONTH(@DATEVALUE("4/15/1994"),2)= 34515 or 6/30/1994

@ERF

Syntax **@ERF(L[,U])**

L = Lower bound for integrating ERF, L>=0
U = (Optional) Upper bound for integrating ERF

@ERF returns the error function integrated between L and U. The function is given by:

$$\frac{2}{\sqrt{\pi}}\int_{L}^{U} e^{-t^2}dt = ERF(U) - ERF(L)$$

If U is omitted, @**ERF** integrates between 0 and L:

$$\frac{2}{\sqrt{\pi}}\int_{0}^{L} e^{-t^2}dt$$

Examples:

@ERF(1) = 0.8427

@ERF(0.35) = 0.3794

@ERF(0.35,0.89) = 0.4125

@ERFC

Syntax **@ERFC(L)**

L = Lower bound for integrating ERF, L>=0

@ERFC returns the complementary error function integrated between L and infinity. The function is given by:

$$\frac{2}{\sqrt{\pi}}\int_{L}^{\infty} e^{-t^2}dt = 1 - ERF(L)$$

Example:

@ERFC(0.45) = 0.47548172

@ERR

Syntax: **@ERR**

Returns an error indicator for this cell.

@EVEN

Syntax: **@EVEN (number)**

Returns the even number with the next larger absolute value. EVEN(1) = 2, EVEN(-1) = -2.

@EXACT

Syntax: **@EXACT(S1, S2)**

S1 = a string value
S2 = a string value

@EXACT returns 1 if string *S1* exactly matches string *S2*; returns 0 otherwise.

Examples:

@EXACT("computer","computer") = 1

@EXACT("Abc","abc") = 0

@EXP

Syntax: **@EXP(X)**

X = a numeric value

@EXP returns *e* raised to the power specified by the argument, where *e* is the base of the natural log 2.71828183. **@EXP** is the inverse of the natural log function **@LN**.

Examples:

@EXP(1) = 2.71828183

@EXP(D30) = 1, where D30 = 0

@LN(**@EXP**(X4)) = 5.1, where X4 = 5.1

@EXP(710) = Error - @EXP, floating exception

@F

Syntax: **@F(M, N, X)**

M,N = degrees of freedom
X = bound

@F returns the integral of Snedecor's F-distribution with *M* and *N* degrees of freedom from minus infinity to *X*.

The function is given by:

$$F(m,n,x) = \int_0^x \frac{\Gamma\left(\frac{m+n}{2}\right)}{\Gamma\left(\frac{m}{2}\right)\Gamma\left(\frac{n}{2}\right)}(m)^{\frac{m}{2}}(n)^{\frac{n}{2}}(z)^{\frac{m-2}{2}}(n+mz)^{-\frac{m+n}{2}}dz$$

Examples:

@F(14,35,99) = 1

@F(D3,W2,Y8) = Error - @F, degrees of freedom must be > 0, where D3 = .5, W2 = 0, and Y8 = .99

@F(B1,B2,B3) = 0.77459667, where B1 = 1, B2 = 2, and B3 = 3

@FACT

Syntax: **@FACT(N)**

N = a numeric value

@FACT returns *N!* of *N*. The formula is given by:

$$N! = N \times (N-1)!, 0! = 1$$

Examples:

@FACT(4) = 24, because 4! = 4 * 3 * 2 * 1

@FACT(C13) = 3628800, where C13 = 10

@FACTDOUBLE

Syntax: **@FACTDOUBLE(N)**

N = a numeric value

@FACTDOUBLE returns *FD* of *N*. The formula is given by:

$$FD(N) = N \times FD(N-2), FD(1) = 1, FD(0) = 1$$

Examples:

@FACT(4) = 24, because 4! = 4 * 3 * 2 * 1
@FACT(C13) = 3628800, where C13 = 10

@FALSE

Syntax: **@FALSE**

@FALSE returns 0.

Examples:

@FALSE = 0
@IF(B17 == 0,@TRUE,**@FALSE**) = 0, where B17 is not equal to 0

@FFT

Syntax: **@FFT(R)**

R = a range

@FFT generates the Discrete Fourier Transform of the range *R* using a Fast Fourier Transform algorithm. The length of the range must be a power of 2. **@FFT** will produce the same results a **@DFT**, but it is much faster (N*log(N)) time, as opposed to N^2 time).

Examples:

Vector C1..C4

	C
1	1.2
2	3.4
3	54.3
4	0.34

@FFT(C1..C4) =

59.24	0
-53.1	3.06
51.76	0
-53.1	-3.06

@FILEEXISTS

Syntax: **@FILEEXISTS(S)**

S = a string value

@FILEEXISTS returns the value 1 if file *S* can be opened for reading; otherwise 0.

Examples:

@FILEEXISTS("connections.c") = 1

@FILEEXISTS("Q1EXPENSES96.XS5") = 1

@FILEEXISTS("Q1EXPENSES90.WKS") = 0

@FIND

Syntax: **@FIND(S1,S2,N)**

S1 = a string value
S2 = a string value
N = a numeric value

@FIND returns the index of the first occurrence of string *S1* in string *S2*, starting the search at position *N* in string *S2*. Note that the string index always starts with 0.

Examples:

@FIND("bc","abcdefg",0) = 1

@FIND(V1,V2,5) = 9, where V1 = "Functions", and V2 = "Built-in Functions"

@FIND(V1,V2,5) = Error - @FIND, substring not found, where V1 = "Built-in" and V2 = "Functions"

@FIXED

Syntax: **@FIXED(X, P)**

X = Numeric value to be converted
P = Optional number of places, default of 2.

@FIXED returns as a string the value X formatted with the Comma format rounded at P fractional digits. If P is less than 0, then the value is rounded at that many digits left of the decimal point.

Examples:

@FIXED(12345.678) = "12,345.68"
@FIXED(-12345.678) = "-12,345.68"
@FIXED(12345.678,1) = "12,345.7"
@FIXED(12345.678,-2) = "12,300"

@FLOOR

Syntax: **@FLOOR(X)**

X = a numeric value

@FLOOR returns the largest integer less than or equal to *X*.

Examples:

@FLOOR(5.5) = 5

@FLOOR(E3) = -10, where E3 = -9.99

@FLOOR(C17) = 3, where C17 = 3.45

@FORECAST

Syntax: **@FORECAST(X', X, Y)**

X'= New x value
X = Old x value
Y = Old y value

@FORECAST returns *Y'*, the predicted value for y for *X'*, given original x and y values X and Y.

Example:

	A	B
1	20	6
2	28	7
3	31	9
4	38	15
5	40	21

@FORECAST(30, A1..A5, B1..B5) = 10.60725

@FORMAT

Syntax: **@FORMAT(F, N, X)**

F = the XEC format code
N = the precision level, from 0 to 15
X = a numeric value

@FORMAT returns the string formed by formatting the numeric value *X* using the XEC format code *F* and the precision specified by *N*. For a list of valid formats see Table 4-1.

Examples:

@FORMAT("dollars",2,660406) = "$660,406.00"

@FORMAT("hex",0,660406) = "OxA13B6"

@FORMAT("general",2,660406) = "6.6e+05"

@FRAC

Syntax: **@FRAC(X)**

X = a numeric value

@FRAC returns the fractional portion of *X*.

Examples:

@FRAC(232.45566) = 0.45566

@FRAC(20) = 0

@FRAC(@PI) = 0.14159265

@FREQUENCY

Syntax: **@FREQUENCY(R, B)**

R = a range of values on which frequencies will be counted
B = a range of intervals used to group values in *R*.

@FREQUENCY returns a frequency distribution for a set of values *R* with a set of intervals *B*

Example:

@FREQUENCY(A1..A8,B1..B2) = 3,2,2
where A1..A8 = 70,79,80,61,83,93,88,97 and B1..B2 = 80,90

@FTEST

Syntax: **@FTEST(R1, R2)**

R1 = a range
R2 = a range

@FTEST returns the significance level (alpha) of the two-sided F-test on the variances of the data specified by ranges *R1* and *R2*. Alpha is the probability of error in rejecting the null hypothesis that var[*R1*]=var[*R2*].

Examples:

@FTEST(A1..A4,B1..B4) = 0.57065573, where A1..A4 = .5, .98, .22, .1, and B1..B4 = .87, .6, .21, .49

@FTEST(H5..H9,K5..K12) = 0.62049415, where H5..H9 = 14, 35, 37, 0, 33, and K5..K12 = 67, 77, 94, 34, 99, 56, 86, 67

@FV

Syntax: **@FV(P, R, N)**

P = periodic payment
R = interest rate
N = number of periods

@FV returns the future value of an annuity given periodic payment *P*, interest rate *R*, and *N* number of periods. The function is given by:

$$P\frac{\left(1+R\right)^{N}-1}{R}$$

Examples:

@FV(100,0.085,5) = 592.54

@FV(G7,C2,2) = 6240, where C2 = 8% and G7 = $3000.00

@FV(1000,0.075,1.5) = 15.27

@FVSCHEDULE

Syntax: **@FVSCHEDULE(P, R)**

P = Principal, or present value
R = An array of interest rates by which to compound

@FVSCHEDULE returns the future value of an initial principal after compounding by a series of interest rates.

Example:

@FVSCHEDULE(100,A1..A4) = 133.4260, where A1..A4 = 7.5%, 6.6%, 8%, 7%

@GAMMA

Syntax: **@GAMMA(X)**

X = a numeric value

@GAMMA returns the value of the Euler's gamma function evaluated for values of $X > 0$, and less than or equal to approximately 171 (less on a few computers with limited mathematics capabilities). Gamma is a continuous function whose value for integer arguments *N* is $(N-1)!$ ($N-1$ factorial). The function is given by:

$$\int_0^{\infty} e^{-x} x^{n-1} dx$$

Examples:

@GAMMA(5) = 24

@GAMMA(1.59) = 0.89243

@GAMMA(L38) = Error - @GAMMA, floating exception, where L8 = 175

@GCD

Syntax: **@GCD (list)**

Returns the greatest common divisor of the numbers in the list.

@GMEAN

Syntax: **@GMEAN(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges with each of the values greater than or equal to 0

@GMEAN returns the geometric mean of its arguments. Empty cells and cells containing strings are not included. The function is given by:

$$\sqrt[n]{\prod_{i=1}^{n} a_i}$$

Examples:

@GMEAN(56,49,99) = 64.76491

@GMEAN(F10..F14) = 3.4712517, where F10..F14 = 2, 2, 3, 6, and 7

@GMEAN(U7..V15) = Error - @GMEAN, operand less than or equal to zero, where U13 = 0

@GRAND

Syntax: **@GRAND**

@GRAND returns a 12th-degree binomial approximation to a Gaussian random number. A set of these numbers will approximate a normal (bell-shaped) distribution with a mean of 0 and a variance of 1. The number will change with every recalculation.

Examples:

@GRAND = 1.2255531

@GRAND = 1.5264478

@GRAND = -0.98732934

@HEXTONUM

Syntax: **@HEXTONUM(S)**

S = a string value

@HEXTONUM returns the numeric value for the hexadecimal (base 16) interpretation of *S*. Since XEES can operate directly on hexadecimal numbers, this function is not very useful; it is included primarily to maintain compatibility with other spreadsheets.

Examples:

@HEXTONUM("A") = 10

@HEXTONUM(J10) = 45019, where J10 = "AFDB"

@HLOOKUP

Syntax: **@HLOOKUP(X, R, N)**

X = a numeric or string value
R = a range
N = a numeric value

@HLOOKUP returns the value of a cell found by performing a horizontal table lookup.

@HLOOKUP searches the first row (known as the index row) in the range *R* for the numeric or string value which "matches" *X*, and returns the value *N* rows beneath the matching cell.

If X is a string value, an exact match must be found or an error is returned.

If *X* is a numeric value, the index row must contain numeric values, sorted in ascending order, and the matching column is determined by the following rules:

1) Strings and empty cells in the index row are ignored.
2) If the first value in the index row is greater than *X*, an error is returned.
3) Searching stops when a numeric value which is greater than or equal to *X* is found in the index row. If the value found is greater than *X*, the preceding column is the matching column.
4) If there are no numeric values in the index row which are greater than or equal to X, the last column in R is considered to be the matching column.

Examples:

	A	B	C	D
1	Lodging	Meals	Airfare	Entertainment
2	$85.00	$30.00	$698.00	$25.00

@HLOOKUP("Meals",A1..D2,1) = 30

@HLOOKUP("Airfare",A1..D2,1) = Error - @HLOOKUP, lookup failed to produce a match

@HLOOKUP("Airfare",A1..D2,3) = Error - @HLOOKUP, row offset out of range

---

@HMEAN

Syntax: **@HMEAN(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges where each value is not equal to 0

@HMEAN returns the harmonic mean of its arguments. Empty cells and cells containing strings are not counted.

The function is given by:

$$\frac{n}{\frac{1}{a_1}+\frac{1}{a_2}+\ldots+\frac{1}{a_n}}$$

Examples:

@HMEAN(F10..F15) = 3.0434783, where F10..F14 = 2, 2, 3, 6, 7

@HMEAN(C1..C5) = Error - @HMEAN, operand equal to 0, where C4 = 0

@HOUR

Syntax: **@HOUR(DT)**

DT = a date/time value

@HOUR returns the hours (0 - 23, where 0 represents midnight) component of the date/time value *DT*.

Examples:

@HOUR(.25) = 6

@HOUR(0) = 0

@HOUR(.99) = 23

@IF

Syntax: **@IF(X, T [,F])**

X = a numeric value
T = a value
F = a value

@IF returns the value of *T* if *X* evaluates to non-zero, or *F* if *X* evaluates to zero. If *F* is omitted, it is assumed to be 0.

Examples:

@IF(A1,7,9) = 7, where A1 = 1

@IF(B17==0,0,"non-zero") = "non-zero", where B17 = 1

@IMABS

Syntax: **@IMABS(A)**

A = a complex numeric value, as a string

@IMABS returns the absolute value (modulus) of the complex number *A*.

Example:

@IMABS("3+4i")= 5

@IMAGINARY

Syntax: **@IMAGINARY(A)**

A = a complex numeric value, as a string

@IMAGINARY returns the value of the imaginary coefficient of the complex number *A*.

Examples:

@IMAGINARY("3+4i") = 4
@IMAGINARY("1-7j") = -7

@IMARGUMENT

Syntax: **@IMARGUMENT(A)**

A = a complex numeric value, as a string

@IMARGUMENT returns as a complex number the argument (or amplitude) of the complex number *A*.

Examples:

@IMARGUMENT("3+4i") = 0.92729522
@IMARGUMENT("1-7j") = -1.4288993

@IMCONJUGATE

Syntax: **@IMCONJUGATE(A)**

A = a complex numeric value, as a string

@IMCONJUGATE returns as a complex number the value of the conjugate of the complex number *A*.

Examples:

@IMCONJUGATE("3+4i") = "3-4i"
@IMCONJUGATE("1-7j") = "1+7j"

@IMCOS

Syntax: **@IMCOS(A)**

A = a complex numeric value, as a string

@IMCOS returns as a complex number the value of the cosine of the complex number *A*.

Examples:

@IMCOS("3+4i") = "-27.0349456-3.851153i"
@IMCOS("1-7j") = "296.256958+461.3921j"

@IMDIV

Syntax: **@IMDIV(A, B)**

A = a complex numeric value, as a string
B = a complex numeric value, as a string

@IMDIV returns as a complex number the quotient of *A* divided by *B*.

Examples:

@IMDIV("3+4i","3-i") = "0.5+1.5i"
@IMDIV("1-7j","3-j") = "1-2j"

@IMEXP

Syntax: **@IMEXP(A)**

A = a complex numeric value, as a string

@IMEXP returns as a complex number the exponetial of the complex number *A*.

Examples:

@IMEXP("3+4i") = "-13.128783-15.20078i"
@IMEXP("1-7j") = "2.04932-1.78588j"

@IMLN

Syntax: **@IMLN(A)**

A = a complex numeric value, as a string

@IMLN returns as a complex number the natural logarithm of the complex number *A*.

Examples:

@IMLN("3+4i") = "1.609438+0.9272952i"
@IMLN("1-7j") = "1.9560-1.4289j"

@IMLOG10

Syntax: **@IMLOG10(A)**

A = a complex numeric value, as a string

@IMLOG10 returns as a complex number the common logarithm (base 10) of the complex number *A*.

Examples:

@IMLOG10("3+4i") = "0.69897+0.40272i"
@IMLOG10("1-7j") = "0.849485+0.620563j"

@IMLOG2

Syntax: **@IMLOG2(A)**

A = a complex numeric value, as a string

@IMLOG2 returns as a complex number the logarithm base 2 of the complex number *A*.

Examples:

@IMLOG2("3+4i") = "2.321928+1.33780i"
@IMLOG2("1-7j") = "2.821928-2.061466j"

@IMPOWER

Syntax: **@IMPOWER(A, X)**

A = a complex numeric value, as a string
X = a number

@IMPOWER returns as a complex number the value of the complex number *A* raised to the power *X*.

Examples:

@IMPOWER("3+4i",3) = "-117+44i"
@IMPOWER("3+4i",0.5) = "2+i"

@IMPRODUCT

Syntax: **@IMPRODUCT(A1, A2, ... An)**

An = a series complex numeric values, as strings
(Each argument may be a range of values.)

@IMPRODUCT returns as a complex number the product of the complex numbers *A1* through *An*.

Examples:

@IMPRODUCT("3+4i","1-7i") = "31-17i"
@IMPRODUCT("1-7j","4j") = "28+4j"

@IMREAL

Syntax: **@IMREAL(A)**

A = a complex numeric value, as a string

@IMREAL returns the value of the real componnent of the complex number *A*.

Examples:

@IMREAL("3+4i") = 3
@IMREAL("1-7j") = 1

@IMSIN

Syntax: **@IMSIN(A)**

A = a complex numeric value, as a string

@IMSIN returns as a complex number the value of the sine of the complex number *A*.

Examples:

@IMSIN("3+4i") = "3.853738-27.016813i"
@IMSIN("1-7j") = "461.392876-296.2564657j"

@IMSQRT

Syntax: **@IMSQRT(A)**

A = a complex numeric value, as a string

@IMSQRT returns as a complex number the square root of the complex number *A*.

Examples:

@IMSQRT("3+4i") = "2+i"
@IMSQRT("1-7j") = "2.00886-1.742278j"

@IMSUB

Syntax: **@IMSUB(A, B)**

A = a complex numeric value, as a string
B = a complex numeric value, as a string

@IMSUB returns as a complex number the difference between the complex numbers *A* and *B*.

Examples:

@IMSUB("3+4i","1-7i") = "2+11i"
@IMSUB("1-7j","3-j") = "-2-6j"

@IMSUM

Syntax: **@IMSUM(A1, A2, ... An)**

An = a series complex numeric values, as strings
(Each argument may be a range of values.)

@IMSUM returns as a complex number the sum of the complex numbers *A1* through *An*.

Examples:

@IMSUM("3+4i","1-7i") = "4-3i"
@IMSUM("1-7j","3-j") = "4-8j"

@INDEX

Syntax: **@INDEX (range, column, row [, worksheet])**

Range = a range
Column = an integer
Row = an integer
Worksheet = an integer

Returns the value of the cell at the indicated offset from the Range. The column, row, and worksheet offsets are 1-origin, and the resulting reference must not be outside the range.

@INFO

Syntax: **@INFO(item)**

item = a string value

Returns information about the current spreadsheet and its environment. The information returned is determined by the value of **item**. The case of the argument is ignored.

"Directory"	Current directory
"OSversion"	Current operating system version
"Processor"	Processor (CPU) type
"Recalc"	Recalculation mode, either "manual" or "automatic"
"Release"	Current release number of XESS.
"Screen-Height"	Height in pixels of current display.
"Screen-Width"	Width in pixels of current display.
"System"	Operating system name.

@INIT

Syntax: **@INIT(X1, X2)**

X1 = initial value
X2 = iterative or subsequent value

@INIT returns its first argument on the first recalculation pass and its second argument on all subsequent recalculation passes when XEC is performing iterative recalculations.

Examples:

C5 = **@INIT**(1,C5+1) C6 = **@INIT**(1,C5*C6)

C5 = *Cycle!* if Iteration Limit = 0
C5 = N if Iteration Limit = N

C6 = *Cycle!* if Iteration Limit = 0
C6 = N! if Iteration Limit = N

@INT

Syntax: **@INT(X)**

X = a numeric value

@INT returns the integer portion of *X*.

Examples:

@INT(232.45566) = 232

@INT(J20) = -10, where J20 = -10.3

@INT(@PI) = 3

@INTERP2D

Syntax: **@INTERP2D(R1,R2,N)**

R1 = a range reference points to x values of the vector;
R2 = a range reference points to y values of the vector.

N = a numerical value or range for which the interpolation value will be based on.

@INTERP2D returns interporlated values for a 2 dimensional vector. *R1* and *R2* have to be same size.

Example:

	A	B
1	1	2.5
2	3	4.5
3	5	8.2
4	7	10.5
5	9	13.4

@INTERP2D(A1..A5,B1..B5,C1..C2) = 6.35
9.35, where C1..C2 = 4,6

@INTERP3D

Syntax: **@INTERP3D(R,X,Y)**

R = a range reference points to x, y and z values of the vector;
X = x values on which the interpolation values are based

Y = y values on which the interpolation values are based

@INTERP3D returns interporlated value for a 3 dimensional vector. *X* and *Y* have to be same size.

Example:

	A	B	C	D	E	F	G
		12.5	14.5	15.5	18.2	19.5	22.5
1	11.5	1	2	3	4	5	6
2	13.5	7	8	9	10	11	12
3	16.5	13	14	15	16	17	18
4	17.5	19	20	21	22	23	24
5	18.5	25	26	27	28	29	30
6	20.5	31	32	33	34	35	36

@INTERP3D(A1..G6,A11..A12,B11..B12) = 3.25
12.5556, where
A11..A12 = 12, 15, and B11..B12 = 14, 17

@INTRATE

Syntax: **@INTRATE(S, M, I, R[, B])**

S = Settlement date, date of purchase
M = Maturity date.
I = Investment amount
R = Redemption amount
B = (Optional) Day count basis as follows:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@INTRATE returns the interest rate for a fully invested investment.

Example:

@INTRATE(@DATE(1993,1,15), @DATE(1993,6,15), 10000, 10545) = 0.1317

@INVDFT

Syntax: **@INVDFT(R)**

R = a range

@INVDFT generates the inverse Discrete Fourier Transform of the range *R*. Like @DFT, *R* must represent a real vector (either its row or column dimension must be 1), or a complex vector (either its row or column dimension must be 2). The result is a complex vector.

Examples:

	A	B
1	.99	0
2	3	6.2
3	4.1	1.1
4	3.3	6.3

With **@INVDFT**(A1..B4) in B6 gives:

	B	C
6	2.8475	3.4
7	-0.8025	-0.2
8	-0.3025	-2.85
9	-0.7525	-0.35

@INVDFT(G4..I6) = Error - @INVDFT, improper dimensions

@INVERT

Syntax: **@INVERT(M)**

M = a regular matrix

@INVERT generates the inverse of the matrix *M*, which must be square. The result matrix is the same size as the argument matrix. Multiplying *M* times the result matrix (**@MMUL**) produces an identity matrix (a matrix with 1's in the diagonal and 0's elsewhere).

@MMUL(A,@INVERT(A))

A singular matrix (a matrix without an inverse) is non-regular and produces an error.

Examples:

Matrix B9..C10

	B	C
9	0	1
10	1	2

@INVERT(B9..C10) =

-2	1
1	2

Matrix A1..B4

	A	B
1	.99	0
2	3	6.2
3	4.1	1.1
4	3.3	6.3

@INVERT(A1..B4) = Error - @INVERT, matrix must be square

Matrix H8..J10

	H	I	J
1	1	1	1
2	3	1	1
3	7	2	6

@INVERT(H8..J10) =

-0.5	0.5	0
1.375	0.125	-0.25
0.125	-0.625	0.25

@INVFFT

Syntax: **@INVFFT(R)**

R = a range

@INVFFT generates the inverse Discrete Fourier Transform or range R using a Fast Fourier Transform algorithm. The length of the vector must be a power of 2. **@INVFFT** will produce the same results as **@INVDFT**, but it is much faster (N*log(N)) time as opposed to N^2 time).

Examples:

Matrix A1..B4

	A	B
1	.99	0
2	3	6.2
3	4.1	1.1
4	3.3	6.3

@INVFFT(A1..B4) =

2.8475	1.9
0.6975	-0.2
-0.3025	-1.35
-2.2525	-0.35

@INVFFT(A1..F3) = Error - @INVFFT, dimension must be power of 2

@IPMT

Syntax: **@IPMT(R, P, NP, PV, FV, [T])**

R = Interest rate per period
P = The period for which the interest will be calculated (an integer)
NP = The total number of payment periods.
PV = The present value of the investment
FV = The future value or a cash balance you would like to attain at the end of the last period.
T = (Optional) timing of the payment
0 payment is made at the end of the period
1 payment is made at the beginning of the period

@IPMT returns the interest payment for a specified period for an loan or investment based on periodic, constant payments and a constant interest rate.

Make sure that the units used for *R* and *P* are consistent. For example, for a 5-year loan with 12% annual interest, if you make payments monthly, use 12%/12 for (monthly) *R* and 5*12 for *NP*.

Example:

@IPMT(10%/12,1,24,2000,0,0) = 16.6667

@IRR

Syntax: **@IRR(G, F)**

G = a numeric value
F = cash flow, represented by a range

@IRR returns the internal rate of return on an investment given a set cash flows contained in range *F*, and an initial "guess" *G* (usually 0). *F* must contain at least two cash flow values. Negative cash flows represent expenditures, and positive cash flows represent income. Empty cells and text are treated as zeros.

Examples:

@IRR(0,L2..L6) = -0.32606171, where L2..L6 = -80, 90, 67, 72, and -90

@IRR(0,I5..I9) = 1.0462142, where I5..I9 = -700, 750, 900, 600 and 850

@IRR(0,-200,100,300) = ERROR: too many arguments to function

@ISERROR

Syntax: **@ISERROR(X)**

X = An expression

@ISERROR returns 1 if *X* "contains" an error, otherwise it returns 0. *X* "contains" an error if it it would generate an error outside of the **@ISERROR** function, which means that the expression itself may generate an error, or it may reference a cell which has generated an error.

Examples:

@ISERROR(1) = 0

@ISERROR(3/0) = 1

@ISERROR(**@ISERROR**(3/0)) = 0

@ISERROR(C1) = 0, where C1 = @PI

@ISEVEN

Syntax: **@ISEVEN(number)**

Returns 1 if a number is even or 0 if not. If a number is not an integer it is truncated before the test.

@ISNUMBER

Syntax: **@ISNUMBER(X)**

X = a numeric value

@ISNUMBER returns 1 if *X* is a numeric value, otherwise 0. Empty cells are considered numeric.

Examples:

@ISNUMBER(C10) = 0, where C10 = "Total"

@ISNUMBER(D10) = 1, where D10 = $1000.00

@ISNUMBER(A1) = 1, where A1 is empty

@ISODD

Syntax: **@ISODD(number)**

Returns a 1 if a number is odd or 0 if not. If a number is not an integer it is truncated before the test.

@ISSTRING

Syntax: **@ISSTRING(X)**

X = a numeric value

@ISSTRING returns 1 if *X* is a string value, otherwise 0. Empty cells are considered numeric.

Examples:

@ISSTRING(C10) = 1, where C10 = "Total"

@ISSTRING(D10) = 0, where D10 = $1000.00

@ISSTRING(A1)= 0, where A1 is empty

@LARGE

Syntax: **@LARGE(R, N)**

R = Range of data
N = Integer specifying Nth largest datum from R

@LARGE returns the *N*th largest datum in the range R.

Examples:

A1..A9 = 1,4,8,3,7,12,54,8,23

@LARGE(A1..A9,3) = 12
@LARGE(A1..A9,1) = 54
@LARGE(A1..A9,@COUNT(A1..A7)) = 1

@LCM

Syntax: **@LCM (list)**

Returns the least common multiple of the numbers in the list.

@LEFT

Syntax: **@LEFT(S,N)**

S = a string value
N = a numeric value

@LEFT returns the string composed of the leftmost characters of string *S*. If *N* is greater than or equal to the length of *S*, then the entire string *S* is returned.

Examples:

F1 = "workstation"

@LEFT(F1,1) = "w"

@LEFT(F1, 4) = "work"

@LEFT(F1,20) = "workstation"

@LENGTH

Syntax: **@LENGTH(S)**

S = a string value

@LENGTH returns the number of characters in string *S*.

Examples:

@LENGTH("computer") = 8

@LENGTH(G3) = 14, where G3 = "Expense Report"

@LENGTH(Z7) = 20, where Z7 = "Linear Least Squares"

@LINCOEF

Syntax: **@LINCOEF(X, Y)**

X = a range representing a column vector of independent variables values,
Y = a range representing a column vector of dependent variables values

@LINCOEF generates the straight line least squares fit. The output is the values for a_1 and a_0 and is a row vector if *X* and *Y* are row vectors, and a column vector if *X* and *Y* are column vectors. This function is equivalent to **@POLYCOEF**(X,Y,1).

Example:

Matrix B1..B5

	B
1	1
2	2
3	3
4	4
5	5

Matrix C1..C5

	C
1	3
2	5
3	11
4	18
5	31

@LINCOEF(B1..B5,C1..C5) =

6.9
7.1

This is the solution for:

$$y_i = 6.9x_i - 7.1$$

@LINFIT

Syntax: **@LINFIT(X, Y)**

X = a range representing a column vector of independent variables values,
Y = a range representing a column vector of dependent variables values

@LINFIT generates the values for a straight line least squares fit.

The output of this function is the vector of estimated y values on the left hand side of the above equation. The input vector *X* and *Y*

must both be row vectors or both column vectors. The output vector will be a row vector if *X* and *Y* are row vectors, and a column vector if *X* and *Y* are column vectors. The length of the output vector is equal the the length of the input vectors. This function is equivalent to **@POLYFIT**(X,Y,1).

Example:

Matrix B1..B5

	B
1	1
2	2
3	3
4	4
5	5

Matrix C1..C5

	C
1	3
2	5
3	11
4	18
5	31

@LINFIT(B1..B5,C1..C5) =

-0.2
6.7
13.6
20.5
27.4

@LLS

Syntax: **@LLS(A, Y [,FLAG])**

A = matrix of X values
Y = vector of observed values for Y

FLAG = an optional value indicating whether the X data intercepts with the origin (0)

@LLS generates the following regression analysis:

1) the linear least squares solution, X, to the overdetermined system of linear equations $AX=Y$

2) the standard errors of the least square estimates of each element of the parameter vector X, the t-statistics that compare each parameter to zero, and the significance level of each.

3) the variance of the model, the R-squared correlation for the model, and its corresponding F-statistic and significance level.

If any columns of *A* are linearly dependent, the function produces an error. If FLAG is set to 1, then the X data intercepts with the origin and the right-most column of 1's is not needed in the matrix A.

The output of @**LLS** is a a table with four rows and n+1 columns, where n is the number of independent variables in the model (i.e., the number of columns in the *A* matrix). The table is presented in the following format:

$$\begin{array}{cccc} \hat{x}_1 & \hat{x}_2 & \cdots & \hat{x}_n & MSE \\ SE\left(\hat{x}_1\right) & SE\left(\hat{x}_2\right) & \cdots & SE\left(\hat{x}_n\right) & R^2 \\ t_{\hat{x}_1} & t_{\hat{x}_2} & \cdots & t_{\hat{x}_n} & F_R \\ p\left(t_{\hat{x}_1}\right) & p\left(t_{\hat{x}_2}\right) & \cdots & p\left(t_{\hat{x}_n}\right) & p\left(F_R\right) \end{array}$$

where

x_i = the least squares estimate of the i^{th} coefficient, corresponding to the independent variable in the ith column of *A*.

$SE(x_i)$ = the standard error of x_i

$t(x_i)$ = the t-statistic for testing whether x_i is significantly different from zero.

$P(t_{xi})$ = the probability of error in rejecting the null hypothesis that x_i=0, based on two-sided t-test.

MSE = the mean squared error of the model.

R^2 = the model coefficient of determination (the square of the model correlation coefficient, *R*)

F_R = the F-statistic for testing whether *R* is significantly different from zero.

$p(F_R)$ = the probability of error in rejecting the null hypothesis that R=0, based on a two-sided t-test.

Matrix A1..C4

	A	B	C
1	0	0	1
2	1	1	1
3	4	2	1
4	9	3	1

Matrix D1..D4

	D
1	3
2	5
3	11
4	18

@LLS(A1..C4,D1..D4)=

1.25	1.35	2.85	0.45
0.34	1.05	0.65	1.00
3.73	1.29	4.36	151.44
0.17	0.42	0.14	0.06

The above result displays only 2 decimal places and is exactly equivalent to **@PLS**(B1..B4,D1..D4,2)

@LLS(A1..A2,B1..C2) = Error - @LLS, improper dimensions

@LN

Syntax: **@LN(X)**

X = a numeric value greater than 0.

@LN returns the log base *e* of *X*. The inverse of **@LN** is the exponentiation function **@EXP**.

Examples:

@LN(6) = 1.7917595

@LN(@EXP(X4)) = 10, where X4 = 10

@LN(-1) = Error - @LN, domain is x > 0

@LNGAMMA

Syntax: **@LNGAMMA(X)**

X = a numeric value greater than or equal to 0

@LNGAMMA returns the log base *e* of the gamma function evaluated at *X*. The function is given by:

$$\ln\left(\int_0^{\infty} e^{-x}x^{n-1}dx\right)$$

Examples:

@LNGAMMA(1.20) = -0.08537

@LNGAMMA(10) = 12.801827

@LNGAMMA(D30) = Error - @LNGAMMA, domain is x > 0, where D30 = 0

@LNGAMMA(K19) = 9.9677617, where K19 = 8.7

@LOG

Syntax: **@LOG(X)**

X = a numeric value greater than 0

@LOG returns the log base 10 of *X*. This function is included for compatibility with WKS and WK1 formats.

Examples:

@LOG(1) = 0

@LOG(14) = 1.146128

@LOG(1.00e+27) = 27

@LOG(0) = Error - @LOG, domain is x > 0

@LOG10

Syntax: **@LOG10(X)**

X = a numeric value greater than 0

@LOG10 returns the log base 10 of *X*.

Examples:

@LOG10(1) = 0

@LOG10(14) = 1.146128

@LOG10(1.00e+27) = 27

@LOG10(0) = Error - @LOG10 domain is x > 0

@LOG2

Syntax: **@LOG2(X)**

X = a numeric value greater than 0

@LOG2 returns the log base 2 of *X*.

Examples:

@LOG2(1) = 0

@LOG2(1.00e+27) = 89.692

@LOG2(0) = Error! domain x > 0

@LOWER

Syntax: **@LOWER(S)**

S = a string value

@LOWER returns returns the alphabetic string *S* converted to lower-case characters.

Examples:

@LOWER("AIRPORT") = "airport"

@LOWER(G3) = "expense report", where G3 = "Expense Report"

@LOWER(K10) = "connections", where K10 = "CONNECTIONS"

@MADD

Syntax: **@MADD(M1,M2)**

M1 = a matrix
M2 = a matrix

@MADD adds the corresponding elements of matrix M2 and matrix M1. If the dimensions of the matrices are incompatible, the function generates an error.

Examples:

Matrix B9..C10

	B	C
9	0	1
10	1	2

Matrix D9..E10

	D	E
9	3	5
10	4	8

@MADD(B9..C10,D9..E10) =

3	6
5	10

@MATCH

Syntax: **@MATCH(V, R[, T])**

V = Value to be matched.
R = Range in which to match *V*
T = Type of match

@MATCH return the relative position of the value *V* in the range *R*, according to the rule specified by *T*:

1 or omitted	find largest value in R <= V
0	find first value in R = V
-1	find smallest value in R >= V

V can be a string or a numeric value. If *V* is a string, *T* must be 0 or omitted. If V is a string, it may contain the wildcard characters, asterisk (*) and question mark (?), to represent *any sequence of characters* and *any single character* respectively.

The items in the *R* do not need to be in any specific order.

Examples:

	A	B
1	**Products**	**Quantity (Boxes)**
2	Apple	32
3	Orange	50
4	Cherry	15
5	Banana	20
6	Cantaloupe	10
7	Strawberry	25

@MATCH(15,B1..B7) = 4

@MATCH(30,B1..B7,1) = 7

@MATCH(30,B1..B7,-1) = 3

@MATCH("Orange",A1..A7) = 3

@MATCH("Can*",A1..A7) = 7

@MAX

Syntax: **@MAX(argumentlist)**

argumentlist = any combination or numbers, cells, or ranges

@MAX returns the maximum of its arguments. Empty cells and cells containing strings are not counted.

Examples:

@MAX(4,56,33,100,0,-1) = 100

@MAX(S3..S7) = -1, where S3..S7 = -1,-4,-99,-20,-1.5

@MAX(A1..B2) = 93, where A1 = 0, A2 = -93, B1 = 93, and B2 = 7

@MDURATION

Syntax: **@MDURATION(S, M, R, Y, F, [B])**

S = Settlement date
M = Maturity date
R = Annual coupon rate
Y = Annual yield
F = Number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) The day count basis to be used:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@MDURATION returns the modified Macauley duration of a security assuming $100 face value.

Example:

@MDURATION(@DATE(1990,1,1),@DATE(1995,1,1),10%,8%,2,0) = 3.9379

@MEAN

Syntax: **@mean(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@MEAN returns the average (arithmetic mean) of its arguments. Empty cells and strings are ignored. The function is given by:

$$\frac{\sum_{i=1}^{n} a_i}{n}$$

Examples:

@MEAN(A1,B9,J32,F16) = 21.125, where A1 = 12, B9 = 34.5, J32 = 22, F16 = 16

@MEDIAN

Syntax: **@MEDIAN(argumentlist)**

argumentlist = any combination or numbers, cells or ranges

@MEDIAN returns the median (middle value) of its arguments. Empty cells and cells containing strings are not counted.

Examples:

@MEDIAN(A1..A6) = 80.5, where A1..A6 = 65,70,74,87,88,95

@MEDIAN(2, 8, 6, 5, 9) = 6

@MESSAGE

Syntax: **@MESSAGE(X,S)**

X = an expression
S = a string

If the value of X is not 0, then **@MESSAGE** displays *S* in the Message Line and beeps. The return value of the function is set to the value of *X*.

Examples:

@MESSAGE(@HOUR(@NOW) > 17, "Time to go home!")

@MID

Syntax: **@MID(S,N1,N2)**

S = a string value
N1 = a numeric value
N2 = a numeric value

@MID returns the string of length *N2* that starts at position *N1* in string *S*. *N1* is the number of characters from the beginning of the string, must be greater than or equal to zero, and less than the length of *S*. *N2* must be greater than or equal to zero. If *N1+N2* is greater than the length of *S*, then the substring starting at position *N1* in *S* is returned. The first character in string *S* is in position zero.

Examples:

T5 = "Spreadsheet"

@MID(T5,6,5) = "sheet"

@MID(T5,10,1) = "t"

@MID(T5,1,0) = " "

@MIN

Syntax: **@MIN(argumentlist)**

argumentlist = any combination or numbers, cells or ranges

@MIN returns the minimum of its arguments. Empty cells and cells containing strings are not counted.

Examples:

@MIN(4,56,33,100,0,-1) = -1

@MIN(S3..S7) = -99, where S3..S7 = -1,-4,-99,-20,-1.5

@MIN(A1..B2) = -93, where A1 = 0, A2 = -93, B1 = 93, and B2 = 7

@MINUTE

Syntax: **@MINUTE(DT)**

DT = a date/time value

@MINUTE returns the minutes (0 to 60) component of the date/time value *DT*.

Examples:

@MINUTE(.99) = 45

@MINUTE(.6) = 24

@MINUTE(.3) = 12

@MIRR

Syntax: **@MIRR(V,F,R)**

V = A range of values representing periodic income (positive values) and payments (negative values)
F = Finance rate, the interest paid on the payments
R = Reinvestment rate, the rate of return on the income

@MIRR returns the Modified Internal Return Rate for a range of periodic cash flows. Empty cells and text are treated as zeros.

Example:

	A	B
1	Investment	-140000
2	1st year return	34000
3	2nd year return	46000
4	3rd year return	45000
5	4th year return	47000
6	5th year return	46000

@MIRR(B1..B6,11%,12.5%) = 0.14522

@MMUL

Syntax: **@MMUL(M1,M2)**

M1 = a matrix
M2 = a matrix

@MMUL generates the product of the multiplication of matrix M2 by matrix M1. If the dimensions of the matrices are incompatible, the function generates an error.

Examples:

Matrix B9..C10

	B	C
9	0	1
10	1	2

Matrix D9..E10

	D	E
9	3	5
10	4	8

@MMUL(B9..C10,D9..E10) =

4	8
11	21

Matrix A1..B3

	A	B
1	.99	0
2	3	6.2
3	4.1	1.1

Matrix C1..E2

	C	D	E
1	.5	.85	3
2	.2	.4	5

@MMUL(A1..B3,C1..E2) =

0.495	**0.8415**	**2.97**
2.74	5.03	40
2.27	3.925	17.8

@MMUL(A1..B3,C1..G10) = Error!, incompatible matrix dimensions

---

@MOD

Syntax: **@MOD(X,Y)**

X = a numeric value
Y = a numeric value

@MOD returns the remainder of *X*/*Y* with the same sign as *X*. (This function is NOT modulus as sometimes documented.)

Examples:

@MOD(8,4) = 0

@MOD(D2,F3) = 12, where D2 = 100 and F3 = 44

@MOD(F5,A1) = Error!, divide by zero, where F5 = 98.6 and A1 = 0

@MOD(-14,3) = -2 (the true modulus is 1)

@MODE

Syntax: **@MODE(argumentlist)**

argument = any combination of numbers, cells, or ranges.

@MODE returns the mode, or most frequently occurring datum, of all the arguments. Empty cells and cells containing text are ignored.

Examples:

@MODE(5,4,10,8,7,5,4,14,5) = 5

@MODE(A1..A7) = 2.3, where A1..A7 = 2.3,3.4,5.0,3.4,3.4,2.3,2.3

@MODULUS

Syntax: **@MODULUS(X,Y)**

X = a numeric value
Y = a numeric value

@MODULUS returns the modulus of *X / Y*.

Examples:

@MODULUS(8,4) = 0

@MODULUS(D2,F3) = 12, where D2 = 100 and F3 = 44

@MODULUS(F5,A1) = Error!, divide by zero, where F5 = 98.6 and A1 = 0

@MODULUS(-14,3) = 1

@MONTH

Syntax: **@MONTH(DT)**

DT = a date/time value

@MONTH returns the months component of the date/time value *DT*.

Examples:

@MONTH(24203) = 4, where 24203 represents April 6, 1966

@MONTH(@TODAY) = 12, where TODAY = December 25, 1994

@MONTH(366) = 12, where 366 represents December 31, 1900

@MSQ

Syntax: **@MSQ(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@MSQ returns the mean of the squares of its arguments. Empty cells and cells containing strings are not counted. The function is given by:

$$\frac{\sum_{i=1}^{n} a_i^2}{n}$$

Examples:

@MSQ(-9,-3,-5,0,1) = 23.2

@MSQ(F10..F14) = 20.4, where F10..F14 = 2, 2, 3, 6, and 7

@MSQ(D1..D6) = 2373.6667, where D1..D6 = 4, 56, 33, 100, 0, and -1

@MSUB

Syntax: **@MSUB(M1,M2)**

M1 = a matrix
M2 = a matrix

@MSUB subtracts corresponding values of matrix M2 from matrix M1. If the dimensions of the matrices are incompatible, the function generates an error.

Examples:

Matrix B9..C10

	B	C
9	0	1
10	1	2

Matrix D9..E10

	D	E
9	3	5
10	4	8

@MSUB(B9..C10,D9..E10) =

-3	-4
-3	-6

Matrix A1..B3

@N

Syntax: **@N(R)**

R = a range

@N returns the numeric value of the upper left cell in the range *R*, or zero if the cell is empty or contains a string. This function is included for compatibility with older spreadsheets.

Examples:

A1..B3	**A**	**B**
1	1	"electrons"
2	2	"protons"
3	3	"neutrons"

@N(A1..B3) = 1

@N(B1..B3) = 0

@N(A1..Z25) = $1,000,000.00, where A1 = $1,000,000.00

@NAND

Syntax: **@NAND(argumentlist)**

argumentlist = any combination or numbers, cell, or ranges

@NAND returns 0 if all arguments are 1; 1 if any argument is 0; otherwise -1 (unknown).

Examples:

A1 = 1, B1 = 1, C1 = 0, D1 = 0, E1 = 1 and A2 = 24

@NAND(A1,B1) = 0
@NAND(A1..E1) = 1
@NAND(A1..A2) = -1

@NETWORKDAYS

Syntax: **@NETWORKDAYS(S,E,H)**

S = Starting date, a date/time value
E = Ending date, a date/time value
H = A range of dates to exclude, such as holidays.

@NETWORKDAYS returns the number of whole working days, beginning with *S* and ending with *E*, excluding days in *H* and weekends.

Examples:

@NETWORKDAYS(@DATE(1993,1,1),@DATE(1993,12,31)) = 261

@NETWORKDAYS(@DATE(1993,1,1),
@DATE(1993,12,31),A1..A5) = 258, where
A1..A5 = @DATEVALUE("1/1/1993"),
@DATEVALUE("5/25/1993"),
@DATEVALUE("7/4/1993"),
@DATEVALUE("9/3/1993"),
@DATEVALUE("11/28/1993")

@NOMINAL

Syntax: **@NOMINAL(R,C)**

R = Effective interest rate
C = Number of compounding periods per year

@NOMINAL returns the nominal annual interest rate for an effective interest rate *R* and the number of compounding periods per year *C*.

Example:

@NOMINAL(6.9347%,5) = 0.0675

@NOR

Syntax: **@NOR(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@NOR returns 0 if any argument is 1; 1 if all arguments are 0; otherwise -1 (unknown).

Examples:

A1 = 1, B1 = 1, C1 = 0, D1 = 0, E1 = 1 and A2 = 24

@NOR(C1,D1) = 1

@NOR(A1..E1) = 0

@NOR(A1..A2) = -1

@NOT

Syntax: **@NOT(X)**

X = a numeric value

@NOT returns 1 if *X*=0; 0 if *X*=1; otherwise -1 (unknown).

Examples:

A1 = 1, B1 = 1, C1 = 0, D1 = 0, E1 = 1 and A2 = 24

@NOT(A1) = 0

@NOT(A2) = -1
@NOT(C1) = 1

@NOW

Syntax: **@NOW**

@NOW returns the date/time value corresponding to the current system time and date.

Examples:

@NOW = 33139.37, where 33139.37 represents September 23, 1990 at 8:52:48 A.M.

@MONTH(**@NOW**) = 9

@HOUR(**@NOW**) = 8

@NPV

Syntax: **@NPV(R,CF)**

R = periodic interest rate
CF = future cash flow series represented by a range

@NPV returns the present value of a series of future cash flows, *CF*, at a given rate *R*. The function is given by:

$$\sum_{i=1}^{n} \frac{CF_i}{(1+R)^i}$$

Empty cells and text are treated as zeros.

Examples:

@NPV(.095, C3..C8) = 287.29, where the interest rate is 9.5% and the future cash flow is in the range C3..C8 and are each $65

@NPV(.10,C3) = Error! cash flow series must be a range

@NUMTOHEX

Syntax: **@NUMTOHEX(X)**

X = a numeric value between $-2^{31} <= X <= (2^{31}) - 1$

@NUMTOHEX returns a string containing the hexadecimal representation of the integer portion of *X*.

Examples:

@NUMTOHEX(10) = "a"

@NUMTOHEX(C17) ="f", where C17 = 15.289374

@OCCUR

Syntax: **@OCCUR(string,pattern)**

Returns the number of times that the substring "pattern" occurs in "string".

@ODD

Syntax: **@ODD(number)**

Returns the odd number with the next larger absolute value. ODD(2) = 3, ODD(-2) = -3.

@ODDFPRICE

Syntax: **@ODDFPRICE(S,M,I,FC,R,Y,RD,F[,B])**

S = settlement date
M = maturity date
I = issue date
FC = first coupon date of the security
R = annual coupon rate of the security
Y = annual yield of the security
RD = redemption value of the security at maturity per $100 face value
F = the number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@ODDFPRICE returns the price per $100 face value of a security with an odd (short or long) first period.

Example:

@ODDFPRICE(A1,A2,A3,A4,7.85%,6.25%,100,2,1) = 113.5977, where A1 = @DATE(1992,11,11), A2 = @DATE(2005,3,1), A3 = @DATE(1992,10,15), A4 = @DATE(1993,3,1)

@ODDFYIELD

Syntax: **@ODDFYIELD(S,M,I,FC,R,PR,RD,F[,B])**

S = settlement date
M = maturity date
I = issue date
FC = first coupon date of the security
R = annual coupon rate of the security
PR - the price of the security per $100 face value
RD = redemption value of the security at maturity per $100 face value
F = the number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual

2	actual/360
3	actual/365

@ODDFYIELD returns the yield per $100 of a security with an odd (short or long) first period.

Example:

@ODDFYIELD(A1,A2,A3,A4,7.85%,113.598,100,2,1) = 0.0625, where A1 = @DATE(1992,11,11), A2 = @DATE(2005,3,1), A3 = @DATE(1992,10,15), A4 = @DATE(1993,3,1)

@ODDLPRICE

Syntax: **@ODDLPRICE(S,M,LC,R,Y,RD,F[,B])**

S = settlement date
M = maturity date
LC = last coupon date of the security
R = annual coupon rate of the security
Y = annual yield of the security
RD = redemption value of the security at maturity per $100 face value
F = the number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@ODDLPRICE returns the price per $100 face value of a security with an odd (short or long) last period.

Example:

@ODDLPRICE(A1,A2,A3.6.5%,5.35%,100,2,0) = 100.5418, where A1 = @DATE(1992,2,7), A2 = @DATE(1993,8,1), A3 = @DATE(1992,2,4)

@ODDLYIELD

Syntax: **@ODDLYIELD(S,M,LC,R,PR,RD,F[,B])**

S = settlement date

M = maturity date
LC = last coupon date of the security
R = annual coupon rate of the security
PR - the price of the security per $100 face value
RD = redemption value of the security at maturity per $100 face value
F = the number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@ODDFYIELD returns the yield per $100 of a security with an odd (short or long) last period.

Example:

@ODDLYIELD(A1,A2,A3.6.5%,100.542,100,2,0) = 0.0535, where A1 = @DATE(1992,2,7), A2 = @DATE(1993,8,1), A3 = @DATE(1992,2,4)

@OR

Syntax: **@OR(argumentlist)**

argumentlist = any combination of numbers, cells or ranges

@OR returns 1 if any argument is 1; 0 if all arguments are 0; otherwise -1 (unknown).

Examples:

A1 = 1, B1 = 1, C1 = 0, D1 = 0, E1 = 1 and A2 = 24

@OR(C1,D1) = 0

@OR(A1..E1) = 1

@OR(A1..A2) = -1

@PERCENTILE

Syntax: **@PERCENTILE(R,N)**

R - A range of data
N - A numeric value between 0 and 1, inclusive.

@PERCENTILE returns the datum from the range *R* which is at the *N*th percentile in *R*. Only numeric data in R are considered. The result will be interpolated if N is not a multiple of 1/(s-1), where s is the size of R.

Examples:

@PERCENTILE(A1..A4,0.65) = 2.95, where A1..A4 = 1,2,3,4

@PERCENTILE(B1..B6,0.75) = 21.35, where A1..A6 = 3.8,23,4,12,67,0.2

@PERCENTRANK

Syntax: **@PERCENTRANK(R,N)**

R - A range of data
N - A number to find

@PERCENTRANK returns the percentile rank of the number *N* among the values in range R

Examples:

@PERCENTRANK(A1..A6,4.5) = 0.7, where A1..A6 = 1,2,3,4,5,6

@PERCENTRANK(B1..B6,21.35) = 0.77, where B1..B8 = 3.8,23,4,12,67,0.2

@PERMUT

Syntax: **@PERMUT(N,K)**

N = Number of objects to choose from

K = Number of objects to be chosen

@PERMUT returns "N choose K", or the permutations of *K* objects that can be chosen from the set *N*, where order is significant.

Examples:

@PERMUT(10,4) = 5040

@PERMUT(8,1) = 8

@PI

Syntax: **@PI**

@PI returns the value of π.

Examples:

@PI = 3.1415927...

@PLS

Syntax: **@PLS(X,Y,d [,flag])**

X - a range representing a row or column vector of independent variable values
Y - a range representing a row or column vector of dependent variable values
d - polynomial degree in the range 1 to 10
flag - omitted or 1 means that X data intercepts with the origin
0 means data does not intercept with the origin

@PLS analyzes the least squares polynomial model.

The format of the table produced by @PLS is:

$$\begin{array}{cccc} \hat{a}_d & \hat{a}_{d-1} & \cdots & \hat{a}_0 & MSE \\ SE\left(\hat{a}_d\right) & SE\left(\hat{a}_{d-1}\right) & \cdots & SE\left(\hat{a}_0\right) & R^2 \\ t_{\hat{a}_d} & t_{\hat{a}_{d-1}} & \cdots & t_{\hat{a}_0} & F_R \\ p\left(t_{\hat{a}_d}\right) & p\left(t_{\hat{a}_{d-1}}\right) & \cdots & p\left(t_{\hat{a}_0}\right) & p\left(F_R\right) \end{array}$$

where

a_i	=	the least squares estimate of the i^{th} coefficient, corresponding to the independent variable in the ith column of *A*.
$SE(a_i)$	=	the standard error of x_i
$t(a_i)$	=	the t-statistic for testing whether a_i is significantly different from zero.
$P(t_{ai})$	=	the probability of error in rejecting the null hypothesis that a_i=0, based on two-sided t-test.
MSE	=	the mean squared error of the model.
R^2	=	the model coefficient of determination (the square of the model correlation coefficient, *R*)
F_R	=	the F-statistic for testing whether *R* is significantly different from zero.

$p(F_R)$ = the probability of error in rejecting the null hypothesis that R=0, based on a two-sided t-test.

. . . . . .

The output of this function is identical to that of ***@LLS****, with the polynomial coefficients listed in order of decreasing degree.*

. . . . . .

Example:

Matrix A1..C4

	A	B	C
1	0	0	1
2	1	1	1
3	4	2	1
4	9	3	1

Matrix D1..D4

	D
1	3
2	5
3	11
4	18

@PLS(B1..B4,D1..D4,2) =

1.25	1.35	2.85	0.45
0.34	1.05	0.65	1.00
3.73	1.29	4.36	151.44
0.17	0.42	0.14	0.06

The above result displays only 2 decimal places and is exactly equivalent to **@LLS**(A1..C4,D1..D4)

@PMT

Syntax: **@PMT(PV,R,N)**

PV = present value of an investment
R = interest rate
N = number of periods

@PMT returns the periodic payment for a loan, given present value *PV* and interest rate *R*. The formula is given by:

$$PV\frac{R}{1-\left(R+1\right)^{-N}}$$

Examples:

@PMT(15000,rate,4) = 4834.90, where rate is a named cell = 11%

@PMT(M4,0.07,G4) = 8058.6404, where G4 = 30 and M4 = 100000

@PMT(1700,11,0) = Error!, "Period" must be an integer>0

@POLY

Syntax: **@POLY(X,...)**

X = a numeric value
... = coefficients of the polynomial in decreasing order of degree

@POLY returns the value of an Nth-degree polynomial in *X*. The coefficient arguments may be any combination of numbers, cells containing numbers, or ranges containing numbers. Any non-numeric argument produces an error. The function is given by:

$$a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$$

@POLY(X,3,4,5) =(3*X**2+4*X+5)

Examples:

@POLY(2,3,4,5) = 25, where (3*(2**2) + 4*(2) + 5) = 25

@POLY(-1,A1,A2) = 1, where A1 = 2 and A2 = 3 because (2*-1 + 3) = 1

@POLY(3,2,5,4,6) = 117

@POLY(-1,-2,-3,-4) = -3

@POLYCOEF

Syntax: **@POLYCOEF(X,Y,d)**

X - a range representing a row or column vector of independent variable values
Y - a range representing a row or column vector of dependent

variable values
d - polynomial degree in the range 1 to 10

@POLYCOEF generates the least squares coefficients for the polynomial fit.

The output of this function is a vector of length *d+1* containing

$$a_d, a_{d-1}, \ldots, a_1, a_0$$

The output vector will be a row vector if *X* and *Y* are row vectors, and a column vector if *X* and *Y* are column vectors.

Example:

Matrix B1..B5

	B
1	1
2	2
3	3
4	4
5	5

Matrix C1..C5

	C
1	3
2	5
3	11
4	18
5	31

@POLYCOEF(B1..B5,C1..C5,2) =

1.6428571
-2.9571429
4. 4

@POLYFIT

Syntax: **@POLYFIT(X,Y,d)**

X - a row or column range of independent variable values
Y - a row or column range of dependent variable values
d - polynomial degree in the range 1 to 10

@POLYFIT generates the least squares polynomial fit. The output of this function is the vector of estimated y-values for the fitted polynomial. The input vector *X* and *Y* must both be row vectors or both column vectors. The output vector will be a row vector if *X* and *Y* are row vectors, and a column vector if *X* and *Y* are column vectors. The length of the output vector is equal the the length of the input vectors.

Example:

Matrix B1..B5

	B
1	1
2	2
3	3
4	4
5	5

Matrix C1..C5

	C
1	3
2	5
3	11
4	18
5	31

@POLYFIT(B1..B5,C1..C5,2) =

3.0857143
5.0571429
10.314286
18.857143
30.685714

@PPMT

Syntax: **@PPMT(R,P,NP,PV,FV[,T])**

R = interest rate per period
P = the period for which the interest will be calculated
NP = the total number of payment periods.
PV = present value of the investment.
FV = future value or a cash balance you would like to attain at the end of the last period.
T = (Optional) timing of the payment

0	payment is made at the end of the period
1	payment is made at the beginning of the period

@PPMT returns the payment on the principal for a specific period for an investment based on periodic, constant payments and a constant interest rate.

Make sure the units used be R and NP are consistent. For example, for a 5=year loan with 12% annual interest, if you make payment monthly, use 12%/12 for (monthly) R and 5*12 for NP. If you make annual payment on the same loan, use 12% for R and 5 for NP.

Examples:

@PPMT(10%/12,1,60,55000,0,0) = 710.2541

@PPMT(10%/12,1,60,55000,1000) = 723.1678

@PRICE

Syntax: **@PRICE(S,M,R,Y,RD,F[,B])**

S = settlement date
M = maturity date
R = annual coupon rate of the security
Y = annual yield of the security
RD = redemption value of the security at maturity per $100 face value
F = the number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@PRICE returns the price per $100 face value of a security that pays periodic interest.

Example:

@PRICE(@DATE(1991,3,15),@DATE(1998,10,15),6%,7%,100,2,0) = 94.1854

@PRICEDISC

Syntax: **@PRICEDISC(S,M,D,RD[,B])**

S = settlement date
M = maturity date
D = discount rate of the security
RD = redemption value of the security at maturity per $100 face value
B = (Optional) the day count basis to be used

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@PRICEDISC returns the price per $100 face value of a discounted security.

Example:

@PRICEDISC(@DATE(1993,2,1),@DATE(1993,6,1),6.5%,100,0) = 97.8333

@PRICEMAT

Syntax: **@PRICEMAT(S,M,I,R,Y[,B])**

S = settlement date
M = maturity date
I = issue date
R = annual coupon rate of the security
Y = annual yield of the security
B = (Optional) the day count basis to be used

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@PRICEMAT returns the price per $100 face value of a security that pays interest at maturity.

Example:

@PRICEMAT(@DATE(1993,3,1),@DATE(1993,6,15),@DATE(1992,11,1), 6.5%,0) = 101.8778

@PRODUCT

Syntax: **@PRODUCT(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@PRODUCT multiplies all the numeric elements of the argument list together, ignoring empty and non-numeric values, and returns the product.

Examples:

@PRODUCT(6,5,8,2) = 480

@PRODUCT(A1..A3) = 25.1327, where A1..A3 = 2,@PI,4

@PROPER

Syntax: **@PROPER(S)**

S = a string value

@PROPER returns the string *S* with the first letter of each word capitalized.

Examples:

@PROPER("president") = "President"

@PROPER(P9) = "Chicago", where P9 = "CHICAGO"

@PROPER(E18) = "Chapel Hill", where E18 = "chapel hill"

@PTTEST

Syntax: **@PTTEST(R1,R2)**

R1 = a range
R2 = a range

@PTTEST returns the significance level (alpha) of the two-sided paired T-test for the paired samples contained in ranges *R1* and *R2*, respectively. Then alpha is the probability of error in rejecting the null hypothesis that mean [y-x]=0. *R1* and *R2* must have the same dimension.

Examples:

@PTTEST(A1..A4,B1..B4) = 0.64, where A1..A4 = .5, .98, .22, .1, and B1..B4 = .87, .6, .21, .49.

@PTTEST(H5..H9,K5..K9) = 0.0008594, where H5..H9 = 14, 35, 37, 0, 33, and K5..K9 = 67, 77, 94, 34, 99.

@PTTEST(A1..A30,B1..B50) = Error!, ranges must be same dimension

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@PURECOUNT

Syntax: **@PURECOUNT(rangelist)**

Returns the count of cells in a list of ranges that contain values, excluding the count of cells that contain strings.

@PV

Syntax: **@PV(P,R,N)**

P = periodic payment
R = interest range
N = number of periods

@PV returns the present value of an annuity given periodic payment *P*, interest rate *R* and *N* number of periods. The function is given by:

$$P\frac{1-\left(1+R\right)^{-N}}{R}$$

Examples:

@PV(360, RATE, 4) = 1116.88, where RATE is a named cell = 11%

@PV(V10, C6,5) = 41001.97, where C6 = 7% and V10 = 10000

@PV(4500,0.05,-1) = Error!, "Period" must be an integer >0

@QUARTILE

Syntax: **@QUARTILE(R,Q)**

R = Range of cells
Q = Quartile as follows:

0	Minimum value

1	First quartile (25th percentile)
2	Second quartile (50th percentile)
3	Third quartile (75th percentile)
4	Maximum value

@QUARTILE finds the quartile *Q* of the data in range *R*. This is equivalent to @PERCENTILE(R,Q/4).

Examples:

A1..A8 = 1,2,4,7,8,9,10,12

@QUARTILE(A1..A8,2) = 7.5

@QUARTILE(A1..A8,1) = 3.5

@RADIANS

Syntax: **@RADIANS(X)**

X = a numeric value

@RADIANS returns π/180 times *X*.

Examples:

@RADIANS(1) = 0.017453293

@RADIANS(@DEGREES(25)) = 25

@COS(**@RADIANS**(*G57*)) = 0.5, where G57 = 60

@RAND

Syntax: **@RAND**

@RAND returns a uniformly distributed random number on the interval [0,1). The number will change every time the sheet is recalculated.

Examples:

@RAND = .38952085

@RAND * 10 = 7.6609264, a number between 0 and 10

@RAND/1 = 0.85737794

@RANGENAME

Syntax: **@RANGENAME(cellref)**

The first range name found for the cell reference.

@RANGEREF

Syntax: **@RANGEREF(N1,N2,N3,N4)**

N1 = the upper left column index of the range
N2 = the upper left row index of the range
N3 = the lower right column index of the range
N4 = the lower right row index of the range

@RANGEREF returns a reference to the range described by corner coordinates *N1*, *N2*, *N3*, and *N4*. Row index must be relative to 1; column index must be relative to 0.

Examples:

@SUM(**@RANGEREF**(0,1,0,2)) is equivalent to @SUM(A1..A2)

@AVG(**@RANGEREF**(1,1,25,10)) is equivalent to @AVG(B1..Z10)

@RANK

Syntax: **@RANK(E,R,[O])**

E = Numeric value whose rank you wish to determine
R = Range of cells containing data to rank
O = Order of rank as follows:

0 or omitted	Ascending
Non-zero	Descending

@RANK returns the rank of a numeric argument *E* in the range *R* based on order *O*. If O is non-zero, the rank is equal to the position of the element if the list were sorted in ascending order, but if O is zero or omitted, the rank is equal to the position of the element if the list were sorted in descending order. Empty cells and text are ignored. Duplicate numbers will have the same rank.

Examples:

A1..A8 = 5,7,5,2,8,1,9,10

@RANK(A1..A8,7) = 4

@RANK(A1..A8,7,1) = 5

@RATE

Syntax: **@RATE(FV,PV,N)**

FV = future value of the investment
PV = present value of the investment
N = number of periods

@RATE returns the interest rate required to go from present value *PV* to future value *FV* in *N* compounding periods.

The formula used is:

$$\left(\frac{FV}{PV}\right)^{\frac{1}{N}} - 1$$

Examples:

@RATE(5000,3000,10) = .05

@RATE(H8,G8,B6) = .149, where B6 = 5, G8 = $5,000.00, and H8 = $10,000.00

@RATE(8700,-1000,3) = Error!, "PV" and "FV" must have the same sign

---

@RECEIVED

Syntax: **@RECEIVED(S,M,I,D[,B])**

S = Settlement date, date of purchase
M = Maturity date.
I = Investment amount
D = Discount rate
B = Day count basis as follows:

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@RECEIVED returns the value at maturity of a fully invested security. Dates must be entered as a serial date value.

Example:

@RECEIVED(@DATE(1993,1,15),@DATE(1993,6,15),,10000,12.5%,1) = 10545.323

@REGEX

Syntax: **@REGEX(S1,S2)**

S1 = a string value
S2 = a string value

@REGEX returns True (1) if the string *S2* matches the pattern specified by the regular expression in string *S1*, and False (0) otherwise. This function is similar to **@EXACT** except it allows "wildcard" comparisons by interpreting *S1* as a regular expression of the type used in the Find and Extract operations. For more information on regular expressions, see **Shortcuts and Tools**.

Examples:

@REGEX("t.p","top") = 1

@REGEX("t.*e","table") = 1

@REGEX("t.*e","talk") = 0

@REGEX("F[0-9]","F3") = 1

@REGEX("F[0-9","F3") = Error! Missing]

@REGEX("a","apple") = 1

@REGEX("ab","apple") = 0

@REPEAT

Syntax: **@REPEAT(S,N)**

S = a string value
N = a numeric value

@REPEAT returns the string *S* repeated *N* times.

Examples:

Z1 = "There's no place like home."

@REPEAT(Z1,1) = "There's no place like home."

@REPEAT(Z1,3) = "There's no place like home.There's no place like home.There's no place like home."

@REPEAT(Z1,0) = " "

@REPLACE

Syntax: **@REPLACE(S1,N1,N2,S2)**

S1 = a string value
N1 = a numeric value
N2 = a numeric value
S2 = a string value

@REPLACE returns the string formed by replacing the *N2* characters starting at position *N1* in string *S1* with string *S2*.

Examples:

@REPLACE("John",1,3,"ack") = "Jack"

@REPLACE(E1,8,3,"Log") = "Expense Logort", where E1 = "Expense Report"

@REPLACE(E1,8,6,"Log") = "Expense Log", where E1 = "Expense Report"

@REPLACE("ABC",0,0,"XYZ") = "XYZABC"

@REVERSE

Syntax: **@REVERSE(string)**

The reverse of a string

@RIGHT

Syntax: **@RIGHT(S,N)**

S = a string value
N = a numeric value

@RIGHT returns the string composed of the rightmost *N* characters of *S*. If *N* is greater than or equal to the length of *S*, then the entire string *S* is returned.

Examples:

F1 = "workstation"

@RIGHT(F1,1) = "n"

@RIGHT(F1,4) = "tion"

@RIGHT(F1,20) = "workstation"

@RMS

Syntax: **@RMS(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges**@RMS** returns the square root of the mean of squares of its arguments. Empty cells and cells containing strings are not counted. The function is given by:

$$\sqrt{\frac{\sum_{i=1}^{n} a_i^2}{n}}$$

Examples:

@RMS(2,2,3,6) = 3.6400549

@RMS(H8..H11) = 97.3413, where H8..H11 are 96, 97, '', and 99

@RMS(D1..D6) = 48.72029, where D1..D6 = 4, 56, 33, 100, 0, and -1

@ROMAN

Syntax: **@ROMAN(X [, n])**

X = a numeric value between 1 and 5,000,000
n = an integer between 0 and 4. with a default of 0

@ROMAN returns as a string of characters the Roman numeral respresentation of the integer part of *X*. The value of *n* determines the level of simiplification performed, where 0 is classic and 4 is most simplified.

For values where a horizontal line is placed above a character to indicate that it is that many thousands, a lower-case of the character is generated.

Examples:

@ROUND(1999,0) = "MCMXCIX"
@ROUND(1999,1) = "MLMVLIV"
@ROUND(1999,2) = "MXMIX"
@ROUND(1999,3) = "MVMIV"
@ROUND(1999,4) = "MIM"
@ROUND(5432) = "vCDXXXII"

@ROUND

Syntax: **@ROUND(X,n)**

X = a numeric value
n = the number of decimal places or whole numbers, between -15 and 15

@ROUND returns *X* rounded to the number of decimal places specified by *n* (when n is positive); it returns *X* rounded to a whole number when *n* is negative.

Examples:

@ROUND(3.1415927,2) = 3.14

@ROUND(-0.95241298,4) = -0.9524

@ROUND(1234.5678,-2) = 1200

@ROUNDDOWN

Syntax: **@ROUNDDOWN(X,n)**

X = a numeric value
n = the number of decimal places or whole numbers, between -15 and 15

@ROUNDOWN returns *X* rounded towards zero at the number of decimal places specified by *n* (when n is positive); it returns *X* rounded to a whole number when *n* is negative.

Examples:

@ROUNDDOWN(3.1415927,2) = 3.14

@ROUNDDOWN(-0.9524129,4) = -0.9524

@ROUNDDOWN(1234.5678,-2) = 1200

@ROUNDUP

Syntax: **@ROUNDUP(X, n)**

X = a numeric value
n = the number of decimal places or whole numbers, between -15 and 15

@ROUNDUP returns *X* rounded away from zero to the number of decimal places specified by *n* (when n is positive); it returns *X* rounded to a whole number when *n* is negative.

Examples:

@ROUNDUP(3.1415927,2) = 3.14

@ROUNDUP(-0.9524129,4) = -0.9525

@ROUNDUP(1234.5678,-2) = 1300

@ROW

Syntax: **@ROW(C)**

C = a cell or range. If *C* is omitted, the current row will be returned.

@ROW returns the row index of the cell referenced by *C*, or the top row if *C* is a range.

Examples:

@ROW(G42) = 42

@ROW(T10..V25) = 10

@ROW = 3, where @ROW is in cell B3.

@ROWS

Syntax: **@ROWS(R)**

R = a range

@ROWS returns the number of rows in the specified range.

Examples:

@ROWS(C4..C13) = 10

@S

Syntax: **@S(R)**

R = a range

@S returns the string value of the top left cell in range *R*, or a null string ("") if the cell is empty or contains a numeric value.

Examples:

A1..B3

	A	B
1	1	electrons
2	2	protons
3	3	neutrons

@S(A1..B3) = " "

@S(B1..B3) = "electrons"

@S(A1..Z25) = " ", where A2 = $1,000,000.00

@SALARM

Syntax: **@SALARM(X,S)**

X = an expression
S = a string

@SALARM evaluates the string *S* as an expression if *X* evaluates non-zero. The return value is set to the result of evaluating expression *S*. If *X* evaluates to zero, *S* is not evaluated and the return value is zero. Unlike **@ALARM**, the terminal does not beep (silent alarm). **@SALARM** differs from **@IF** by taking a string argument whose contents are evaluated as an expression only when *X* is non-zero. Important in real-time control.

Examples:

@SALARM(Pressure > 500, "@REMOTE_FN(Pressure)")
If "Pressure" exceeds 500, REMOTE_FN is called with the value of "Pressure".

@SEC

Syntax: **@SEC(x)**

Return the secant

@SECH

Syntax: **@SECH(x)**

Return the hyperbolic secant of x.

@SECOND

Syntax: **@SECOND(DT)**

DT = a date/time value

@SECOND returns the seconds (0 to 59) component of date/time value *DT*.

Examples:

@SECOND(.1000000) = 0

@SECOND(.8755342) = 46

@SECOND(.0645977) = 1

@SETSTRING

Syntax: **@SETSTRING(string,len[,align])**

Returns a string of length **len** with alignment **align**. The default alignment is 0. If the string is longer than len then the original string is returned. The valid alignments are:

0 - Left-aligned.
1 - Center-aligned.
2 - Right-aligned.

@SHEET

Syntax: **@SHEET(cellref)**

The number of the sheet in a cell reference.

@SHEETS

Syntax: **@SHEETS(range)**

The number of sheets in a range.

@SIGMOID

Syntax: **@SIGMOID(X)**

X = a numeric value

@SIGMOID returns the value of the sigmoid function. The result is between 0 and 1. The function is given by:

$$\frac{1}{1+e^{-x}}$$

Examples:

@SIGMOID(1) = 0.26894142

@SIGMOID(D14) = .5, where D14 = 0

@SIGMOID(T5) = 1.026188e-10, where T5 = 23.

@SIGN

Syntax: **@SIGN(number)**

Returns the sign of the number (1, 0, -1).

@SIN

Syntax: **@SIN(X)**

X = a numeric value expressed in radians.

@SIN returns the sine of the angle *X*. To convert the argument from degrees to radians, use the **@RADIANS** function.

Examples:

@SIN(1) = 0.841470984
@SIN(-2) = -0.90929743
@SIN(@RADIANS(R5)) = 0.70710678, where R5 = 45

@SINH

Syntax: **@SINH(X)**

X = a numeric value expressed in radians

@SINH returns the hyperbolic sine of angle *X*.

Examples:

@SINH(1) = 1.175201194
@SINH(O12) = -4.0218567, where O12 = -2.1
@SINH(A1/A2) = 0.521095305, where A1 = 1 and A2 = 2

@SLN

Syntax: **@SLN(C,S,L)**

C = cost
S = salvage value
L = allowable life

@SLN returns the straight-line depreciation allowance given cost *C*, salvage value *S*, and allowable life *L*. The function is given by:

$$\frac{(C-S)}{L}$$

Examples:

@SLN(5000,1500,15) = 233.333
@SLN(S10,S9,20) = 5, where S9 = 400 and S10 = 500
@SLN(500,1000,12) = error!, must have "Cost" >= "Salvage" >= 0

@SMALL

Syntax: **@SMALL(R,N)**

R = range of cells containing the numerical data
N = the nth position from the smallest in the range specified

@SMALL returns the *N*th smallest number in range *R*. Cells that are empty or that contain text are ignored.

Examples:

A1..A9 = 1,4,8,3,7,12,54,8,23

@SMALL(A1..A9,3) = 4
@SMALL(A1..A9,1) = 1
@SMALL(A1..A9,@COUNT(A1..A7)) = 54

@SQRT

Syntax: **@SQRT(X)**

X = a numeric value

@SQRT returns the positive square root of *X*.

Examples:

@SQRT(100) = 10
@SQRT(@ABS(P9)) = 2, where P9 = -4
@SQRT(-3) = Error!, argument is negative

@SQRTPI

Syntax: **@SQRTPI(number)**

Returns SQRT(number * π).

@SSE

Syntax: **@SSE(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@SSE returns the sum squared error of its arguments. It is equivalent to **@VAR**(...) *** @COUNT**(...).

Examples:

@SSE(1.5,2.5,3.5,4.5) = 5

@SSE(-1.5,4.5,7.65,9.56) = 70.31

@SSQ

Syntax: **@SSQ(argumentlist)**

argumentlist = any combination or numbers, cells or ranges

@SSQ returns the sum of squares of its arguments. Empty cells and cells containing strings are not counted. The function is given by:

$$\sum_{i=1}^{n} a_i^2$$

Examples:

@SSQ(2,2,3,6) = 53

@SSQ(G1..G4) = 132, where G1 = -8, G2 = -6, G3 = -4, and G4 = -4

@SSQ(D1..D6) = 14242, where D1..D6 = 4, 56, 33, 100, 0, and -1

@STD

Syntax: **@STD(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@STD returns the population standard deviation (N weighting) of its arguments. Empty cells and cells containing strings are not counted. The function is given by:

$$\sqrt{\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2}{n}}$$

Examples:

@STD(1,2,7) = 2.6246693

@STD(Y1..Y5) = 8.2316463, where Y1..Y5 = 22, 24, 29, 34, and 45

@STD(K6..K10) = 0.7076892, where K6..K10 = 1, .33, 0, -0.66, and -0.99

@STDS

Syntax: **@STDS(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@STDS returns the sample standard deviation (N-1 weighting) of its arguments. Empty cells and cells containing strings are not counted.

$$\sqrt{\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2}{n-1}}$$

Examples:

@STDS(1,2,7) = 3.2145503

@STDS(Y1..Y5) = 9.2032603, where Y1..Y5 = 22, 24, 29, 34, and 45

@STDS(K6..K10) = 0.79122058, where K6..K10 = 1, .33, 0, -0.66, and -0.99

@STRCAT

Syntax: **@STRCAT(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@STRCAT returns the concatenation of all its arguments. For cell arguments, the actual formatted contents of the cell are used, even if the cell contains a numeric value.

Example:

@STRCAT("The bottom line is ",B3,"!") = "The bottom line is 1!", where B3 = 1

@STRCAT("The sum is ",@SUM(I1..I5) = "The sum is 4", where I1..I5 = 1, 1, -4, 0, and 6

@STRCAT("The Word is ",@PROPER(S3)) = "The word is Boston", where S3 = "Boston"

@STRING

Syntax: **@STRING(X,N)**

X = a numeric value
N = a numeric value

@STRING returns the string representing the numeric value of *X*, formatted to *N* decimal places, where *N* is in the range 0 to 15. The results are rounded.

Examples:

@STRING(2,4) = "2.0000"

@STRING("2",4) = "0.0000"

@STRING(@SUM(A1..A3),1) = "1.7", where A1 = 0.33, A2 = 0.55, and A3 = 0.77

@STRLEN

Syntax: **@STRLEN(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@STRLEN returns the total length of all the strings in its argument list. It differs from @LENGTH in that it can take multiple arguments, but more significantly, it returns the length of the formatted contents of a cell, even if it contains a numeric argument.

Example:

@STRLEN("PHYSICS") = 7

@STRLEN(B1) = 34,
where B1 ="Engineering Scientific Spreadsheet"

@STRLEN(A1) = 10, where A1 contains the value formatted as currency with two decimal places so that it appears on screen as $1,000.00 (plus a trailing space).

@SUBSTITUTE

Syntax: **@SUBSTITUTE(string,old,new[,instance])**

Substitutes the new pattern for the occurrences of the old pattern. If instance is not specified, all occurrences are substituted. If instance is specified, only that occurrence number is substituted.

@SUM

Syntax: **@SUM(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@SUM returns the sum of its arguments. Empty cells and cells containing strings are not counted.

Examples:

@SUM(10,20,30,40,50) = 150

@SUM(L1..L3) = 15.10564, where L1 = 1.32342, L2 = 5.45735, and L3 = 8.32487

@SUM(A1,B1,C1,D1) = 0, where A1 = -1, B1 = -9, C1 = 9, and D1 = 1

@SUMNEGATIVE

Syntax: **@SUMNEGATIVE(list)**

Returns the sum of the negative values in the list. List can contain ranges, single cells, or expressions.

@SUMPOSITIVE

Syntax: **@SUMPOSITIVE(list)**

Returns the sum of the positive values in the list. List can contain ranges, single cells, or expressions.

@SUMPRODUCT

Syntax: **@SUMPRODUCT(R1,R2)**

R1 = a vector
R2 = a vector

@SUMPRODUCT returns the sum of products of two vectors. *R1* must have the same number of rows and columns as *R2*, or *R1* and *R2* can be one-dimensional vectors of the same length.

Examples:

Matrix 1, D4..E5

	D	E
4	2	3
5	4	6

Matrix 2, D7..E8

	D	E
7	-5	0
8	2	8

@SUMPRODUCT(D4..E5,D7..E8) = 46

@SUMPRODUCT(D4..D5,D7..E7) = -10

@SUMPRODUCT(A1..A2, M1..P4) = Error!, incompatible range dimensions

---

@SUMSQ

Syntax: **@SUMSQ(list)**

Returns the sum of the squares of the values in the list. List can contain ranges, single cells, or expressions.

@SUMXMY2

Syntax: **@SUMXMY2(range1,range2)**

Returns the sum of squares of the differences of corresponding elements in the ranges. Range1 and Range2 must have conforming sizes.

@SUMX2MY2

Syntax: **@SUMX2MY2(range1,range2)**

Returns the sum of the squares of the values in the first range minus the sum of the squares of the values in the second range. (SUM(X(I)**2-Y(I)**2). Equal to

```
SUMSQ(range1) - SUMSQ(range2)
```

but ensures that both ranges are conforming sizes.

@SUMX2PY2

Syntax: **@SUMX2PY2(range1,range2)**

Returns the sum of the squares of the values in the first range plus the sum of the squares of the values in the second range. (SUM(X(I)**2+Y(I)**2). Equal to

```
SUMSQ(range1) + SUMSQ(range2)
```

but ensures that both ranges are conforming sizes.

@SYD

Syntax: **@SYD(C,S,L,P)**

C = cost
S = salvage value
L = allowable life
P = the period for which the depreciation allowance is being calculated

@SYD returns the "sum-of-years-digits" depreciation allowance given cost *C*, salvage value *S*, allowable life *L*, and depreciation period *P*. The function is given by:

$$\frac{(C-S)(L-P+1)}{L(L+1)/2}$$

Examples:

@SYD(5000,1500,15,14) = 58.333
@SYD(S10,S9,20,2) = 9.048, where S9 = 400 and S10 = 500
@SYD(2500,750,0,5) = Error!, "Life" must be > 0

@T

Syntax: **@T(N,T)**

N = a numeric value
T = a numeric value

@T returns the integral of Student's T-distribution with *N* degrees of freedom from minus infinity to *T*. The function is given by:

$$T(n,t) = \int_{-\infty}^{t} \frac{\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi}\Gamma\left(\frac{n}{2}\right)}\left(1+\frac{z^2}{2}\right)^{-\frac{n+1}{n}}dz$$

Examples:

@T(14,35) = 1

@T(F3,G6) = 0.8411029, where F3 = 500, and G6 = 1

@T(C1,C2) = Error!, degrees of freedom must be > 0, where *C1* = 0 and *C2* = -1

@TAN

Syntax: **@TAN(X)**

X = a numeric value expressed in radians

@TAN returns the tangent of angle *X*.

Examples:

@TAN(1) = 1.554707725
@TAN(Y1) = 1.619775191, where Y1 = 45

@TANH

Syntax: **@TANH(X)**

X = a numeric value expressed in radians

@TANH returns the hyperbolic tangent of angle *X*. The result is between -1 and 1.

Examples:

@TANH(0) = 0

@TANH(G4) = 0.454216432, where G4 = .49

@TANH(X8) = -1, where X8 = -30

@TBILLEQ

Syntax: **@TBILLEQ(S,M,D)**

S = Settlement date
M = Maturity date
D = Discount rate of Treasury bill

@TBILLEQ returns the bond-yield equivalent (BEY) for a Treasury Bill equivalent to a bond, given settlement date *S*, maturity date *M*, and discount rate *D*. Dates must be expressed as serial date values. If the term is one half-year or less, BEY is equivalent to an actual/365 simple interest rate. If the term of the security is more than one-half year, BEY is equivalent to a semiannually compounded Treasury bond yield.

Examples:

@TBILLEQ(@DATE(1993,3,31),@DATE(1993,6,20),9.14%) = 0.09462

@TBILLEQ(@DATE(1993,3,31),@DATE(1993,12,15),9.14%) = 0.09819

@TBILLPRICE

Syntax: **@TBILLPRICE(S,M,D)**

S = Settlement date
M = Maturity date
D = Discount rate of Treasury bill

@TBILLPRICE returns the price per $100 face value for a Treasury bill, given settlement date *S*, maturity date *M*, and discount rate *D*. Dates must be expressed as serial date values.

Example:

@TBILLPRICE(@DATE(1993,4,2),@DATE(1993,7,5),9.25%) = 98.5847

@TBILLYIELD

Syntax: **@TBILLYIELD(S,M,D)**

S = Settlement date
M = Maturity date
D = Discount rate of Treasury bill

@TBILLYIELD returns the yield on a treasury bill, given settlement date *S*, maturity date *M*, and discount rate *D*. Dates must be expressed as serial date values.

Example:

@TBILLYIELD(@DATE(1993,4,2),@DATE(1993,7,5),97.585) = 0.09478

@TERM

Syntax: **@TERM(P,R,FV)**

P = amount of periodic payments
R = interest rate
FV = future value of the investment

@TERM returns the number of payment periods for an investment given the periodic payment P, the interest rate R and future value FV. The function is given by:

$$\frac{\ln\left(1+\left(FV*\frac{R}{P}\right)\right)}{\ln\left(1+R\right)}$$

Examples:

@TERM(1050,0.105,300000) = 34.39

@TERM(R13,RATE,S19) = 16.48, where R13 = 360, S19 = 15000, and RATE is a named cell = 11%

@TERM(100,0.095,-1) = error!, "P" and "FV" must have same sign

---

@TEXT

Syntax: **@TEXT (X, S)**

X = A numeric value
S = A format string

Formats the value X using the the picture format string S. It returns a string with the value converted to the specified user-defined format.

The string S may contain any of the User Defined format. The color component, if any, will be ignored. See the section on User Defined formats for a complete discussion of valid options.

Examples:

@TEXT(@NOW, "dddd\, mmmm d")
returns "Monday, October 19"

@TIME

Syntax: **@TIME(H,M,S)**

H = hour
M = minute
S = second

@TIME returns the time value represented as a fraction of a day, starting at midnight. *H* must be between 0 and 23, and *M* and *S* must be between 0 and 59.

Examples:

@TIME(12,0,0) = 0.5, where 0.5 represents half of a day, which is noon

@TIME(8,45,46) = 0.36511574

@HOUR(**@TIME**(C1,D1,E1)) = 13, where C1 = 13, D1 = 40, and E1 = 2

@TIMEVALUE

Syntax: **@TIMEVALUE(S)**

S = a string value

@TIMEVALUE returns the corresponding time value for a given string value *S*. The function interprets the times specified in the following formats:

HH:MM:SS AM or PM	(1 <= HH <=12)
HH:MM:SS	(0 <= HH <=23)
HH.MM.SS	(0 <= HH <=23)
HH,MM,SS	(0 <= HH <=23)
HHhMMmSSs	(0 <= HH <=23)

The first format is the international 12-hour AM/PM time format. All others are international 24-hour time formats.

In all formats the seconds (SS) may be omitted, in which case they default to 00.

In all formats the hours may be specified with 1 or 2 digits, while the minutes (MM) and seconds (SS) must be 2 digits.

The following are equivalent:

@TIMEVALUE("12:55:00 AM")

@TIMEVALUE("12:55 am")

@TIMEVALUE("00:55:00")

@TIMEVALUE("00:55")

@TIMEVALUE("0.55.00")

@TIMEVALUE("0h55m00s")

The result is 0.038194444

@TODAY

Syntax: **@TODAY**

@TODAY returns the date value corresponding to the current system date.

Examples:

@DATE(**@TODAY**) = 33139, where 33139 represents September 23, 1990

@MONTH(**@TODAY**) = 9

@DAY**(@TODAY**) = 23

@TRANSPOSE

Syntax: **@TRANSPOSE(M)**

M = a matrix

@TRANSPOSE generates the transpose of the numeric matrix *M*.

Examples:

Matrix B9..C10

	B	C
9	1	3
10	2	4

@TRANSPOSE(B9..C10) =

1	2
3	4

Matrix A1..B4

	A	B
1	.99	0
2	3	6.2
3	4.1	1.1
4	3.3	6.3

@TRANSPOSE(A1..B4) =

.99	3	4.1	3.3
0	6.2	1.1	6.3

@TRANSPOSE(B17) = Error!, improper argument type

@TREND

Syntax: **@TREND(NX, KX, KY)**

NX = range for new x values for which TREND will return corresponding y values
KX = known x values
KY = known y values

@TREND fits a straight line to KX (known x's) and KY (known y's) using least square method, and then returns the y values along the line for NX (new x's).

Example:

	B	C
10	*X values*	*Y values*
11	1	242
12	2	256
13	3	263
14	4	274
15	5	279
16	6	285
17	7	290

@TREND(A1..A2, B11..B17, C11..C17) =

301
308.7857
316.5714

@TRIM

Syntax: **@TRIM(S)**

S = a string value

@TRIM returns the string formed by removing leading, trailing and consecutive embedded spaces from string *S*.

Examples:

@TRIM(" Alpha Beta Gamma ") = "Alpha Beta Gamma"

@TRIM(R5) = "There's no place like home.", where *R5* = "There's no place like home."

@TRUE

Syntax: **@TRUE**

@TRUE returns the value 1.

Examples:

@TRUE = 1

@IF(B17 == 0,**@TRUE**,@FALSE) = 1

@TRUNC

Syntax: **@TRUNC(X [, n])**

X = a numeric value
n = the number of decimal places or whole numbers, between -15 and 15

@TRUNC returns *X* rounded towards zero at the number of decimal places specified by *n* (when n is positive); it returns *X* rounded to a whole number when *n* is negative.

Examples:

@TRUNC(3.1415927,2) = 3.14

@TRUNC(-0.9524129,4) = -0.9524

@TRUNC(1234.5678,-2) = 1200

@TTEST

Syntax: **@TTEST(R,X)**

R = a range
X = a numeric value

@TTEST returns the significance level (alpha) of the two-sided single population T-test for the population samples contained in the range *R*. Alpha is the probability of error in rejecting the null hypothesis that mean [*R*]=*X*.

Examples:

@TTEST(A1..A4,B1) = 0.12093936, where A1..A4 = .5, .98, .22, .1, and B1 = .87,

@TTEST(H5..H9,K5) = 0.0039514106, where H5..H9 = 14, 35, 37, 0, 33, and
K5 = 67

@TTEST(V1..V10,W1..W10) = Error!, improper argument type

@TTEST2EV

Syntax: **@TTEST2EV(R1,R2)**

R1 = a range
R2 = a range

@TTEST2EV returns the significance level (alpha) of the two-sided dual population T-test for the population samples contained in the ranges *R1* and *R2* under the assumption that the population variances are the same. Alpha is the probability of error in rejecting the null hypothesis that mean[*R1*] = mean[*R2*] assuming var[*R1*] = var[*R2*].

Examples:

@TTEST2EV(A1..A4,B1..B4) = 0.71153758, where A1..A4 = .5, .98, .22, .1, and B1..B4 = .87, .6, .21, .49.

@TTEST2EV(H5..H9,K5..K9) = 0.0061236, where H5..H9 = 14, 35, 37, 0, 33, and K5..K9 = 67, 77, 94, 34, 99.

@TTEST2UV

Syntax: **@TTEST2UV(R1,R2)**

R1 = a range
R2 = a range

@TTEST2UV returns the significance level (alpha) of the two-sided dual population T-test for the population samples contained in the ranges *R1* and *R2* without assuming that the population variances are the same. Alpha is the probability of error in rejecting the null hypothesis that mean[*R1*] = mean[*R2*], assuming var[*R1*] and var[*R2*] are unrelated.

Examples:

@TTEST2UV(A1..A4,B1..B4) = 0.71306706, where A1..A4 = .5, .98, .22, .1, and B1..B4 = .87, .6, .21, .49.

@TTEST2UV(H5..H9,K5..K9) = 0.0083561, where H5..H9 = 14, 35, 37, 0, 33, and K5..K9 = 67, 77, 94, 34, 99.

@UPPER

Syntax: **@UPPER(S)**

S = a string value

@UPPER returns the string *S* converted to uppercase characters.

Examples:

@UPPER("New York") = "NEW YORK"

@UPPER(H7) = "POPULAR VOTE", where H7 = "popular vote"

@VALUE

Syntax: **@VALUE(S)**

S = a string value

@VALUE returns the numeric value represented by string *S*, or 0 if *S* does not represent a number.

Examples:

@VALUE("324.399") = 324.399

@VALUE(G10) = 1.7, where G10 = "1.7"

@VALUE(M8) = 0, where M8 = "cosine"

@VAR

Syntax: **@VAR(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@VAR returns the population variance (N weighting) of its arguments. Empty cells and cells containing strings are not counted. The formula is given by:

$$\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2}{n}$$

Examples:

@VAR(1,2,7) = 6.8888889

@VAR(Y1..Y5) = 67.76, where Y1..Y5 = 22, 24, 29, 34, and 45

@VAR(K6..K10) = 0.500824, where K6..K10 = 1, .33, 0, -0.66, and -0.99

@VARS

Syntax: **@VARS(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@VARS returns the sample variance (N-1 weighting) of its arguments. Empty cells and cells containing strings are not counted. The formula is given by:

$$\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2}{n-1}$$

Examples:

@VARS(1,2,7) = 10.333333

@VARS(Y1..Y5) = 84.7, where Y1..Y5 = 22, 24, 29, 34, and 45

@VARS(K6..K10) = 0.62603, where K6..K10 = 1, .33, 0, -0.66, and -0.99

@VDB

Syntax: **@VDB(C,S,L,S,E)**

C = the initial cost of the asset
S = salvage value (the value at the end of the depreciation)
L = life (the total number of periods over which the asset is being depreciated)
S = start period (first period in the calculation)
E = end period (last period in the calculation)

@VDB returns the depreciation of an asset between two specific period using the fixed-declining balance method.

Examples:

@VDB(10000,500,120,2,4) = 319.6289

@VECLEN

Syntax: **@VECLEN(argumentlist)**

argumentlist = Any combination of numbers, cells or ranges

@VECLEN returns the square root of the sum of squares of its arguments. It calculates the length of a vector in N-dimensional space. In the two-argument case, **@VECLEN** is the Pythagorean

theorem for the hypotenuse of a right triangle, given the length of the other two sides. The formula is given by:

$$\sqrt{a_1^2 + a_2^2 + \ldots + a_n^2}$$

Examples:

@VECLEN(3,4) = 5

@VECLEN(-1,-2,-3,0) = 3.7416574

@VECLEN(A1..A2) = 2 where A1 = 1 and A2 = 2.236068

@VECLEN(S1..S3,4) = 5.4772256,where S1 = 1, S2 = 2, and S3 = 3

@VERIFY

Syntax: **@VERIFY(string,valid)**

Returns the number of the first character in string that is not contained in the list of valid characters. The number returned is 0-based as in the FIND() function. If all characters in the string are found in the list of valid characters, VERIFY returns the length of the string.

@VLOOKUP

Syntax: **@VLOOKUP(X,R,N)**

X = a numeric or string value
R = a range
N = a numeric value

@VLOOKUP searches the first column (known as the index column) in range R for the numeric or string value which "matches" X, and returns the value N columns to the right in the row where the match is found. The index column is searched from top to bottom. If the column contains numeric values, they must be in ascending order, and cannot contain an empty cell.

If X is a string value, an exact match must be found or an error is returned.

If X is a numeric value, the matching row is determined by the following rules:

1) Strings and empty cells in the index column are ignored.
2) If the first value in the index column is greater than X, an error is returned.

3) Searching stops when a numeric value which is greater than or equal to X is found in the index column. If the value found is greater than X, the preceding row is the matching row.

Examples:

	A	B
1	Lodging	$85.00
2	Meals	$30.00
3	Airfare	$698.00
4	Entertainment	$25.00

@VLOOKUP("Meals",A1..B4,1) = 30
@VLOOKUP("Airfare",A1..B4,1)) = Error - @VLOOKUP, lookup failed to produce a match

@VLOOKUP("Airfare",A1..B4,2)) = Error - @VLOOKUP, column out of range

---

@VSUM

Syntax: **@VSUM(argumentlist)**

argumentlist = any combination of numbers, cells or ranges

@VSUM returns the "visual sum" of its arguments. This function differs from @SUM in that it uses the precision and rounding of the actual formatted values appearing in the cells instead of the internal double-precision value of the cell. This ensures that what you see is what you get when calculating a sum.

Examples:

@VSUM(L1..L3) = .99 where L1 = 1/3, L2 = 1/3, and L3 = 1/3 and are displayed with two decimal places

---

@WEEKDAY

Syntax: **@WEEKDAY(D)**

D = serial date value

@WEEKDAY returns an integer representing the day of the week on which the day *D* falls. 1 is Sunday, 7 is Saturday.

Examples:

@WEEKDAY(@DATEVALUE("2/25/1994")) = 6
@WEEKDAY(34466) = 5

@WORKDAY

Syntax: **@WORKDAY(S,D[,H])**

S = Serial start date value
D = Number of days before (negative) or after (positive) start date
H = Cell or range of cells containing serial date values to exclude

@WORKDAY returns the serial day value that is *D* working days after day *S* (if D is positive) or D working days before day S (if D is negative),excluding weekends and all holidays specified as dates in range *H*.

Examples:

@WORKDAY(@DATE(1991,1,1),5,B1..B2) = 33249 or 01/11/1991, where A1..A2 = @DATEVALUE("1/7/1991"),
@DATEVALUE("1/8/1991")

@WORKDAY(@DATE(1993,1,1),258,A1..A5) = 34334n or 12/31/1991, where A1..A5 = @DATEVALUE("1/1/1993"),
@DATEVALUE("5/25/1993"),
@DATEVALUE("7/4/1993"),
@DATEVALUE("9/3/1993"),
@DATEVALUE("11/28/1993")

@XHLOOKUP

Syntax: **@HLOOKUP(F,X, R, N)**

F = a filename (as a string)
X = a numeric or string value
R = a range
N = a numeric value

@XHLOOKUP is the same as **@HLOOKUP** except that it has an extra argument.which specifies the file containing the spreadsheet where the lookup table is located. The range argument can be a range specification or a string which contains a range specification to be evaluated in the context of the external spreadsheet file.

Example:

```
=@XHLOOKUP("table.xs5",1,"input",3)
```

@XIRR

Syntax: **@XIRR(G,V,D)**

G - a guessed value of the result
V - a range containing a series of cash flows
D - a range containing the dates of cash flows in V

@XIRR returns the internal rate of return for a series of cash flows (*V*) with variable intervals (*D*). V and D must be one-dimensional ranges and have the same size.

Example:

	A	B
1	02/01/91	-12000
2	05/01/91	2800
3	10/01/91	3250
4	02/01/92	4460
5	04/01/92	5000

@XIRR(0.5,B1..B5,A1..A5) = 0.3632

@XNPV

Syntax: **@XNPV(R,V,D)**

R - discount rate to apply to the cash flows
V - a range containing a series of cash flows
D - a range containing the dates of cash flows in V

@XNPV returns the net present value for a series of cash flows (V) with variable intervals (D). V and D must be one-dimensional ranges and have the same size.

Example:

	A	B
1	01/10/91	-12000
2	04/01/91	3000
3	09/30/91	4150
4	01/10/92	3300
5	04/01/92	3150

@XNPV(9.00%,B1..B5,A1..A5) = 705.1677

@XOR

Syntax: **@XOR(argumentlist)**

argumentlist = any combination of numbers, cells, or ranges

@XOR returns -1 if any argument is not 0 or 1; otherwise 1 if the total number of arguments with the value 1 is odd; 0 if the total number of arguments with the value 1 is even. Text and empty cells are ignored.

Examples:

A1 = 1, B1 = 1, C1 = 0, D1 = 0, E1 = 1 and A2 = 24

@XOR(A1,B1) = 0
@XOR(A1..E1) = 1
@XOR(A1..A2) = -1

@XVALUE

Syntax: **@XVALUE(N,C)**

N = a string containing the pathname of another spreadsheet file
C = a valid cell reference, #, or string

@XVALUE returns the value of cell *C* in sheet saved as file *N*.. When the cell reference *C* is the same as the cell containing the @XVALUE function, use the hash mark (#) as the second argument. If C is a string containing a range name, that name is resolved in the workbook specified by N.

If sheet *N* is currently loaded into another instance of XEDIT or some other spreadsheet program and you change a value, you must first save sheet *N* then recalculate the sheet containing the @XVALUE function to retrieve the new value entered into sheet *N*.

Examples:

@XVALUE("controls.xs5",A1) returns the value of cell A1 from the sheet saved as the file controls.xs5 in your default directory *when the @XVALUE function is stored in a cell other than A1.*

@XVALUE("controls.xs5",#) returns the value of cell A1 from the sheet saved as the file controls.xs5 in your default directory *when the @XVALUE function is stored in cell A1.*

```
=@XVALUE("table.xs5","Sheet3!C5")
=@XVALUE("sales1997.xs5","Q4.total")
```

@XVLOOKUP

Syntax: **@HLOOKUP(F,X, R, N)**

F = a filename (as a string)
X = a numeric or string value
R = a range
N = a numeric value

@XVLOOKUP is the same as **@VLOOKUP** except that it has an extra argument.which specifies the file containing the spreadsheet where the lookup table is located. The range argument can be a range specification or a string which contains a range specification to be evaluated in the context of the external spreadsheet file.

Example:

=@XVLOOKUP("table.xs5",1,"input",3)

@YEAR

Syntax: **@YEAR(DT)**

DT = a date/time value

@YEAR returns the years component of the date/time value *DT*.

Examples:

@YEAR(24203) = 1966, where 24203 represents April 6, 1966

@YEAR(@TODAY) = 1999, where TODAY = December 31, 1999

@YEARFRAC

Syntax: **@YEARFRAC(S,E[,B])**

S = a date value that represents the start date
E = a date value that represents the end date
B = (Optional) The day count basis to be used.

0 or omitted	30/360
1	Actual/actual
2	Actual/360
3	Actual/365

@YEARFRAC returns the year fraction representing the number of whole days between *S* (start date) and *E* (end date). This function is useful in calculating the percent of benefit or obligation to assign a specific period.

Examples:

@YEARFRAC(@DATE(1994,1,1),@DATE(1994,5,30),0) = 0.4167

@YEARFRAC(@DATE(1994,1,1),@DATE(1994,5,30),1) = 0.4110

@YIELD

Syntax: **@YIELD(S,M,R,PR,RD,F[,B])**

S = settlement date
M = maturity date
R = annual coupon rate of the security
PR = the price of the security per $100 face value
RD = redemption value of the security at maturity per $100 face value
F = the number of coupon payments per year (frequency):

1	annual
2	semi-annual
4	quarterly

B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@YIELD returns the yield at maturity of a security that pays periodic interest. All dates must be entered as serial date value.

Example:

@YIELD(@DATE(1991,3,15),@DATE(1998,10,15),6%,94.1854,100,2,0) = 0.07

@YIELDDISC

Syntax: **@YIELDDISC(S,M,PR,RD[,B])**

S = settlement date
M = maturity date
PR = the price of the security per $100 face value
RD = redemption value of the security at maturity per $100 face value
B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@YIELDDISC returns the annual yield for a discounted security. All dates must be entered as serial date value.

Example:

@YIELDDISC(@DATE(1993,3,1),@DATE(1993,5,1),98,875,100,0) = 0.06827

@YIELDMAT

Syntax: **@YIELDMAT(S,M,I,R,PR[,B])**

S = settlement date
M = maturity date
I = issue date
R = interest rate at date of issue
PR = the price of the security per $100 face value
B = (Optional) the day count basis to be used:

0 or omitted	30/360
1	actual/actual
2	actual/360
3	actual/365

@YIELDMAT returns the annual yield of a security which pays interest at maturity. All dates must be expressed as serial date values.

Examples:

@YIELDMAT(@DATE(1993,3,1),@DATE(1993,10,1),@DATE(1992, 11,5), 6.5%,99.875,0) = 0.06585

Appendix B

XESS Resources

The X Window operating environment provides resources for customizing the appearance of the display. XESS defines many of these resources to set startup parameters, default type style for printing, screen colors, and much more.

XESS resources are separated into two sections: *Motif* resources and *local* resources. XESS local resources define aspects and functionality of the spreadsheet, while XESS Motif resources define the actual XESS environment such as text on menu buttons and in dialog boxes—the aesthetics of the spreadsheet.

The default appearance of the Xess spreadsheet is defined by the file **Xess5** (or **xess5.dat** for VMS systems).. This file is placed in the appropriate directory by the installation procedures . **/usr/lib/X11/app-defaults** on most UNIX and Linux systems). If this file is not present, default values are derived from the fallbacks internal to the program. A supplemental resource file can be placed in a user's home or login directory.

The resource file can be edited to customize the XESS work environment to suit your applications and preferences. Each resource is entered on a separate line in the resource file. For a more general explanation of X resources, we recommend chapter 2 of the *X Window System Administrator's Guide*, by Linda Mui and Eric Pearce, published by O'Reilly & Associates, ISBN: 0-937175-83-8, or 1-56592-052-X with a CDROM.

XESS Motif Resources

XESS uses the Motif widget set. Widgets are "little windows" that are "children" of your main window. Buttons, menus, and text fields are examples of widgets.

Each widget can alter its behavior based on its resources. Almost the entire user interface for XESS is defined by assigning values to widget resources. Each type of widget has a certain list of resources that it examines to determine how to look and behave; the resources used to control Motif widgets are documented in full in the *OSF/Motif Programmer's Reference Manual*.

The names of all the Motif widgets used in XESS are in the Xess5 application defaults file, where the XESS defaults are assigned. Although it is possible to radically alter the XESS user interface by changing resources, we do not recommend doing this, as it is also possible to crash XESS or render the user interface useless because the Motif widgets provide only limited internal protection against bad resource settings.

However, it is easily possible to change default widget attributes by setting a few resources. For example, to change the default Motif widget background color for all the XESS Motif widgets, but not the widgets for any other programs, you can put the line:

```
*Background: ghost white
```

in your resource file.

Be careful: setting the Background and Foreground resource colors to the same value will make all the Motif widgets impossible to read. There are other ways to confuse widgets by assigning widget resources indiscriminately, as well.

You can specify resource values on the execution line when you start XESS using the -xrm switch. For example:

```
xess -xrm "*inCellEditOn: True"
```

XESS Local Resources

There are a number of resources which control the default setting of various options within XESS. You may decide you would rather have a different default value. The tables in this section address resources which correspond to the following: start-up parameters, XESS aesthetics, option dialogs, color palette, and accelerator keys.

Once you modify these values and place the resource file in the appropriate location, the next XESS session will reflect the new values.

Note that the resource definition does not include the class name, Xess5/Xessu5, which needs to be added only if you choose to include the resource definitions in your current .Xdefaults file.

XESS Administration

XESS Administration resources define the location of the license and on-line help files and printer definitions. The first two are assigned during the installation process. Any printer definitions must be manually entered into the resource file.

Item	Resource	XESS Default	Accepted Values
License File Location	*licenseFile	<set by Install>	Valid file name *(Not used by xessu.)*
On-line Help Location	*helpFile	<set by Install>	Valid file name
Default Printer *(applicable only when destination is set to Printer in Printer Options.)*	*printers	Default:lpr %s	Any valid print command with optional parameters ending with "%s" which is replaced by the file name.
Up to 31 more "printer" destinations which may include pipes to third-party products such as a PostScript previewer.	continuation of *printers definition	*undefined*	Up to 31 more definitions in the format: *name:command\n* Note; the last entry must NOT include "\n\".

Table B-1 XESS Administration Resources

Command Line Parameters

Command Line Parameter resources allow you to set the default values of those parameters which can be passed from the command line when XESS is invoked.

Start-up Parameters	Resource	XESS Default	Accepted Values
-rows	*rows	20	Integer
-columns	*columns	9	Integer
-position	*position	50,100	X and Y integer values
-nomenu	*menuActive	True	True/False
-connect	*connect	Refusing	Refusing/R, Accepting/A, Locking/L

Table B-2 Command Line Parameter Resources

Miscellaneous Options

Miscellaneous Options resources are a set of session-wide resources which are not reflected in a specific dialog box

Option	Resource	XESS Default	Accepted Values
display column identifiers and function names in lower case instead of upper case	*displayLowerCase	False	True/False
display function names with at-sign (@) prefix	*displayAtSign	True	True/False
mouse button 3 popup menu	*popupMenu	True	True/False
automatically resize window with each Open operation to the size last saved	*windowAutoResize	True	True/False
If True, may circumvent problems using the numeric keypad on certain Sun keyboards.	*sunKeyboard	False	True/False

Table B-3 Miscellaneous Options

Workbook Defaults

Workbook Defaults resources allow you to set defaults associated with the Workbook Defaults dialog.

Workbook Default	Resource	XESS Default	Accepted Values
Default Column Width	*columnWidth	12	1 - 511
Default Row Height	*rowHeight	1	1 - 20
Grid Lines (On/Off)	*gridEnabled	True	True/False
Grid Color	*gridColorIndex	36	Color Palette #
Move On Entry	*autoMove	Off	Off/Up/Down/Left/Right
Check Protection (On/Off)	*protectionEnabled	False	True/False
Toolbar (On/Off)	*toolBar	True	True/False
Case Collation	*caseOrder	lowercase_normal	lowercase_normal lowercase_after lowercase_with
Accent Collation	*accentOrder	accent_normal	accent_normal accent_after accetn_with

Figure B-1 Workbook Defaults Resources

XESS Aesthetics

Aesthetic resources are used to set characteristics which affect the overall XESS "appearance".

Aesthetic Feature	Resource	XESS Default
font used in all the menus and text widgets	*fontList	-*-helvetica-medium-r-*-*-*-120-*-*-*-*-*-*
background of selection highlighting	*selectBackground	White
foreground of selection highlighting	*selectForeground	#a0a0a0
color used to indicate active cell	*cursorColor	Red
foreground color of all Motif components	*foreground	Black
background color of all XmTextField widgets	*XmTextField*background	White
background color of data area	*dataArea.background	White
background color of row/column border	*borderButton.background	#c0c0c0
foreground color of row/column border	*borderButton.foreground	#303030
background color of active cell border marker	*highlightButton.background	#405070
foreground color of active cell border marker	*highlightButton.foreground	White
background color of title bar	*titleButton.background	#908080
foreground color of title bar	*titleButton.foreground	#d0d0d0
background color of graph edit window	*geGraphArea.background	White

Table B-4 Aesthetic Resources

Page Options

Page Option resources allow you set defaults associated with the Page Options dialog.

Page Option	Resource	XESS Default	Accepted Values
Page Size	*pageSize	Letter	Letter, Legal, Ledger, Executive, 7X9, 35MM, A5, A4, A3, B5, B4, C6, C5, C4, C7/6, C5/6, Other
Orientation	*pageOrientation	Landscape	Landscape/L, Portrait/P
Page Height	*pageHeight	792	#points
Page Width	*pageWidth	612	#points
Top Margin	*topMargin	72	#points
Bottom Margin	*bottomMargin	36	#points
Left Margin	*leftMargin	36	#points
Right Margin	*rightMargin	36	#points
Fit to Page	*autoShrink	Off	Off, Horizontal/H, Vertical/V, Both/B
Centering	*autoCenter	Off	Off, Horizontal/H, Vertical/V, Both/B
Shrink/Expand	*pageScale	100	percent value
Expand Graph to Page	*graphExpand	False	True/False
Page Header (On/Off)	*pageHeader	False	True/False
Page Footer (On/Off)	*pageFooter	False	True/False
Borders (On/Off)	*pageBorder	False	True/False
None - unit of measure of margin calculations	*pageUnits	Inch	Point/PT, Centimeter/CM, Inch/IN

Table B-5 Page Option Resources

Printer Options

Printer Option resources allow you to set defaults associated with the Printer Options dialog.

Printer Option	Resource	XESS Default	Accepted Values
Printer Type	*printerType	ps	PostScript/PS, Text /T
Destination	*printDestination	printer	Printer/P, File/F, Both/B
Horizontal Pitch	*textCPI	12	10,12,16
Vertical Pitch	*textLPI	6	6,8,12
Default Printer *See explanation under XESS Administration resources.*			

Table B-6 Printer Option Resources

Cell Defaults

Cell Default resources allow you to set defaults associated with the Cell Defaults dialog.

Cell Default	Resource	XESS Default	Accepted Values
Cell Format	*defaultFormat	General	Float, Fixed, General, Dollars, Comma, Hex, Logic, dd_mmm_yy, dd_mmm, mmm_yy, mm/dd/yy, Hidden, hh:mm:ss, yy-mm-dd, dd.mm.yy, Percent, Text
Decimal Place	*defaultPlaces	8	0-15
Font Family	*cellFontFamily	Helvetica	Courier, Helvetica, Times-Roman, Souvenir, New-Century-Schoolbook, Avant-Garde, Symbol1, User1, User2, User3, User4, User5, User6, User7
Font Style	*cellFontStyle	Normal	Normal, Bold, Italic, Bold-italic
Font Size	*cellFontSize	12	8/10/12/14/18/24
Underline	*defaultUnderline	False	True/False
Alignment	*defaultJustification	Auto	Auto/A, Left/L, Right/R, Center/C
Wrap	*defaultWrap	False	True/False
Foreground Color	*protectForegroundIndex	5	Color Palette #
Background Color	*protectBackgroundIndex	6	Color Palette #
UnProtect FG Color	*cellForegroundIndex	2	Color Palette #
UnProtect BG Color	*cellBackgroundIndex	1	Color Palette #
Protection	*defaultProtection	Unprotected	Unprotected/Protected

Table B-7 Cell Default Resources

Highlight Options

Highlight Option resources allow you to set defaults associated with the Highlight Options dialog.

Highlight Option	Resource	XESS Default	Accepted Values
Errors (On/Off)	*errorHighlight	True	True/False
Error FG Color	*errorForegroundIndex	1	Color Palette #
Error BG Color	*errorBackgroundIndex	3	Color Palette #
Negative Values (On/Off)	*negativeHighlight	True	True/False
Neg Value FG Color	*negativeForegroundIndex	3	Color Palette #
Neg Value BG Color	*negativeBackgroundIndex	1	Color Palette #
Constraints not met (On/Off)	*constraintHighlight	True	True/False
Constraint FG Color	*constraintForegroundIndex	5	Color Palette #
Constraint BG Color	*constraintBackgroundIndex	8	Color Palette #

Table B-8 Highlight Option Resources

Recalc Options

Recalc Option resources allow you to set defaults associated with the Recalc Options dialog.

Recalc Option	Resource	XESS Default	Accepted Values
Recalc Mode	*recalcMode	Auto	Automatic/A, Manual/M
Recalc Method	*recalcMethod	As_Needed	As_Needed/A, Foreground/F
Constraint Checking	*constraintsEnabled	False	True/False
Iteration Limit	*iterationLimit	0	0-100

Table B-9 Recalc Option Resources

Copy Option

Copy Option resources allow you to set defaults associated with the Copy Options dialog.

Copy Option	Resource	XESS Default	Accepted Values
Copy Formats	*copyFormat	True	True/False
Copy Fonts	*copyFont	True	True/False
Copy Alignment	*copyJustification	True	True/False
Copy Colors	*copyColor	False	True/False
Copy Range Name	*copyRangeName	True	True/False
Copy Cell Notes	*copyCellNotes	True	True/False

Table B-10 Copy Option Resources

Import Option

Import Option resources allow you set defaults associated with the Import Options dialog.

Import Option	Resource	XESS Default	Accepted Values
One Word/Cell	*oneWordPerColumn	False	True/False
Whitespace Threshold	*whiteSpaceThreshold	100	0-100

Table B-11 Import Option Resources

Graph Options

Graph Option resources allow you to set the default values associated with the following graphics option dialogs: General Options, X Axis Options, Y Axis Options, Z Axis Options, Data Set Options, and New Graph Options.

General Graph Option	Resource	XESS Default	Accepted Values
Redraw on Recalculation	*defaultGraphLiveRedraw	False	True/False
Legend	*defaultGraphLegend	False	True/False
Skew Data	*defaultGraphSkew	False	True/False
Default Foreground	*defaultGraphForegroundColor	black	Color Palette #
Default Background	*defaultGraphBackgroundColor	white	Color Palette #
Default Font	*defaultGraphFontFamily	Helvetica	Courier, Helvetica, Times-Roman, Souvenir, New-Century-School book, Avant-Garde, Symbol1, User1, User2, User3, User4, User5, User6, User7
Default Style	*defaultGraphFontStyle	Bold	Normal, Bold, Italic, Bold-italic
Graph Title	*defaultGraphTitle:	Untitled	Label string
Font Family	*defaultGraphTitleFontFamily	default	Default, or any of the fonts list for Default Font.
Font Style	*defaultGraphTitleFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Font Size	*defaultGraphTitleFontSize	default	Default, 8, 10, 12, 14, 18, 24
Title Color	*defaultGraphTitleColor	0	0 (default) or Color Palette #
None	*defaultGraphWidth	55	# points
None	*defaultGraphHeight	25	# points

Table B-12 General Option Resources

X Axis Options

X Axis Option	Resource	XESS Default	Accepted Values
Auto Scale (On/Off)	*defaultGraphXAutoScale	True	True/False
Min	*defaultGraphXScaleMin	0.0	Number
Max	*defaultGraphXScaleMax	100.0	Number
Auto Ticks (On/Off)	*defaultGraphXAxisAutoTick	True	True/False
Major	*defaultGraphXTicks	11	Number
Minor	*defaultGraphXMinorTicks	0	Number
Log Scale (On/Off)	*defaultGraphXAxisLog	False	True/False
Ticks Out (On/Off)	*defaultGraphXTickOut	True	True/False
Exploded Axis (On/Off)	*defaultGraphXExploded	False	True/False
Axis Color	*defaultGraphXAxisColor	0	0 (default) or Color Palette #
Grid Lines (On/Off)	*defaultGraphXGridLines	False	True/False
Grid Color	*defaultGraphXGridColor	0	0 (default) or Color Palette #
Axis Label	*defaultGraphXLabelString	<blank>	Character string
Label Font	*defaultXLabelFontFamily	default	Default, Courier, Helvetica, Times-Roman, Souvenir, New-Century-Schoolbook, Avant-Garde, Symbol1, User1, User2, User3, User4, User5, User6, User7
Label Style	*defaultXLabelFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Label Size	*defaultXLabelFontSize	default	Default, 8, 10, 12, 14, 18, 24
Label Color	*defaultGraphXLabelColor	0	0 (default) or Color Palette #
Tick Font	*defaultGraphXTickFontFamily	default	same as Label Font
Tick Style	*defaultGraphXTickFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Tick Size	*defaultGraphXTickFontSize	default	Default, 8, 10, 12, 14, 18, 24
Tick Label Color	*defaultGraphXTickColor	0	0 (default) or Color Palette #

Table B-13 X Axis Option Resources

Y Axis Options

Y Axis Option	Resource	XESS Default	Accepted Values
Auto Scale (On/Off)	*defaultGraphYAutoScale	True	True/False
Min	*defaultGraphYScaleMin	0.0	Number
Max	*defaultGraphYScaleMax	100.0	Number
Auto Ticks (On/Off)	*defaultGraphYAxisAutoTick	True	True/False
Major	*defaultGraphYTicks	11	Number
Minor	*defaultGraphYMinorTicks	0	Number
Log Scale (On/Off)	*defaultGraphYAxisLog	False	True/False
Ticks Out (On/Off)	*defaultGraphYTickOut	True	True/False
Exploded Axis (On/Off)	*defaultGraphYExploded	False	True/False
Axis Color	*defaultGraphYAxisColor	0	0 (default) or Color Palette #
Grid Lines (On/Off)	*defaultGraphYGridLines	False	True/False
Grid Color	*defaultGraphYGridColor	0	0 (default) or Color Palette #
Axis Label	*defaultGraphYLabelString	<blank>	Character string
Label Font	*defaultYLabelFontFamily	default	Default, or any supported font family listed elsewhere.
Label Style	*defaultYLabelFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Label Size	*defaultYLabelFontSize	default	Default, 8, 10, 12, 14, 18, 24
Label Color	*defaultGraphYLabelColor	0	0 (default) or Color Palette #
Tick Font	*defaultGraphYTickFontFamily	default	Default, or any of the supported font families listed elsewhere.
Tick Style	*defaultGraphYTickFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Tick Size	*defaultGraphYTickFontSize	default	Default, 8, 10, 12, 14, 18, 24
Tick Label Color	*defaultGraphYTickColor	0	0 (default) or Color Palette #

Table B-14 Y Axis Option Resources

Z Axis Options

Z Axis Option	Resource	XESS Default	Accepted Values
Auto Scale (On/Off)	*defaultGraphZAutoScale	True	True/False
Min	*defaultGraphZScaleMin	0.0	Number
Max	*defaultGraphZScaleMax	100.0	Number
Auto Ticks (On/Off)	*defaultGraphZAxisAutoTick	True	True/False
Major	*defaultGraphZTicks	11	Number
Minor	*defaultGraphZMinorTicks	0	Number
Log Scale (On/Off)	*defaultGraphZAxisLog	False	True/False
Ticks Out (On/Off)	*defaultGraphZTickOut	True	True/False
Exploded Axis (On/Off)	*defaultGraphZExploded	False	True/False
Axis Color	*defaultGraphZAxisColor	0	0 (default) or Color Palette #
Grid Lines (On/Off)	*defaultGraphZGridLines	False	True/False
Grid Color	*defaultGraphZGridColor	0	0 (default) or Color Palette #
Axis Label	*defaultGraphZLabelString	<blank>	Character string
Label Font	*defaultZLabelFontFamily	default	Default, or any supported font family listed elsewhere.
Label Style	*defaultZLabelFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Label Size	*defaultZLabelFontSize	default	Default, 8, 10, 12, 14, 18, 24
Label Color	*defaultGraphZLabelColor	0	0 (default) or Color Palette #
Tick Font	*defaultGraphZTickFontFamily	default	Default, or any supported font family listed elsewhere.
Tick Style	*defaultGraphZTickFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Tick Size	*defaultGraphZTickFontSize	default	Default, 8, 10, 12, 14, 18, 24
Tick Label Color	*defaultGraphZTickColor	0	0 (default) or Color Palette #

Table B-15 Z Axis Option Resources

Data Set Options

Data Set Option	Resource	XESS Default	Accepted Values
Segment Type	*defaultGraphSegmentType	Line	Line/Spline/Bar
Shading	*defaultGraphShadeType	none	None, Directed Light, Z Height
Line Style	*defaultGraphLineStyle	solid	No Line, Solid, Dotted, Dashed, Long Dashed, Dot-Dashed
Line Width	*defaultGraphLineWidth	thin	Thin, Medium, Thick
Line Color	*defaultGraphLineColor	0	0 (Default) or Color Palette #
Marker	*defaultGraphMarker	none	None, Square, Circle, Triangle, Diamond, Inverted Triangle, Hi-Low
Fill Style	*defaultGraphFillStyle	none	None, Solid, Gray 0, Gray 25, Gray 50, Gray 75, Gray 100
Fill Color	*defaultGraphFillColor	0	0 (Default) or Color Palette #
Legend Font	*defaultGraphLegendFontFamily	default	Default, or any supported font family listed elsewhere.
Legend Size	*defaultGraphLegendFontSize	default	Default, 8, 10, 12, 14, 18, 24
Legend Style	*defaultGraphLegendFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
Legend Color	*defaultGraphLegendColor	0	0 (Default) or Color Palette #
None	*defaultGraphAnnotFontSize	default	Default, 8, 10, 12, 14, 18, 24
None	*defaultGraphAnnotFontStyle	default	Default, Normal, Bold, Italic, Bold-italic
None	*defaultGraphAnnotFontFamily	default	Default, or any supported font family listed elsewhere.

Table B-16 Data Set Option Resources

New Graph Options

New Graph Option	Resource	XESS Default	Accepted Values
Vary Markers	*autoLineMarkers	True	True/False
Vary Line Colors	*autoLineColor	True	True/False
Vary Line Styles	*autoLineStyle	False	True/False
Vary Fill Styles	*autoFillStyle	False	True/False
Vary Fill Colors	*autoFillColor	True	True/False

Table B-17 New Graph Option Resources

Color Palette

Whenever XESS allows you to specify a color, a color palette list box containing up to 63 colors is displayed from which you select. The color palette is defined as below and can be modified. In addition, you may also specify how many colors are displayed in the palette list box. *It is recommended that you always maintain White, Black, Red, and Blue as those colors are used as default colors within the XESS product.*

Color	Resource	XESS Default	Accepted Values
1	*color1	#ffffffffffff	White
2	*color2	#000000000000	Black
3	*color3	#ffff00000000	Red
4	*color4	#0000ffff0000	Green
5	*color5	#00000000ffff	Blue
6	*color6	#0000ffffffff	Any valid X11 color hex string
7	*color7	#ffff0000ffff	Any valid X11 color hex string
8	*color8	#ffffffff0000	Any valid X11 color hex string
9	*color9	#ddddda0a0dddd	Any valid X11 color hex string
10	*color10	#dadaa5a52020	Any valid X11 color hex string
11	*color11	#f5f5dedeb3b3	Any valid X11 color hex string
12	*color12	#b2b222222222	Any valid X11 color hex string
13	*color13	#ffff80808080	Any valid X11 color hex string
14	*color14	#707080809090	Any valid X11 color hex string
15	*color15	#ffffe4e4e1e1	Any valid X11 color hex string
...	...		
63	*color63	#46468282b4b4	Any valid X11 color hex string
# colors displayed	*DialogColors:	15	1 - 63

Table B-18 Color Palette Resources

User-defined Fonts

In addition to the standard fonts defined in XESS, you may specify up to seven (7) other font families of choice by adding resource definitions. *Each* user-defined font distinguished by numeric index, *x*, must have a complete set of these resources defined . In each resource, set *x* to a number 1 - 7.

Resource	XESS Default	Accepted Value
userFont*x*	<*undefined*>	True/False
userFont*x*B	<*undefined*>	label for Font menu ex: Courier
userFont*x*Normal	<*undefined*>	X11 font name for Normal version of font. The name must include the entire section of the X11 font name from the vendor through the width description. For example, normal Courier would be described as: adobe-courier-medium-r-normal
userFont*x*Bold	<*undefined*>	X11 font name for **Bold** version of font. ex: adobe-courier-bold-r-normal
userFont*x*Italic	<*undefined*>	X11 font name for *Italic* version of font. ex: adobe-courier-medium-o-normal
userFont*x*BoldItalic	<*undefined*>	X11 font name for ***Bold-Italic*** version of font. ex: adobe-courier-bold-o-normal
userFont*x*PSmetrics	<*undefined*>	file name containing the Postscript metrics for the font. If this is not specified, the font will not print properly on a Postscript printer but will display correctly on the screen.
userFont*x*Fallback	<*undefined*>	X11 font that will be used for a screen font if font fallbacks are enabled and the specified X11 font is not available on the X server. Possible values for this font and all other Xess resources that specify font names are: COURIER, HELVETICA, TIMES-ROMAN, SOUVENIR, LUBALIN-GRAPH, NEW-CENTURY-SCHOOLBOOK, AVANT-GARDE, SYMBOL, USER1, USER2, USER3, USER4, USER5, USER6, USER7. More information on font fallback is described with the fontFallbacks resource.
fontFallbacks	True	True/False Determines whether font fallbacks are enabled. If set to True, font fallbacks will be used for the screen display if the preferred font is not available. Some X servers implement a default font if the requested font is not available. If this is the case, you must disable this option in the X server in order to use the Xess font fallbacks.

Table B-19 User-defined Font Resources

Accelerator Keys

Menu Option	Resource	XESS Default
File->New	*newB.accelerator *newB.acceleratorText	Meta Shift<Key>N Meta+N
File->Open	*openB.accelerator *openB.acceleratorText	Ctrl<Key>o Ctrl+o
File->Save	*saveB.accelerator *saveB.acceleratorText	Ctrl<Key>s Ctrl+s
File->Print	*printB.accelerator *printB.acceleratorText	Meta<Key>p Meta+p
File->Close	*closeB.accelerator *closeB.acceleratorText	Meta Shift<Key>C Meta+C
File->Exit	*quitB.accelerator *quitB.acceleratorText	Meta<Key>q Meta+q
Edit->Undo	*undoB.accelerator *undoB.acceleratorText	Ctrl<Key>u Ctrl+u
Edit->Edit Cell	*editCellB.accelerator *editCellB.acceleratorText	<Key>F2 F2
Edit->Select All	*selectAllB.accelerator *selectAllB.acceleratorText	Ctrl<Key>a Ctrl+a
Edit->Select...	*selectB.accelerator *selectB.acceleratorText	Ctrl<Key>space Ctrl+<space>
Edit-> Reselect	*reselectB.accelerator *reselectB.acceleratorText	Ctrl Meta<Key>space Ctrl+Meta+<space>
Edit->Move	*moveB.accelerator *moveB.acceleratorText	Ctrl<Key>m Ctrl+m
Edit->Copy-> Formulas	*copyFormulaB.accelerator *copyFormulaB.acceleratorText	Ctrl<Key>f Ctrl+f
Edit->Copy-> Values	*copyValueB.accelerator *copyValueB.acceleratorText	Ctrl<Key>v Ctrl+v
Edit->Clear	*eraseB.accelerator *eraseB.acceleratorText	Delete Delete
Edit->Insert ->Row	*insertRowB.accelerator *insertRowB.acceleratorText	Ctrl<Key>r Ctrl+r
Edit->Insert ->Column	*insertColB.accelerator *insertColB.acceleratorText	Ctrl<Key>c Ctrl+c

Table B-20 Accelerator Key Resources

Menu Option	Resource	XESS Default
Edit->Delete ->Row	*deleteRowB.accelerator *deleteRowB.acceleratorText	Ctrl Shift<Key>r Ctrl+R
Edit->Delete ->Column	*deleteColB.accelerator *deleteColB.acceleratorText	Ctrl Shift<Key>c Ctrl+C
Search->Find	*findB.accelerator *findB.acceleratorText	<Key>F6 F6
Search->Find Next	*findNextB.accelerator *findNextB.acceleratorText	<Key>F7 F7
Search->Find Previous	*findPrevB.accelerator *findPrevB.acceleratorText	<Key>F8 F8
View->Go To	*gotoB.accelerator *gotoB.acceleratorText	Ctrl<Key>g Ctrl+g
View->Create New View	*newViewB.accelerator *newViewB.acceleratorText	Ctrl Shift<Key>v Ctrl+V
Format-> Cell Format	*cellFormatB.accelerator *cellFormatB.acceleratorText	Ctrl Shift<Key>f Ctrl+F
Format->Font Style->Normal	*menuBar*normalB.accelerator *menuBar*normalB.acceleratorText	Ctrl<Key>n Ctrl+n
Format->Font Style->Bold	*menuBar*boldB.accelerator *menuBar*boldB.acceleratorText	Ctrl<Key>b Ctrl+b
Format->Font Style->Italic	*menuBar*italicB.accelerator *menuBar*italicB.acceleratorText	Ctrl<Key>i Ctrl+i
Format->Font Style-> Bold-italic	*menuBar*boldItalicB.accelerator *menuBar*boldItalicB.acceleratorText	Ctrl Shift<Key>i Ctrl+I
Format-> Alignment-> Automatic	*menuBar*autoB.accelerator *menuBar*autoB.acceleratorText	Meta<Key>a Meta+a
Format-> Alignment-> Left	*menuBar*leftB.accelerator *menuBar*leftB.acceleratorText	Meta<Key>l Meta+l
Format-> Alignment-> Right	*menuBar*rightB.accelerator *menuBar*rightB.acceleratorText	Meta<Key>r Meta+r
Format-> Alignment-> Center	*menuBar*centerB.accelerator *menuBar*centerB.acceleratorText	Meta<Key>c Meta+c
Tools-> Recalculate	*recalcB.accelerator *recalcB.acceleratorText	<Key>F9 F9

Appendix C

Error Messages

XESS checks for a variety of errors. Depending on the error type, the most recent error message is displayed either inside the affected cell(s), on the Message Line or is displayed inside the XESS Message dialog box.

Types of Errors

Errors in Functions

Errors that occur inside functions are reported along with the name of the function in which the error occurred.

Note that error messages returned from user-written functions through XESS connection (API) programs are indistinguishable from the error messages for XESS built-in functions.

Formula Syntax Errors

These errors occur only when you are typing in a formula. When you finish entering the formula, XESS will attempt to read the formula and convert it to an internal representation. If it is unable to do so, it continues to display the erroneous formula, switches into "edit mode", places the text cursor at the beginning of the text which it had difficulty parsing, and displays the error message. The problem must be corrected before XESS can continue.

Formula Evaluation Errors

Formula evaluation error occurs when XESS reads in a formula and converts it into its internal formula representation, but is not able to evaluate the formula and produce a correct numeric or string formula. In some cases, the formula has been entered incorrectly, for example, an operand or parenthesis is missing. In other cases, an error has occurred as a result of computation that cannot be handled properly by the computer's floating point hardware, or there is an error condition in a cell or range that is referenced in the context of this formula. Errors can also occur in the evaluation of XESS built-in functions.

Summary of Error Messages

# of histogram bins not specified; using 10

The number of bins, or buckets, has not been specified for the histogram, so XESS is using the default of 10. To change this, set the number of tick marks for the X axis.

allocating negative-dimensional matrix

A bug has been triggered in XESS. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

annotation lacks (x,y) position

An attempt has been made to annotate a graph without giving the coordinates at which to place the annotation.

argument is negative

@SQRT has been passed a negative argument. Xess does not work with complex numbers, so @SQRT takes only positive arguments.

argument must be an integer

@FACT has been passed a non-integer argument.

argument not a cell or range

@@ has been passed an argument that is neither a cell nor a range.

argument out of range

An argument to a function is not within the correct range for the function and its other arguments.

arguments must be numeric

The function requires numeric arguments, which may be literal numbers, formulas which return numeric values, or references to cells containing numeric values.

arguments must be positive

The arguments in this function must be all positive values.

bad continuation record

The Xess input file has been corrupted. A line ending in "\" has not been followed by a line beginning with a space or a tab.

bad sheet or graph index

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

bars with the same X coordinate

All values specified in the X Range for a bar graph must be unique.

Bar graph - skewing is always enforced

The skewing option is used to differentiate between Bar graphs and Stacked Bar graphs. For Bar graphs it is always enforced and thus the Skew Data button in the Graph Options dialog should be on for Bar graphs.

beginning line with subscript command

Line begins with subscript start character, '_'. The subscript is ignored, if possible, with the text that would have been in a subscript set as normal text.

can not access file

Insufficient permission to open file. The causes for this are system-dependent.

can not parse condition string

Xess has encountered a malformed conditional expression.

cannot allocate color

Xess was not able to allocate a color from the X server. This can be caused by having other applications active which allocate too many colors of their own without creating a new colormap. It may also be caused by specifying a color name in the user's X resource file(s) which is not a legal color in the color database for the X server.

cannot find help topic

The requested topic was not found in the *xess5-help.html* file.

cannot get font

Xess was not able to allocate a font from the X server. This is usually caused by the font being unavailable to the server. This is likely to happen when the server is an older release of X which does not come with as many fonts as later releases of X, or when a font has been specified incorrectly in the user's X resource file(s). It may

also be caused by a low-memory condition which causes the X server to be unable to store the font, although this is less likely to happen in most circumstances.

cannot open help file

The help file does not exist or could not be read. The default directory to the XESS help file (*xess5-help.html*) is */usr/local/lib/xess/*. If installed elsewhere, the alternate path must be specified inside the XESS application defaults file. Also, make sure that the help file is readable, and that there are no faulty resources pointing to the help file in any X resource files on your system.

cannot read file

The file does not exist or the user has insufficient permissions to read the file.

cannot find interpolation

@INTERP2D or @INTERP3D is unsuccessful in finding interporlated values.

cannot write file

The user has insufficient permissions to write the file or an out of disk space condition has occurred.

cash flow series must be a range

@NPV and @MIRR require that their cash flow series must be a range, which must represent a single column or row.

cash flow series must be single column or row

@NPV and @MIRR require that their cash flow series must be a range, which must represent a single column or row.

cell is protected

User has attempted to edit a protected cell.

cell operand contains error condition

A cell which is referenced from the cell in which the error occurs contains an error condition.

cell reference out of range

A cell reference has been made which is outside the supported range.

coefficient matrix has linearly dependent columns

The existence of a unique solution to a linear least squares (@LLS) problem, Ax=b, requires that the columns of A are linearly independent.

column offset out of range

The third argument to the @VLOOKUP function specifies an offset that is less than 0 or is greater than the width of the range specified in the second argument.

compass window is too small

A window is too small to draw in. This is probably because the user resized the window so that it became less than 16 pixels wide or deep. Alternately, this may be the fault of the window manager not honoring the size Xess requested for the new window.

constraint check not supported with "As Needed"

Constraint checking is not supported when the recalculation is set to "As Needed".

contains an error indicator

A cell in one or more of the data ranges for a graph contains an error condition. The error condition must must be resolved before Xess can plot the graph.

could not find real root

@IRR could not find a real root. This suggests that the data given to @IRR is probably wrong.

could not open external file

@XVALUE could not access the external file referenced.

count less than zero

User has passed a negative argument to a function which requires a count, for example, with @LEFT, it is impossible to take the -2 leftmost characters of a string.

data set size must be >= 3

@LINFIT and @LINCOEF require a data set of size 3 or larger.

data set size must be >= polynomial degree + 2

@PLS, @POLYFIT, and @POLYCOEF require that the data set size be greater than or equal to the polynomial degree + 2.

dataset index out of range

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

date series must be single column or row

@XIRR and @XNPV require the argument D (date series) to be a single column or single row.

decimal places out of range

@STRING only takes a decimal place argument between 0 and 15.

degrees of freedom must be > 0

@F and @T require degrees of freedom greater than zero, as "degrees of freedom" is mathematically undefined for zero or less.

delete operation would erase all cells

Delete row(s) or delete column(s) operation would delete all the data on the sheet. If you intend to delete all the data, use File|New instead.

dimension must be power of 2

@FFT and @INVFFT require matrices whose dimensions are powers of two. The somewhat slower functions @DFT and @INVDFT, respectively, are equivalent functions which do not share this requirement.

divide by zero

An attempt has been made to divide by zero. Note that Xess considers cells which are empty or contain text strings to have the value zero in the context of a numerical calculation.

does not accept arguments

Several Xess functions, including @PI, @TRUE, @FALSE, @RAND, and @GRAND, do not accept any arguments.

domain is -1 < x < 1

@ATANH only takes arguments between -1 and 1, exclusive.

domain is -1 <= x <= 1

@ACOS and @ASIN only take arguments between -1 and 1, inclusive.

domain is 0 <= x <= 170

@FACT only takes arguments between 0 and 170, inclusive. (Most platforms)

domain is 0 <= x <= 33

@FACT only takes arguments between 0 and 33, inclusive. (VAX platforms)

domain is x > 0

@LN, @LOG2, @LOG, @GAMMA, and @LNGAMMA only take arguments greater than zero.

domain is x >= 1

@ACOSH only takes arguments greater than or equal to 1.

ERROR: license error license is not authorized on display

This message appears when you try to run Xess from s display other than the one's on which Xess is licensed.

ERROR: license error license cannot connect to a license server

This message appears when you are trying to run Xess and the license management daemons have not been started or were killed. Please refer to the Xess installation document for instructions regarding startup of the license management daemons.

ERROR: license error license feature has expired

This message appears if you are trying to use your Xess demo past the licensed expiration date.

ERROR: license error licensed number of users already reached

This message appears when someone tries to start Xess and all the available Xess copies are being used.

"End Period" must be >= 1

@CUMIPMT and @CUMPRINC require the argument E (end period) to be greater than or equal to 1.

"End Period" must be >= "Start Period"

@CUMIPMT, @CUMPRINC and @VDB require the argument E (end period) to be greater than or equal to S (start period).

end-of-file occurred while reading Xess file

Indicates a truncated (or possibly otherwise corrupted) Xess file.

**ending line with a **

The \ is an escape sequence introducer, which should be followed by another character for interpretation, but the string ended prematurely.

ending line with a superscript command

When displaying text in the context of graphics, a ^ is a superscript introducer. Like y^2 means "y squared". This message occurs when a ^ occurs at the end of the string.

ending line with subscript command

When displaying text in the context of graphics, a _ is a subscript introducer. Like y_2 means "y subscript 2 ". This message occurs when a _ occurs at the end of the string.

error decoding option field

Your Xess file contains an invalid option in a record.

error decoding record

Your Xess file contains an invalid record.

error in regular expression

An error occurred while parsing the regular expression used in a search or extract operation, or while executing @REGEX or @MATCH.

error occurred while reading Xess file

Some error occurred while reading which was not an end of file. This might include an out-of-space condition, a loss of network connectivity, or some other system-dependent error.

error occurred while writing Xess file

An error occurred while writing. This might include an out-of-space condition, a loss of network connectivity, or some other system-dependent error.

expected the right hand side of a range here

The outer range reference is missing.

expected to find <something> here

There was a parsing error. The cursor will be placed in the edit window in edit mode. Read the documentation for the function and correct the error.

expecting a function

There is something wrong with the formula you have entered on the edit line. The parser was expecting to find a function name at the point indicated by the cursor position."

expecting an operand

There is something wrong with the formula you have entered on the edit line. The parser was expecting to find a function name at the point indicated by the cursor position."

expecting an operator

There is something wrong with the formula you have entered on the edit line. The parser was expecting to find a function name at the point indicated by the cursor position."

extraneous operands

There is something wrong with the formula you have entered on the edit line. The parser was expecting to find a function name at the point indicated by the cursor position."

F must be >= 0

The third argument to @F must be greater than or equal to 0.

file is encrypted and cannot be read

Encrypted Excel files can not be opened or accessed.

file is not valid [XS5|XS4|XS3|XS|WK1|WKS|WK3|XLS] format

Xess was expecting to open a file in the specified format, and the file was not valid. This may happen if the file has been corrupted.

file is unknown Excel format and cannot be read

first argument must be numeric

@NPV and @CHOOSE require that their first argument be numeric

floating exception

A floating-point arithmetic hardware exception occurred during the computation of the function or expression. This means that the calculations resulted in a number out of the range that the computer hardware is able to represent.

format error reading file

There has been an error reading an XS spreadsheet file. The file is probably corrupt.

found number where string should be

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message and contact AIS technical support.

found something unexpected here

Xess has found something it does not understand in an expression.

"Fraction" must be >= 1

@DOLLARDE and @DOLLARFR require the argument F (fraction) to be greater than and equal to 1.

freeing data pointed to by NULL

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message and contact AIS technical support.

freeing negative-dimensional matrix

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message and contact AIS technical support.

"Frequency" must be 1, 2 or 4

The argument Frequency (number of coupon payment per year) in financial functions is limited to one of the following choices: 1, 2 or 4

function not installed

This error occurs when Xess encounters an "@" followed by a function name which it does not recognize as one of its built-in functions, or one that has been installed by a connection program or xsBasic.

function stack overflow

This error occurs when functions are nested too deeply. Xess supports nesting of functions up to 50 levels deep.

graph index out of range

A graph index greater than 100 has been found while reading an Xess file. This probably indicates a corrupted data file.

graph window is too small

The graph window has been rescaled to the point where Xess could not draw anything inside. This occurs when a window has a 16x16 pixel area or smaller inside the window.

hex number greater than 32 bits

Xess cannot convert a hex string to a number if the hex string is longer than 8 characters, which translates to 32 bits in the internal binary representation.

histogram data max and min are the same

The max and min are the same for the histogram. Xess will default to a bin size of 1.0, which is probably not what you want. Fix the max and min.

IEEE Floating Exception (Infinity or NaN)

This error means that the formula caused a computation to occur which could not be calculated properly by the computer's IEEE standard floating point hardware. Most likely, this means that the computation would produce an intermediate or final result outside the range +/- 1.8e308, or 1.8e32 on a VAX.

illegal cell address specification

An illegal cell address has been entered in a dialog box.

illegal cell identifier in record

A cell record in the Xess file specifies a cell address which is outside the range defined for the version of Xess.

illegal cell or range reference

It happens when a copy or move operation results in a cell or range reference that is outside the supported range.

illegal column width

User tried to set an illegal column width.

illegal combination of source/destination range

The destination range is not compatible with the source range. For example: In a copy operation -

If the source is:	The destination may be:
single cell	any range, including a single cell
row, or portion of a row	column, or portion of a column
column, or portion of a column	row, or portion of a row
2D range	single cell

illegal operand of "operator"‘

This error occurs when one or both of the operands of the specified "operator" are not valid. Most likely, a range name was used as an operand in an arithmetic expression.

illegal range specification

A range specification entered in an Xess dialog box is invalid.

illegal range specifier in View record

You have a corrupted data file.

illegal record type specifier

You have a corrupted data file.

illegal row height

User tried to set an illegal row height.

improper argument type

One or more arguments to the function are incompatible with the type of arguments required by the functions.

improper coefficient type

In the polynomial evaluation function (@POLY), one or more of the polynomial coefficients are non-numeric.

improper dimensions

Several Xess matrix functions have certain requirements on the dimensions of their matrix arguments. Check the reference manual if you are uncertain about those requirements.

incompatible matrix dimensions

In matrix multiplication (@MMUL), the number of columns in the first matrix must equal the number of rows in the second matrix.

incompatible range dimensions

The Xess dot product functions (@DOT) requires vectors of equal size. It will also compute the sum-of-products of any two ranges with equal dimensions.

index column contains empty cell

The first column in the lookup table referenced by @VLOOKUP must not contain empty cells.

index out of range

In @FIND, the third argument may not be larger than the length of the second argument. In @MID, the second argument may not be larger than the length of the first argument.

index row contains empty cell

The first row in the lookup table referenced by @HLOOKUP must not contain empty cells.

insert operation would erase all cells

If you selected a column and then did Edit/Insert/Row, this error would occur. Same with selecting a row.

integer parameter out of range

An integer parameter greater than 4294967296 or less than -2147483649 has been entered.

interest rate should be > 0

@EFFECT and @NOMINAL require that argument R (interest rate) to be greater than 0.

interest schedule must be a single column or row

The argument R (array of interest rates) in @FVSCHEDULE must be a single column or row.

internal error freeing node

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

internal error---unconsumed operands

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

invalid Xess file access mode

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

invalid cell reference

User has tried to access a cell with a row which is negative, zero, or greater than the maximum row, or with a column which is negative or greater than FAN, or 4095.

invalid character in formula

The Xess spreadsheet has probably been corrupted.

invalid date

Xess could not understand the date format.

invalid day count basis

The day count basis in financial functions should be one of the following choices: 0 (30/360), 1 (actual/actual), 2 (actual/360) or 3 (actual/365)

invalid range name

User tried to either reference or delete a named range that does not exist.

invalid range reference

User has tried to make a range reference that references cells beyond the range of the spreadsheet; that is, a row which is negative, zero, or greater than the maximum row supported, or a column which is negative or greater than FAN, or 4095.

invalid table

The table of reference points in @INTERP2D or @INTERP3D contains non-numeric values or blank cells.

invalid time

Xess cannot parse a time which the user has provided. Time values are fractional values from 0 to 1, representing fractions of a 24-hour period. When interpreting a number as a date/time value, Xess interprets the integer portion of the number as the date and the fractional portion as the time on that date. A negative value is invalid. Also, the @TIME function must have arguments in the range of 0-23 hours, 0-59 minutes, and 0-59 seconds. Any other values are invalid.

iterative calculation not supported with "As Needed"

To avoid infinite looping, iterative (self-referential) calculations are not supported when the recalculation method is "As Needed". To use iterative calculations, the user must choose manual recalculation.

label and slice data ranges have different sizes

The "X Data" and "Y Data" ranges (meaning label and slice, respectively) in the "Data Sets..." option dialog box are of different sizes. There needs to be exactly one label for each slice on a pie graph.

label missing [closing|opening] quote

This error indicates a corrupt data file. Check your data carefully, as it is likely to be corrupt.

less than 2 arguments

@POLY requires 2 or more arguments.

"Life" and "Period" must be integers

@DDB requires that "Life" and "Period", arguments 3 and 4, respectively, be integers.

"Life" must be > 0

@SLN and @SYD require that "Life" is greater than 0.

lookup failed to produce a match

@HLOOKUP or @VLOOKUP failed to produce a match. This should only happen with an alphabetic lookup.

"Lower limit" must be >=0

The argument L (lower limit) should be greater than or equal to 0 in @ERF and @ERFC.

magnitude too large

@NUMTOHEX requires an argument between 2147483646 and -2147483647, inclusive.

making null list

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

matrix is singular

It is mathematically impossible to invert a singular matrix.

matrix must be square

It is impossible to invert, take the eigenvalue of, or take the determinant of a non-square matrix.

"Match Type" must be 0 for string match

The argument T (type of match) must be 0 if argument V (value to be matched) is text in @MATCH.

matrix must be symmetric

@EIGEN requires a symmetric matrix.

mismatched {}'s

When using subscripts and superscripts in graph text, there must be an ending '}' for every beginning '{'.

misplaced newline

It is not legal to have a newline within a superscript or subscript in graph text.

misplaced }

To include a '}' in regular graph text, use '\}'. Subscripts and Superscripts cannot be empty. '^}' and '_}' are illegal character sequences.

missing X record in Xess import file or paste buffer

The Xess file has been corrupted, or pasting has failed.

modula divide by zero

Mod 0 is an undefined operation.

must be -15 to +15 places

@ROUND cannot round to greater than 15 places on either side of the decimal point.

must have "Cost" >= "Salvage" >= 0

@DDB, @SLN, @SYD, @DB, and @VDB require that the "Cost" argument be greater than or equal to the "Salvage" argument, which must be greater than or equal to 0.

must have issue < first coupon < maturity

The values of argument I (issue date), FC (first coupon date) and M (maturity date) must satisfy the following condition: I < FC < M

must have issue < last coupon < maturity

The values of argument I (issue date), LC (last coupon date) and M (maturity date) must satisfy the following condition: I < LC < M

must have "Life" >= "Period" >= 1

@DDB, @DB, and @VDB all require that the "Life" argument be greater than or equal to the "Period" argument, which must be greater than or equal to 1.

must have N > 0, K > 0 and N < K

The arguments N (number of objects to choose from) and K (Number of objects to be chosen) in @PERMUT must follow the following condition: N>0, K>0 and N<K.

need at least 2 cash flow values

A single data point does not a cash flow series make; it takes two to trend. Computing the internal rate of return (@IRR) is undefined for only one value.

negative data in pie chart

There is no way to show negative data in a pie chart, unlike, say, a line graph or histogram.

no PostScript description for marker

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and contact AIS technical support.

no duplicate number found

The @MODE can not find the most frequently occurring number because all numbers appears only once in the argument list.

no file specified at end of path name:

The filename that was given was a directory, not a file.

no match was found

@MATCH is unsuccessful in finding a match.

no title areas specified

User has tried to create view titles with the upper-left cell selected.

non hex digits in string

@HEXTONUM requires that its argument be a string containing only hex digits, 0-9 and a-f.

non-existent object

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

non-numeric operand

An expression of some sort has a non-numeric operand where a numeric operand is required, making the result of the expression undefined.

non-numeric value in ...

Doing arithmetic on alphabetic entities is undefined.

non-string in annotation field

Graph annotations must be strings.

normalizing zero-length vector

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

not allowed with protection enabled

Most edit operations are not allowed when cell protection is enabled.

not enough arguments to function

User has entered too few arguments to the function.

nothing to find

There is nothing to find in an empty sheet.

NULL graphics pixmap

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

"Number" is not in the reference list

The number to be ranked is not in the reference list in @RANK.

number is too [large|small]

The number is at or beyond the limit of the ability of the computer to express, and is treated as if it were slightly within the limit.

number of compounding periods should be >=1

@EFFECT and @NOMINAL require that argument C (number of compounding periods) to be greater than or equal to 1.

odd character in numeric string

A bug in Xess or your system libraries has been triggered. Please save the sheet you are working on and contact AIS technical support.

one argument must be non-zero

@ATAN2 requires that one of it's arguments be non-zero.

operand contains error condition

Some cell referenced by the operand is in an error condition, or contains a reference to a cell which is in an error condition, etc.

operand equal to 0

@HMEAN does not take arguments whose value is 0.

operand larger than 32 bits

Integers in Xess cannot take more than 32 bits to express. This restricts integers to the range 2147483647 to -2147483648, or 4294967295 to zero, depending on whether the operand is only positive or can be negative.

operand less than or equal to 0

@GMEAN does not take arguments which are 0 or negative.

operand out of range

@CHAR only takes integers between 1 and 255

operands of "&" must be same type

The "&" operator serves a dual purpose: if its operands are numeric, then it performs a bitwise AND operation; if its operands are text strings, then it concatenates the two strings. If the operands are neither both numeric nor both strings, this error occurs.

operands of ".." must be cell reference

The .. operator can only join two cell references to create a range. It cannot join integers to make a range of integers, or do anything else.

operator not available in Lotus Mode

Some Xess operators are not available in Lotus spreadsheets, and therefore are incompatible with Lotus Mode.

option value illegal or out of bounds

This is a corrupted file. The "options" in an Xess record are the entities between the colons, separated by vertical bars. Each option consists of a name-value pair.

out of memory

The operating system has run out of memory to give Xess. You may close other applications, add physical memory, add swap space, or use smaller or less complex spreadsheets to remedy this problem in the future. However, this error forces Xess to terminate the current session.

"Payment" and "FV" must have the same sign

@TERM requires that Payment and Future Value have the same sign.

Payment" must be non-zero

@TERM requires that Payment be non-zero.

"Period" must be >= 0

@SYD requires that Period be greater than or equal to 0.

"Period" must be an integer > 0

@FV, @PMT, @PV, and @RATE require that Period be an integer greater than 0.

polynomial degree must be between 1 and 10

@PLS, @POLYFIT, and @POLYCOEF require that the polynomial degree by between 1 and 10.

pooled sample size less than 3

@TTEST2EV requires a pooled sample size greater than 2 to be mathematically defined.

population less than 1

@CVAR, @CSTD, @SSE, @VAR, and @STD require a population greater than or equal to 1.

"PV" and "FV" must be non-zero

@CTERM and @RATE require that Present and Future Values be non-zero by definition.

"PV" and "FV" must have the same sign

@CTERM and @RATE require that Present and Future Values have the same sign.

range should not be a block

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

range should not be a column

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

range should not be a row

A bug has been triggered in Xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

ranges must be same dimensions

@PTTEST and @CORR require that both their arguments be ranges of equal dimensions, since they work with pairs of values, one value from each range.

"Rate" must be greater than -1

@CTERM, @FV, @PMT, @PV, @TERM, @NPV, @XNPV, and @XIRR require that their Rate argument be greater than -1.

"Rate" must be non-zero

@CTERM requires that its Rate argument be non-zero.

rate found is less than -1

@IRR has found a rate less than -1 after iterating the maximum number of times.

record contains too many options

Your spreadsheet has probably been corrupted.

record line too long

Your spreadsheet has probably been corrupted.

record value illegal or out of bounds

Your spreadsheet has probably been corrupted.

recursion too deep

This error will occur if Xess encounters "a condition string within a condition string." For example, it happens with a conditional statistical formula whose condition string calls another conditional statistical function which in turn contains its own condition string.

remote function error

An external function, one installed via the Xess connections API, has returned an error.

removing NULL

A bug has been triggered in xess. Please save a copy of your current spreadsheet and contact AIS technical support.

requested unknown type of graph

Either a bug has been triggered in Xess, or possibly a corrupted file has been loaded. Please save a copy of your current spreadsheet and contact AIS technical support.

result of expression is a range

Some Xess functions, such as @CELLREF and @RANGEREF, return cell references or range references as a result. Cell and range references can not be the final result of a formula.

resultant string too long

A string generated by a formula is too long (greater than 4095 characters).

row offset out of range

The third argument to the @HLOOKUP function specifies an offset that is less than 0 or is greater than the depth of the range specified in the second argument.

sample missing from pair

The two input ranges to the paired t-test (@PTTEST) and Pearson product-moment correlation (@CORR) functions contain paired values. If a value appears at a given position in the first range, then there must also be a value in the corresponding position of the second range.

sample size less than 2

@CVARS, @CSTDS, @VARS, @STDS, @TTEST, @PTTEST, @TTEST2UV, and @FTEST require a sample size greater than 1.

searching NULL list

searching list with a NULL function.

selector out of range

The first argument to @CHOOSE must be 0 or more and be less than or equal to the number of the rest of the arguments - 1.

settlement date should be < maturity date

Settlement date should be earlier than maturity date in financial functions.

settlement date should be >= issue date

Settlement date should not be earlier than the issue date.

showing NULL list

showing list with a NULL function

specified file is not a valid Xess file

The file is either badly corrupted, missing parts (probably the beginning), or really is not an Xess file.

Stacked Bar graph - skewing is always ignored

The skewing option is used to differentiate between Stacked Bar graphs and Bar graphs. For Stacked Bar graphs it is always ignored and thus the Skew Data button in the Graph Options dialog should be *off* for Stacked Bar graphs.

"Start Period" must be >= 1

@CUMIPMT and @CUMPRINC require the argument S (start period) to be greater than or equal to 1.

starting date should be at beginning of "Dates"

The number in argument D (dates) should not precede the starting date in @XIRR and @XNPV.

strange (X,Y,Z) point in surface data

A bug has been triggered in xess. Please save a copy of your current spreadsheet and contact AIS technical support.

substring longer than string

@FIND cannot find an instance of the pattern string within a shorter target string, since it is impossible to embed a string in a string shorter than itself.

substring not found

@FIND could not find an instance of the pattern string in the target string.

sum of piechart data exceeds graphics INFINITY

The sum of the pie chart data being graphed exceeds 1e38.

sum of piechart data is zero

The sum of the pie chart data being graphed is zero. Since percentages are determined by dividing by the sum, and division by zero is undefined, this does not work.

target is not a valid numeric value

The target value specified for a goal seek is not a valid number.

titles already locked

User has attempted to lock titles when they are already locked.

titles not locked

User has attempted to unlock titles when they are already unlocked.

token buffer overflow

This error can only occur when a formula is entered which is more complex than Xess can accept. Xess can accept up to 200 operators, numbers, function calls, and text strings in a single formula, which is more than any human can reasonably deal with.

too few arguments

The function requires more arguments.

too few contour levels were requested

Fewer than 3 levels were requested in "No. Ticks" when drawing a contour graph.

too few points in plane

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

too few points in spline

A point on a spline is not within the legal X-range of the spline. This error can occur if the user tries to draw a spline through only a single point.

too few tick marks specified

At least 2 tick marks must be specified, one for the beginning, and the other for the end, of the axis.

too many arguments to function

User has provided too many arguments to the function. No function can take more than 100 arguments.

too many arguments

@NOT only takes one argument, unlike the rest of the digital logic functions. @ROW and @COL take 1 argument, @ANNOTATE takes 3-5 arguments.

too many graph editors

Only 20 graph editors can be activated at once.

too many graph viewers

Only 20 graph viewers can be activated at once.

too many simultaneous views

Only 10 views are allowed simultaneously.

Treasury Bill should not be outstanding more than 1 year

The period between the settlement date and maturity date of a Treasury bill should not exceed one year.

unable to open Xess file

The operating system did not allow xess to open the Xess file in question.

unable to open file

The operating system did not allow xess to open the file in question.

unable to parse extract filter

Happens when you are doing an Extract operation and you specify an invalid boolean expression; e.g., #==/5.

unable to parse search condition

Happens when you are doing a numeric search and you specify an invalid boolean expression; e.g., #==/5

undefined symbolic name

This error occurs when Xess encounters a symbolic range or cell reference which has not been defined. To use a symbolic name to refer to a cell or range, you must first define it using the "Named Range..." dialog box under the "Edit" menu.

unexpected question mark

Xess supports C-language compatible condition expressions, which use the operator pair "?" and ":". If one of these operators appears without the other, an error occurs.

unknown format

The format argument to the @FORMAT function must be a string containing one of the Xess cell format names appearing in the "Cell Format" menu in the "Cell Format..." Dialog box on the "Format" menu.

unknown object command

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

unknown type of graph data

A bug has been triggered in xess. Please save a copy of your current spreadsheet and make a note of the action which caused this message, and contact AIS technical support.

unrecognized option in record

Xess file has probably been corrupted.

unrecognized record subtype

Xess file has probably been corrupted.

unrecognized record type

Xess file has probably been corrupted.

unresolved name in expression

A name which is not a valid function or named range has been used in the expression.

unspecified or invalid

A bug has been triggered in Xess. Please save a copy of your spreadsheet and the idraw file you created when this error appeared and contact AIS technical support.

unsupported .xs file option

While reading an .xs file, Xess encountered an object which is unrecognized. This probably indicates a corrupt .xs file.

"Upper limit" must be >=0

The argument U (Upper limit) should be greater than or equal to 0 in @ERF.

"v" option only allowed in formula records

Either your Xess file is corrupt, or you are trying to read a file in another format as an Xess file.

"values" and "dates" series must have the same dimension

@XIRR and @XNPV require the argument V (cash flow series) and the argument D (date series) to have the same dimension.

"Values" must have at least one inflow and one outflow

@MIRR requires the value range contains at least one income (positive value) or one payment (negative value)

Version 2 writes are unsupported

Writing to an old .xs file is not supported under later version.

wks/wk1/wk3 file error

Your WKS, WK1, or WK3 file is corrupt or Xess could not understand it.

would alter protected cells

This could happen with a copy, move, clear, extract or other operation that would overwrite or erase protected cells.

wrong number of arguments

The number of arguments passed to the function is incorrect. Check the reference manual to determine the correct number of arguments that the function expects.

X and Y data ranges have different sizes

Since all the X's and Y's come in pairs, the X and Y data ranges must be the same size.

X, Y, and Z data ranges have different sizes

Since all the X's, Y's, and Z's come in tuples, the X, Y, and Z data ranges must be the same size.

[X|Y|Z] axis maximum set too low

The specified axis has a maximum value which is too low. Raise the maximum using the "X-", "Y-", or "Z Axis..." dialog box on the Options menu of the graph editor.

[X|Y|Z] axis minimum set too high

The specified axis has a minimum set too high. Lower the minimum using the "X-", "Y-", or "Z Axis..." dialog box on the Options menu of the graph editor.

xls file error

Your XLS file is corrupt or Xess could not understand it. Ensure that the XLS file is an Excel version 4 file.

zero or negative coordinate in logarithmic plot

Logarithmic plots cannot plot negative or zero values.

Appendix D

Internationalization

Locale and Language Support

You can switch among locales of single-byte ISO 8859-1, -2, -5, -7, -9, -11, -15 (and other) languages and multi-byte languages (e.g. Chinese) while using a single Xess executable image. Language-specific resources, messages, and on-line help files are dynamically accessed by the same binary executable.

When it starts, Xess retrieves workstation locale settings for currency, decimal point, thousands separator, and date formats. If locale settings are not available, the initial defaults are retrieved from the Xess resource file. In either case, the settings are accessible from the **Locale** dialog underneath the **Options** menu and are applied globally within the session.

These locale settings are used to define applicable cell formats and the character used as decimal point when entering numeric data into a cell or when formatting relevant cell data.

. . . . . .

If you wish Xess to ignore locale setting and use the defaults or those defined in the Xess resource file, you may pass the command line argument, `-nolocale`*, when you invoke Xess.*

. . . . . .

Currency

Currency settings for the default locale are derived from the operating system locale information. Additional currency formats can be defined using the Custom format type.

Messages

A new resource, `*messageFile:`, can be used to point to the location of a translated message file, `xess5-messages.txt`. If it is found at startup, then the translated messages replace the default English messages. This file is *not* needed for the English version of the messages. Refer to your distribution media and installation instructions for any further details applicable to this file.

Menus and Dialogs

All of the text displayed in menus and dialogs is defined using resources. They may be changed by editing the resource file and replacing the text for the buttons and labels.

Names of Days and Months

The names of the days of the week and the months of the year in both short and long forms are specified by resources. (These values are not picked up from the locale specification.) The fallback values are of the form:

```
*longMonthName1:  January
          ...
*longMonthName12: December
*shortMonthName1: Jan
          ...
*shortMonthName12: Dec
*longDayName1:  Sunday
          ...
*longDayName7:  Saturday
*shortDayName1: Sun
          ...
*shortDayName2: Sat
```

Character Sets for ISO 8859

For single-byte languages, Xess5 lets you specify a character set ID which indicates which of the standard character sets is being

used. The `*defaultCharset` resource is supported for the following values:

- **1 -** ISO 8859-1, ISO Latin-1 -- The default value supported by previous versions of Xess and supporting most Western European languages.
- **2** - ISO 8859-2, ISO Latin-2 -- Central and Eastern European
- **5 -** ISO 8859-5 -- Cyrillic.
- **7 -** ISO 8859-7 -- Greek.
- **9** - ISO 8859-9, ISO Latin-9 -- Southern European (Turkish)
- **11** - ISO 8859-11 -- Thai
- **15** - ISO Latin-9, "Revised Latin-1"

The characters used to identify column labels are adjusted to reflect the character set. Cell references can use the alternate column definitions (e.g. Γ1 in Greek would correspond to C1).

Font Definitions for Single-Byte ISO 8859 Languages

The resources for the fonts must be modified to correspond with the character set selection. This following resources in the Xess(u)4 resource file will be effected:

```
*fontList
*tabArea.fontList
```

In addition, the standard Xess system fonts may need to be changed if compatible fonts are not available on the system (see below).

Font Definitions for Multi-Byte Languages

The resources for the fonts must be modified to correspond to the language using the following resources in the Xess(u)4 resource:

```
*fontList
*tabArea.fontList
*defaultFontEncodings
*defaultFontNames
```

For example, Chinese support on Alpha/UNIX requires the following font definitions:

```
*fontList: -*-helvetica-bold-r-*-*-14-*-*-*-*-*-*;\
       -adecw-screen-medium-r-*-*-*-*-*-*-*-*-gb2312.1980-1:
```

```
*tabArea.fontList: -*-helvetica-bold-r-*-*-14-*-*-*-*-*-*;\
       -adecw-screen-medium-r-*-*-*-*-*-*-*-*-gb2312.1980-1:


*defaultFontEncodings: iso8859-%d,gb2312.1980-1


*defaultFontNames: adobe-helvetica-medium-r-normal,\
                   adecw-screen-medium-r-normal
```

Redefining Standard Fonts

Many non-western systems do not have localized fonts corresponding to the standard Xess system fonts (e.g. Helvetica, Roman). It may be necessary to substitute alternate font families in order to execute in such an environment. A series of resources define the standard fonts and can be modified to specify the replacement fonts.

The following shows how to replace the system font Times Roman with the Cyrillic font Nimrod:

```
*timesB.labelString: Nimrod
*systemFont2Normal: *-nimrod-medium-r-normal
*systemFont2Bold:   *-nimrod-bold-r-normal
*systemFont2Italic: *-nimrod-medium-i-normal
*systemFont2BoldItalic: *nimrod-bold-i-normal
*systemFont2Fallback:   ROMAN
```

The label string is the name displayed on the menus. The fallback is still given in terms of the standard Xess font name.

Input Method Accelerator Key for Multi-Byte Languages

If you are using an Input Method which is invoked by `Ctl-space`, you need to redefine that key sequence in the Xess(u)4 resource file. The two resources which need to be redefined are:

- `*selectB.accelerator`
- `*selectB.acceleratorText`

Glossary

ASCII

An abbreviation for the American Standard Code for Information Interchange. A widely compatible format for storing computer data, easily shared among different computers and operating systems. XESS files are stored in ASCII format.

absolute references

References to cells or ranges that remain fixed, no matter where the cell containing the formula is moved or copied. Absolute references are preceded with the dollar sign ($) before each coordinate to be fixed, such as $A1 or $A$1 .

accelerator

A key or sequence of keys (typically a modifier key such as **[Ctrl]**, **[Shift]**, or **[Alt]** and some other key) that provides a shortcut to use a program function.

active window

The window that is affected by keyboard and mouse actions. Only one window can be active at a time.

annotate

Adding text to the data area of a graph.

application program interface (API)

A toolkit which provides the XESS connections library, a set of callable subroutines, for customizing, extending, and integrating XESS functionality.

argument

A parameter appended to a function statement, specifying the values that XESS should use in calculating the function.

argumentlist

In the syntax statement for a function, the list of arguments the function should use for its calculation.

cell protection

A feature whereby XEss prohibits the user from making direct changes to the contents of a protected cell. The cell may be changed by recalculation, or by removing or disabling cell protection.

circular references

Two or more cells defined by each other.

click

To quickly press and release a mouse button.

clock

An icon that appears on the screen while XEss is working and the keyboard and mouse are temporarily disabled.

computed cell references

The result of a function that is itself a cell reference or range reference.

concatenation

Linking two strings together. For example, if you concatenate the string "John" in cell A1 with the string "Smith" in cell A2, the result is the value "John Smith."

conditional statistical function

A statistical function in which the last argument is a constraint expression that XEss evaluates for each cell in the argument list. Only cells that meet constraint criteria are included in the calculation.

connections

The XEss facility whereby worksheets can be linked with up to 15 external data sources for real-time data transfer.

connections library

The XEss-provided programming routines, embedded in the external program, that enable connections to take place.

constant offset

In conditional statistical functions, an instruction to XEss to reference another cell in the calculation.

constraint-checking

A process whereby XESS checks constraint expressions while recalculating the worksheet. If constraint-checking is disabled in the Default Sheet Characteristics dialog box, XESS ignores constraint expressions.

constraint expression

An expression appended to a formula that establishes conditions under which the formula operates or boundaries for valid results of the formula.

cost

The original cost of a depreciable capital asset.

CSV

Comma Separated Values, data imported or exported using commas as the only delimiters separating the data.

cursor

A graphical image, usually a vertical bar or block, that shows the location where text will appear when keys are pressed or where a selection will be made. Current cursor position is often shown by highlighting in reverse video or another color.

date and time function

A function that returns a value corresponding to the specified date, month, year, hour, minute or second. It can also be the current system time and date.

dates

A value represented as an integer equal to the number of days before or since December 30, 1899 (for the 1900 system system) or January 1, 1904 (for the 1904 date system).

default

An object or action that is specified for selection if no other selection is specified.

dialog box

A pop-up window that XESS displays for you to enter information about certain commands and functions.

digital logical function

A function that returns the values 0, 1 or -1 (unknown) based on the value of its arguments. Digital logical functions evaluate the integer portion of a value. Any value not equal to 0 or 1 is considered unknown.

dimmed selection

A selection that is not currently available.

double-click

To press and release a mouse button (usually the left button) twice in rapid succession.

drag

To press and hold a mouse button while moving the mouse.

Edit Mode

An mode of operation whereby XESS is ready to accept edits to cell contents. (As opposed to input mode, where XESS accepts new cell contents).

enabled

Turned on. Many XESS capabilities, such as cell protection, title printing, automatic recalculation and constraint-checking, can be enabled or disabled to suit your preferences.

File Filter

A dialog box that XESS presents in certain cases where you must specify a source file or destination file, such as in Import and Export operations.

financial function

A function that performs a common financial calculation, such as future value of an annuity at a given interest rate.

font metrics

The calculation tables required for XESS to handle proportionally spaced fonts. Your XESS package includes the Adobe Font Metric files required for the PostScript fonts used with XESS.

formula

A way of establishing and calculating mathematical relationships between the elements of a spreadsheet. Formulas are automatically changed to reflect any changes in referenced cells.

forward reference

A cell whose value depends on values calculated later in a spreadsheet.

function

An XESS-provided formula that performs the work of many formulas, or performs special functions that cannot be achieved by formulas, such as manipulating text strings.

goal-seeking

An XESS tool that uses iterative calculation to find the value required in one cell (variable) in order to achieve a desired value in another cell.

graph

A pictorial representation of data.

highlight

A visual cue to the current selection or current location of the cursor, frequently accomplished by reverse video.

HTML

A popular file format which can be used with web browsers or similar tools.

I-beam

A graphic image used to represent the location of the mouse pointer in a text entry box, providing a visual cue that text can be entered in an area.

icon

A small graphic imaged used to represent a window. Windows can be turned into icons, (minimized) to save room or unclutter the workspace.

inactive

A window that does not have the current input focus.

indirect reference

A unique cell referencing technique in XESS which allows you to refer to cells by row and/or column offset values relative to the current cell. This can be used anywhere a cell reference is expected: function arguments, formulas, constraint expressions. It uses the following construct: #{column offset,row offset}.

input focus

The cell, range, area or window where keyboard and mouse actions will take effect. The computer can work on many tasks at once, but can only one can have the attention of the keyboard and mouse.

insertion cursor

A graphic symbol that provides a visual cue to the insertion point for data and text.

insertion point

The point marked by the insertion cursor in a text entry area, where text will appear when keys are pressed on the keyboard.

iterative calculation

A method of calculation whereby XESS passes through the worksheet more than once, addressing circular references or performing goal-seeking.

justification

Alignment. Left-justified text is aligned on the left; right-justified text is aligned on the right.

LaTeX

A trademarked product of the American Mathematical Society, a typesetting program popular in scientific and academic environments.

location cursor

A graphic symbol that marks the current location of the keyboard input focus for selection, typically a box that surrounds the current object or a highlight that shows the current object in reverse video.

logical function

A functions that evaluates conditions on a purely true/false basis, returning the value 0 if the condition is False and the value 1 if the condition is True.

lower

To move a window to the bottom of the window stack in the workspace.

mathematical function

A function that performs calculations with numeric values as arguments.

maximize

To enlarge a window to its maximum size.

maximize button

The control button in the window frame that is used to maximize a window.

menu

A list of available selections from which the user chooses.

menu bar

A bar at the top of the window that contains the titles of XESS pull-down menus.

message box

Any dialog box that provides information, tells the status of a work in progress, asks a question, issues a warning or draws attention to an error.

minimize

To turn a window into an icon.

minimize button

The control button in the window frame that is used to minimize a window.

miscellaneous function

A function that performs a variety of calculations such as returning a reference to a specific cell or range.

mnemonic

A single character (usually the initial character) of a menu selection, which initiates a selection when a menu is displayed.

mouse

A pointing device commonly used with a keyboard for using XESS.

named cell

A cell to which a name has been assigned with the Named Range utility. Named cells can be referenced by their names or addresses.

named range

A range of cells to which a name has been assigned with the Named Range utility. Named ranges can be referenced by name anywhere that a standard range reference is accepted.

natural recalculation

A method of calculation that follows a natural hierarchy of the importance of cell dependencies.

operators

The characters that establish the relationships between values in a formula, such as +, -, * and <= . Arithmetic operators calculate numeric values; text operators act on strings of text, and logical operators evaluate true/false conditions.

paste

Inserting data into an area after it has been cut from another area, perhaps another worksheet.

point

To position the pointer or location cursor.

pointer

The graphic image that appears on the workspace and represents the current location.

PostScript

A registered trademark of Adobe Systems, Inc., that refers to a popular format for producing highly formatted printed documents.

primary key

In the Sort operation, the primary column on which XEss should base the sort. If two entries in the primary key column are identical, XEss sorts based on the value in the secondary key column.

protection

The act of prohibiting users from making direct changes to entries in a protected cell. Cell protection is applied with the Protect utility, removed with the Unprotect utility, and enabled/disabled for the entire sheet in the Default Sheet Characteristics dialog box.

radio button

A graphic control that simulates the buttons on a car radio, representing mutually exclusive selections.

range

A contiguous, rectangular block of cells that has been referenced as a group in a cell formula, or selected to be affected by some editing action, such as Copy Formulas or Move.

recalculation

The process whereby XEss re-computes the mathematics of the worksheet after the user makes changes. XEss lets you designate whether recalculation takes place on demand or after any change is made.

relative references

Cell or range references that are interpreted relative to the current position of the cell containing the formula. Relative references are updated whenever a cell is copied or moved, to reflect the new position of the cell. By default, XEss considers references to be relative.

restore

To return an icon or maximized window to its normal size.

save

To write changes to a data file to a storage device for safekeeping.

statistical function

A function that performs aggregation and counting operations on a group of values expressed as a list of arguments.

string functions

Functions that act on strings of text, rather than on numeric values.

scroll bar

A graphic device used to change the view of a worksheet or list box. A user changes the view by moving a slider within the scroll bar or by pressing a scroll arrow at either end of the slider.

secondary key

In the Sort operation, the column on which XEss should base the sort, if two entries in the primary key column are identical, from a sorting standpoint.

selection cursor

A highlighted area that indicates the current selection.

select

To choose a menu selection, worksheet cell, range of cells or other area to be acted upon or an action to be performed. Selections are usually displayed in reverse video.

setting

A parameter that does not cause an operation, but rather influences the outcome of related operations.

slider

The object that is dragged within a scroll bar to change the view of a worksheet or list box.

spreadsheet

The foundation of the XEss way of working; a row-by-column matrix of cells that contain constant values, text values and formulas that calculate values -- much like traditional spreadsheet programs. However, with its extensive range of features and functions designed for scientific and engineering environments, XEss transcends the realm of the typical financial spreadsheet, and therefore is known as a worksheet.

string function

A function that manipulates and evaluates character strings.

submenu

A subsidiary menu that is called from within another menu.

target

In the goal-seeking operation, the target value sought by manipulating another value.

target cell

In the goal-seeking operation, the cell that contains the target value, the objective of the goal-seeking.

titles (row, column)

In the general worksheet view, row labels and column headings that have been protected by the Set Title utility. These titles remain in view, even as you scroll through far-reaching areas of the worksheet.

titles (graph)

In graphics, the title of the graph, usually displayed centered above the graph.

TSV

Tab Separated Values, data imported or exported using tabs as the only delimiters separating the data.

variable cell

In goal seek, the cell that will be changed in order to reach the target.

WKS/WK1/WK3/WK4

The formats used by many other spreadsheets for storing information. XESS can load and save spreadsheet files in the WKS, WK1, WK3, or WK4 formats.

window

A rectangular subset of the terminal's display screen, surrounded by a window frame consisting of a resize border, window menu button, title bar and window control buttons.

window manager

A program that controls the size, placement and operation of windows on the screen.

window menu

A menu activated from within the window frame, containing selections for restoring, moving, sizing, minimizing, maximizing and closing the window.

XLS

A file format which originated with the Microsoft Excel spreadsheet.

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