Xspread Reference Manual

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Manual Updated by Robert Parbs II
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May, 2001

Contents

A note on version 2.4

Version 2.4 of xspread represents a "revival" of the program, designed primarily for use on the Agenda VR3 Linux-based Personal Digital Assistant (PDA). This manual is based on the version included with xspread 2.3, which is part of the Slackware Linux distribution. I have, however, made many changes: the changes fall into the following categories:

1. Editorial amendments in the interest of greater concision.
2. Removal of "wishful" references to features that were in the manual, but not actually implemented in version 2.3 of the program.
3. Removal of references to features that have been eliminated in version 2.4, in the interest of a smaller xspread binary.
4. Addition of references to new features added in version 2.4, e.g. the Linear Regression option and the functions `@entropy`, `@log2`, `@norm`, `@normcdf` and `@rand`.

Website for version 2.4: `http://www.ecn.wfu.edu/~cottrell/agenda/`

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1 Introduction

Xspread is a spreadsheet program which runs under the X Window system. It supports many standard spreadsheet features, such as:

- Cell entry and editing
- Worksheet size: 702 columns by unlimited rows
- File reading and writing
- Absolute and relative cell references
- Numeric and string ("label") data in cells
- Left or right justification for labels
- Row and column insertion and deletion
- Hiding and unhiding of rows and columns
- Range names
- Manual or automatic recalculation
- Numeric, relational and Boolean operators
- Function references, including references to external programs
- Use of the mouse in pointing and menu selection

The structure and operation of the spreadsheet is similar to but not identical with popular spreadsheets such as Lotus 1-2-3 and its clones. Like other spreadsheets, the workspace is arranged into rows and columns of cells. Each cell can contain a number, a label (i.e. character string), or a formula which evaluates to a number or label.

You can start the program with or without specifying a file to be read in. This file must be a worksheet in xspread format. Such files are created either by saving a worksheet after entering data manually, or with the auxiliary program xsdata, a filter which reads plain space-separated data and writes it out in the appropriate format. If a file is specified on the command line, xspread attempts to locate and read in the file. If it is successful, xspread starts with the file's contents in the workspace. If it is unsuccessful or no file is specified on the command line, xspread starts with the workspace empty.

For a tutorial introduction, type:

```
xspread examples/tutorial.xsw
```

This directory also contains other spreadsheet templates which you may be interested in.

To start xspread, type the program name followed by any command flags you want to use and then by the optional file name. The full form of the command line is:

```
xspread [-c] [-h] [-m] [-n] [-C] [-R] [-fn font] [filename]
```

The optional flags given above have the following meanings:

`-c` Recalculation is done in column order. When xspread recalculates, it will start at the top of the leftmost column, and recalculate the all the cells from top to bottom. Then, it will recalculate the next column in the same order. It will continue in this fashion until it has recalculated the rightmost column.

Xspread does NOT support natural order recalculation.

Default: Row order recalculation.

`-h` Display command line help.

`-m` Start with manual recalculation. With this option, the spreadsheet will recalculate values only when the `@` command is used. With automatic recalculation, the spreadsheet recalculates values whenever a cell's contents change.
Default: Automatic recalculation.

`-n` Use "alternative" data entry mode. See section 2.3 below for details.

`-fn` Change the font size to whatever, e.g. `-fn 9x15`.

`-C` The action after the `Enter` key is released is to move the cursor down the current column.

`-R` The action after the `Enter` key is released is to move the cursor right in the current row.
Default: Stay at the current position.

2 Using the Worksheet

2.1 Worksheet Structure

The xspread window is divided into four regions. The top line is used for displaying the cell address the cursor is on, displaying cell values, and entering commands. The second region consists of the second and the third line. Here xspread displays messages or options for the `/` (menu) command. In the latter case the third line is used to show a short description of the highlighted option. A third region, immediately under the third line and along the left edge of the window, shows the column addresses and row addresses. The fourth region is the worksheet work space.

The worksheet has 702 columns labeled alphabetically `A` through `ZZ` (`A` through `Z` and `AA` through `ZZ`). The number of rows only depends on the available memory. Rows are numbered from `0` on.

Where a row meets a column, the intersection is called a cell. Cells have addresses which consist of their column letter(s) and row number. Examples of cell addresses are `A1`, `E56`, and `AH187`. The upper left corner has cell address `A0`. The cell address occupied by the cursor is indicated on the top line.

If a cell's numeric value is wider than the column width, the cell is filled with asterisks. If the cell's label string is wider than the column width, the display of the label is truncated at the start of the next non-blank cell in the same row.

The xspread window has two cursors. The cell cursor highlights the current cell. The character cursor shows up when you type a command on the top line.

Commands are fed to xspread using the mouse (or stylus, on the Agenda) and via various keystrokes.

This manual indicates control key combinations by showing a caret (`^`) immediately prior to the control key's letter. For example, `Ctrl-A` is shown as `^A`.

2.2 Navigating the Worksheet

Moving the Cursor One Cell at a Time

The arrow keys (or the directional buttons on the Agenda) may be used to move the cell cursor by single rows or columns, if the "focus" is on the worksheet. The other place the focus can be is the top line, where the left and right keys (or buttons) can be used to move the text cursor when you're editing a command. To see where the focus is, look at the top left corner of the region displaying the row and column headings: when the focus is on the worksheet a reverse-video asterisk `*` is displayed there; if the focus is on the top line this asterisk disappears. To shift the focus onto the worksheet, click on the bar showing the column headings; to shift it onto the top line, click there.

In addition, you can move the cursor around the worksheet via various control key sequences. (The control key commands always are available even if the character cursor is on the top line.)

`^B` (back) and `^F` (forward) move the cursor left and right, respectively.

`^P` (previous) and `^N` (next) move the cursor up and down, respectively.

Additional vi-like cursor control commands are available if the character cursor is *not* on the top line of the window:

`h` (back) and `l` (forward) move the cursor left and right.

`k` (up) and `j` (down) move the cursor up and down.

`^H` and the spacebar move the cursor back and forward, respectively.

Larger Cursor Moves

`^` Go to the top row of the worksheet.

`#` Go to the bottom row.

`0` Left edge: Move the cursor to column A.

`$` Right edge: Move the cursor to the last column of the worksheet.

`b` Scans the cursor backwards (i.e. to the left and up) to the previous valid (non-blank) cell.

`w` Scans the cursor forwards (i.e. to the right and down) to the next valid (non-blank) cell.

`^Ed` Goes to the next non-blank cell in the indicated direction. The character `d` must be replaced by one of the valid cursor direction indicators (i.e., `^B`, `^F`, `^P`, or `^N`). When you execute this command, if the cursor is on a blank cell, it goes in the indicated direction until it reaches the first non-blank cell.

Moving to Specific Locations

`g` goes to a specific cell. You are prompted for a cell address, range name, a string expression surrounded by quotes, or a number. If you specify a cell address or a range name, xspread goes directly to that cell, or the starting (upper left) cell of the range. If you supply a quoted string, xspread will search for a cell containing the given expression. If you specify a number, xspread will search for a cell containing that number.

Xspread's searches proceed from the current cell to the end of the worksheet, then wrap to cell `A0` and continue from there forward to the current cell.

Moving to Specific Locations via the mouse

The mouse can also be used for navigation: clicking on a cell with the left or middle mouse button will move the highlight onto that cell. The third mouse button is used to invoke the menu system. (Agenda: tap a cell with the stylus to move the cell cursor onto that cell.)

2.3 Cell Entry and Editing

Cells can contain either numeric or string constants or expressions.

Data entry

There are two data entry modes: "quick numeric" mode (the default) and "alternative" mode.

The two modes have this in common: to enter a **label or string**, you must first enter one of these characters: `"`, `>`, or `<`. (Entering a letter first does NOT start a label, since bare letters are used as xspread commands.)

`"` indicates that the label will be centered in the current cell.

`<` indicates that the label will placed flush left.

`>` indicates that the label will be flush right.

The two entry modes differ in regard to entry of **numerical** constants or expressions. In quick numeric entry mode, a numerical entry may be started with `=`, a digit (`0-9`), `+` or `-`. In alternative mode, a numeric entry must start with the `=` sign. In this case, unprefixed digits, `+` and `-` have a different function, as explained in the following subsection.

In all cases, xspread prompts you for the expression on the top line.

Cell Editing Commands

When the highlight is on a given cell in the worksheet, and its contents are displayed on the top line, you can "open" the cell for editing by clicking on the top line: the line displaying the current content will change to a prompt allowing you to edit the content. This prompt somewhat resembles the bash command line. You can use the arrow keys to move left or right, and the keystrokes `^A`, `^E` and `^K` can be used to go to the beginning of the line, go to the end of the line, and delete to the end of the line, respectively.

To commit changes made at this prompt, press `Enter`; to abandon any changes, press `Esc` or `^G`.

In addition various letter keys perform editing commands, provided the cell is *not* already "opened" as described above.

- `e` edit the numeric value associated with the current cell. Xspread will display the current numeric expression on the top line with the character cursor at the end of the numeric expression.
- `E` edit the label that already exists in the current cell. Xspread will display the current label on the top line with the character cursor at the end of the label.
- `c` copy the last marked cell to the current cell. For compatibility with other programs, `^V` ("Paste") is a synonym.
- `m` mark a cell for later use by the `c` command. For compatibility with other programs, `^C` ("Copy") is a synonym.
- `x` clear (erase) the current cell. You can use any of the pull commands to retrieve cell contents that were previously deleted.
- `+` in "alternative" entry mode, add the value of its argument (i.e. a number typed before the `+`) to the value of the current cell and store the result in the current cell. If no numeric argument is given the increment is 1.0.
- `-` in "alternative" entry mode, subtract the value of its argument (i.e. a number typed before the `-`) from the value of the current cell and store the result in the current cell. If no numeric argument is given the decrement is 1.0.

To adjust the alignment of a string label in a given cell, select the cell and hit one of `"` (center), `<` (left) or `>` (right). The original cell content will be shown on the top line with the new alignment. Just hit `Enter` if you don't want to change the string itself.

2.4 Formulas, Cell Expressions, and Functions

Formulas

Without formulas, a computer spreadsheet would not be any better than its paper counterpart. It is the ability to enter and recalculate formulas that gives an electronic spreadsheet its real power. Formulas can link result cells to other cells in the spreadsheet. These other cells can, in turn, reference still other cells so that a recalculation of the entire spreadsheet can have a cascade effect. Through formulas, a single cell can affect cells throughout the entire worksheet.

Formulas can reference cells either through the cell's address (e.g. `K20`) or through defined range names. Both cell addresses and range names can be either relative, absolute, or a combination of the two. Relative cell addresses and range names change when the cell's formula is copied to another position in the worksheet. Absolute cell addresses and range names do not change when the cell's formula is copied to another position in the worksheet.

Cell References

The method of specifying absolute cell addresses follows the convention of Lotus 1-2-3: absolute references are preceded by a dollar sign, `$`. The dollar sign can precede either the column reference, row reference, or both. Here are some examples, each of which references cell `K20` in a different way:

`K20` Both the column and row references change when the cell is copied.

`$K$20` Both the column reference and row reference remain fixed when the cell is copied.

`$K20` The column reference remains fixed but the row reference changes when the cell is copied.

`K$20` The column reference changes but the row reference remains fixed when the cell is copied.

These conventions also hold on defined (named) ranges—see section 3.8 below. In general, range references vary when formulas containing them are copied, but if the range is defined with `$` references, these do not change.

Operators

The numeric operators for formulas are as follows:

- `+` Addition
- `-` Subtraction
- `*` Multiplication
- `/` Division
- `^` Exponentiation (raise to a power)
- `%` Modulus or remainder
- `()` Parentheses can be used to change the order of operations

You can use relational operators to compare two numeric expressions to see if they satisfy the specified relation. The result is a logical value, either true (1) or false (0). The relational operators are:

- `=` Equal to
- `!=` Not equal to
- `>` Greater than
- `>=` Greater than or equal to
- `<` Less than
- `<=` Less than or equal to

Logical operators may be used to construct compound logical expressions. The logical operators are:

- `~` Logical NOT
- `&` Logical AND
- `|` Logical OR

You can use the conditional operator to test for a condition and take action depending on whether that condition is true or false (i.e., perform an IF test). The conditional operator is:

`e1?e2:e3` If expression `e1` is true, return the value of expression `e2`, otherwise return the value of expression `e3`.

Function References

Xspread supports a number of functions that make it easy to perform calculations of a specific nature. Formulas can reference any of the functions defined in the Function Reference (section 4). You can use these function references just as you would any cell or range reference. All functions begin with the `@` character. Since the `@` character by itself is used as a command character (to recalculate the spreadsheet), you must prefix `@` in a function reference with a `+` sign or `-` sign if a function reference is the first item in a formula.

2.5 Toggle Commands

Xspread has several optional settings which operate as toggle switches. Most switches have just two settings: the toggle commands change the setting of the selected switch to its opposite without your having to go through the / menu tree. (See also section 3.6 below.)

All of these commands are of the form `Ctrl-Tx` (`^Tx`), where `x` is replaced by the letter denoting the option that you want to toggle. The settings of all toggle options are saved with the worksheet when it is written to file. The toggle options and their code letters are as follows:

`a` **Automatic / Manual Recalculation.** If automatic recalculation is set, every change to the spreadsheet will cause the spreadsheet to be recalculated. If manual recalculation is set, xspread does not recalculate the spreadsheet unless you explicitly issue the recalculation command, `@`.

`c` **Recalculate by Columns / Rows.** The default is to recalculate by rows.

`e` **External Function Execution.** If external function execution is enabled, xspread calls such functions whenever the screen is updated. Otherwise any such functions are not called during screen updates. If external functions are referenced in the worksheet and they are disabled, xspread prints a warning each time the screen is updated. See also the entry for `@ext` in section 4 below.

`g` **Grid Lines Show/Hide.** Show (the default) or hide worksheet grid lines, separating the cells.

`i` **Round to Infinity.** If set, .5 is always rounded up, as opposed to the default which is to round .5 to the nearest even number (known as "banker's rounding").

`n` **Quick Numeric Entry.** If set, you can start numeric entry with any digit, a plus sign, or a minus sign. If not set, you must start a numeric entry with `=` (and you can use `+` and `-` to increment or decrement cell entries). Quick numeric mode is the default.

`$` **Dollar Prescale.** If set, numeric amounts are automatically scaled by .01 when you enter them into cells. This allows users to avoid typing the decimal points in monetary amounts. If not set (the default), numeric amounts are not scaled.

`r` **Newline Action.** Three-way toggle for the cursor motion on hitting `Enter` at the conclusion of editing a cell entry (none, move down one row, or move right one column). The default is no motion.

`z` **Set Newline Action Limit.** Set the limit to the "newline action" (see above) to the current cell. If the newline action is to move down, setting (e.g.) cell `A5` as the limit will cause the cursor motion to wrap to a new column after row 5, i.e. the cursor motion sequence will be `A4`, `A5`, `B0`, `B1` and so on. This can be useful for filling in a block of data of known size.

2.6 Miscellaneous Commands

`Q` `q` Exit from xspread

`^G` , `Esc` Abort the current command.

`?` Bring up an index to on-line help. The index will display a list of topics together with the letter that allows you to select a particular topic. The help facility is not context sensitive.

`Tab` The "point" command. When composing an expression on the top line, you can use `Tab` to define a range by pointing, instead of by typing cell addresses. First use the motion keys to get the highlight onto the cell that starts the desired range, then press `Tab`. Use the motion keys again to move to the end of the desired range (the intervening range will be highlighted as you go). Hit `Tab` a second time to enter the selected range into the expression on the top line.

`^L` Redraw the screen.

`^R` Redraw the screen, highlighting cells containing constant numeric values. This may be useful for showing values which you need to provide or update.

`^X` Redraw the screen, highlighting cells containing expressions. Xspread shows all expressions as formulas, not their current values. All expressions are displayed as left-justified text. This command makes it easier to check expressions.

Two `Ctrl` commands insert current cell information into the top line, if an expression is being composed there:

`^V` **Numeric Value.** Inserts the numeric value of the current cell.

`^W` **Cell Expression.** Inserts the expression attached to the current cell, if any. If there is no expression, this command inserts `?`.

In addition, while an expression is being composed or edited, clicking on a cell with the mouse (or tapping on it with the stylus on the Agenda) will insert that cell's address into the top line, at the cursor position.

3 Alphabetical Command Reference

3.1 /C Column/Row

The `Column/Row` commands perform various operations on entire columns or rows in the worksheet (deletion, insertion and so on). Details on the individual commands follow.

/CA Column/Row Append

Inserts a new row or column immediately following the cursor position and copies the contents of the current row or column into the newly inserted row or column.

1. Move the cursor to the cell in a row or column where you want the new row or column to be inserted. Rows are inserted below and columns to the right.
2. Type `/CA`
3. Type `R` for Row or `C` for Column.
4. The row or column is inserted and filled with the copied values.

/CD Column/Row Delete

Deletes a row or column from the worksheet. The remaining rows or columns are renumbered to close the space.

1. Move the cursor to the row or column you want to delete.
2. Type `/CD`
3. Type `R` for row or `C` for column.
4. Press `Enter`. The row or column at the current cursor position is deleted.

/CF Column/Row Format

Sets column width and the numeric display format for a column. (There is no command to format a row.)

1. Move the cursor to the column you want to format.
2. Type `/CF`
3. Enter the column width and the number of digits to follow the decimal point. E.g. if you specify `8 1` the column will be 8 characters wide and show one decimal place. Values are rounded off to the least significant digit displayed.

/CH Column/Row Hide

Hides the current row or column: this keeps it from being displayed but it remains in the worksheet.

1. Move the cursor to the row or column you want to format.
2. Type `/CH`
3. Type `R` for row or `C` for column.
4. Press `Enter`. The row or column at the current cursor position is hidden.

/CI Column/Row Insert

Inserts a row or column into the worksheet at the current cursor position. A new row appears immediately below the cursor and a new column immediately to the right.

1. Move the cursor to a cell in the row or column where you want the new row or column to be inserted.
2. Type `/CI`
3. Type `R` for Row or `C` for Column.

/CP Column/Row Pull

Reinserts ("pulls") deleted information back into the worksheet at the current cursor location. `/CPR` inserts enough rows to hold the last deleted set of cells. `/CPC` inserts enough columns to hold the last deleted set of cells. `/CPM` (Merge) does not insert rows or columns; it overwrites the cells beginning at the current cursor location.

1. Move the cursor to the position where you want the previously deleted information to appear.
2. Type `/CP`
3. Type `R` for row, `C` for column or `M` for merge.
4. Press `Enter`. Xspread inserts the deleted information in the manner specified.

/CS Column/Row Show

Shows (unhides) hidden rows or columns. It is the reverse of the `/CH` (`Column/Row Hide`) command.

1. Type `/CS`
2. Type `R` for row or `C` for column.
3. Enter a range of rows or columns to be revealed. The default action is the first range of rows or columns currently hidden.

/CV Column/Row Values

Converts formulas in the affected rows or columns, inserting the values which are in the cells when the command is executed. This "freezes" the values.

1. Move the cursor to a cell in the row or column you want to convert from formulas to values.
2. Type `/CV`
3. Type `R` for row or `C` for column.

3.2 /F File

The `File` commands transfer information between the current worksheet and files on disk. As of version 2.4.4, xspread uses the FLTK file browser to select file names.

Details on the individual commands follow.

/FO File Open

Retrieves a worksheet file from disk. Only files in xspread's native format can be opened in this way. The auxiliary program xsdata can be used to convert plain text data files into xspread format. See `man 1 xsdata`.[1]

/FM File Merge

Merges the chosen file with the current worksheet. To the degree the data ranges in the specified file overlap the ranges of the current worksheet, the existing data are overwritten.

/FS File Save

Saves the current worksheet or a specified range (see `/FR` below) to disk in xspread's native format.

/FE File Export

Exports the worksheet data or a specified range thereof (see below) in a format suitable for use with other programs. A submenu is presented with a choice of export formats: `Screen` (plain text, formatted as shown in the xspread worksheet window), `CSV` (Comma Separated Values, suitable for opening in other spreadsheet programs), `LaTeX` (LaTeX tabular environment), and `Tbl` (in the format of tbl, the table processor for troff). You can access these options via their initial letters, `S`, `C`, `L` or `T`.

/FR File Range

Allows you to set a range of cells for use with the `Save` and `Export` file commands. If this option is not set, the range defaults to the entire worksheet.

3.3 /G Graph

The Graph commands set up and generate graphs using worksheet data. Submenus let you choose the `Type` of the graph (XY, line or bar) and the data ranges to use (`X` and `A` through `D`). The `Options` submenu to `Graph` offers further submenus for controlling details of the plot such as titles, legends and grids.

/G A-D Graph A-D (Data Ranges)

These items let you designate up to four data ranges for plotting on the Y axis.

1. Type a letter from `A` through `D` at the Graph menu.
2. Respond to the prompt with a range such as `K1:K20`.
3. To specify more ranges, use this command again with a different letter for the next range.

/GE Graph Export

This item allows you to export an xspread graph in the format of gnuplot. (Once your graph is in gnuplot you can convert it to a wide range of other formats.) You are prompted for the name of the file to save, by default with the extension `.gp`.

/GO Graph Options

These commands allow you to add enhancements to your graph. If you save the worksheet, the graph options most recently selected are saved with the data.

Legend Adds text identifying each Y axis data range.

Format Defines how graph information will be presented.

[1] This program was formerly known as psc.

Titles Adds titles at the top of the graph and along the X and Y axes.

Grid Adds horizontal and/or vertical grid lines.

Scale Sets the upper and lower limits for the graph axes.

/GOF Graph Options Format

Controls the representation of data points in a line or XY graph. The default setting is `Symbols`: data points are represented by marker symbols. The `Lines` option uses lines to connect the points; `Both` uses symbols as well as connecting lines.

1. Type `F` at the Graph Options menu.
2. Select a single data range (`A` through `D`) or `Graph` for the entire graph.
3. Choose a format for the specified range: `Lines`, `Symbols` or `Both`.
4. Continue choosing ranges or formats as desired.
5. To exit the Graph Format menu, press the `Esc` key.

/GOG Graph Options Grid

Adds or clears grid lines from graphs. Options are `Horizontal` grid lines, `Vertical` grid lines, `Both` (a full grid) and `Clear` (no grid, only tick marks). `Clear` is the default.

/GOL Graph Options Legend

Defines strings to be used as identifying "legends" for each Y axis data range.

1. Type `L` from the Graph Options menu.
2. Specify the data range (`A` to `D`) to be identified with a legend.
3. Type the legend (up to 39 characters) and press `Enter`.
4. To exit the Graph Options Legend menu, press the `Esc` key. To create more than one legend, select another menu item.

/GOS Graph Options Scale

These commands allow you to specify maxima and minima for the ranges of the data on the X and/or Y axes. The default is `Automatic` (the graph is adjusted to include all points in each data range).

/GOT Graph Options Titles

This command lets you define titles for the X and Y axes and for the top of the graph.

First Places a centered title at the top of the graph.

Second Places a centered title under the first title line.

X Places a label below the horizontal (X) axis.

Y Puts a label beside the vertical (Y) axis.

1. Type `T` from the Graph Options menu.
2. Select an option for the position of the title.
3. At the prompt, type your title (up to 39 characters) and press `Enter`.
4. To exit the Graph Options Titles menu, press the `Esc` key. To create more than one title, select another item from the menu.

/GR Graph Reset

This command resets all graph parameters to their default values (graph type is `XY`, symbols are used for plotting, no grid, axis scales are automatic, all data ranges are undefined, and any titles and legends are erased).

/GT Graph Type

This menu lets you select the type of graph to be created, from the choices `XY` (scatter diagram, the default), `Line` (suitable for time series) and `Bar` (bar chart).

/GV Graph View

Xspread displays the graph in a separate window. Press any key or mouse button (with the mouse pointer in the graph window) to return to the `Graph` menu.

/GX Graph X

For XY graphs, sets the X data range. For line and bar graphs, sets the range of cell labels for the horizontal axis. In the case of a line graph, you can leave the X range undefined, in which case the graphing routine will supply automatic labels for the horizontal axis (consecutive integers representing the observation number).

1. Type `X` at the Graph menu.
2. Xspread will give you the prompt `range for X data:` or `range for X labels:` Respond with a range such as `B1:B20` and press `Enter`.

3.4 /L Linreg

This item allows you to estimate a simple linear regression. You are prompted for a range of cells representing the dependent variable, then for a second range containing values of the independent variable, and finally for a cell marking the top left corner of the results. Note that the results occupy an area of 3 rows by 2 columns; it is probably best to specify a cell in a blank column to the right of your data to hold the results.

The printed results comprise the estimated value of the constant or intercept of the regression, the estimated regression slope, the estimated standard error of the slope coefficient—labeled `s(slope)`—and the coefficient of determination, R^2.

3.5 /M Matrix

Each command under the Matrix menu performs a particular matrix function.

/MT Transpose Transpose a matrix: You are prompted for the range defining the source matrix, and then for the top left cell of the destination (result) range.

/MA Addition Add two matrices: You are prompted for the range of the first matrix, then for the range of a second matrix, then for the top left cell of the destination range. The matrices to be added must be of the same size.

/MS Subtraction Subtract one matrix from another: You are prompted first for "matrix 1" which is the left-hand matrix, then for "matrix 2", the right-hand one, and then for the top left cell of the destination range. Matrix 2 is subtracted from matrix 1 (if they are of the same dimensions).

/MM Multiplication Multiply one matrix into another: You are prompted first for the left-hand matrix range, then for the right-hand range, then for the top left cell of the destination range. If the two matrices are conformable for multiplication, the result is the second matrix pre-multiplied by the first.

/MI Inversion Invert a Matrix: You are prompted for the range of the source matrix, which must be square, and then for the top left cell of the result range. If the source matrix is non-singular the result is the inverse of the source.

3.6 /O Options

These commands set various worksheet options. (See section 2.5 above for an alternative means of accessing these switches, and for greater detail on the options). The `Option` items are as follows.

`Auto` Toggle the recalculation mode between automatic (the default) and manual (recalculation is done only in response to the `@` command).

`Numeric` Toggle the cell entry mode between "quick numeric" (the default) and "alternative".

`PreScale` Toggle the automatic prescaling of numeric entries by .01.

`Ext` Toggle the evaluation of "external functions" on recalculation of the worksheet.

`NL-Action` Three-way toggle for the cursor motion on hitting `Enter` at the conclusion of editing a cell entry (none, move down one row, or move right one column).

`Col/Row-Limits` Set the current cell as the limit for the "newline action" (see above).

`Recalc` Toggle the recalculation order: by rows (the default) or by columns.

`Up` Toggle rounding of .5 between always up and to the nearest even (the default).

`Iterations` Set the maximum number of iterations on recalculation (you are prompted for an integer).

`Grid lines` Toggle between showing and hiding grid lines that separate the cells of the worksheet.

3.7 /Q Quit

The `Quit` command ends the current worksheet session. If changes have been made since the last time the worksheet was saved, `xspread` will ask whether the most recent changes should be saved prior to exiting: respond with `Y` to save the changes or `N` to exit without saving the worksheet.

3.8 /R Range

The Range commands affect a single cell or rectangular group of adjacent cells. Options are `Copy`, `Define` and `Remove`, `Erase`, `Fill`, `Lock` and `Unlock`, and `Values` (freeze the output from formulas). Details follow.

/RC Range Copy

Copies the values and formulas in the source range into the destination range. Relative cell references are adjusted for the new position; absolute cell references are left alone.

CAUTION: The Range Copy command overwrites the contents of the destination cells.

1. Type `/RC`
2. At the `copy` prompt, supply the source range and the destination range.

/RD Range Define

Lets you specify a name for a cell or range of cells. Later, you can use this name instead of cell references in formulas. Range names are case sensitive. For example, "`foo`" and "`Foo`" are distinct range names.

1. Type `/RD`
2. At the `define` prompt, enter a string enclosed in double quotes, followed by a range specification such as `A4:B8`.

/RE Range Erase

Erases the contents of cells in a specified range.

1. Type `/RE`
2. Specify a range at the `erase` prompt. Xspread erases the contents of all cells in the range.

/RF Range Fill

Fills a specified range of cells with a designated value. All of the cells can have the same value or each succeeding cell can differ from the previous one by a stated increment.

1. Type `/RF`
2. At the `fill` prompt, specify in order the range to be filled, the value to use in the first cell, and the amount by which the next cell should differ from the previous cell. If all cells are to have the same value, the increment should be zero (0).

/RL Range Lock

Protects a specified range against overwriting. To remove the protection, use `/RU`, `Range Unlock`.

/RS Range Show

Shows the user all of the named ranges.

1. Type `/RS`
2. Xspread displays in a separate window a list of the currently defined range names and the ranges that are denoted by those names. Press any key or click the mouse on the list window to dismiss it.

/RR Range Remove

Removes (undefines) a range name; it does not delete the cells in the range.

1. Type `/RU`
2. Specify the range to be "removed". Xspread deletes the associated range name.

/RV Range Values

Converts the results of formulas to the values they yield at the time that the command is executed.

1. Type `/RV`
2. At the prompt, specify the range. Xspread then substitutes the values of the formulas for the formulas. (There will be no apparent change in the screen display.)

4 Function Reference

Functions can be used by themselves or as part of formulas in xspread. Their names begin with an `@` symbol. Any necessary arguments are enclosed in parentheses, immediately following the function name. The general form of a function reference is: `@function(`*arg1*, *arg2*, ..., *argN*`)`

4.1 Argument types

`date`	unix date: the number of seconds since midnight on January 1, 1970.
`format`	string containing a valid C-language format specification for converting character expressions to numeric and vice versa.
`i`	The interest rate per period on a loan or investment, expressed as a decimal fraction.
`n`	Any integer.
`pmt`	The payment made at the end of each term of a loan or investment.
`position`	Integer value specifying the position inside a character string.
`pv`	The present value of a series of payments. The original amount of a loan or investment.
`range`	A range name or cell address.
`crange`	A range with an optional logical expression attached (see section 4.4 below).
`term`	The number of payment periods over the life of a loan or investment.
`string`	A character string enclosed in quotes or the cell address of a label.
`x,y`	Double precision floating point numbers or cells containing such numbers.

4.2 Functions by type

Date and Time Functions

`@date`	`@day`	`@hour`	`@minute`	
`@month`	`@now`	`@second`	`@year`	

Financial functions

`@fv`	`@pmt`	`@pv`	`@irr`

Lookup Functions

`@index`	`@lookup`	`@stindex`

Mathematical Functions

`@ceil`	`@exp`	`@fabs`	`@floor`	`@hypot`
`@ln`	`@log`	`@log2`	`@max`	`@min`
`@nval`	`@pi`	`@pow`	`@rnd`	`@sqrt`

Special Functions

`@ext`	`@norm`	`@rand`

Statistical Functions

`@avg`	`@count`	`@entropy`	`@max`	`@min`
`@normcdf`	`@prod`	`@stddev`	`@sum`	

String Functions

`@eqs`	`@fmt`	`@ston`	`@substr`	`@sval`

Trigonometric Functions

`@acos`	`@asin`	`@atan`	`@atan2`	`@cos`
`@dtr`	`@rtd`	`@sin`	`@tan`	

4.3 Alphabetical Function Reference

`@acos(x)` Returns the arc cosine, i.e. the angle in radians whose cosine is x. The argument x must be in the range -1 to 1. The angle is in the range 0 to π.

`@asin(x)` Returns the arc sine, i.e. the angle in radians whose since is x. The argument x must be in the range -1 to 1. The angle is in the range $-\pi/2$ to $\pi/2$.

`@atan(x)` Returns the arc tangent, i.e. the angle in radians whose tangent is x. The angle is in the range $-\pi/2$ to $\pi/2$.

`@atan2(x,y)` Returns the arc tangent, i.e. the angle in radians whose tangent is y/x. The angle is in the range $-\pi$ to π. This function distinguishes between angles that lie in the first and third quadrants and those that are in the second and fourth.

`@avg(crange)` Returns the average (arithmetic mean) of the values in the given (conditional) range. If the range contains blank cells, they are ignored.

`@ceil(x)` Returns the smallest integer which is not less than x.

`@cos(x)` Returns the cosine of x. The argument x must be in radians.

`@count(crange)` Returns the number of non-empty cells in `crange`.

`@date(date)` Converts the unix date to a character string of the form `Nnn Mmm dd hh:mm:ss yyyy`, where

`Nnn` is the name of the day of the week
`Mmm` is name of the month of the year
`dd` is the day of the month
`hh:mm:ss` is the 24-hour time in hours, minutes, and seconds
`yyyy` is the year

`@day(date)` Returns the day of the month given a unix date.

`@dtr(x)` Converts the angle measurement x in degrees to radians.

`@entropy(range)` Returns $H = -\sum p_i \log_2 p_i$, the Boltzmann entropy or Shannon information of a set of probabilities, p_i, contained in the given `range`. The values in `range` must satisfy the rules for probabilities: $0 \leq p_i \leq 1$ for all i and $\sum p_i = 1$.

`@eqs(string1,string2)` Compares the values of two string expressions: returns 1 if `string1` has the same value as `string2`, otherwise returns 0.

`@exp(x)` Returns the value of e (2.718281828...) raised to the power of x. `@exp` is the inverse function of `@ln`.

`@ext(string,x)` This function allows the user to call external functions from inside a spreadsheet. The external function must be a valid program that the shell can run when the function is called.

`string` contains the program command line that is passed to the command interpreter. x is a numeric value which is passed to the function named in string. The value of x is converted to character format and concatenated to the end of string before the command interpreter is called.

The result of `@ext` is a string containing the first line which the external program prints to standard output. Any additional output to standard output, or any output to standard error, will mess up the screen. `@ext` returns a null string if external function evaluation is disabled, `string` is null, or the attempt to run the command fails.

`@fabs(x)` Returns the absolute value of the number specified by the argument. The absolute value is either zero or the positive value of the number.

`@floor(x)` Returns the largest integer which is less than or equal to the value of the argument.

`@fmt(format,x)` Converts the numeric argument x to a string under the guidance of `format`, which must be a string containing a C-language format specification on one of the following patterns: `%ew.d`, `%Ew.d`, `%fw.d`, `%gw.d`, or `%Gw.d`, where `w` gives the total width of the field in characters and `d` gives the number of characters to the right of the decimal point.

`@fv(pmt,i,term)` Returns the future value of an ordinary annuity with the payment made at the end of each term, at a fixed interest rate. The arguments are the periodic payment amount, `pmt`, the interest rate per period, `i`, and the number of periods, `term`. The time interval for expressing the interest rate and `term` must be the same. For example, if `term` is in months, the interest rate must be given on a monthly basis.

`@hour(date)` Returns the hour from a unix date. The hours are the number of hours since midnight. Thus, 0 represents midnight and 23 represents 11 p.m.

`@hypot(x,y)` Returns the length of the hypotenuse of a right triangle, i.e. $\sqrt{x^2 + y^2}$.

`@index(n,range)` Returns the numeric contents of a cell specified by the index number `n` and `range`, which is any single row or column in the worksheet. The range cells are numbered from 1 to n, starting with the leftmost cell in the row or the topmost cell in the column.

`@irr(range)` Returns the Internal Rate of Return (i.e. the discount rate which yields a net present value of zero) for the specified range of cells, where the first cell is taken as the negative of the initial investment and the subsequent cells hold values representing the net income (positive) or outlay (negative) in succeeding periods.

`@ln(x)`

`@log(x)`

`@log2(x)` These functions return the logarithm (to base e, base 10, and base 2, respectively) of $x > 0$.

`@lookup(x,range)`

`@lookup(string,range)` These functions return the contents of a cell from a "table", which can be either two rows or two columns.

The numeric version compares the value of x to the table given by the row or column `range`. The function searches the row or column for the last value less than or equal to x. If `range` is a row, the function returns the value in the next row and the same column. If `range` is a column, the function returns the value in the same row and the next column.

The string version compares the value of `string` to the table located in the row or column range. The function searches the row or column for an exact string match. If `range` is a row, the function returns the value in the next row and the same column. If `range` is a column, the function returns the value in the same row and the next column.

`@max(crange)`

`@max(x1,x2,...)` These functions return the largest value specified by the arguments. The arguments can be either a single range or a list of numeric expressions separated by commas.

`@min(crange)`

`@min(x1,x2,...)` These functions return the smallest value specified by the arguments. The arguments can be either a single range or a list of numeric expressions separated by commas.

`@minute(date)` Returns the number of minutes (0 to 59) since the last whole hour, given a unix date.

`@month(date)` Returns the number of the month (1 to 12), given a unix date.

`@norm` (No argument and no parentheses required.) Returns a pseudo-random number from the standard normal or Gaussian distribution (with a mean of 0 and standard deviation of 1).

`@normcdf(x)` The normal cumulative density function: returns the proportion of the standard normal distribution lying between $-\infty$ and x.

`@now` Returns the current unix date.

`@nval(string,n)` Returns the numeric value of the cell specified by the arguments. The `string` argument specifies the column (`A`, `B`, etc.) and `n` specifies the row number. If either of the arguments are outside of the worksheet limits or the cell has no numeric value, the function returns 0.

`@pi` Returns the value of π (3.141592654...).

`@pmt(pv,i,term)` Returns the payment for an ordinary annuity with the payment made at the end of each term. The arguments are the principal present value of the loan amount, `pv`, the periodic interest rate, `i`, and the `term` (number of periods) for paying off the loan. The period for expressing the interest rate and the term must be the same. E.g., if `term` in is months, `i` must be given on a monthly basis.

`@pow(x,y)` Returns the result of x raised to the power y, i.e. x^y. x must be nonnegative.

`@prod(crange)` Returns the product of all the nonblank cells in the given (conditional) range.

`@pv(pmt,i,term)` Returns the present value of an ordinary annuity with the payment made at the end of each period, at a fixed interest rate. The arguments are the periodic payment amount, the interest rate, and the term (number of payments). The period for expressing the interest rate and `term` must be the same.

`@rand` (No argument and no parentheses required.) Returns a pseudo-random number from the uniform distribution on the range 0 to 100.

`@rnd(x)` Returns the value that rounds off x to the nearest integer.

`@rtd(x)` Converts the angle measurement x in radians to degrees.

`@second(date)` Returns the number of seconds since the last full minute from a unix date.

`@sin(x)` Returns the sine of x, which is an angle in radians.

`@sqrt(x)` Returns the square root of x, for $x \geq 0$.

`@stddev(crange)` Returns the sample standard deviation of the cell values in `crange`.

`@stindex(n,range)` Returns the string contents of a cell specified by the index number `n` and `range`, which is any single row or column in the worksheet. The range cells are numbered from 1 to n, starting with the leftmost cell in the row or the topmost cell in the column.

`@ston(string)` Converts `string` (which must be a valid string representation of a number) to its numeric value.

`@sval(string,n)` Returns the string value of the cell specified by the arguments. The `string` argument specifies the column (`A`, `B`, etc.) and the argument `n` specifies the row number. If either of the arguments are outside of the worksheet limits or the cell has no string value, the function returns a null string.

`@substr(string,position1,position2)` Returns the characters from `position1` through and including `position2` from the designated `string`. The first character in `string` is at position number 1. If `position2` is greater than the length of the string, `position2` is the length of the string. If `position1` is less than 1 or greater than `position2`, the function returns the null string.

`@sum(crange)` Returns the sum of all the nonblank cells in the given `crange`. The function ignores empty cells and treats labels as 0.

`@tan(x)` Returns the tangent of x, an angle in radians.

`@year(date)` Returns the year from the unix date. Valid years start with 1970; the latest valid year is system dependent.

4.4 Conditional Ranges

An ordinary range of cells is something like `B5:C20`; a *conditional range* is a range plus a logical expression, separated from the range itself by a hash mark, for instance `B5:C20#A5=1`. A conditional range says, in effect, "Operate on each cell in the given range if and only if the associated expression evaluates as true (1) for that cell." The logical expression may be compound (see page 6).

This feature offers considerable flexibility: it allows you to treat the spreadsheet as a database, selecting cases for processing based on some criterion of interest. The functions that support the conditional range syntax are `sum`, `product`, `count`, `max`, `min`, `avg` and `stddev`. We illustrate the idea with reference to the `sum` function.

Suppose we have an expenses worksheet, with a column of disbursements and a column of "budget codes" indicating the type of expense. For example a code of 1 might indicate spending on food and 2 indicate entertainment. Now we'd like to find the total expenditure in each category. Let's say the budget codes are in column `A`, starting at row 0 and running through row 20, and the expense items are next door in column `B`. The formula for the sum of food expenses is `@sum(B0:B20#A0=1)`, and the sum of entertainment expenses is `@sum(B0:B20#A0=2)`. Note that the logical condition is "advanced" appropriately as evaluation proceeds down the column: `A0` is the first cell tested, but at the next step `A1` is tested, and so on.