Introduction to Spreadsheets

Go through this handout if you are not familiar with spreadsheets and relative addressing. The details below refer to Excel 2000, but any version of Excel will be sufficient for the homework. The command-line features work the same on all versions (and on most other spreadsheet programs), but some of the menus and graphical shortcut features may be different. Click **Help** for information on the version you are using.

Warning: Excel, like all programs, can crash unpredictably, losing all your unsaved work. Save frequently onto your own floppy disk.

1 Cells

A *spreadsheet* is simply a rectangular array on the screen, consisting of boxes called *cells*. A cell is labelled by its column (lettered A, B, C,...) and its row (numbered 1, 2, 3,...). Thus, cell C19 is in the third (C) column and the 19th row. You may type small letters in referring to columns: the program will know that `e9` means the cell E9.

A cell can contain three types of data: a string of *text*; a *number*; or a *formula*. In spreadsheets, as in algebra, formulas compute a number by performing operations (like addition) on other numbers (the contents of other cells). The cell then displays the resulting number, rather than the formula itself.

2 Entering Information

To put information in a cell, first *select* that cell. That is, click on it with the mouse, or use the arrow keys to move the selected cell to the one you want. The currently selected cell will have a dark frame around it.

To enter text or numbers, simply type what you want, and press `Enter` (line-return). What you type is displayed in the cell and in the formula bar at the top of the screen. You can also type into the formula bar by clicking on it, instead of into the cell itself.

To enter a formula, you first type an equals sign `=`, followed by an algebraic expression referring to other cells. For example, if you want cell B3 to display the sum of the numbers in cells B2 and C3, select B3 and enter `=B2+C3`. (If you have not yet entered any numbers into B2 and C3, they count as zero.) A formula will react to any changes you make in the other cells. Thus, if you change the numbers in B2 and C3, the cell B3 will change to display the sum of the new values. This makes it easy to do "what if" simulations of different

situations.

Examples

multiply B6 and C7	`=B6*C7`
you *must* use an asterisk ∗ to multiply	WRONG: `=B6C7` or `=B6 C7`
add all the cells between A1 and A15	`=sum(A1:A15)`
cosine of D2	`=cos(D2)`
parentheses are essential	WRONG: `=cos D2`
one half times the square of A3	`=1/2*A3^2` or `=.5*A3^2`
square of half of A3	`=(1/2*A3)^2`

3 Relative and Absolute Addressing

Copying is done as in other windows programs: click on the cell you want to copy from, click on the **Edit** menu at the top of the screen, move down to **Copy**, and click. Next click on the cell you want to copy to, click on the **Edit** menu, move down to **Paste**, and click. (Shortcut: instead of the menus, click `<Ctrl>+C` to copy, `<Ctrl>+V` to paste.)

This will copy text and numbers literally, but formulas in a much more subtle and useful way which is the real magic of spreadsheets. A formula can be copied quickly into large regions of cells, and the cell addresses in the formula *change* depending on which cell it has been copied to. This is called *relative addressing*. To keep a formula from changing when copied, use *absolute addressing*.

Example. Suppose in cell B3 you put the formula `=B2+A1`. In performing the addition, the program thinks of the other cells *relative to the current cell*: that is, B2 is 'the cell one row up from the current cell (B3)', and A1 is 'the cell two rows up and one column left from the current cell (B3)'.

Now copy-and-paste from B3 to B4. You will find that your formula has *changed* in B4 to `=B3+A2` ! This is because when you are at B4, cell B3 is 'the cell one row up from the current cell (B4)', and A2 is 'the cell two rows up and one column left from the current cell (B4)'. If you copy B3 to D4, the formula in D4 will be `=D3+C2`.

If you want to keep an address *unchanged* when copied, use absolute addressing, indicated by `$` signs before the row and column of the address. Thus, if B3 contains the formula `=$B$2+A1`, and this is copied to D4, it becomes `=$B$2+C2` : that is, the absolute address `$B$2` did not change, but the relative address A1 did change. The `$` sign does not affect the value of the formula within its cell: it only affects the way the formula is copied to other cells.

You can also make the column-part of an address absolute and the row-part relative, or vice-versa. Thus, if `=$B2+A1` is copied from B3 to D4, it becomes `=$B3+C2`. If `=B$2+A1` is copied from B3 to D4, it becomes `=D$2+C2`.

4 Block Copying and Filling

A *block* or *range* of cells is a part of a row or column, or any rectangular patch of cells. It is denoted by its upper left cell, a colon, and its lower right cell. For example, the block B5:H12 includes all cells below and right of B5, but above and left of H12 (inclusive). To select a block, move the mouse to the upper left corner of the block, and hold down the mouse button while moving to the lower right corner, then let go the button. (This is called *dragging over* the block.) Once selected the rectangle should be highlighted in a dark color.

To select a block that is too large to drag over, click on its upper left cell, use the scroll bar to bring the lower right corner into view, and hold down the shift key while clicking on the lower right corner. The entire block should again be highlighted.

To copy a formula from a cell to a whole block, move to the cell you want to copy from, click on **Edit** and **Copy** (or just `<Ctrl>+C`). Now select a block to copy to, and click **Edit** and **Paste** (or `<Ctrl>+V`). The text, number, or formula will be copied to every cell in the rectangle. Formulas will be copied with relative addressing, as before.

Excel also offers a faster way to copy a formula from the top of a column range to the rest. First, drag over the range (within a column) that you want to copy to, including the cell at the top which you want copy from. Then click on **Edit** and **Fill Down.** The top cell becomes the model for all the selected cells below it. There is a similar **Fill Right** option for filling from the left end of a row. (Shortcut: Select the cell to copy from. At its lower right corner will appear a small dot which is a 'handle'. Click on this dot and drag it down over the range you want to Fill Down to.)

To copy a block to another location, select the block by dragging, **Copy**, select the upper left-hand corner cell of the block you want to copy to, and **Paste**. To move a block use **Cut** (or `<Ctrl>+X`) instead of **Copy**.

5 Application of Relative Addressing

Example. How to make a column of numbers from 1.5 to 6, spaced at intervals of 0.5 .

Go to the cell where you want to begin your list, say B2, and enter the number `1.5`. In cell B3, enter `=B2+.5`. Now highlight cells B3:B11, click **Edit** and **Fill Down**. (Shortcut: Click on B3 and drag the handle-dot down to B11.) The cells B2:B11 should now display 1.5, 2.0, 2.5, . . . , 6.0. The formula in B5 (which you can view by clicking on the cell), should be `=B4+.5` . WRONG: If you highlight B2 to B11 and fill down, all the cells will contain the number 1.5.

After any task, save your work: under the **File** menu, choose **Save** or

Save As. Excel can crash or freeze at any time for no reason, losing all work which is not saved to a file. Save onto your own floppy disk (which you should back up periodically), or to a file on the computer you are at, transferring it to your own account at the end.

Exercise. (Not to hand in.) Use **Fill Down** and **Fill Right** to efficiently create the array:

1.5	1.6	1.7	1.8	1.9	2.0
2.0	2.1	2.2	2.3	2.4	2.5
2.5	2.6	2.7	2.8	2.9	3.0
3.0	3.1	3.2	3.3	3.4	3.5
3.5	3.6	3.7	3.8	3.9	4.0

Save your work when finished.

6 Application of Absolute Addressing and Naming

Example. Here is how to make a column of evenly-spaced numbers whose spacing is easy to change. First, put the spacing increment into a cell: say, into B1 put the number 0.5 . Then start the column of numbers: into B3, for example, put 1.5. Underneath, into B4, put the formula `=B3+$B$1`. Here B3 is a relative address, `$B$1` an absolute address. Now select the block B4:B12 (that is, the range between these two cells, inclusive) and **Fill Down**.

You should get the same column of numbers as in a previous exercise: 0.5, 1.0, 1.5.... So B5 should contain `=B4+$B$1`, etc. Now if you change the value of B1 to 0.2, the column immediately changes to 1.5, 1.7, 1.9, etc. As an experiment, repeat the above exercise without $ signs in the formula in B4. Click to see what formulas got copied into the column. Now try filling down from `=B3+B$1` in B4. Can you understand what happened?

Absolute addressing is necessary when referring to a quantity (like the increment) which stays constant throughout a computation, but which you might want to change later.

Another convenient way to refer to such a constant is *naming* a cell. In A1, type an alphabetic name for the value in the adjacent cell B1 (call it 'dt', for example), followed by `=`. That is, in A1 enter `dt=` . Now select B1, and in the **Insert** menu choose **Name > Define** . (In older versions, this is in the **Formula** menu, under **Define > Name**.) In the dialog box, Excel will suggest the name `dt` which you entered. Click OK. (If Excel suggests the wrong name or cell, enter the correct information in the boxes.) Now in your formulas you can write `dt` instead of `$B$1`, and get the same list. Formulas are more understandable with named constants instead of fussy absolute addresses. Save your work.