# Cass Business School 

# MSc Induction Programme 

## Introduction to Computing Skills Advanced Excel

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## Introduction to Computing Skills: <br> Excel

All MSc programmes at Cass involve extensive use of IT through online materials, exercises and course work. Each student is therefore expected to be computer literate and be able to use packages such as Microsoft Office especially the data analysis spreadsheets. To level the playing field we provide computing skills refresher materials that are made available before the start of the first term in September.

This material is presented in the form of self assessment online exercises so that each candidate can work through on their own. There will also be a weekly face to face session to go through the Induction excel exercises. These sessions will be offered as optional computing skills exercises during the first term only.

The key objective of this induction module is to provide each student with a check list of minimum computer data analysis skills that are essential before commencing an MSc programme at Cass. These basic skills include:

1. Functions and Keyboard skills
2. Core Functions (i) Logical (ii) Maths \& Trig (iii) Statistical and (iv) Financial
3. Inputting formulas and functions
4. Financial Calculations
> Time value of money
> Project appraisal techniques
> Sensitivity analysis
> Regular payments eg annuities
> Optimisation
> Asset pricing and valuation
5. Descriptive statistics
6. Creating Charts
7. Statistical distributions
8. Hypothesis testing
9. Basic econometric analysis e.g regression model
10. Macros e.g Visual basic

This handbook contains a brief introduction to each of these concepts and also provides data to enable you to practice solving these using excel functions. The data can be accessed on your induction website

You are strongly encouraged to attend the excel lab sessions and attempt these exercises during weekly sessions shown on your timetable Should you need further clarification or help please feel free to contact your instructor Oliver Manyemba by email at Oliver.Manyemba@city.ac.uk

## Table of Contents

$\qquad$
TABLE OF CONTENTS
$\qquad$

1. WHAT IS EXCEL?
$\qquad$
2. MENU ITEMS
3. KEYBOARD SKILLS ..... 8
3.1. Function keys ..... 9
4. EXCEL MENU RIBBON ..... 11
4.1. Overview of Menu Ribbon ..... 11
4.2. Frequently Used Commands ..... 11
4.3. Formatting Commands ..... 13
5. DATA INPUT ..... 15
6. FORMATTING ..... 16
6.1. Number ..... 17
6.2. Alignment ..... 18
6.3. FONT ..... 19
6.4. Border ..... 20
6.5. Patterns ..... 21
7. PRINTING ..... 23
7.1. Page Layout ..... 23
7.2. Print the active sheets, a Selected range, or an entire workbook ..... 23
8. CELL MANIPULATION ..... 25
8.1. SELECTING OR HIGHLIGHTING CELLS ..... 25
8.2. COPYING AND MOVING CELLS ..... 26
8.3. Filling cells ..... 27
8.4. INSERTING AND DELETING CELLS, ROWS AND COLUMNS ..... 28
9. ENTERING FORMULAS ..... 29
MSc. Induction Programme Introduction to Excel
9.1. USING EXCEL AS A 'CALCULATOR ..... 29
9.2. USING CELL REFERENCES ..... 29
9.3. REFERENCE TO A RANGE OF CELLS ..... 29
9.4. RELATIVE CELL ADDRESSES ..... 30
10. COPYING FORMULAS ..... 31
10.1. FIXED CELL ADDRESSES ..... 32
11. FUNCTIONS ..... 36
11.1. LOGICAL FUNCTION ..... 37
11.2. Math \& Trig Functions ..... 39
11.3. STATISTICAL FUNCTIONS ..... 41
11.4. FinANCIAL FUNCTIONS ..... 43
12. SENSITIVITY ANALYSIS ..... 49
13. ADD-INS ..... 52
12.1. DESCRIPTIVE STATISTICS ..... 53
12.2. BASIC ECONOMETRIC ANALYSIS: Regression Model ..... 54
14. GRAPHS ..... 57
15. MACROS ..... 60
14.1. Visual basic: Introduction ..... 54
14.2 Your First Macro ..... 55

## What is Excel?

Excel is one of the leading spreadsheet packages, with a wide range of capabilities, including financial analysis, statistics, graphics, database and sensitivity analysis functions. To activate Excel, click Start button and point to Programs and click on Microsoft Excel.

After displaying the Excel logo, you are presented with a screen similar to any Windows screen, with the usual maximise/minimise buttons, title bar, scroll bars and menu bar. We will be reviewing most of the menu items, the options under each item and several shortcuts (tools) that will facilitate your work. At the end of the instruction you should be able to put together a relatively sophisticated spreadsheet, use a series of financial analysis tools, perform a sensitivity analysis, produce graphs and use the program's optimisation utility. You will also be able to enhance the appearance of your work, using different types of fonts, letter sizes and cell outlines.


## The window borders

A box in the top left hand corner of the spreadsheet shows the reference of the cell pointer (e.g. A7). A box to the right of the cell-pointer reference displays the contents of the cellpointer (e.g. 26). The area that contains both boxes is called "Formula Bar".
The bottom left hand corner of the spread sheet contains a box showing the spreadsheet status. The status "Ready" indicates that it is possible to enter data into the cell; the status "Cell:" or "Calculating Cells:" indicates that the computer is processing and is not yet ready; the status "Enter" indicates that data is currently being entered into the cell.


## 1. Menu Items

## File

click this item or press <Alt+F> for options regarding printing set-up, printing, opening, closing and saving files

## Edit

click this item or press <Alt+E> to cut, copy or paste an item, insert/delete rows, columns, cells or entire sheets and find cells with specific text or numerical input

## View

click this item or press <Alt+ $\mathrm{V}>$ change the appearance of the toolbars and the view ratio, i.e. the number of cells that you can see on your desktop at any time

## Insert

click this item or press <Alt+l> in order to insert cells, rows, columns in your spreadsheet; new worksheets, charts or modules in your file; or insert functions, pictures and OLE objects

## Format

click this item or press <Alt+O> to change the way text and numbers look. You can make a number be displayed with decimal places, preceded by a currency unit, or displayed as a percentage. You also use this option to change the alignment and the orientation of text, outline or shade a cell or a group of cells

## Tools

click this item or press <Alt+T> to use facilities like spell-checking, the Solver, the Goal Seek and Scenario analyses and to run, record or edit macros

## Data

click this item or press <Alt+D> for database functions, when you use Excel as a database. A very useful option in this submenu Data|Table, which is used for oneway or two-way sensitivity analysis

## Window

click this item or press <Alt+W> to view other windows in Excel (if you have opened more than one file) and to arrange windows on the desktop

## Help

click this item or press <Alt+H> to get information on various Excel items. This option is also useful for Lotus users who wish to switch to Excel, as it gives quite a lot of information on how to replace the classic Lotus menus with the mouse-driven Excel menus

## 2. Keyboards

Excel has the following commonly used key operations:

## Arrow keys <br> 

Move the cell-pointer

## Tab



Move the cell-pointer right

## Shift-Tab



Move the cell-pointer left
Home


Move to the left most sell in the row (column A)

## Ctrl-Home



Move to the top left hand cell in the spreadsheet (A1)
Insert


Toggle Typeover mode

## End



Move to the end of a range

## Page-up

Page
Up

Move the window up by the screen height

## Page-down

Move the window down by the screen height

### 2.1. Function keys

Excel has a number of function keys. The commonly used keys are as follows:

## F1

Access the help facility

## F2

Activate the formula bar

## F3

Display the Paste Name dialog box if there are names defined

## F4

Toggle a reference between relative, absolute and mixed
[5]

Go To command

## F6

Next pane

Check spelling

## F8

Turn extend mode on or off

## F9

Calculate all sheets

## Fio

Activate the bar menu

Insert new chart sheet

Save file

## 3. Excel Menu Ribbon

### 3.1. Overview of Menu Ribbon

On the menu ribbon you can have different sets of toolbars. Excel is configured by default to show the menu ribbon with 7 tabs while several other combinations can be selected, depending on the user's requirements.

### 3.2. Frequently Used Commands



## Spelling

Checks spelling in the active document, file, workbook or item.
Cut
品
Removes the selection from the active document and places it on the clipboard.

## Copy

㬝

Copies the selection to the clipboard.

## Paste <br> 院

Inserts the contents of the clipboard at the insertion point and replaces any selection. This command is only available if you have copied an object, text or contents of a cell

## Format Painter

Copies the format from a selected object or text and applies it to the object or text you click.

## Undo <br> 

Reverses the last command or deletes the last entry you typed. To reverse more than one action at a time use the arrow next to the button

## Redo ra.

Reverses the action of the Undo command.

## AutoSum ${ }^{\Sigma}$

Adds numbers automatically with the sum function.

## Paste Function $f_{x}$

Displays a list of functions and their formats and allows you to set values for arguments.

## Sort Ascending <br> A $\downarrow$

Sort Descending ${ }_{A}^{Z} \downarrow$
Sorts the selected items in ascending or descending order alphabetically, numerically, or by date using the column that contains the insertion point

## Chart

Starts the Chart Wizard which guides you through the steps for creating an embedded chart on a worksheet or modifying an existing chart.

## Map

Creates a map based on the selected data. The data should contain geographic references such as abbreviations of countries or states.

## Drawing

Displays or hides the Drawing toolbar Zoom Enters a magnification between 10 and 200 percent to reduce or enlarge the display of the active document

## Office Assistant <br> (3)

The Office Assistant provides help topics and tips to help you accomplish your tasks.

### 3.3. Formatting Commands

## Arial

Changes the font of the selected text and numbers

## Font Size 10 -

Changes the size of the selected text and numbers.

## Bold <br> B

Makes selected text and numbers bold.

$$
\text { Italic } I
$$

Makes selected text and numbers italic.

```
Underline \(\underline{\underline{U}}\)
```

Makes selected text and numbers underlined.

## Align Left 플

Aligns the selected text, numbers or inline objects to the left.

## Align Centre $\overline{\underline{\underline{\underline{\underline{~}}}}}$

Aligns the selected text, numbers or inline objects to the centre.

## Align Right <br> 三

Aligns the selected text, numbers or inline objects to the right.

## Merge \& Centre 畕

Combines two or more selected adjacent cells to create a single cell

## Currency Style 동

Applies the currency formatting style to the selected cells

## Percent Style \%

Applies the percent formatting style to the selected cells

## Comma Style ,

Applies the comma formatting style to the selected cells.

## Increase Decimals <br> ${ }^{4} .0$

Increases the number of digits displayed after the decimal point in the selected cells

## Decrease Decimals <br> $\square$

Decreases the number of digits displayed after the decimal point in the selected cells.

## Decrease Indent

Increase Indent
Reduces or Increases the indentation of the selected cell or range.

## Borders

$\square$
Adds a border to the selected cell or range.

## Fill Colour

Adds, modifies or removes the fill colour or the fill effect from the selected object.

## Font Colour .

Formats the selected text with the colour you click.
Increase Font Size $\mathbf{A}^{-}$
Decrease Font Size $A^{*}$
Increases or decreases the font size of the selected cell(s) to the

## 4. Data Input

There are two main different types of cell entries:
text entries
numerical (numbers, formulas or functions) entries
To insert text in a cell, click on the cell and then start typing your text straight away. If your text contain numbers, Excel will still read it as text, irrespective of the position of your numbers.

To insert numbers, click on the cell and type in your number. If it is a single number and not a formula, Excel will read it as a number straight away. If it is, however, a series of mathematical operations (addition, subtraction, etc.), text will be displayed instead of the result of the operation. To solve this problem type $=$ or + at the beginning of the input (Excel will insert the $=$ sign even if you put +. The special characters E, e, \%, - and . can be used and will be automatically recognised.

Excel will also format the cell automatically to display numbers as percentages, as multiples of 10 raised to a power, etc. If you want to edit the contents of a cell, double-click on the cell itself or click on the cell contents in the reference area (Formula Bar). When you do so two buttons, a cross and a checkmark, will appear between the cell address and the contents. When you finish
$\downarrow$ Enter
changing the cell contents hit
or click on the checkmark. If, however, you change your mind and want to keep the cell contents intact, hit .

or click on the $\times$ cross

## 5. Formatting

Formatting can be applied to a single cell, a group (range of cells), the entire spreadsheet, or even to part of the input of a cell. To apply any type of formatting, you need to either:
click on the cell (for a single cell)

or highlight a range of cells ('click \& drag' with your mouse)

or click on the top left grey button of the spreadsheet (to select the entire spreadsheet)


There are several types of format attributes you can change:
number format (display as a percentage, with a fixed number of decimal places, with a currency prefix, etc.)
alignment (flush left, flush left or centre inside the cell)
font (change typeface, font size, font colour, underline, embolden, etc.)
border (apply lines around a single cell or a range of cells)
patterns (apply a colour or pattern on the cell background)
you can also change the width of columns and height of rows


### 5.1. Number

There are several ways you can display numerical cell input. You may wish to display all your figures with the same number of decimal places, as a percentage, with currency symbols, with negative numbers in red, etc. There two ways to do so:

## The long way...

The advantage of this method is that you can fully customise the format attributes you apply to your cells and you can even create your own formatting styles.
Step 1: Select the cells you want to format
Step 2: Select Format | Cells from the menu bar in order to display the window shown below. Click on the Number tab and use one of the available numerical formats, e.g. currency, percentage, accounting, etc.


Step 3: Specify the attributes available for each style. In the example above, for instance, you can change the number of decimal places, change the currency symbol that is used and select an alternative way to display negative numbers.

## The short cut...

You can use any of the buttons on the formatting toolbar 国 \% , $\quad \pm .00$ is that the currency, percentage and comma styles apply preset number formats. For example, the currency format uses the default currency (e.g. \$ in a PC with US as the default country), comma separated thousands and 2 decimal places. You can, of course, make further changes to the number format, as discussed above.

### 5.2. Alignment

Excel automatically aligns any text or numbers you insert in a cell.
Text is by default aligned to the left, whereas numbers are aligned to the right.
The long way...
You may change the alignment of the cells, as well as a few more attributes, by selecting Format | Cells and then clicking on the Alignment tab (displayed below)


Apart from the straightforward horizontal alignment (left, centre or right), you can also change the vertical alignment (top, middle or bottom) of the cell input. You can also changing the orientation of text or numbers by clicking and dragging on the red point of the 'clock dial' displayed above, or change the number of degrees below the dial.

## The short cut...

Use any of the alignment buttons on the formatting toolbar $\square$
The fourth button on this bar performs an action called 'merge \& centre'.
You can use this if you highlight more than one cells.
The selected cells are merged in one cell and their input is centred in the new single cell.


### 5.3. Font

There are several font attributes you can change: typeface, style, size, underlining, colour and use effects such as strikethrough, superscript or subscript.

## The long way...

Select the cell or cells whose font attributes you want to change. Then click on Format | Cells and select the Font tab. The window displayed below appears on the screen.


Change any of the attributes you wish and then click OK.

## The short cut..

 change the typeface and size of cells, or make text appear bold, italicised or underlined.

### 5.4. Border

Cells in your spreadsheet appear as small rectangles with grey borders (called 'gridlines'). These gridlines can be printed if you want, but instead of them you can apply your own customised borders. You can apply borders on one or more sides of each cell (or range of cells). A border can be a solid, dashed or double line, in black or in any other colour.

## The long way...

From the menu select Format | Cells and then click on the Border tab. You can then change any of the attributes you see displayed below.


## The short cut...

Use the - - button. Click on the small arrow on the right hand side to display the dropdown menu on the right and then select any of the available preset borders. The dotted border on the top left corner of the dropdown menu simply removes
 all borders from the selected cell or cells.

### 5.5. Patterns

In addition to changing the colour of a cell's contents, you can also change the colour of its background. You may also choose to use a pattern instead of a solid colour. This is very useful when the final output will be printed in black \& white only, whereby patterns are easier to read than different shades of grey (which is what colours look like in a black \& white printout).

## The long way...

From the menu bar select Format | Cells... and click on the Patterns tab to get the dialogue box displayed below.


The example below shows the appearance of text after changing the background colour to yellow and the font colour to red.

## Red text in yellow background

## 6. Printing

### 6.1. Page Layout

You can control the appearance, or layout, of printed worksheets by changing options in the Page Setup dialog box. A worksheet can be printed in portrait or landscape orientation, and you can use different sizes of paper. Worksheet data can be centred between the left and right margins and the top and bottom margins. You can change the order of the printed pages, as well as the starting page number.

## Change the page orientation

Step 1: Click Page Layout.
Step 2: Under Orientation, click Portrait or Landscape.

## Set the size of the paper

Step1: Click Page Layout.
Step 2: Select Size command, click the size of paper you want.

## Centre worksheet data on the printed page

Step 1: On Page Layout, click Margin.
Step 2: To centre worksheet data horizontally on the page between the left and right margins, select the Horizontally check box under Centre on page.

To centre worksheet data vertically on the page between the top and bottom margins, select the Vertically check box under Centre on page.

## Create Headers and Footers

Step 1: On Insert tab, select Header and Footer command.
Step 2: Select from a variety of existing Headers/Footers or create your own by pressing either the Custom Header or the Custom Footers button

### 6.2. Print the active sheets, a selected range, or an entire workbook

If the worksheet has a defined print area, Microsoft Excel will print only the print area. If you select a range of cells to print and then click Selection, Microsoft Excel prints the selection and ignores any print area defined for the worksheet.
Step 1: On the File menu, click Print.
Step 2: Under Print what, select the option you want.
Step 3: Check the printout using the print Preview command, by simply clicking the bottom left corner button on the dialog box

Step 4: Click the Print button which appears on the top of the screen.

If you want to print more than one sheet at the same time, select the sheets before you print.

## 7. Cell Manipulation

### 7.1. Selecting or highlighting cells

Using your mouse you can point to a corner of the area you want to select and drag it to the opposite corner. If you want to highlight a part of a column (row), point to the first cell and drag it to the last one.


If you want to highlight the entire column (row), click on its header (row header).


To select the entire workbook click on they grey button where the row and column headings meet.
To highlight non-adjacent ranges of cells, click and drag to highlight the first range, then press and hold the <Ctrl> key every time you highlight an additional range. You can use the same procedure to highlight non-adjacent columns and rows, or any combination of any of the above.

### 7.2. Copying and moving cells

To copy the contents of a cell or a range of cells to another cell or range of cells:
Highlight the cell(s)
Press the Copy 舄 button on the toolbar
Point to the cell or select the range of cells where you want to paste your selection Press the Paste button.

Point to the cell which contains the data you want to copy
Point to the dot at the bottom right-hand corner of the cell, where the cursor changes from a white to a black crosshair
Click and drag to the appropriate position and then release the mouse
button When you want to move your cells from one part of the workbook to another:
Highlight the cell(s)
Press the Cut button on the toolbar.
Point to the cell or select the range of cells where you want to paste your selection. Press the Paste button.

Highlight the cell(s)
Point to any of the edges of the highlighted cells; you will see your pointer change from a white cross to an arrow

Click and drag to the appropriate position and then release the button

### 7.3. Filling cells

You can fill a series of cells with consecutive numbers, dates etc. To do this:
Put a start value in a cell
Click Edit | Fill | Series
Fill in the step and stop values, and the type of series (linear, growth etc.)

## Alternatively:

Type in the first and second value of the series (linear growth will be assumed)
Highlight both values
Point to the bottom right-hand corner of the cell, where the cursor changes from a white to a black crosshair

Click and drag to the appropriate direction and then release the button
Excel has a neat shortcut to fill in standard series, such as days of the week (Monday,

Tuesday, etc.) and months of the year (January, February, etc.). In addition, you may also create series of the form Year 1, Year 2, .... or Quarter 1, Quarter 2, .... and so on. Simply:

Type the first item in the series, e.g. Monday (the abbreviation Mon is also acceptable)

Select the cell, point at the bottom right corner of it and drag down (right) to create the series in a column (row)
To expand (reduce) the series, highlight all of it, point at its bottom right corner and drag up (down) or to the left (right) to reduce (expand) it
Watch a screenshow of autofilling days of the week.

### 7.4. Inserting and deleting cells, rows and columns

You will often need to create more space on your spreadsheet. This can be done by inserting or deleting rows or columns. To do so:

Select a column (row) by simply clicking on its header
Right-click on the header of the column (row); a pop-up menu appears
Click Insert on the pop-up menu to insert a column (row) or Delete to delete it

## 8. Entering Formulas

Probably the most important feature of a spreadsheet is the ability to perform algebraic operations not only between pure numbers, but between cells that contain numbers. Although not apparently useful for a small number of trivial calculations, the facility of using formulas is extremely efficient when a large number of routine calculations is necessary, or when numerical inputs are bound to change. Let's start at the beginning, however.

### 8.1. Using Excel as a 'calculator

You can use Excel to perform simple or complex calculations. Just precede any numerical operations with the $=$ sign and the type numbers with any of the 5 common operators: + (addition), - (subtraction), * (multiplication), / (division), ^ (power).

As in simple mathematics, the order of precedence for the operators is ${ }^{\wedge} * /+-$. If you need to change this order, you need to enclose numbers in parentheses. For example:
$=8 * 2+3$ gives you a result of 19 , whereas
$=8^{*}(2+3)$ gives you a result of 40 .
Calculations can be as complicated as you may wish, provided that the total characters (numbers and operators) typed in any single cell are not more than 256.

### 8.2. Using cell references

The beauty of a spreadsheet is the facility it provides to:
recalculate numerical operations every time one of the numbers in your calculations change; and
repeat long series of essentially the same routine calculations.
To achieve this you need to instruct Excel to perform calculations making reference to cell contents, rather than using the pure numbers themselves. This way, every time you change the contents of the referenced cells Excel will simply recalculate the new result of your numerical calculations.

Reference can be made to cells in a spreadsheet by using the convention of column (letter) followed by row (number). For example the reference $\mathbf{A 7}$ refers to the origin cell at column $\mathbf{A}$ and row 7 . The reference $B 7$ refers to the origin cell at column $\mathbf{B}$ and row 7 . Formulae can then be constructed by using a series of cell references. For example, when we have to multiply the value in cell A7 by a number, say 7, we can use the following formula:
$=A 7 * 7$
If we wanted to add the contents of cell $\mathbf{A 7}$ to the contents of cell B7 and then multiply the result by 10, we should write the following formula:
$=(A 7+B 7)^{\star} 10$

### 8.3. Reference to a range of cells

Sometimes you need to perform mathematical calculations using a range of cells rather
than using one single cell. Such a range could be either a contiguous range of cells or a rectangle range of cells.

## A contiguous range of cells in a row or a column

The range A1:A6 refers to the cells A1,A2, A3, A4, A5 and A6. The sum of the latter cells can be calculated with the formula:
=SUM(A1:A6)

## A rectangular block of cells within the spreadsheet

The range $\mathrm{B} 2: \mathrm{C} 3$ refers to cells $\mathrm{B} 2, \mathrm{~B} 3, \mathrm{C} 2$ and C 3 . The average of the latter cells can be calculated using the following formula:

## =AVERAGE(B2:C3)

More sophisticated cell manipulations (e.g. adding different ranges of cells, multiplying a range of cells by another range of cells, dividing a range of cells by a single cell etc.) can also be easily constructed using the same principle.

### 8.4. Relative cell addresses

Once you have created a formula, you can easily copy it in order to perform exactly the same calculation for a different set of cells with the same characteristics.

Say, for example, that you have to calculate the Operating Profit in the spreadsheet pictured below, which is derived as follows:

## Operating profit = Revenue $\boldsymbol{-}$ Production cost $\boldsymbol{-}$ Advertising

## 9. Copying Formulas



On the spreadsheet you would need to put the following formula in cell B5:

## =B2-B3-B4

Say now that needs to repeat this operation for all months until June. Instead of retyping the formula over and over again, simply copy cell B5 and copy it across in cells C5...G5.


The picture above shows the result of this operation and also displays the formulas entered instead of the numerical results. Notice cells B3...G3 and B5...G5. Excel has not copied exactly the same cell addresses, but the relative cell addresses that perform the same operation. As a result, every month you get the correct operating profit by subtracting the month's production cost and advertising from the month's revenue. The formula effectively instructs Excel to take the content of the cell 3 rows above and from it subtract the contents of the cell 2 rows above and those of the cell 1 row above. Try copying this anywhere in the spreadsheet and you will get the same result.

### 9.1. Fixed cell addresses

Sometimes you may need to perform a calculation between a number of successive cells and a single other cell. Say, for example, that you need to calculate the annual interest rate on the outstanding amount of a loan, given that the interest rate remains the same throughout the loan repayment.
This is what happens when you use the copy+paste method used above:


The results in column C are wrong, except that in cell C 5 . This is because Excel has copied the relative cell addresses as you can see in the picture below.

instead of this, you need to multiply each of the cells B5...B9 with cell B2. You can either do this manually for every single cell. If you work smartly, however, you can avoid extra work by using a fixed reference for cell B2 when you first type your formula in cell C5 and then copy it down. This you can do by preceding the cell co-ordinates with the $\$$ symbol, i.e. $\$ \mathrm{~B} \$ 2$. See how this looks in the picture below.


And now see how you get the correct results!

|  | Home | Insert | Page Lay |  | Formulas |
| :---: | :---: | :---: | :---: | :---: | :---: |
| あ Cut <br> 且 Copy <br> Paste <br> F Format Painter |  |  |  | $\rightarrow$ | - A |
|  |  |  | B $I$ |  | -32. |
| Clipboard |  |  | Font |  |  |
| (1) 4 C - |  |  |  |  |  |
| Picture31 |  | - $f_{x}$ |  |  |  |
| 4 | A | B |  | C |  |
| 1 |  |  |  |  |  |
| 2 | Interest rate | 8\% |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  | Loan outstanding |  | Interest |  |
| 5 | 2000 | 100,000 |  | 8,000 |  |
| 6 | 2001 | 80,000 |  | 6,400 |  |
| 7 | 2002 | 60,000 |  | 4,800 |  |
| 8 | 2003 | 40,000 |  | 3,200 |  |
| 9 | 2004 | 20,000 |  | 1,600 |  |
| 10 |  |  |  |  |  |
| 11 |  |  |  |  |  |

Fixing a cell address can be done as described above or by using the F4 key after typing the address you want to fix. F4 can be used to toggle among 4 different versions of the
cell address. For cell B2 it could be:
\$B\$2 (both co-ordinates are fixed)
\$B2 (only the column is fixed)
$B \$ 2$ (only the row is fixed)
B2 (nothing is fixed, back to relative address)

## 10. Functions

Excel offers a series of functions for a wide range of needs. Functions are classed as:

## Logical

## Mathematical \& trigonometric

Statistical

## Financial

Time \& date
Database
Text
Lookup \& reference
Information
Because it is difficult to remember all but a few common functions, Excel provides a menu choice that lets you paste a function into a cell. To activate the option:

Select Insert | Function or press the Paste Function button $f_{x}$ on the toolbar
From the pop-up window select the function you wish to use; at the bottom of the pop-up window more information on the function's syntax is displayed

Click on OK to insert the function
Excel will not automatically recognise functions unless you put = at the beginning (you don't need to type $=$ when you use the Paste Function button)

The following dialogue box is now displayed.


Define the arguments (arguments specify individual cells or cell ranges that contain parameters needed for the calculation performed by the function) and click OK.
Several functions also can (or can only) be inserted as array formulas. Array formulas can be described as multiple value formulas and they differ from single-value formulas
because the can produce more than one result. For this reason they are usually (but not always) collectively inserted in a range of cells.

Three such functions are FREQUENCY, MMULT and MINVERSE, which are covered under statistical (FREQUENCY) and math \& trig (MMULT and MINVERSE) functions.

To insert a function in an array:
Highlight the range where it is going to be inserted
Type the function and its arguments
Insert the function in the highlighted range of cells by simultaneously pressing Ctrl+Shift+Enter. Array functions are automatically enclosed in braces $\}$, which you cannot insert manually. Any attempt to do so will result in Excel reading the function

### 10.1. Logical Function

Some of the Logical functions include:
AND(logical1, logical2,...): Returns the value TRUE if all arguments are true, and FALSE if any of the arguments is false
OR(logical1, logical2,...): Returns TRUE if any of the arguments is true, and FALSE if all of the arguments are false
IF(logical_test, value_if_true, value_if_false): Performs a logical test first. If the test returns TRUE it performs the first operation, otherwise it performs the second one. An example of where you could use IF statements is if you were asked to calculate tax charges on profits, taking into account that losses generate zero tax instead of negative tax (tax return)


Logical functions make use of a series of logical operators. These are:
> greater than
$>=$ greater than or equal to
< less than
<= less than or equal to
<> not equal to

## Example



### 10.2. Math \& Trig Functions

Some of the Mathematical functions include:
INT(number): Rounds a number down to the nearest integer
LN(number), LOG10(number): Returns the natural/decimal logarithm of a number
COMBIN(number, number_chosen): Returns the number of combinations for a given number of objects; it is based on the formula $n!/ k!(n-k)$ ! where $n$ is the total number of objects and $k$ is the number of objects that are chosen each time

MDETERM(array): Returns the matrix determinant of an array
MINVERSE(array): Returns the matrix inverse of an (nxn) array and has to be inserted as an array formula (i.e. by pressing simultaneously Ctrl+Shift+Enter) in a (nxn) range
MMULT(array1, array2): Returns the matrix product of two arrays (mxk and kxn) and has to be inserted as an array formula in a (mxn) range

PRODUCT(number 1, number 2, ...): Calculates the product of its arguments, which can be numbers or cell addresses
RAND(): Generates a random number between 0 and 1
ROUND(number, number_digits): Rounds a number to a specified number of decimal places

SQRT(number): Returns the positive square root of a number
SUM(number1, number2, ...): Adds the sum of its arguments, which can be numbers or cell addresses.



### 10.3. Statistical Functions

Some of the Statistical functions include:
AVERAGE(number 1, number 2, ...): Returns the average of its arguments; if a range is specified, blank cells are omitted form calculation, but cells with 0 values do get included

CORREL(array1, array2): Returns the correlation coefficient between two data sets

FREQUENCY(data_array, bins_array): Returns the frequency distribution of a data set as an array; it has to be inserted as an array formula and the bins_array must contain the lower ends of the intervals
GEOMEAN(number1, number2, ...): Returns the geometric mean of its arguments
KURT(number1, number2, ...): Returns the kurtosis of the data set
MEDIAN(number1, number2, ...): Returns the median of its arguments
MIN/MAX(number1, number2, ...): Returns the minimum/maximum value in a list of values

MODE(number1, number2, ...): Returns the most common value in a data set
SKEW(number1, number2, ...): Returns the skewness of a distribution
STDEV (number1, number2, ...): Estimates the standard deviation based on a sample

STDEVP(number1, number2, ...): Estimates the standard deviation based on the population

VAR(number1, number2, ...): Estimates the variance based on a sample
VARP(number1, number2, ...): Estimates the variance based on the population
PERMUT(number, number_chosen): Returns the number of permutations (where internal order is important) for a given number of objects; it is based on the formula $n!/(n-k)!$, where $n$ is the total number of objects and $k$ is the number of objects that are chosen each time


There are also numerous other functions that calculate probability mass functions and cumulative functions for a number of distributions, such as the binomial, normal, Chi-square, F and several others.
There are also several statistical functions that are available as add-ins, such as the z-test, t-test, chi-square test, and the F-test.

### 10.4. Financial Functions

Financial functions perform common business calculations, such as determining the payment for a loan, the future value of an investment, and the values of bonds or coupons.

Common arguments for the financial functions include:

DB(cost, salvage, life, period): Returns the depreciation of an asset for a specified period using the fixed-declining balance method

SLN (cost, salvage, life): Calculates the straight-line depreciation for an asset for one period, given the cost of the asset, its salvage value and its life

PMT(rate, nper, pv): Returns the periodic payment for an annuity, given the interest rate per period, the number of periods and the present value of the series of future payments

PPMT(rate, per, nper, pv): Returns the payment on the principal for an investment for a given period; in effect it returns the principal portion of the annuity calculated by the PMT function

IPMT(rate, per, nper, pv): Returns the interest payment for an investment for a given period (per) which must be in the interval [1, nper]; in effect, it returns the interest portion of the annuity calculated by the PMT function

IRR(values, guess): Calculates the internal rate of return for a series of cash flows; you need to specify the series of values and a guess for the discount rate which Excel will use as a starting point for the subsequent calculations

MIRR(values, finance_rate, reinvest_rate): Returns the internal rate of return where positive and negative cash flows are financed at different rates; finance_rate applies to negative cash flows and reinvest_rate applies to positive cashflows

NPV (rate, value1, value2, ...): Calculates the sum of a series of discounted cash flows; you need to determine the discount rate and the series of values that represent the cash flows. Do not include the capital outlay in year 0 in the function's arguments; subtract from the NPV of the cash inflows


## IRR

Suppose you want to start a restaurant business. You estimate it will cost $\$ 70,000$ to start the business and expect to net the following income in the first five years: $\$ 12,000$, $\$ 15,000, \$ 18,000, \$ 21,000$, and $\$ 26,000$.

Cells B3:B8 contain the following values: $\$-70,000, \$ 12,000, \$ 15,000$, $\$ 18,000, \$ 21,000$ and $\$ 26,000$, respectively.
To calculate the investment's internal rate of return:
after four years: $\operatorname{IRR}(B 3: B 7)$ equals -2.12 percent
after five years: $\operatorname{IRR}(B 3: B 8)$ equals 8.66 percent
after two years, you need to include a guess: $\operatorname{IRR}(B 3: B 5,-10 \%)$ equals 44.35 percent


NPV

## Example 1

Suppose you're considering an investment in which you pay $\$ 10,000$ one year from today and receive an annual income of $\$ 3,000, \$ 4,200$ and $\$ 6,800$ in the three years that follow.

Assuming an annual discount rate of 10 percent, the net present value of this investment is: $=\operatorname{NPV}(10 \%,-10000,3000,4200,6800)$ equals $\$ 1,188.44$


## Example 2

In the preceding example, you include the initial $\$ 10,000$ cost as one of the values, because the payment occurs at the end of the first period. Consider an investment that starts at the beginning of the first period. Suppose you're interested in buying a shoe store. The cost of the business is $\$ 40,000$, and you expect to receive the following income for the first five years of operation: $\$ 8,000, \$ 9,200, \$ 10,000$, $\$ 12,000$, and $\$ 14,500$. The annual discount rate is 8 percent. This might represent the rate of inflation or the rate of return of a competing investment.

If the cost and income figures from the shoe store are entered in B7 through B 12 respectively, then net present value of the shoe store investment is given by: =NPV(8\%, B8:B12)+B7 equals \$1,922.06


## Example 3

In the preceding example, you don't include the initial $\$ 40,000$ cost as one of the values, because the payment occurs at the beginning of the first period (or the end of the previous period, year 0). Suppose your shoe store's roof collapses during the sixth year and you assume a loss of $\$ 9000$ for that year. The net present value of the shoe store investment after six years is given by: $=\mathrm{NPV}(8 \%, \mathrm{~B} 19: B 23,-9000)+\mathrm{B} 18$ equals - \$3,749.47


## 11. Sensitivity Analysis

One of the most useful features of a spreadsheet is the ability to perform a sensitivity analysis in order to find out what happens to one or more end results of a long calculation when one or two of the original assumptions change. You can perform a one- or two-way sensitivity analysis, depending on whether you vary one or two assumptions at a time.

To run a sensitivity analysis, click and drag the mouse to highlight the range, including the reference cell and sensitivity values for one or two of the variables. This range is known as the 'table range'. The reference cell must be linked through a formula to an 'input cell' which is the one that will be varied to see the effects on the reference cell. To initiate the sensitivity analysis select Data Tab => What if Analysis => Data Table. Then the pop-up dialogue box will ask you to specify one or two input cells. When performing a one-way sensitivity, you need only specify one input cell, either column or row. For two-way sensitivity, specify both a row and a column input cell.

## Example 1

The example below shows a one-way sensitivity analysis for the calculation of an annuity, when the interest rate varies from 12-18\%. The calculation procedure and results are self-explanatory. At the bottom of the example, the same one way sensitivity is performed in a row, rather than in a column, to demonstrate the difference between a column and a row input cell.


## Example 2

The example below shows a two-way sensitivity analysis for the calculation of an annuity, when both the interest rate and the present value (the loan) vary. A range of values for interest rate is given in the first column of the sensitivity table; a range of values for the loan value is given in the first row of the table. The top left cell of the table contains the formula calculating the parameter that is affected by the changes in the two variables. The calculation procedure and results are self-explanatory.


## 12. Add-ins

In addition to the functions available under its default menus, Excel also comes with a number of additional features which expand its capabilities in fields such as finance and statistics.

In order to load these:

1. Click the Microsoft Office Button
 , and then click Excel Options.
2. Click Add-Ins, and then in the Manage box, select Excel Add-ins.
3. Click Go.
4. In the Add-Ins available box, select the Analysis ToolPak check box, and then click OK.
5. If you get prompted that the Analysis ToolPak is not currently installed on your computer, click Yes to install it.

After you load the Analysis ToolPak, the Data Analysis command is available in the Analysis group on the Data tab. Once you have loaded an add-in for the first time, it will automatically be loaded every time you start Excel, so there is no need to repeat the previous procedure.

Note, however, that the more add-ins you load up the more time Excel takes to initialise and the less memory you have available for other operations.


In these notes, we will deal with types of add-ins: the Analysis ToolPak, which includes Descriptive Statistics and Regression Analysis

### 12.1. Descriptive Statistics

You can generate a series of standardised descriptive statistics for any data series you want to statistically analyse.
From the menu select Data => Data Analysis and you will see the dialogue box displayed on the right.


Select Descriptive Statistics, click OK and you will see the dialogue box displayed next.


In this box you will need to fill the details of the time series you need to produce the descriptive stats for.
Type in the cell range containing your data and make sure to check Labels in First Row if you range also contains the names of the series.
Then choose whether you want the results to be displayed in the same sheet (where you will need to specify the top left corner of an empty cell range), in a new sheet or in a new Excel file (new workbook) altogether.

Make also sure to tick the box titled Summary statistics, in order for Excel to produce them! An example of what kind of statistics are produced is given below.


You will note that all of the produced stats are also available as functions, but this add-in is a very neat shortcut. Note, however, that the numbers contained in the results are pure numbers, NOT formulas, and will not recalculate if any observations change subsequently in the series.

### 12.2. Basic Econometric Analysis: Regression

Regression is one of the commonest econometric tools used to explore the relationship between two or more variables.


The variable you are trying to explain is called the 'explained' or 'dependent' variable and is normally denoted with ' $Y$ '.

The variable(s) you use to interpret the Y is (are) called the explanatory variable(s) and is (are) normally denoted with $\mathrm{X}(\mathrm{X} 1, \mathrm{X} 2$, etc.)


Although there are several statistical and econometric packages that provide a full array of regression tools, Excel also has a convenient (but rudimentary) add-in to let you calculate regression results.

Select Tools | Data Analysis and then select Regression, click OK and you will see the dialogue box appearing above.

Fill in the cell range containing the dependent $(\mathrm{Y})$ and independent $(\mathrm{X})$ variables, making sure to let Excel know if you are including the names of the data series (labels).

As in descriptive statistics, you may paste the results in the same sheet, a different sheet or a different file. You may also choose whether Excel displays residuals from the regression, whether these residuals are standardised, etc.

An example of what regression calculations Excel can perform for you, look at the example below.


## Key steps in basic econometric analysis

$>$ Create statement of theory/hypothesis
> Collect data
$>$ Specify mathematical model of hypothesis
> Specify econometric model of theory
$>$ Estimate the parameters of the model
> Check model adequacy: test specification
$>$ Test hypothesis derived from model
> Use model for prediction or forecasting

## 13. Graphs

Excel provides a variety of graphs for data analysis and presentation. Both two- and three-dimensional charts are provided, including column, bar, line, pie and area charts. Before creating a chart, you need to have data on the worksheet, which will be the chart's input.

To create a chart:
Step 1: Click and drag with the mouse to highlight the required range of cells (use Ctrl to highlight non-adjacent cells)
Step 2: Click on the Chart Wizard button. A dialogue box titled Chart Wizard - Step 1 of 4 will appear.
Step 3: Choose the type of the chart that fits your case. You can choose from a great variety of chart types and you also have the option to preview your chart by simply clicking on the 'Press and Hold to view Sample' button.
Step 4: The next dialogue box (Step 2 of 4) asks you to specify the range of the data you want to have plotted. If you have already selected the range of data you are using, as you have already done, just click Next.

Step 5: In Step 3 of 4 you can turn on and off some standard options for the chart you selected.

Step 6: In Step 4 of 4 you specify where you want your chart to be placed. It is advisable to place your chart in a new worksheet.


A chart type that is widely used to present statistical data is the Pie-Chart. To have your data plotted as in the following figure, follow the above mentioned procedure and choose Pie when you are asked to define the chart's type.


## 14. Macros

### 14.1. Introduction

## What is a VBA Macro?

A Macro is a set of instructions that tells Microsoft Excel to perform an action for you. Macros are like computer programs, but they run completely within Excel. They allow the user of a program to record a series of actions and play them back at a later time. In addition Microsoft Excel 97 VBA allows the user to develop his/her own programming code using more complex programming logic to create fully functional applications.

For example you can create a macro that enters a series of dates across one row of a worksheet, centres the date in each cell, and then applies a border format to the row.

## When do you need a Macro?

There are two main occasions where the use of Macros offers invaluable help:
When a specific task has to be performed over and over again.
When functions particular to a user have to be used.

## How can a Macro be constructed?

There are two ways to create a macro:
Use the built-in macro recorder
Type the VBA code of the macro directly into the VBA Editor
When the macro recorder is used the VBA code is created into the VBA Editor.

## Getting started

Throughout the practise of Visual Basic several operations available on the Excel's menu are going to be performed. Shortcut buttons for these operations are available on the Visual Basic toolbar. If the Visual Basic toolbar is not displayed on the Excel window you can view it by

Step 1: Click-right any toolbar
Step 2: Select Visual Basic

## Visual Basic toolbox



Run Macro


Runs an existing Macro

Record Macro
Records a series of actions as VBA code
Resume Macro
II
Pauses/Resumes recording or running of a Macro

## VB Editor



Runs the Visual Basic editor
Control Toolbox
8
Initiates the Control Toolbox facility which allows the addition command buttons, options buttons, list boxes etc. on a workbook.
Design Mode
$\leftrightarrow$

Switches on/off the Design mode

### 14.2. Your First Macro

## CurrencyFormat

## Recording the Macro

Step 1:From the file budget.xls open the Budget97 worksheet and select cells D3:F4.
Step 2: On the VB toolbar click Record Macro and name your macro CurrencyFormat.


Give your Macro a name by typing it in the Macro Name field. Define a Short Cut key that will run the Macro in the Short Cut Key field; use Ctrl + Shift rather than Ctrl to avoid conflict
with built in functions. Finally store your macro in This Workbook if you want it to be available only on this workbook, in the Personal Macro Workbook if you want your Macro to be available on any existing or new workbook and in a New if you want it to be available only on a new workbook.

Step 3: On the Format menu click the cells command and then the Number Tab.
Step 4: Select Currency from the Category list and type 0 to change the number of Decimal places to 0

Step 4: Click the Stop Recording button
Step 5: Save the workbook as Lesson 1.

## Running the Macro

Step 1: Open the Budget97 worksheet and select cells D7:F8
Step 2: On the VB toolbar click Run Macro
Step 3: Select the CurrencyFormat and click Run.

## Some comments on the code

i. What are the lines with apostrophes? The lines beginning an apostrophe are comments which simply are not taken into account when the Macro runs. Use comments to distinguish between statements
ii. The macro begins with Sub followed by the name of the macro and ends with End Sub.
iii. Selection stands for the current selection. Number format refers to an attribute of the selection. Simply Put : "Let's '\$\#,\#\#0' be the number format of selection" Reads from RIGHT TO LEFT.
iv. What can you get rid of? Everything apart from the Selection.NumberFormat... command.

## Practice

For practice you can:
Record a Macro to Merge cells vertically. Can you eliminate the unnecessary lines from the macro?

Record a macro to remove gridlines.
Convert a formula to a value.

