FINANCIAL ANALYSIS USING EXCEL

					Frequency, and related						Yields and interest/ discount rates		
													Interest
		✓			✓	✓					✓	✓	
		✓			✓	✓					✓	✓	
		✓			✓	✓					✓	✓	
		✓			✓	✓					✓	✓	
COUPNUM		✓	✓								✓	✓	
DURATION		✓	✓		✓						✓		
MDURATION		✓	✓		✓					✓			
PRICE		✓	✓			✓		✓			✓		✓
PRICEDISC		✓	✓			✓		✓			✓	✓	
PRICEMAT	✓		✓	✓		✓					✓	✓	✓
RECEIVED		✓	✓			✓	✓				✓	✓	
YIELD		✓	✓	✓		✓	✓		✓		✓	✓	✓
YIELDDISC		✓	✓	✓		✓	✓				✓		
YIELDMAT	✓		✓	✓	✓						✓		✓
ACCRINT	✓	✓	✓			✓			✓		✓		✓
ACCRINTM	✓		✓		✓						✓		✓
INTRATE		✓	✓			✓	✓	✓			✓		
DISC		✓	✓	✓		✓	✓				✓		

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From initial (100,000) to salvage value (20,000)

- Straight line (SLN)
- Sum-of-years (SYD)
- Fixed Declining Balance (DB) factor=1
- Double Declining Balance (DDB) factor=2
- Variable Declining Balance (DDB with factor=1.5)
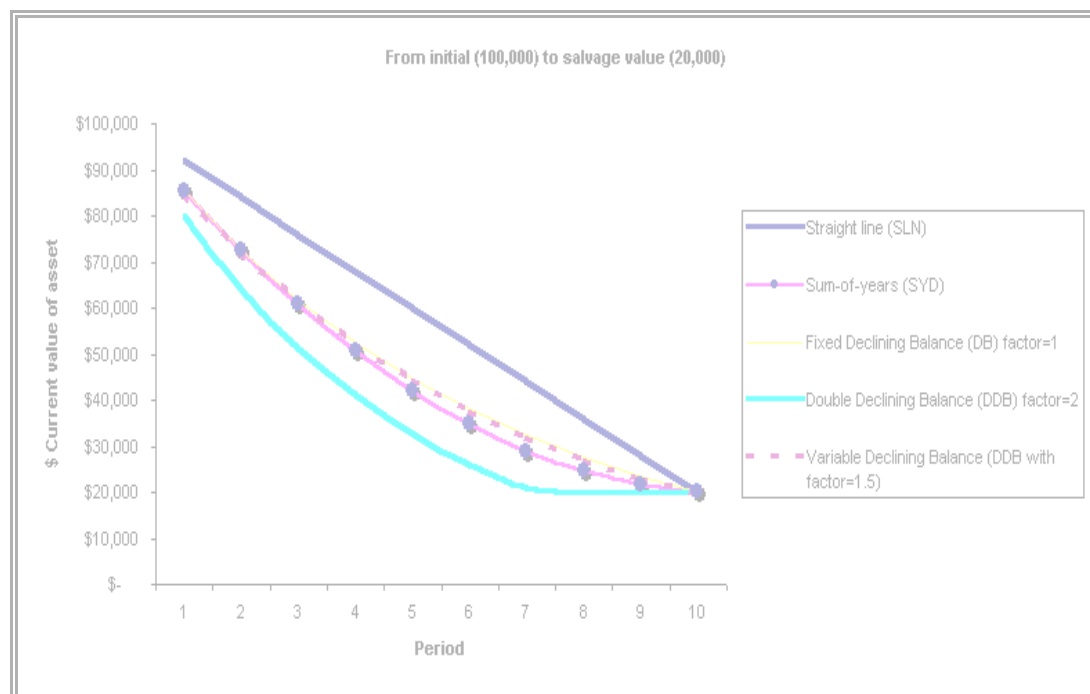
Financial Analysis using Excel

Volume 6 in the series **Excel for Professionals**

Volume 1: Excel For Beginners

Volume 2: Charting in Excel

Volume 3: Excel-- Beyond The Basics

Volume 4: Managing & Tabulating Data in Excel

Volume 5: Statistical Analysis with Excel

Volume 6: Financial Analysis using Excel

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Publisher: VJ Books Inc, Canada

Author: Vijay Gupta

To Dr "Chini" at the Business School Georgetown Universitry and SEC.

Thanks for the timely support and advice.

ABOUT THE AUTHOR

Vijay Gupta has taught statistic, econometrics, and finance to institutions in the US and abroad, specializing in teaching technical material to professionals.

He has organized and held training workshops in the Middle East, Africa, India, and the US. The clients include government agencies, financial regulatory bodies, non-profit and private sector companies.

A Georgetown University graduate with a Masters degree in economics, he has a vision of making the tools of econometrics and statistics easily accessible to professionals and graduate students. His books on SPSS and Regression Analysis have received rave reviews for making statistics and SPSS so easy and "non-mathematical." The books are in use by over 150,000 users in more than 140 nations.

He is a member of the American Statistics Association and the Society for Risk Analysis.

In addition, he has assisted the World Bank and other organizations with econometric analysis, survey design, design of international investments, cost-benefit, and sensitivity analysis, development of risk management strategies, database development, information system design and implementation, and training and troubleshooting in several areas.

Vijay has worked on capital markets, labor policy design, oil research, trade, currency markets, and other topics.

VISION

Vijay has a vision for software tools for Office Productivity and Statistics. The current book is one of the first tools in stage one of his vision. We now list the stages in his vision.

Stage one: Books to *Teach* Existing Software

He is currently working on books on word-processing, and report production using Microsoft Word, and a booklet on Professional Presentations.

The writing of the books is the first stage envisaged by Vijay for improving efficiency and productivity across the world. This directly leads to the second stage of his vision for productivity improvement in offices worldwide.

Stage two: *Improving* on Existing Software

The next stage is the construction of software that will radically improve the usability of current Office software.

Vijay's first software is undergoing testing prior to its release in Jan 2003. The software — titled "Word Usability Enhancer" — will revolutionize the way users interact with Microsoft Word, providing users with a more intuitive interface, readily accessible tutorials, and numerous timesaving and annoyance-removing macros and utilities.

He plans to create a similar tool for Microsoft Excel, and, depending on resource constraints and demand, for PowerPoint, Star Office, etc.

Stage 3: *Construction* of the first "feedback-designed" Office and Statistics software

Vijay's **eventual goal** is the construction of productivity software that will provide stiff competition to Microsoft Office. His hope is that the success of the software tools and the books will convince financiers to provide enough capital so that a successful software development and marketing endeavor can take a chunk of the **multi-billion dollar** Office Suite market.

Prior to the construction of the Office software, Vijay plans to construct the "Definitive" statistics software. Years of working on and teaching the current statistical software has made Vijay a master at picking out the weaknesses, limitations, annoyances, and, sometimes, pure inaccessibility of existing software. This **1.5 billion dollar** market needs a new visionary tool, one that is appealing and inviting to users, and not forbidding, as are several of the current software. Mr. Gupta wants to create integrated software that will encompass the features of SPSS, STATA, LIMDEP, EViews, STATISTICA, MINITAB, etc.

Other

He has plans for writing books on the "learning process." The books will teach how to understand one's approach to problem solving and learning and provide methods for learning new techniques for self-learning.

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Mapping of menu options with sections of the book
and in the series of books

You may be looking for a section that pertains to a particular menu option in Excel. I now briefly lay out where to find (in the series) a discussion of a specific menu option of Excel.

Table 1: Mapping of the options in the "FILE" menu

Menu Option	*Section that discusses the option*
OPEN SAVE SAVE AS	*Volume 1: Excel For Beginners*
SAVE AS WEB PAGE	*Volume 3: Excel– Beyond The Basics*
SAVE WORKSPACE	*Volume 3: Excel– Beyond The Basics*
SEARCH	*Volume 1: Excel For Beginners*
PAGE SETUP	*Volume 1: Excel For Beginners*
PRINT AREA	*Volume 1: Excel For Beginners*
PRINT PREVIEW	*Volume 1: Excel For Beginners*
PRINT	*Volume 1: Excel For Beginners*
PROPERTIES	*Volume 1: Excel For Beginners*

Table 2: Mapping of the options in the "EDIT" menu

Menu Option	*Section that discusses the option*
UNDO	*Volume 1: Excel For Beginners*
REDO	*Volume 1: Excel For Beginners*
CUT COPY	*Volume 1: Excel For Beginners*

Menu Option	Section that discusses the option
PASTE	
OFFICE CLIPBOARD	*Volume 1: Excel For Beginners*
PASTE SPECIAL	*Volume 3: Excel– Beyond The Basics*
FILL	*Volume 4: Managing & Tabulating Data in Excel*
CLEAR	*Volume 1: Excel For Beginners*
DELETE SHEET	*Volume 1: Excel For Beginners*
MOVE OR COPY SHEET	*Volume 1: Excel For Beginners*
FIND	*Volume 1: Excel For Beginners*
REPLACE	*Volume 1: Excel For Beginners*
GO TO	*Volume 3: Excel– Beyond The Basics*
LINKS	*Volume 3: Excel– Beyond The Basics*
OBJECT	*Volume 3: Excel– Beyond The Basics* *Volume 2: Charting in Excel*

Table 3: Mapping of the options in the "VIEW" menu

Menu Option	Section that discusses the option
NORMAL	*Volume 1: Excel For Beginners*
PAGE BREAK PREVIEW	*Volume 1: Excel For Beginners*
TASK PANE	*Volume 1: Excel For Beginners*
TOOLBARS	*Volume 1: Excel For Beginners* *Volume 3: Excel– Beyond The Basics*
FORMULA BAR	Leave it on (checked)
STATUS BAR	Leave it on (checked)
HEADER AND FOOTER	*Volume 1: Excel For Beginners*
COMMENTS	*Volume 3: Excel– Beyond The Basics*
FULL SCREEN	*Volume 1: Excel For Beginners*

Menu Option	Section that discusses the option
ZOOM	*Volume 1: Excel For Beginners*

Table 4: Mapping of the options in the "INSERT" menu

Menu Option	Section that discusses the option
CELLS	*Volume 1: Excel For Beginners*
ROWS	*Volume 1: Excel For Beginners*
COLUMNS	*Volume 1: Excel For Beginners*
WORKSHEETS	*Volume 1: Excel For Beginners*
CHARTS	*Volume 2: Charting in Excel*
PAGE BREAK	*Volume 1: Excel For Beginners*
FUNCTION	chapter 1-chapter 4
FUNCTION/FINANCIAL	chapter 6-chapter 8
FUNCTION/STATISTICAL	chapter 9-chapter 10
FUNCTION/LOGICAL	*Volume 3: Excel– Beyond The Basics*
FUNCTION/TEXT	*Volume 3: Excel– Beyond The Basics*
FUNCTION/INFORMATION	*Volume 3: Excel– Beyond The Basics*
FUNCTION/LOOKUP	*Volume 3: Excel– Beyond The Basics*
FUNCTION/MATH & TRIG	*Volume 3: Excel– Beyond The Basics*
FUNCTION/ENGINEERING	*Volume 3: Excel– Beyond The Basics*
FUNCTION/DATABASE	*Volume 3: Excel– Beyond The Basics*
FUNCTION/DATE & TIME	*Volume 3: Excel– Beyond The Basics*
NAME	2.8
COMMENT	*Volume 3: Excel– Beyond The Basics*
PICTURE	*Volume 2: Charting in Excel*
DIAGRAM	*Volume 2: Charting in Excel*

Menu Option	Section that discusses the option
OBJECT	*Volume 3: Excel– Beyond The Basics*
HYPERLINK	*Volume 3: Excel– Beyond The Basics*

Table 5: Mapping of the options inside the "FORMAT" menu

Menu Option	Section that discusses the option
CELLS	*Volume 1: Excel For Beginners*
ROW	*Volume 1: Excel For Beginners*
COLUMN	*Volume 1: Excel For Beginners*
SHEET	*Volume 1: Excel For Beginners*
AUTOFORMAT	*Volume 1: Excel For Beginners*
CONDITIONAL FORMATTING	*Volume 3: Excel– Beyond The Basics*
STYLE	*Volume 1: Excel For Beginners*

Table 6: Mapping of the options inside the "TOOLS" menu

Menu Option	Section that discusses the option
SPELLING	*Volume 1: Excel For Beginners*
ERROR CHECKING	*Volume 3: Excel– Beyond The Basics*
SPEECH	*Volume 4: Managing & Tabulating Data in Excel*
SHARE WORKBOOK	*Volume 3: Excel– Beyond The Basics*
TRACK CHANGES	*Volume 3: Excel– Beyond The Basics*
PROTECTION	*Volume 3: Excel– Beyond The Basics*
ONLINE COLLABORATION	*Volume 3: Excel– Beyond The Basics*
GOAL SEEK	15.2
SCENARIOS	15.1
AUDITING	*Volume 3: Excel– Beyond The Basics*

Menu Option	Section that discusses the option
TOOLS ON THE WEB	The option will take you to a Microsoft site that provides access to resources for Excel
MACROS	In upcoming book on "Macros for Microsoft Office"
ADD-INS	chapter 13
AUTOCORRECT	*Volume 1: Excel For Beginners* *Volume 4: Managing & Tabulating Data in Excel*
CUSTOMIZE	*Volume 3: Excel– Beyond The Basics*
OPTIONS	*Volume 1: Excel For Beginners*

Table 7: Mapping of the options inside the "DATA" menu

Menu Option	Section that discusses the option
SORT	*Volume 4: Managing & Tabulating Data in Excel*
FILTER	*Volume 4: Managing & Tabulating Data in Excel*
FORM	*Volume 4: Managing & Tabulating Data in Excel*
SUBTOTALS	*Volume 4: Managing & Tabulating Data in Excel*
VALIDATION	*Volume 4: Managing & Tabulating Data in Excel*
TABLE	2.12
CONSOLIDATION	section 48.5
GROUP AND OUTLINE	*Volume 1: Excel For Beginners*
PIVOT REPORT	*Volume 4: Managing & Tabulating Data in Excel*
EXTERNAL DATA	*Volume 4: Managing & Tabulating Data in Excel*

Table 8: Mapping of the options inside the "WINDOW" menu

Menu Option	Section that discusses the option
HIDE	*Volume 3: Excel– Beyond The Basics*
SPLIT	*Volume 1: Excel For Beginners*
FREEZE PANES	*Volume 1: Excel For Beginners*

Table 9: Mapping of the options inside the "HELP" menu

Menu Option	Section that discusses the option
OFFICE ASSISTANT	*Volume 1: Excel For Beginners*
HELP	*Volume 1: Excel For Beginners*
WHAT'S THIS	*Volume 1: Excel For Beginners*

INTRODUCTION

Are there not enough Excel books in the market? I have asked myself this question and concluded that there are books "inside me," based on what I have realized from observation by friends, students, and colleagues that I have a "vision and knack for explaining technical material in plain English."

Read the book practicing the lessons on the sample files provided in the zipped file you downloaded. I hope the book is useful and assists you in increasing your productivity in Excel usage. You may be pleasantly surprised at some of the features shown here. They will enable you to save time.

The "Make me a Guru" series teach technical material in simple English. A lot of thinking went into the sequencing of chapters and sections. The book is broken down into logical "functional" components. Chapters are organized into sections and sub-sections. This creates a smooth flowing structure, enabling "total immersion" learning. The current book is broken down into a multi-level hierarchy:

—Chapters, each teaching a specific skill/tool.

— Several sections within each chapter. Each section shows aspect of the skill/tool taught in the chapter. Each section is numbered—for example, "Section 1.2" is the numbering for the second section in chapter 1.

— A few sub-sections (and maybe one further segmentation) within each section. Each sub-section lists a specific function, task, or proviso related to the "master" section. The sub-sections are numbered——for example, "1.2.a" for the first sub-section in the second section of chapter 1.

Unlike other publishers, I do not consider you dummies or idiots. Each and everyone had the God given potential to achieve mastery in any field. All one needs is a guide to show you the way to master a field. I hope to play this role. I am confident that you will consider your self an Excel "Guru" (in terms of the typical use of Excel in your profession) and so will others.

Once you learn the way to master a windows application, this new approach will enable you to pick up new skills" on the fly." Do not argue for your limitations. You have none.

I hope you have a great experience in learning with this book. I would love feedback. Please use the feedback form on our website vjbooks.net. In addition, look for updates and sign up for an infrequent newsletter at the site.

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We provide productivity-enhancement and capacity building for corporate, government, and other clients. The onsite training includes courses on:

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Contact our corporate training group at http://www.vjbooks.net.

BASICS

The fundamental operations in Excel are taught in *Volume 1: Excel For Beginners*, *Volume 2: Charting in Excel*, and *Volume 3: Excel– Beyond The Basics*

FUNCTIONS

I teach the writing of formulas and associated topics in *Volume 3: Excel– Beyond The Basics*. I show, in a step-by-step exposition, the proper way for writing cell references in a formula. The book describe tricks for copying/cutting and pasting in several examples. In addition, I discuss special pasting options.

Finally, different types of functions are classified under logical categories and discussed within the optimal category. The categories include financial, Statistical, Text, Information, Logical, and "Smart" Logical.

FINANCE

In three chapters on financial functions, I list the functions used for estimating loan repayments (for example, like a car loan or house mortgage), discount cash flow analysis (used often for estimating the returns and present values of multi-period investment projects), and parameters associated with securities market instruments like bonds and

T-bills.

If your interest is Investment Banking or Feasibility Studies (Project Finance), you should learn Scenarios, the Solver utility, and Goal Seek. With Scenarios, you can perform basic risk analysis.

STATISTICS PROCEDURES

Three chapters teach statistics functions including the use of Excel functions for building Confidence Intervals and conducting Hypothesis Testing for several types of distributions. The design of hypothesis tests and the intermediate step of demarcating critical regions are taught lucidly.

MANAGING & TABULATING DATA

Excel has extremely powerful data entry, data management, and tabulation tools. The combination of tools provide almost database like power to Excel. Unfortunately, the poor quality of the menu layout and the help preclude the possibility of the user self-learning these features. These features are taught in *Volume 4: Managing & Tabulating Data in Excel*

CHARTING

Please refer to book two in this series. The book title is *Charting in Excel.*

Sample data

All the sample data files are included in the zipped file.

CHAPTER 1

WRITING FORMULAS

This chapter discusses the following topics:

— THE BASICS OF WRITING FORMULAE

— TOOL FOR USING THIS CHAPTER EFFECTIVELY: VIEWING THE FORMULA INSTEAD OF THE END RESULT

— The A1 VS THE R1C1 STYLE OF CELL REFERENCES

— TYPES OF REFERENCES ALLOWED IN A FORMULA

— REFERENCING CELLS FROM ANOTHER WORKSHEET

— REFERENCING A BLOCK OF CELLS

— REFERENCING NON–ADJACENT CELLS

— REFERENCING ENTIRE ROWS

— REFERENCING ENTIRE COLUMNS

— REFERENCING CORRESPONDING BLOCKS OF CELLS/ROWS/COLUMNS FROM A SET OF WORKSHEETS

The most important functionality offered by a spreadsheet application is the ease and flexibility of writing formulae. In this chapter, I start by showing how to write simple formula and then build up the level of complexity of the formulae.

Within the sections of this chapter, you will find tips and notes on commonly encountered problems or issues in formula writing.

1.1 **THE BASICS OF WRITING FORMULAE**

This section teaches the basics of writing functions.

1.2 **TOOL FOR USING THIS CHAPTER EFFECTIVELY: VIEWING THE FORMULA INSTEAD OF THE END RESULT**

For ease of understanding this chapter, I suggest you use a viewing option that shows, in each cell on a worksheet, the formula instead of the result. Follow the menu path TOOLS/OPTIONS/VIEW. In the area "Window Options" select the option "Formulas" as shown in Figure 1.

Execute the dialog by clicking on the button OK. Go back to the worksheet. The formula will be shown instead of the calculated value.

Eventually you will want to return to the default of seeing the results instead of the formula. Deselect "formula" in the area "Windows Options" in TOOLS/OPTIONS/VIEW.

Figure 1: Viewing the formulas instead of the formula result
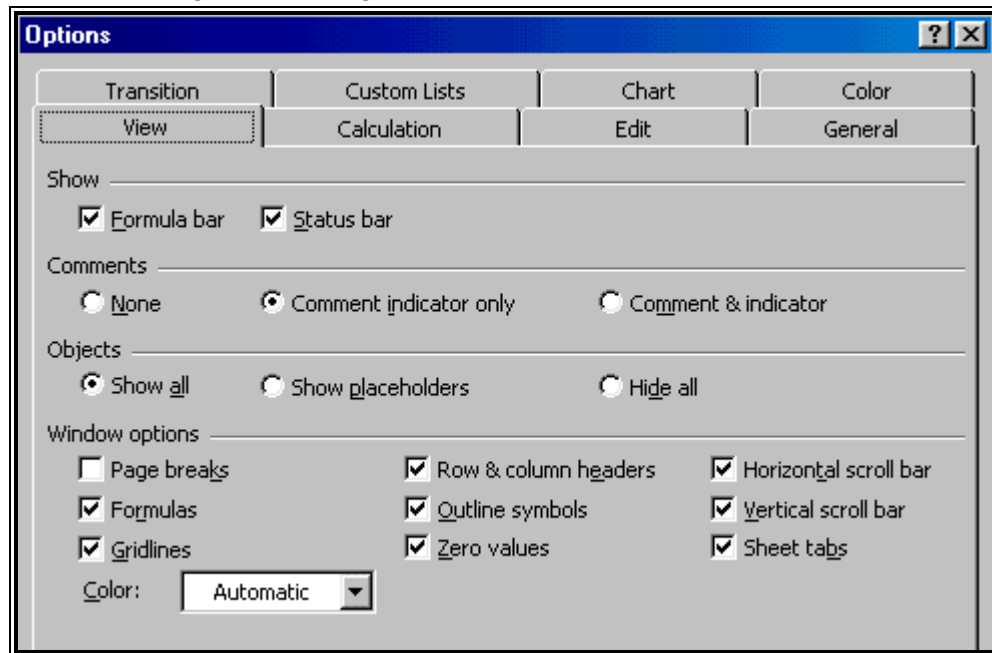
The effect is only cosmetic; the results will not change. As you shall see later, what you have just done will facilitate the understanding of functions.

In addition, leave the option VIEW/ FORMULA BAR selected as shown in Figure 2.

Figure 2: Select "Formula Bar"
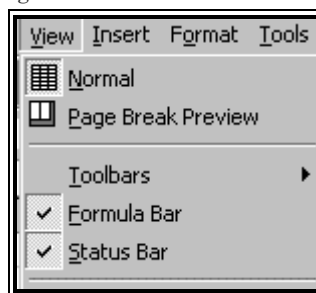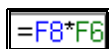
THE "A1" VS. THE "R1C1" STYLE OF CELL REFERENCES

The next figure shows a simple formula. The formula is written into cell G15. The formula multiplies the values inside cells F8 and F6.
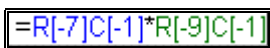
Figure 3: A1-style cell referencing

=F8*F6

This style of referencing is called the "A1" style or "absolute" referencing. The exact location of the referenced cells is written. (The cells are those in the 6th and 8th rows of column F.) One typically works with this style.

However, there is another style for referencing the cells in a formula. This style is called the "R1C1" style or "relative" referencing. The same formula as in the previous figure but in R1C1 style is shown in the next figure.

Figure 4: The same formula as in the previous figure, but in R1C1 (Offset) style cell referencing while the previous figure showed A1 (Absolute-) style cell referencing

=R[-7]C[-1]*R[-9]C[-1]

Does not this formula look different? This style uses relative referencing. So, the first cell (F8) is referenced relative to its position in reference to the cell that contains the formula (cell G15). Row 8 is 7 rows below row 15 and column F is 1 column before column G. Therefore, the cell reference is "minus seven rows, minus 1 column" or "R[— 7]C[— 1]."

If you see a file or worksheet with such relative referencing, you can switch all the formulas back to absolute "A1" style referencing by going to TOOLS/OPTIONS/GENERAL and deselecting the option "R1C1 reference style."

Figure 5: Settings for Formula Referencing
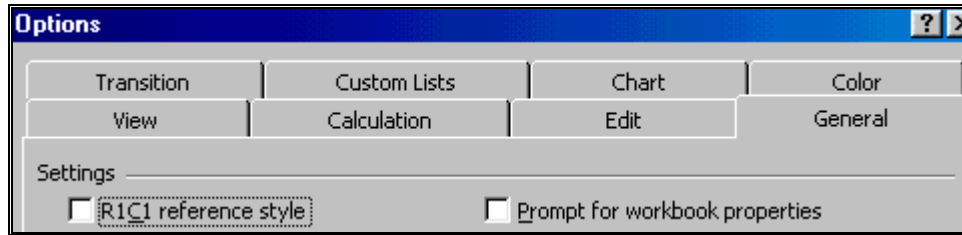
1.2.B   WRITING A SIMPLE FORMULA THAT REFERENCES CELLS

Open the sample file "File3.xls" and choose the worksheet "main."
Assume you want to write add the values in cells C223[1] and D223 (that is,
to calculate "C223 + D223") and place the result into cell F223.

Click on cell F223. Key-in "="and then write the formula by clicking on
the cell C223, typing in "+" then clicking on cell "D223."

Figure 6: Writing a formula
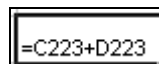
After writing in the formula, press the key ENTER. The cell F223 will
contain the result for the formula contained in it.

Figure 7: The result is shown in the cell on which you wrote the formula

---
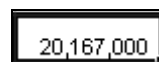
[1] Cell C223 is the cell in column C and row 223.

TYPES OF REFERENCES ALLOWED IN A FORMULA

1.3.A   REFERENCING CELLS FROM ANOTHER WORKSHEET

You can reference cells from another worksheet. Choose cell H235 on the worksheet "main." In the chosen cell, type the text shown in the next figure. (Do not press the ENTER key; the formula is incomplete and you will get an error message if you press ENTER.)

Figure 8: Writing or choosing the reference to the first referenced range
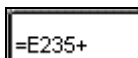
Then select the worksheet "second" and click on cell D235. Now press the ENTER key. The formula in cell H235 of worksheet "main" references the cell D235 from the worksheet "second". The next figure illustrates this.

Figure 9: Writing or choosing the reference to the second referenced range which is not on the worksheet on which you are writing the formula
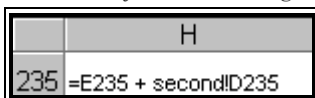
In this formula, the part "second!" informs Excel that the range referenced is from the sheet "second.

1.3.B   REFERENCING A BLOCK OF CELLS

Select the worksheet "main." Choose cell H236. In the chosen cell, type the text shown in the next figure.

Figure 10: This formula requires a block of cells as a reference

H
236	=SUM(

Use the mouse to highlight the block of cells "E223 to E235." Type in a closing parenthesis and press the ENTER key. The resulting function is shown in the next figure.

Figure 11: Formula with a block of cells as the reference

H
236	=SUM(E223:E235)
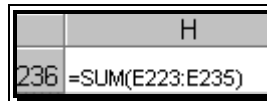
1.3.C REFERENCING NON−ADJACENT CELLS

Choose cell H237. Click in the cell and type the text shown in the next figure.

Figure 12: The core function is typed first

H
237	=SUM(
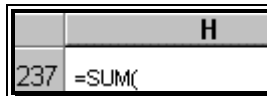
As in the previous example, choose cells E223 to E235 by highlighting them— the formula should like the one shown in the next figure.

Figure 13: The first block of cells is referenced

H
237	=SUM(E223:E235
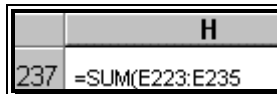
Type a comma. The resulting formula should look like that shown in the next figure.

Figure 14: Getting the formula ready for the second block of cells

H
237 =SUM(E223:E235,
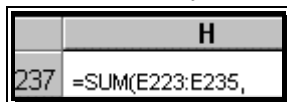
Highlight the block of cells "E210 to E222." Key-in a closing parenthesis and press the ENTER key.

Figure 15: The formula with references to two non-adjacent blocks of cells

H
237 =SUM(E223:E235,E210:E222)
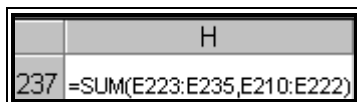
1.3.D   REFERENCING ENTIRE ROWS

Choose cell H238. In this cell, type the text shown in the next figure.

Using the mouse, highlight the rows 197 to 209. Type in a closing parenthesis and press the ENTER key. The resulting formula is shown in the next figure.

Figure 16: Referencing entire rows

H
238 =SUM(197:209)
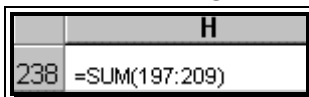
1.3.E   REFERENCING ENTIRE COLUMNS

Choose cell H239. In this cell, type the text shown in the next figure

Using the mouse, highlight the columns C and D. Key-in a closing parenthesis and press the ENTER key.

Figure 17: Referencing entire columns

1.3.F   REFERENCING CORRESPONDING BLOCKS OF CELLS/ROWS/COLUMNS FROM A SET OF WORKSHEETS

Assume you have a workbook with six worksheets on similar data from six clients. You want to sum cells "C4 to F56" across all six worksheets.

One way to do this would be to create a formula in each worksheet to sum for that worksheet's data and then a formula to add the results of the other six formulae.

Another way is using "3–D references." The row and column make the first two dimensions; the worksheet set is the third dimension. You can use only one formula that references all six worksheets that the relevant cells within them.

While typing the formula,

- Type the "="sign,
- Write the formula (for example, "Sum"),
- Place an opening parenthesis "(," then
- Select the six worksheets by clicking at the name tab of the first one and then pressing down SHIFT and clicking on the name tab of the sixth worksheet, and then
- Highlight the relevant cell range on any one of them,
- Type in the closing parenthesis ")"
- And press the ENTER key to get the formula

=SUM(Sheet1:Sheet6!"C4:F56")

1.4   **WORKING SIMULTANEOUSLY ON CELLS IN DIFFERENT WORKSHEETS**

Assume your workbook has 18 worksheets, each for a different country. Assume further that all the worksheets have a similar composition— the same variables in the same columns and rows. You want to make some calculations for each country/worksheet. The long way of doing this is calculating separately for each country/worksheet. However, this means that you will be repeating the same step 17 times.

An easier way is to select all the worksheets and do the calculations only once. Whenever you select several worksheets[2] and perform some formatting on a range of cells, rows, or columns in one of the worksheets, the same is automatically conducted for the same range of cells, rows, or columns in all the selected worksheets.

If you write a formula on a cell (for example, in cell "C3") in one of the worksheets, the same formula is automatically written in the same cell (in cell "C3") on all the selected worksheets. Whenever you copy and paste formulas or cell values in one worksheet, the same copy and paste action is replicated on the other worksheets.

Try this Once again, as the other sections in this chapter, this

---

[2] Selecting multiple consecutive worksheets: (a) click on the first sheet, (b) press down on the SHIFT key, and, (c) click on the last sheet. Selecting multiple non-consecutive worksheets: (a) click on the first sheet, (b) press down on the CTRL key, and, (c) one by one, click on the other worksheets you want to select. If a sheet is selected successfully, its sheet tab will be highlighted.

feature is best learned by practice. So, try it out on the sample file "Files1.xls." In that file, all the worksheets whose names are country names (see the worksheets "Algeria," "Bahrain," … , "Yemen") are identical in their structure.

— In cell D5 of each cell, I wanted the formula "= (C5/C4) — 1." I selected all the worksheets and typed the formula into cell D5 of only one of the worksheets. The formula was automatically replicated on all the worksheets I had selected.

— Write the formula "= (C6/C5) — 1" into cell D6 of all these worksheets using this method. With all the worksheets selected, try different things like formatting cells, changing the width of columns, etc. Notice that you only have to work on one worksheet, and the work is automatically replicated for all the selected worksheets.

The use of this feature is optimized if data in separate worksheets is arranged in a manner that facilitates work on several sheets.

<div align="right">

CHAPTER 2

</div>

<div align="right">

COPYING/CUTTING AND
PASTING FORMULAE

</div>

This chapter teaches the following topics:

— COPYING AND PASTING A FORMULA TO OTHER CELLS IN
    THE SAME COLUMN

— COPYING AND PASTING A FORMULA TO OTHER CELLS IN
    THE SAME ROW

— COPYING AND PASTING A FORMULA TO OTHER CELLS IN A
    DIFFERENT ROW AND COLUMN

— CONTROLLING CELL REFERENCE BEHAVIOR WHEN
    COPYING AND PASTING FORMULAE (USE OF THE "$"
    KEY)

— USING THE "$" SIGN IN DIFFERENT PERMUTATIONS AND
    COMPUTATIONS IN A FORMULA.

— COPYING AND PASTING FORMULAS FROM ONE
    WORKSHEET TO ANOTHER

— SPECIAL PASTE OPTIONS

— PASTING ONLY THE FORMULA (BUT NOT THE FORMATTING
    AND COMMENTS)

— PASTING THE RESULT OF A FORMULA, BUT NOT THE
    FORMULA ITSELF

— CUTTING AND PASTING FORMULAE

— THE DIFFERENCE BETWEEN "COPYING AND PASTING"
    FORMULAS AND "CUTTING AND PASTING" FORMULAS

— SAVING TIME BY WRITING, COPYING AND PASTING
FORMULAS ON SEVERAL WORKSHEETS
SIMULTANEOUSLY

2.1 **COPYING AND PASTING A FORMULA TO OTHER
CELLS IN THE SAME COLUMN**

Often one wants to write analogous formulae for several cases. For
example, assume you want to write a formula analogous to the formula in
F223 into each of the cells F224 to F235[3]. The quick way to do this is to:

— Click on the "copied from" cell F223.

— Select the option EDIT/COPY. (The menu can also be accessed by
right-clicking on the mouse or by clicking on the COPY icon.)

— Highlight the "pasted on" cells F224 to F235 and

— Choose the menu option EDIT/PASTE. (The menu can also be
accessed by right-clicking on the mouse or by clicking on the
PASTE icon.)

— Press the ENTER key.

The formula is pasted onto the cells F224 to F235 and the cell references

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[3] The formula in F223 adds the values in cells that are 3 and 2 columns to the left (that
is, cells in columns in C and D.)

within each formula are adjusted[4] for the location difference between the "pasted on" cells and the "copied from" cell.

Figure 18: Pasting a formula

	C	D	E	F
223	9133000	11034000	15223000	=C223+D223
224	1626000	1852000	2818000	=C224+D224
225	1417000	1600000	2255000	=C225+D225
226	1202000	1389000	1802000	=C226+D226
227	976000	1176000	1550000	=C227+D227
228	607000	951000	1339000	=C228+D228
229	464000	589000	1124000	=C229+D229
230	396000	447000	897000	=C230+D230
231	331000	375000	544000	=C231+D231
232	279000	307000	400000	=C232+D232
233	221000	250000	319000	=C233+D233

2.2 COPYING AND PASTING A FORMULA TO OTHER CELLS IN THE SAME ROW

Select the range F223— F235 (which you just created in the previous sub–section). Select the option EDIT/COPY. Choose the range G223— G235 (that is, one column to the right) and choose the menu option EDIT/PASTE. Now click on any cell in the range G223— G235 and see how the column reference has adjusted automatically. The formula in

---

[4] The formula in the "copied cell" F223 is "C223 + D223" while the formula in the "pasted on" cell F225 is "C225 + D225." (Click on cell F225 to confirm this.) The cell F225 is two rows below the cell F223, and the copying-and-pasting process accounts for that.

G223 is "D223 + E223" while the formula in F223 was "C223 + D223".

The next figure illustrates this. Because you pasted one column to the right, the cell references automatically shifted one column to the right. So:

— The reference "C" became "D," and

— The reference "D" became "E."

Figure 19: Cell reference changes when a formula is copied and pasted

The examples in 2.1 on page 32 and 2.2 on page 33 show the use of "Copy and Paste" to quickly replicate formula in a manner that maintains referential parallelism.

2.3

COPYING AND PASTING A FORMULA TO OTHER CELLS IN A DIFFERENT ROW AND COLUMN

Select the cell F223. Select the option EDIT/COPY. Choose the range H224 (that is, two columns to the right and one row down from the copied cell) and choose the menu option EDIT/PASTE. Observe how the column and row references have changed automatically— the formula in H224 is

"E224 + F224" while the formula in F223 was "C223 + D223".

The next figure illustrates this. Because you pasted two columns to the right and one row down, the cell references automatically shifted two columns to the right and one row down. So:

— The reference "C" became "E" (that is, two columns to the right)

— The reference "D" became "F" (that is, two columns to the right)

— The references "223" became "224" (that is, one row down)

Figure 20: Copying and pasting a formula

F	G	H
=C223+D223	=D223+E223	
=C224+D224	=D224+E224	=E224+F224

2.4   **CONTROLLING CELL REFERENCE BEHAVIOR WHEN COPYING AND PASTING FORMULAE (USE OF THE "$" KEY)**

The use of the dollar key "$" (typed by holding down SHIFT and choosing the key "4") allows you to have control over the change of cell references in the "Copy and Paste" process. The use of this feature is best shown with some examples.

— The steps in copy and pasting a formula from one range to another:

— Click on the "copied from" cell F223.

— Select the option EDIT/COPY. (The menu can also be accessed by right-clicking on the mouse or by clicking on the COPY icon.)

— Choose the "pasted on" cell F219 by clicking on it, and

— Select the menu option EDIT/PASTE. (The menu can also be
  accessed by right-clicking on the mouse or by clicking on the
  PASTE icon.)

— Press the ENTER key.

— The formula "C219 + D219" will be pasted onto cell F219. (For a
  pictorial reproduction of this, see Figure 21.)

Figure 21: The "pasted-on" cell
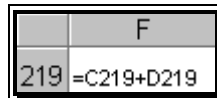
Change the formula by typing the dollar signs as shown Figure 22.

Figure 22: Inserting dollar signs in order to influence cell referencing
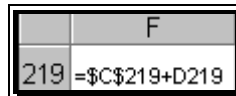
Copy cell F219. Paste into G220 (that is, one column to the right and one
row down). The dollar signs will ensure that the cell reference is not
adjusted for the row or column differential for the parts of the formula
that have the dollar sign before them[5]— see the formula in cell F220

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[5] In this example, the parts are the "C" reference and "219" reference in "C219" part of
the formula.

(reproduced in Figure 23).
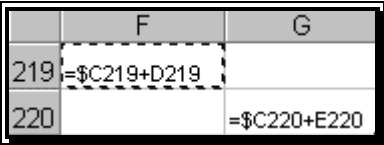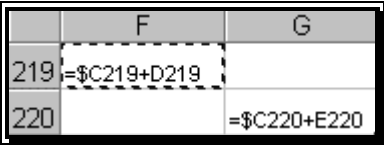
Figure 23: The "copied-from" and "pasted-on" cells with the use of the dollar sign
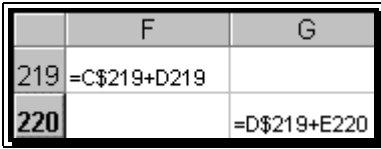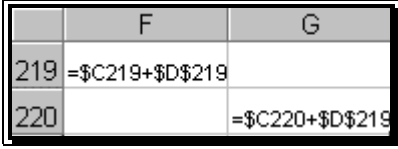
For the parts of the cell that do not have the dollar sign before them, the cell references adjust to maintain referential integrity[6].

2.4.A   USING THE "$" SIGN IN DIFFERENT PERMUTATIONS AND COMPUTATIONS IN A FORMULA

The dollar sign in the "copied from" cell	*The copy & paste action*	*The cell references in the "pasted on" cell depend on the location of the dollar signs in the formula in the original, "copied from" cell*
Reference behavior with a dollar sign before one of the column references Original cell: F219 = $C219 + D219	Copy F219 and paste into G220.	Figure: 24: Only the reference to "C" does not adjust because only "C" has a dollar prefix
Reference behavior with a dollar sign before one of the row references Original cell:	Copy F219 and paste into G220.	Figure 25: Only the reference to "219" (in the formula part "C$219") does not adjust because only that "219" has a dollar prefix

---

[6] The part "D219" adjusts to "E220" to adjust for the fact that the "pasted on" cell is one column to the right (so "D→E") and one row below (so "219→220".)

The dollar sign in the "copied from" cell	The copy & paste action	The cell references in the "pasted on" cell depend on the location of the dollar signs in the formula in the original, "copied from" cell
F219 = C$219 + D219		
Reference behavior with a dollar sign before all but one of the row/column references Original cell: F219 = $C219 + D219	Copy F219 and paste into G220.	Figure 26: the references to "C," "D" and to "219" (in the formula part "D219") do not adjust because they all have a dollar prefix
Original cell: F219 = C219 + D219	Copy F219 and paste into G220.	Try it… G220 = C219 + D219
Original cell: F219 = $C219 + $D219	Copy F219 and paste into G220.	Try it... G220 = $C220 + $D220
Original cell: F219 = C219 + D219	Copy F219 and paste into G220.	Try it... G220 = D220 + D219

2.5 ## COPYING AND PASTING FORMULAS FROM ONE WORKSHEET TO ANOTHER

The worksheet "second" in the sample data file has the same data as the worksheet you are currently on ("main.") In the worksheet main, select the cell F219 and choose the menu option EDIT/COPY. Select the worksheet "second" and paste the formula into cell F219. Notice that the formula is duplicated.

2.6 **PASTING ONE FORMULA TO MANY CELLS, COLUMNS, ROWS**

Copy the formula. Select the range for pasting and paste or "Paste Special" the formula.

2.7 **PASTING SEVERAL FORMULAS TO A SYMMETRIC BUT LARGER RANGE**

Assume you have different formulas in cells G2, H2, and I2. You want to paste the formula:

— In G2 to G3:G289

— In H2 to H3:H289

— In I2 to I3:I289

Select the range G2:I2. Pick the menu option EDIT/COPY. Highlight the range G3:I289. (Shortcut: select G3. Scroll down to I289 without touching the sheet. Depress the SHIFT key and click on cell I289.) Pick the menu option EDIT/PASTE.

2.8 **DEFINING AND REFERENCING A "NAMED RANGE"**

You can use range names as references instead of exact cell references. Named ranges are easier to use if the names chosen are explanatory.

First, you have to define named ranges. This process involves informing

Excel that the name, for example, "age_nlf," refers to the range "C2:C19." Pick the menu option "INSERT/NAME/DEFINE." The dialog (user-input form) that opens is shown in the next figure. Type the name of the range into the text-box "Names in workbook" and the "Cell References" in the box "Refers to:" See the next figure for an example.

Figure 27: The DEFINE NAMES dialog
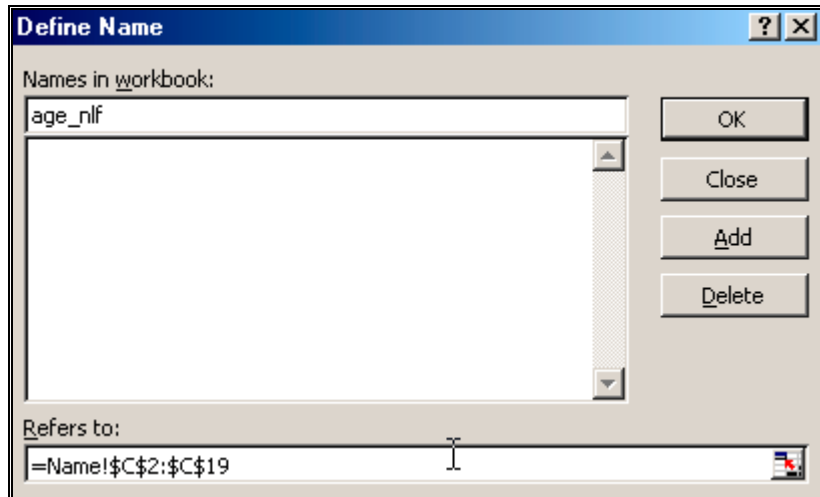
Click on the button "Add." The named range is defined. The name of a defined range is displayed in the large text-box in the dialog. The next figure illustrates this text.

Figure 28: Once added, the defined named range's name can be seen in the large text-box
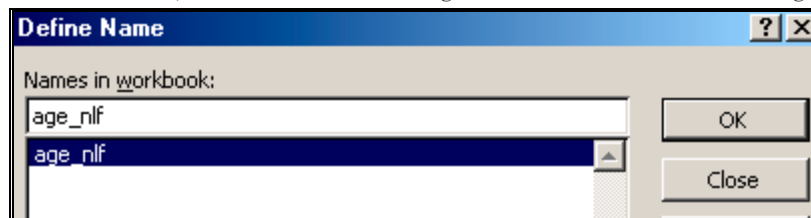
Several named ranges can be defined. A named range can represent multiple blocks of cells.

Figure 29: Defining a second named range. On clicking "Add," the named range is defined, as shown in the next figure.
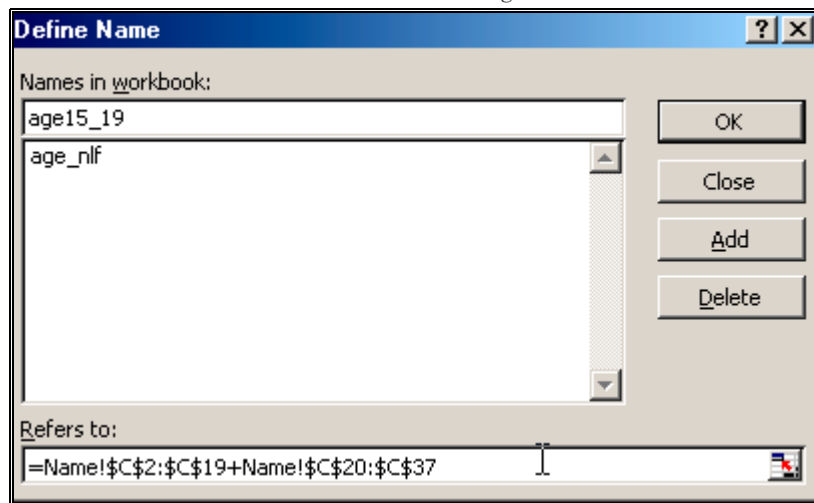
You can view the ranges represent by any name. Just click on the name in the central text-box and the range represented by the name will be displayed in the bottom box.

Figure 30: Two named ranges are defined
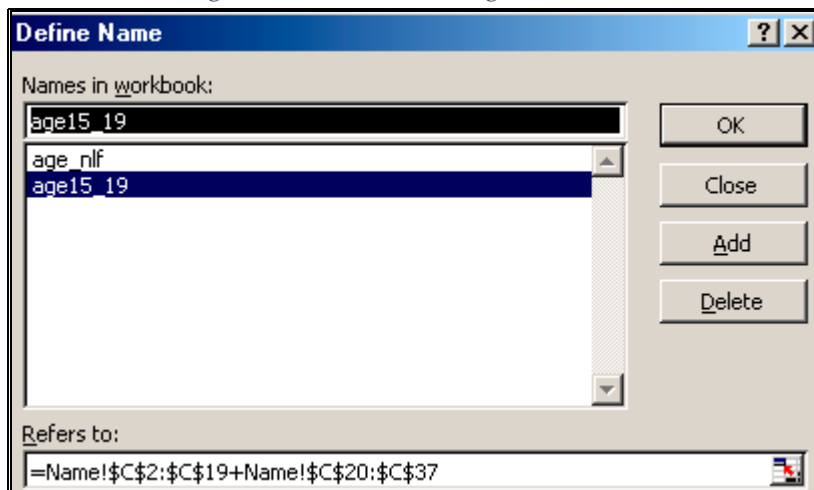
Figure 31: You can define many ranges. Just make sure that the names are explanatory and not confusing.
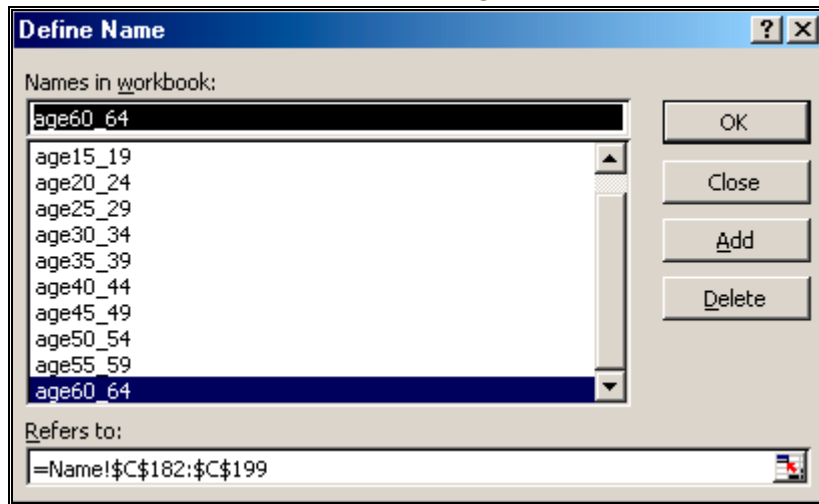
Adding several named ranges in one step

> If the first/last row/column in your ranges has the labels for the range, then you can define names for all the ranges using the menu option INSERT/NAMES/CREATE. The dialog is reproduced in the next figure.

Figure 32: CREATE NAMES
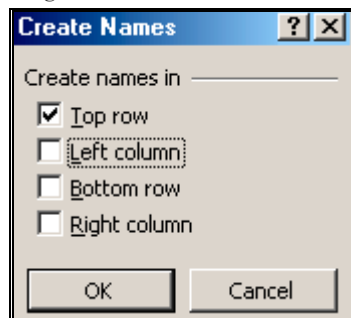
> In our sample data set, I selected columns "A" and "B" and created the names from the labels in the first row.

Figure 33: The named ranges "Country_Name," and "Series_Name" were defined in one step using "Create Names"
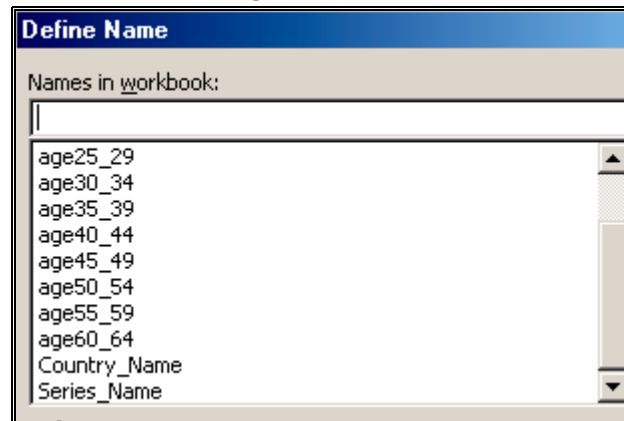
Using a named range

Named ranges are typically used to make formulas easier to read. The named ranges could also be used in other procedures

Assume you want to sum several of the ranges defined above. One way to sum them would be to select them one-by-one from the worksheet.

Another way is to use the menu option INSERT/NAME/PASTE to select and paste the names of the ranges. The names are explanatory and reduce the chances of errors in cell referencing.

A reference to the named range is pasted onto the formula as shown below.

Figure 34: Pasting named ranges
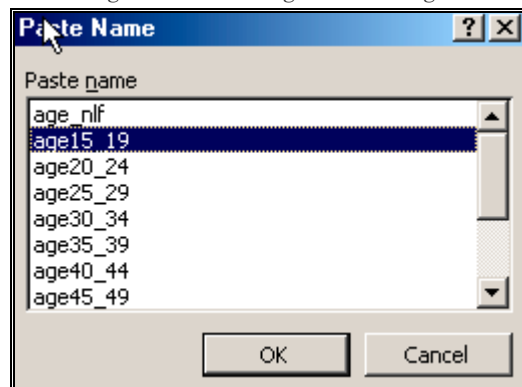
2.9   SELECTING ALL CELLS WITH FORMULAS THAT EVALUATE TO A SIMILAR NUMBER TYPE

Volume 3: Excel– Beyond The Basics.

2.10   SPECIAL PASTE OPTIONS

2.10.A   PASTING ONLY THE FORMULA (BUT NOT THE FORMATTING AND COMMENTS)

Refer to page 52 in chapter 3.

2.10.B   PASTING THE RESULT OF A FORMULA, BUT NOT THE FORMULA ITSELF

Refer to page 49 in chapter 3.

2.11   **CUTTING AND PASTING FORMULAE**

2.11.A   THE DIFFERENCE BETWEEN "COPYING AND PASTING" FORMULAS AND "CUTTING AND PASTING" FORMULAS

Click on cell F223, select the option EDIT/CUT, click on cell H224 and choose the menu option EDIT/PASTE. The formula in the "pasted on" cell is the same as was in the "cut from" cell. (The formula "=C223 + D223.") Therefore, there is no change in the cell references after cutting–and–pasting. While copy–and–paste automatically adjusts for cell reference differentials, cut–and–paste does not.

If you had used copy and paste, the formula in H224 would be "=D224 + E224."

Figure 35: Cut from cell F223

	F	G	H
223	=C223+D223	=D223+E223	
224	=C224+D224	=D224+E224	

Figure 36: Paste into cell H223. Note that the cell references do not adjust.

	F	G	H
223		=D223+E223	
224	=C224+D224	=D224+E224	=C223+D223

After doing this, select the option EDIT/UNDO because I want to maintain the formulas in F223— F235 (and not because it is required for a cut and paste operation).

2.12   **CREATING A TABLE OF FORMULAS USING DATA/TABLE**

The menu option DATA/TABLE supposedly offers a tool for creating an X-Y table of formula results. However, the method needs so much data arrangement that it is no better than using a simple copy and paste operation on cells!

2.13   **SAVING TIME BY WRITING, COPYING AND PASTING FORMULAS ON SEVERAL WORKSHEETS SIMULTANEOUSLY**

Refer to *Volume 3: Excel– Beyond The Basics* to learn how to work with multiple worksheets. The section will request you to follow our example of writing a formula for several worksheets together.

CHAPTER 3

PASTE SPECIAL

This chapter teaches the following topics:

- — PASTING THE RESULT OF A FORMULA, BUT NOT THE FORMULA

- — OTHER SELECTIVE PASTING OPTIONS

- — PASTING ONLY THE FORMULA (BUT NOT THE FORMATTING AND COMMENTS)

- — PASTING ONLY FORMATS

- — PASTING DATA VALIDATION SCHEMES

- — PASTING ALL BUT THE BORDERS

- — PASTING COMMENTS ONLY

- — PERFORMING AN ALGEBRAIC "OPERATION" WHEN PASTING ONE COLUMN/ROW/RANGE ON TO ANOTHER

- — MULTIPLYING/DIVIDING/SUBTRACTING/ADDING ALL CELLS IN A RANGE BY A NUMBER

- — MULTIPLYING/DIVIDING THE CELL VALUES IN CELLS IN SEVERAL "PASTED ON" COLUMNS WITH THE VALUES OF THE COPIED RANGE

- — SWITCHING ROWS TO COLUMNS

This less known feature of Excel has some great options that save time and reduce annoyances in copying and pasting.

3.1 **PASTING THE RESULT OF A FORMULA, BUT NOT THE FORMULA**

Sometimes one wants the ability to copy a formula (for example, "=C223 + D223)") but paste only the resulting value. (The example that follows will make this clear.)

Select the range "F223:F235" on worksheet ""main."

Choose the menu option FILE/NEW and open a new file. Go to any cell in this new file and choose the menu option EDIT/PASTE SPECIAL.

In the area "Paste," choose the option "Values" as shown in Figure 37.

Figure 37: The PASTE SPECIAL dialog in Excel versions prior to Excel XP
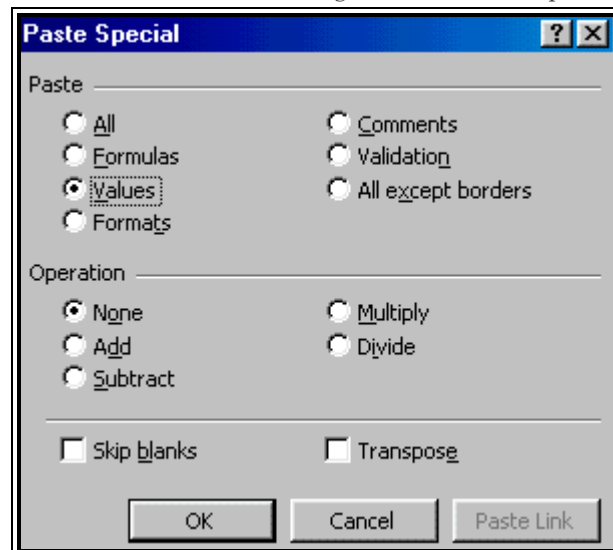
In Excel XP, the "Paste Special" dialog has three additional options:

- Paste Formulas and number formats (and not other cell formatting like font, background color, borders, etc)

- Paste Values and number formats (and not other cell formatting like font, background color, borders, etc)

- Paste only "Column widths."

Figure 38: "Paste Special" dialog In Excel XP,
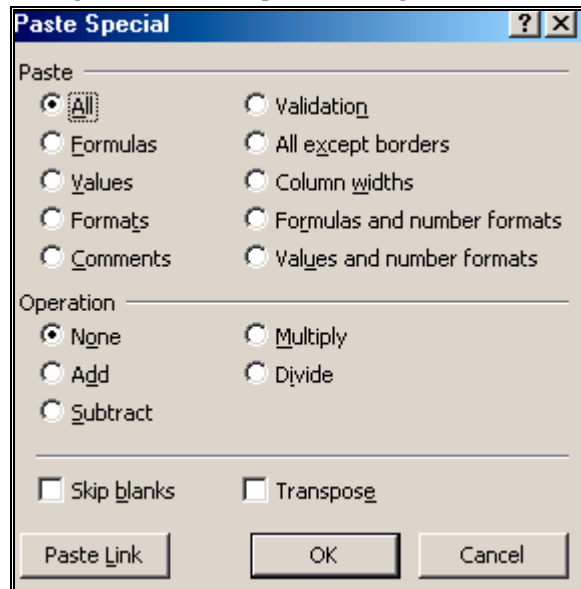
In Excel XP, the "Paste" icon provides quick access to some types of "Paste Special." The options are shown in the next figure.

The calculated values in the "copied" cells are pasted. The formula is not pasted. Try the same experiment using EDIT/PASTE instead of EDIT/PASTE SPECIAL. The usefulness of the

Figure 39: The pasting options can be accessed by clicking on the arrow to the right of the "Paste" icon
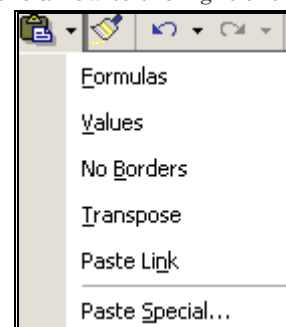
In Excel XP, the "Paste Special" dialog has three additional options:

- Paste Formulas and number formats (and not other cell formatting like font, background color, borders, etc)

- Paste Values and number formats (and not other cell formatting like font, background color, borders, etc)

- Paste only "Column widths."

Figure 38: "Paste Special" dialog In Excel XP,

former will be apparent.

| 3.2 | **OTHER SELECTIVE PASTING OPTIONS** |

| 3.2.A | PASTING ONLY THE FORMULA (BUT NOT THE FORMATTING AND COMMENTS) |

Choose the option "Formulas" in the area "Paste" of the dialog (user-input form) associated with the menu "EDIT/PASTE SPECIAL." This feature makes the pasted values free from all cell references. The "pasted on" range will only contain pure numbers. The biggest advantage of this option is that it enables the collating of formula results in different ranges/sheets/workbooks onto one worksheet without the bother of maintaining all the referenced cells in the same workbook/sheet as the collated results.

Figure 40: Pasting formulas only
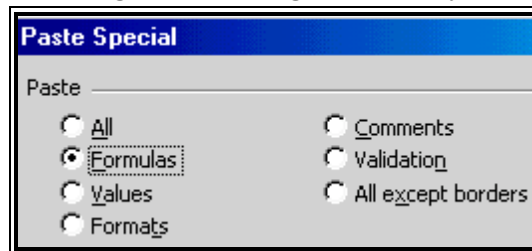
| 3.2.B | PASTING ONLY FORMATS |

Choose the option "Formats" in the area "Paste" of the dialog associated with the menu "EDIT/PASTE SPECIAL use the "Format Painter" icon. I prefer using the icon.

Refer to *Volume 1: Excel For Beginners* for a discussion on the format painter.

3.2.C   PASTING DATA VALIDATION SCHEMES

Pick the option "Validation" in the area "Paste" of the dialog associated with the menu "EDIT/PASTE SPECIAL." Data validation schemes are discussed in *Volume 4: Managing & Tabulating Data in Excel*. This option can be very useful in standardizing data entry standards and rules across an institution.

3.2.D   PASTING ALL BUT THE BORDERS

Choose the option "All except borders" in the area "Paste" of the dialog associated with the menu "EDIT/PASTE SPECIAL." All other formatting features, formulae, and data are pasted. This option is rarely used.

3.2.E   PASTING COMMENTS ONLY

Pick the option "Comments" in the area "Paste" of the dialog associated with the menu "EDIT/PASTE SPECIAL." Only the comments are pasted. The comments are pasted onto the equivalently located cell. For example, a comment on the cell that is in the third row and second column that is copied will be pasted onto the cell that is in the third row and second column of the "pasted on" range. This option is rarely used.

3.3 ## PERFORMING AN ALGEBRAIC "OPERATION" WHEN PASTING ONE COLUMN/ROW/RANGE ON TO ANOTHER

3.3.A ### MULTIPLYING/DIVIDING/SUBTRACTING/ADDING ALL CELLS IN A RANGE BY A NUMBER

Assume your data is expressed in millions. You need to change the units to billions— that is, divide all values in the range by 1000. The complex way to do this would be to create a new range with each cell in the new range containing the formula "cell in old range/1000." A much simpler way is to use PASTE SPECIAL. On any cell in the worksheet, write the number 1000. Click on that cell and copy the number. Choose the range whose cells need a rescaling of units. Go to the menu option EDIT/PASTE SPECIAL and choose "Divide" in the area *Options*. The range will be replaced with a number obtained by dividing each cell by the copied cells value!

The same method can be used to multiply, subtract or add a number to all cells in a range

Figure 41: You can multiply (or add/subtract/divide) all cells in the "pasted on" range by (to/by/from) the value of the copied cell
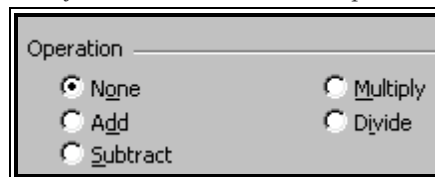
3.3.B   MULTIPLYING/DIVIDING THE CELL VALUES IN CELLS IN SEVERAL "PASTED ON" COLUMNS WITH THE VALUES OF THE COPIED RANGE

You can use the same method to add/subtract/multiply/divide one column's (or row's) values to the corresponding cells in one or several "pasted on" columns (or rows).

Try this Copy the cells in column E and paste special onto the cells in columns C and D choosing the option "Add" in the area "Operation" of the paste special dialog. (You can use EDIT/UNDO to restore the file to its old state.)

3.4   **SWITCHING ROWS TO COLUMNS**

Choose any option in the "Paste" and "Operations" areas and choose the option "Transpose." If pasting a range with many columns and rows you may prefer to paste onto one cell to avoid getting the error "Copy and Paste areas are in different shapes."

<div align="right">

CHAPTER 4

</div>

<div align="center">

INSERTING FUNCTIONS

</div>

This chapter teaches the following topics:

— A SIMPLE FUNCTION

— FUNCTIONS THAT NEED MULTIPLE RANGE REFERENCES

— WRITING A "FUNCTION WITHIN A FUNCTION"

— NEW IN EXCEL XP

— RECOMMENDED FUNCTIONS IN THE FUNCTION WIZARD

— EXPANDED AUTOSUM FUNCTIONALITY

— FORMULA EVALUATOR

— FORMULA ERROR CHECKING

4.1 **BASICS**

Excel has many in–built functions. The functions may be inserted into a formula.

Accessing the functions dialog/wizard

(a) select the menu path INSERT/FUNCTION, or

(b) click on the function icon (see Figure 42)

Figure 42: The Function icon

The "Paste Function" dialog (or wizard, because it is a series of dialogs) opens. The dialog is shown in Figure 43.

Figure 43: Understanding the PASTE FUNCTION dialog
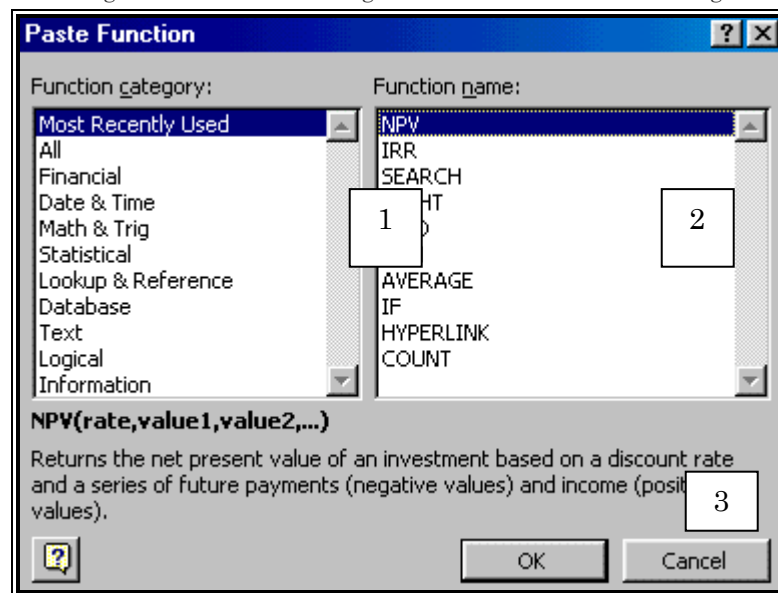
The equivalent dialog in the XP version of Excel is called INSERT FUNCTION. (It is reproduced in the next figure below.) The dialog has one new feature—a "Search for a function" utility. The "Function category" is now available by clicking on the list box next to the label "Or select a category."

Figure 44: The equivalent dialog in the XP version of Excel is called INSERT FUNCTION
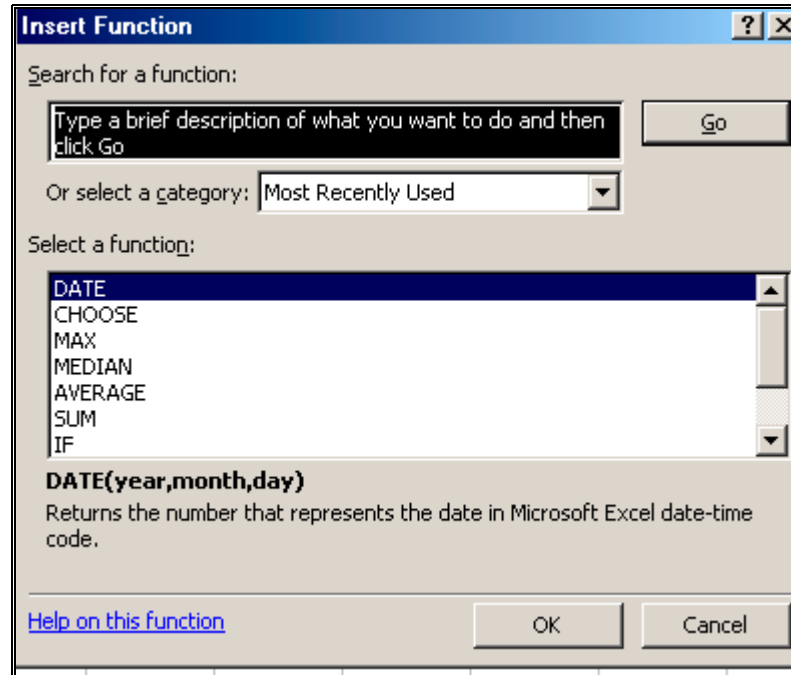
This dialog has three parts:

(1) The area "Function category" on the left half shows the labels of
    each group of functions. The group "Statistical" contains
    statistical functions like "Average" and "Variance." The group
    "Math & Trig" contains algebra and trigonometry functions like
    "Cosine." When you click on a category name, all the functions
    within the group are listed in the area "Function name."

(2) The area "Function name" lists all the functions within the
    category selected in the area "Function category." When you
    click on the name of a function, its formula, and description is
    shown in the gray area at the bottom of the dialog.

(3) The area with a description of the function

Step 2 for using a function in a formula

Click on the "Function category" (in area 1 or the left half of the dialog)

that contains the function, then click on the function name in the area "Function name" (in area 2 or the left half of the dialog) and then execute the dialog by clicking on the button OK.

A SIMPLE FUNCTION

In my first example, I show how to select and use the function "Average" which is under the category "Statistical."

Choose the category "Statistical" as shown in Figure 45.

Figure 45: Choosing a function category
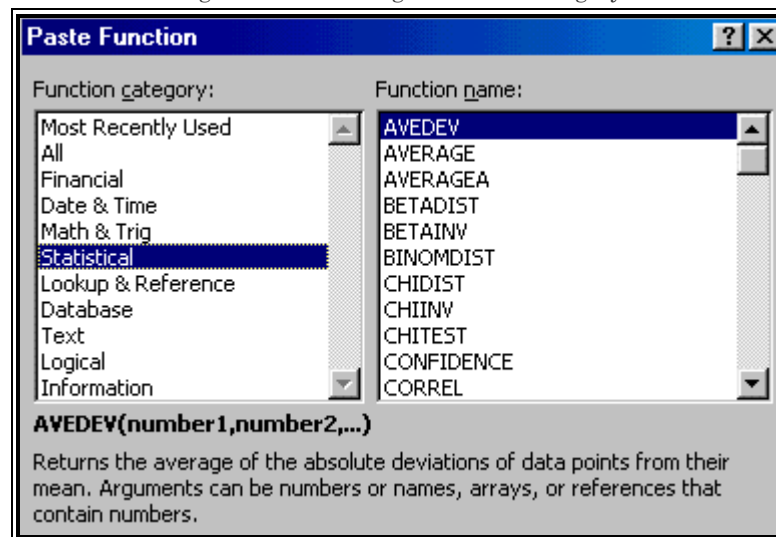
Choose the formula "Average" in the area "Function name."

This is shown in Figure 46.

Execute the dialog by clicking on the button OK.

Figure 46: Choosing a function name
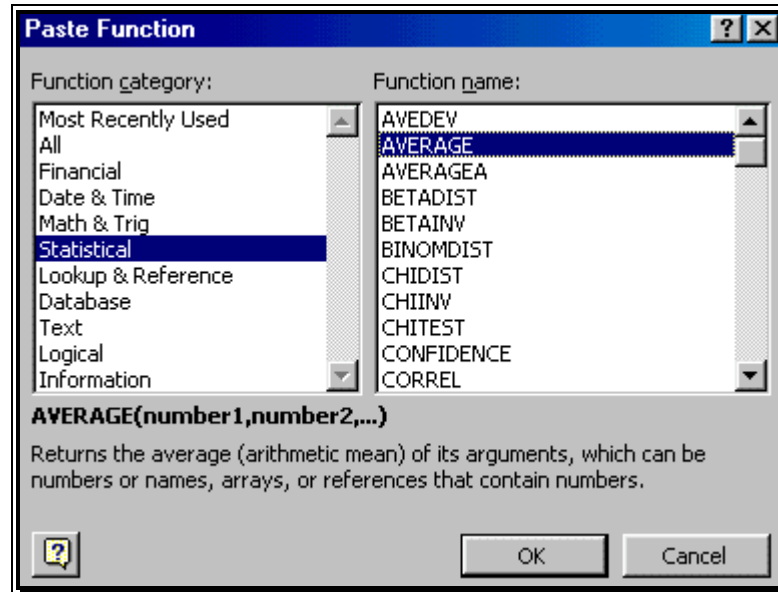
The dialog (user-input form) for the "Average" function opens.

For a pictorial reproduction of this, see Figure 47.

Figure 47: The dialog of the chosen function
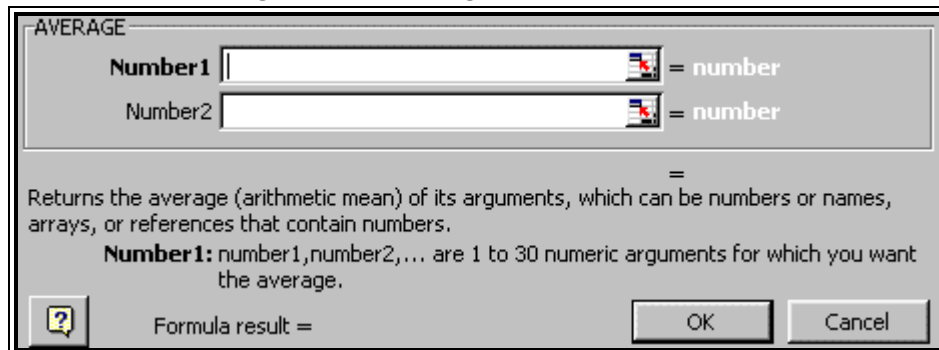
Step 3 for inserting a function — defining the data arguments/requirements for the function

Figure 48: Selecting the cell references whose values will be the inputs into the function

You have to tell Excel which cells contain the data to which you want to apply the function "AVERAGE." Click on the right edge of the text-box "Number1"[7]. (That is, on the red–blue–and–white corner of the cell.) Go to the worksheet that has the data you want to use and highlight the range "C2 to E3." Click on the edge of the text-box. (For a pictorial reproduction of this, see Figure 48.)

You will be taken back to the "Average" dialog. Notice that — as shown in Figure 49 — the cell reference "C2:E3" has been added.

Furthermore, note that the answer is provided at the bottom (see the line "Formula result = 9973333.333").

Execute the dialog by clicking on the button OK.

Figure 49: The completed function dialog

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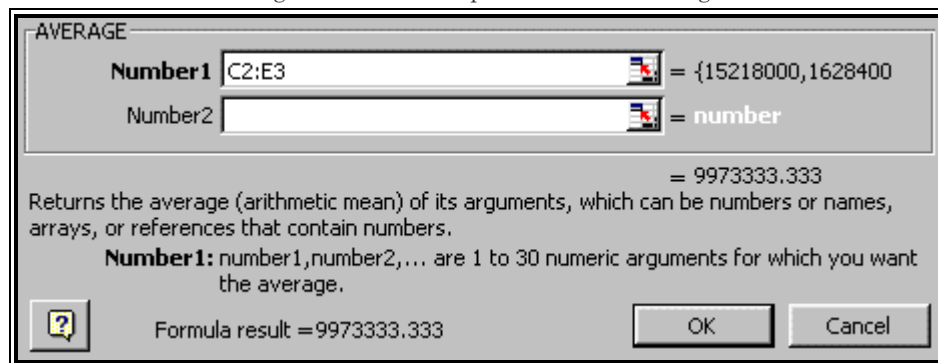
[7] If you want to use non-adjacent ranges in the formula, then use the text-box "Number 2" for the second range. Excel will add more text-boxes once you fill all the available ones. If the label for a text-box is not in bold then it is not essential to fill that text-box. In the AVERAGE dialog shown in Figure 402, the label for the first text-box ("Number 1") is in bold—so it has to be filled. The label for the second text-box ("Number 2") is not in bold — so, it can be left empty.

The formula is written into the cell and is shown in Figure 50.

Figure 50: The function is written into the cell

=AVERAGE(C2:E3)

Press the ENTER key and the formula will be calculated.

You can work with this formula in a similar manner as a simple formula — copying and pasting, cutting and pasting, writing on multiple worksheets, etc.

If you remember the function name, you do not have to use INSERT/FUNCTION. Instead, you can simple type in the formulas using the keyboard. This method is faster but requires that you know the function.

4.3 FUNCTIONS THAT NEED MULTIPLE RANGE REFERENCES

Some formulas need a multiple range reference. One example is the correlation formula ("CORREL"). Assume, in cell J1, you want to calculate the correlation between the data in the two ranges: "D2 to D14" and "E2 to E14."

Activate cell J1. Select the option INSERT/FUNCTION. Choose the function category "Statistical." In the list of functions that opens in the right half of the dialog, choose the function "CORREL" and execute the dialog by clicking on the button OK.

Figure 51: Choosing the function CORREL
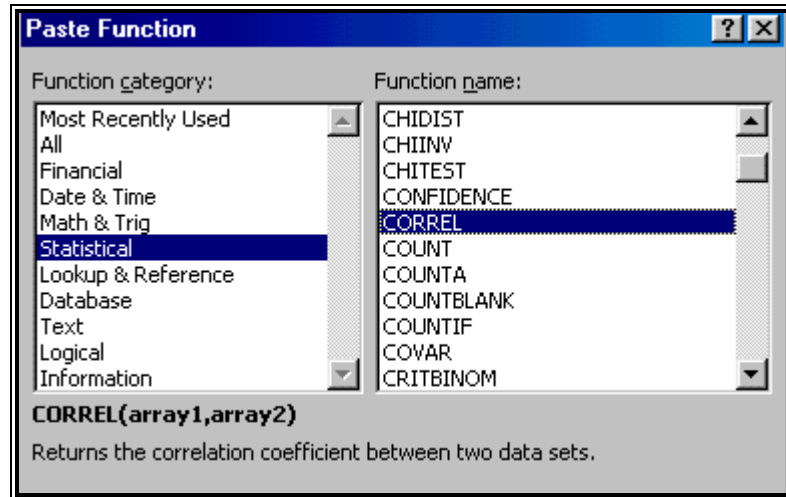
The CORREL dialog (shown in the next figure) opens. The function needs two arrays (or series) of cells references. (Because the labels to both the text-box labels are bold, both text-boxes have to be filled for the function to be completely defined.) Therefore, the pointing to the cell references has to be done twice as shown in Figure 53 and the next two figures.

Figure 52: The CORREL dialog
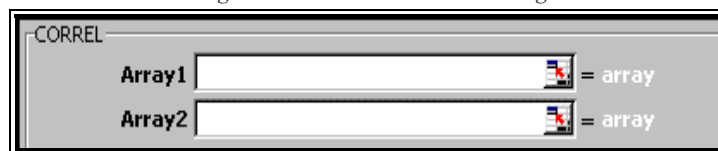
Choosing the first array/series

Click on the box edge of "Array1" (as shown in Figure 52.) Then go to the relevant data range (D2 to D14 in this example) and select it.

Figure 53: Selecting the first data input for the function
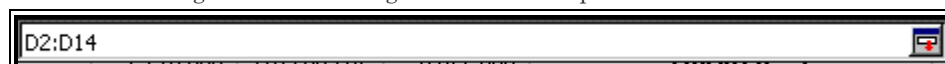
Repeat the same for "Array 2," selecting the range "E2:E14" this time.

Figure 54: The first data input has been referenced
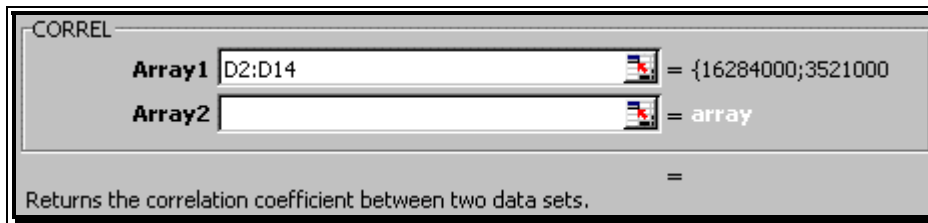
The formula is complete. The result is shown in the dialog in the area at the bottom "Formula result." Execute the dialog by clicking on the button OK.

Figure 55: The second data input has also been referenced
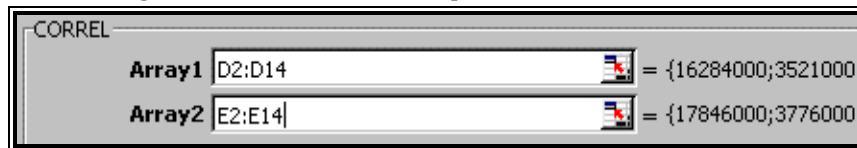
Once the dialog closes, depress the ENTER key, and the function will be written into the cell and its result evaluated/calculated.

Figure 56: The function as written into the cell.

=CORREL(D2:D14,E2:E14)

4.4   WRITING A "FUNCTION WITHIN A FUNCTION"
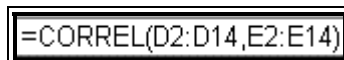
I use the example of the CONFIDENCE function from the category "Statistical."

Choose the menu option INSERT/FUNCTION.

Choose the function category "Statistical."

In the list of functions that opens in the right half of the dialog, choose the function CONFIDENCE and execute the dialog by clicking on the button OK.

Figure 57: Selecting the CONFIDENCE function
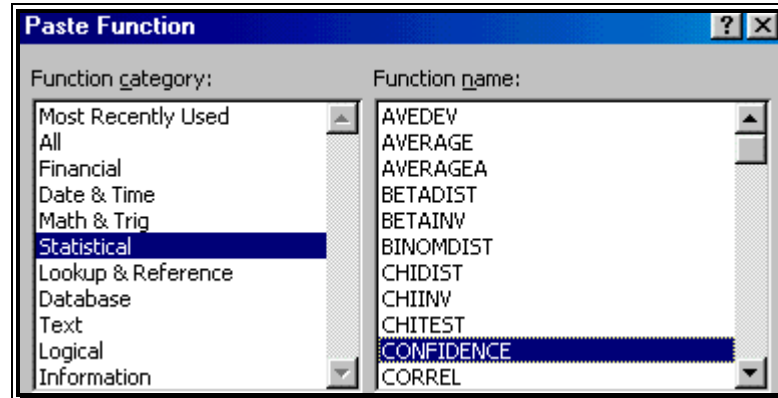
The Confidence dialog (user-input form) requires[8] three parameters: the alpha, standard deviation, and sample size. First type in the alpha desired as shown in Figure 58. (An alpha of ".05" corresponds to a 95% confidence level while an alpha value of ":.1" corresponds to a confidence interval of 90 %.)

Figure 58: Dialog for CONFIDENCE

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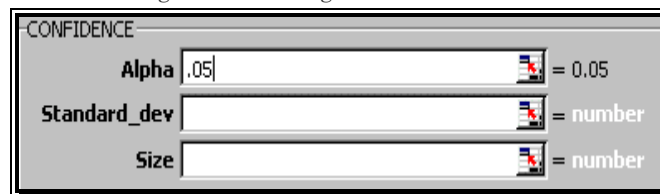
[8] We know that all three are necessary because their labels are in bold.

Press the OK button.

Figure 59: The first part of the function

=CONFIDENCE(.05)

Type a comma after the ".05" (see Figure 60) and then go to INSERT/FUNCTION and choose the formula STDEV as shown in Figure 61.

Figure 60: Placing a comma before entering the second part

(.05,)

Choose the range for which you want to calculate the STDEV (for example, the range "E:E") and execute the dialog by clicking on the button OK.

Figure 61: Using STDEV function for the second part of the function

STDEV

| Number1 | E:E | = E:E |
| Number2 | | = number |

The formula now becomes:

Figure 62: A function within a function

=CONFIDENCE(.05, STDEV(E:E))

The main formula is still CONFIDENCE. The formula STDEV provides one of the parameters for this main formula. The STDEV function is nested within the CONFIDENCE function.

Type a comma, and then go to INSERT/FUNCTION and choose the function "Count" from the function category "Statistical" to get the final formula.

Figure 63: The completed formula

=CONFIDENCE(0.05,STDEV(E:E),COUNT(E:E))

<u>There are two other ways to write this formula.</u>

Select the option INSERT/FUNCTION, choose the function CONFIDENCE from the category "Statistical" and type in the formulae "STDEV(E:E)" and "COUNT(E:E)" as shown in Figure 64.

This method is much faster but requires that you know the function names STDEV and COUNT.

Figure 64: If sub-functions are required in the formula of a function, the sub-functions may be typed into the relevant text-box of the function's dialog

CONFIDENCE
Alpha	.05	= 0.05
Standard_dev	stdev(E:E)	= 10353405
Size	count(E:E)	= 235

The third way to write the formula is to type it in. This is the fastest method.

Figure 65: The result is the same

=CONFIDENCE(0.05,STDEV(E:E),COUNT(E:E))

4.5   **NEW FUNCTION-RELATED FEATURES IN THE XP**
VERSION OF EXCEL

Searching for a function

Type a question (like "estimate maximum value") into the box "Search for a function" utility and click on the button "Go." Excel will display a list of functions related to your query.

Figure 66: Search for a function utility is available in the XP version of Excel
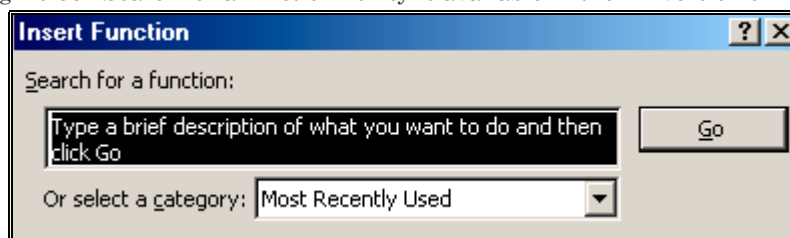
4.5.A   ENHANCED FORMULA BAR

After you enter a number or cell reference for the first function "argument" (or first "requirement") and type in a comma, Excel automatically converts to bold format the next argument/requirement. In the example shown in the next figure, Excel makes bold the font for the argument placeholder *pmt* after you have entered a value for *nper* and a comma.

Figure 67: The Formula Bar Assistant is visible below the Formula Bar
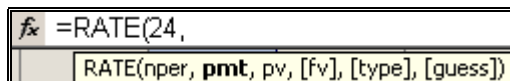
Similarly, the argument/requirement after *pmt* has a bold font after you have entered a value or reference for the argument *pmt*

Figure 68: The next "expected" argument/requirement if highlighted using a bold font
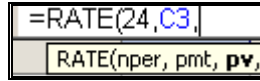
The square brackets around the argument/requirement "fv" indicate that the argument is optional. You need not enter a value or reference for the argument.

Figure 69: An optional argument/requirement
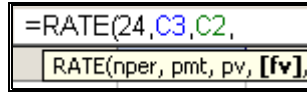
4.5.B   ERROR CHECKING AND DEBUGGING

This topic is taught in *Volume 3: Excel– Beyond The Basics*

Page for Notes

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CHAPTER 5

</div>

TRACING CELL REFERENCES & DEBUGGING FORMULA ERRORS

This short chapter demonstrates the following topics:

— TRACING THE CELL REFERENCES USED IN A FORMULA

— TRACING THE FORMULAS IN WHICH A PARTICULAR CELL
   IS REFERENCED

— WATCH WINDOW

— ERROR CHECKING

— FORMULA EVALUATION

5.1   **TRACING THE CELL REFERENCES USED IN A FORMULA**

Click on the cell that contains the formula whose references need to be visually traced. Pick the menu option TOOLS/AUDITING/TRACE PRECEDENTS. (For a pictorial reproduction of this, see Figure 70.)

Figure 70: Tracing precedents. These options are from Excel versions prior to Excel XP.
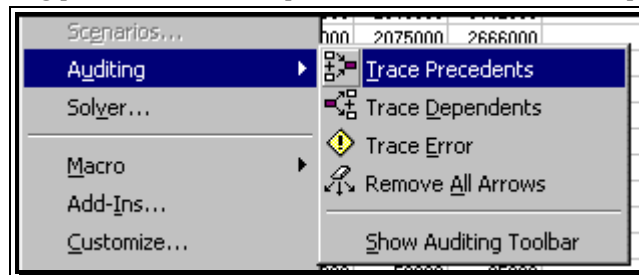
Figure 71: Excel XP offers several error-checking and debugging tools.
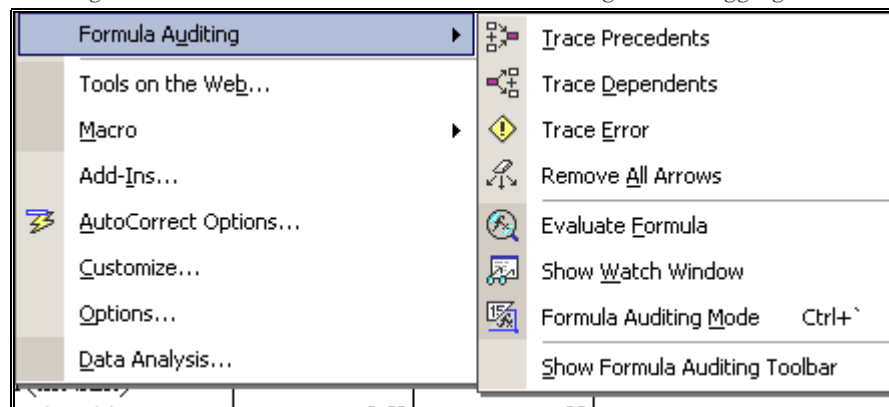
As shown in Figure 72, blue arrows will trace the references.

If a group of cells is referenced, then the group will be marked by a blue rectangle. The two rectangular areas are referenced in the formula.

Figure 72: The arrows define and trace all the cells/ranges referenced in the active cell

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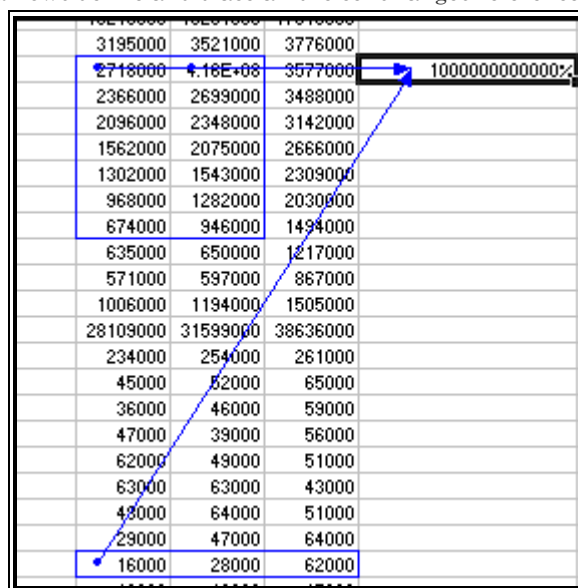
5.2   **TRACING THE FORMULAS IN WHICH A PARTICULAR
             CELL IS REFERENCED**

You may want to do the opposite— see which formulas reference a
particular cell.

- First, click on the cell of interest.

- Then, pick the menu option TOOLS/AUDITING/TRACE
  DEPENDENTS as shown in Figure 73. Now the arrows will go
  from the active cell to all the cells that have formulas that use
  the active cell.

Figure 73: Tracing Dependents. These options are from Excel versions prior to Excel XP.
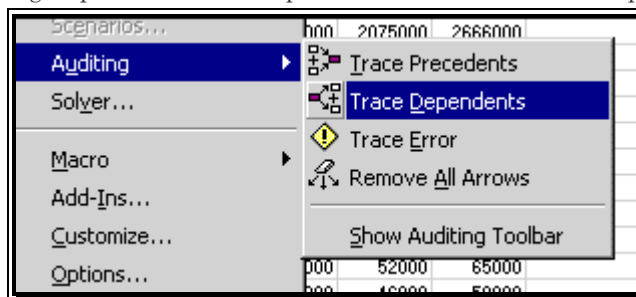
Remove all the auditing arrows by following the menu path
TOOLS/AUDITING/REMOVE ALL ARROWS.

5.3   **THE AUDITING TOOLBAR**

The "Auditing" toolbar opens automatically when you are using the
auditing option (TOOLS/AUDITING) to review formula references.

Figure 74: The "Auditing" toolbar

5.4   **WATCH WINDOW (ONLY AVAILABLE IN THE XP
                            VERSION OF EXCEL)**

The window is accessed through the menu path TOOLS/ AUDITING/
SHOW WATCH WINDOW, or VIEW/ TOOLBARS/ WATCH WINDOW.

Figure 75: The Watch Window may not display correctly. Use the mouse to drag the walls of the dialog to a workable size.

Add one cell on whose values you want to keep tabs.

The value will be shown in the Watch Window so that you can see the value even if you are working on cells or sheets that are far from the cell whose value is being "watched."

Figure 76: Add Watch
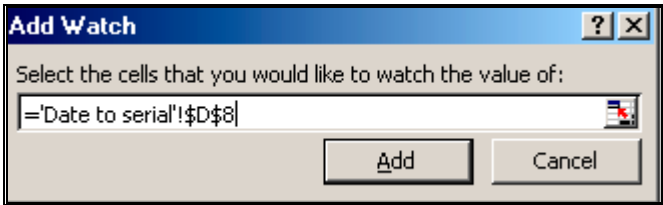
You can add many cells to the Watch Window. Note that the Watch Window provides precise information on the location of the cell being watched and the formula in the cell. For example, the first watched cell is on cell D8 in sheet "Date to serial" in the file "Date and Time.xls." The formula in the cell is "=DATE(F7, E7, D7)".

Figure 77: You can add many cells to the Watch Window

Book	Sheet	Name	Cell	Value	Formula
Date and Time.xls	Date to serial		D8	36988.00	=DATE(F7,E7,D7)
Date and Time.xls	Date to serial		D12	0.141932870	=TIME(D11,E11,F...
Date and Time.xls	Date to serial		B2	37444.284525	=NOW()
Date and Time.xls	Date to serial		B3	37444.00	=TODAY()

ERROR CHECKING AND FORMULA EVALUATOR (ONLY AVAILABLE IN THE XP VERSION OF EXCEL)

The tools are accessed through TOOLS/ERROR CHECKING and TOOLS/FORMULA AUDITING/EVALUATE FORMULA.

The Error Checking dialog shows the formula in the cell as well as the type of error. In this example, these are "=DEGREE(COS(C6))" and "Invalid Name Error," respectively.

The button ("Help on this error") links to a help file containing assistance on understanding and debugging the error.

The button "Show Calculation Steps" links to a step-by-step debugger that assists in catching the calculation step at which the error occurred.

This debugger has the same functionality as the Formula Auditor (accessed through TOOLS/FORMULA AUDITING/EVALUATE FORMULA).

Figure 78: The Error Checking dialog shows the formula in the cell as well as the type of error
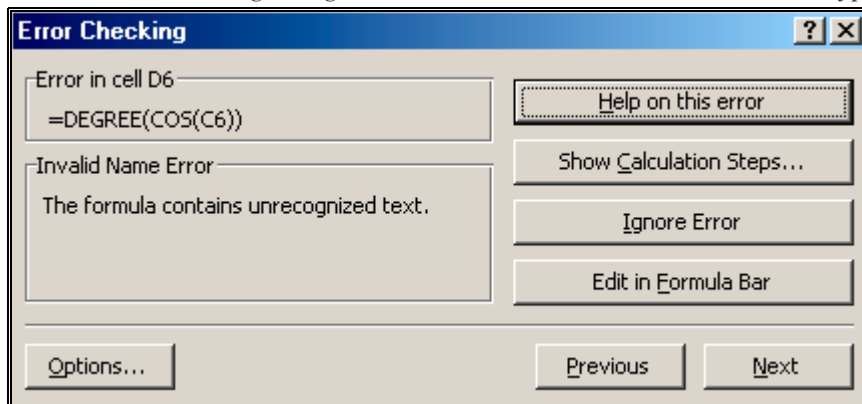
The button "Ignore Error" keeps the error "as is." The button Options

opens the dialog for setting error-checking options. The choices within the
dialog are listed in section 5.8.

The Formula Evaluator shows the step at which the first calculation error
occurred. This helps in identifying the primary problem. In this example,
no error has occurred in the formula part "COS(C6))". The dialog informs
you that "The next evaluation (that is, calculation step), will result in an
error."

Figure 79: The Formula Evaluator shows the step at which the first calculation error occurred
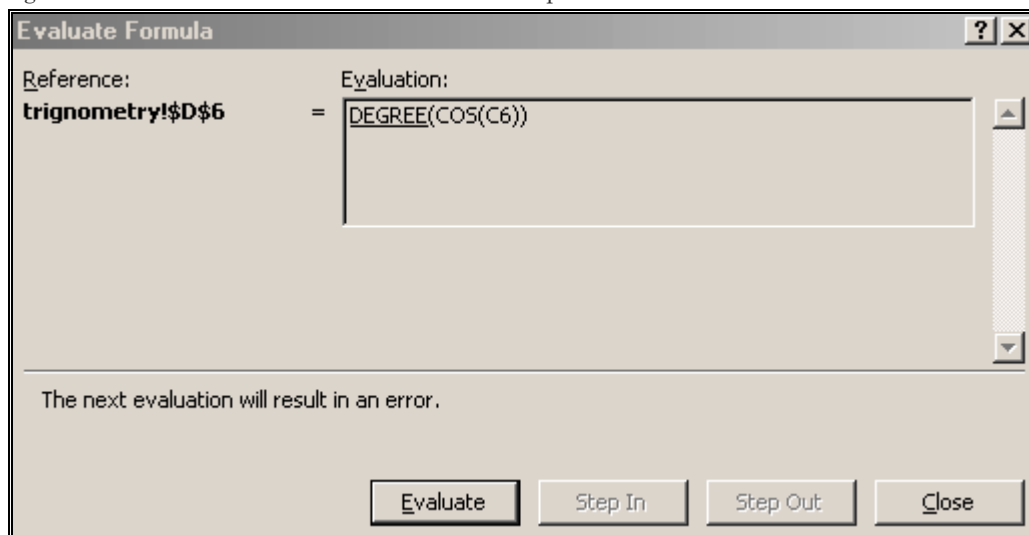
After clicking on evaluate, you see that the error is in the formula part
"DEGREE." Excel also informs you of the type of error— "#NAME?"
suggests that "DEGREE" does not match the name of any Excel function.
(The correct function is "DEGREES.")

The "COS" function is nested within the DEGREE function. Clicking on
"Step In" will evaluate the nested function only.

Figure 80: After clicking on evaluate...
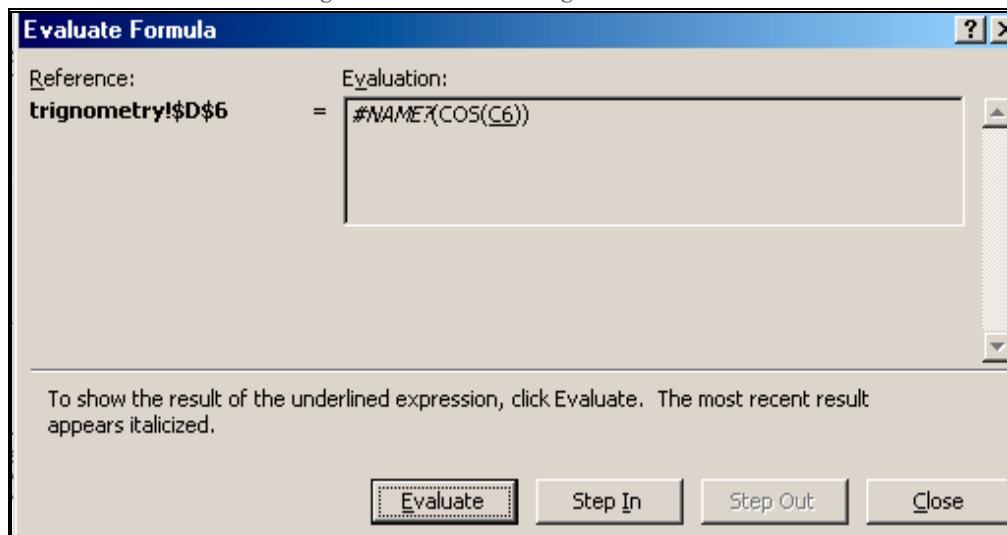
The "COS" function is evaluated. The function has no error.

Tip If a function has more than two levels of nesting, then you can use the "Step Out" button to evaluate the function at the higher level of nesting.

Figure 81: The "COS" function is evaluated
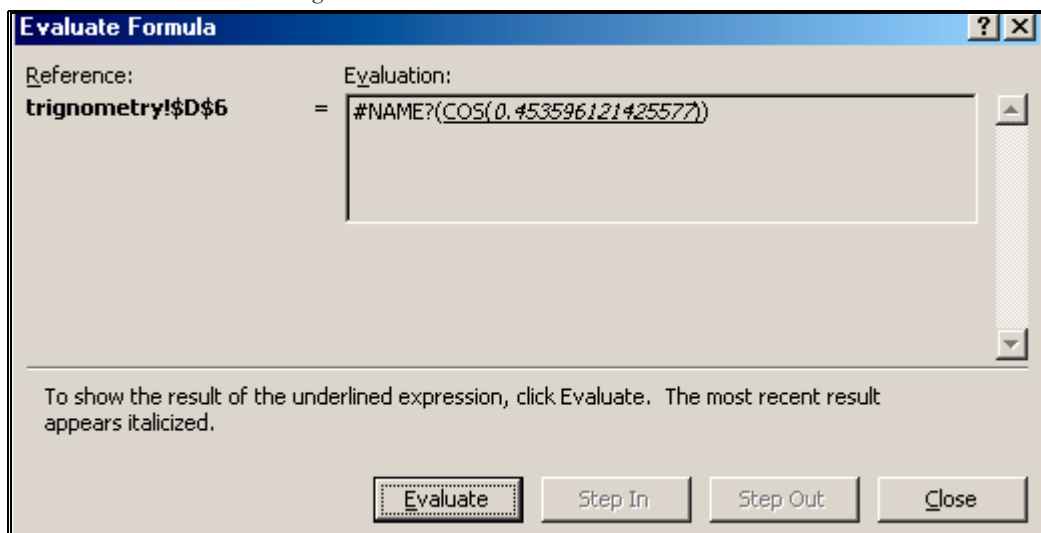
5.6 FORMULA AUDITING MODE (ONLY AVAILABLE IN THE XP VERSION OF EXCEL)

This feature is accessed through TOOLS/FORMULA AUDITING/FORMULA AUDITING MODE. After this mode is selected, when you select a cell that has or is referenced by a formula, Excel highlights the other referenced/referencing cells.

In addition, you have quick access (via the "Formula Auditing" toolbar) to all the Auditing tools discussed earlier in this chapter.

Figure 82: Formula Auditing Mode
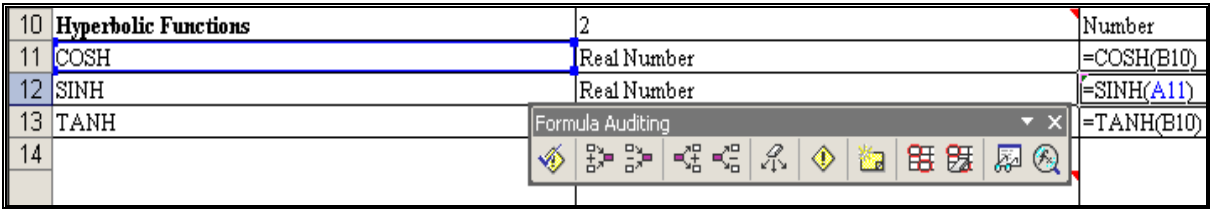
5.7 CELL-SPECIFIC ERROR CHECKING AND DEBUGGING

On every cell whose value evaluates to an error value, you will see a small icon with a "!" image and a downward arrow. Click on the arrow to obtain assistance for debugging the error.

Figure 83: Cell-specific Error Checking and Debugging
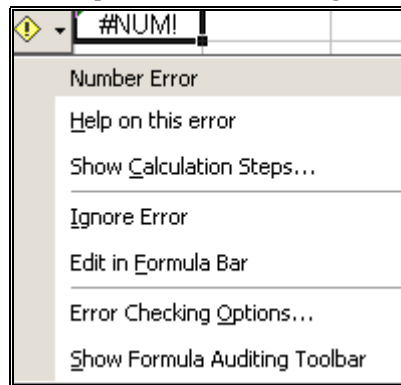
In the example shown in the figure, the options show:

— the error type ("Number Error"),

— a link to assistance on understanding and debugging the error ("Help on this error"),

— a step-by-step debugger to catch the calculation step at which the error occurred ("Show Calculation Steps"),

— the option to ignore and thereby keep the error as is ("Ignore Error"),

— a link to directly edit the formula in the cell ("Edit in Formula Bar"),

— the overall error-checking options ("Error Checking Options"), and

— direct access to the Formula Auditing Toolbar ("Show Formula Auditing Toolbar") and, thereby, to all the features of Auditing (these features are taught in this chapter)

5.8 **ERROR CHECKING OPTIONS**

The Error Checking options can be assessed through
TOOLS/OPTIONS/ERROR CHECKING or through TOOLS/ERROR
CHECKING/OPTIONS. The dialog is reproduced in the next figure.

Figure 84: Error Checking options
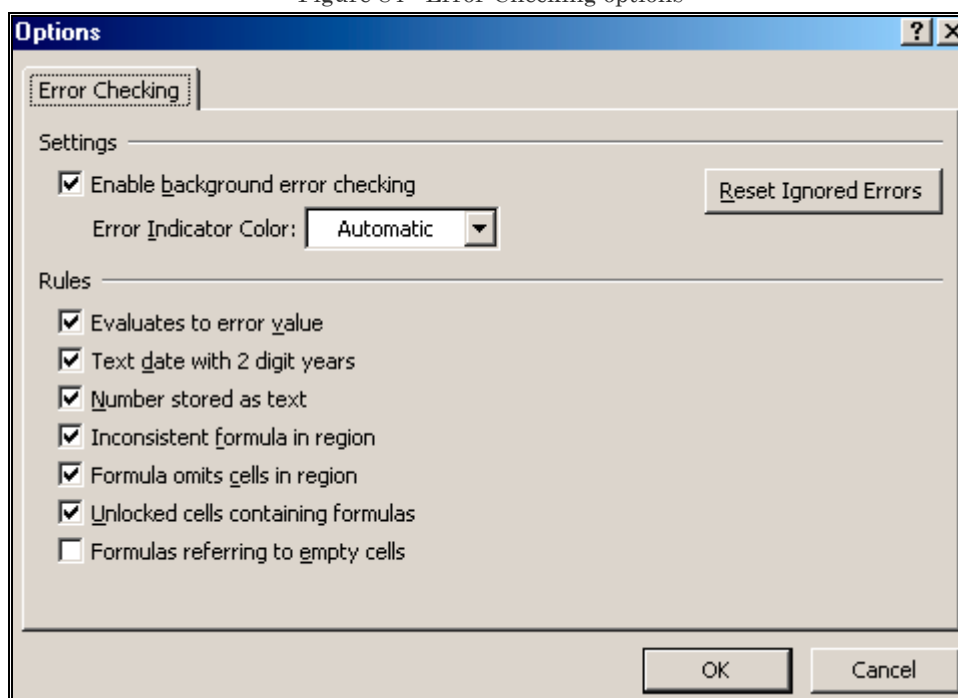
You can inform Excel to show as an error any cell: that contains:

- A formula that evaluates to an error value

- A formula that refers to an empty cell

- A formula that is not consistent with the other formulas and cell
  references in neighboring cells

- A two-digit year (like "02") instead of a four-digit year (like "2002")

- A number stored as text

The other options are beyond the scope of this book. I recommend sticking with the default settings reproduced in the next figure.

CHAPTER 6

LOAN REPAYMENTS

This chapter lists functions on:

— SINGLE PERIOD PAYMENT ON PRINCIPAL AND INTEREST

— RELATION BETWEEN NPER AND RATE WHEN THE PAYMENT PERIOD IS LESS THAN ONE YEAR.

— PAYMENT ON PRINCIPAL ONLY (NOT ON INTEREST)

— PAYMENT ON INTEREST ONLY (NOT ON PRINCIPAL)

— PAYMENT ON INTEREST AND PRINCIPAL

— LOAN REPAYMENTS (CUMULATIVE PAYMENT OVER PERIODS)

— CUMULATIVE REPAYMENT OF PRINCIPAL

— CUMULATIVE INTEREST PAID ON A LOAN

— CUMULATIVE INTEREST AND PRINCIPAL PAID ON A LOAN BETWEEN THE START AND END OF THE LOAN

— SUMMARY OF LOAN REPAYMENT FORMULAE

— ASSOCIATED FUNCTIONS

— RATE, NPER

— CONVERTING BETWEEN EFFECTIVE AND NOMINAL INTEREST RATES OR MAPPING BETWEEN SIMPLE AND COMPOUND INTEREST RATES FOR THE SAME ANNUAL INTEREST CHARGES

— EFFECT, NOMINAL

6.1 **SINGLE PERIOD PAYMENT ON PRINCIPAL AND INTEREST**

Calculates the payment for a loan based on constant payments and a constant interest rate.

6.1.A RELATION BETWEEN NPER AND RATE WHEN THE PAYMENT PERIOD IS LESS THAN ONE YEAR

If you make monthly payments on a four-year loan at an annual interest rate of 24 %, use 24%/12 for RATE and 4*12 for NPER. If you make annual payments on the same loan, use 12 % for RATE and 4 for NPER.

Table 10: Annual rates have to be converted into the rates relevant to the periodicity of repayments

For the annualized rates of:...	*If periodic payments are:*	*Then the rate and nper to use Excel formulas are:*	
		RATE	*NPER*
Annual Rate 24% Number of years 5	Annual (so 1 per year)	24/1 = 24%	5 * 1 = 5
Annual Rate 24% Number of years 5	Semi-Annual (2 payments per year	24/2 = 12%	5 * 2 = 10
Annual Rate 24% Number of years 5	Every four months (so 3 payments per year)	24/3 = 8%	5 * 3 = 15
Annual Rate 24% Number of years 5	Quarterly (4 payments per year)	24/4 = 6%	5 * 4 = 20
Annual Rate 24% Number of years 5	Bi-monthly (6 payments per year)	24/6 = 4%	5 * 6 = 30

For the annualized rates of:...	If periodic payments are:	Then the rate and nper to use Excel formulas are:	
		RATE	*NPER*
Annual Rate 24% Number of years 5	Monthly (12 payments per year)	24/12 = 2%	5 * 12 = 60

Payment on Principal only (not on interest)

The function PPMT calculates the payment on the principal for a given period for an investment based on periodic, constant payments and a constant interest rate. This function can be accessed through the menu option INSERT/FUNCTION/FINANCIAL/PPMT.

An example is shown in the next table.

The data requirements for PPMT and IPMT are similar. The requirements are listed in the next sub-section.

6.1.B   PAYMENT ON INTEREST ONLY (NOT ON PRINCIPAL)

The function IPMT calculates the payment on the interest for a given period for an investment based on periodic, constant payments and a constant interest rate. Access this function through the menu option INSERT/FUNCTION/FINANCIAL/IPMT

The data requirements for PPMT and IPMT are similar. The requirements are shown in the next figure.

Figure 85: Requirements of the functions PPMT and IPMT

— Rate is the interest rate per payment period.

— Nper ("Number of Periods") is the number of payment periods.

— Per ("Period") is a positive whole number less than *nper*.

— PV ("Present Value"): in this context, the PV is the loan amount or the principal.

— FV ("Future Value"): in this context, FV is the balance after the last payment. This requirement is optional. If it left blank, then the default of zero is used.

An example is shown in the next table.

6.1.C   PAYMENT ON INTEREST AND PRINCIPAL

The function PMT calculates the total loan repayment (principal plus interest chares) in any period. The loan must be characterized by periodic, constant payments and a constant interest rate. Access this function through the menu option INSERT/FUNCTION/FINANCIAL/PMT.

The information requirements are the same as for IPMT and PPMT (see previous sub-section) with one addition. PMT also needs information on the due date of payments in relation to the period end and start. This

information is input in the box "Type."

Figure 86: The function PMT

Type: payments are due either at the end or the beginning of a period.

— Type = 0 or omitted, if payments are due at the end.

— Type = 1, if payments are due at the beginning

An example is shown in table at the end of this chapter.

6.2 LOAN REPAYMENTS (CUMULATIVE PAYMENT OVER PERIODS)

6.2.A CUMULATIVE REPAYMENT OF PRINCIPAL

CUMPRINC calculates the cumulative repayments of principal from the first period of the loan until a user chosen future period. The loan must be characterized by periodic, constant payments and a constant interest rate. Access this function through the menu option INSERT/FUNCTION/FINANCIAL/CUMPRINC.

Figure 87: Requirements of the functions CUMIPMT and CUMPRINC

— *Rate* is the interest rate per payment period.

— *nper* ("Number of Periods") is the total number of payment periods in the loan agreement.

— *PV* ("Present Value"): in this context, the PV is the loan amount or the principal.

— *Start_Period* and *End_period* are the two periods (both inclusive) that define the tome period whose cumulative payments you wish to calculate.

An example is shown in the next table.

6.2.B   CUMULATIVE INTEREST PAID ON A LOAN

CUMIPMT calculates the cumulative interest payments from the first period of the loan until a user chosen future period. The loan has to be characterized by periodic, constant payments and a constant interest rate. Access this function through the menu option INSERT/FUNCTION/FINANCIAL/CUMIPMT

The information requirements are the same as for the function CUMPRINC. An example is shown in the next table.

Cumulative interest and principal paid on a loan between user-chosen periods

This amount may be estimated by adding CUMIPMT & CUMPRINC. An example is shown in the next table.

Table 11: Example of a car loan. This example is on the sheet "Car Loan" in the sample file "Loan.xls." Additional samples will be available at http://www.vjbooks.net/excel/samples.htm.

Loan Terms: 20,000 dollars at 8.99% per year, to be repaid over 48 months			
Principal or PV: 20000			
Interest Rate per Year: 8.99%			
Interest Rate per Month:	0.75%		Rate per Repayment Period (month)
Number of Periods for Loan Repayment:	48		Nper— is the number of periods (months)— 48 in this case
Function			Result
Interest Payment (month 24)	IPMT		-84.70
Principal Repayment (month 24)	PPMT		-412.90
Interest plus Principal Payment (month 24)	PMT		-497.61
Interest Payment (month 37)	IPMT		-42.63
Principal Repayment (month 37)	PPMT		-454.98
Interest plus Principal Payment (month 37)	PMT		-497.61
Cumulative Interest Payment (months 1-24)	CUMIPMT		-2666.00
Cumulative Principal Repayment (months 1-24)	CUMPRINC		-9187.74

Cumulative Interest plus Principal Payment (months 1-24)	CUMIPMT + CUMPRINC	-11853.74
Cumulative Interest Payment (year 2 or months 13-24)	CUMIPMT	-1205.10
Cumulative Principal Repayment (year 2 or months 13-24)	CUMPRINC	-4721.77
Cumulative Interest plus Principal Payment (year 2 or months 13-24)	CUMIPMT + CUMPRINC	-5926.87

Note that the total repayments are the same in months 24 and 37, the share of interest goes down over time as more of the principal is repaid

Summary of loan repayment formulae

Table 12: Summary of loan repayment formulae
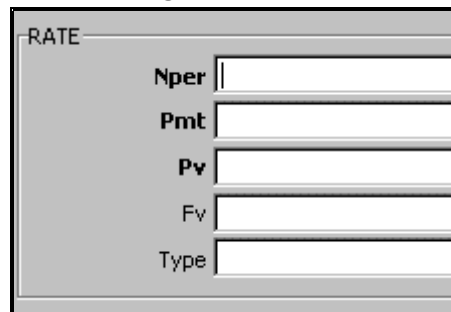
	Payment includes interest		*Payment includes principal*		*Period for which payment is calculated*		
	Yes	No	Yes	No	One period	One specific period defined by the user	Cumulative over several periods
IPMT	✓			✓	✓	✓	
PPMT		✓	✓		✓	✓	
PMT	✓		✓		✓		✓
CUMIPMT		✓		✓			
CUMPRINC		✓	✓				

6.3   **RELATED FUNCTIONS: RATE & NPER**

RATE ("Interest Rate per period of an Annuity")

This function calculates the interest rate per period of an annuity. Because the RATE is estimated using iterations, the result may be none, one or more solutions.

Location within INSERT/FUNCTION: FINANCIAL/RATE

Figure 88: RATE

pmt (payment): payment made each period; it cannot change over the life of the annuity. Typically, *pmt* contains principal and interest but no other fees or taxes. The other information requirements are the same as in the previous sub-section.

Example:
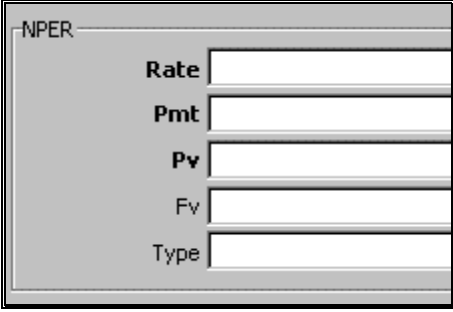
Use this function to estimate the rate of a four-year $8,000 loan with monthly payments of $200: RATE (48, -200, 8000) = 0.77 %. This is the monthly rate, because the period is monthly. The annual rate is 0.77%*12, which equals 9.24 %.

NPER ("Number of periods in an Investment")

This function calculates the number of periods for an investment based on periodic, constant payments and a constant interest rate.

Location within INSERT/FUNCTION: FINANCIAL/NPER

Figure 89: NPER

```
┌NPER──────────────────────────┐
│         Rate │            │   │
│          Pmt │            │   │
│           Pv │            │   │
│           Fv │            │   │
│         Type │            │   │
└──────────────────────────────┘
```

pmt (payment): payment made each period; it cannot change over the life of the annuity. Typically, *pmt* contains principal and interest but no other fees or taxes. The other information requirements are described in the previous sub-section.

Examples

- NPER (12%/12, -100, -1000, 10000, 1) = 60

- NPER (1%, -100, -1000, 10000) = 60

- NPER (1%, -100, 1000) = 11
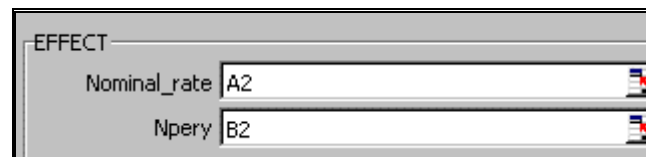
6.4 **MAPPING BETWEEN SIMPLE AND COMPOUND RATES FOR THE SAME ANNUAL INTEREST**

EFFECT ("Effective Interest Rate")

This function calculates the effective annual interest rate, given the nominal annual interest rate and the number of compounding periods per year— *Nominal_rate*, and *nperY*, respectively, in the dialog reproduced in the next figure.

This rate is equivalent (in terms of generating the same interest charges during a year) to a one-year simple interest rate applied to the same principal with no within-year compounding.

Figure 90: Access this function through the menu option INSERT/ FUNCTION/ FINANCIAL/ EFFECT

NOMINAL ("Nominal Interest Rate")

This function calculates the nominal annual interest rate, given the effective rate and the number of compounding periods per year— *Effect_rate*, and *nperY*, respectively, in the dialog reproduced in the next figure.

This rate maps a one year simple interest rate to the equivalent (in terms of generating the same interest charges during an year) nominal compound interest rate if the interest is compounded in periods of less

than one year.

Figure 91: Access this function through the menu option INSERT/ FUNCTION/ FINANCIAL/ NOMINAL

Table 13: This Example is from the worksheet "Effective Nominal" in the sample file "Loans.xls." This example is on the sheet "Car Loan" in the sample file "Loan.xls."

EFFECTIVE	
Terms: 14% nominal annual interest, compounded quarterly	
Nominal Rate	14.0%
Npery— number of compounding periods in an year	4
Effective Rate	*14.8%*
NOMINAL	
Terms: 14.8% effective annual interest after compounding quarterly	
Effective Rate	14.8%
Npery— number of compounding periods in an year	4
Effective Rate	*14.0%*

CHAPTER 7

DISCOUNT CASH FLOWS

The topics taught in this chapter are:

— PRESENT VALUES

— PV, NPV, XNPV

— DISCOUNT CASH FLOW ANALYSIS: RATES OF RETURN FOR AN INVESTMENT/PROJECT

— IRR, MIRR, XIRR

— FUTURE VALUES

— FV, FVSCHEDULE

— DIFFERENCE BETWEEN FV AND FVSCHEDULE

— ANNUITIES — COMPARATIVE SUMMARY OF FUNCTIONS

— DEPRECIATION

— RISK ANALYSIS— "IF-THEN" SCENARIOS
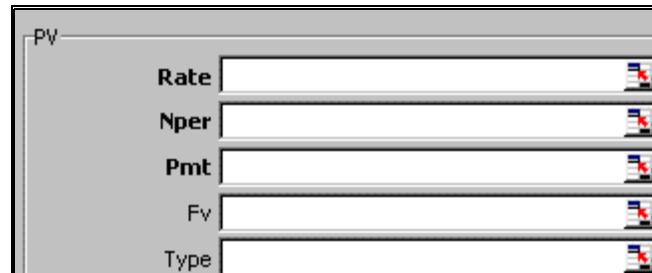
7.1 **PRESENT VALUES**

Examples of the functions shown in this section are provided in the sample file "Cash_Flow.xls."

PV

This function calculates the present value of an investment. The present value is the total amount that a series of future payments is worth now.

Figure 92: PV

Type: equals 0 or 1 and indicates when payments are due. This information is optional. If left empty, the default of zero is used. Set type equal to 0 If payments are due At the end of the period, 1 if payments are due at the beginning of the period.

Location within INSERT/FUNCTION: FINANCIAL/PV

Rate: interest rate per period.

For example, if you obtain an automobile loan at a 10 % annual interest rate and make monthly payments, your interest rate per month is 10%/12, or 0.83%. You would enter 10%/12, or 0.83%, or 0.0083, into the formula as the *rate*.

NPER: number of periods

Fv (future value): the cash balance desired after the last payment. This information is optional. If left empty, the default of zero is used.

pmt: The amount paid. The *pmt* data should be entered as positive if cash is received (such as profits) from the investment and negative if cash is spent on the investment (such as the initial investment, subsequent spending (investment) at future time periods, etc. You should net, for each year, recurrent expenditures including depreciation allowances from recurrent revenues. Further, at least one of the cash flows must be negative and at least one positive

NPV

This function calculates the net present value of an investment by using a discount rate and a series of future payments (negative values) and income (positive values).

The primary difference between PV and NPV is that PV allows cash flows to begin either at the end or at the beginning of the period. Unlike the variable NPV cash flow values, PV cash flows must be constant throughout the investment.

Figure 93: NPV

Location within INSERT/FUNCTION: FINANCIAL/NPV

Rate: discount rate over one period.

Value1, value2, ... must be equally spaced in time and occur at the end of each period.

The NPV investment begins one period before the date of the value1 cash flow and ends with the last cash flow in the list. The NPV calculation is based on future cash flows. If the first cash flow occurs at the beginning of the first period, this flow's value must not be included in the arguments for the NPV function. Instead, you should add this value to the results of the NPV function.

XNPV

This function calculates the net present value for a schedule of cash flows that is not necessarily periodic. Use this function instead of the NPV when the cash flows from the investment/project may not be at periodic intervals (or are not accounted for on a periodic basis).

Figure 94: XNPV

Location within INSERT / FUNCTION: FINANCIAL/XNPV

Same as above. In addition, you need to supply the *reinvestment rate.*

Notes:

— An annuity is a series of constant cash payments made over a continuous period. For example, a car loan or a mortgage is an annuity. For more information, see the description for each annuity function.

— In annuity functions, a negative number represents cash paid out; a positive number represents cash received.

— The primary difference between PV and NPV is that PV allows cash flows to begin either at the end or at the beginning of the period. Unlike the variable NPV cash flow values, PV cash flows must be constant throughout the investment.

— IRR is the rate for which NPV equals zero

— XIRR is the rate for which XNPV equals zero

7.2 DISCOUNT CASH FLOW ANALYSIS: RATES OF RETURN FOR AN INVESTMENT/PROJECT

IRR

This function is used when the cash flows occur (or are estimated as in an annual report) at periodic intervals. (Typically, the period is a year; but the period could be monthly, quarterly, etc).

Figure 95: IRR

The default initial guess is 10% or 0.10. Typically one does not enter any number as a guess

Location within INSERT/FUNCTION: FINANCIAL/IRR

The data should be entered as positive if cash is received (such as profits) from the investment and negative if cash is spent on the investment (such as the initial investment, subsequent spending (investment) at future

time periods, etc. You should net, for each year, recurrent expenditures including depreciation allowances from recurrent revenues. Further, at least one of the cash flows must be negative and at least one must be positive.

MIRR

A good measure of the rate of return should include the cost of raising capital (an outflow) and returns from reinvestment of the profits from the investment (an inflow). The MIRR function includes the cost of funds and the earnings on profit reinvestment. The function is an extension of the IRR function.

For example, over a 10 period investment, the profits earned in year 2 will be reinvested for eight years. The cash inflows may be (re-)invested in interest-earning assets like bonds, money market, etc.

On the other hand, the rate of return should also consider the return on the next best use of the funds invested. (Alternatively, as may be the case, the interest cost of borrowing these funds).

Location within INSERT/FUNCTION: FINANCIAL/MIRR

Same as for IRR. In addition, you need to supply the borrowing (financing) and reinvestment rates.

Figure 96: MIRR

XIRR

Use this function instead of the IRR when the cash flows from the investment/project may not be at periodic intervals (or are not accounted for on a periodic basis).

Figure 97: XIRR

Location within INSERT/FUNCTION: FINANCIAL/XIRR

Same as for IRR. In addition, you need data on the dates when the cash flow will occur.

Notes:

— If a #NUM! error is displayed it may indicate that the underlying algorithm is generated an estimate on the 20th iteration/try for IRR (and 100th for XIRR) that was too far from the estimate on the 19th (or 99th for XIRR) to consider the estimate to be the "final" correct estimate.

— IRR corresponds to the function NPV. IRR is the rate of return at which NPV=zero.

— XIRR corresponds to the function NPV. XIRR is the rate of return at which XNPV=zero.

7.3 **FUTURE VALUES**

FV function

This function calculates the "end-of-project" or "Future Value" of a set of periodic investment. The function can be used only if all the investments are— of the same amount, at the same interest rate, and include principal and interest only. Funds received are included as positive numbers and fund outflows as negative numbers.

This function calculates the "end-of-project" or "Future Value" of a set of periodic investment. The function can be used only if all the investments are— of the same amount, at the same interest rate, and include principal and interest only. Funds received are included as positive numbers and fund outflows as negative numbers.

You can also use the function to evaluate the Future Value of a Present Value. Follow the menu path INSERT/FUNCTION/FINANCIAL/FV[9]

---

[9] Suppose you want to save money for a special project occurring a year from now. You deposit $1,000 into a savings account that earns 6 percent annual interest compounded monthly (monthly interest of 6%/12, or 0.5%). You plan to deposit $100 at the beginning of every month for the next 12 months. How much money will be in the account at the end of 12 months?

FV(0.5%, 12, -100, -1000, 1) equals $2301.40

Figure 98: The FV dialog

FV(interest *rate per period*, *NPER* - the number of payments in an year, *PER* - the periodic payment *or PV* - the present value of the series of payments (include PER or PV), *TYPE*- period extremity at which payment is due with 0="period end" and 1= "period beginning")

Rate versus NPER

If you make monthly payments on a four-year loan at 12 percent annual interest, use 12%/12 for RATE and 4*12 for NPER. If you make annual payments on the same loan, use 12% for RATE and 4 for NPER.

FVSCHEDULE function

This function calculates the "end-of-project" or "Future Value" of one initial investment at interest rates that may differ across periods. The function uses a series of compound interest rates to evaluate the Future Value.

Figure 99: The FVSCHEDULE dialog

Location: INSERT/FUNCTION/FINANCIAL/FVSCHEDULE

FVSCHEDULE(Principal or Present Value, set of interest rates over the number of periods of the investment—this number should equal the number of periods of the investment and is typically referenced from a range of cells that contain information on the rates as numbers in the range 0 to 1)

Example: FVSCHEDULE(1,{0.09, 0.11, 0.1}) equals 1.33089

Difference between FV and FVSCHEDULE

Table 14: Difference between FV and FVSCHEDULE

Parameter/Issue	*FV*	*FVSCHEDULE*
Nature of the investments	Periodic, constant	One time only
Rate applied	Constant	Variable
Periods	Needs information only on total number of periods	Needs information on the rate during each period

7.4   ANNUITIES – COMPARATIVE SUMMARY OF FUNCTIONS

Table 15: Annuities — comparative summary of functions

	Payment amounts		*Periodicity of payments*		*Interest rates*		*Consideration of reinvestment*
	Same each period	May differ each period	Fixed time periods	Variable time period	Constant across periods	May differ across periods	Cash inflows are reinvested; borrowing costs included
Present values of multi-period cash flows							

	Payment amounts		Periodicity of payments		Interest rates		Consideration of reinvestment
	Same each period	May differ each period	Fixed time periods	Variable time period	Constant across periods	May differ across periods	Cash inflows are reinvested; borrowing costs included
PV	✓		✓		✓		
NPV		✓	✓		✓		
XNPV		✓		✓	✓		
Estimation of implicit or explicit interest rates							
RATE	✓		✓		✓		
IRR		✓	✓		✓		
MIRR		✓	✓		✓		✓
XIRR		✓		✓	✓		
Future value estimation							
FV	✓		✓		✓		
FVSCHEDULE			✓			✓	
Estimating number of periods							
NPER	✓		✓		✓		
Estimating repayments for a loan							
IPMT	✓		✓		✓		
PPMT	✓		✓		✓		
PMT	✓		✓		✓		
CUMIPMT	✓		✓		✓		
CUMPRINC	✓		✓		✓		

7.5 **DEPRECIATION**

7.5.A DEPRECIATION OF AN ASSET OVER A SINGLE PERIOD

Straight-line and Sum-of-year's depreciation methods

SLN function: Straight line depreciation

Estimates depreciation during a particular period. All periods have the same depreciation amount.

Location within INSERT/FUNCTION: FINANCIAL/SLN

Cost: initial cost of asset,

Salvage: value of asset at end of depreciation period,

Life: life of asset in number of periods)

SYD function: Sum-of-years' digit method

Estimates depreciation during a particular period. Depreciation amounts decline over time.

Location within INSERT/FUNCTION: FINANCIAL/SYD

Same as for SLN, plus: *Per*– the period for which depreciation amount needs to be calculated.

Figure 100: Difference between SLN and SYD for a typical asset

Comparing depreciation scedules across different methods
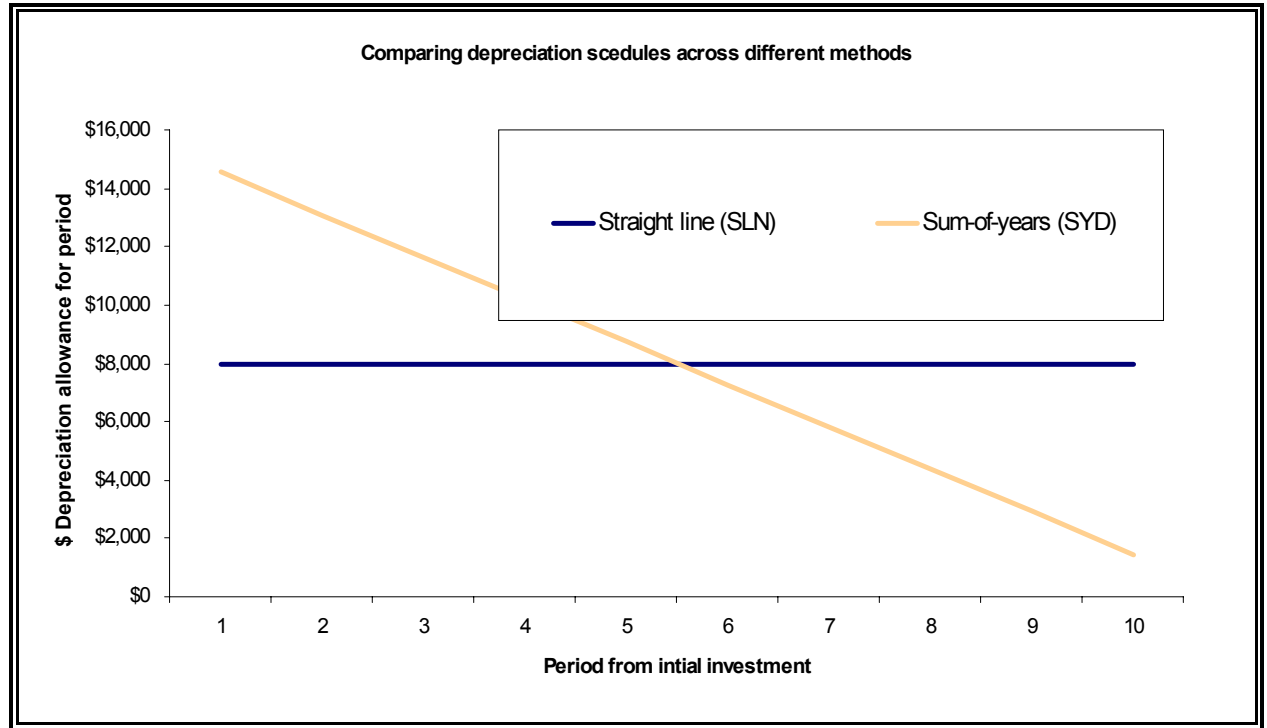
7.5.B DEPRECIATION OF AN ASSET OVER SPECIFIED PERIOD USING DECLINING BALANCE METHODS

Fixed declining balance method

Select the option INSERT/FUNCTION/FINANCIAL/DB

Figure 101: The DB function

Month: number of months in the first year. If omitted, Excel defaults to 12.

Figure 102: Comparing SYD and DB
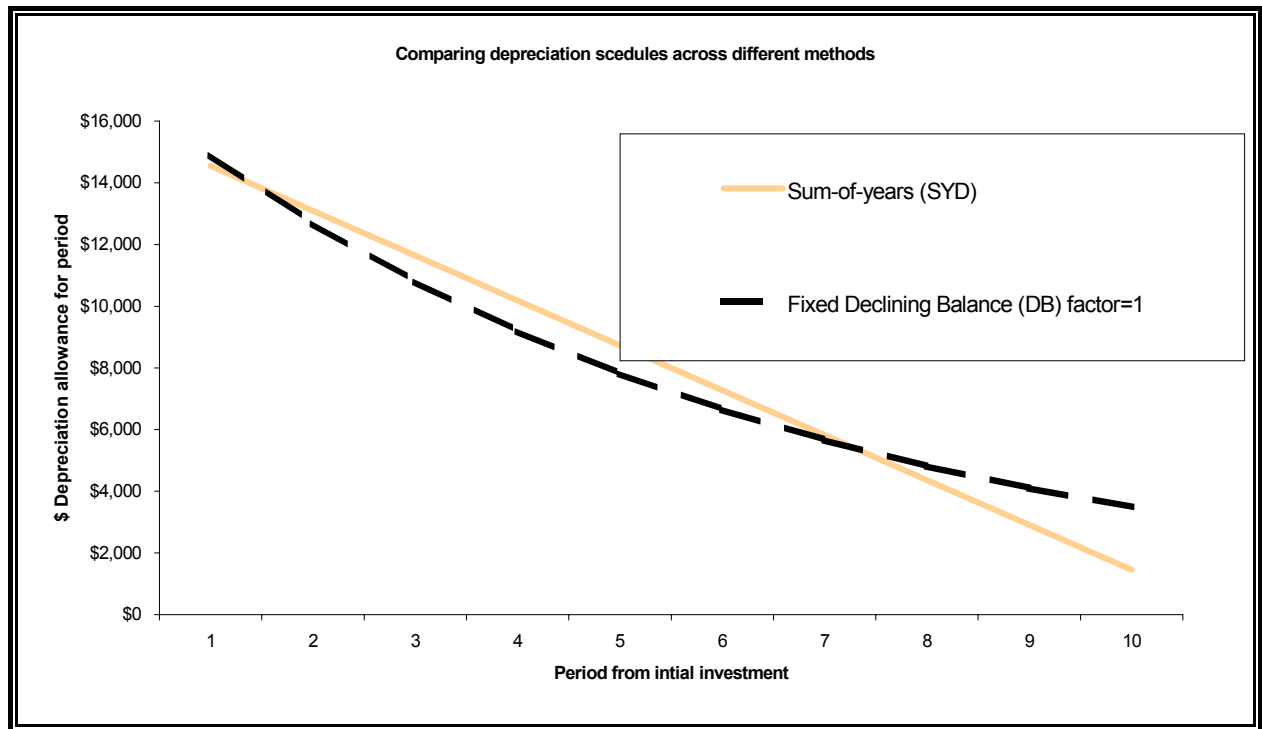
Variable declining balance method

You can choose the factor at which the balance declines. The default is two, that is, "Double Declining."

Location: INSERT/FUNCTION/FINANCIAL/DDB.

Figure 103: The DDB function

This function this method computes depreciation at a higher rate than the fixed declining balance function. The depreciation is much higher than SLN, SYD, and DB in the first few periods.

Example:

Assume the following parameters define a piece of capital equipment:

— Initial Cost =$100, 000

— Salvage Value =$20, 000

— Life =10 yrs

The different depreciation amounts per period, estimated using different depreciation functions are shown in the table below and the next figure.

Table 16: Comparing SLN, SYD, DB and DDB results

Period	Method— >	Straight line (SLN)	Sum-of-years (SYD)	Fixed Declining Balance (DB)	Double Declining Balance (DDB) factor=2	Double Declining Balance (DDB with factor=1.5)	Double Declining Balance (DDB with factor=0.5)
1	Depreciation in specific period	$8, 000	$14, 545	$14, 900	$20, 000	$15, 000	$5, 000
2		$8, 000	$13, 091	$12, 680	$16, 000	$12, 750	$4, 750
3		$8, 000	$11, 636	$10, 791	$12, 800	$10, 838	$4, 513
4		$8, 000	$10, 182	$9, 183	$10, 240	$9, 212	$4, 287

Period	Method— >	Straight line (SLN)	Sum-of-years (SYD)	Fixed Declining Balance (DB)	Double Declining Balance (DDB) factor=2	Double Declining Balance (DDB with factor=1.5)	Double Declining Balance (DDB with factor=0.5)
5		$8, 000	$8, 727	$7, 815	$8, 192	$7, 830	$4, 073
6		$8, 000	$7, 273	$6, 650	$6, 554	$6, 656	$3, 869
7		$8, 000	$5, 818	$5, 659	$5, 243	$5, 657	$3, 675
8		$8, 000	$4, 364	$4, 816	$972	$4, 809	$3, 492
9		$8, 000	$2, 909	$4, 098	$0	$4, 087	$3, 317
10		$8, 000	$1, 455	$3, 488	$0	$3, 162	$3, 151

Figure 104: Value of an asset after depreciation— comparing SLN, SYD, DB, and DDB
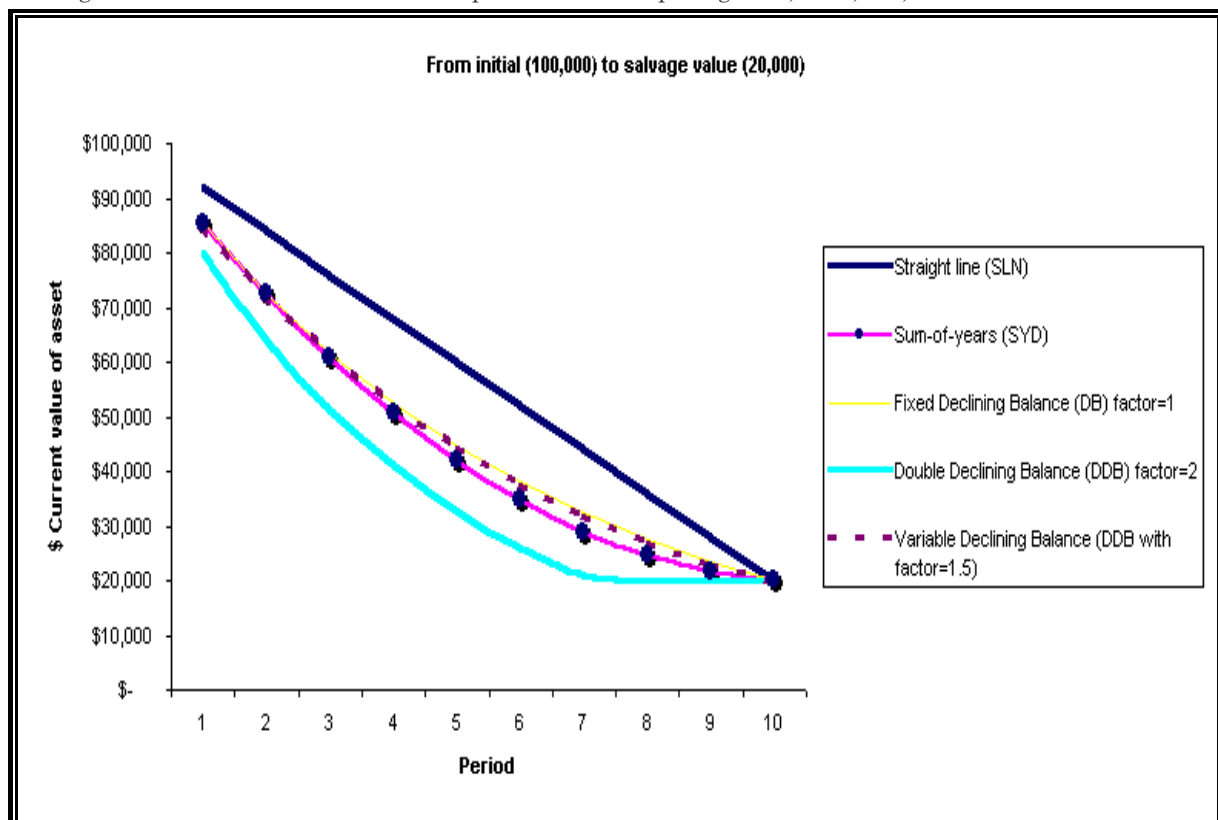
Allowing for a switch over between declining balances and straight line –the VDB function

This function uses a general declining method with <u>switch over</u> to straight line if depreciation goes above straight line before the salvage/end date.

Location: INSERT/ FUNCTION/ FINANCIAL/ VDB

Figure 105: VDB

Select the option INSERT/FUNCTION/FINANCIAL/VDB (*cost* of investment, *salvage* cost, *starting period* which equals zero for 1st period's depreciation, end of period which equals n for period n's depreciation, *factor*, *TRUE* if you do not want to switch to Straight Line and *FALSE* or omitted otherwise)

A comparison of variable declining depreciation is shown in the next table.

Table 17: VDB with factors of 1 and 1.5

Period	General declining method with switch over to straight line if depreciation goes above straight line before salvage date (a use of VDB; using factor=1)	General declining method with switch over to straight line if depreciation goes above straight line before salvage date (a use of VDB; using factor=1.5)
1	$10, 000.00	$15, 000.00
2	$9, 000.00	$12, 750.00
3	$8, 100.00	$10, 837.50

Period	General declining method with switch over to straight line if depreciation goes above straight line before salvage date (a use of VDB; using factor=1)	General declining method with switch over to straight line if depreciation goes above straight line before salvage date (a use of VDB; using factor=1.5)
4	$7, 557.14	$9, 211.88
5	$7, 557.14	$7, 830.09
6	$7, 557.14	$6, 655.58
7	$7, 557.14	$5, 657.24
8	$7, 557.14	$4, 808.66
9	$7, 557.14	$4, 087.36
10	$7, 557.14	$3, 161.69

7.6   **RISK ANALYSIS– "IF-THEN" SCENARIOS**

Discount cash flow analysis has to take into account different scenarios because most of the input information is based on as-yet unknown future cash flows and future financial parameters. A method for including the different possible future scenarios is available through the menu option TOOLS/SCENARIOS. Refer to 15.1.

CHAPTER 8

SECURITIES FUNCTIONS

In this chapter, you will learn about the following topics:

— CALCULATING NUMBER OF DAYS (BETWEEN ISSUE/
PURCHASE/ NEXT COUPON/SETTLEMENT)

— BOND PRICES RESPONSIVENESS TO YIELD

— PRICE, YIELD, AND DISCOUNT RATES FOR A SECURITY

— INTEREST ACCRUALS

— T BILL FORMULAE

8.1 INFORMATION REQUIREMENTS

This section explains the various information/data requirements for the functions taught in this chapter.

— *Issue* is the date the security was issued into the primary securities market.

— *Settlement* is the date (after the issue date) when the current owner purchased the security.

— *Maturity* is the date the securities legal obligations end. For some securities, the maturity date may be the only date when a payment is made. A 30-year bond issued on January 1, 1996 is

purchased by a buyer six months post-issue. The issue date would be January 1, 1996, the settlement date would be July 1, 1996, and the maturity date would be January 1, 2026, 30 years after the January 1, 1996 is the date when the security was issued (first sold)— the issue date.

— *Date of first coupon*: is the security's first coupon date. Furthermore, in chronological descending order, maturity > first coupon > settlement > issue.

— *Date of last coupon*: the security's last coupon date. In addition, in chronological descending order, maturity > settlement > date of last interest payment

— *Rate* is the security's <u>annual</u> coupon rate. (Only relevant for securities that make coupon payments.)

— *Discount Rate* is the discount rate implicit from the security.

— *Price* is the security's price per $100 face value.

— amount invested (*Investment*) or *Present Value* (PV) is the amount invested on the date th security was purchased.

— *Yield* is the annual yield or return on the security

— *Redemption* is the security's redemption value per $100 face value. (Only relevant for securities that hold value at maturity. For some securities, *Redemption* is the security's redemption value per $100 face value.)

— *Frequency* is the number of coupon payments per year.

— If annual, then frequency = 1

— If semiannual, then frequency = 2

— If quarterly, then frequency = 4

— If monthly, then frequency= 12

— *Basis* is the type of day count. The different optional values are listed in the next table.

Table 18: Codes for type of day count

Basis	*Day count*
0 or omitted	30/360 or US basis: 30 days in the month and 360 days in the year.
1	Actual/Actual: Actual number of days in the month and Actual number of days in the year.
2	Actual/360: Actual number of days in the month and 360 days in the year.
3	Actual/365: Actual number of days in the month and 365 days in the year.
4	30360 or European 30 days in the month and 360 days in the year.

8.2 **COUPON-RELATED FUNCTIONS**

COUPDAYBS

This function calculates the number of days from the beginning of the coupon period to the settlement date[10].

Period calculated by the function

COUPDAYBS = Days from beginning of coupon period to the settlement (purchase)

Location within INSERT / FUNCTION: FINANCIAL/COUPDAYBS

Figure 106: The information requirements for the functions COUPDAYBS, COUPDAYS, COUPDAYSNC

---

[10] Assume that a bond is defined by the following terms: January 25, 1998 is the date when the bond was traded (the settlement date). November 15, 1999 is the date when the bond will pay back in full and will close (the maturity date). The security's interest (and coupon payment) is calculated on a semiannual basis -- that is, the security has a semiannual coupon. The type of day count basis is actual number of days in the month and actual number of days in the year -- Actual / Actual basis. For this bond, the number of days from the beginning of the coupon period to the settlement date is:

COUPDAYBS ("1/25/1998", "11/15/1999", 2, 1) = 71

Data requirements
- settlement date

- maturity date

- frequency of payments

- basis

See section 8.1 on page 116 for a definition of each of the information requirements.

COUPDAYS

This function calculates the number of days in the coupon period that contains the settlement date[11].

Period calculated by the function

COUPDAYS = Days in coupon period

Location within INSERT/FUNCTION: FINANCIAL/COUPDAYS

Data requirements
- settlement date

- maturity date

- frequency of payments

[11] Continuing the example from the previous footnote. For this bond, the number of days in the coupon period that contains the settlement date is:

COUPDAYS ("1/25/1998", "11/15/1999", 2, 1) = 181

- basis

(Same as for COUPDAYBS.)

> See section 8.1 on page 116 for a definition of each of the information
> requirements.

COUPDAYSNC

This function calculates the number of days from the settlement date to
the next coupon date[12].

Period calculated by the function

COUPDAYSNC= Days to next coupon after settlement (purchase)

Location within INSERT / FUNCTION: FINANCIAL/COUPDAYSNC

Data requirements
- settlement date
- maturity date
- frequency of payments
- basis

> See section 8.1 on page 116 for a definition of each of the information
> requirements.

---

[12] Continuing the example from the previous footnote. For this bond, the number of
days from the settlement date to the next coupon date is:

COUPDAYSNC ("1/25/1998", "11/15/ 1999", 2, 1) = 110

126

COUPNCD

This function calculates a number that represents the next coupon date after the settlement date[13].

Period calculated by the function

COUPNCD = Next Coupon Date

Location within INSERT/FUNCTION: FINANCIAL/COUPNCD

Data requirements
- settlement date
- maturity date
- frequency of payments
- basis

Same as the previous two functions, but the output is a number — a serial number for the date. To view the number as a date, click Cells on the Format menu, click Date in the Category box, and then click a date format in the Type box.

See section 8.1 on page 116 for a definition of each of the information requirements.

---

[13] Continuing the example from the previous footnote. For this bond, the next coupon date after the settlement date (in the 1900 date system) is:
COUPNCD ("1/25/1998", "11/15/1999", 2, 1) = 35930.

To view the number as a date (May 15, 1998) instead of a serial number (35930), click Cells on the Format menu, click Date in the Category box, and then click a date format in the Type box

COUPPCD

This function calculates a number that represents the previous coupon date before the settlement date[14].

Period calculated by the function

COUPPCD = Previous Coupon Date

Location within INSERT / FUNCTION: FINANCIAL/COUPPCD

Data requirements
- settlement date
- maturity date
- frequency of payments
- basis

Same as for COUPNCD — see above.

See section 8.1 on page 116 for a definition of each of the information requirements.

---

[14] Continuing the example from the previous footnote. For this bond, the previous coupon date before the settlement date (in the 1900 date system) is:

COUPPCD ("1/25/1998", "11 /15/1999", 2, 1) = 35749. or November 15, 1997

To view the number as a date (November 15, 1997) instead of a serial number (35749), click Cells on the Format menu, click Date in the Category box, and then click a date format in the Type box.

COUPNUM

This function calculates the number of coupons payable between the settlement date and maturity date, rounded up to the nearest whole coupon[15].

<u>Number calculated by the function</u>

COUPNUM = Coupon + Number of Coupon Payments from "Now" Till Maturity

Location within INSERT/FUNCTION: FINANCIAL/COUPNUM

<u>Data requirements</u>
- settlement date
- maturity date
- frequency of payments
- basis

Same as for COUPNCD — see above.

See section 8.1 on page 116 for a definition of each of the information requirements.

Table 19: Example of Coupon functions

Issue Date	1/25/1998	

---

[15] Continuing the example from the previous footnote. For this bond, the number of coupon payments is:

COUPNUM ("1/25/1998", "11/15/1999", 2, 1) = 4.

Maturity Date	11/15/1999	…make sure that the dates are in date format. Go to the menu option FORMAT/CELLS/NUMBER. Select the type "Date."
Settlement Date	3/14/1999	
Frequency	2	
Basis	1	
FUNCTIONS	RESULT	
COUPDAYBS	119	…number of days from the beginning of the coupon period to the settlement date
COUPDAYS	181	…number of days in the coupon period that contains the settlement date
COUPDAYSNC	62	…number of days from the settlement date to the next coupon date
COUPNCD	36295	…implies that Excel has returned a "Date Serial Number" instead of the date. If this happens, then go to FORMAT/CELLS/NUMBER. Select the type "Date." The serial number will change to the date shown on the right
COUPPCD	11/15/1998	…previous coupon date before the settlement date
COUPNUM	2	…number of coupons from settlement to maturity

DURATION & MDURATION (Bond price's response to changes in yield) functions

This function calculates the Macaulay duration for an assumed par value of $100[16]. Duration is the weighted average of the present value of future

---

[16] Assume that a bond is defined by the following terms: January 1, 1998 is the date when the bond was traded (the settlement date). January 1, 2006 is the date when the bond will pay back in full and will close (the maturity date)

cash flows. The function measures a bond price's response to changes in the annual yield.

Location: INSERT/FUNCTION/FINANCIAL/DURATION or MDURATION.

Figure 107: Data requirements for DURATION and MDURATION

8 % coupon. 9.0 % yield. Frequency is semiannual. The type of day count basis is actual number of days in the month and actual number of days in the year -- Actual / actual basis (so the value of basis = 1).

-- For this bond, the duration (in the 1900 date system) is:

DURATION ("1/1/1998", "1/1/2006", 0.08, 0.09, 2, 1) = 5.993775

-- For this bond, the modified duration is:

MDURATION ("1/1/1998", "1/1/2006", 0.08, 0.09, 2, 1) = 5.73567

8.3   **PRICE VERSUS YIELD, & INTEREST CALCULATIONS**

8.3.A   SECURITY THAT PAYS PERIODIC INTEREST (COUPON PAYING BOND)

YIELD

This function calculates the yield on a security that pays periodic interest, that is, bonds[17].

Location within INSERT / FUNCTION: FINANCIAL/YIELD

Data requirements
- settlement date
- maturity date
- price or par value
- redemption amount
- frequency of payments
- basis

---

[17] Assume that a bond is defined by the following terms: February 15, 1999 is the date when the bond was traded (the settlement date). November 15, 2007 is the date when the bond will pay back in full and will close (the maturity date)

5.75 % coupon. 95.04287 price. $100 redemption value. Frequency is semiannual. The type of day count basis is 30 days in the month and 360 days in the year -- 30 / 360 basis (so the value of basis = 0).

For this bond, the yield is:

YIELD ("2/15/1999", "11/15/2007", 0.0575, 95.04287, 100, 2, 0) = 0.065 or 6.5 %

- rate, where:

    Rate is the security's <u>annual</u> coupon rate, *Price* is the security's price per \$100 face value, and *Redemption* is the security's redemption value per \$100 face value.

> See section 8.1 on page 116 for a definition of each of the information requirements.

PRICE

This function calculates the price per \$100 face value on a security that pays periodic interest.

Location within INSERT/FUNCTION: FINANCIAL/PRICE

<u>Data requirements</u>
- settlement date

- maturity date

- annual rate

- yield

- redemption amount

- frequency of payments

- basis

> See section 8.1 on page 116 for a definition of each of the information requirements.

ACCRINT

This function calculates the accrued interest for a security that pays

periodic interest.

Location within INSERT / FUNCTION: FINANCIAL/ACCRINT

Data requirements
- issue date

- settlement date

- date of first payment

- annual rate

- par value. If you omit par value a default of $1,000 is used

> See section 8.1 on page 116 for a definition of each of the information
> requirements.

Price and Yield for odd (long or short) first or last period Bonds

Odd First Period

Price per $100 face value

Location within INSERT / FUNCTION: FINANCIAL/ODDFPRICE

Data requirements
- settlement date

- maturity date

- rate

- yield

- redemption amount

- frequency of payments

- basis

- date of first coupon, where:

Date of first coupon: is the security's first coupon date. Furthermore, , in chronological descending order, maturity > first coupon > settlement > issue.

> See section 8.1 on page 116 for a definition of each of the information requirements.

Yield

Location within INSERT/FUNCTION: FINANCIAL/ODDFYIELD

Data requirements
- settlement date

- maturity date

- rate

- price

- redemption amount

- frequency of payments

- basis

- date of first coupon, where:

Date of first coupon: is the security's first coupon date. Furthermore, in chronological descending order, maturity > first coupon > settlement > issue

> See section 8.1 on page 116 for a definition of each of the information requirements.

Odd Last Period

<u>Price per $100 face value</u>

Location within INSERT / FUNCTION: FINANCIAL/ ODDLPRICE

<u>Data requirements</u>
- settlement date
- maturity date
- rate
- yield
- redemption amount
- frequency of payments
- basis
- date of last coupon, where:

Date of last coupon: the security's last coupon date. In addition, , in chronological descending order, maturity > settlement > date of last interest payment

See section 8.1 on page 116 for a definition of each of the information requirements.

Yield

Location within INSERT / FUNCTION: FINANCIAL/ODDLYIELD

<u>Data requirements</u>
- settlement date
- maturity date
- rate

- price

- redemption amount

- frequency of payments

- basis

- date of last coupon, where:

Date of last coupon: the security's last coupon date. Furthermore, maturity > settlement > date of last interest payment

---

See section 8.1 on page 116 for a definition of each of the information requirements.

8.3.B A DISCOUNTED SECURITY[18] WHICH MAY PAY REDEMPTION AT MATURITY

DISC

This function calculates the discount rate for a security[19].

Location within INSERT/FUNCTION: FINANCIAL/ DISC

---

[18] Assume that a bond is defined by the following terms:

- February 15, 1999 is the date when the bond was traded (the settlement date)

- March 1, 1999 is the date when the bond will pay back in full and will close (the maturity date)

- 5.25 % discount rate

- $100 redemption value

- The type of day count basis is actual number of days in the month and 360 days in the year -- Actual / 360 basis (so the value of basis = 2) basis

The bond price (in the 1900 date system) is:

PRICEDISC ("2/15/1999", "3/1/1999", 0.0525, 100, 2) = 99.79583

[19] Assume that a bond is defined by the following terms: February 15, 1998 is the date when the bond was traded (the settlement date). June 10, 1998 is the date when the bond will pay back in full and will close (the maturity date). $97.975 is the market price of the security. $100 redemption value. The type of day count basis is actual number of days in the month and 360 days in the year -- Actual / 360 basis (so the value of basis = 2) basis.

For this bond, the discount rate is:

DISC ("2/15/1998", "6/10/1998", 97.975, 100, 2) = 0.063391 or 6.3391 %

Figure 108

Data requirements
- settlement date

- maturity date

- basis

- price

- redemption amount, where:

Price is the security's price per $100 face value and *Redemption* is the security's redemption value per $100 face value.

See section 8.1 on page 116 for a definition of each of the information requirements.

PRICEDISC

This function calculates the price per $100 face value of a discounted security

Location within INSERT/FUNCTION: FINANCIAL/ PRICEDISC

Data requirements
- settlement date

- maturity date

- discount rate

- annual yield

- redemption amount

YIELDDISC

This function calculates the annual yield for a discounted security

Location within INSERT/FUNCTION: FINANCIAL/ YIELDDISC

Data requirements
- settlement date

- maturity date

- price per $100 face value

- redemption amount

- basis

See section 8.1 on page 116 for a definition of each of the information requirements.

8.3.C   SECURITY THAT PAYS INTEREST AT MATURITY[20]

PRICEMAT

This function calculates the price per $100 face value of a security that pays interest at maturity

Location within INSERT/FUNCTION: FINANCIAL/ PRICEMAT

Data requirements
- settlement date
- maturity date
- issue date
- discount rate
- annual yield

See section 8.1 on page 116 for a definition of each of the information requirements.

---

[20] Assume that a bond is defined by the following terms: February 15, 1999 is the date when the bond was traded (the settlement date). April 13, 1999 is the date when the bond will pay back in full and will close (the maturity date)

November 11, 1998 is the date when the security was issued (first sold)-- the issue date. 6.1 % The security's interest (and coupon payment) is calculated on a semiannual basis -- that is, the security has a semiannual coupon. 6.1 % yield. The type of day count basis is 30 days in the month and 360 days in the year -- 30 / 360 basis (so the value of basis = 0)

For this bond, the price is:

PRICEMAT ("2/15 /1999", "4/13/1999", "11/11/1998", 0.061, 0.061, 0) = 99.98449888

YIELDMAT

This function calculates the annual yield of a security that pays interest at maturity

Location within INSERT/FUNCTION: FINANCIAL/ YIELDMAT

Data requirements
- settlement date
- maturity date
- issue date
- discount rate
- price per $100 face value (par value)

See section 8.1 on page 116 for a definition of each of the information requirements.

ACCRINTM

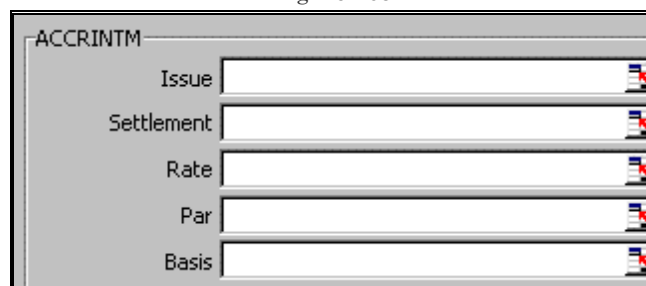This function calculates the accrued interest for a security that pays interest at maturity[21].

Location within INSERT/FUNCTION: FINANCIAL/ ACCRINTM

---

[21] A treasury note has the following terms: April 1, 1998 is the date when the security was issued (first sold)-- the issue date. June 15, 1998 is the date when the bond will pay back in full and will close (the maturity date). 10.0 % coupon. $1,000 par value. The type of day count basis is actual number of days in the month and 365 days in the year -- Actual / 365 basis (so the value of basis = 3).

For this treasury note, the accrued interest (in the 1900 date system) is:

ACCRINTM ("4/1/1998", "6/15/1998", 0.1, 1000, 3) = 20.54795

Figure 109

Data requirements

- settlement date

- issue date

- basis

- discount rate

- price per $100 face value (par value). If you omit par, ACCRINTM uses $1,000.

See section 8.1 on page 116 for a definition of each of the information requirements.

FULLY INVESTED SECURITY

INTRATE

This function calculates the interest rate for a fully invested security[22].

Location within INSERT/FUNCTION: FINANCIAL/ INTRATE

Data requirements
- settlement date

- maturity date

- discount rate

- amount invested (Investment)

- basis

> See section 8.1 on page 116 for a definition of each of the information
> requirements.

RECEIVED

This function calculates the amount received that is, the redemption) at

---

[22] Assume that a bond is defined by the following terms: February 15, 1999, settlement
(and also the -issue) date. May 15, 1999 is the date when the bond will pay back in
full and will close (the maturity date). 1, 000, 000 investment. 5.75 % discount rate.
The type of day count basis is actual number of days in the month and 360 days in
the year -- Actual / 360 basis (so the value of basis = 2).

For this bond, the total amount received at maturity (in the 1900 date system) is:

RECEIVED ("2/15/1999", "5/15/1999", 1000000, 0.0575, 2) = 1, 014, 420.266,
or $1, 014, 420.27

maturity for a fully invested security.

Location within INSERT / FUNCTION: FINANCIAL/ RECEIVED

<u>Data requirements</u>

- settlement date

- maturity date

- discount rate

- amount invested (Investment)

- basis

See section 8.1 on page 116 for a definition of each of the information requirements.

8.4   INFORMATION REQUIREMENTS FOR LOAN REPAYMENT AND SECURITIES FUNCTIONS

Table 20: Summary of information requirements for loan repayment and securities functions

Function	Information requirements for function														
	Dates				Prices and par values					Frequency, and related			Yields and interest/ discount rates		
	Issue	First coupon	Settlement	Maturity	Price	Par/coupon	Any amount paid at maturity	Investment amount	Redemption amount	Frequency of payments pa	# of periods	Basis	Yield	Discount	Interest
COUPDAYBS			✓	✓						✓		✓			
COUPDAYS			✓	✓						✓		✓			
COUPDAYSNC			✓	✓						✓		✓			
COUPNCD			✓	✓						✓		✓			
COUPPCD			✓	✓						✓		✓			

Function	Issue	First coupon	Settlement	Maturity	Price	Par/coupon	Any amount paid at maturity	Investment amount	Redemption amount	Frequency of payments pa	# of periods	Basis	Yield	Discount	Interest
Information requirements for function															
	Dates				Prices and par values					Frequency, and related			Yields and interest/ discount rates		
COUPNUM			✓	✓						✓		✓			
DURATION			✓	✓		✓				✓			✓		
MDURATION			✓	✓		✓				✓			✓		
PRICE			✓	✓			✓		✓				✓		✓
PRICEDISC			✓	✓			✓		✓			✓		✓	
PRICEMAT	✓		✓	✓			✓						✓		✓
RECEIVED			✓	✓				✓				✓		✓	
YIELD			✓	✓	✓		✓	✓		✓		✓			✓
YIELDDISC			✓	✓	✓		✓	✓				✓			
YIELDMAT	✓		✓	✓	✓							✓			✓
ACCRINT	✓	✓	✓			✓				✓		✓			✓
ACCRINTM	✓			✓		✓						✓			✓
INTRATE			✓	✓			✓	✓	✓			✓			
DISC			✓	✓	✓		✓	✓				✓			

8.5

T BILL FORMULAE

TBILLEQ function

This function estimates the "bond-equivalent" yield for a T-Bill.

Location within INSERT / FUNCTION: FINANCIAL/TBILLEQ

Data requirements
- settlement date
- maturity date

- discount rate

See section 8.1 on page 116 for a definition of each of the information requirements.

Example:

TBILLEQ ("3/31/1999", "6/1/1999", 0.0914) = 0.094151 or 9.4151 %

Figure 110: TBILLEQ

TBILLPRICE function

This function evaluates the price per $100 face value (this value is the amount the Treasury – the issuer of the T-Bill -- has to pay you at maturity) of a T-Bill, given the *Settlement* and *Maturity* dates, and the *Discount Rate.*

The price must be less than 100, because an investor will only purchase a T-Bill if the amount she receives at maturity (which is always $100 per $100 face value) is more than the market price of the T–Bill.

Figure 111: TBILLPRICE

Location within INSERT/FUNCTION: FINANCIAL/ TBILLPRICE

Data requirements
- settlement date
- maturity date
- discount rate

See section 8.1 on page 116 for a definition of each of the information requirements.

For Example, if 9% (or 0.09) is the discount rate on a T-Bill purchased on 3/31/1999 maturing on 6/1/1999, then the price per $100 face value of the T-Bill is:

TBILLPRICE ("3/31/1999", "6/1/1999", 0.0914) = 98.45

Table 21: Example of functions for estimating the bond-equivalent T-Bill yield and the market price (par value) of a T-Bill[23].

Settlement Date	3/31/1999	
Maturity Date	6/1/1999	
Discount Rate	9.14%	
Function	Result	
TBILLEQ	9.42%	The 9.14% yield of the T-Bill is equivalent to a Bond with a yield of 9.42%

---

[23] The example is in the worksheet "T-Bill formulas given discount" in the sample file "T-Bill.xls." Additional samples will be available at http://www.vjbooks.net/excel/samples.htm.

TBILLPRICE	98.43	Price per $100 face value— this value is the amount the Treasury has to pay you at maturity— of a T-Bill

TBILLYIELD function: Yield for a treasury bill (given market price or par value)

This function measures the yield of a T-Bill, given the *Settlement* and *Maturity* dates, and the Treasury bill's *Price* per $100 face value.

Location within INSERT / FUNCTION: FINANCIAL/TBILLYIELD.

Figure 112: TBILLYIELD

Data requirements
- settlement date
- maturity date
- Price per $100 face value

See section 8.1 on page 116 for a definition of each of the information requirements.

For Example, if 98.45 is the market price of the security per $100 face value of a T-Bill purchased on 3/31/1999 maturing on 6/1/1999, then:

TBILLYIELD ("3/31/1999", "6/1/1999", 98.45) = 0.091417 or 9.1417 %

Table 22: T-Bill Yield. The example is in the worksheet "T-Bill Yield" in the sample file "T-Bill.xls."

Settlement Date	3/31/1999	
Maturity Date	6/1/1999	
Price	98.40	(market price of the security per $100 face value)
Function	Result	
TBILLYIELD	9.44%	The yield on the T-Bill

Page for Notes

FUNCTIONS FOR BASIC STATISTICS

This chapter discusses the following topics:

— "AVERAGED" MEASURES OF CENTRAL TENDENCY

— AVERAGE, TRIMMED MEAN, HARMONIC MEAN, GEOMETRIC MEAN

— LOCATION MEASURES OF CENTRAL TENDENCY

— MEDIAN, MODE

— OTHER LOCATION PARAMETERS

— QUARTILE, PERCENTILE

— MAXIMUM VALUE, MINIMUM VALUE, LARGE, SMALL

— RANK OR RELATIVE STANDING OF EACH CELL WITHIN THE RANGE OF A SERIES

— MEASURES OF DISPERSION (STANDARD DEVIATION & VARIANCE)

— STDEV, VAR, STDEVA, VARA, STDEVP, VARP, STDEVPA, VARPA

— SHAPE ATTRIBUTES OF THE DENSITY FUNCTION

— SKEWNESS, KURTOSIS

— FUNCTIONS ENDING WITH AN "A" SUFFIX

I am presuming that the reader is familiar with basic statistical functions and/or has access to a basic statistics reference for learning more about

each function.

9.1 "AVERAGED" MEASURES OF CENTRAL TENDENCY

These set of functions perform some type of averaging to measure a "mean" value. You may want to use the Trimmed Mean function to estimate an average that excludes the extreme values of the data series. The Harmonic Mean estimates the averages of the reciprocals of the numbers in the series. The Geometric Mean is used to average rates of change.

Samples will be available at http://www.vjbooks.net/excel/samples.htm.

9.1.A AVERAGE

The function calculates the simple arithmetic average of all cells in the chosen range.

Menu path to function: Go to the menu option INSERT/FUNCTION and choose the formula "AVERAGE the function category STATISTICAL.

Figure 113: AVERAGE function
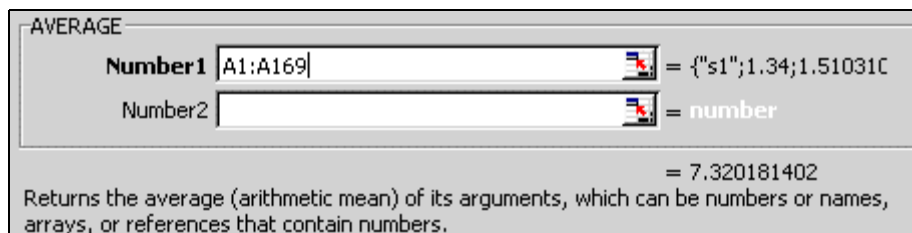
Data requirements: The X values can be input as references to one or more ranges that may be non–adjacent. The second range can be referenced in the first text-box "Number1" after placing a comma after the first range, or it could be referenced in the second text-box "Number2." If you use the second text-box, then a third text-box "Number3" will automatically open. (As you fill the last visible box, another box opens until the maximum number of boxes — 30 — is reached.)

The function does not count invalid cell values when counting the number of X values. The X values can take any real number value.

9.1.B   TRIMMEAN ("TRIMMED MEAN")

This function is a variation of the average or mean. This function calculates the average for a set of X values after removing "extreme values" from the set. The excluded cells are chosen by the user based on the extremity (from mean/median) of the values in the range. TRIMMEAN calculates the mean taken by excluding a percentage of data points from the top and bottom tails of a data set. The user decides on the percentage of extreme values to drop. For symmetry, TRIMMEAN excludes a set of values from the top and bottom of the data set before moving on to the next exclusion.

Menu path to function: INSERT/FUNCTION/STATISTICAL/TRIMMEAN.

Data requirements: The X values can be input as references to one or more ranges that may be non–adjacent. The function does not count invalid cell values when counting the number of X values. The X values can take any real number value.

Figure 114: TRIMMEAN (Trimmed Mean)

In the dialog (shown above), *Percent* is the fractional number of data points to exclude from the calculation. Percent must be greater than zero and less than one.

9.1.C   HARMEAN ("HARMONIC MEAN")

The function calculates the harmonic mean of all cells in the chosen range(s). The harmonic mean is the reciprocal of the arithmetic mean of reciprocals. In the formula below, H is the harmonic mean, n the sample/range size and the Y's are individual data values.

Menu path to function: INSERT/FUNCTION/STATISTICAL/HARMEAN.

Figure 115: HARMEAN (Harmonic Mean)

Data requirements: The X values can take any real number value except zero.

Table 23: Comparing the results of the functions Average, Trimmed Mean and Harmonic Mean

Function	s1	s2	x1	x2	x3	x4
Average/mean	7.32	7.23	1173.00	14.55	0.17	1158.45
Trimmed Mean	7.13	7.00	1173.00	14.42	0.02	1158.71
Harmonic Mean	3.84	3.18	120.17	13.52	0.01	#NUM!

Harmonic mean for x4 is zero because one value of x4 is not positive.

9.1.D   GEOMEAN   ("GEOMETRIC MEAN")

This function is typically used to calculate average growth rate given compound interest with series rates. In general, the function is good for estimating average growth or interest rates.

Menu path to function: INSERT/ FUNCTION/ STATISTICAL/ GEOMEAN. *Data requirements*: All values should be positive.

Figure 116: GEOMEAN (Geometric Mean)

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9.2   **LOCATION MEASURES OF CENTRAL TENDENCY (MODE, MEDIAN)**

The Median and — less often — the Mode are also used for estimating the central tendency of a series. The Median is much better in situations where, either:

(a) A few extreme highs or lows are influencing the Mean (note that the TRIMMEAN or Trimmed Mean function shown in the previous section can reduce the chance of extreme values over-influencing a Mean estimate), or

(b) The central tendency is required to obtain the mid-point of observed values of the data series as in the "Median Voter" models, which are used to know if the "Median Voter" threshold is crossed in support of a point on the nominee's agenda. (In a two-person face-off, any more than the Median vote will result in a greater than 50% majority).

Samples will be available at http://www.vjbooks.net/excel/samples.htm.

Figure 117: Some location indicators
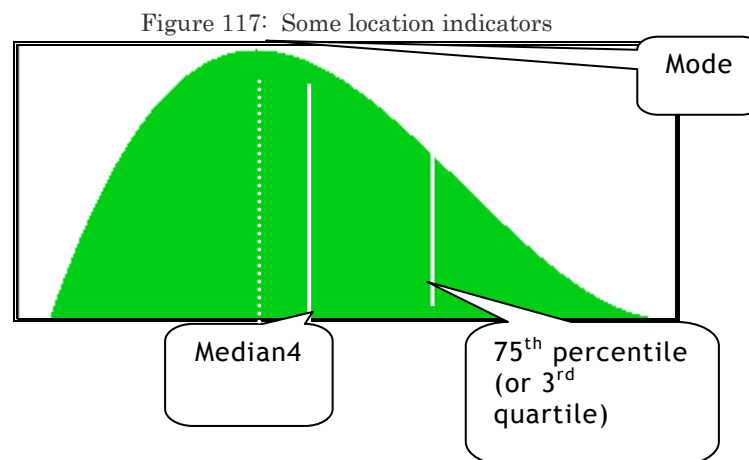
9.2.A MEDIAN

The Median is the number in the middle of a set of numbers. It is the 50th percentile.

Menu path to function: INSERT/FUNCTION/STATISTICAL/MEDIAN.
Data requirements: Any array/range with real numbers.

9.2.B MODE

This function returns the most frequently occurring value in a range.

Menu path to function: INSERT/FUNCTION/STATISTICAL/MODE.
Data requirements: Any array/range with real numbers. The range has to contain duplicate data values.

9.3 **OTHER LOCATION PARAMETERS (MAXIMUM, PERCENTILES, QUARTILES, OTHER)**

Other useful location indicators for key points in a series are the quartiles, percentiles, maximum value, minimum value, the Kth largest value, and the rank.

Samples will be available at http://www.vjbooks.net/excel/samples.htm.

9.3.A   QUARTILE

This function calculates a quartile of a data series.

QUARTILE (Data, Quartile)

Choose the quartile you desire to obtain. The five quartiles are shown in the next table.

Table 24: Choosing the Quartile

Quartile value of…	*Calculates the...*
0	0.0….1% ile
1	First quartile (25th percentile)
2	Median value (50th percentile)
3	Third quartile (75th percentile)
4	Fourth quartile (99.9x%ile)

Menu path to function: INSERT/FUNCTION/STATISTICAL/QUARTILE.

Data requirements: Any array/range with real numbers. Note: the data series has to contain between 1 and 8,191 data points

9.3.B   PERCENTILE

This function returns the Pth percentile of values in a data series. You can use this function to establish a threshold of acceptance. For example, you can prefer to examine candidates who score above the 95th percentile will qualify for a scholarship.

Menu path to function:

INSERT/FUNCTION/STATISTICAL/PERCENTILE.

Figure 118: Estimating the 5th percentile. K is the percentile value in the range 0 to 1.

Data requirements: Any array/range with real numbers. If the data array is empty or contains more than 8,191 data points, PERCENTILE returns the" #NUM!" error value. If K is not a multiple of (1/(n — 1)), then Excel interpolates the value at the Kth percentile.

Figure **119**: Estimating the 95th percentile

9.3.C   MAXIMUM, MINIMUM AND "KTH LARGEST"

MAX ("Maximum value")

MAX and MAXA: The functions calculate the largest value in a series.

Menu path to function: STATISTICAL/MAX , & STATISTICAL/MAXA.

Data Requirements: Any array/range with real numbers. In addition, MAXA may include "True," "False," or numbers in text format

MIN ("Minimum value")

MIN and MINA: The functions calculate the smallest value in a series

Menu path to function: STATISTICAL/MIN, & STATISTICAL/MINA

Data Requirements: Any array/range with real numbers. In addition, MINA include "True," "False," or numbers in text format

LARGE

This function calculates the Kth largest value in a range.

Figure 120: LARGE

Menu path to function: STATISTICAL/LARGE

Data Requirements: Any real number.

SMALL

This function calculates the Kth smallest value in a range.

Menu path to function: STATISTICAL/SMALL

Data Requirements: Any real number.

9.3.D   RANK OR RELATIVE STANDING OF EACH CELL WITHIN THE
             RANGE OF A SERIES

PERCENTRANK

The PERCENTRANK function returns the rank of a value in a data set as
a percentage of the data set. The function can be used to evaluate the
relative standing of a value within a data set. For example, you can use
PERCENTRANK to evaluate the standing of a test score among all scores
for the test.

Figure 121: Percentrank of the average/mean

Menu path to function: INSERT/FUNCTION / STATISTICAL /
PERCENTRANK.

Data requirements: Any array/range with real numbers.

RANK

The function RANK calculates the relative rank of a value within a series of numbers data. You can choose to obtain the ranks on the basis of ascending or descending values. X is the data point whose rank is desired within the range. Order sets the sorting direction— 1 for ascending ranking, 0 or blank for descending ranking. Cells with the same value cells are given the same rank.

Menu path to function: INSERT / FUNCTION / STATISTICAL / RANK.

Data requirements: Any array/range with real numbers.

9.4 **MEASURES OF DISPERSION (STANDARD DEVIATION & VARIANCE)**

Table 25: Standard Deviation & Variance.

Function	*Description*	*Location within INSERT / FUNCTION*	*Data Requirements*

Function	Description	Location within INSERT / FUNCTION	Data Requirements
ple dispersion: EV, VAR	The functions STDEV and VAR estimate the sample standard deviation and variance, respectively. VAR is the square of STDEV.	STATISTICAL / STDEVA & STATISTICAL / VARA	Any range with sufficient number of numeric data points. Text and logical values are excluded.
STDEVA, VARA	These are variants of the functions above but with a wider range of acceptable data types as input data.	STATISTICAL / STDEVA & STATISTICAL / VARA	Text and logical values such as TRUE and FALSE are included in the calculation. TRUE is valued as 1; text or FALSE is valued as 0.
ulation dispersio EVP, P	The less often used population dispersion functions are sometimes also used for large sample sizes. STDEVP assumes that its data are the entire population. Typically, you use the sample formulae. For large sample sizes, STDEV and STDEVP return approximately equal values. VARP is square of STDEVP	STATISTICAL / STDEVA & STATISTICAL / VARA	A large number of observations. Text and logical values are excluded.
STDEVPA, VARPA	These are variants of the functions above but with a wider range of acceptable data types as input data	STATISTICAL / STDEVA & STATISTICAL / VARA	Text and logical values such as TRUE and FALSE are included in the calculation. TRUE is valued as 1; text or FALSE is valued as 0. Text and logical values such as TRUE and FALSE are included in the calculation. TRUE

Function	Description	Location within INSERT / FUNCTION	Data Requirements
			is valued as 1; text or FALSE is valued as 0.

Figure 122: Dialog for STDEV

Figure 123: Dialog for STDEVA. Note that the functions with the "A" suffix request "Values" as input while the equivalent non–suffixed functions request "Numbers"

9.5

SHAPE ATTRIBUTES OF THE DENSITY FUNCTION (SKEWNESS, KURTOSIS)

9.5.A   SKEWNESS

Skewness measures asymmetry around the mean. The parameter is best interpreted as relative to the Normal Density Function (whose Skewness equals zero). The interpretation of the Skewness for a series (relative to the Normal Density Function) is:

— Skewness > 0 → asymmetric tail with more values above the mean.

— Skewness < 0 → asymmetric tail with more values below the mean.

The next three figures shown Density Functions that have a Skewness > 0, = 0, and < 0, respectively, for three variables Y1, Y2 and Y3. (Y2 is distributed Normally).

Figure 124: Distribution of series Y1.
Skewness > 0
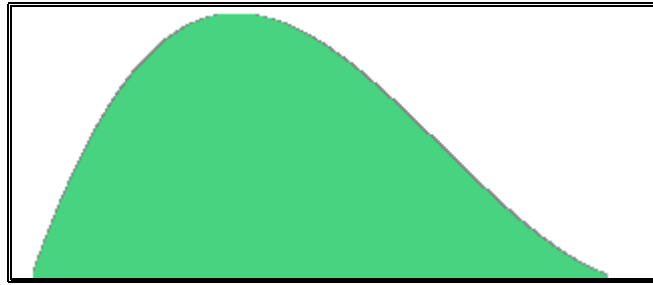
Figure 125: Distribution of series Y2.
Skewness = 0.
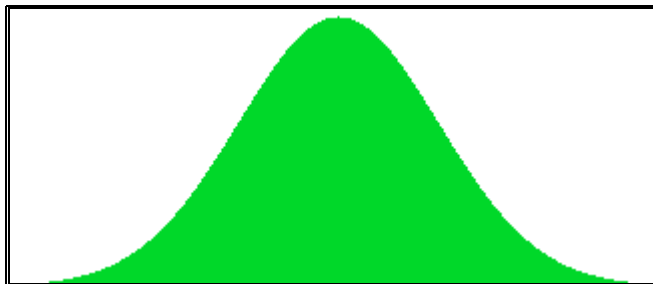
Figure 126: Distribution of series Y3
Skewness < 0

Samples will be available at http://www.vjbooks.net/excel/samples.htm.
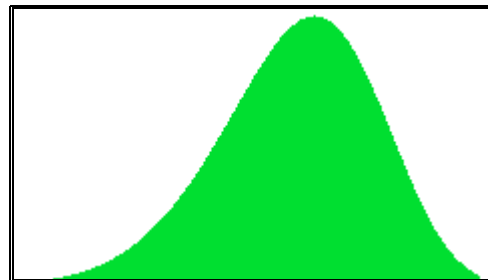
Figure 127: SKEW (Skewness)
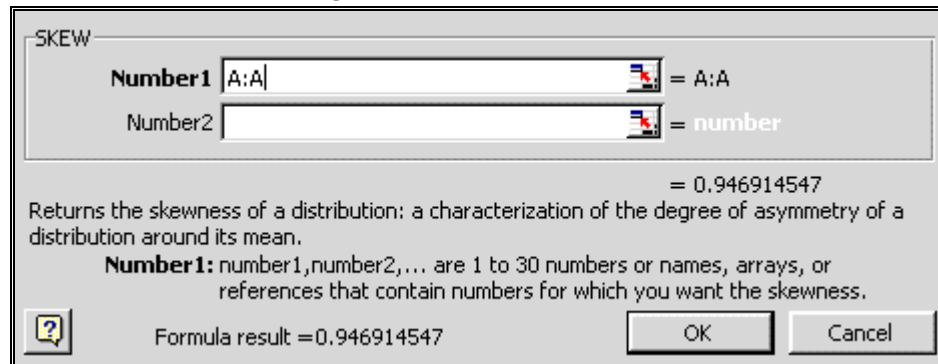
Menu path to function: INSERT / FUNCTION / STATISTICAL / SKEW

9.5.B   KURTOSIS

Compared with the Normal Density Function (which has a Kurtosis of zero), the interpretation of the kurtosis for a series is:

— Kurtosis > 0→ peaked relative to the Normal Density Function

— Kurtosis < 0→ flat relative to the Normal Density Function

The next figure shows three Density Functions. The Density Functions lie around the same Mean and Median, but note the difference in the relative flatness of the Density Functions:

Distribution of series X1 is the flattest with a Kurtosis < 0, that of X2 is less flat with a Kurtosis = 0 (a Normal Density Function) and that of series X3 is the least flat with a Kurtosis > 0.

Figure 128: Example of Density Functions with different Skewness

Samples will be available at http://www.vjbooks.net/excel/samples.htm.
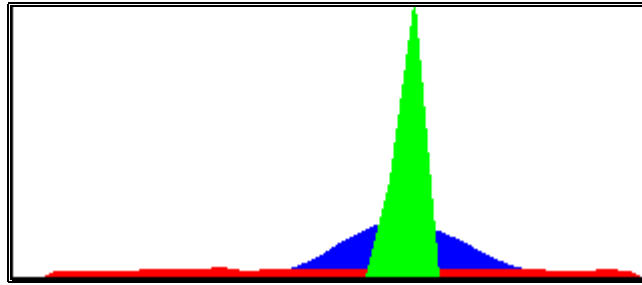
Menu path to function: INSERT / FUNCTION / STATISTICAL / KURT

9.6   **FUNCTIONS ENDING WITH AN "A" SUFFIX**

These functions calculates the same statistic as their "twin" formula (the one without the prefix "A") but include a wider range of valid cell values in the relevant formula. The "A" –suffixed functions include the following types of cell values:

— Logical (and not numeric) like "True" and "False" (valued as 1 and 0, respectively),

— Blank cells (valued as 0), and

— Text (valued as 0).

A text string or a blank cell is valued as zero. The next table lists these twin functions:

Table 26: Functions ending with the "A" suffix.

The non–prefixed function	*The "A" prefixed "twin" formula*	*Comment*
AVERAGE	AVERAGEA	Simple average/mean
COUNT	COUNTA	Count of valid cells. The prefixed function is very useful in counting.
STDEV	STDEVA	Standard deviation
STDEVP	STDEVPA	Standard deviation from a population or a very large sample (relative to population)
VAR	VARA	Variance
VARP	VARPA	Variance from population (and not sample) data, or from a very large sample (relative to population)
MIN	MINA	Minimum value
MAX	MAXA	Maximum value

<div align="right">

CHAPTER 10

</div>

OTHER MATHEMATICS & STATISTICS FUNCTIONS

This chapter briefly displays some other functions available in Excel. The topics in this chapter are:

— COUNTING AND SUMMING

— COUNT, COUNTA

— COUNTBLANK

— COMPARING COUNT, COUNTA AND COUNTBLANK

— SUM

— PRODUCT

— SUMPRODUCT

— THE "IF "COUNTING AND SUMMING FUNCTIONS

— SUMIF

— COUNTIF

— TRANSFORMATIONS (LIKE LOG, EXPONENTIAL, ABSOLUTE, ETC)

— STANDARDIZING A SERIES THAT FOLLOWS A NORMAL DENSITY FUNCTION

— DEVIATIONS FROM THE MEAN

— CROSS SERIES RELATIONS

— COVARIANCE AND CORRELATION FUNCTIONS

— SUM OF THE SUM OF THE SQUARES OF TWO VARIABLES

— SUM OF THE SQUARES OF DIFFERENCES ACROSS TWO
VARIABLES

— SUM OF THE DIFFERENCE OF THE SQUARES OF TWO
VARIABLES

10.1   COUNTING AND SUMMING

COUNT function

This function counts the number of valid cells in a range. Cells are valid
only if there value is numeric or a date.

Menu path to function: INSERT / FUNCTION / STATISTICAL
/ COUNT.

Data requirements: Numbers and dates are included in the count. Not
counted cells include those that contain error values, text, blank cells, and
logical values (like TRUE and FALSE). The X values can be input as
references to one or more ranges that may be non–adjacent.

The second range can be referenced in the first text-box "Value1" after
placing a comma after the first range, or it could be referenced in the
second text-box "Value2."

If you use the second text-box, then a third text-box "Value3" will
automatically open. (As you fill the last visible box, another box opens
until the maximum number of boxes — 30 — is reached.)

Table 27: Sample data for the "Count" functions.
The example is in the sample file "Count.xls."

A	B	C	D
	Y	Date	Respondent is employed
.51	24.34	24— Sep— 2000	TRUE
20.07	24.34	25— Sep— 2000	FALSE
VALUE!	24.34	26— Sep— 2000	#VALUE!
15.28	24.34	27— Sep— 2000	FALSE
DIV/0!	#VALUE!	28— Sep— 2000	TRUE
11.63	24.34	29— Sep— 2000	#N/A!
.86		30— Sep— 2000	TRUE
REF!	22.00	1— Oct— 2000	FALSE
.74	22.00		TRUE
NAME?	22.00	3— Oct— 2000	
.13	22.00	4— Oct— 2000	TRUE
N/A!	21.58	5— Oct— 2000	TRUE

Figure 129: COUNT

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COUNTA function also counts cells with logical or text values

This function counts the number of valid cells in a range. Valid values include cells with numeric, date, text, logical, or error value. COUNTA only excludes empty cells, but text and logical values are only counted if you type them directly into the list of arguments are counted. If an argument is a data array or range reference, only numbers in that data array or range reference.

Figure 130: The function COUNTA is a variant of the COUNT function. The example is in the sample file "Count.xls."
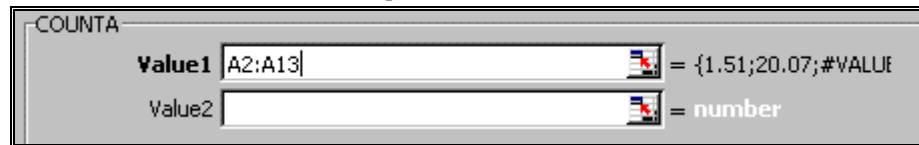
Menu path to function: INSERT / FUNCTION / STATISTICAL / COUNTA.

Data requirements: Unlike the COUNT function, COUNTA will include the label row in the count. (So, if you have one label in the referenced range, you may want to use "= COUNTA (A:A) — 1".) The X values can be input as references to one or more ranges that may be non–adjacent. The second range can be referenced in the first text-box "Value1" after placing a comma after the first range, or it could be referenced in the second text-box "Value2." If you use the second text-box, then a third text-box "Value3" will automatically open. (As you fill the last visible box, another box opens until the maximum number of boxes — 30 — is reached.) The function does not count invalid cell values when counting the number of X values.

COUNTBLANK function counts the number of empty cells in the range reference

This function counts the number of blank cells in a range.

Menu path to function: INSERT /FUNCTION /INFORMATION/COUNTBLANK.

Figure 131: COUNTBLANK. The example is in the sample file "Count.xls."
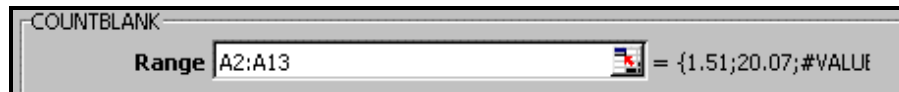
SUM function

This function sums the values in the data array.

$$SUM = X_1 + X_2 + \dots + X_n$$

Menu path to function: INSERT / FUNCTION / MATH / SUM.

Figure 132: SUM
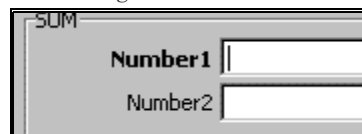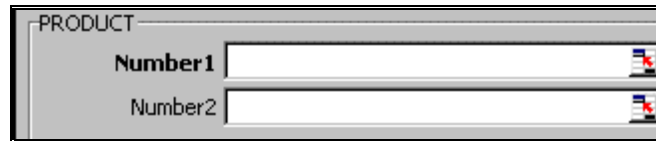
Data requirements: This function does not include blank cells or cells with values that are of the following formats: text, and logical values (that is, TRUE and FALSE.)

PRODUCT function

This function multiplies all the values referenced.

PRODUCT = $X_1 * X_2 *....* X_n$

Figure 133: PRODUCT (multiplying all the values in a range)
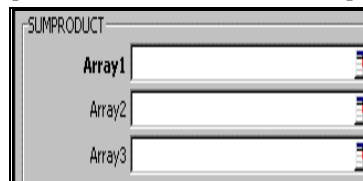
Menu path to function: INSERT / FUNCTION / MATH / PRODUCT.

SUMPRODUCT function

This function multiplies corresponding components in two or more data arrays/ranges, and then sums the results of these multiplications. The data arrays/ranges must have the same number of data points.

Menu path to function: INSERT /FUNCTION /MATH /SUMPRODUCT

Figure 134: SUMPRODUCT (multiplying individual data points across data series and then adding up the results of all these multiplications).

Data Array1, data Array2, data Array3 ... are 2 to 30 data arrays/ranges whose components you desire to multiply and then add. The minimum number of arrays is two. The data arrays must have the same number of data points. Non-numeric cell values are assigned the value of zero.

The X values can be input as references to two or more ranges that may be non–adjacent. The second range should be referenced in the second text-box "Array2." If you use the third text-box, then a fourth text-box "Array4" will automatically open. (As you fill the last visible box, another box opens until the maximum number of boxes — 30 — is reached.)

Example

The following formula multiplies all the components of the two data arrays on the preceding worksheet and then adds the products— that is, 3*2 + 4*7 + 8*6 + 6*7 + 1*5 + 9*3.

Note:

Samples will be available at http://www.vjbooks.net/excel/samples.htm.

Figure 135: Columns A and B make up one data series while columns D and E make up the other data series

10.2   THE "IF" COUNTING AND SUMMING FUNCTIONS: STATISTICAL FUNCTIONS WITH LOGICAL CONDITIONS
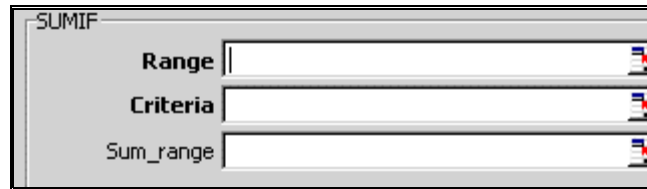
I display two "if-then" two-step functions in this section. The functions first evaluate a criterion. If a cell in the referenced range satisfies the criteria then the second part of the function includes this cell.

SUMIF function

This function adds the values in a range if the cell with the value satisfies a user-defined criterion.

- In the box *Range*, enter a reference to the range of cells you want evaluated.

Figure 136: SUMIF (summing only the cells whose value satisfies one "if" condition)

- In the box *Criteria*, enter the condition (a number, expression, or text) that defines which cells values will be summed. For example, *Criteria* can be expressed as 32, "32," ">32".

- In the box *Sum_range*, you may reference the actual cells to sum. The cells in sum range are summed only if their corresponding cells in the entire *Range* match the criteria. If sum range is omitted, all the "criterion-satisfying" cells in the *Range* are summed.

Menu path to function: INSERT / FUNCTION / MATH / SUMIF. The Criteria should be relevant to the type of data/text in the queried range.

COUNTIF function

This function counts the number of cells in a range that satisfy a user-defined criterion.

The dialog for "COUNTIF" requires two inputs from the user. The "Range" is similar to the functions shown previously. The "Criteria" is a logical condition set by you.

Figure 137: COUNTIF (counting only the cells whose value satisfies one "if" condition)
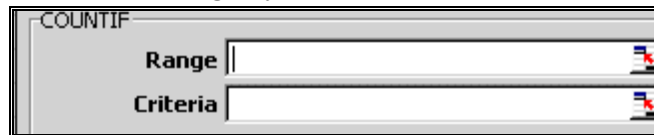
- In the box *Range*, enter a reference to the range of cells you seek to evaluate.

- In the box *Criteria*, enter the condition (a number, expression, or text) that defines which cells will be counted. For example, *Criteria* can be expressed as 32, "32," ">32," "tea."

Menu path to function: INSERT /FUNCTION /STATISTICAL /COUNTIF.

Data requirements: The range can take any values. The Criteria should be relevant to the type of data/text in the queried range.

Example

Choose the range "D:D" and the condition ">1,000,000". The function is "Count the number of cases in the range D:D, but only if the value of the cell is greater than 1 million."

For a pictorial reproduction of this, see the next figure.

Figure 138: Entering the data input and logical criterion

Execute the dialog by clicking on the button OK. The formula is written onto the cell. The next figure illustrates this. Depress the ENTER key.

Figure 139: The function as written into the cell

10.3

TRANSFORMATIONS (LOG, EXPONENTIAL, ABSOLUTE, SUM, ETC)

Table 28: Common transformation functions

Function	*Description*	*Location within INSERT /FUNCTION*	*Data Requirements*
Sign	This function outputs the sign of a number. Returns 1 if the number is positive, zero (0) if the number is 0, and –1 if the number is negative. Useful for red–flagging data, or using in functions like IF, COUNTIF, SUMIF and CHOOSE.	MATH /SIGN	Any real value.

Function	Description	Location within INSERT /FUNCTION	Data Requirements
Absolute number	ABS = | X |	MATH /ABS	One real number.
Square root	The square root of a number. $Y = X^{1/2}$	MATH/SQRT	One positive real number.
Log natural	LN (X) This function calculates the natural logarithm of a number. Natural logarithms are based on the constant e (2.718). LN (85) = 4.454347. This mean: "If you raise the base e to the power of 4.45 you will get 85. → LN (85) = 4.45. Conversely, exp (4.45) = e^ (4.45) = 2.718^ (4.45) = 85.	MATH /LN	One positive real number.
Exponential	This function calculates the exponential to a number.	MATH /EXP	One positive real number.

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Function	*Description*	*Location within INSERT /FUNCTION*	*Data Requirements*
Log to the base 10	LOG10 (X) This function calculates the base 10 logarithm of a number. LOG10 (85) = 1.934 because the base of 10 needs to be raised 1.934 times to get 85: $10^{1.934} = 85$ LOG10 (10) = 1 because $10^1 = 10$ LOG10 (1000) = 3 because $10^3 = 1000$	MATH /LOG10	One positive real number.
Log to a user defined base	This function calculates the logarithm of a number to the base you specify. The default base is 10. For natural log use base e = 2.718. LOG (X, base) LOG (100) = 2 → base 10. (Since $10^2 = 100$). LOG (27, 3) = 3 → base 3. (Since $3^3 = 27$). LOG (86, 2.7182818) = 4.45 → same as natural log. Because— (exp (4.45) = 85).	MATH/LOG.	A positive real number *X* and the (optional) *base* of the logarithm. If base is omitted, it is assumed = 10.

Standardizing a series that follows a Normal Density Function

Converts a value in a series X to its equivalent standard normal transformation.

STANDARDIZE (x, AVERAGE (X), STDEV (X)) where X is all the numbers in the X data series.

Menu path to function:
INSERT/FUNCTION/STATISTICAL/STANDARDIZE.

Data requirement: The function requires three input numbers: x, mean of the X series, and the standard deviation of the X series. The mean and standard deviation can be written as a "function within a function."

10.4   **DEVIATIONS FROM THE MEAN**

The formulas in this and the next section provide estimates of functions used in formulas for parameters obtained in advanced analysis like ANOVA, Correlation, Regression, etc.

DEVSQ

This function calculates the sum of squares of deviations of data points from their sample mean

Σ ((x — mean (x))²

Menu path to function: MATH/DEVSQ

Data Requirements: A range(s) of real numbers, inclusive of zero.

Figure 140: Summation of the squares of the "differences of individual points from the mean of the series"
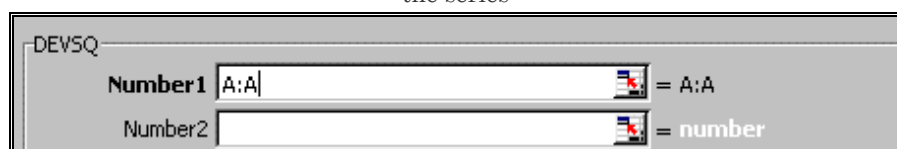
AVEDEV

This function calculates the average of the absolute deviations of data points from their mean. AVEDEV is a measure of the variability in a data set.

$$\frac{1}{n}\sum |x - \bar{x}|$$

Menu path to function: STATISTICAL/AVEDEV

Menu path to function: A range(s) of real numbers, inclusive of zero.

10.5   **CROSS SERIES RELATIONS**

10.5.A   COVARIANCE AND CORRELATION FUNCTIONS

The functions are CORREL, COVAR, PEARSON, & RSQ. I recommend using the Analysis ToolPak Add-In — refer to *Volume 5: Statistical Analysis using Excel.*

10.5.B   SUM OF SQUARES

SUMX2PY2 function evaluates the "Sum of the sum of the squares of each case in two variables"

This function estimates the summation of the squares of individual points in two series.

$\Sigma\ (x^2 + y^2)$

Figure 141: Summation of the squares of individual points in two series. Samples will be available at http://www.vjbooks.net/excel/samples.htm.
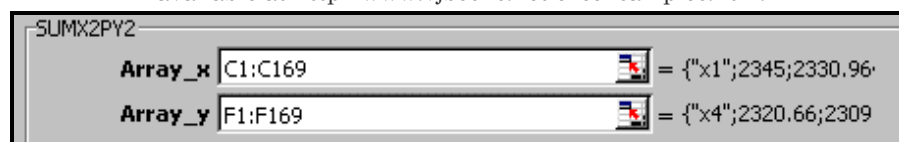
Menu path to function: INSERT/FUNCTION/MATH/SUMX2PY2.

Data requirements: This function needs two data series.

SUMXMY2 function

This function estimates Sum of the squares of differences of each case in two across two variables.

$\Sigma ((x - y)^2)$

Figure 142: Summation of the squares of the "differences in individual points in two series." Samples will be available at http://www.vjbooks.net/excel/samples.htm.
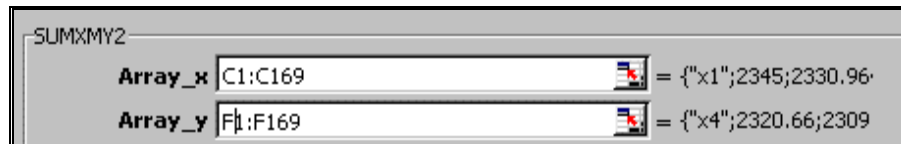
Menu path to function: INSERT/FUNCTION/MATH/SUMXMY2. *Data requirements*: This function needs two data series.

SUMX2MY2 function

This function estimates the Sum of the difference of the squares of each case in two variables.

$\Sigma (x^2 - y^2)$

Menu path to function: INSERT/FUNCTION/MATH/SUMX2MY2.

Data requirements: This function needs two data series.

CHAPTER 11

LOGICAL & INFORMATION FUNCTIONS

This chapter teaches the following topics:

— NEGATIVE NESTING (THE NOT FUNCTION)

— FUNCTIONS THAT OUTPUT TRUE/FALSE AFTER EVALUATING IF ALL/ONE/NONE OF THE LOGICAL EXPRESSIONS ARE TRUE

— AND, OR, NOT(AND), NOT(OR)

— INFORMATION FUNCTIONS ON TYPE OF DATA IN CELL (IS FUNCTIONS)

— ISBLANK, NOT(ISBLANK), ISLOGICAL, NOT(ISLOGICAL), ISNUMBER, NOT(ISNUMBER), ISTEXT, ISNONTEXT, NOT(ISTEXT), ISREF, NOT(ISREF)

— TYPE FUNCTION PROVIDES INFORMATION ON THE DATA TYPE OF THE VALUE IN A CELL

— TESTING IF ODD OR EVEN NUMBER

— ISODD, — ISEVEN

— INFORMATION ON ERROR TYPE IN A CELL (#N/A, #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!)

— ISERR, NOT(ISERR), ISNA, NOT(ISNA), ISERROR, NOT(ISERROR),

— ERROR.TYPE FUNCTION PROVIDES INFORMATION ON THE

ERROR TYPE — IF ANY - IN A CELL

11.1   NEGATIVE NESTING (THE NOT FUNCTION)

The NOT function switches a TRUE to FALSE and vice versa.

NOT(FALSE) = TRUE

NOT(10+1=11) gives the result FALSE, because the expression is TRUE. Examples are in the worksheet "Logical and, or, not" in the sample file "Logical and Information.xls." Additional samples will be available at http://www.vjbooks.net/excel/samples.htm.

As you will see in the next sections, the NOT function can be extremely powerful when combined with other logical/information functions. In effect, the combination is a new and unique logical function.

The function is useful inside IF and other nested logical functions. Refer to chapter 12.

11.2 | **FUNCTIONS THAT OUTPUT TRUE/FALSE AFTER EVALUATING IF ALL/ONE/NONE OF THE LOGICAL EXPRESSIONS ARE TRUE (THE FUNCTIONS– AND, OR)**

11.2.A | AND FUNCTION

The function tests for "ALL EXPRESSIONS ARE TRUE"

The function can have many logical expressions/arguments, each separated by a comma. If –and only if - **all** the logical expressions/arguments are true, the function result is TRUE.

If **even one** of the logical expressions/arguments is not true, the function result is FALSE.

Location wthin INSERT / FUNCTION: LOGICAL/AND

Data Requirements: One or more logical expressions. A comma separates each expression.

> AND(expression 1, expression 2, ….., expression k)

<u>Examples</u>:

- AND(TRUE, FALSE) = FALSE
  (because one of the logical expressions is not equal to TRUE)

- AND(10+1=11, 10*1=1, 10-2=8, 10<100) = TRUE

(because all four expressions are TRUE)

but,

AND(10+1=11, 10*1=10, 10-2=12, 10<100) = FALSE
(because the third expression is FALSE while the other
expressions are true)

11.2.B   OR FUNCTION

The function tests for "EVEN IF ONE EXPRESSION IS TRUE"

The function can have many logical expressions/arguments, each
separated by a comma. If **even one** of the logical expressions/arguments
is TRUE, then the function result is TRUE.

If –and only if - **all** of the logical expressions/arguments are FALSE, the
function result is FALSE.

Location wthin INSERT / FUNCTION: LOGICAL/OR

Data Requirements: One or more logical expressions. A comma separates
each expression.

OR(expression 1, expression 2, ….., expression k)

Examples:

- OR(TRUE, FALSE) = TRUE
  (because one of the logical expressions is TRUE)

- OR(10+1=11, 10*1=11, 10-2=8, 10<100) = TRUE
  (because all four expressions are TRUE)

  and,

  OR(10+1=11, 10*1=10, 10-2=12, 10<100) = TRUE
  (because at least one expression is TRUE)

11.2.C   NOT(AND) FUNCTION

The function tests for "EVEN IF ONE IS TRUE"

It provides the same test for FALSE expressions as the function AND does for TRUE expressions. If **even one** of the logical expressions/arguments is FALSE, then the function result is TRUE.

If –and only if - **all** of the logical expressions/arguments are TRUE the function result is FALSE.

Location wthin INSERT / FUNCTION: LOGICAL/AND, & LOGICAL/NOT

Data Requirements: One or more logical expressions. A comma separates each expression.

NOT (AND (expression 1, ….., expression k))

Examples:

- NOT (AND(TRUE, FALSE)) = TRUE

(because one of the expressions is FALSE)

- NOT (AND(10+1=11, 10*1=10, 10-2=8, 10<100)) = FALSE
  (because none of the expressions are FALSE. They are all
  TRUE)

and,

NOT (AND(10+1=11, 10*1=10, 10-2=12, 10<100)) = TRUE
(because at least one expression –the third expression in this
example -is FALSE)

but,

NOT (AND(10+1=1, 10*1=1, 10-2=1, 10<1))= TRUE
(because at least one expression is FALSE)

11.2.D NOT(OR) FUNCTION

The function tests for "ALL FALSE"

It provides the same test for FALSE expressions as the function AND does
for TRUE expressions. If –and only if - **all** the logical
expressions/arguments are FALSE, then the function result is TRUE.

If **even one** of the logical expressions/arguments is TRUE, the function
result is FALSE.

Location wthin INSERT / FUNCTION: LOGICAL/OR, & LOGICAL/NOT

Data Requirements: One or more logical expressions. A comma separates each expression.

NOT (OR(expression 1, ….., expression k))

Examples:

- NOT (OR(TRUE, FALSE)) = FALSE

  (because one of the expressions is TRUE)

- NOT (OR(10+1=11, 10*1=10, 10-2=8, 10<100)) = FALSE

  (because all four expressions are TRUE)

  and,

  NOT (OR(10+1=11, 10*1=10, 10-2=12, 10<100)) = FALSE

  (because at least one expression is TRUE)

- but,

- NOT (OR(10+1=1, 10*1=1, 10-2=1, 10<1))= TRUE

  (because all the expressions are FALSE)

The functions are useful inside IF and other nested logical functions. Refer to chapter 12.

Table **29**: Examples of the logical functions AND, OR, and NOT. Examples are in the worksheet "Logical and, or, not" in the sample file "Logical and Information.xls." Additional samples will be available at http://www.vjbooks.net/excel/samples.htm.

Function	Result
AND	
AND(TRUE, FALSE)	FALSE

Function	Result
AND(10+1=11, 10*1=10, 10-2=8, 10<100)	TRUE
AND(10+1=11, 10*1=10, 10-2=12, 10<100)	FALSE
OR	
OR(TRUE, FALSE)	TRUE
OR(10+1=11, 10*1=10, 10-2=12, 10<100)	TRUE
NOT (AND)	
NOT (AND(TRUE, FALSE))	TRUE
NOT (AND(10+1=11, 10*1=10, 10-2=8, 10<100))	FALSE
NOT (AND(10+1=11, 10*1=10, 10-2=12, 10<100))	TRUE
NOT (AND(10+1=1, 10*1=1, 10-2=1, 10<1))	TRUE
NOT (OR)	
NOT (OR(TRUE, FALSE))	FALSE
NOT (OR(10+1=11, 10*1=10, 10-2=8, 10<100))	FALSE
NOT (OR(10+1=11, 10*1=10, 10-2=12, 10<100))	FALSE
NOT (OR(10+1=1, 10*1=1, 10-2=1, 10<1))	TRUE

11.3 **INFORMATION FUNCTIONS ON TYPE OF DATA IN CELL (IS FUNCTIONS)**

The following "IS" functions are used to test if a value or the result of a function in a referenced cell conforms (or, does not conform, if one adds the NOT function to the IS function) to a certain data type.

The functions are used as, for example,

ISBLANK(Reference to a Cell),

or

NOT(ISBLANK(Reference to a Cell))

Table **30**: The "IS" information functions. Examples are in the worksheet '"IS" information functions' in the sample file "Logical and Information.xls."

Function	*The formula result = TRUE if...*	*Location within INSERT/FUNCTION*	*Data Requirements*
ISBLANK	The referenced cell is empty.	INFORMATION/ISBLANK	One referenced cell.
NOT(ISBLANK)	The referenced cell is not empty	INFORMATION/ISBLANK & LOGICAL/NOT	One referenced cell.
ISLOGICAL	The referenced cell's value is TRUE or FALSE.	INFORMATION/ISLOGICAL	One referenced cell.
NOT(ISLOGICAL)	The referenced cell's value is <u>neither</u> TRUE nor FALSE.	INFORMATION/ISLOGICAL & LOGICAL/NOT	One referenced cell.
ISNUMBER	The referenced cell's value is a number.	INFORMATION/ISNUMBER	One referenced cell.
NOT(ISNUMBER)	The referenced cell's value is not a number.	INFORMATION/ISNUMBER & LOGICAL/NOT	One referenced cell.
ISTEXT	The referenced cell's value is a text string.	INFORMATION/ISTEXT	One referenced cell.
ISNONTEXT	The referenced cell's value is not a text string or is blank.	INFORMATION/ISNONTEXT	One referenced cell.

Function	*The formula result = TRUE if...*	*Location within INSERT / FUNCTION*	*Data Requirements*
NOT(ISTEXT)	The referenced cell's value is not a text string.	INFORMATION/ISTEXT & LOGICAL/NOT	One referenced cell.
ISREF	The referenced cell's value is a reference to a range.	INFORMATION/ISREF	One referenced cell.
NOT(ISREF)	The referenced cell's value is not a reference to a range.	INFORMATION/ISREF & LOGICAL/NOT	One referenced cell.

The functions are useful inside IF and other nested logical functions. Refer to chapter 12.

TYPE FUNCTION PROVIDES INFORMATION ON THE DATA TYPE OF THE VALUE IN A CELL

The TYPE function may be used in nested logical functions like AND, OR, NOT, IF and CHOOSE. The function TYPE gives as result the numbers shown in the right column of the table below.

The function is: TYPE(Reference to a Cell)

Table 31: Mapping of the output of the function TYPE and specific data types. Examples are in the worksheet '"IS" information functions' in the sample file "Logical and Information.xls."

If the referenced cell's value is	*The result of the TYPE function is:*

If the referenced cell's value is	The result of the TYPE function is:
Number	1
Text	2
Logical value	4
Error value	16
Array	64

The function is useful inside IF, CHOOSE and other nested or logical functions. Refer to chapter chapter 12 starting on page 202.

Table 32: Examples of the IS functions. Examples are in the worksheet "'IS" information functions' in the sample file "Logical and Information.xls."

Test Values→	10	TEST		#VALUE!	TRUE	235	TRIAL 1
ISBLANK	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
NOT(ISBLANK)	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE
ISLOGICAL	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
NOT(ISLOGICAL)	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE
ISNUMBER	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
NOT(ISNUMBER)	FALSE	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE
ISTEXT	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE
ISNONTEXT	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	FALSE
NOT(ISTEXT)	TRUE	FALSE	TRUE	TRUE	TRUE	TRUE	FALSE
TYPE	1	2	1	16	4	1	2

11.4   **TESTING IF ODD OR EVEN NUMBER**

ISODD function

Outputs TRUE if the referenced value is an Odd number.

Location wthin INSERT / FUNCTION: INFORMATION/ISODD

Data Requirements: One Integer. (Non-integers are truncated by Excel

Examples:

- ISODD(-1) = TRUE
- ISODD(1) = TRUE
- ISODD(2) = FALSE
- ISODD(2.5) = FALSE, because the number "2.5" is truncated to 2.

ISEVEN function

Outputs TRUE if the referenced value is an Even number.

Location wthin INSERT / FUNCTION: INFORMATION/ISEVEN

Data Requirements: One Integer. (Non-integers are truncated by Excel)

Examples:

- ISEVEN(-1) = FALSE
- ISEVEN(1) = FALSE
- ISEVEN(2) = TRUE

- ISEVEN(2.5) = TRUE, because the number "2.5" is truncated to 2.

11.5 INFORMATION ON ERROR TYPE IN A CELL (#N/A, #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!)

The functions are used as, for example,

ISERR(Reference to a Cell) *or* NOT(ISERR(Reference to a Cell))

Table 33: The "IS Error" information functions. Examples are in the worksheet "Errors' in the sample file "Logical and Information.xls."

Function	*The formula result=TRUE if...*	*Location within INSERT/FUNCTION*	*Data Requirements*
ISERR	The referenced cell's value is any error value except #N/A. These error values are— #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!.	INFORMATION/ISERR	One referenced cell.
NOT(ISERR)	The referenced cell's value is not any of the following error values: #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!.	INFORMATION/ISERR & LOGICAL/NOT	One referenced cell.
ISNA	The referenced cell's value is the #N/A (not available) error value.	INFORMATION/ISNA	One referenced cell.
NOT(ISNA)	The referenced cell's value is the not equal to the #N/A (not available) error value.	INFORMATION/ISNA &	One referenced cell.

Function	*The formula result=TRUE if...*	*Location within INSERT/FUNCTION*	*Data Requirements*
		LOGICAL/NOT	
ISERROR	The referenced cell's value is any error value. The error values are— #N/A, #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!.	INFORMATION/ISERROR	One referenced cell.
NOT(ISERROR)	The referenced cell's value is <u>not</u> any error value. The error values are— #N/A, #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!.	INFORMATION/ISERROR & LOGICAL/NOT	One referenced cell.
N	Converts the information in the referenced cell into its numeric equivalent. Excel evaluates the logical values TRUE & FALSE as 1 and 0, respectively. A date is converted into a serial number. (A serial number can represent each date. On reformatting (or using one of the "Serial number to date" functions), the serial number will show as dates. Excel evaluates a Text string as zero. Errors retain their error value.	INFORMATION/N	One referenced cell

11.5.A   ERROR.TYPE FUNCTION PROVIDES INFORMATION ON THE ERROR TYPE — IF ANY - IN A CELL

The function is used as, for example:

ERROR.TYPE (Reference to a Cell)

This function is often used in an IF or CHOOSE function.

Table 34: Mapping of the output of the function ERROR.TYPE and specific Error values.
Examples are in the worksheet "Errors' in the sample file "Logical and Information.xls."

If the value is...	Then the ERROR.TYPE result is:
NULL!	1
DIV/0!	2
VALUE!	3
REF!	4
NAME?	5
NUM!	6
N/A	7
No error	#N/A

The function is useful inside IF, CHOOSE and other nested OR logical functions. Refer to chapter 12. Note: you can color code cells whose values have error terms using "Conditional Formatting." This topic is taught in book 3.

Table 35: Examples of the IS (ERROR) functions

Formula or cell value	ISNA	NOT(ISNA)	ISERROR	NOT(ISERROR)	ERROR.TYPE
VALUE!	FALSE	TRUE	TRUE	FALSE	3
NAME?	FALSE	TRUE	TRUE	FALSE	5
REF!	FALSE	TRUE	TRUE	FALSE	4

Formula or cell value	ISNA	NOT(ISNA)	ISERROR	NOT(ISERROR)	ERROR.TYPE
N/A	TRUE	FALSE	TRUE	TRUE	7
35	FALSE	TRUE	FALSE	FALSE	#N/A
NULL!	FALSE	TRUE	TRUE	TRUE	1
FALSE	FALSE	TRUE	FALSE	TRUE	#N/A
NUM!	FALSE	TRUE	FALSE	TRUE	#N/A
	FALSE	TRUE	FALSE	FALSE	#N/A
DIV/0	FALSE	TRUE	TRUE	TRUE	2

11.6

LOOKUP OR "LOCATION" FUNCTIONS

All the functions mentioned in this section are accessible through INSERT/FUNCTION/LOOKUP.

The functions: COLUMN/ROW

This function evaluates the column/row number of a reference.

- COLUMN(F181) = 6

- ROW(F181) = 181

The functions: COLUMNS/ROWS

This function evaluates the number of columns/rows in a reference.

- COLUMNS(B2:F181) = 5

- ROWS(B2:F181) = 180

The functions: INDEX, MATCH, OFFSET, HYPERLINK, ADDRESS, TRANSPOSE, AREAS, INDIRECT

Discussion of these functions is beyond the scope of this book. The functions are useful while developing Excel using Visual Basic for Applications (VBA).

Page for Notes

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CHAPTER 12

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"SMART" NESTED FUNCTIONS
THAT RESPOND TO FORMULA
RESULT

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The topics discussed in this chapter are:

— *IF* FUNCTION

— *CHOOSE* FUNCTION

— TOOLS THAT ASSIST WITH NESTING

— NEW TOOLS IN EXCEL XP

12.1 **IF FUNCTION**

The function "IF" is probably the most useful Excel function. A clever use of the IF function makes available an amazing level of smartness in formulae. The function provides almost coding-like binary functionality — you can nest up to seven IF functions. Therefore, you can write in 21 possible actions as long as the actions can be set up as TRUE/FALSE conditions. The innermost "IF" is evaluated first, and the outermost the last.

IF(logical expression that may evaluate to TRUE or FALSE, x1 or value/action if the logical expression is TRUE, x2 or value/action if the

logical expression is TRUE)

Stage 1:

Excel evaluates the logical expression first. The result is TRUE or FALSE.

Stage 2:

If the first stage result is TRUE, then Excel evaluates x1. If the first stage result is FALSE, then Excel evaluates x2. An option may be a number, string, formula or function, or cell reference

The IF function often nests and uses many other information or IS and logical/smart functions. Many samples will be available at http://www.vjbooks.net/excel/samples.htm.

12.2 **CHOOSE FUNCTION**

CHOOSE runs one of several optional user-defined/chosen values/references/formulas based on an index number which that may take the values 1 to 29. The index number is from a user-set cell reference. CHOOSE can be used as a "super-IF if the conditionality inherent in the analysis may have more than a simple YES/NO result.

CHOOSE(index, option 1, option 2,..., up to a maximum of option 29)

The index is a number 1 between 29, or a formula or reference to a cell evaluating to an integer between 1 and 29. (Excel truncates down decimal-bearing numbers.) If the value of the index = 1, then option 1 (a value, cell reference, or function) will be evaluated. If the index equals 2,

then option 2 will be evaluated ...and so on until a maximum of 29 options.

Stage 1:

The function first evaluates the index. The cell referenced as the index may contain a number, a reference to another cell or a formula. Assume that the result is index = x, where x is between 1 and 29.

Stage 2:

In the second stage, the function chooses "option x" where x is the evaluated value of the index. An option may be a number, string, formula, or function, or cell/range reference.

AVERAGE(CHOOSE(7, A1:A100, A101:A200, A201:A300, A301:A400, D1:D100, D101:D200, D201:D300, D301:D400)) **=** AVERAGE (D201:D300)

Many samples will be available at
http://www.vjbooks.net/excel/samples.htm.

12.3 **WORKING WITH NESTED FUNCTIONS**

12.3.A DEFINING THE NESTED FUNCTION

Nested functions may be written in by hand or with the assistance of the "Insert Function" dialog.

Nesting by hand

Once you are familiar with the function names and arguments/requirements, you can type in the nested function directly into the cell. In Excel XP, the Formula Bar Assistant makes this process easier by:

(a) providing the list of arguments/requirements for a function once you type in the name of the function (in the next figure note that the Assistant shows the expanded formula notation for AVERAGE with the requirement "number1" in bold even though I have only typed "AVERAGE" in the Formula Bar, and

b) using different colors for the parenthesis (brackets) enclosing each function. This reduces the probability of errors in placing the closing parenthesis, or in failing to include sufficient number of closing brackets.

Figure 143: Using the Formula Bar Assistant

12.3.B   NESTING WITH THE ASSISTANCE OF THE "INSERT FUNCTION" DIALOG

Excel (XP and earlier versions) provide access to the "Insert/Paste Function" dialog at each level of nesting within a formula.

Figure 144: Click on the arrow

Assume you want to define the same formula as shown in the previous figure. You have already user INSERT/FUNCTION to define the outer function "NORMDIST." Now, you have to define the inner function AVERAGE. Place the cursor at the location (within the NORMDIST function) where the function AVERAGE is to be inserted, and click on the arrow shown at the left edge of the Formula Bar.

A list of recently-used functions will be displayed. The next figure illustrates this.

Pick the last option "More Functions" in case the sought function is not in this list (or, if you have a desire for searching for a "better" function).

Figure 145: Recently-used functions and a link to the "Insert/Paste Function" dialog
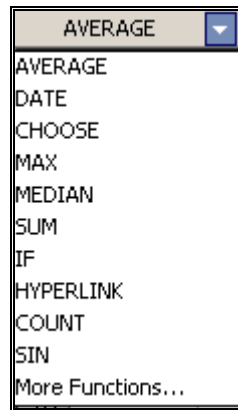
The "Insert/Paste function" dialog opens. Use this dialog to select or completely define a function. (Always define the "inner" nested functions completely in one step.)

Figure 146: "Insert/Paste Function" dialog
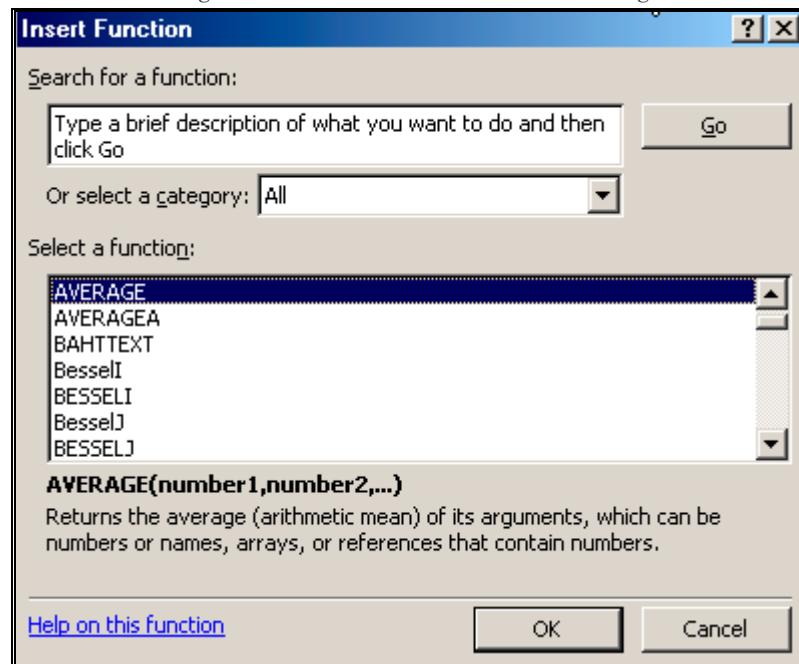
Select the function and complete all function arguments/requirements.

Figure 147: The "inner" nested function is best defined using its dialog
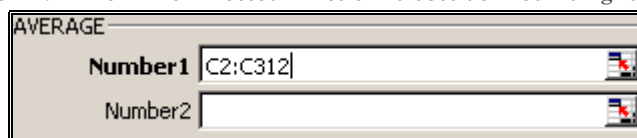
When you execute the dialog by clicking on OK, you will be taken back to the Formula Bar. The updated Formula bar is reproduced in the next figure.

Figure 148: The "inner" function is fully defined
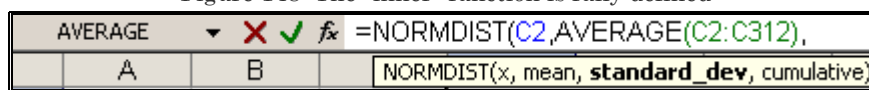
You need to define the next argument/requirement for the "outer" function NORMDIST. (Note that the Formula Bar Assistant is suggesting this by making bold the font for the requirement "standard_dev." This requirement can also be completed using the "Insert/Paste Function" dialog as you did earlier for the function AVERAGE.

Figure 149: The requirement "standard_dev" can be defined with the function STDEV

12.3.C   FORMULA AUTOCORRECTION

In case you make a simple error (like forgetting to place a closing parenthesis), Excel will suggest a correction after you try to finish the formula.

Evaluate whether Excel has corrected your error correctly; if so, click on OK.

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Figure 150: Formula AutoCorrection
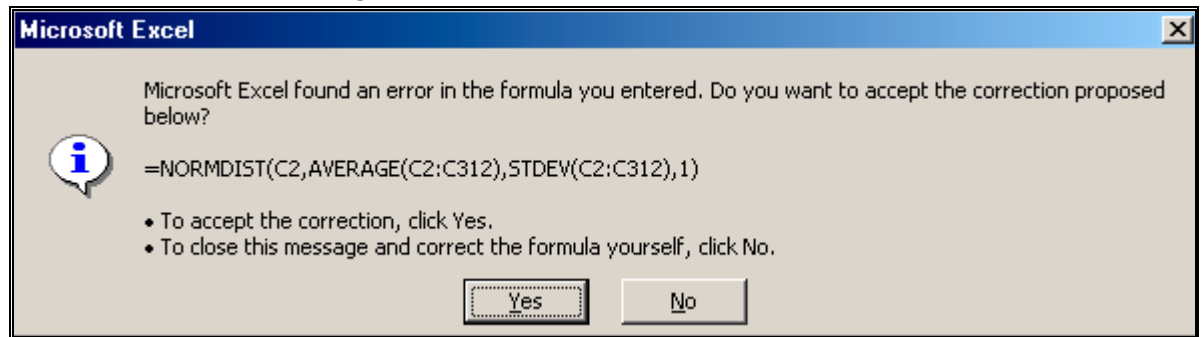
The AutoCorrection feature is upgraded in the XP version of Excel in terms of the types of errors AutoCorrected.

12.3.D   FORMULA BAR IDENTIFICATION OF ERROR

Even if Autocorrect does not correct the error, Excel will indicate the location of the error. Assume you use the same formula as before, but failed to type a comma before the function STDEV.

Figure 151: The erroneous formula

When you finish the formula and press the ENTER key, Excel will show the warning reproduced in the next figure.

Figure 152: Formula Error warning
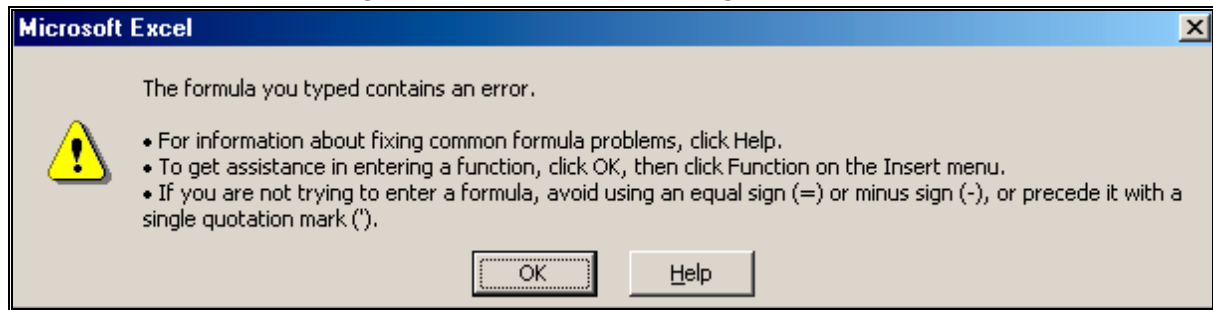
Choose the option OK. Look at the Formula Bar. Excel has highlighted the location where an error was found.

Figure 153: Excel locates the location of the error

=NORMDIST(C2,AVERAGE(C2:C312)STDEV(C2:C312),1)

12.3.E   FUNCTION IDENTIFICATION IN THE FORMULA BAR ASSISTANT

In Excel XP, the Formula Bar Assistant displays only that function which directly references the argument/requirement on which you place the cursor.

For example, if you place the cursor on the cell references used in the function "AVERAGE," then the Formula Assistant Bar only shows the function AVERAGE and placeholders for its requirements.

Figure 154: Cursor within the arguments for AVERAGE

=IF(ISNUMBER(AVERAGE(C2:C312)),"The mean equals","The mean cant be calculated")

| C | D | AVERAGE(**number1**, [number2], ...) | | G | H | I | |

Cursor is on an argument of the function ISNUMBER[24]

The Formula Assistant Bar will show only the ISNUMBER function and placeholders for its requirements.

Figure 155: Cursor within the arguments for ISNUMBER but not within the arguments for AVERAGE

=IF(ISNUMBER(AVERAGE(C2:C312)),"The mean equals","The mean cant be calculated")

| C | ISNUMBER(**value**) | E | F | G | H | I | |

Cursor is on an argument of the function IF[25]

The Formula Assistant Bar will show only the IF function and placeholders for its requirements.

Figure 156: Cursor within the arguments for IF but not within the arguments for ISNUMBER or AVERAGE

=IF(ISNUMBER(AVERAGE(C2:C312)),"The m

IF(**logical_test**, [value_if_true], [value_if_false])

---

[24] The function AVERAGE is an argument for the function ISNUMBER.

[25] The function ISNUMBER is an argument for the function IF.

Identification of cells referenced by the function highlighted in the Formula Bar

In Excel XP, blue rectangles will identify the cells referenced by the function currently shown in bold in the Formula Bar Assistant.

12.4 **MULTIPLE NESTING: TIPS**

— Always use the "Insert/Paste Function" dialog for defining functions.

— Write the specifics of the innermost function first.

— Complete the innermost function first, and then move up levels.

— Do not forget to include all the arguments/requirements of the outer functions. This eventuality can be precluded by always using the "Insert/Paste Function" dialog.

— If the function has an error that cannot be easily identified, use the Error Checking or Formula Evaluation tools. These tools are taught in 5.5.

CHAPTER 13

ADD-INS: ENHANCING EXCEL

This chapter discusses the following topics:

- — WHAT CAN AN ADD-IN DO?
- — WHY USE AN ADD-IN (AND NOT JUST EXCEL MACROS/PROGRAMS)?
- — ADD–INS INSTALLED WITH EXCEL
- — OTHER ADD-INS
- — THE STATISTICS ADD-IN
- — CHOOSING THE ADD-INS

13.1   ADD-INS: INTRODUCTION

An "Add-In" is a software application that adds new functionality to Excel. The Add-In typically seamlessly fits into the Excel interface, providing accessibility to its functionality through

— new menus

— new options in existing menus

— new functions

— new toolbars and specific toolbar icons

13.1.A WHAT CAN AN ADD-IN DO?

Almost anything an imaginative software developer could create. Usually, an Add-In provides functionality that is useful for a particular type of analysis/industry — statistics, finance, real estate, etc.

13.1.B WHY USE AN ADD-IN?

The Add-In could have its base code written in software languages like C, C++, FORTRAN, Pascal, etc. This is important because some algorithms and operations (like simulations) operate best when written in a specific language. Therefore, the developer uses the best language/tool to create the functionality and then packages this inside an Add-In.

13.2 ADD–INS INSTALLED WITH EXCEL

Some Add–Ins are available in the Microsoft Office CD–ROM and are installed (but not activated[26]) along with Excel. I show the use of three Add–ins.

13.3 OTHER ADD-INS

Many commercially sold Add-Ins can be almost like separate software just

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[26] Figure 540 and Figure 542 show how to activate the Add-ins

needing Excel as the "host." Two examples:

— Crystal Ball™ risk analysis software

— *UNISTAT*™ software for conducting advanced statistics and econometrics from inside Excel

Hundreds of software companies construct Add-Ins. The greatest contribution of this book, if I succeed in doing so, would be the opening of this massive potential functionality to Excel users.

13.4   **THE STATISTICS ADD-IN**

The Analysis ToolPak Add-In that ships with Excel can conduct several procedures including descriptives, regression, ANOVA, F-test, correlation, T-tests, moving average, and histogram. Let us learn how to use this "Add-In."

13.4.A   CHOOSING THE ADD-INS

Choose the menu option TOOLS/ADD-INS. You will see several Add-Ins as shown in Figure 157. (You may not see all the Add–Ins shown in the next two figures.)

Figure 157: Selecting an Add-In
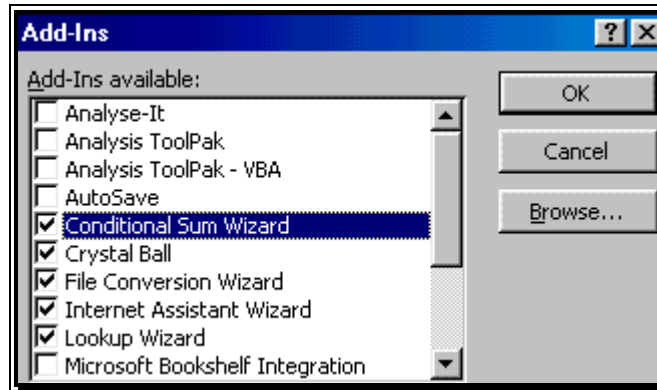
Figure 158: In Excel XP, the Add-Ins dialog provides access to "Automation." This topic is beyond the scope of this book.
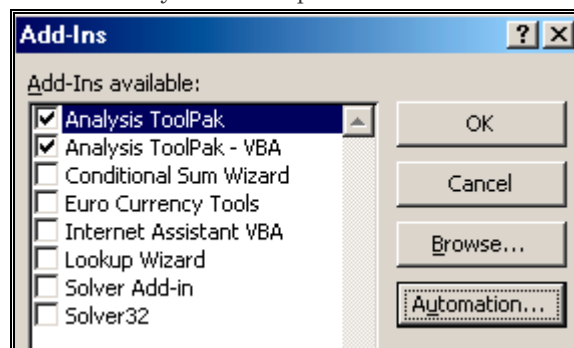
You need the "Analysis ToolPak Add-Ins." Select — by clicking on it — the box to the left of these Add-Ins (shown in Figure 159). Execute the dialog by clicking on the button OK and wait for some time while the Add-Ins are "loaded" or "registered" with Excel. An Add-In has to be loaded/registered before it is available for use. The Add-In remains loaded across sessions. It is only "unloaded" when you select the option TOOLS/ADD-INS and deselect the Add-In[27].

---

[27] If too many Add-Ins are loaded, Excel may work too slowly, or even freeze. If you find this problem occurring, then just load the Add-in when you are going to use it and unload it before quitting Excel.

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Figure 159: The Add-In pair for data analysis

You have activated the "Analysis ToolPak." At the bottom of the menu TOOLS, you will see the option "DATA ANALYSIS the bottom— this option was not there before you accessed the Add-In. (This is illustrated in Figure 160.)

The statistical procedures are accessed through this new option.

> Note:
>
> Usually Add-Ins expose their functionality by creating new menu options or even new menus. The menu option "Data analysis" provides the statistics functionality available in "Analysis ToolPak" and "Analysis ToolPak VB." The menu options "Optquest" down till CB Bootstrap" are linked to the Add-in "Crystal Ball" (not shipped in the Office CD-ROM).

Figure 160: The "Data Analysis" menu option

CHAPTER 14

THE SOLVER TOOL FOR CONSTRAINED LINEAR OPTIMIZATION

This chapter teaches:

— DEFINING THE OBJECTIVE FUNCTION (CHOOSING THE OPTIMIZATION CRITERION)

— ADDING CONSTRAINTS

— OPTIONS

14.1   DEFINING THE OBJECTIVE FUNCTION (CHOOSING THE OPTIMIZATION CRITERION)

The problem of constrained optimization:

For example,

Maximize/*Minimize* /*other* (over the choice parameters Xc …)   Y = f(X1, X2 …)

Subject to the inequality constraints:-

C1 = ….

C2 >=...

C3 <= ...

The Add-In "Solver" can solve such models. In the Solver dialog (user-input form), the options equate with the function above. The "mapping" of the dialog to different parts of the optimization function is shown in the next table.

Table 36: The "Solver"

Option in the Solver dialog	*Equate to the following part of the optimization function...*
Equal to:"	The optimization function
Set Target Cell"	Function that needs to be optimized
By Changing Cells"	The choice parameters Xc....
Subject to the Constraints"	The constraints C1, C2, ...

The Solver permits constraints of inequality. This makes the solver extremely powerful.

Choose the menu option TOOLS/ADD-INS. Choose the Add-In "Solver" as shown in Figure 161. Execute the dialog by clicking on the button OK.

Figure 161: Selecting the Solver Add-In

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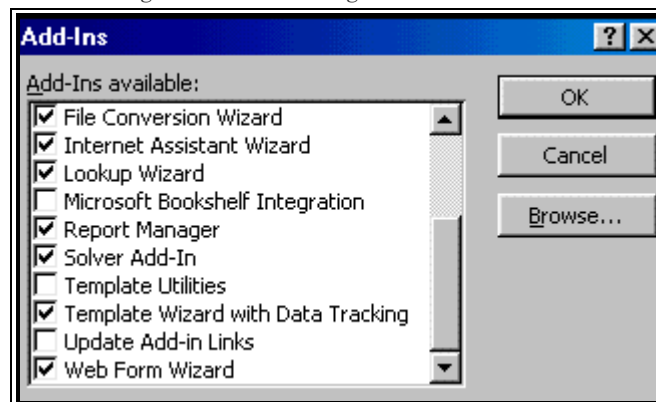
You have activated the "Analysis ToolPak." If you go to the menu TOOLS, you will see the option "SOLVER"— this option was not there before you accessed the Add-In. Please define a sample problem and try it on an Excel workbook[28].

Access the feature through the menu path TOOLS/SOLVER. The dialog shown in Figure 162 opens. The "Target Cell" contains the formula for the function you are attempting to optimize.

The "Equal to" area is where you choose the optimization criterion–

— Maximization (Max)

— Minimization (Min)

— The "Value of" option permits a more complex value seek method than the rough one in TOOLS/GOAL SEEK shown in chapter 15 on page 230.

[28] I do not supply the sample data for most of the examples in chapter 42 to chapter 46. My experience is that many readers glaze over the examples and do not go through the difficult step of drawing inferences from a result if the sample data results are the same as those in the examples in the book.

Figure 162: Setting the target cell
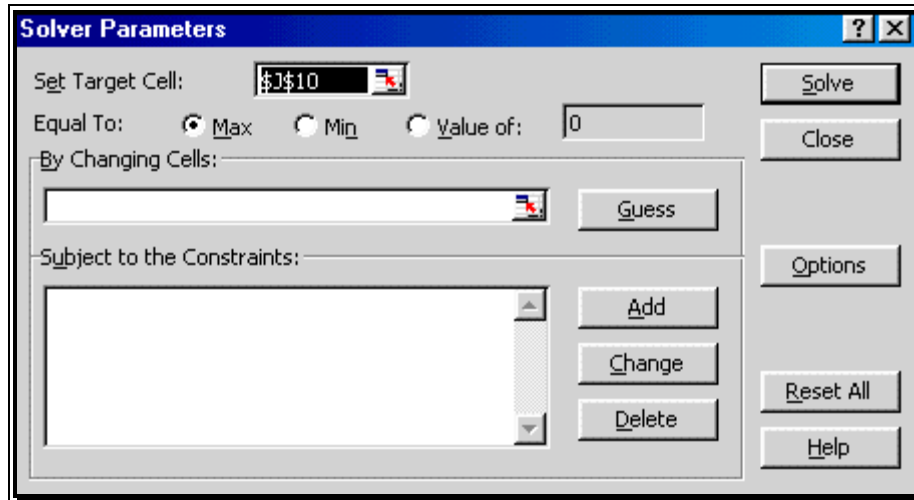
The choice parameters are the numbers the algorithm plays around with to find the max/min.

You have to tell Excel about the cells that contain these parameters. One can do it manually, or, an easier option is to click on the button "Guess."

Excel automatically chooses all the cell references for use in the formula in J10 (the target cell/objective function). This is illustrated in Figure 163.

Figure 163: Selecting the criterion for optimization
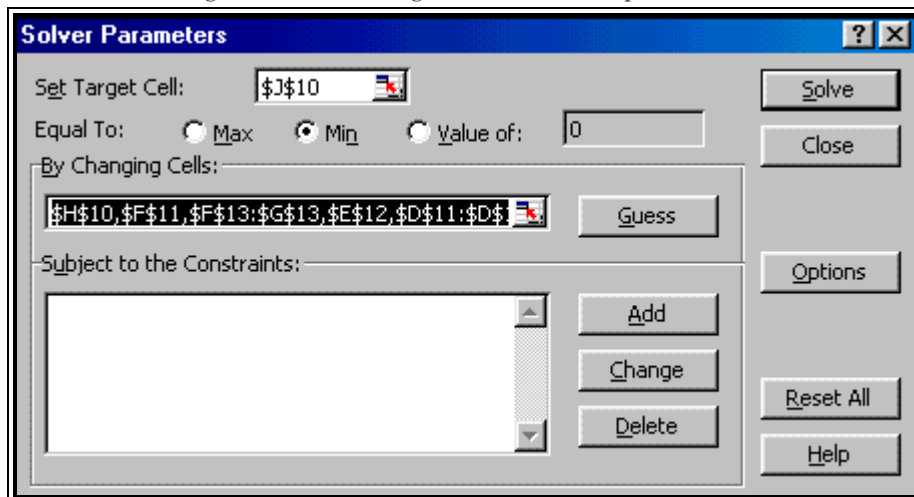
14.2　　　　　　　　　　**ADDING CONSTRAINTS**

The optimization function has been defined, as have the "choice parameters." At this stage, you have to add the constraints.

Click on the button "Add" and write in a constraint as shown in Figure 164.

Figure 164: The first constraint
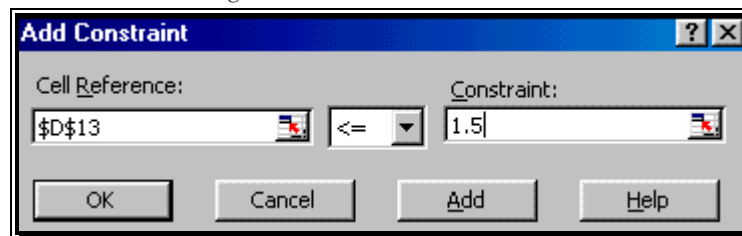
After defining the first constraint, click on the button "Add" (see Figure 164.)

Write the second constraint— see Figure 165.

Figure 165: The second constraint
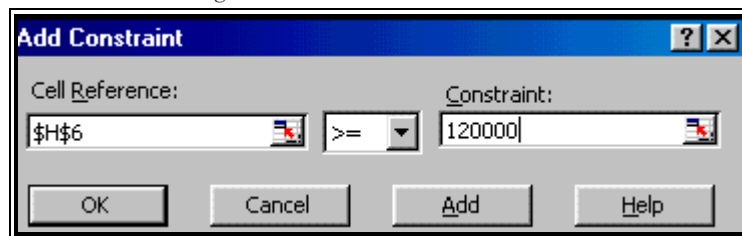
Continue with constraint definitions.

After defining the last constraint, execute the dialog by clicking on the button OK (see Figure 165).

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Note:

The constraints are shown in the area "Subject to the Constraints" as shown in Figure 166.

Figure 166: The constraints for the Solver
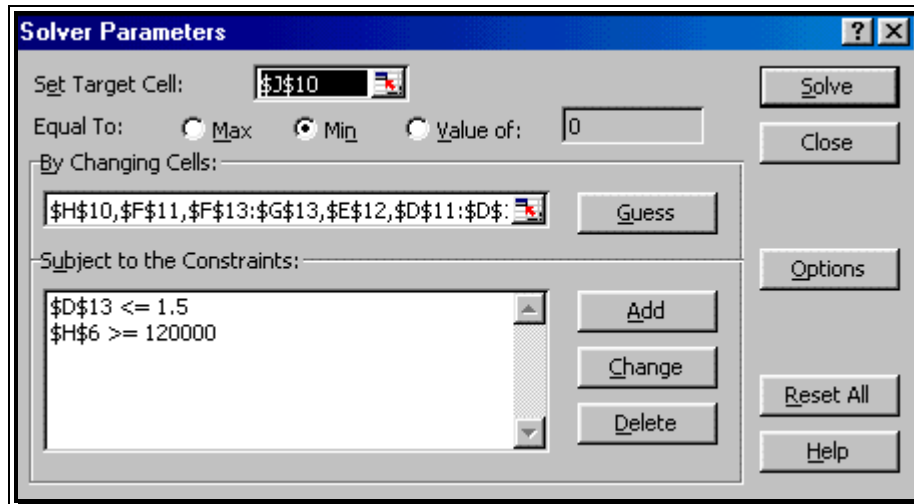
14.3   **CHOOSING ALGORITHM OPTIONS**

You need to choose the options for the analysis. So, click on the button "Options." The dialog shown in Figure 167 opens.

You may want to increase the iterations to 10,000. If you want to relax the requirements for preciseness, increase the value of "Precision" by removing some post-decimal zeros.

"Save Model" is used to save each optimization model. You can define several optimization problems in one workbook.

The other options are beyond the scope of this book. Click on the button "Continue."

Figure 167: Options in the Solver Add-In
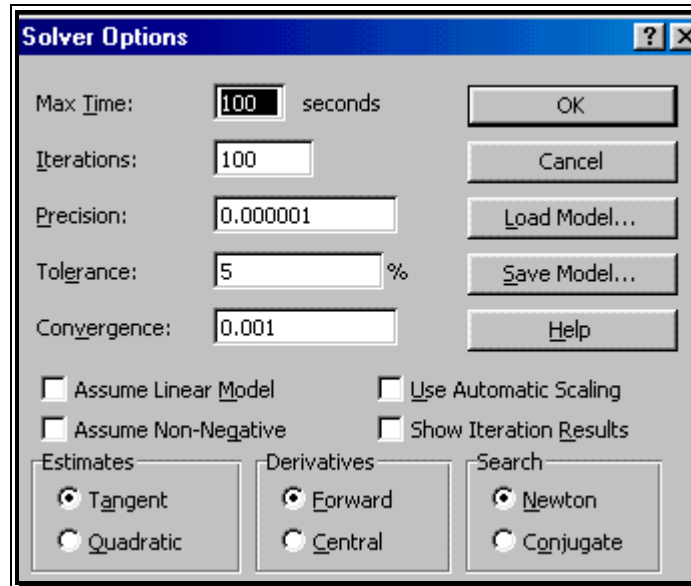
Running the Solver

Execute the procedure by clicking on the button "Solve."

The following output can be read from the spreadsheet.

- the optimized value of the Objective Function (that is, the value of the formula in the cell defined in the box "Set Target Cell")

- is the combination of the choice variables (that is, those whose value is obtained from the cells defined in the dialog area "By Changing Cells")

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Figure 168: The completed constrained optimization dialog
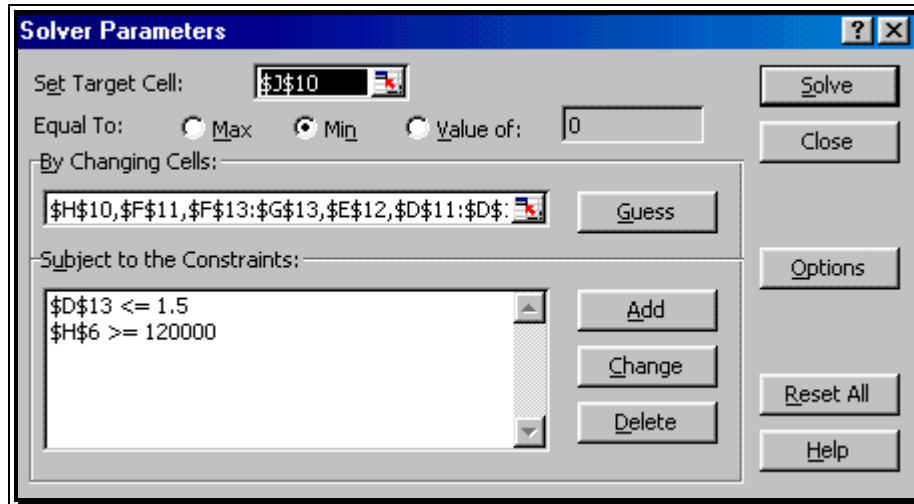
CHAPTER 15

"IF-THEN" ANALYSIS: SCENARIOS AND GOAL SEEK

This chapter discusses the following topics:

— SETTING THE DESIRED VALUE FOR THE "TARGET" CELL
(THE ONE WITH THE FORMULA THAT REFERENCES THE
"SOLUTION" CELL)

— CHOOSING THE "SOLUTION" CELL

— RUNNING THE UTILITY

15.1   SCENARIOS (FOR "IF THIS ASSUMPTION-THEN THIS RESULT")

The sample data for this section is in the file "Scenarios.xls."

The data in columns "C," "D" and "E" is the size of the labor force in years "1995," "2000" and "2010," respectively, for specific age groups defined in column "A" and for countries defined in column "B." The cell "H3" holds the assumption of the "cumulative or total" growth rate of the labor force from the year 2010 to 2020. This rate is assumed equal for all age groups and countries. Column "F" is calculated by multiplying the corresponding cell in column "E" with "100% plus the growth rate of 40% in cell H3." Therefore, column "F" values are 40% higher than the values in column "E." The formulas in the cells in column "G" directly reference cell "H3."

The cells "H6," "H7," and "H8" provide statistical parameters for the year 2020 for the country Algeria (that is, for the cells "F2" to "F14").

These formulas indirectly reference cell "H3" through the formulas in the cells "F2" to "F14."

Figure 169: The sample data and formula cells

	B	C	D	E	F	G	H
1	Country Name	1995	2000	2010	2020		
2	Algeria	15,218,000	16,284,000	17,846,000	24,984,400	Assumption on Growth Rate 2010-20, Algeria	
3	Algeria	3,195,000	3,521,000	3,776,000	5,286,400	10 year growth in Labor Force=	40%
4	Algeria	2,718,000	415,730,292	3,577,000	5,007,800		
5	Algeria	2,366,000	2,699,000	3,488,000	4,883,200	Output	
6	Algeria	2,096,000	2,348,000	3,142,000	4,398,800	Average	8,890,323
7	Algeria	1,562,000	2,075,000	2,666,000	3,732,400	Median	3,732,400
8	Algeria	1,302,000	1,543,000	2,309,000	3,232,600	Maximum	54,090,400
9	Algeria	968,000	1,282,000	2,030,000	2,842,000		
10	Algeria	674,000	946,000	1,494,000	2,091,600		
11	Algeria	635,000	650,000	1,217,000	1,703,800		
12	Algeria	571,000	597,000	867,000	1,213,800		
13	Algeria	1,006,000	1,194,000	1,505,000	2,107,000		
14	Algeria	28,109,000	31,599,000	38,636,000	54,090,400		

15.1.A   DEFINING THE SCENARIOS

Go to the menu option TOOLS/SCENARIOS. The relevant dialog is shown in the next figure.

Figure 170: The dialog for TOOLS/SCENARIOS before any scenarios are defined. Click on the button "Add" to define a scenario.
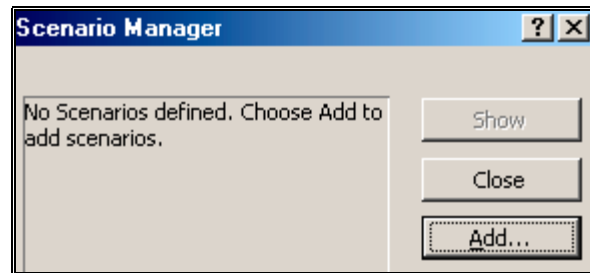
Click on "Add" and define the first scenario. The scenario is the next figure illustrates. The first scenario is named "40." It assumes that the value of cell "H3" is 40% or 0.40.

You can make assumptions of several cells, including non-adjacent cells and cells across sheets.

Figure 171: The first scenario
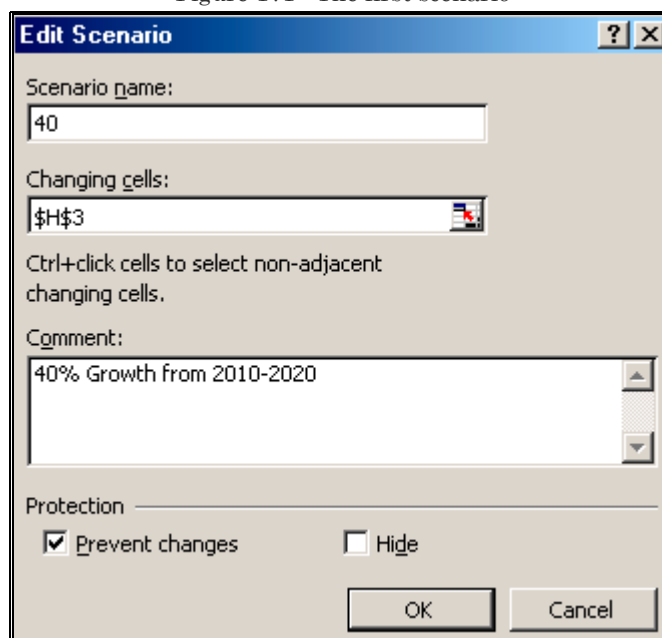
A comment has been added to explain the scenario. All the other options are the defaults — I recommend sticking with them.

After the first scenario is defined, click on the button "Add" and define the

second scenario. This scenario is named "50" and works on changing the cell "H3."

Figure 172: The second scenario is named "50" and works on changing the cell "H3"
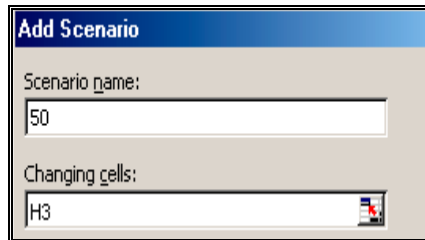
The second scenario assumes that the value of cell "H3" is 50% or 0.50.

Figure 173: The second scenario assumes that the value of cell "H3" is 50% or 0.50
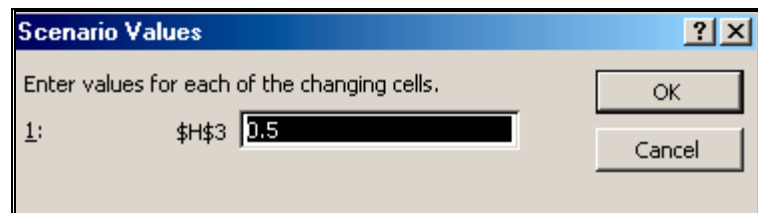
The two scenarios are defined. The dialog shows the two scenarios. The dialog is reproduced in the next figure.

Figure 174: The two scenarios are defined
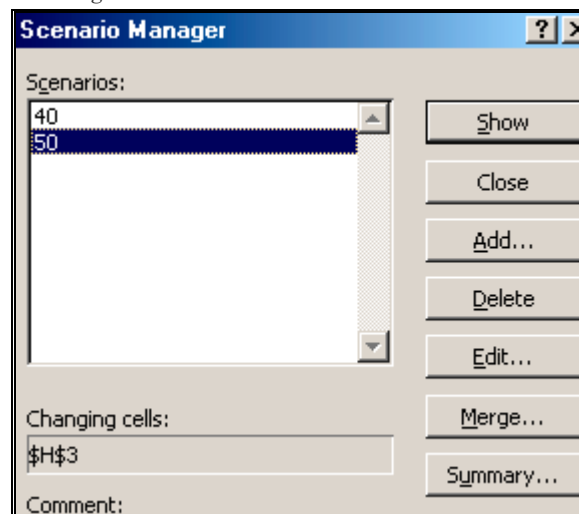
You can define more scenarios.

Using the Scenarios

Viewing the result of a scenario

Click on the scenario name "40," followed by the button "Show." The cell "H3" will take on the value assumed in the scenario (40% or 0.40). All the cells whose formula references the "assumption cell H3" will change.

In this example, these cells are those in the column "G" (direct reference to the assumption cell) and the values of the formulas for the mean, median and maximum of column "G" (indirect reference to the "assumption cell H3").

Figure 175: Result of the first scenario

Assumption on Growth Rate 2010-20, Algeria	
10 year growth in Labor Force=	**40%**
Output	
Average	**8,890,323**
Median	**3,732,400**
Maximum	**54,090,400**

Switching over to the view of the result of *another* scenario

Click on the scenario name "50," followed by the button "Show." The cell "H3" will take on the value assumed in the scenario (50% or 0.50). All the cells whose formula references the "assumption cell H3" will change.

In this example, these cells are those in the column "G" (direct reference to the assumption cell) and the values of the formulas for the mean,

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median and maximum of column "G" (indirect reference to the "assumption cell H3").

Figure 176: Result of second scenario

Scenario summary

At this stage, the use of scenarios is not very useful because you can only see the results of one scenario at one time. You may wonder if a better option is to copy the worksheet and use 40% in cell "H3" of 1 worksheet and 50% in cell "H3" of the other worksheet.

Figure 177: Obtaining a "Scenario Summary"
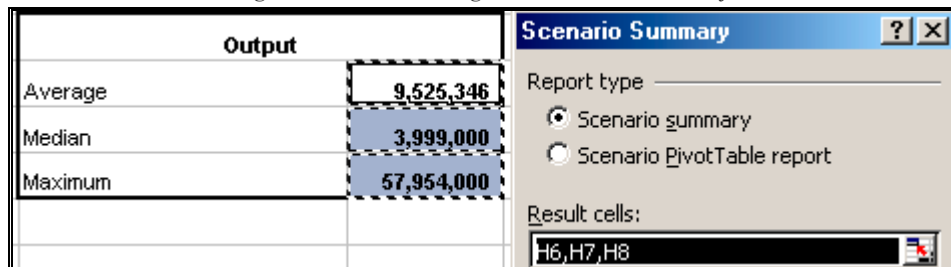
The real power of Scenarios comes from its ability to create a comparative summary table from the different scenarios. Click on the button "Summary." Choose the option "Scenario summary" and the cells whose values you want to compare across the scenarios. I have chosen the cells

that contain the mean, median and maximum of column "G."

The "Scenario Summary" is created and displayed on a new worksheet. Note that the columns compare across scenarios, while the rows display the formula results you wish to compare.

Making the output easily interpretable

You can type in "Assumed Growth Rate," "Mean," "Median" and "Maximum" into cells "C6," "C8," "C9," and "C10," respectively.

Figure 178: The "Scenario Summary" is created and displayed on a new worksheet

Using the "Group and Outline" tool

Note that Excel has automatically inserted the "plus and minus" signs, grouping range outlines, and grouping levels ("1" and "2") to the Scenario Summary table. Experiment with using these indicators to learn more about "Grouping and Outlining," a skill taught in *Volume 1: Excel For Beginners*.

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Figure 179: Collapsing the grouped Scenario columns "D" –"F" by clicking on the grouping indicator "minus" at the top. (The indicator can be seen in the previous figure. The indicator changes to a "plus.")

Figure 180: Expand the columns so that all the columns can be seen. Now contract the group of row "4" and the group of row "6" by clicking on the "minus" signs for both of them. (The indicators can be seen in the previous figure. The indicators change to a "plus.")

Figure 181: Re-expand the rows by clicking on the two "plus" indicators for the rows

Scenario-based Pivot Tables

Go to the dialog (user-input form) for TOOLS/SCENARIOS after the scenarios have been defined.

Click on the button "Summary."

Choose the option "Scenario Pivot" and the cells whose values you want use in the data region of the Pivot.

Figure 182: Obtaining a "Scenario Pivot"
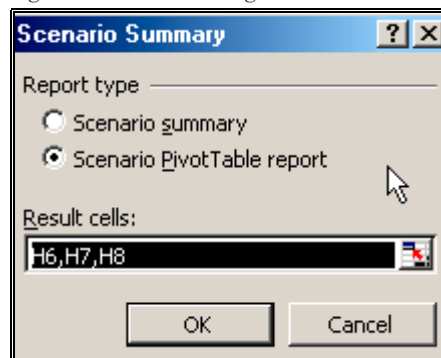
The Pivot is created on a new worksheet. This Pivot is simple and small because we have defined only one "assumption cell," two scenarios within this assumption cell, and three "result cells."

- The number of data rows in the Pivot equals the number of scenarios.

- The number of data columns equals the number of result cells.

- The number of "pages" in the Pivot is defined by the number of users who have defined assumption cells.

Figure 183: The Pivot is created on a new worksheet

	A	B	C	D
1	H3 by	(All) ▼		
2				
3		Result Cells ▼		
4	H3 ▼	H6	H7	H8
5	40	8890323.077	3732400	54090400
6	50	9525346.154	3999000	57954000
7				
8				

See *Volume 3: Excel– Beyond The Basics* to learn how to collaborate and work simultaneously on one file. If you click on the "Merge" button in the main Scenarios dialog, then you can merge the scenarios defined by different users. Choose a different page — if you have more than one user — by clicking on its name in the list that opens when you press the arrow on the right of cell "B1."

You can create a separate worksheet and a separate chart for each page using methods taught in *Volume 4: Managing & Tabulating Data in Excel*. See that book for more on working with Pivot Reports.

The users who have defined scenarios will be listed. All lists all the

scenarios defined by all users. Use the "Merge" button to merge scenarios by different users.

Figure 184: The users who have defined scenarios will be listed

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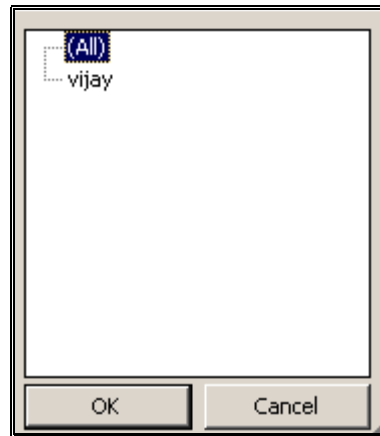
GOAL SEEK ("IF I WANT THIS CELL TO HAVE A CERTAIN RESULT, WHAT VALUE SHOULD THAT CELL TAKE)

Type this formula into cell F4 of the sample data file ""Advanced File2.xls." —

=SUM(B2:B8) +(D4*1.23)

This formula will add the values in cells B2, B3… B8 and then add this sum to the value in cell D4 multiplied by 1.23. *Note that the formula references the cell D4 and the cells B2 to B8.*

I will show how Excel permits you to find a value for D4 such that F4 equals a desired "target" value. Assume you want to find the value in cell D4 that will make the value of the formula in F4 equal to 10,000,000,000.

15.2.A   SETTING THE DESIRED VALUE FOR THE "TARGET" CELL (THE ONE
              WITH THE FORMULA THAT REFERENCES THE "SOLUTION" CELL)

Click on the cell "F4"— that is, the cell for which a desired value is
"sought." Then choose the menu option TOOLS/GOAL SEEK. The
relevant dialog is shown in Figure 185.

Enter the desired/target value into the box "to value" as shown in Figure
186.

Figure 185: The "Goal Seek" dialog
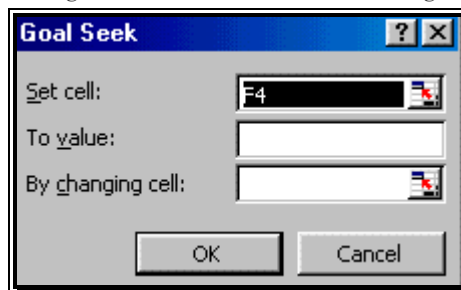
15.2.B   CHOOSING THE "SOLUTION" CELL

You want F4 to achieve the given value by changing the value in cell D4.
So enter D4 in the box "By changing cell" as shown in Figure 186[29].

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[29] Alternatively, click on the box marked by the arrow and then choose the cell from the
sheet.

Figure 186: Choosing the "solution" cell
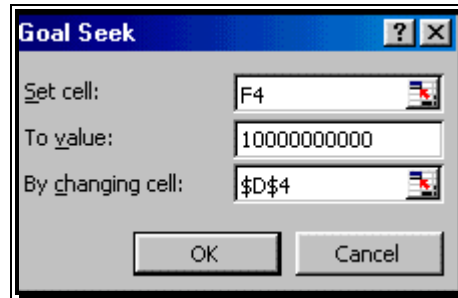
Running the utility

Execute the dialog by clicking on the button OK. You will be told if a solution was found. Go and look at cell D4. The value in there is the desired one— the value that makes F4 = "target or desired value."

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Q