

INVESTMENT KNOWLEDGE SERIES

# FINANCIAL MODELLING

4th edition



INVESTMENT KNOWLEDGE SERIES

# Financial Modelling

4th edition

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At various points in the manual a number of financial analysis issues are examined.

The financial analysis implications for these issues, although relatively standard in treatment, remain an opinion of the authors of this manual. No responsibility is assumed for any action taken or inaction as a result of the financial analysis included in the manual.

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- Management development training

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# Guide to financial modelling

This book is a practical guide to help you get the most out of your financial modelling. The book shows you what is best practice in model building and demonstrates the Excel functionality you will need to use along the way. The manual is intended for users who have Excel 2007/2010 or the latest release of Excel in Office 365.

We've split the manual in two: Part 1 contains best practice guidance and details the relevant functionality in Excel 2007/2010 and Office 365. In Part 2 we provide a guide to the Excel interface for new users. The format of Excel and its functionality has not changed significantly for modellers since 2007, but this Part 2 will also be useful for users who are upgrading from 2007 as we highlight the key differences across Excel 2007/2010 and the Office 365 release. Tricks and keyboard shortcuts for Excel can be found in the Appendix. This is at the end, but it's perhaps one of the first bits you should read if you don't use shortcuts.

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# 1 • Best practice financial modelling

## Introduction

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This chapter sets out how Excel can be controlled and exploited to enable:

- Faster and more efficient use of Excel tools
- Better understanding of model design principles
- Reliable, robust and flexible models to be built
- Improved efficiency in identifying inconsistencies when auditing financial models

It will also introduce the tools to better analyse and assess the sensitivity of financial models. The aim is to provide the practical skills to build, modify and audit an integrated and flexible financial model.



### QUICK ACCESS GUIDE

Look out for this Quick Access Guide at the start of each section where you will find new or different best practice and functionality if using Excel 2007/2010/2013. You can then use the appropriate section in Part 2 – “The changing Excel interface from 07 to 16” for assistance. This is also a handy guide to some useful Excel functionality such as data validation and charts.



## Meeting user needs

The most common complaint about spreadsheet models is that they cannot be understood. The lack of understanding could be a problem for users other than the model preparer, or even the preparer of the model when the model is revisited.

This complaint arises because models:

- Are rarely documented
- Include cumbersome formulae (difficult to understand, check and modify)
- Include wide and/or long spreadsheets
- Are made up of purely numbers (a chart can quickly highlight results)

- Have no consistent format
- Mix the assumptions, other inputs, workings and outputs.

Useful models are those that can be picked up and easily and quickly understood by a reviewer. The more logical, consistent and rigorous the model, the more confidence will be engendered in the results.

These notes should help ensure that models are not only logical, but can also be reviewed by others with the minimum of effort.

### Excel vs. modelling

Excel is a particularly powerful application which can be used to generate, analyse and present both simple and complex data. Like any sophisticated tool, when used properly, it can be harnessed to create highly efficient, interactive and robust financial spreadsheets.

The skills introduced by financial modelling harness the functionality of Excel within a methodical and rigorous financial framework which can be applied to a large number of different applications.

Financial modelling, therefore, combines:

1. Financial skills
  - The strategy of the business or project
  - The product, project or industry competitive dynamics and their value-drivers and key sensitivities
  - Accounting, analysis, forecasting, structuring and/or valuation techniques
2. Excel functionality
  - Knowledge of the mechanics of functions and tools
  - How to practically apply the functions and tools
  - Practical limitations of the functions and tools
3. Robust spreadsheet modelling techniques
  - Design principles
  - Modularity
  - Quality controls and diagnostics
  - Version control
  - Formulae conventions

- Format conventions
- Logical thought
- Data analysis and sensitivity

### The golden rules of modelling

The following modelling rules have been developed to:

- Enhance the quality of models
- Ensure that flexibility can be easily added
- Make models robust
- Enhance the efficiency of calculations within models
- Ensure internal consistency
- Make models easier to review.

### The magic numbers

A financial model is different from a calculator. In a calculator, arguments are input and an answer results.

- The calculator will have limited functionality
- The cumulative effects of a number of calculations are difficult to assess
- There is limited scope to flex the inputs without doing the calculation again
- The inter-relationships between each input/calculation cannot easily be evaluated

Often Excel is used like a calculator but Excel has enormous functionality which can be harnessed to create cumulative calculations which can be flexed and enable inter-relationships to be examined. Consequently, to use Excel efficiently for financial modelling:

**Data must only ever be entered once**

Therefore all dates, currencies, numbers, labels etc will be entered once and if used in other places in the model will refer back to this first input cell.

For example, the current year end is often the only date that is entered. All other year ends are related back (via formulae) to this cell. Consequently, if the date is changed, then only one cell needs to be changed and the remainder of the model updates automatically.



Never use hard-wired (input) numbers within formulae. Permitted exceptions are:

Number	Justification
0	Often defines start period or used to define whether a number is positive or negative (as part of a logical test); also used to denote false as a flag (multiply by 0 if a logical test is failed)
1	Often defines the first period or used to define true as flag (multiply by 1 if a logical test is true); starting point for and increment for row and column counters
12 (and 7)	Number of months in a year (days in a week) – i.e. a fact
100	p in £, c in € and \$ etc – i.e. a fact
365 (or 360 or similar)	Number of days in a year – i.e. a fact

All formulae should therefore only be made up of cell references and the above 5 numbers.

### Presentation issues

- Stick to consistent colour-coding, e.g. inputs blue, workings black (see Colours, size and number formats later)
- Format consistency: consistent number styles (see Styles later) and sheet set-up (see Sheet consistency later) enables quick interpretation of the results
- Shade areas in different colours for ease of navigation (some sheets may be large)
- Develop a consistent sign convention across all workings, e.g. all numbers are positive unless unusual
- Never hide columns or rows. If data is to be hidden, group the data (see Group outline later). It is then obvious to the user

### Formula construction

- Always refer back to the original reference unless it becomes onerous to do so. For example, if EBITDA is used in many different places, the cell where it was first calculated / input should always be the reference for all other cells. This will speed up calculation and reduce the file size
- The rule of two-thirds: if the formula takes up more than 2/3 of the formula bar, then it is too long
  - The worksheet is 16,384 cells wide and 1,048,575 cells deep – just under 17.2 billion cells to play with per sheet

- Breaking down long formulae into several steps makes them easier to understand and edit
- Where possible, use logical operators (AND, OR, etc.) rather than nested IF functions
- Use flags (e.g. for dates, event triggers) where possible to shorten formulae
- Avoid the indirect and abstruse
  - The shortest formula is often, though not always, the best. ‘=MAX(0,D16)’ and ‘=IF(D16<0,0,D16)’ do exactly the same thing. However, the first is a little less obvious in how it operates than the second which mimics more closely the syntax of spoken English: simplicity will help you, as well as other users. You will be surprised how you won’t recognise your own code when you come back to it after a week or two!
- Do not create circular references
  - They slow down calculations and may cause Excel to crash
  - Results depend on Excel settings (in the Tools; Options; Calculations menu), i.e., maximum iterations and maximum change
  - Once a circular reference has been created, it is very easy to add further circular references without being aware of it
  - They can almost always be avoided with more careful formulation or automated goal seeks. However, in the interests of time you may be able to tolerate it if you close the circularity whilst editing the model (for example by having some sort of switch) (see later).
- Row consistency: where possible, avoid changing formulae across a single row (see F5-Special later)
- Try to keep to one row / one formula
- If unavoidable, highlight the non-standard cells
- A reviewer needs to be confident that there are no hidden fixes in individual cells

### ***Other best practice modelling rules***

- Only name those ranges/cells that will be used away from the near vicinity (see Names later)
- Insert notes/comments where it may not be obvious what the logic is (for easy review)

- When deleting data at the end (either vertically or horizontally) of a sheet, use Edit, Clear All across the whole area – this will re-set the size of the sheet in the memory, making it easier to identify the reference of the bottom-right of the active sheet: (short cut - Ctrl-End) and may significantly reduce the size of the file
- Make all check digits positive for ease of use in subsequent conditional statements (see Common problems with IF statements and some simple solutions later)
- Use the mouse as little as possible – keyboard shortcuts will make you faster, more efficient and less prone to errors when using Excel.

## Model set up



### QUICK ACCESS GUIDE

- Changes to the layout of Excel 2007/2010/2013 (Part 2 – ‘New Layout’)
- Excel set up, Calculations and Add-Ins (Part 2 – ‘Excel Options’ and ‘Workbook setup in 2007/2010/2013’)
- Steps in model set up (Part 2 – ‘Workbook setup in 2007/2010/2013’), also see creating a template (Part 2 – ‘Creating a workbook template’)
- New menu position for freeze panes command (Part 2 – ‘Introducing the Ribbon’ and ‘Appendix’)

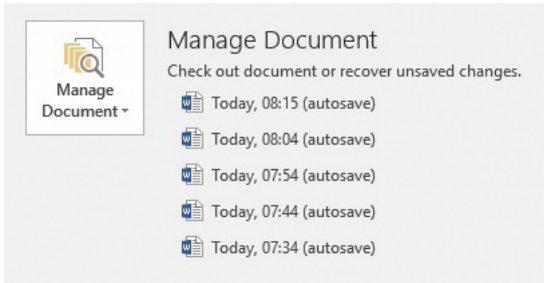
### Excel set up for efficient modelling

In order to use Excel efficiently, it is worth ensuring the profile (where possible) has been amended for the following:

#### Autorecover

Excel, like all the Office programmes, automatically saves your work in the background every 9-10 minutes. Even better than this, it saves workbooks that you haven't closed as drafts.

The clip below shows the autosave history for a document in Word – this is accessed – File; Info. The autosaved file details show again the Manage Documents button.



If you have accidentally closed a workbook without saving it, to use the Autorecover function – File; Info; Manage Workbooks; Browse recent unsaved files. Excel then shows a list of the unsaved drafts which can be reopened.

Autosave and autorecover are useful tools. Crashes will not worry you and you won't worry either about saving, only to realise that you accidentally deleted a sheet 10 minutes ago. The worst position you will be in will be to lose 10 minutes work.

### *Analysis ToolPak*

The standard set-up of Excel is fine for most users. However, in some financial models, some more advanced statistical tools are needed. This procedure was really essential for 2003 users, but the essential date functions which were in the Toolpak are now accessible in a normal install, so today it is very optional.

File; Options; Add-Ins; Go; tick the Analysis ToolPak box; OK

**Note 1:** If you are logged into the network at the time of doing this, your profile will be updated so that these advanced functions are available for all future sessions.

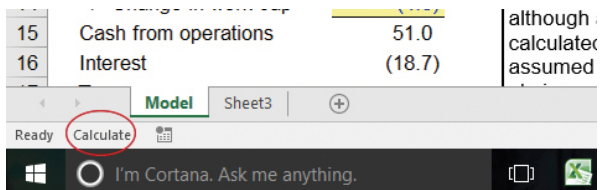
**Note 2:** If the model is to be sent to others, they may not have incorporated this add-in and so some of the calculated formulae may appear as #NAME?. It may be necessary to indicate that the user must go through the add-in routine to ensure the model works effectively.

### *Calculation settings*

- Formulas; Calculation Options; Calculation tab; Automatic except tables

The model will calculate automatically as the model is modified, but F9 must be pressed whenever Data Tables are to be calculated (see Data Tables later).

If you are opening a third party model, look in the bottom left on the status bar. The word "Calculate" there is a giveaway that the model is circular and that iteration is enabled.



If Iteration is enabled, Excel will iterate any circularities created within the model. Circularities make the model slower to calculate, unstable and more likely to crash. Often circularities within models are created in error or are unnecessary. Whilst the iteration option remains off, any circularities will be flagged (and can be eliminated).

**Note:** if a circularity exists and the iteration option remains off, the calculated numbers in the model cannot be trusted as Excel will not calculate completely.

To change the iteration settings – File; Options; Formulas; uncheck the “Enable Iterative Calculations” box.

## Design

Time spent on design is never wasted and you will recoup it many times over while you are building your model and also when you use it. Clear design objectives at the start (which don't change) will let you build a simple and straightforward model which should also be transparent in structure, helping you find mistakes and making it easy to use.

The first step is to scope out the model. The following questionnaire aims to help you uncover the key issues which will drive the way you structure your model and which will also determine the user friendliness and flexibility that you will have to build in.

The questionnaire is designed for modellers to sit down with the potential users and consumers of the results (are they different people?) and get them to give you the answers to all of the questions.

### Scope questionnaire

1. Who is the customer? Who wants the outputs and why? What are detailed questions the model will be used to answer? What are the important outputs? Is there a mandatory or preferred format for them? What are the key decisions which need to be made based on the outputs?
2. What is the nature and form of the input data? How detailed and how good quality will it be? Can you set the format, or get a commitment to format from the input data's author?

The Investment Knowledge Series Financial Modelling manual provides a detailed reference for analysts building financial models. The manual focuses on the technical and best practice skills required to effectively build flexible and responsive financial models. The 4th edition has been updated to include best practice and functionality of Excel 2016 as well as 2007 and 2010.

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