Introduction to Financial Modelling in Excel

Online Course Notes

Module 4 of 4

"Model Analysis Tools"

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MODULE FOUR: Model Analysis Tools

Module 4 consists of five videos:

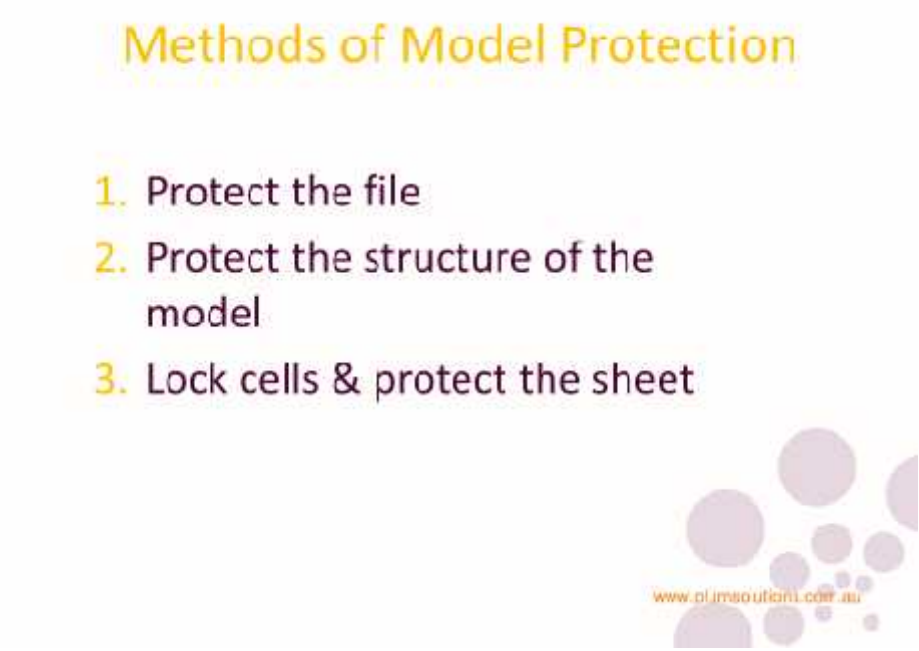
- Bullet-Proofing Your Model
- Data Validations & Drop-Downs
- Conditional Formatting
- Charting Cash vs Profit
- Model Build - Modelling Scenarios

Log into your online course and open the Excel financial model built in the last module. Follow along with the video demonstration, and save your model. Note that the Excel model you build in Module Four ***is a required upload for this course*** *which needs to be uploaded on completion of this module.*

Video: Bullet-Proofing your Model

Recommended Reading: See the section on "Bullet-Proofing Your Model" in Chapter 7, Page 204 of Using Excel for Business Analysis

There are three methods of protection in Excel we can use so that someone else does not inadvertently (or deliberately!) make unauthorised changes to your model



Protect the File

Exercise:

1. Open the file called "Model Protection" as shown in the video
2. Select the File tab in the top left-hand corner (or the Microsoft button if you're still using Excel 2007) and select Save As to save the file in your desired location. Then select the Tools button at the bottom of the dialog box as shown, choose General Options and here you can enter a password to open the file, or password to modify. [For Mac users: select Save As, then under File Format select Options]
3. Enter the password, and you will be asked to confirm the password. Type in the password again and press OK, and then save. You may choose a password to open and a password to modify. You can choose one or the other, or both. [This works in the same way for Mac Users]
4. You can test this by closing the file and reopening and it will ask you for the password/s that you've just created

Selecting the Password to Modify option is handy if you want others to be able to access your file, but not make any changes to the original document. Whichever option you choose, make sure you take a note of the password and try not to forget it. Of course a password is not quite as secure as we'd like to think it is. It's actually pretty easy to get into a file if you really want to – try googling "Excel password cracker" and you'll see what I mean. The purpose of putting password protection onto a model is supposed to stop people from being nosy. If it's market sensitive information, salaries or something like that then put it in a secure location, don't trust an Excel password.

Read Only Option

Instead of using a password to prevent access, you could use the Read Only option to deter users from changing your workbooks, but allow a user to make changes if required. This way you prevent inadvertent changes to models.

Protect the Structure of the Model

If we don't want people to view parts of the model, or add or delete sheets, there is an option to protect the structure of our model, with or without a password.

Exercise:

1. Return to the file called "Model Protection" as shown in the video
2. Right-hand click on the "Salaries" tab and select Hide. This will hide the sheet from view, but it can be easily unhidden by a user unless we protect the structure of this workbook.
3. We can do this by selecting Protect Workbook from the Review Tab in the Ribbon

4. A dialog box will appear. Leave the Structure tick-box checked, and apply a password if desired, and press OK.
5. Note that if we right-hand click on the sheet tabs now, the option to unhide a sheet has been greyed out
6. However, remember that although a user cannot view your hidden sheet, they can still access your data. Try copying cells **A9** and **B9** on your budget sheet up to the top of the sheet, and you'll see all your carefully protected data appear on the page!

So bear in mind that just because you've protected your data, it doesn't necessarily mean that a persistent user will not be able to get in and see what you've entered.

Lock Cells & Protect the Sheet

If you have created a spreadsheet that you do not want to be altered by the other people that might view it, you can protect the sheet. You can either protect the whole sheet, or just certain key cells in the sheet (probably those containing the formulas) so that new data can still be entered onto the sheet.

Exercise:

1. Return to the file called "Model Protection" and select the first tab called Exercise
2. Calculate your forecast sales by selecting cell **C6** and adding the formula **=B6*(1+B3)** and copying the formula across the row
3. Protect the sheet by selecting the Protect Sheet icon from the Review tab in the Ribbon
4. Leave the default tick boxes checked, enter a password if desired, and press OK

This entire sheet is now protected. Note that it is not possible to change *any* of the cells, including the input cells which are designed to be changed!

To fix this, we should have unlocked the individual input cells *first* before protecting the sheet. Then when we apply the protection, only the locked cells cannot be changed. (Note that by default every cell is locked, and we manually need to change the cells we want unlocked.)

5. Firstly unprotect the sheet by selecting the Unprotect Sheet icon from the Review tab in the Ribbon
6. Then highlight cells **B3:F3** and also cell **B6**. Hold down the control key in order to highlight non-consecutive ranges. [Hold down the Command Key for Mac Users]
7. Right-hand click with the mouse and select Format Cells, go to the last tab in the dialog box labelled Protection, and unselect the Locked tick box. This will ensure that *only* those cells will be able to be changed once the protection has been turned back on.
8. Protect the sheet again by selecting the Protect Sheet icon from the Review tab in the Ribbon
9. Test your protection is working correctly by trying to change the cells containing formulas. An error message should appear when you try to change these. It should be possible to make changes to any of the input variable cells which we had unlocked.

So, in summary:

- By default, every cell in a sheet has 'locking' applied to it. It is the locking that is activated when the sheet is protected and stops people from editing cells
- If you want to protect part of a sheet (usually those containing the formulas), but leave other cells open so that users can enter new data, you will need to 'Unlock' the cells that will be changed at a later date
- Every cell is already locked by default, so when you protect the whole sheet you will not be able to change any cell. If you want to be able to edit some cells, you will need to unlock them
- The difference between password protecting a worksheet and protecting a workbook is that if the *workbook* is protected, the user cannot change the structure of the model (eg. unhiding hidden sheets) without a password, whereas if the *worksheet* is protected, they cannot make changes to the sheet itself

Video: Data Validations & Drop-downs

Recommended Reading: See the section on "Restricting Incorrect Data Entry with Data Validations" in Chapter 7, Page 210 and also "Using Validations to Create a Drop-down List" on Page 213 of Using Excel for Business Analysis

Restricting Incorrect Data Entry

Usually we are building models for other people to use, and they probably are not as spreadsheet savvy as you. These people might find unusual ways to enter the wrong type of data – entering text where you expect numbers, or spelling names the wrong way. Using data validation will control what can be entered in your spreadsheet, and avoid errors.

By default, every cell in Excel is set to allow any value. You can use the Data Validation dialog box to control what values people can enter in a cell.

Background: We would like to edit a staff budget costing model such that other staff completing their budgets cannot enter invalid data.

Exercise:

1. Open the file called "Data Validations & Drop-downs" as shown in the video (a completed version is also available which you can download at the end if you wish to compare your work)
2. Select cell **B3** and try typing in "TBA" instead of the number and we'll see that this messes up our calculations. Control-Z to undo. [Command + Z for Mac Users]

In order to stop this from happening, we're going to restrict the inputs on this cell. *Be aware, however, that it is possible to paste values over a restricted cell!*

3. Select Data Validation from the Data Tab on the Ribbon, and on the first tab, change the drop-down from "Any value" to "Whole number"
4. Edit the fields such that the Minimum value which can be entered is 100,000 and the Maximum amount is 1,000,000
5. Press OK, and then try changing the value again in cell **B3** to text. We will now get a warning message if the value entered is not a whole number between 100,000 and 1,000,000.
6. We can customise that warning by going back into the Data Validation dialog box. On the second tab called Input Message, type your custom message in the fields. For example, we could enter "Warning" in the Title, and "Only enter numerical values" in the input message field or whatever you wish.
7. Press OK, and go back to your sheet. When you click on the cell, the warning message should appear. This only serves to warn the user; if they then proceed to enter invalid data, an error message will then appear.

8. We can also customise this error message by going back into the Data Validation dialog box. On the last tab called Error Alert, we can add a customised error message to appear when the user adds invalid data. Do try to resist writing a rude message ☺ Tempting, I know.
9. Once you have added your error alert go back to the sheet, and test it and check that your customised message appears when incorrect data has been added

Note that we have done this example to restrict the input data to numerical whole numbers, but this can also be applied to percentages, and dates as well. For example, you could restrict the data entered to only contain a date not more than one year in the past by editing the settings to allow a date between the Minimum value of **=TODAY()-365** and the Maximum value of **=TODAY()**.

Creating Drop-Down Boxes

We can also restrict our inputs to a pre-defined list instead, and this is how we create the *data validation drop-down boxes*.

Background: We would like to restrict a cell such that only a pre-defined list of values can be selected from a drop-down list

Exercise:

1. Return to the "Data Validations & Drop-downs" file, and select the second sheet called Drop-down
2. Select a random cell such as **B3** and open the Data Validation dialog box again
3. This time, we are going to select List from the options at the top, and in the Source field, enter the words "yes, no" as shown
4. Press OK, and return to the sheet and cell **B3** should now contain a drop-down box with only two options; yes and no.
5. Try entering in the value "maybe" and this will not be a valid option

Similarly, in cell **A1**, we'd like to restrict the values which can be entered into this cell to the pre-defined list of countries shown in column E. For example, we want to ensure that users enter "United States", not simply "US", or "U.S."

6. Select cell **A1** and open the Data Validation dialog box again
7. Allow a list, but this time instead of typing the restricted values into the Source field, we can link this to the values which already exist in column E on the sheet. Do this by typing an equals sign in the Source field, and then highlighting the list with the mouse as shown. The formula in the Source field should be **=$E$1:$E$6**
8. Go to the Error Alert tab and change the message to "Error" in the title and "Please read the instructions properly. You have listed an invalid country!" or similar. (Note this step is not shown in the video).

9. Press OK, and test that your drop-down box is working correctly. Try entering an invalid country, such as New Zealand, and the error alert will appear.
10. If we then decide that we'd like for New Zealand to appear in the list instead of France, simply change the word France to New Zealand in the list, and this will automatically become a valid option

Video: Conditional Formatting

Recommended Reading: See the section on "Conditional Formatting" in Chapter 7, page 193 of Using Excel for Business Analysis

Exercise: Automatically Highlighting Large Variances in Reporting

Background: We'd like to highlight any large variances so that they automatically change colour as the numbers change.

Exercise:

1. Open the file called "Conditional Formatting" as shown in the video.
2. Select the first tab called "CF P&L" and highlight the range **F6:F73**
3. Select the Conditional Formatting Icon on the Home Tab, Highlight Cells Rules and then Between
4. Edit the fields to format the cells which fall between -30% and 30% as shown in the video, leave the default colour as Light Red Fill with Dark Red Text, and press OK
5. This gives us the *opposite* of what we want to show, so we are going to edit this by going back into Conditional Formatting, select Manage Rules, select the rule that you have just created and select Edit Rule
6. Change the rule so that instead of "between" it highlights the cells "not between" instead
7. Test that your conditional formatting works by changing one of the values in the report, for example, go to cell **C6** and change the value to $310,000 instead which is an acceptable amount, and we can see that the red conditional formatting will disappear

Exercise: Graphically show Magnitude of Values on a Report Using Data Bars

Background: We are trying to decide between showing data as a chart or as a table on our report, to give our numbers a little more meaning.

Exercise:

1. Go to the file "Conditional Formatting" and select the sheet called "Data Bars", as shown in the video
2. Highlight the range **D4:D35** and select the Conditional Formatting Icon on the Home Tab
3. Select Data Bars, and then choose the bar you'd like to show on the report
4. Test your data bars by changing one of the values, for example, go to cell **C4** and change the value from $400,000 to $40,000. We can see that this changes the distribution of the data bars throughout the column.

Exercise: Adding Visual Interest using Colour Scales

Background: Let's jazz up an otherwise boring report using some basic conditional formatting and colour scales.

Exercise:

1. Go to the file "Conditional Formatting" and select the sheet called "Colour Scales", as shown in the video
2. Highlight the range **B3:M7** and select the Conditional Formatting Icon on the Home Tab
3. Select Color Scales, and then choose the colour scale you'd like to show on the report
4. We can edit the colours shown by going back into Conditional Formatting, selecting Manage Rule, and then selecting the rule that you have just created and selecting Edit Rule. Change the colours to your desired selection.

Now let's apply some informative colour to the next block of data below. We cannot apply data bars, colour scales or icon sets to this data because it contains text instead of numbers, but we can still apply colour using standard conditional formatting.

5. Highlight the range **B10:M14** and select the Conditional Formatting Icon again. Select Highlight Cells Rules and then Equal To.
6. In the field type OK and change the colour in the drop-down box to green. This will change all the cells with a value of "OK" to green.
7. Let's do the same thing for the next one. Create another rule for when the cells are equal to "Too Hot", and select Light Red Fill with Dark Red Text (this step is not shown in the video).
8. Now we will create the last rule for when the cells are equal to "Too Cold" and we'd like to change the colour to blue. This colour does not exist in the pre-set options however, so we will need to select Custom Format… and manually select a blue background and font colour.
9. Test your formatting now by changing either of the Min or Max Temp values, for example, change the Max Temp in cell **P3** from 25 to 20 and watch the formulas and colours change.

Using Conditional Formatting can quickly and easily provide a little more meaning to the outcome of our model. Automatically changing colours can really add an extra element of depth and meaning to your model.

Video: Model Build - Charting Cash vs Profit

Recommended Reading: See Chapter 12 of Using Excel for Business Analysis called "Presenting Model Output" which contains instructions for many different types of charts used in financial modelling.

Contained in the supplementary files for the book is a PDF document called Supplementary Material. On page 14 of this document is a section on "How to Create a Basic Line Chart".

Background: Let's go back to our case study that we've been working on earlier in the course, and we're going to go back and add in a few visuals. Although we're happy with the output of our model so far, it's always nice to spend a little time at the end of the model making it look nice. We're going to add in a couple of charts to add a visual element to our financial model.

Exercise:

1. Go back to the case study "IFME Café Model", and select the Revenue page as shown in the video We'd like to show the split of daily sales between large and small cups over the year

2. Highlight cells **A6:M7** and if you are using Excel 2013 or later, select Recommended Charts from the Insert tab on the Ribbon which gives a preview of what the chart will look like. The Stacked Column looks like an interesting display of our data.
3. The dates are not showing across the bottom, so we need to cancel and return to the data. Highlight cells **A6:M7** again, but this time we are going to hold down the control key and select the dates as well which are in cells **A3:M3** (make sure that you start from cell **A3**, not **B3** otherwise the range will not match your data below.) [Command for Mac Users]
4. Go back into Recommended Charts and select the Stacked Column, or for older versions of Excel select the 2D Stacked Column Chart from the Insert tab and press OK
5. Move the chart to below the data if necessary

Let's change the colours from the default red and blue. This is always recommended, as it only takes a few seconds, and gives your model a much more polished, professional look.

6. Select the chart, then select from Change Colours on the Design Tab in the Ribbon. In previous versions of Excel, this can be done through the Styles, or select each series individually, and change the colour manually from the Home Tab on the Ribbon.
7. Change the title of the chart by clicking on the Chart Title, and start typing "Cups Sold per Day". In previous versions of Excel the chart title may not automatically appear, so insert the title by selecting Chart Title from the Layout Tab which appears on the Ribbon as soon as the chart is selected.
8. Look through the Styles on the Design Tab, and select a style that you like. These options will be far more limited in Excel 2010 than later versions.

Now that we're happy with this chart, let's go now to the Summary page and add another chart to our model on this sheet.

9. Select the Summary sheet as shown, and look through the numbers to decide which output would be appropriate to include in our chart
10. Let's show the Profit after Tax amount and the Closing Cash on our chart
11. The data we need to show is contained in the ranges **A5:M5**, **A15:M15** and **A29:M29**. Highlight these non-consecutive ranges by holding down the control key, and insert a Line Chart.
12. Move the chart to below the data if necessary. If freeze panes in enabled, you may wish to remove this depending on your screen size it may be difficult to see your chart and your data at the same time. Freeze panes or Unfreeze panes is located on the View Tab in the Ribbon.
13. Edit the chart title to show the title "Café Model Cash vs Profit", or a description appropriate to the data you have chosen to display on this chart
14. Change the design and colours of the chart as desired

Note that you may choose to include different numbers on your chart if you prefer – when you submit your model, the numbers will be checked for accuracy, however, the two charts may contain any information from the model, as long as it is relevant and useful.

Video: Model Build - Modelling Scenarios

Recommended Reading:

1. See Chapter 11 of Using Excel for Business Analysis called "Stress-Testing, Scenarios, and Sensitivity Analysis in Financial Modelling" which contains a lot of information on how to perform various types of scenario analysis.
2. In this course, we focus on simple drop-down scenario analysis which is discussed on page 355 in the section on "Creating Built-in Scenarios Using a Data Validation Drop-Down"
3. Read the article Scenarios, Sensitivities, What-if Analysis - What's the Difference?

Scenarios and sensitivity analysis are a great way to insulate your model from risk. What would be the absolute worst that could happen? If everything that can go wrong does go wrong, will this business still be OK? There are usually effects and interactions between multiple variables which may change in the model. With a well-built model which has all inputs linked to outputs, (as we have done here!) it is relatively easy to change inputs and watch the outputs change.

Because of the way we have built this model, it will now be relatively straightforward to perform some scenario analysis.

Background: The last thing that we need to do with this model is to apply some scenarios by changing some of the input variables that we have created.

Exercise:

We are going to create three scenarios;
Base case - which is the current model we have already built.
Worst case - we will change a few variables to see what is the worst that can happen to our business.
Best case - we will change a few variables to see how the numbers look if all goes well in our business.

The changes to the variables under the worst case scenario are:

- Reduce cups sold per day by 20 cups
- Increase rent by 10%

The changes to the variables under the best case scenario are:

- Increase cups sold per day by 20 cups
- Reduce rent by 10%

1. Return to the "IFME Café Model" and select the Assumptions Sheet as shown
2. Enter the base case numbers of 120 and $1,200 in cells **J14** and **J15** which are the inputs that are already in the model

We are going to tweak these numbers up and down just a little bit in this scenario analysis exercise to see the impact that this will have on our financials.

3. Enter the worst case number of cups per day of 100 in cell **I14** and the best case amount of 140 in cell **K14**
4. We'll do the same for the rent. We're going to assume that under the worst case scenario the rent will go up by 10%, so in cell **I15**, enter the formula **=J15*1.1**.
5. Under the best case scenario, let's assume that the rent will decrease by 10% so in cell **K15** enter the formula **=J15*.9**

Now that we have built the scenario inputs, we need to build the drop-down box which is going to drive our scenario analysis from the Summary page

6. Go to the Summary tab, and select cell **B1**
7. Create a drop-down box here by selecting Data Validation from the Data Tab in the Ribbon and change the Any value field to List

Note that we could type the words Best, Base and Worst directly into the field, but we may not spell it exactly right, so it's best to link it through to the source.

8. Type equals in the Source field and then click on the Assumptions tab with the mouse, and find the scenario names. Your formula in the Source field should be **=Assumptions!$1$13:$K$13** and press OK
9. Go back to cell **B1** and test that the drop-down box is working as expected and gives the options Best, Base and Worst as shown in the video

We now need to edit our input assumptions for number of cups and rent such that as the drop-down box on the Summary page changes, the input assumptions change to the corresponding scenario. For example, when "Best" has been selected on the Summary page, the value in cell **B9** on the Assumptions page is 140, and the value in cell **B19** is $1,080. This should be done using a formula. You'll get the most out of this course if you pause the video here, and try to work it out on your own before continuing to watch the instructions.

Hint: you may find it useful to review the exercises in the Logical Nested Functions sections if you're seeking inspiration ☺

10. Select cell **B19** and change the background colour to no fill and the font colour to black
11. We need to now enter an IF statement which will firstly just evaluation the Worst and Base case scenarios. Your formula should be **=IF(Summary!$B$1=I13,I14,IF(Summary!$B$1=J13,J14,K14))**.

Note that if you use the mouse, we did in the video, the formula will probably look more like this **=IF(Summary!$B$1=Assumptions!I13,Assumptions!I14,IF(Summary!$B$1=Assumptions!J13,Assumptions!J14,Assumptions!K14))** which is unnecessarily long-winded. You can manually remove the "Assumptions!" parts of the latter part of the formula, or if you're feeling particularly clever, you can highlight cell **B19** and a neighbouring cell and use a find and replace to remove all six occurrences of the superfluous word.

12. Go back to cell **B1** on the Summary page, change the drop-down box to Best and check that the numbers are changing. Go to the Assumptions page and ensure that the value in cell **B9** is 140, as shown in the video

Now we need to do exactly the same thing for the rent. Firstly we are going to change the formatting of the rent input cell, as it is about to change from a hard-coded number to a formula. We can easily do this using the Format Painter which is located on the far left-hand side of the Home Tab in the Ribbon.

13. Select cell **B9**, which contains the format that we wish to copy, and hit the Format Painter. This format has now been copied onto the clipboard and will be applied to the next cell we select. Select cell **B19** to paste the formatting.
14. Change the currency formatting back to show the dollar sign
15. Now create the IF statement one more time. Your formula in cell **B19** should look like this: **=IF(Summary!$B$1=I13,I15,IF(Summary!$B$1=J13,J15,K15))**
16. Change the scenarios in the drop-down box again, and check your inputs on the assumptions page and the charts as shown to make sure that your formulas are working correctly

Congratulations! You've now completed your financial model which is the major component for this course. Please submit this model via the website, and make sure you have completed all the quiz questions for each module. We will check your model and as long as it meets the required standard you will receive your certificate via email which completes this course.

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