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REDUCING THE RISK IN EXCEL RISK MODELING
by Rickard Warnelid

In a world demanding more and more quantitative analysis, never has the actuary placed so much reliance on spreadsheets. Indeed, *Pryor et al.* [1] showed Excel as the software of choice for day-to-day analysis:

Percentage of Actuaries Using Various Software Packages
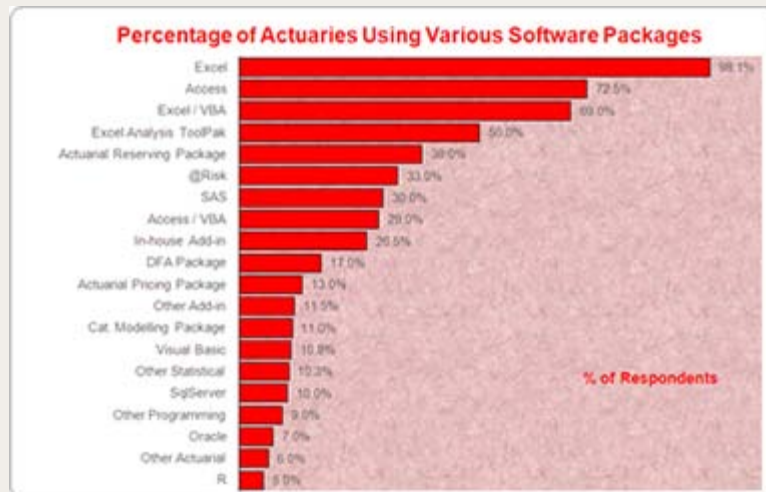
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As a group, actuaries are no different than other finance professionals in their use of Excel. Most are self-taught and only realize there is a better way to model once burned. Various studies have shown that Excel models **will** contain errors:

- 100 percent of models contain errors of some kind; *Ernst & Young.* [2]

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90 percent of all Excel spreadsheets with more than 150 rows of Excel formulae contain material errors; *KPMG*. [*3*]

- MBA students with over 250 hours of spreadsheet development experience had a 24 percent chance of introducing spreadsheet errors into the first worksheet they built; *R. Panko*. [*4*]
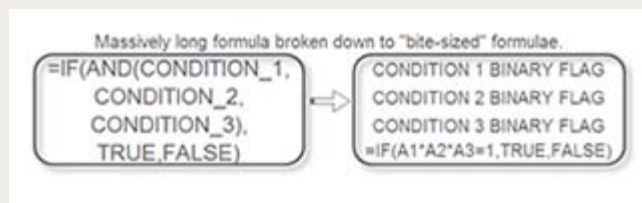
Actuaries have a reputation for being fastidious and meticulous, and they are conversant in many of Excel's flaws: the RAND() function does not generate truly random numbers; the Analysis ToolPak does not use the best available algorithms and uses non-standard definitions; missing data is handled incorrectly and various functions do not calculate correctly in the tail of various distributions.

But are actuaries conversant in their own modelling flaws? Do they consider how they may reduce the risk in the models they build in Excel?

I have spent more than 20 years working with and auditing the spreadsheets of many professionals. Based on our work with Corality auditing hundreds of third party models, I suggest the following Top 10 tips to reduce the likelihood of errors.
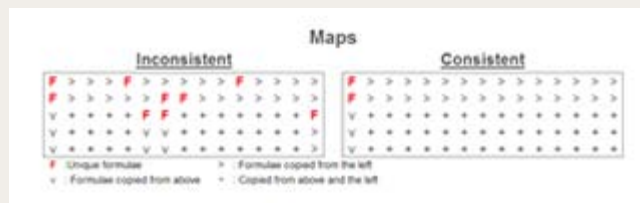
1. **Be transparent**
   Most end users see the outputs and/or conclusions as an appendix in a written document or as a slide in a presentation. By stepping out key calculations and making the assumptions explicit, many simple errors can be spotted immediately.

Massively long formula broken down to "bite-sized" formulae.
=IF(AND(CONDITION_1, CONDITION_2, CONDITION_3), TRUE,FALSE)

CONDITION 1 BINARY FLAG
CONDITION 2 BINARY FLAG
CONDITION 3 BINARY FLAG
=IF(A1*A2*A3=1,TRUE,FALSE)

2. **Fewer formulae**
   Various studies seem to suggest that error rates in spreadsheets remain consistent regardless of the experience of the author. It's a naïve thought, but if error rates remain constant, shouldn't fewer calculations reduce the number of absolute errors in a spreadsheet, and in turn, make it quicker to check? Of course there is a balance between the number of formulae used and the related complexity. Further, the point here is not to prepare fewer, but very long formulae. Instead, consider using high-level models to verify more detailed models.

Maps

Inconsistent   Consistent

F Unique formulae   > Formulae copied from the left
v Formulae copied from above   : Copied from above and the left

🔍 Enlarge

3. **Be consistent in Excel calculation blocks**
   Try to code only one unique formula per row or block of calculations. Errors in logic often jump out when spreadsheets are modelled this way. Consistency can be far-reaching: consider keeping worksheets similar in design, layout and format wherever possible. It also makes it easier for the end user to understand the spreadsheet as well as being quicker to review.

4. **Be flexible to allow for all assumptions to change**
   Assume every assumption may change. Avoid including hard coded numbers in any formula, where possible. Of course, like with all good rules there are exceptions: e.g., X > 0 is always a test for a positive number and percentages must add up to 100 percent.

5. **Keep it simple stupid**
   Endeavour to keep your formulae short and use commonly used functions. If a formula must be longer, try and split it up over several lines. If this seems like a difficult exercise, it can be a flag that the modeller has not thought through the underlying logic sufficiently.

6. **Use checks to verify calculations in Excel**
   We all make "simplifying assumptions" or can spot where X calculated in one part of a spreadsheet should equal Y calculated somewhere else. As you build the model, ensure that checks are included to confirm that totals agree, assumptions remain valid, etc.

7. **Control relative and absolute references in Excel with '$'**
   As you write formulae, check that absolute references remain absolute and that relative references remain relative. Inserting the $ symbol (or using the F4 key in edit mode), is a good practice for keeping columns and rows anchored as necessary. This helps ensure that formulae can be copied to other sections of the spreadsheet free of error and with consummate ease.

8. **Use formats and styles**
   Rather than divide numbers by 1,000,000 or other common

divisors, it is less risky if numbers are suitably formatted using Excel's custom number formatting (CTRL + 1). Furthermore, if all cells are given a suitable style (ALT + O + S) as coded, it can make it much easier to protect or alter the appearance of cells as required.

For more information on custom formatting:

http://www.corality.com/training/tutorials/custom-formats-excel/

http://www.navigatorpf.com/tutorials/custom-number-formats-excel/

9. **Have models peer reviewed**

How many times have we handed a model over to a line manager who points out a *#DIV/0!* or *#REF!* error immediately upon receipt? Whilst checks for these prima facie errors can be automated using the keyboard shortcut *CTRL + F* and searching for '#', it makes sense to arrange for a colleague to quickly review our models. It is beneficial to remember that we will seldom spot flaws in our own logic.
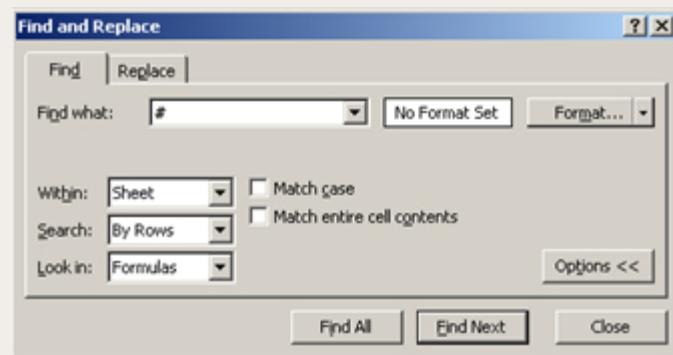
10. **Assess your team's capabilities and introduce modelling standards**

Among finance professionals, actuaries tend to maintain some of the most complex spreadsheet models. Based on this fact alone, many organizations regard actuaries as Excel experts. While this is often true for experienced actuaries, the more junior team members may not have all the necessary skills to prepare robust, transparent and flexible Excel models. A good first step to understanding your limitations is to speak to an expert in the field who can help evaluate your internal capabilities and assess the risks you are taking. The most efficient way of getting this started is to speak to a professional services provider such as Ernst & Young, KPMG or Corality. These professionals are experienced in formally auditing such models by making use of software and expertise not readily possessed by others. Very often the risks can be significantly reduced through a quickly

implemented best-practice modelling framework.

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