The Depth of a Financial Model

Extending a Simple Retirement Model in Excel

Nick DeRobertis[1]

[1]University of Florida
Department of Finance, Insurance, and Real Estate

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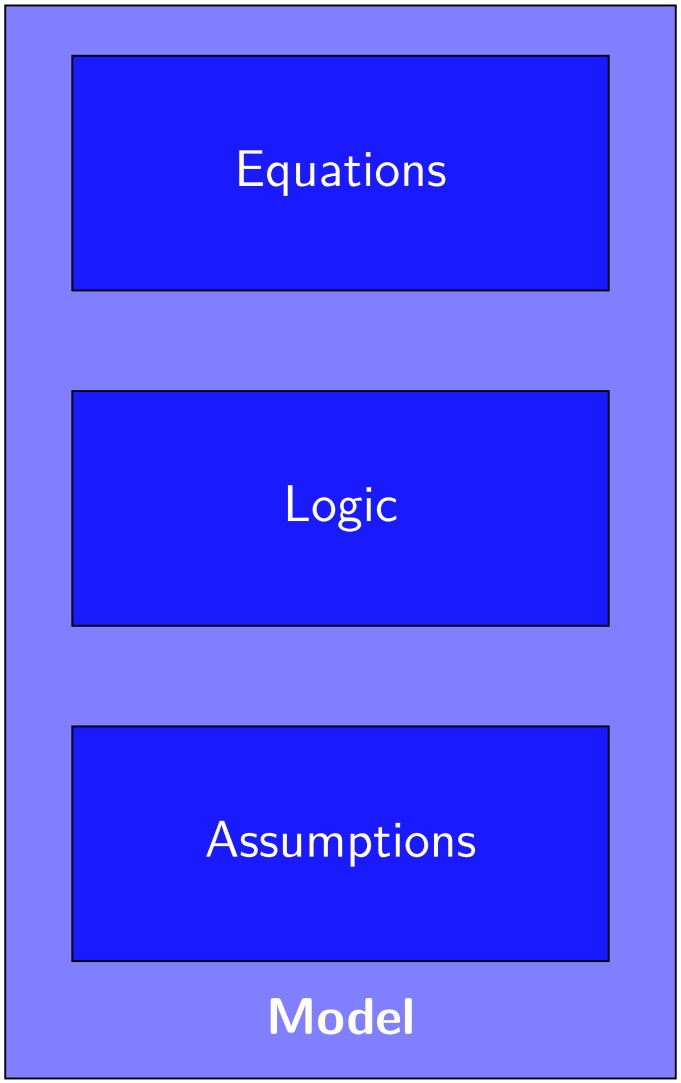
From Simple to Complex

- In the last class, we built a simple retirement model
- Today we will see how any financial model can become complex very quickly
- We will continue building the model in both Excel and Python, later combining the two

The Conceptual Parts of a Model



What Did we Assume?

- We made a few assumptions last time in building a general retirement model

Assumptions

1. The salary is constant over time
2. The savings rate is constant over time
3. Investment returns are constant over time
4. The amount needed in retirement is given by a fixed amount of desired cash
5. The amount needed in retirement does not depend on market conditions or life situations

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Relaxing the salary assumption

- Assumptions can be relaxed to create a more realistic model
- Often we still need an assumption, but it can be a more realistic one
- We shall relax the constant salary assumption
- **New assumption:** The salary grows at a constant rate for cost of living raises, and every number of years the salary grows at an additional rate for a promotion.

Relaxing the salary assumption

The Equation from the New Assumption

$$S_t = S_0(1 + r_I)^t(1 + r_p)^p$$

- S_t: Salary at year t
- S_0: Starting wealth
- r_I: Return for cost of living
- r_p: Return for promotion
- t: Number of years
- p: Number of promotions

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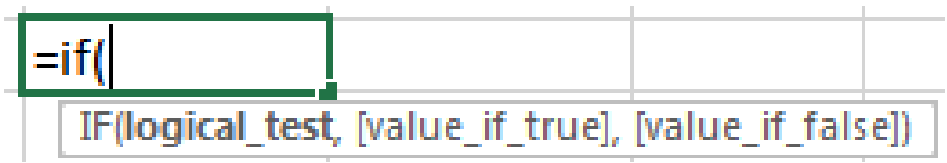
An Organized Structure of an Advanced Excel Model

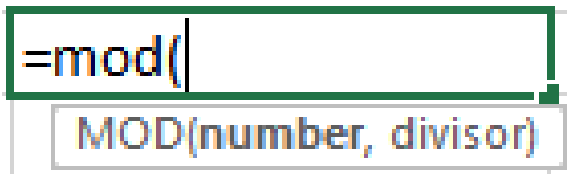
- We are going to build our first complex Excel model
- It is important to start structuring your model so that it is navigatable
- Inputs in one area, outputs in one area, sub-models in individual tabs

Modeling Salary Growth in Excel - If Command

- We need to learn a few formulas and patterns in Excel to model the new assumption
- 

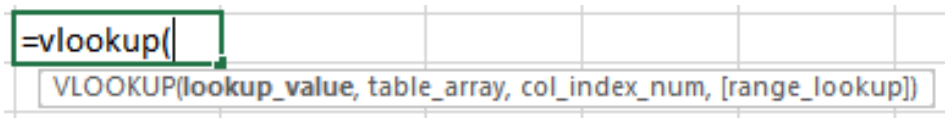
- `=IF(5=5, "this", "that")` -> "this"
- `=IF(4=5, "this", "that")` -> "that"

Modeling Salary Growth in Excel - Modulo

- 

- Returns the remainder after a number is divided by a divisor
- `=MOD(3, 4) -> 3`
- `=MOD(7, 2) -> 1`

Modeling Salary Growth in Excel - Table Lookup

- 

- Use VLOOKUP when you need to find things in a table or by row

Item	Food Group
Apple	Fruit
Celery	Vegetable
Orange	Fruit
Papaya	Fruit

- `=VLOOKUP("Celery", J3:K6, 2)` -> "Vegetable"

- Lookup column must be first column, and must be sorted in ascending order.

Salary Growth in Excel

Extending the Excel Retirement Model for Realistic Salaries

- I will now relax the assumption that salary is a fixed number in the Excel model.
- As this will be quite different from the last model, I will start from scratch.
- I have uploaded the finished product to Examples > Intro > Excel > "Dynamic Salary Retirement Model.xlsx"

Relaxing the Static Desired Cash in Excel

- We want to relax the assumption that the amount needed in retirement is given by a fixed amount of desired cash

Modeling Desired Cash

- Add new inputs to the model, "Annual Cash Spend During Retirement" and "Years in Retirement"
- Calculate desired cash based on interest, cash spend, and years in retirement
- Use the calculated desired cash in the model to determine years to retirement
- If annual spend is 40k for 25 years in retirement, $563,757.78 should be the retirement cash