

# The Depth of a Financial Model

## Extending a Simple Retirement Model in Excel

Nick DeRobertis<sup>1</sup>

<sup>1</sup>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

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

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



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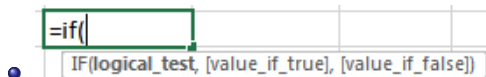
# An Organized Structure of an Advanced Excel Model

- 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



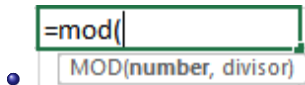
# Modeling Salary Growth in Excel - If Command

- 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

`=vlookup(`  
`VLOOKUP(lookup_value, table_array, col_index_num, [range_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 [the course site](#) as Dynamic Salary Retirement Model

# 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