# Getting Started with Python and Excel Building a Basic Model in Both Excel and Python

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DeRobertis (UF) Getting Started September 21, 2020 1/

#### Table of Contents

- An Introductory Model

 The focus today is to get familiar working in both Excel and Python

Basic Problem

 We will approach this by building a simple model with both tools

 In later lectures, we will move to combining the tools

DeRobertis (UF) Getting Started September 21, 2020 3/2

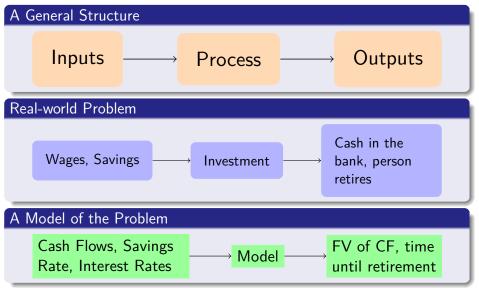
## A Simple Retirement Problem

 Let's take what is perhaps the simplest finance problem, which everyone should understand

- While you may have approached such a problem with a calculator before, we will build models for it instead
- Martha is saving for retirement. She earns \$60,000 per year and is able to save 25% of that. If she invests her savings, earning 5% per year, and she needs \$1,500,000 to retire, how soon can she retire?

DeRobertis (UF) Getting Started September 21, 2020 4/22

## Breaking Down the Retirement Problem



5/22

#### Table of Contents

- **Excel Solution**

# Solving the Problem in Excel

- It is easy to use Excel as a calculator and just type the math in directly. But we want to build a model.
- Changing inputs should result in a change to outputs. The way to do this in Excel is cell references
- Fixed references become important when trying to drag formulas, e.g. \$A\$2 (fully fixed), \$A2 (fixed on column), or A\$2 (fixed on row).



#### Simple Retirement Problem in Excel

#### Intro Excel Exercise

- Go to <u>the course site</u> and download Simple Retirement Model Excel
- Follow along as I recreate the simple model.

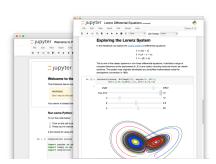
DeRobertis (UF) Getting Started September 21, 2020 8/22

#### Table of Contents

- An Introductory Mode
- 2 Excel Solution
- 3 Python Solution
- Extending the Model and Iteration

## How We'll Work in Python

- Using Python in the terminal is kind of a pain. And so, tools were born.
- Jupyter is a graphical interface we can use for Python. It also supports over 40 other languages such as R, SAS, Julia, and Scala
- You can use jupyter notebook or jupyter lab. The latter has a lot more features outside of the notebook. We will focus on using jupyter lab in this class as it is the future of Jupyter.



## Let's Get Set up with Jupyter

#### Launch Jupyter Notebook

- Launch Anaconda Navigator
- 2 Find Jupyter Notebook on the main screen, and click launch
- 3 You should see a list of folders and files. Click New and then Python 3
- Now you should see a code cell with In []: next to it

If you don't have Anaconda Navigator, just open a terminal (search cmd on Windows, terminal on Mac). Then in the terminal, type jupyter lab and enter. Then continue with the third step.

DeRobertis (UF) Getting Started September 21, 2020 11/22

## Some Python Basics

- In Excel, the basic unit is a cell. In Python, the basic unit is an object.
- In Excel, content in a cell is either a number (123) or a string (ABC)
- In Python, all objects have types. They might also be a number or a string, or something else.
- Rather than using a cell reference like \$A\$2, we assign names to objects in Python

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12 / 22

## Doing Some Math in Python



#### Note: Deprecation warning

In the future, these numpy financial functions are being moved to a separate package numpy\_financial. For the purposes of this class, this won't matter, but in the future you may have to install numpy\_financial to use these functions. In the meantime, you will see a warning come up when calling the functions.

- Basic operations in Python are straightforward
- 2 + 5 = 7
- $\bullet$  6 2 = 4
- 2 \* 3 = 6
- 5 / 2 = 2.5
- A lot more is available using the numpy package
- np.pv, np.nper, np.fv, np.pmt
- All numpy financial functions

DeRobertis (UF) Getting Started September 21, 2020 13/22

## Simple Retirement Problem in Python

#### Intro Python Exercise

- Go to the course site and download Simple Retirement Model Python
- In Jupyter, then navigate to your Downloads folder (or wherever you saved it)
- You should then see Simple Retirement Model.ipynb come up in the list of files in Jupyter. Click it to open it and follow along.

DeRobertis (UF) Getting Started September 21, 2020 14/22

## Table of Contents

- An Introductory Model
- 2 Excel Solution
- 3 Python Solution
- 4 Extending the Model and Iteration

DeRobertis (UF) Getting Started September 21, 2020 15/22

## Extending the Model - Multiple Interest Rates

 Now we've got basic models to determine how long it will take Martha to retire.

 We've got a few assumptions built into the model. One is that Martha will earn 5% on her investments

• Rates of return are volatile, so we want to see how long it would take her to retire if her return was different

DeRobertis (UF) Getting Started September 21, 2020 16/22

## Programming Fundamentals - Iteration

- In programming, for model building or otherwise, you often need to repeat the same process for multiple different things
- In Excel, you would do this by dragging formulas.
- In Python, as in most other programming languages, we would use a for loop
- This says, do something, for each value I pass into the loop

DeRobertis (UF) Getting Started September 21, 2020 17 / 22

# Iteration - Python vs. Excel

#### Python Iteration

```
inputs = [5, 10, 15]
for item in inputs:
    new value = item + 2
    print(new_value)
```

Excel Iteration		
Input	Output	Function
5	7	=B4+2
10	12	=B5+2
15	17	=B6+2

DeRobertis (UF) Getting Started September 21, 2020 18 / 22

- There's a few things to unpack here
- Here's another type of object: not a number or a string, but a list
- A list holds multiple objects, and you can add or remove items from lists

#### Python Iteration

```
inputs = [5, 10, 15]
for item in inputs:
   new value = item + 2
   print(new value)
```

12

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# Explaining Python Iteration (pt. 2)

- Here we define a list of three numbers as inputs
- Then we use a for loop to get each input out of the list, and add 2 to it to create the new value
- Finally we print each value as it is generated

#### Python Iteration

```
inputs = [5, 10, 15]
for item in inputs:
   new_value = item + 2
   print(new_value)
```

20 / 22

```
7
```

12

17

DeRobertis (UF) Getting Started September 21, 2020,

## Iterating the Existing Model

#### Expanding on Python and Excel

- I will now expand the existing Excel and Python models to examine multiple interest rates
- Continue viewing the same previously downloaded files.

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## Vary Savings Rate Lab

#### Extending a Simple Retirement Model

- Now we want to see the effect of savings rate on time until retirement, in addition to interest rate
- 2 In both Excel and Python, calculate the years to retirement for savings rates of 10%, 25%, and 40%, and each of these cases with each of the interest rate cases, 4%, 5%, and 6%
- Be sure that you drag formulas in Excel and use for loops in Python to accomplish this
- In total you should have 9 calculated years to retirement numbers, in each of the two models.

Answers: Slide 24 Resources: Slide 25

DeRobertis (UF) Getting Started September 21, 2020

22 / 22

#### Lecture Resources

#### Lecture Resources

- Slides Getting Started with Python and Excel
- Lecture Notes Getting Started with Python and Excel
- Simple Retirement Model Excel
- Simple Retirement Model Python

## Vary Savings Rate Lab, Answers

#### Extending a Simple Retirement Model, Answers

- 1 Martha has 61.1 years to retirement if she earns a 4% return and saves 10%.
- ② Martha has 41.0 years to retirement if she earns a 4% return and saves 25%.
- Martha has 31.9 years to retirement if she earns a 4% return and saves 40%.
- Martha has 53.3 years to retirement if she earns a 5% return and saves 10%.
- Martha has 36.7 years to retirement if she earns a 5% return and saves 25%.
- Martha has 29.0 years to retirement if she earns a 5% return and saves 40%.
- Martha has 47.6 years to retirement if she earns a 6% return and saves 10%.
- Martha has 33.4 years to retirement if she earns a 6% return and saves 25%.
- Martha has 26.7 years to retirement if she earns a 6% return and saves 40%.

Exercise: Slide <u>22</u> Resources: Slide <u>25</u>

### Vary Savings Rate Lab Resources

#### Extending a Simple Retirement Model Resources

- Simple Retirement Model Excel
- Simple Retirement Model Python
- Slides Getting Started with Python and Excel

Exercise: Slide 22 Answers: Slide 24