Understanding Complex Results

An Introduction to Visualization and pandas

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April 28, 2021

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Why Visualize?

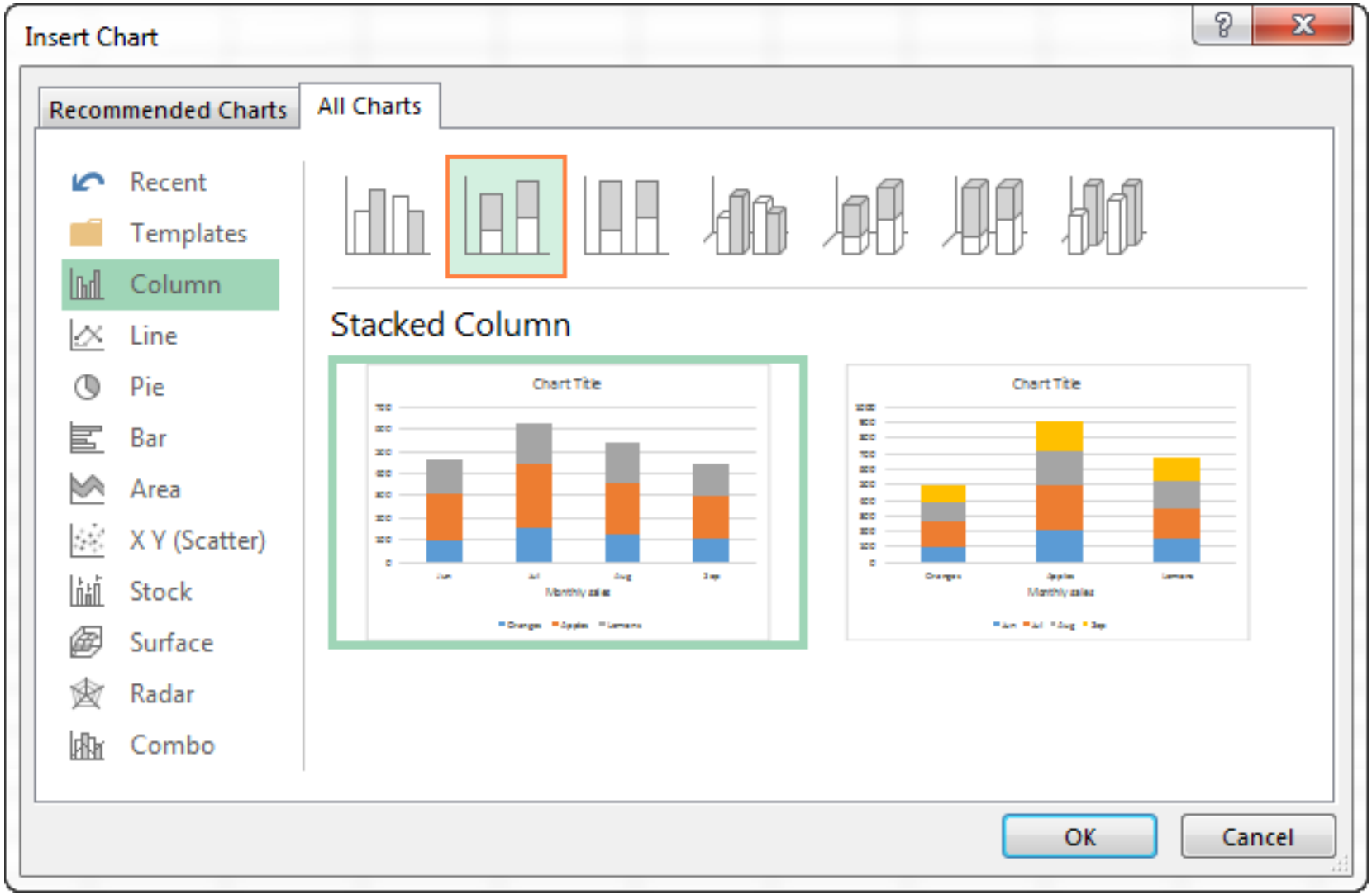
- So far we've had one main output from our model, number of years
- Salaries and wealth over time have also been outputs, but we haven't had a good way of understanding that output. It's a bunch of numbers.
- This is where visualization comes in. We have some complex result, and want to make it easily interpretable.

What we Have so Far

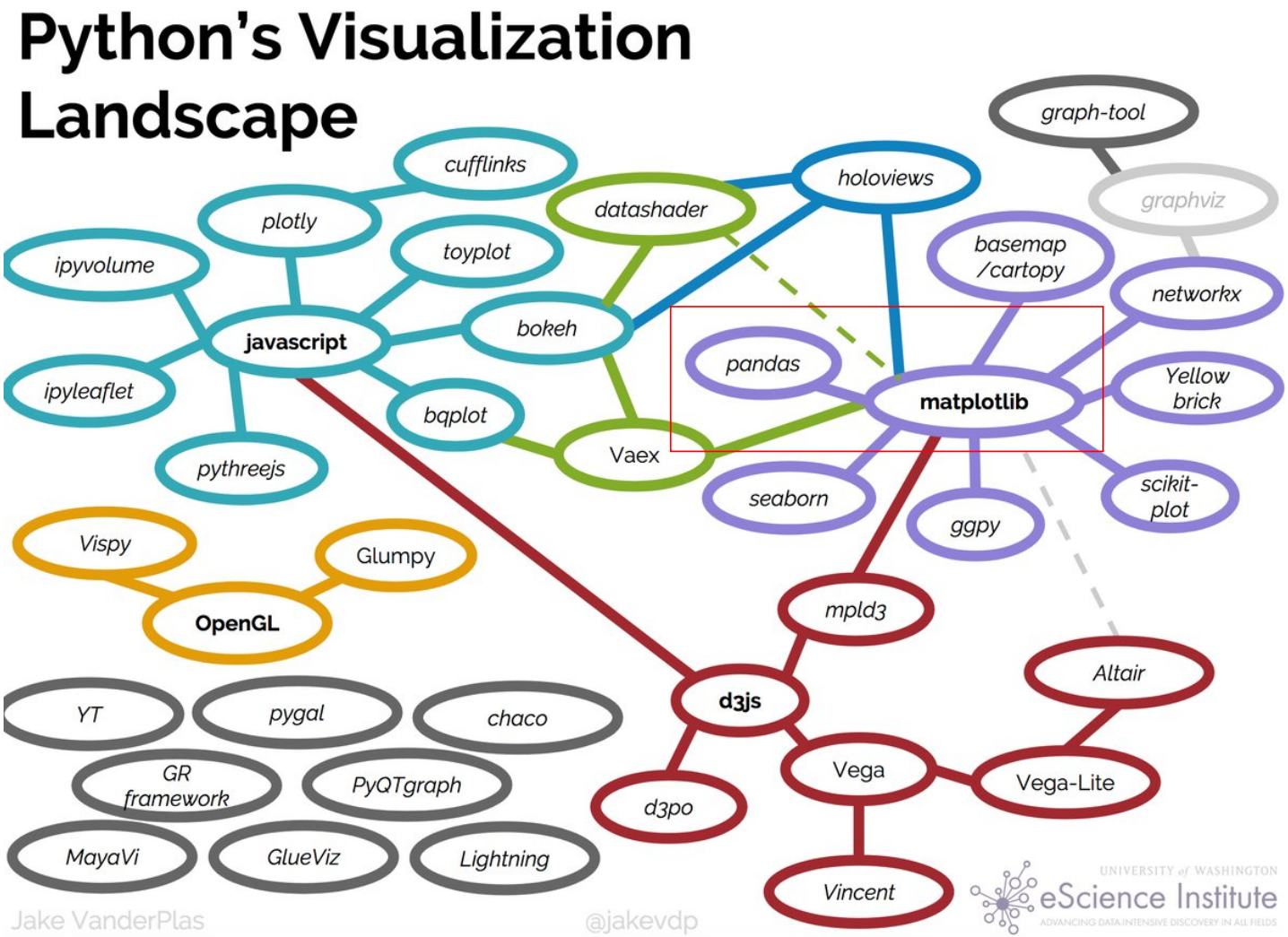
Retirement Info

Time	Salaries	Wealths
1	61,200	31,050
2	62,424	48,208
3	63,672	66,537
4	64,946	86,100
5	76,182	109,451
6	77,705	134,350
7	79,259	160,882
8	80,844	189,137
9	82,461	219,209
10	96,727	254,352
11	98,662	291,735
12	100,635	331,480

Visualization in Excel



An Overwhelming Number of Options in Python



Explaining Python Visualization in This Class

- Ultimately, we will be creating graphs using `matplotlib` but we won't use it directly.
- Instead, we will use `pandas`
- `pandas` is actually creating its graphs using `matplotlib` for us, but it is simpler to use.

Visualization in Excel

Adding Graphs to the Dynamic Salary Retirement Excel Model

- I will now go back to the "Dynamic Salary Retirement Model.xlsx" Excel model to add visualization
- I have also uploaded the completed workbook from this exercise as "Dynamic Salary Retirement Model Visualized.xlsx"
- Follow along as I go through the example.

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Some Setup Before we can Visualize in Python

- `pandas` does **a lot** more than just graphing. We will use it throughout the rest of the class.
- Previously we've worked with lists, numbers, strings, and even our custom types (our model dataclasses)
- `pandas` provides the `DataFrame` as a new type that we can use.
- Before we can get to graphing, we must learn how to use the `DataFrame`.

What is a `DataFrame`?

A `DataFrame` is essentially a table. It has rows and columns, just like in Excel.

Some Features of the `DataFrame`

- Add or remove columns or rows
- Group by and aggregate
- Load in and output data from/to Excel and many other formats
- Merge and join data sets
- Reshape and pivot data
- Time-series functionality
- Slice and query your data
- Handle duplicates and missing data

A Basic DataFrame Example

```
>>> import pandas as pd
>>> df = pd.DataFrame()
>>> df['Sales'] = [1052, 212, 346]
>>> df['Category'] = ['Aprons', 'Apples', 'Bowties']
df
```

	Sales	Category
0	1052	Aprons
1	212	Apples
2	346	Bowties

Introduction to Pandas

Creating and Using Pandas DataFrames

- I will now go through the notebook in "Intro to Pandas and Table Visualization.ipynb"
- Follow along as I go through the example.
- We will complete everything up until DataFrame Styling

Intro Pandas Lab

Getting Started with Pandas

1. Work off of the Jupyter notebook Pandas and Visualization Labs.ipynb
2. Complete the lab exercises in the first section entitled "Pandas"

Resources: Slide 26

Styling Pandas DataFrames

- It is possible to add styling to our displayed tabular data by styling the `DataFrame`
- The styling is very flexible and essentially allows you to do anything
- Out of the box, it is easy to change colors, size, and positioning of text, add a caption, do conditional formatting, and draw a bar graph over the cells.

Introduction to Pandas

Creating and Using Pandas DataFrames

- I will now go through the next section in "Intro to Pandas and Table Visualization.ipynb"
- Follow along as I go through the example.
- This time we are covering the remainder of the notebook starting from "DataFrame Styling"

Pandas Styling Lab

Styling Pandas DataFrames

1. Keep working with the same lab Jupyter Notebook
2. Complete the lab exercises in the second section entitled "Pandas Styling"

Resources: Slide 27

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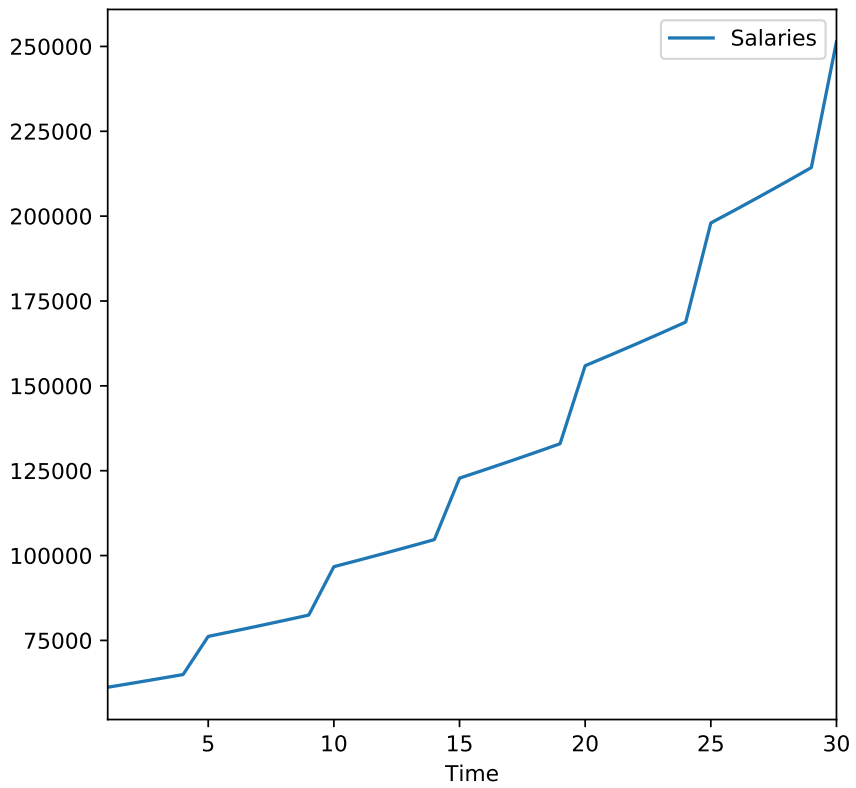
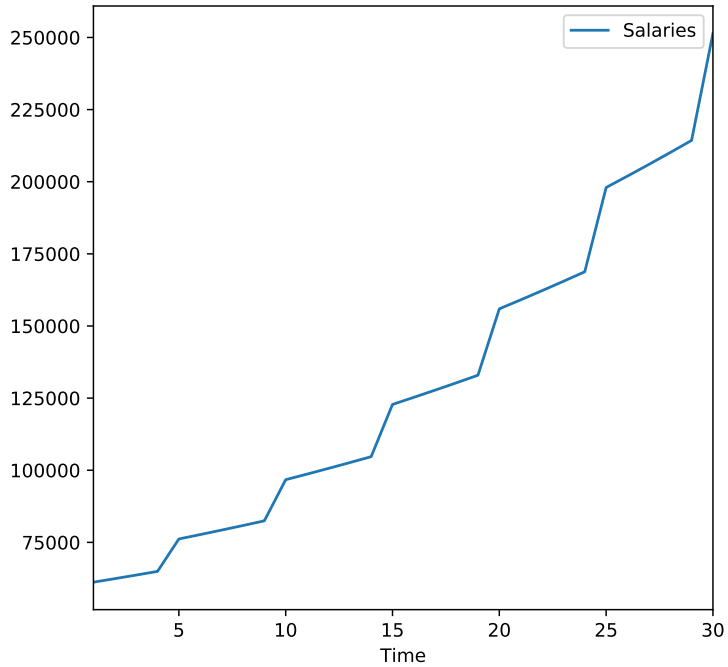
A Minimal Plotting Example

Line Graphs using pandas

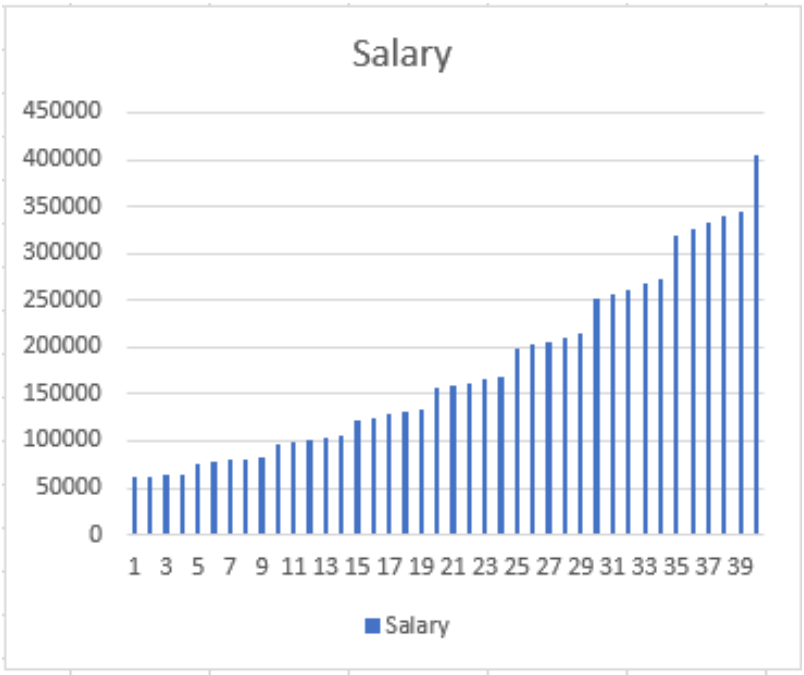
```
>>> %matplotlib inline
>>> ret_df.plot.line(x='Time', y='Salaries')
```

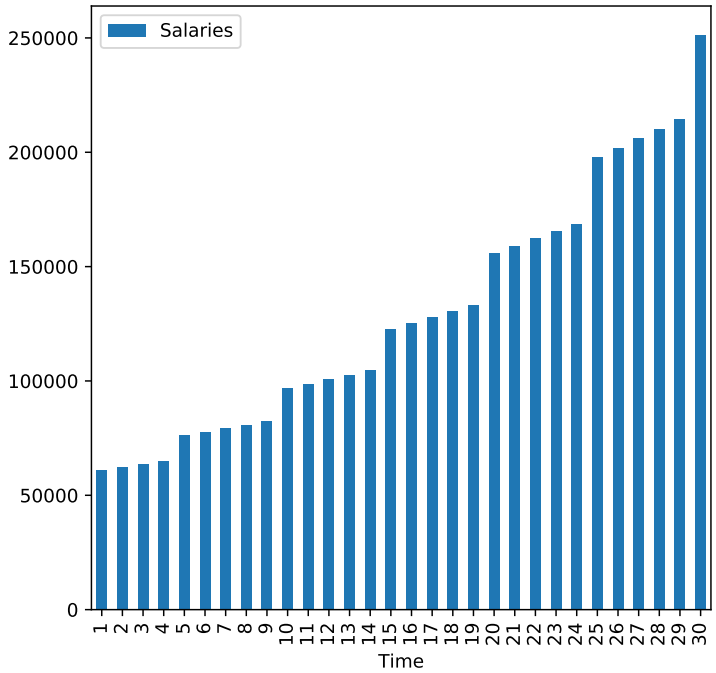


Basic Graph Types: Line Graphs

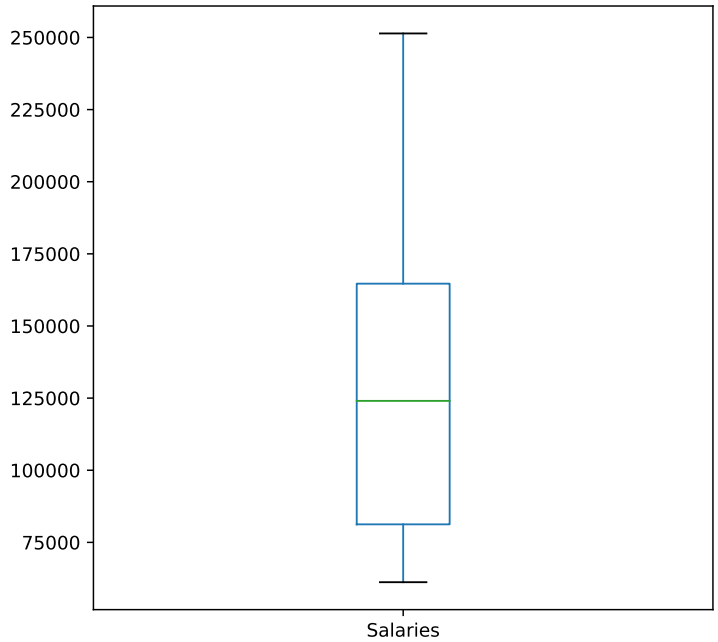


Basic Graph Types: Bar Graphs





Basic Graph Types: Box and Whisker Plots



Introduction to Graphing

Graphing Using Pandas

- I will now go through "Intro to Graphics.ipynb"
- Follow along as I go through the entire example notebook.

Intro Visualization Lab

Introduction to Graphing with Pandas

1. Keep working with the same lab Jupyter Notebook
2. Complete the lab exercises in the final section entitled "Graphics"

Resources: Slide 28

Lecture Resources

Lecture Resources

1. Slides - Understanding Complex Results
2. Lecture Notes - Understanding Complex Results
3. Dynamic Salary Retirement Model Visualized
4. Intro to Pandas and Table Visualization
5. 10 Minutes to Pandas (Official Intro)
6. Pandas Official Styling Guide
7. Intro to Graphics
8. Pandas Official Visualization Guide
9. Dynamic Salary Retirement Model Visualized
10. Pandas and Visualization Labs

Intro Pandas Lab Resources

Getting Started with Pandas Resources

1. Pandas and Visualization Labs
2. Slides - Understanding Complex Results
3. 10 Minutes to Pandas (Official Intro)

Exercise: Slide 14

Pandas Styling Lab Resources

Styling Pandas DataFrames Resources

1. Pandas and Visualization Labs
2. Slides - Understanding Complex Results
3. Pandas Official Styling Guide

Exercise: Slide 17

Intro Visualization Lab Resources

Introduction to Graphing with Pandas Resources

1. Pandas and Visualization Labs
2. Slides - Understanding Complex Results
3. Pandas Official Visualization Guide

Exercise: Slide 24