Financial Calculations with Python: Part 1

Python for Financial Analysis

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Syllabus Review

1 Introduction to Python: Python in Finance

2 Python Basic Syntax: Importing Libraries

3 Working with Pandas

4 Pandas Underneath the Hood: Working with NumPy

5 Data Wrangling and Visualization

6 Extracting Financial Insights from Charts and Graphs

7 Financial Calculations with Python: Part 1

8 Financial Calculations with Python: Part 2

9 CAPM and Portfolio Management

10 Linear Regression

**11** Time Series Analysis

12 Algorithmic Trading

+ **Bonus Class:** Cryptocurrency Beyond the Basics with a Fintech Guest Speaker

Class agenda

- Calculating rate of return (single-period, percentage)

- Calculating logarithmic change (and why we use natural log)

- Normal distribution and standard deviation

- Calculating volatility

- Pythonic: Defining your own functions

- Pythonic: who throws exceptions? How are they caught?

Normal Distribution and Standard deviation

- A little about normal distributions

  A. symmetric bell shape
  B. mean and median are equal; both located at the center of the distribution

- A little about normal distributions

  C. About 68% of the data falls within ±1 standard deviation of the mean
  D. About 95% of the data falls within ±2 standard deviations of the mean
  E. About 99.7% of the data falls within ±3 standard deviations of the mean

Average Velocity 2700 FPS--SD of 10
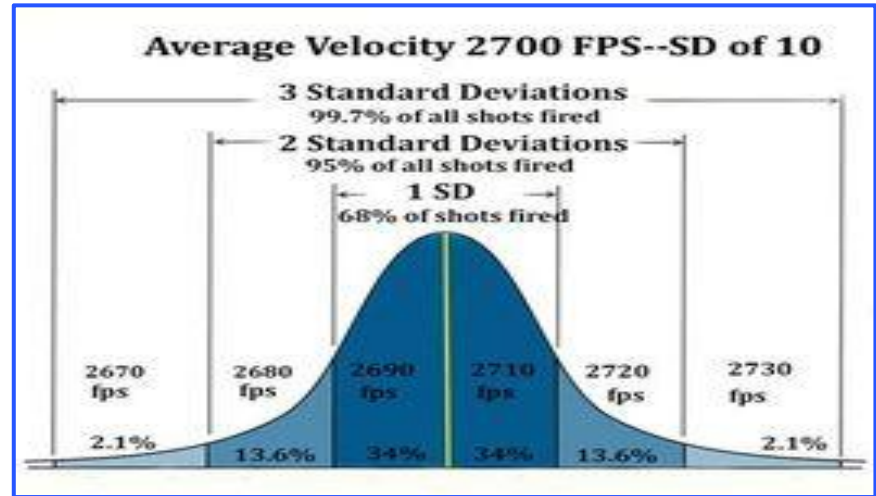
Calculating rate of return

- Single-period (Excel vs Python)

- How to calculate Year-over-Year?

- Percentage

Calculating logarithmic change

- About natural logarithm

  A. e ^ x and ln x are inverses
  B. Numpy has log (base 10), log (base 2), and log (plain - natural log)

- Why we use natural log

  A. Natural log and e tell us about time and growth
  B. Sidebar on compounding in Python

Calculating Volatility

- Q&A: https://insights.som.yale.edu/insights/why-does-market-volatility-matter
  - A. Volatility is up-and-down movement of the market.
  - B. It's usually measured by the standard deviation from the expectation.
  - C. Historical volatility of the stock market ≅ 20% a year and 5.8% a month.
  - D. The VIX Index is the most common measure of market volatility.

- Risk is not always risky

- Calculating standard deviation, σ
  - A. using Excel: https://www.investopedia.com/terms/v/volatility.asp
  - B. NumPy docs use ddof of 0 (that is n - 1 in denom) / Pandas uses ddof of 1

- Brief note on Bessel's Correction and how to "correct" Pandas.
  - A. https://stackoverflow.com/questions/25695986/why-is-pandas-series-std-different-from-numpy-std

Calculating logarithmic change

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Pandas describe and percentiles

- You can call the describe function with df.describe()

  A. Pitfall: This gives you an uncorrected standard deviation

- Percentiles, quartiles, quintiles.

  B. Sort your set and divide it into quarters (or fifths).
  C. Find the numbers at ¼, ½, and ¾ of the way down the list.
  D. These are the 25th, 50th, and 75th percentile.
  E. (Ponder: why isn't the mean equal to the 50th percentile?)

Pythonic: Defining your own functions

- Abstraction and reusability

  A. Abstraction of functionality
  B. Principal: Don't Repeat Yourself.
  C. Avoid code smell

- Namespaces
- What's wrong with cut and paste?
- The def keyword and helping your future self
- Calling the function by position or by keyword
- Pass-by-value or pass-by-reference?
- Return statement
- Docstring

Exceptions

- Errors at runtime
- Examples:

    A. ValueError
    B. KeyError
    C. ZeroDivisionError
    D. FileNotFoundError

- Raising exceptions
- How to catch exceptions

Assignment #7

You'll take daily returns for a stock (or index) and calculate its volatility, and produce the basic statistics for the returns (mean, standard deviation, 25th, 50th, and 75th percentile). Compare the results from the Pandas describe() with your manual calculation and explain the differences, if any.

Take home (optional):
Redo one of your previous assignments or practices as a function that raises an error. Handle that error in your main routine.

Resources
(part 1)

- Helpful functions

Shift:
https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.DataFrame.shift.html

log:
https://www.geeksforgeeks.org/log-and-natural-logarithmic-value-of-a-column-in-pandas-python/

- Natural logs and e

https://betterexplained.com/articles/demystifying-the-natural-logarithm-ln/

https://stats.stackexchange.com/questions/27682/what-is-the-reason-why-we-use-natural-logarithm-ln-rather-than-log-to-base-10

- Normal distributions

https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/normal-distributions-library/a/normal-distributions-review

https://www.statisticshowto.com/probability-and-statistics/normal-distributions/

Resources
(part 2)

- Standard deviation

  https://financesjungle.com/standard-deviation-and-variance/

- Volatility

  Ibbotson:
  https://insights.som.yale.edu/insights/why-does-market-volatility-matter

  Formal definition:
  https://en.wikipedia.org/wiki/Volatility_(finance)

- Standard deviation calculation

  Step by step w/Excel:
  https://www.investopedia.com/terms/v/volatility.asp

  NumPy:
  https://numpy.org/doc/stable/reference/generated/numpy.std.html

  Pandas:
  https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.std.html

Resources
(part 3)

- Defining your own functions

  Really basic:
  https://www.guru99.com/functions-in-python.html

  More extensive:
  https://realpython.com/defining-your-own-python-function/#functions-in-python

- Exceptions

  Examples:
  https://realpython.com/python-exceptions/

  Reference:
  https://docs.python.org/3/library/exceptions.html

Q&A