Portfolio Selection Tutorial: Building Your Quantitative Analyst Skills for Wall Street

Introduction

Are you aspiring to become a quantitative analyst on Wall Street? Do you want to learn how to construct and analyze portfolios with regard to their expected return and volatility? In this tutorial, we will guide you through the process of retrieving historical data across various asset classes via the Eikon Data API, working with data using popular Python libraries such as pandas, Plotly, and Cufflinks, and implementing the Mean-Variance Portfolio Theory (MVP) of Markowitz (1952) to optimize portfolio composition. By the end of this tutorial, you will have a solid foundation to tackle real-world portfolio selection challenges in the finance industry.

Background: Mean-Variance Portfolio Theory

Before diving into the technical aspects, let's briefly discuss the theoretical framework that underlies portfolio selection — the Mean-Variance Portfolio Theory proposed by Harry Markowitz in 1952. The core idea of MVP is to construct portfolios that maximize the expected return for a given level of risk or minimize the risk for a given expected return. The expected return is calculated as the weighted sum of the individual assets' expected returns, where the weights represent the proportion of each asset's allocation in the portfolio. The risk is measured by the portfolio's variance or standard deviation, which takes into account both the individual asset's volatilities and their pairwise covariances.

Getting Started: Importing Required Packages and Connecting to Eikon Data API

To begin, we need to import the necessary Python libraries and connect to the Eikon Data API. The Eikon Data API is a powerful tool that provides access to a vast amount of financial data, including equities, ETFs, currencies, and more.

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import math

import eikon as ek

import numpy as np

import pandas as pd

import cufflinks as cf

import configparser as cp

cf.set\_config\_file(offline=True) # set the plotting mode to offline

# Connecting to Eikon Data API

cfg = cp.ConfigParser()

cfg.read('eikon.cfg')

ek.set\_app\_id(cfg['eikon']['app\_id'])

Retrieving Cross-Asset Data

The first step in portfolio selection is to retrieve historical data for a selection of financial instruments. In this tutorial, we will focus on a small universe of assets, including Apple stock, Amazon stock, S&P 500 ETF, Gold ETF, and the EUR/USD exchange rate. We will fetch end-of-day (EOD) data for these assets within a specific time range.

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rics = [

'AAPL.O', # Apple stock

'AMZN.O', # Amazon stock

'SPY', # S&P 500 ETF

'GLD', # Gold ETF

'EUR=' # EUR/USD exchange rate

]

data = ek.get\_timeseries(rics, # the RICs

fields='CLOSE', # the required fields

start\_date='2017-01-01', # start date

end\_date='2018-02-16') # end date

data.dropna(inplace=True) # deletes rows with NaN values

Analyzing Single Instrument Statistics

Next, we calculate the log returns for each financial instrument, which are used to approximate the expected returns. Additionally, we calculate the historical volatility (standard deviation of returns) of each instrument, which plays an important role in the MVP theory.

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rets = np.log(data / data.shift(1)) # log returns in vectorized fashion

average\_returns = rets.mean() \* 252 # annualized mean returns

historical\_volatilities = rets.std() \* math.sqrt(252) # annualized volatilities

Portfolio Statistics: Expected Return and Volatility

Assuming a portfolio with equal weights in all financial instruments, we can calculate the expected portfolio return and volatility according to the MVP theory.

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weights = len(rics) \* [1 / len(rics)] # equal weights

expected\_portfolio\_return = np.dot(average\_returns, weights)

expected\_portfolio\_volatility = math.sqrt(np.dot(weights, np.dot(rets.cov() \* 252, weights)))

Simulating Portfolio Compositions

To optimize the portfolio composition, we simulate various combinations of asset weights and calculate the resulting portfolio statistics. We begin with two instruments (Apple and Amazon stocks) and later consider all financial instruments in our universe.

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fis = ['AAPL.O', 'AMZN.O']

num\_portfolios = 500

weights\_two\_instruments = np.random.random((num\_portfolios, len(fis)))

weights\_two\_instruments = (weights\_two\_instruments.T / weights\_two\_instruments.sum(axis=1)).T

mvp\_two\_instruments = [(portfolio\_volatility(fis, weights),

portfolio\_return(fis, weights))

for weights in weights\_two\_instruments]

mvp\_two\_instruments = pd.DataFrame(np.array(mvp\_two\_instruments), columns=['volatility', 'return'])

Minimum Volatility Portfolio

Now, we aim to find the portfolio composition that minimizes the expected volatility while adhering to some constraints, such as weight boundaries and sum of weights equaling 1.

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bounds = len(rics) \* [(0, 1)] # boundary conditions for weights

constraints = {'type': 'eq', 'fun': lambda weights: weights.sum() - 1} # constraint for sum of weights

res = sco.minimize(lambda x: portfolio\_volatility(rics, x), # function to be minimized

len(rics) \* [1 / len(rics)], # initial guess

bounds=bounds, # boundary conditions

constraints=constraints) # single equality constraint

optimal\_portfolio\_weights = res['x']

optimal\_portfolio\_volatility = res['fun']

Conclusion

Congratulations! You have completed the tutorial on portfolio selection using the Eikon Data API and various Python libraries. By now, you should have a solid understanding of how to retrieve financial data, calculate returns and volatilities, and optimize portfolio compositions using the Mean-Variance Portfolio Theory. Armed with this knowledge, you are well-equipped to embark on a career as a quantitative analyst in the financial industry.

Eikon Data API Developer Resources

If you want to further explore the capabilities of the Eikon Data API and sharpen your skills, you can refer to the following developer resources:

Overview

Quick Start

Documentation

Downloads

Tutorials

Q&A Forums

Remember, practice and continuous learning are essential to excel in the finance industry, and mastering data analysis and portfolio optimization will make you a valuable asset on Wall Street.

\*Disclaimer: The information provided in this blog post is for educational purposes only and should not be considered as financial advice. Always conduct thorough research and consult with a