Weekly Meeting Notes

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Overview:

- There is a current lawsuit alleging that CBOE, ICE, NASDAQ and other exchanges gave high frequency traders and advantage
- In portfolio management we use a wide variety of ratios or other tools to measure risk and return
- Although finding the ways to generate alpha are important an important questions is putting all of those pieces together
- Although making neural networks are important, a key part of their performance comes from the how we tune it
- Lagrangians are integral part of optimization

News: HFT lawsuit

Providence v. Bats et. al

- There is a $5bn lawsuit saying that high frequency traders received information received and “advantage” from exchanges such as
    - Chicago Board of Options Exchange - CBOE
    - Intercontinental Exchange - ICE
    - NASDAQ
- The $5bn is to supposedly cover the amount of money that was lost by investors
- The exchanges loss a dismissal to withdraw
- In another case where this happened a Barclay’s operated darkpool but they settled the case for $70m
- The written summaries ended in Sept 17th and the case will probably go through 2022

News: Quant Value Trade

- With treasuries starting to go higher there is less room for them to make money in that area
- A lot of risk neutral strategies are starting to play out
    - They will go long on value and short their most expensive companies
    - Energy companies tend to be “cheap” and “cyclical” so the traders went long on them for value but rising energy prices are making them extra profits
- Some of the other things that they see
    - Contracts trading the Russell 2000 Index are doing better than contracts trading NASDAQ
    - NASDAQ tends to be more sensitive to interest rates
    - The Russell 2000 Index is with riskier companies

AQR

SOCIETE GENERALE

Value and Bond yields

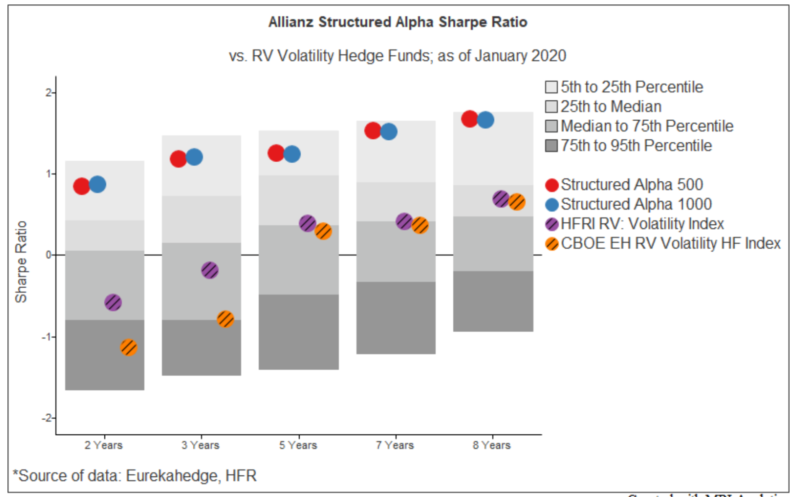
- Value tends to track bond yields
- That is probably because value does well when companies get “repriced”
- The repricing is updating the models with new WACC rates
- With higher discount rates growth companies don’t do well because their terminal value depends more on their cash flow growth

They are seeing a sign of confidence in riskier stocks:

- That means that investors think that supply chain problems will get worked out
- They also think the economic recovery will be strong and that COVID variant’s effects will be minimal
- Traders are eyeing cyclical exposed shares and they prefer near term cash flows

Finance: Sharpe Ratio, and other ratios

- Although there are many criticisms the Markov Process International looked at Allianz Structure Alpha Portfolio
- It was first developed by Henry Markowitz in 1956 who was one of the first pioneers of quantitative finance
- The optimization technique allows for a way to find an optimal allocation strategy
- The way it is setup is that it looks to find the best risk-to-reward ratio
- This method can also be used to find the minimum-variance portfolio which is the allocation strategy with the least amount of risk



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What the mean variance portfolio says:

- That risk and reward are a tradeoff and that although there are high-returning portfolios the amount of risk they take on is not proportional
- Breaking down the location on the outer curve
  - All values right of the red star are portfolios that are taking on too much risk for their return
  - All values left of the red star are taking on too little risk

Criticisms:

- The model uses covariance matrix to determine the risk component, and covariance matrices are not best suited
- The use of standard deviation treats the idea that good days are equal to bad days which is usually not the case for most investors
- The model assumes that the expected value of each security can be found which doesn't capture how each tail events exist for different distributions

CU QUANTS

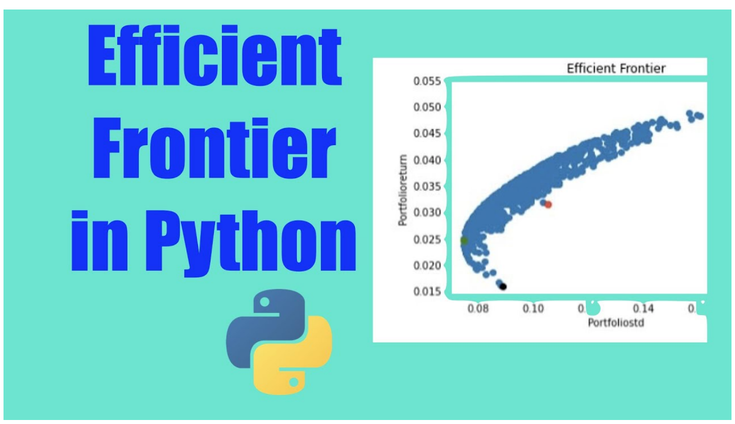
Methods for calculating:

- The equations we want to maximize
    - Maximize expected returns
    - Minimize risk for those returns
    - Keep in mind our money constraint
- The most common method is to use a monte carlo simulation (5 stock example)
    - Generate 5 numbers less than 1 that sum to 1 and then apply returns and risk
    - Do that a couple thousand time and then find the best portfolio
- The method that Markowitz used was Lagrangians

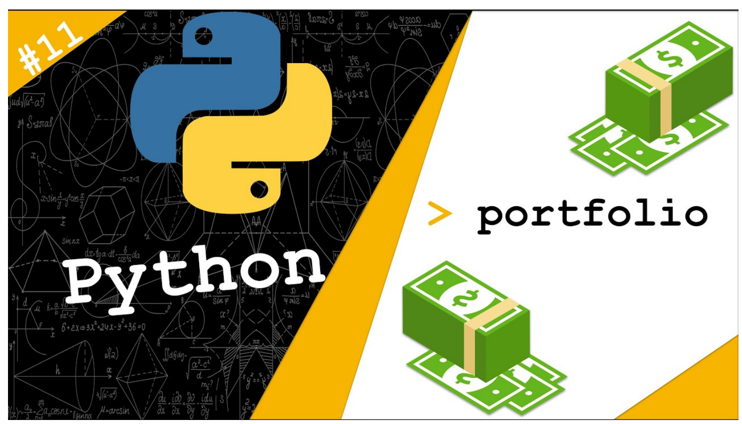
Future questions:

- What is the best way that we should update the portfolio?
- When is the best time to update the portfolio?
- What is the best number of stocks for this model?
- Is expected returns or the way we calculated expected returns the best way?
- Is it always worth it to optimize a portfolio given a set of outcomes?
- Is there a better way to calculate our risk, or covariance matrix.

Algovibes: Modern portfolio theory in Python: Efficient Frontier and minimum-variance portfolio



Ahmad Bazzi: Stock Market Analysis & Markowitz Efficient Frontier on Python | Python # 11



Resources:

Python For finance: INVESTMENT PORTFOLIO OPTIMISATION WITH PYTHON (here)

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Finance: Portfolio Optimization: Mean-Variance Optimization (MVO)

- Mean variance goes by a series of names such as maximized sharpe, MVO, mean-markowitz portfolio
- It was first developed by Henry Markowitz in 1956 who was one of the first pioneers of quantitative finance
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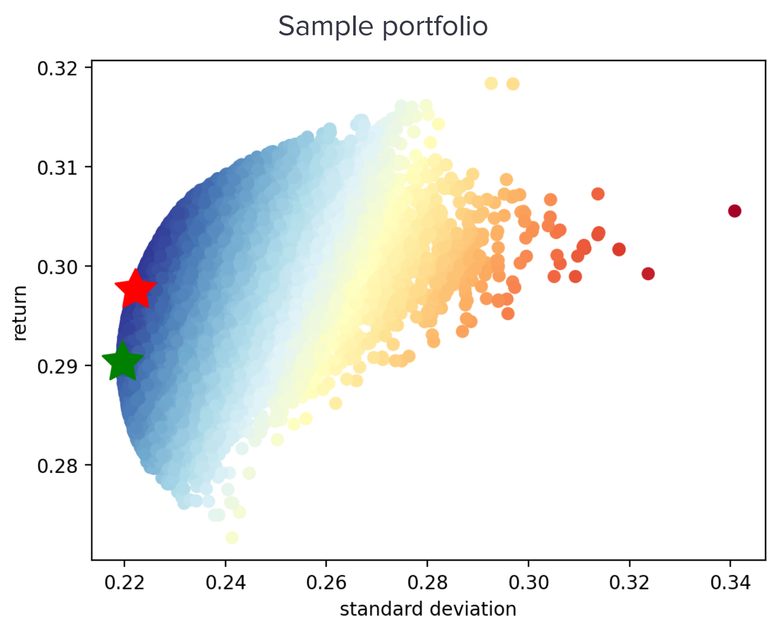

10 years of Adj Close of AAPL, AMZN, GOOG, FB, and MSFT

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September 30th, 2021

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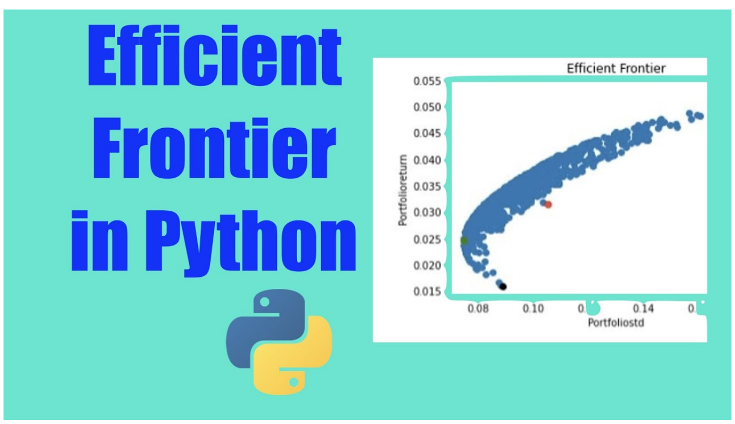

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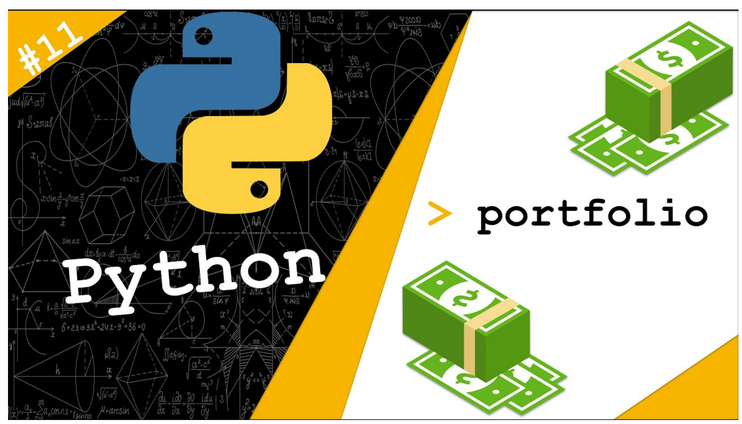

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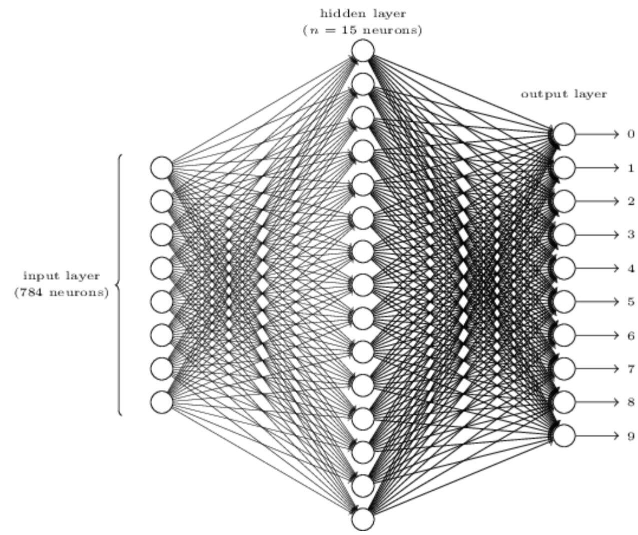
Computer Science: Neural Networks: Hyperparameter Tuning

Last week we covered neural networks and their activation functions

- Hyperparameters are all of the parameters that were used in the model but were not optimized
- Things that people would be interested in changing
  - The number of layers
  - The number of neurons per layer
  - The cost function: rate of gradient descent
- From a computational standpoint it seems like the best idea is to loop through each scenario with the model

Example of Neural Network



Grid Search

- This is when the search space is discretized as Cartesian products
- Then the algorithm launches a search for each hyper-parameter configuration
- The problem has curse of dimensionality

Random Search

- Instead of fixing to a cartesian grid it has no end and all of the samples are randomly put there
- Random Search tends to be a bit more effective than grid search
- The opposite can happen and the gradient can explode.

Mathematics: Method of Lagrangians

Lagrangians goal	Applications in finance & Economics
• They are used for optimization problems with minimization and maximization constraints • They require things to be linear • They are used to find maxima and minima constraints	• The are used to maximize utility with wealth constraints • Volatility parameters • Portfolio optimization or portfolio minimization / maximization tasks

Mathematically we can find that by

$$min\left(\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}w_i w_j \sigma_{ij}\right)$$

What makes this portfolio interesting is that it is an optimization problem, which means that there is a minimizing and maximizing constraints. Other research in allocation strategies are optimization problems with different minimizing and maximizing constraints.

In the Markowitz mean-variance portfolio we have these constraints

$$\sum_{i=1}^{N} w_i R_i = \mu_P$$

$$\sum_{i=1}^{N} w_i = 1$$

To work out this optimization problem we can use the Lagrangian method for constrained optimization. We can set up the equation as

$$L = \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}w_i w_j \sigma_{ij} - \lambda_1\left(\sum_{i=1}^{N} w_i - 1\right) - \lambda_2\left(\sum_{i=1}^{N} w_i R_i - \mu_P\right)$$

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