Portfolio Playground

CPSC 437/537

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Motivation

We've **all** wanted to trade stocks

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We've **all** wanted to trade stocks

...but are afraid to lose large amounts of money

Motivation

Solution: *Paper Trading* - simulated trading to practice buying and selling securities without actual money being involved.

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Enter **Portfolio Playground**, the premier paper-trading web application developed at Yale University!

Outline

Main Functionality

Portfolio Playground is a paper trading web-application with three main functionalities

- Portfolio creation and analysis
- Portfolio comparison
- Portfolio recommendation

Main Functionality - Creation and Analysis

FRONT END PICTURE GOES HERE

Our portfolio creation supports a variety of features including

- Stocks pulled from over 37,000 US equities and mutual funds
- Large amounts of historical stock price data (19XX-2016)
- User inputs include number of shares purchased, portfolio creation date

Main Functionality - Creation and Analysis

Suppose we have a portfolio P consisting of stocks $P = \{s_1 \dots s_N\}$, where x_i is the number of shares of stock s_i, D_i is the dividends for stock s_i, and P_i^t is the price of a single share of stock s_i at time t. Then we can define,

Total Stock Return - (Weighted Percent Increase)

$$TSR = \sum_{i=1}^{N} x_i \left(\frac{P_i^{t_f} - P_i^{t_0} + D_i}{P_i^{t_0}} \right)$$

Diversity - (Weighted Correlation Coefficients)

$$Div = 1 - \frac{1}{Z} \sum_{i<j}^{N} x_i x_j Cor(P_i, P_j) \in [0, 1]$$

Main Functionality - Comparison

FRONT END PICTURE GOES HERE

Our portfolio comparison supports a variety of features including

- Stock price, total stock return, and diversity comparisons
- Aesthetically pleasing visualizations

Main Functionality - Recommendation

The most unique feature of Portfolio Playground is its state-of-the-art recommendation algorithms. This helps shape trading intuition for novice traders. The algorithms used are

- Random
- Highest Return
- Diverse Options

Recommender Algorithms - Random

The Random algorithm recommends a random portfolio under a total budget constraint.

Highest Return

1. Initialize portfolio $P = \emptyset$. Until budget constraints active,
   1. $P \leftarrow P+$ random stock, random number of shares (under budget constraint)

Recommender Algorithms - Random

The Random algorithm recommends a random portfolio under a total budget constraint.

Highest Return

1. Initialize portfolio $P = \emptyset$. Until budget constraints active,
   1. $P \leftarrow P+$ random stock, random number of shares (under budget constraint)

This can be used as a "control portfolio" and can also test the Efficient Market Hypothesis!

Recommender Algorithms - Highest Return

The Highest Return algorithm recommends an optimal forecasted portfolio under budget constraints such as total portfolio budget and maximum investment per stock.

Highest Return

1. Fit a Vector Autoregression Model to historical stock data
2. Forecast the stock prices d days away
3. Initialize portfolio $P = \emptyset$. Until budget constraints active,
    1. $P \leftarrow P+$ stock that maximizes TSR

Recommender Algorithms - Diverse Options

The Diverse Options algorithm recommends an optimal portfolio under budget constraints and *diversity* or *correlation* constraints.

Diverse Options

1. Fit a Vector Autoregression Model to historical stock data
2. Forecast the stock prices d days away
3. Initialize portfolio $P = \emptyset$. Until budget constraints active,
   1. $A = \{s | corr(s, x) < \sigma \ \forall \ x \in P\}$ (options diverse from P)
   2. $P \leftarrow P+$ stock from A that maximizes TSR

Database Design

What do we need to store?
Where are we getting it from?

Database Design

A diagram of the architecture goes here.

Front End Design

What are the design decisions?

Front End Design

What tools did we use to achieve this?

Questions

Questions?