**Title:** Portfolio Optimization using Mean-Variance optimization with price prediction driven by historical data

**Background:** In financial economics, portfolio optimization is one of important topics that have been continuously studied since Markowitz proposed a portfolio optimization method in the 1950's. With impractical assumptions of these portfolio models, there are many other portfolio management methods proposed after this work. One of the flaws of Markowitz’s portfolio is that the method is backward-looking. That is, the portfolio is optimal for the historical data, not the future data. Yet, there are many other portfolio methods proposed to solve this problem such as a famous Black-Litterman model and its variants. In the past few years, Deep Learning has shown promising results in prediction and classification. So, we propose to use advanced machine learning techniques to forecast the stock price based on historical data and use the predicted data to construct a forward-looking portfolio.

**Objective:**

1. Predict asset price (which is stock) using various machine learning techniques based on historical prices.
2. Construct portfolio using the predicted data

**Method:**

There are two things to consider. The first is the portfolio model we are going to use and the second is the machine learning model to predict the future price.

Mainly use the python as programming language to perform machine learning process.

we use the conventional Mean-Variance portfolio model that is proposed by Markowitz.

Portfolio models: MV

Machine Learning Models: CNN, LSTM (basically, RNN)

Datasets:

We mainly select stocks from the SP500 index. Specifically, we will select 5 stocks from each sections:

Technology: META, AAPL, MSFT, GOOG, IBM

Healthcare: CVS,JNJ,UNH,TMO,REGN

Financials: V, JPM,PYPL,MA,BAC

Real Estate: DLR, AMT, PLD,SPG, BXP

Energy: XOM, SHEL, CVX, COP, HAL

Materials: DD,CE, SHW, APD, EMN

Consumer Discretionary: SBUX, AMC,BBY,HD,NKE

Industrials: HON, MMM, SWK, DAL, BA

Utilities: AES, UGI, CNP, DUK, D

Consumer Staples: GIS, KO, PG, CAG, COST

Communications: CMCSA, T, DISH,WBD,ATVI

**Supporting references:**

Chaweewanchon A, Chaysiri R. Markowitz Mean-Variance Portfolio Optimization with Predictive Stock Selection Using Machine Learning. International Journal of Financial Studies. 2022; 10(3):64. <https://doi.org/10.3390/ijfs10030064>

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