

2025 OSU Quantathon

Problem Statement

It is widely accepted that short-term movements in individual stock prices cannot be predicted. However, some investors believe that aggregate market fluctuations can be predicted, and that investors, on average, may accurately predict these large fluctuations. In this competition we will explore this hypothesis.

Economists classify market fluctuations as Bear or Bull markets. Any period of time in which a market drawdown exceeds 20% from peak to trough is classified as a Bear market. Any market not a Bear market is a Bull market (see here for more information: <https://www.investopedia.com/terms/b/bearmarket.asp>). These classifications are made after market movements; however, investors would like to know in advance if the future market will be a Bear or Bull market. Indeed, an investment strategy which invested in equities during Bull markets and in bonds during Bear markets would do very well.

Investor sentiment can be calculated from prices of derivative securities. The Federal Reserve Bank of Minneapolis compiles market-based probabilities. In the attached, you will find market-based probabilities for a future increase or decrease in the S&P 500 of 20% or more, as well as historical prices of the S&P 500. You need to:

1. Find and classify periods of time as Bear, Bull or Static markets.
2. Determine if the market-based probabilities are able to predict Bull or Bear markets. In particular, you need to develop a technique to predict the state of the market (Bear, Bull, Static). There are a variety of approaches that could be used: hidden Markov models, random forests, neural networks, linear regression, etc.
3. Is there an investment strategy based on the Bull or Bear market predictions that can beat a buy-and-hold strategy, or reduce market risk for investors, over the period January 1 2019-December 31, 2022?

Your portfolio can only invest in the S&P 500 and in short term bonds. You may assume any money not invested in the S&P 500 will earn interest at a rate equal to the short-term bond rate. You may assume there are no transaction costs, no short-selling or buying on margin (or use of leverage). You may only use the attached data to build and analyze your investment strategy. The data set includes the market-based probabilities for an increase of 20% or more, a decrease of 20% or more, daily prices of the S&P 500, and the daily short-term interest rates reported as a per annum rate. You should be aware that the market-based probabilities are not calculated daily.

More information about the market-based probabilities can be found here:

<https://www.minneapolisfed.org/banking/current-and-historical-market--based-probabilities>

The daily prices of the S&P 500 are taken from:

<https://finance.yahoo.com/quote/%5EGSPC/history/>

The historical bond rates are taken from:

<https://finance.yahoo.com/quote/%5EIRX/history/>

Submission

On Saturday, a submission form will be posted on the Discord Server. This form will ask you to:

- Submit a 5-7 minutes video describing your model/approach, proposed next steps, and visualizations to back up your claims.
- Put all your code files on a Github Repository or a folder on OneDrive/Google Drive and share the link.