# MA498 – Senior Thesis I: Research and Proposal

# Research Proposal

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## Research Title: Time Series Forecasting in Financial Markets

## Background:

Financial markets constitute a large part of the modern economy. As such, they generate a lot of attention from academics and investment bankers alike. While the predictability of the financial market is a very controversial topic, many believe that the future of the market depends on the past to some extent. Financial markets can be modeled as a time series and there are a number of existing techniques to forecast based on a time series, or to predict what will happen next.

Financial markets are intriguing on a more individual level as well. The stakes of investing are high. Your portfolio determines your retirement, or whether your children get to attend the college of their choice.

The problem of forecasting financial markets is complicated and has a rich history. There have been many attempts to crack the code, and there are a number of sources of information that could possibly shed light on the future. For example, Elon Musk’s tweets appear to effect the performance of Tesla stock, while a monsoon may harm some pharmaceutical company. Various factors influence financial markets and make forecasting very difficult.

## Statement of the Problem:

One common investment strategy is dollar-cost averaging. The strategy involves investing a fixed amount at some fixed interval. This strategy removes attempts to time the market, requires little effort, and results in good average performance. By applying various techniques in machine learning and time series analysis to advise an investment strategy, we will create a strategy that outperforms traditional dollar-cost averaging.

The first step involves exploring different machine learning techniques and applying them to the time series data sets. This will involve an expansive literature review and the comparison of a number of different models. It culminates in using the machine learning models to inform an investment strategy that will buy or sell more or less stocks based on the predictions of the model. We will explore feature engineering to see how different features, like weather, season, or day of the month can help explain variations in stock prices. Ultimately, we will see how the machine learning investing compares to dollar cost averaging by running a simulation of both short-term and long-term investing over real market data.

The next step is exploring the relationships between different stocks and different sectors. Starting with the intuition that stocks within the same financial sector have some correlation, we will explore this relationship and try to classify it in some numerical and useful way. This additional data can then inform the machine learning time series forecasting described above.

**Tentative Timeline:**

07SEP-05OCT: Lit review

05OCT-20OCT: Implement traditional and machine learning techniques

20OCT-21NOV: Explore stock-sector relationships and connect to other techniques

21NOV-14DEC: Run tests, compile initial results, and reevaluate direction