

# DATA3888: Volatility Prediction in Financial Markets

## 1 Introduction

Volatility is a fundamental concept on any trading floor. In financial markets, volatility quantifies the extent of price fluctuations. High volatility typically corresponds to periods of market turbulence and large price swings, whereas low volatility indicates calmer, more stable markets.

## 2 Project Objective

The main goal of this project is to build a model that predicts future volatility. In particular, the project aims to:

- Develop a volatility predictor using a dataset provided by Optiver.
- Forecast the volatility of over 100 stocks over a specified future horizon.
- Communicate the prediction methodology through multimedia presentations targeted at traders.

## 3 Relevance for Trading Firms

For trading firms such as Optiver, accurately predicting volatility is essential. Since the price of options is directly linked to the volatility of the underlying asset, a reliable volatility predictor is crucial for:

- Risk management.
- Formulating effective trading strategies.
- Pricing options correctly.

## 4 Project Components

The project is divided into several key components:

## 4.1 Financial Knowledge and Data Processing

- **Order Book Analysis:** Learn to use the order book to compute essential statistics such as the Bid-Ask Spread, weighted average price, and volatility.
- **Ultra-High-Frequency Data:** Process ultra-high-frequency data to extract meaningful information.

## 4.2 Modeling Framework

- **Framework Selection:** Choose an appropriate modeling approach, for example, by directly modeling the realised volatility or by modeling the stock price dynamics.
- **Time Series Models:** Implement classic and potentially advanced time series models to capture the dynamics of historical stock prices and volatility.

## 4.3 Performance Evaluation

- Use multiple performance measures to assess the accuracy and reliability of the prediction model.
- Analyze the impact of various tuning parameters (e.g., weights) on the prediction outcomes.

## 4.4 Communication Strategy

- Develop a communication product that explains how the predictor works and outlines its limitations.
- Ensure that the tool is interpretable so traders can understand and use the predictions to guide their trading strategies.
- Example strategies include:
  - Educational **shiny** apps.
  - Animations demonstrating the predictor's functionality.
  - Short videos or infographics.

## 4.5 Exploratory Analysis

- Use the predictor to gain insights into stock behavior.
- Cluster different stocks based on prediction results to quantify differences.
- Explore the use of predicted volatility for pricing and other financial applications.

## 5 Challenges

The project presents several challenges:

- (a) **Data Processing:** Handling and processing ultra-high-frequency data.
- (b) **Model Selection:** Choosing the appropriate modeling framework for volatility prediction.
- (c) **Evaluation:** Defining and implementing multiple performance measures to assess the model.
- (d) **Financial Acumen:** Gaining the necessary financial knowledge to interpret volatility and related statistics.
- (e) **Interpretability:** Developing a tool that is sufficiently interpretable for traders.
- (f) **Insight Extraction:** Using the predictor to understand stock behavior and to highlight differences among stocks.

## 6 Conclusion

Accurately predicting volatility is critical for market makers like Optiver. This project not only focuses on building a robust prediction model by processing high-frequency data and applying advanced time series methods but also emphasizes the importance of effective communication. By ensuring the prediction tool is both accurate and interpretable, traders can make informed decisions, thereby enhancing trading strategies and risk management.