

## **MIS 515 GROUP ASSIGNMENT – Hedging of Stocks Team Name: Brown Munde**

### **Project Report:**

**Objective:** The primary aim of our code is to analyze and hedge a portfolio of stocks using options. The project involves retrieving historical to-date stock price data, calculating option Greeks, and identifying suitable options strategies for hedging purposes. The analysis encompasses well-known companies like Tesla, JP Morgan, Boeing Co., Procter & Gamble Co., Apple, Newmont Corporation, Exxon Mobil Corp, and Pfizer Inc. We focused on analyzing the data spanning the past 5 years.

**Data Retrieval and Processing:**

- We utilized the yfinance library to download historical stock price data for the selected companies from sources like Yahoo Finance.
- Data cleaning involved addressing missing values, converting date columns, creating lag features, rolling averages, and engineering additional features like day of the week and month.
- The dataset was split into training and test sets (typically 80-20) to facilitate model training and evaluation.

### **Option Greeks Calculation:**

- The yoptions library was employed to retrieve option chain data and calculate essential metrics like Option Greeks.
- Option Greeks are pivotal in assessing and managing the risk associated with options positions, aiding in strategic decision-making.

### **Model Selection and Evaluation:**

- Three models were tested: Linear Regression, Ridge Regression, and Random Forest Regression.
- The models were evaluated using cross-validation, and Ridge Regression was chosen as the best model based on root mean squared error (RMSE).

### **Features Build:**

**Bid-Ask Spread:** The difference between the bid and ask prices, indicates liquidity.

**Moneyness:** Indicates whether the option is in-the-money, at-the-money, or out-of-the-money.

**Time to Expiry:** The time remaining until the option contract expires. **Price of Underlying Stock:** Current price of the underlying stock.

### **Bid-Ask Spread for Call Options (options\_call dictionary):**

- **Bid:** Bid price of the call option.
- **Ask:** Ask the price of the call option.
- **Bid-Ask Spread:** The difference between the asking price and the bid price, representing the cost difference between buying and selling the option.

**Bid-Ask Spread for Put Options (options\_put dictionary):**

- **Bid:** Bid price of the put option.
- **Ask:** Ask the price of the put option.
- **Bid-Ask Spread:** The difference between the asking price and the bid price, representing the cost difference between buying and selling the option.

**Moneyness for Call Options (options\_call dictionary):**

- **Strike:** Strike the price of the call option.
- **Moneyness:** Moneyness of the call option  
 $(\text{Strike} - \text{Underlying Stock Price}) / \text{Underlying Stock Price}$ . Moneyness represents how much in or out of the money the option is.

**Moneyness for Put Options (options\_put dictionary):**

- **Strike:** Strike the price of the put option.
- **Moneyness:** Moneyness of the put option  
 $(\text{Strike} - \text{Underlying Stock Price}) / \text{Underlying Stock Price}$ . Moneyness represents how much in or out of the money the option is.

**Time to Expiry for Call Options (options\_call dictionary):**

- **Time to Expiry:** Time remaining to the expiry date of the call option, calculated in years.  
 $(\text{Expiry Date} - \text{Current Date}) / 365$ .

**Time to Expiry for Put Options (options\_put dictionary):**

- **Time to Expiry:** Time remaining to the expiry date of the put option, calculated in years.  
 $(\text{Expiry Date} - \text{Current Date}) / 365$ .

**Visualization:**

- A grid of subplots was created, each representing the implied volatility of different stock options.
- Each subplot contained a line plot illustrating how implied volatility changes across various options, providing valuable insights for decision-making.

Linear Regression accuracy achieved is: 84%, out of which the Ridge Regression performed the best.

**Conclusion:** In summary, our project equips investors and traders with sophisticated tools to navigate the complexities of options trading and risk management. By leveraging historical data and advanced mathematical models, our approach facilitates informed decision-making, empowering stakeholders to make strategic moves in the dynamic world of stock hedging.