Experiential Learning assignment (Group Size – Maximum 3 members)

**Project Objective:**

You will construct and analyze a **multi-asset portfolio**, perform **risk estimation and forecasting**, conduct **model validation**, and demonstrate **hedging strategies** using **option Greeks or portfolio diversification**. The objective is to **mimic the role of a risk analyst or portfolio risk manager** in a trading or investment firm.

**Timeline:**

Duration: **4 weeks**

Final submission: 26-Apr-25

**Step-by-Step Instructions**

**Step 1: Asset Selection & Data Download**

**[Weight: 1 marks]**

Choose a **diverse portfolio** of 4–5 financial assets. Ensure inclusion of at least:

* 1 large-cap stock (e.g., INFY.NS, RELIANCE.NS, AAPL)
* 1 index corresponding to the stocks (e.g., NIFTY 50, S&P 500)
* 1 FX rate (e.g., USD/INR or EUR/USD)
* 1 small-cap stock in the same market
* 1 commodity

**Tools**: Download daily data for the past **5 years (Start from the Birthday date of one person 5 years back and end at the birthday date of another member for the current year)** from:

* Yahoo Finance
* Bloomberg Terminal (if available)
* RBI Database / Investing.com for bond yields or FX rates

**Step 2: Data Cleaning & Preprocessing**

**[Weight: 1 marks]**

* Align all series on **common dates**.
* Handle missing data using forward-fill or interpolation.
* Calculate **log returns** for each asset.
* Visualize returns with line charts and histograms.

Include:

* Summary statistics (mean, std dev, skewness, kurtosis)
* Initial interpretations of risk and return characteristics

**Step 3: Volatility Modeling and Forecasting**

**[Weight: 3 marks]**

Perform **volatility estimation and forecasting** for all the selected assets and an equal weighted portfolio (20% investment in each of the five assets) using:

* **Historical Volatility (Rolling Window)**
* **GARCH-type models**:
  + GARCH(1,1)
  + EGARCH or GJR-GARCH (try at least one asymmetric model)
  + You need to perform the complete process right from ARIMA, GARCH etc.
* Compare model AIC/BIC and interpret results.
* Forecast volatility for the **next 30 days**.
* Write detailed interpretation of the output

**Step 4: Value at Risk (VaR) Estimation**

**[Weight: 2 marks]**

Estimate **1-day and 10-day VaR** for the portfolio using:

* **Variance-Covariance method**
* **Historical Simulation**
* **Monte Carlo Simulation**

Key Outputs:

* VaR table across models
* Confidence levels: 95% and 99%
* Interpret differences between models and their assumptions

**Step 5: Backtesting & Model Validation**

**[Weight: 2 marks]**

Backtest your 1-day 99% VaR using at least 250 historical observations.

Use:

* **Kupiec Test**
* **Christoffersen Test**
* Ljung-Box test on residuals (for GARCH models)

Discuss:

* Number of exceptions
* Interpretation of p-values
* Should model be accepted or recalibrated?

**Step 6: Option Pricing & Greek Sensitivities**

**[Weight: 2 marks]**

Choose one stock (or index) and:

* Simulate GBM paths for Last Thursday of April starting from 1-Apr-2025
* Use these paths to **compute European call/put option prices**
* Estimate:
  + **Delta** using finite differences
  + **Gamma**, **Vega**, and **Theta** (interpret their values)
* Comment on risk exposures and how Greeks evolve over time.

Show how Greeks behave across **different strikes and maturities**.

**Step 7: Hedging Strategy Implementation**

**[Weight: 2 marks]**

Implement one of the following:

* **Delta-Neutral Hedging**: Rebalance a portfolio dynamically to maintain Δ ≈ 0
* **Volatility Hedge**: Use Vega-neutral strategy with options
* **Diversification Hedge**: Use negatively correlated asset(s) to reduce risk

Write a detailed interpretation of your hedging strategy

**Step 8: Report and Executive Summary**

**[Weight: 2 marks]**

* Explain your modeling process clearly.
* Focus on **interpretations, not just results**.
* Include risks, limitations, and suggestions for improvement.
* Executive summary (1 page) should be business-style:
  + Portfolio profile
  + Main risk findings
  + Hedge strategy and recommendations