

# Financial Index Analysis Project Guidelines

## Objective

Students will analyze a financial index time series by applying appropriate volatility modeling techniques. The goal is to conduct exploratory analysis, compute and analyze log-returns, apply models such as ARCH, GARCH, and their extensions, and use these models for risk measurement, including Value at Risk (VaR) and Expected Shortfall (ES).

## Submission Requirements

Each group must submit:

- **Lightning Talk Presentation** (4 minutes):
  - Briefly describe the dataset and its relevance.
  - Justify the choice of volatility models.
  - Present key findings and risk analysis.
  - Conclude with the implications of the results.
- **Jupyter Notebook**: A well-documented notebook containing:
  - All steps of the analysis, from data exploration to risk modeling.
  - Code, explanations, and interpretation of results.

## Tasks

### 1. Selecting a Financial Time Series Dataset

Each group must select their own financial index time series. The dataset should be publicly available, sourced from reliable financial data providers, and include sufficient historical data for volatility modeling. Examples include:

- Broad market indices: S&P 500, NASDAQ, Dow Jones.
- International indices: FTSE 100, DAX, Nikkei 225.
- Sector-specific indices: Technology (e.g., NASDAQ-100), Transport (e.g., Dow Jones Transportation Index), Hospitality (e.g., STR Hotel Index), Luxury (e.g., S&P Global Luxury Index).
- Cryptocurrency indices: Bitcoin Index, Ethereum Index, Crypto Market Cap Index.
- Individual company stocks: LVMH, Delta Air Lines, Amazon (AMZN), Tesla (TSLA), Microsoft (MSFT), Apple (AAPL), Google (GOOGL).

Groups must provide a brief description of their selected dataset, its source, and its relevance to financial risk analysis.

### 2. Exploratory Data Analysis (EDA)

Perform an initial analysis of the financial time series:

- Plot the raw time series and discuss volatility clustering.
- Compute and analyze log-returns of the time series.
- Compute summary statistics and analyze stationarity of log-returns.
- Check autocorrelation and partial autocorrelation functions of log-returns.

### 3. Volatility Modeling

Apply and compare multiple volatility models:

- Fit various models (e.g., ARCH, GARCH, GJR-GARCH, EGARCH) to the log-returns.
- Justify model selection using statistical criteria (AIC, BIC, likelihood ratio tests).
- Evaluate model diagnostics and residual behavior.

#### **4. Risk Modeling and Interpretation**

Use volatility models for risk analysis:

- Compute and interpret Value at Risk (VaR) at different confidence levels using log-returns.
- Estimate Expected Shortfall (Conditional VaR) and assess tail risk.
- Discuss financial implications of risk estimates.

#### **Additional Notes**

- Clearly label and annotate all plots.
- Write concise explanations for every step in the Jupyter Notebook.
- Ensure the presentation is engaging and to the point.