

PREDICTIVE OPTIMIZATION ANALYTICS CAT 2

CAT Objective

The objective of this assignment is to implement and compare various Time Series Forecasting techniques to predict future values using:

1. **Traditional Methods** (ARIMA, SARIMA)
2. **Machine Learning Methods** (Linear Regression, Random Forest)
3. **Prophet** (Facebook Prophet)
4. **Neural Networks** (LSTM - Long Short-Term Memory)

Note:

Use the stock dataset in `yfinance` api or select a similar time series dataset (e.g weather data, energy consumption). Ensure you clearly document each step of the process.

Task 1: Data Preparation (1 marks)

- Load and inspect the dataset.
 - Convert the Date column to a datetime object and set it as the index.
 - Visualize the time series data.
 - Handle missing values if present.
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Task 2: Traditional Methods (5 marks)

1. **ARIMA Model**

- Perform ACF and PACF analysis to identify the p and q parameters.
- Fit an ARIMA model and tune hyperparameters for optimal results.
- Evaluate the model using appropriate metrics (RMSE, MAE, MAPE).

2. **SARIMA Model**

- Introduce seasonality into the model.

- Compare SARIMA results with ARIMA.
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✓ **Task 3: Machine Learning Methods (5 marks)**

- Implement and compare at least **two different models** (Linear Regression, Random Forest).
 - Use appropriate feature engineering techniques (lagged features, rolling means).
 - Split the data into training and testing datasets.
 - Evaluate models using RMSE, MAE, and MAPE.
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✓ **Task 4: Prophet Model (5 marks)**

- Implement **Facebook Prophet** for time series forecasting.
 - Include special event handling (Holidays).
 - Perform cross-validation and hyperparameter tuning.
 - Compare predictions with Traditional and Machine Learning models.
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✓ **Task 5: Neural Network - LSTM (5 marks)**

- Implement an **LSTM model** using TensorFlow/Keras.
 - Scale data and create sequences for training.
 - Build, compile, and fit the model.
 - Forecast future values and evaluate performance.
 - Plot actual vs. predicted values using Plotly.
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✓ **Task 6: Results Comparison & Report (5 marks)**

- Compare all models based on performance metrics.
- Discuss advantages and limitations of each approach.

- Suggest improvements for better forecasting.
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Submission Requirements

- Jupyter Notebook containing all code and outputs.