

Time Series Analysis Report

1. Introduction

This report presents a time series analysis and forecasting of stock prices using Python. The dataset used contains historical stock prices. The goal is to analyze patterns, apply various smoothing techniques, and build a forecasting model using ARIMA. The performance is evaluated using RMSE, and the forecast is visualized for interpretability.

2. Importing Required Libraries

We imported essential Python libraries for data manipulation and analysis:

- pandas and numpy for data handling
- matplotlib and seaborn for visualization
- statsmodels for time series modeling (decomposition, ARIMA)
- sklearn for evaluation metrics (RMSE)

3. Loading and Exploring Dataset

The dataset was loaded using pandas. We parsed the 'Date' column as datetime and set it as the index.

Only the 'Close' price was used for time series analysis. Initial exploration was done using `df.head()`, `df.info()`, and `df.describe()`.

4. Time Series Visualization

We plotted the 'Close' prices over time to understand the overall trend and seasonality. This step helps in identifying potential patterns in the data.

5. Decomposing the Time Series

Using statsmodels' seasonal_decompose function, we decomposed the time series into three components:

- Trend
- Seasonality
- Residuals

This helped in understanding the nature of the series.

6. Moving Average and Exponential Smoothing

Two smoothing techniques were applied:

- Simple Moving Average (window=12)
- Exponential Weighted Moving Average (EWMA)

These techniques help reduce noise and better understand the trend.

7. ARIMA Model for Forecasting

An ARIMA model was fitted to the data after ensuring stationarity. The model was trained on the majority of the data and tested on the last 30 days.

Predictions were made and compared to actual values.

8. Model Evaluation and Forecast Visualization

The performance of the ARIMA model was evaluated using RMSE (Root Mean Squared Error). A good RMSE value indicates better prediction accuracy.

The forecast was visualized to compare predicted vs actual values. The RMSE obtained was approximately 19.18.

9. Conclusion

The time series analysis of stock prices demonstrated the utility of smoothing techniques and ARIMA modeling.

The decomposition helped reveal the structure of the time series, and forecasting using ARIMA provided reasonably accurate results.

This analysis can aid in making informed decisions in financial applications.