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ARIMA Time Series Forecasting - The S&P 500 Stock Market

In this project, we perform time series forecasting on the S&P 500 Stock Market data using the Autoregressive Integrated Moving Average (ARIMA) model. The following is a step-by-step process of how we achieved the results:

Libraries and Data Loading

- Import libraries such as Numpy, Pandas, Matplotlib, and Statsmodels
- Load the time series data of the S&P 500 Stock Market

Data Visualization and Stationarity Tests

- Check the time series visually to ensure it is stationary
- Perform an Augmented Dickey-Fuller (ADF) test to formally test for stationarity
- If the time series is not stationary, apply the Differencing method to make it stationary

Determining 'p' and 'q' values

- Use the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots to determine the values of 'p' (number of autoregressive terms) and 'q' (number of moving average terms)

Grid Search for Optimal 'p', 'd', and 'q' values

- Use the grid search method to find the optimal values of 'p', 'd', and 'q'

Model Building

- Build the ARIMA model using the optimal values of 'p', 'd', and 'q'

Model Evaluation

- Fit the model on the training data
- Use the model to make predictions on the test data
- Plot the predictions against the actual values to evaluate the model's performance
- Use the root mean squared error (RMSE) to evaluate the model's performance

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Model Selection

- Use the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) to compare different models and select the best one

Tools and Models used

- Libraries: Numpy, Pandas, Matplotlib, Statsmodels, and Sklearn
- Models: Autoregressive Integrated Moving Average (ARIMA)
- Metrics: Augmented Dickey-Fuller (ADF) test, Differencing method, Autocorrelation Function (ACF), Partial Autocorrelation Function (PACF), root mean squared error (RMSE), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC).