Sigma Internship Coding Challenge

-21PD36-SUBASH S

Data Acquisition

- **Source:** Quantrocket
- **Stock:** Apple (AAPL)
- **Data:** Daily closing prices only
- **Timeframe:** Year 2023 (01-01-2023 to 12-31-2023)

Model Design

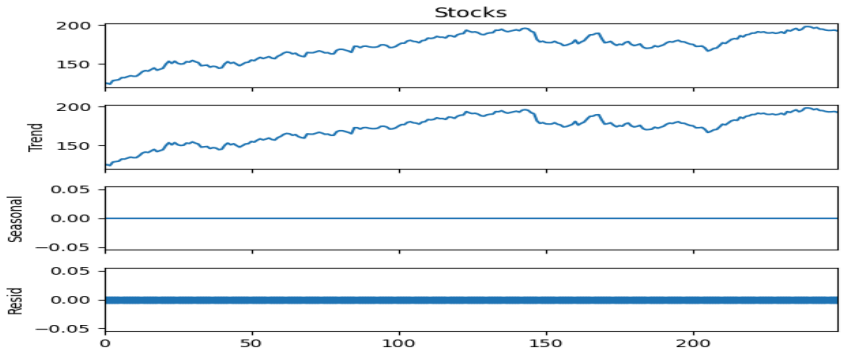
- **Class Name:** Model
- **Purpose:** Make stock trading decisions

Model Functions

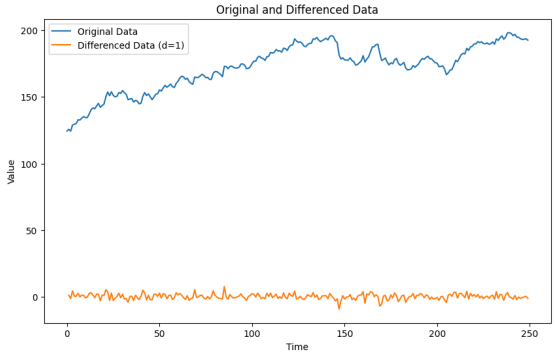
- **calculate_state**:
  Analyzes daily price changes to identify market trends:
  - Bull: Market is going up.
  - Flat: Market is staying flat.
  - Bear: Market is going down.
- **calculate_portfolio_values**:
  Tracks how much money you would have based on a strategy of:
  - Buying during flat markets.
  - Selling during bull markets.
  - Considers transaction costs.
- **transition_probability**:
  Analyzes historical data to determine the likelihood of transitioning between bull, flat, and bear markets.
- **decide_buy**:
  Based on portfolio value changes, it recommends whether it's a good day to buy stocks.

Data Analysis

- **Visualizations:** Created to understand:
  - Stock price movements.
  - Trends.
  - Seasonal patterns.



- **Stationarity Tests:**
  - Checks if the stock price data has a constant trend over time (important for some prediction models).
  - Results indicated a trend and no seasonality.
  - To make the data stationary (suitable for modeling), differencing of order 1 was applied.



  - The Kwiatkowski–Phillips–Schmidt–Shin test confirmed the removal of the trend component.

```
Results of KPSS Test:
Test Statistic           0.256073
p-value                  0.100000
#Lags Used               3.000000
Critical Value (10%)     0.347000
Critical Value (5%)      0.463000
Critical Value (2.5%)    0.574000
Critical Value (1%)      0.739000
dtype: float64
```

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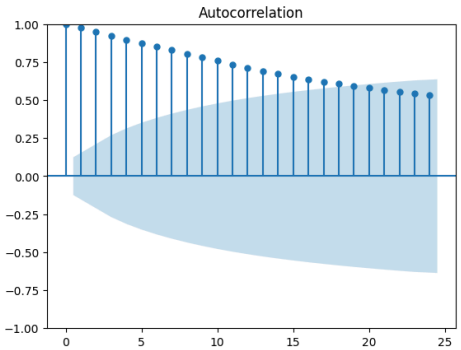
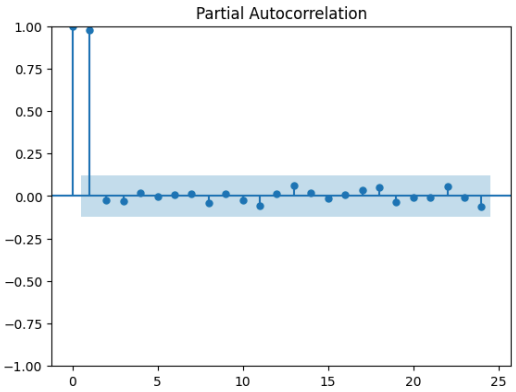
Model Fitting

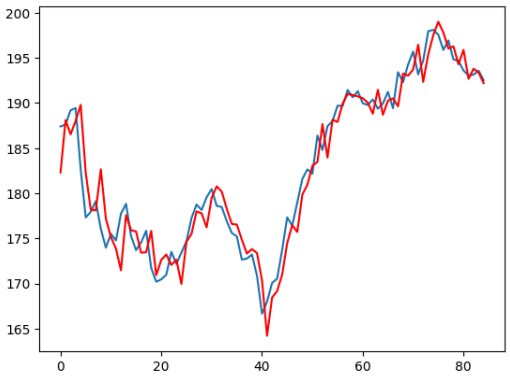
- **ARIMA Model:** Chosen based on its performance compared to other models:
  - ARIMA
  - LSTM
  - Exponential Smoothing
  - Prophet
  - Holt Winters
- **Model Parameters:** ARIMA (1,1,18)
  ACF:



PACF:

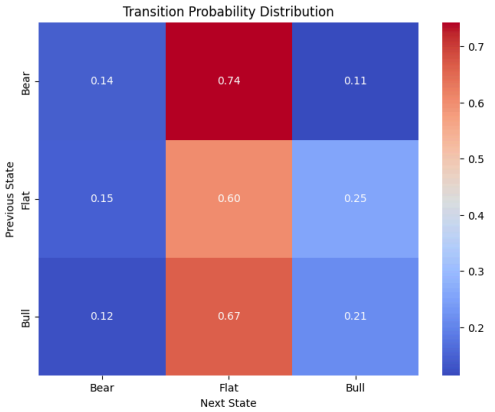


- **Training:** The model was fit using the entire dataset.
- **Validation:** Walk-forward validation was used to generate predictions on a test set.
- **Evaluation:** Root Mean Squared Error (RMSE) was used to evaluate the model's performance (RMSE = 2.347).



Model Outputs

- **Transition Matrix:** Shows the probability of transitioning between bull, flat, and bear markets.



Matrix with Indices:

	Bear	Flat	Bull
Bear	0.14	0.74	0.11
Flat	0.14	0.62	0.24
Bull	0.12	0.67	0.21

- **Buy Dates:** Identified based on model analysis.
  Buy_Dates : ['2023-01-04', '2023-01-11', '2023-01-13', '2023-01-20', '2023-01-26', '2023-02-02', '2023-02-13', '2023-02-15', '2023-03-03', '2023-03-16', '2023-03-20', '2023-03-29', '2023-03-31', '2023-04-13', '2023-04-27', '2023-05-05', '2023-05-10', '2023-05-18', '2023-05-26', '2023-06-01', '2023-06-08', '2023-06-12', '2023-06-15', '2023-06-22', '2023-06-27', '2023-06-30', '2023-07-17', '2023-07-28', '2023-08-23', '2023-08-29', '2023-09-18', '2023-10-02', '2023-10-06', '2023-10-30', '2023-11-01', '2023-11-06', '2023-11-10', '2023-11-14', '2023-12-05', '2023-12-07', '2023-12-13']
- **Portfolio Value:** Calculated based on the buying and selling strategy.
  Portfolio_value : 17

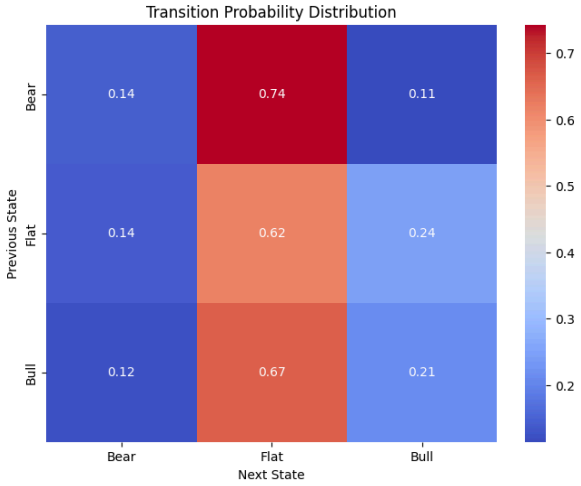
Prediction:

- **Input:** Date (excluding weekends)
- **Process:**
  - The number of days (excluding weekends) from the last prediction is calculated.
  - This value is used as the number of steps to predict using the ARIMA model.
  - The predicted value is added to the dataset.
- **Output:**
  - The model is recalculated to update:
    - Transition probabilities
    - Buy dates
    - Portfolio value
  - Predicted value for the given date (if not a weekend)

Example: Predicting for January 10th, 2024

1. The model considers data up to the last prediction (which could be December 31st, 2023).
2. It excludes weekends and calculates the number of days since the last prediction.
3. This number of days is used to predict the price forJanuary 10th, 2024 using the ARIMA model.
4. The predicted value is added to the dataset.
5. The model is then recalculated to update transition probabilities, buy dates, and portfolio

value.



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Buyl_Indices : [1, 6, 8, 12, 16, 21, 28, 30, 41, 50, 52, 59, 61, 69, 79, 85, 88, 94, 100, 103, 108, 110, 113, 117, 120, 123, 133, 142, 160, 164, 177, 187, 191, 207, 209, 212, 216, 218, 232, 234, 238]

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Dont buy Stock on that Day