SIGMA WEDGE

Getting Started:

Installed Quantrocket and extracted the daily close prices of Apple stock (sid='AAPL') for the year 2023 from the freely available us-stock price data in Quantrocket.

Objective:

We want to build a model to decide whether to place a buy trade for day d+1 to maximize the portfolio value.

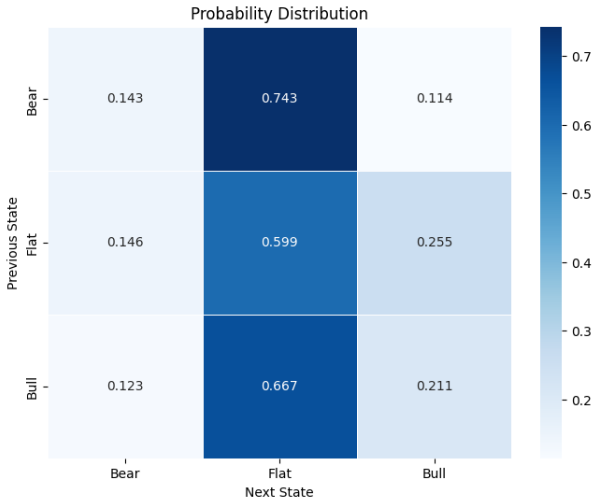
Class StockTrading:

This python Class includes Stock price model that uses historical stock prices and categorizes it to daily market states (Bear, Flat, Bull) and determines whether to place a buy order trade for the day d+1 in order to maximize the portfolio value V(N). This class members functions includes :

- classify_states(): Calculates daily returns of the stock using **r(d) = (p(d) - p(d-1))/p(d-1)** and classifies it to states as Bear (-1), Flat (0), Bull (1).
- find_portfolio(): Finds the portfolio value of the day and collects the optimal buy indices.
- probability_distribution(): Computes transition probability matrix of goin from one state to different possible states.
- output(): Shows an output of portfolio value, optimal buy indices and buy dates of the stock along with visualized transition probability matrix.
- predict(): Predicts whether to place a buy order trade or not on certain dates.

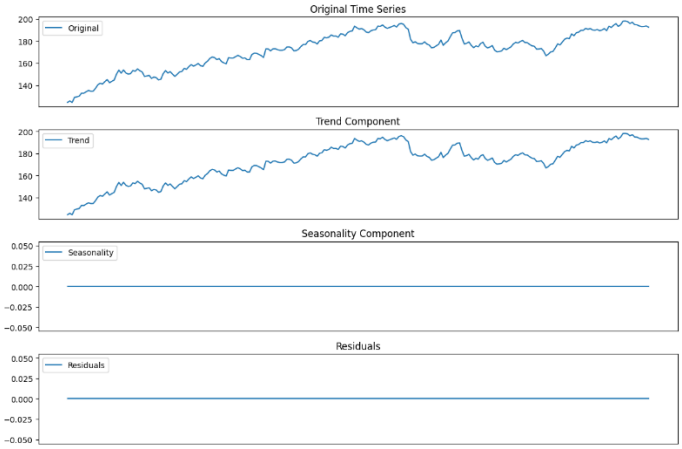
Output:

```
PORTFOLIO VALUE V(N):  17

OPTIMAL BUY INDICES: [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]

BUY DATES :  ['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']
```



Time Series Forecasting:

- **Components**: Checks for Trend,Seasonality,Residual Components in the data.
  Result: Increasing Trend, No Seasonality, No Residuals.



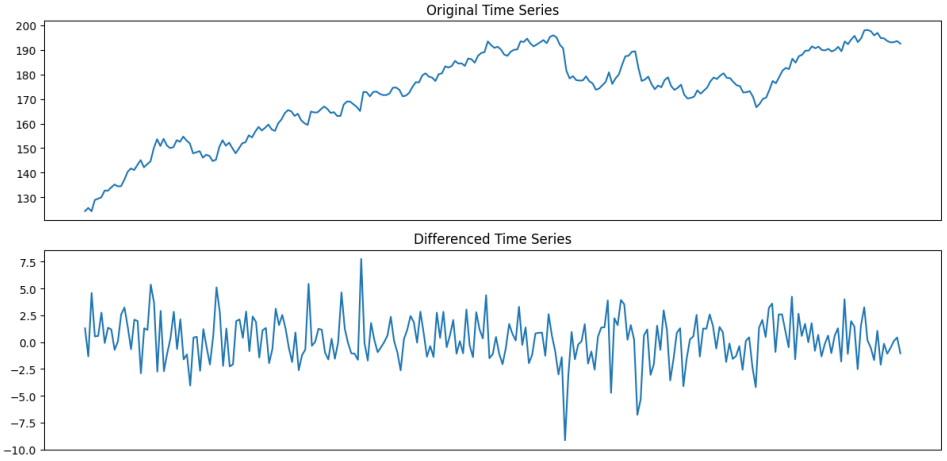
- **Testing Stationarity:** Checks whether the data is stationary or not inorder to proceed with time series forecasting.
  KPSS Test:

```
KPSS Statistic: 1.7159551343844486
p-value: 0.01
Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}


The time series is not stationary (reject the null hypothesis)
```

  Dickey Fuller Test:

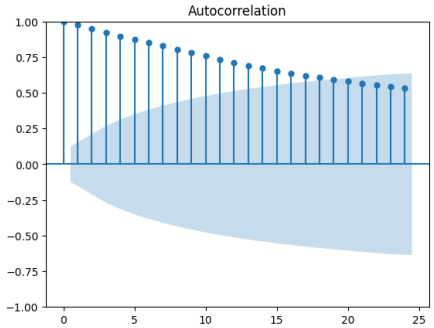
```
ADF Statistic: -2.5861110326138066
p-value: 0.09590194595133555
Critical Values: {'1%': -3.4568881317725864, '5%': -2.8732185133016057, '10%': -2.5729936189738876}


The time series is not stationary (fail to reject the null hypothesis)
```

- **ARIMA (Auto Regression Integrated Moving Average):**
  Chosen ARIMA model after comparison done other models like LSTM, Prophet, Exponential Smoothening.
  - **Differenced Data:** To make non stationary as stationary data. Stationarity (constant mean and variance) achieved after first order differencing used KPSS test for testing.

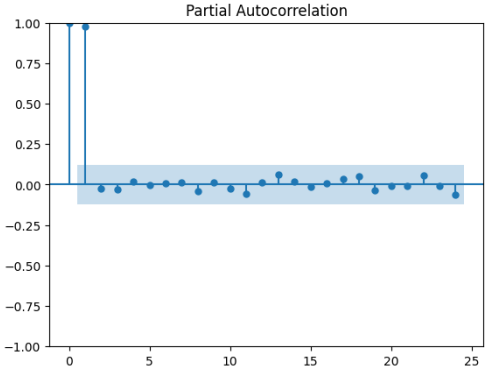



```
KPSS Statistic: 0.2560725802772843
p-value: 0.1
Critical Values: {'10%': 0.347, '5%': 0.463, '2.5%': 0.574, '1%': 0.739}


The time series is stationary (fail to reject the null hypothesis)
```

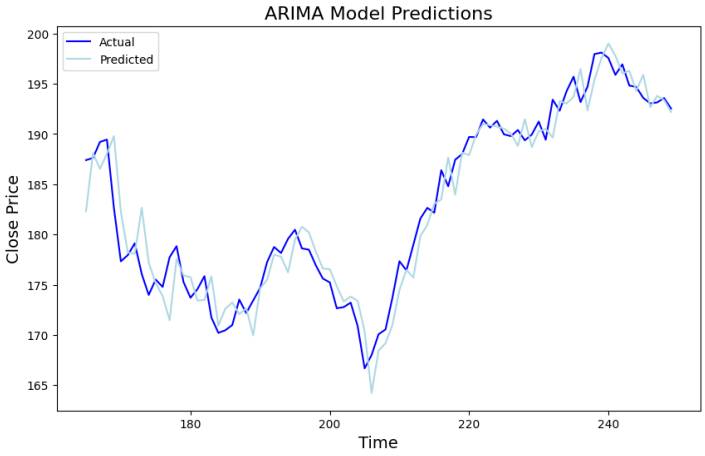
  - **ACF Plot:** To calculate q (Moving average) parameter for model.



  - **PACF Plot:** To calculate p (Auto Regression) parameter for the model.



ARIMA Parameters: (1,1,18)
RMSE Value: 2.347



Prediction:

Input: Any Date of the format (YYYY-MM-DD)

Method:

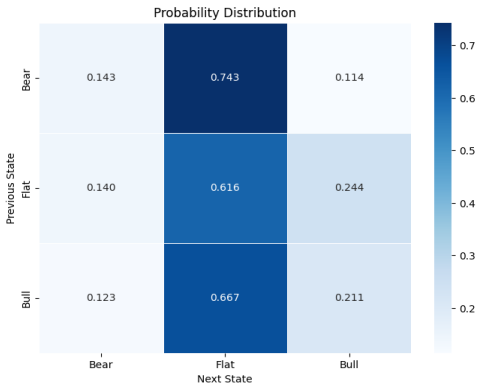
- Calculates the number of days between the last date in the dataset and the give date - no_of_days().
- This is used as steps to forecast using the ARIMA model.
- The StockTrading model uses predicted dataframe to check the condition after calculating necessary calculations.

Output: The model StockTrading calculates

- Transition probability
- Optimal Buy Indices
- Buy Dates

Also, predicts whether the stock can be bought on the specified day or not.(Note: Stock cannot be bought on weekends. These conditions are also checked.)

Predicted Result:



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You can't buy the stock on 2024-03-01.