**Module Three Project**

**Forecasting Financial Time Series**

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ALY - 6050: Introduction to Enterprise Analytics

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1. **Overview:**

In this assignment, I analyzed stock price data for Netflix and Amazon over one year. First, I used different forecasting methods, like exponential smoothing and moving averages, to predict future stock prices in the short and long term. I calculated forecast errors to determine which methods worked best. Then I used regression analysis on the stock data and checked if the assumptions were met. Finally, I compared all the forecasting approaches to a baseline model that just uses the most recent price. At the end, I gave my opinion on how to split an investment between the two stocks based on the analysis.

1. **Analysis & Findings:**

**Part - 1:**

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**Insights:**

* Netflix prices showed an overall increasing trend with fluctuations, no obvious seasonal patterns.
* Amazon prices also trended upwards overall, but had larger fluctuations compared to Netflix.
* No clear seasonal behaviors were detected visually in either stock's prices.

(ii) & (iii):

| **Exponential Smoothing** | | |
| --- | --- | --- |
| Alpha | MAPE A | MAPE N |
| 0.3 | 2.36% | 2.58% |
| 0.45 | 2.05% | 2.23% |
| 0.6 | 1.90% | 2.08% |
| 0.75 | 1.82% | 2.03% |

| **Adjusted Exponential Smoothing** | | | |
| --- | --- | --- | --- |
| Alpha | Beta | MAPE A | MAPE N |
| 0.6 | 0.3 | 1.82% | 2.07% |
| 0.45 | 1.81% | 2.08% |
| 0.6 | 1.80% | 2.11% |
| 0.75 | 1.81% | 2.15% |

**Result graphs:**

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**Insights:**

* In using exponential smoothing with various alpha (0.3, 0.45, 0.6, and 0.75) to forecast a 253-day period, I observed that for both Amazon and Netflix, an alpha of 0.75 yielded the most accurate predictions, showcasing a substantial influence of recent prices.
* Higher alphas emphasized the importance of the latest data, implying that recent periods significantly impact prices.
* Subsequently, when applying adjusted exponential smoothing with alpha set at 0.6 and exploring betas (0.3, 0.45, 0.6, and 0.75) to consider trends, I found that optimal beta values were stock-specific.
* For Amazon, beta = 0.6 indicated a moderate trend influence, while for Netflix, beta = 0.45 suggested a slightly weaker trend compared to Amazon over the forecast period.
* Adjusting for trends notably enhanced forecast accuracy, underscoring the significance of tailoring parameters to individual stock characteristics.

**Part - 2:**

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**Insights:**

* I used a weighted moving average for the initial 50 periods and transitioned to a linear trend line from period 51 onward.
* Assessing accuracy by comparing forecasts against real "close" prices from Yahoo Finance, I observed significant errors with MAPEs of 12.464% for Amazon and 6.763% for Netflix during periods 253-262.
* Calculating overall MAPEs for periods 4–252, my method yielded 5.837% for Amazon and 4.838% for Netflix.
* Interestingly, this approach exhibited lower accuracy than the exponential smoothing models used in Part 1 for the entire time span.
* Despite its shortcomings, my methodology provides insights into the challenges of predicting stock prices accurately, emphasizing the importance of considering alternative forecasting techniques.
* The higher MAPEs in the later periods underscore the need for continuous refinement and adaptation in forecasting models to enhance predictive performance.

**Part - 3:**

*Charts obtained in this section:*

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**Insights:**

* The R-squared values of 0.8387 for Amazon and 0.794 for Netflix indicate a moderate to strong fit of the linear regression models, explaining a significant portion of the variance in the data.
* For both Amazon and Netflix, the homoscedastic and independence tests suggest that the residuals are not homoscedastic and not independent, potentially indicating issues with the model assumptions.
* The normal distribution of residuals is not met for Amazon, suggesting that the model may not accurately capture certain patterns in the data.
* In contrast, for Netflix, the residuals are normally distributed, indicating a better fit to the assumed linear relationship between the variables.
* The QQ plot analysis reveals that the predicted values for both Amazon and Netflix generally fall within the 95% confidence interval, but the presence of some noise suggests potential areas for improvement in the models.
* Overall, while the models show reasonable predictive performance, there are concerns regarding homoscedasticity, independence, and the normal distribution of residuals, highlighting the need for further investigation and potential model refinement.

**Part - 4:**

**Observed & Predicted Trend graphs:**

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**Analysis & Findings for above charts:**

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**Insights:**

* Exponential smoothing: optimal alpha (0.75) for Amazon and Netflix, emphasizing recent price importance.
* Adjusted exponential smoothing: Netflix (beta = 0.45) suggests a slightly weaker trend compared to Amazon.

*Charts obtained in this section:*

|  |  |
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**Insights:**

* The R-squared values of 0.8966 for Amazon and 0.7662 for Netflix suggest a strong and moderate fit, respectively, of the linear regression models in explaining variance within the data.
* Both Amazon and Netflix exhibit issues with homoscedasticity and independence of residuals, as indicated by the lack of randomness in scatter plots, highlighting potential limitations in the models.
* Residuals for both Amazon and Netflix are not normally distributed, suggesting deviations from the assumption of a normal distribution, which may impact the reliability of the models.
* The QQ plots show that predicted values generally fall within the 95% confidence interval, but the presence of noise indicates potential areas for improvement in the models' accuracy.
* While the models have reasonable predictive performance based on the R-squared values, the identified issues with homoscedasticity, independence, and the normal distribution of residuals signal the need for careful interpretation and potential adjustments.
* Considering refining the models or exploring alternative regression approaches to address the identified concerns and enhance the reliability of predictions for both Amazon and Netflix.

**Final Question’s Answer:**

I am allocating 60% to Amazon and 40% to Netflix in my 2-stock portfolio. Amazon's superior predictive performance and lower variance in predicted prices support this decision.

1. **Conclusion:**

In conclusion, navigating the intricate landscape of financial time series forecasting for Netflix and Amazon stocks has been both challenging and enlightening. Through a comprehensive analysis employing exponential smoothing, moving averages, and regression models, I uncovered valuable insights into each stock's behavior. In crafting my investment strategy, a 60-40 split favoring Amazon reflects its superior predictive prowess and lower price variance. This journey underscores the dynamic nature of financial markets, emphasizing the perpetual need for adaptability in forecasting methodologies.

1. **Citations:**

Exponential Smoothing: [source](https://youtu.be/YH9O0Mj2diw?si=86zMGZmdt6EFwdg3).

Adjusted Exponential Smoothing: [source](https://youtu.be/SxKOklTGXLQ?si=_1Rcc6O2re2gPxi6).

Predicting trends in time series data: Lab Video.