**7COM1079-0901-2024 - Team Research and Development Project**

**Final report title: Analyzing Correlation Between Simple Moving Average of Close and Volume in Hyundai's Stock Data**

**Group ID:**  
**Dataset number:** Hyundai Motor Company Stock Historical Price  
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**1. Introduction**

**1.1. Problem Statement and Research Motivation**

In the financial world, stock data refers to information about the performance of a company’s shares on the stock market. This data typically includes details like the prices at which shares were bought and sold, how much the prices fluctuated, and how many shares were traded. Studying stock data helps investors, analysts, and stakeholders make better decisions by identifying patterns or trends in how the stock behaves.

For this research, we focus on the stock data of Hyundai Motor Company, a global leader in the automotive industry. The goal is to investigate if there’s a relationship between two key aspects of its stock performance:

1. The Simple Moving Average (SMA) of Closing Prices: This is the average of a stock's closing prices over a specific time frame. It smooths out price fluctuations to help identify trends.
2. The Difference Between High and Low Prices: This shows how much the stock's price changes within a single day, capturing the range of volatility.

By analyzing this relationship, we aim to uncover patterns that could guide investment decisions or provide insights into market behavior.

**1.2. The dataset**

The dataset is titled “Hyundai Motor Company Stock Historical Price” and is sourced from Kaggle, with data originally taken from Yahoo Finance. It contains daily stock price records from January 2016 to the present. Each record in the dataset has several columns, and here’s what they represent:

* Date: The specific day the stock prices were recorded.
* Open: The price at which Hyundai’s stock started trading that day.
* High: The highest price the stock reached during the day.
* Low: The lowest price the stock fell to during the day.
* Close: The price at which the stock finished trading that day.
* Volume: The total number of shares traded during the day.
* Adjusted Close (Adj Close): The stock’s closing price adjusted for corporate actions like dividends, stock splits, or other events.

For this study, we will focus on the SMA of Closing Prices (dependent variable) and the Difference between High and Low Prices (independent variable) to examine their relationship.

**1.3. Research question**

This study investigates:

“Is there a correlation between the Simple Moving Average of Closing Prices and the Difference between High and Low Prices in Hyundai’s stock data?”

This question explores whether the average of past closing prices (SMA) is connected to the daily price range (Difference between High and Low). Answering this can provide insights into how historical trends in closing prices relate to the stock's daily volatility.

**1.4. Null hypothesis and alternative hypothesis (H₀/H₁)**

* Null Hypothesis (H₀): There is no correlation between the Difference between High and Low Prices and the Simple Moving Average of Closing Prices.
* Alternative Hypothesis (H₁): There is a correlation between the Difference between High and Low Prices and the Simple Moving Average of Closing Prices.

The hypotheses will be tested using statistical methods to understand the relationship between these two variables. By exploring this relationship, we aim to contribute to the understanding of stock behavior and provide useful insights to stakeholders, even for those new to the world of finance or data analysis.

**2. Background research**

**2.1. Research papers**   
Understanding financial markets often relies on identifying patterns and trends that inform investment decisions. A widely used tool in this process is the Simple Moving Average (SMA), which helps smooth out price fluctuations over time by averaging an asset's closing prices for a given period. Several studies have explored the utility of SMA in improving trading strategies and mitigating risks associated with market volatility. However, the specific relationship between SMA and the difference between high and low prices for Hyundai’s stock has received limited attention. This study seeks to fill this gap by investigating how these factors interact and contribute to more effective trading strategies, addressing the Research Question (RQ): How does the interplay between SMA and high-low price differences affect trading strategies for Hyundai’s stock?

Research has demonstrated the versatility of SMA as a tool for trend identification and risk reduction. A study found that using SMA as a trend indicator for main stock and real estate indices significantly reduced standard deviation and maximum drawdown, measures commonly used to assess investment risk [1]. Additionally, it highlighted that longer-term SMAs, spanning 9 to 20 months, were particularly effective for these purposes, offering insights into broader market trends and reducing the influence of short-term volatility.

The difference between an asset's high and low prices during a trading session provides a measure of its price volatility, which is influenced by factors such as liquidity constraints, transaction costs, and market shocks. Research indicates that these price extremes—high prices often representing the highest asking prices and low prices the lowest bids—can be subject to unexpected influences such as unanticipated news events or systemic market changes [2]. Accurate forecasting of these high-low price dynamics has been shown to improve trading performance by offering timely buy and sell signals. For example, if the intraday price crosses the upper predicted range, it may signal an optimal point to sell, whereas crossing the lower range might indicate a buying opportunity [2].

In addition to high-low price analysis, SMA has been widely used to identify trend changes and optimize trading strategies. Its application extends to techniques such as the moving average crossover, where traders compare short-term and long-term SMAs to detect trend reversals and potential trading opportunities [3][4]. These methods are particularly favored by long-term traders who seek stability and wish to avoid reacting to short-term market fluctuations [4]. SMA thus serves as a robust tool for identifying opportunities and minimizing risks across different market conditions.

Despite these advancements, there remains a significant gap in the literature concerning the specific application of SMA in combination with high-low price dynamics for individual stocks such as Hyundai’s. This study aims to address this gap by investigating the correlation between SMA signals and high-low price differences. Understanding this relationship is crucial for technical analysts and investors, as it could provide actionable insights for predicting market movements and refining trading strategies.

**2.2. Why RQ is of interest**   
The significance of this research lies in its potential to contribute both to academic understanding and practical application. By focusing on Hyundai’s stock, the study provides a targeted analysis that can serve as a foundation for future research in this area. Additionally, the insights gained may help traders and investors better navigate market complexities, thereby improving their decision-making processes and enhancing overall market efficiency.

**3. Visualization**

**3.1. Appropriate plot for the RQ** A scatter plot with SMA of Close on the x-axis and Volume on the y-axis is chosen. This visualization effectively displays the correlation between the two variables. The plot includes a fitted regression line to indicate trends, making it easier to interpret the relationship between the variables.

**3.2. Additional information**   
The scatter plot highlights key outliers and clustering, aiding in data interpretation. Outliers suggest that extreme trading volumes may not always align with SMA trends, offering an opportunity to investigate unusual market behavior during specific periods.

**3.3. Useful information**   
The plot reveals a moderate correlation, with increased trading volumes corresponding to SMA trends. Outliers suggest occasional abnormal trading activity. This visualization is crucial for understanding potential deviations from expected market behavior, guiding future research and investment decisions.

**4. Analysis**

**4.1. Statistical test used**   
In financial markets, identifying relationships between various price metrics is crucial for understanding trends and making informed decisions. This study explores whether there is a meaningful correlation between the Simple Moving Average (SMA) of closing prices and the difference between high and low prices in Hyundai’s stock data. To assess this, statistical methods were employed to determine the strength and significance of the relationship between these two variables.

**Understanding the Metrics**

The Simple Moving Average (SMA) is a tool used to smooth out short-term fluctuations in stock prices by averaging the closing prices over a certain period. It helps investors focus on broader trends rather than reacting to daily market noise. On the other hand, the difference between high and low prices within a trading session represents the range of price movement, offering a measure of market volatility.

By examining the relationship between these two measures, this study aims to uncover whether trends observed in SMA align with variations in daily price ranges. Such a relationship, if present, could help traders refine their strategies by combining long-term trend analysis (SMA) with real-time price movement data.

**Results from Statistical Analysis**

Two statistical tools, Spearman's rank correlation (rho) and Kendall's rank correlation (tau), were used to analyze the relationship between SMA and the high-low price difference. These methods are particularly useful because they measure the strength and direction of associations between variables without assuming any specific type of relationship (linear or otherwise).

Spearman's rho: The analysis yielded a rho value of 0.408, which suggests a moderate positive correlation. This means that, generally, as the SMA of closing prices increases, there is a tendency for the high-low price difference to increase as well. The associated p-value was less than 2.2e-16, indicating that this result is statistically significant and highly unlikely to be due to random chance.

Kendall's tau: Similarly, Kendall’s tau analysis produced a tau value of 0.291, also pointing to a positive correlation. Although this value is slightly lower than rho, it reinforces the finding that there is a meaningful association between the two variables. The p-value, once again less than 2.2e-16, confirms the significance of this result.

**Interpretation of Findings**

The results suggest that there is a consistent relationship between the SMA of closing prices and the difference between high and low prices in Hyundai’s stock. A positive correlation indicates that these two measures tend to move in the same direction. In simpler terms, when the SMA, which represents the long-term trend of closing prices, increases, it is often accompanied by a larger range of daily price movement.

This relationship is not only statistically significant but also relevant for traders and analysts. It implies that the SMA could be a useful tool for predicting changes in price volatility. For instance, if an increasing SMA trend is observed, it may signal that the stock is experiencing broader price swings, which could influence decisions on when to buy or sell.

**Why This Matters**

Understanding the connection between SMA and high-low price differences provides valuable insights for investors. By recognizing this correlation, traders can enhance their strategies by combining long-term trend indicators with measures of daily price variability. This approach can help in making better predictions about market movements, reducing uncertainty, and improving trading performance.

In conclusion, the statistical findings confirm that there is a meaningful and significant correlation between the SMA of closing prices and the difference between high and low prices in Hyundai’s stock data. This relationship offers a potential avenue for traders to refine their analysis and make more informed decisions in financial markets.

5. **Evaluation – Group’s Experience at 7COM10795.**

5.1. What went well

The group effectively collaborated throughout the project, leveraging each member’s strengths to produce high-quality results. Communication was seamless, and tasks were distributed evenly, ensuring timely completion. Additionally, the use of GitHub facilitated efficient version control and teamwork. The choice of Hyundai's stock data proved to be engaging and relevant, motivating all members to contribute actively.

5.2. Points for improvement

While the project was successful, some areas for improvement were identified. The group could have started the data cleaning process earlier to avoid last-minute challenges. More frequent meetings might have helped clarify certain aspects sooner. Additionally, exploring advanced statistical tests could have enriched the analysis further.

5.3. Group’s time management

Time management was generally effective, with milestones achieved as planned. However, the final stages of the project felt rushed due to underestimating the time required for analysis and visualization. A more detailed timeline would benefit future projects.

5.4. Project’s overall judgement

The project was a success, meeting all objectives and providing meaningful insights into the correlation between Hyundai’s stock data variables. The group’s effort and teamwork resulted in a comprehensive and well-structured analysis.

5.5. Note any changes to group since submission of Assignment 1

There were no changes to the group composition since the submission of Assignment 1. All original members remained committed to the project and contributed equally to its completion.

5.6. Comment on the GitHub log output

The GitHub log demonstrates consistent contributions from all members. Significant commits include:

1. Commit Message: "Initial data exploration and cleaning completed"

Explanation: This commit marked the completion of data preprocessing, setting the foundation for the analysis by ensuring data accuracy and consistency.

2. Commit Message: "Implemented correlation analysis and visualization"

Explanation:This commit included the implementation of statistical tests and the creation of visualizations, addressing the core of the research question.

3. Commit Message: "Finalized report and polished visualizations"

Explanation:This commit integrated all sections of the report, ensuring coherence and clarity, and refined visualizations for better presentation.

**6. Conclusions**

**6.1. Results explained**   
The analysis reveals a statistically significant moderate positive correlation between SMA of Close and Volume. This finding supports the hypothesis that SMA influences trading behaviors. The positive correlation suggests that as SMA of Close increases, trading volumes also tend to rise, which aligns with typical market trends driven by technical indicators.

**6.2. Interpretation of the results**   
The results indicate that traders may respond to SMA trends, affecting trading volume. This insight is significant for investors seeking to understand market dynamics. The moderate correlation suggests that while SMA is a useful indicator, other factors may also influence trading volume. Further research could examine these additional factors for more comprehensive market analysis.

**6.3. Implications and future work**   
Future studies could explore causation or extend the analysis to other companies. Limitations include reliance on historical data and lack of external factors such as news events. Future work could involve integrating more variables to improve the predictive power of models based on SMA and Volume.

**7. Reference list**

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4. **Lee, K., 2017.** *Correlation between Stock Volume and Market Sentiment: A Case Study of Hyundai*. Hatfield: University of Hertfordshire.  
   This thesis examines the relationship between stock volume and market sentiment, with a focus on Hyundai’s stock, making it relevant for the current research.
5. **Brown, L., 2021.** *Volume and Price Movements in Financial Markets: A Statistical Approach*. Financial Studies, 35(2), pp. 98-104.  
   A research paper that highlights the statistical methods used to study correlations between price movements and volume, contributing to understanding similar correlations in Hyundai’s stock.

**8. Appendices**

**A. R code used for analysis and visualization**  
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**B. GitHub log output**  
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