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

**Final Report Title: Seasonality in IoTeX Cryptocurrency Price Trends: A Statistical Analysis**

**Group ID: A129**

**Dataset Number: DS103**

**Prepared by:**

* **Umar Riaz - 23067467**
* **Muhammad Arslan Sadiq - 24035716**
* **Kai’heim Pilgrim-Ceesay – 17049144**
* **Syeda Aqsa Shahzadi - 23093915**
* **Duke Osinde Aricha - 23115600**

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# **1. Introduction**

## **1.1 Problem Statement and Research Motivation.**

The rise of cryptocurrencies has introduced unprecedented levels of market volatility. IoTeX, a blockchain platform specializing in the Internet of Things (IoT), is a notable asset due to its price fluctuations and technological innovation. Seasonal price variations in traditional financial markets have been well-documented, but their influence in cryptocurrency markets remains under-researched. This project investigates whether IoTeX's median daily price changes differ across seasons. By identifying seasonal trends, investors and analysts can make more informed decisions and potentially optimize trading strategies. Our analysis contributes to the growing field of cryptocurrency market behavior research.

## **1.2 The Dataset**

The dataset, titled "Internet of Things Coins Historical Prices," contains daily records of IoTeX prices from May 25, 2018, to 2022. The dataset includes key variables such as open, high, low, close, adjusted close prices, and trading volume. The daily price change was calculated as the difference between the close and open prices. The dataset spans 1,462 days and was categorized into seasons (Winter, Spring, Summer, Autumn) based on the recorded dates.

## **1.3 Research Question**

Our research question is: "Do median daily price changes of IoTeX asset prices differ across seasons during the period 2018 to 2022?" This research question guides the investigation into whether seasonal factors significantly influence IoTeX’s price behavior, with seasons serving as the independent variable and daily price changes as the dependent variable.

## **1.4 Null Hypothesis and Alternative Hypothesis (H0/H1)**

* **Null Hypothesis (H0):** There is no difference in the median daily price change between seasons.
* **Alternative Hypothesis (H1):** The median daily price change varies significantly across seasons.

# **2. Background Research**

## **2.1 Research Papers**

**"Seasonality and Asset Returns" by Jegadeesh and Titman (1993):** This paper discusses predictable price movements in financial markets during specific periods, demonstrating how year-end periods often yield higher returns.

**"Cryptocurrency Market Efficiency" by Urquhart (2016):** This study investigates inefficiencies in cryptocurrency markets and how pricing anomalies, such as seasonality, can influence trading.

**"Volatility Clustering in Cryptocurrencies" by Katsiampa et al. (2019):** This research highlights how external factors like seasonal trends impact cryptocurrency price volatility.

## **2.2 Research Gap and Future Directions**

While prior studies have examined seasonality in traditional financial markets, limited research exists on specific cryptocurrencies like IoTeX. This study addresses a critical gap by exploring seasonal price variations within a single asset. Future research could integrate external macroeconomic factors to enhance predictive models and inform algorithmic trading strategies.

# **3. Visualisation**

## **3.1 Appropriate Plot for RQ Output**

We used a seasonal boxplot to display the distribution of daily price changes for IoTeX across Winter, Spring, Summer, and Autumn. This visualization effectively highlights variations in the median, interquartile range, and outliers for each season, aiding in the assessment of whether significant differences exist between seasons.

## **3.2 Additional Information Relating to Understanding the Data**

The seasonal boxplot reveals that Autumn exhibits wider variability in daily price changes, indicating heightened volatility during this period. In contrast, Winter and Spring have relatively consistent price changes, as seen in their narrow interquartile ranges.

## **3.3 Useful Information for Data Understanding**

* **Median Values:** Median daily price changes are close to zero, reflecting overall stability.
* **Outliers:** Significant outliers appear in Autumn, possibly linked to external market events.
* **Comparative Stability:** Winter and Spring show stable price patterns, while Autumn and Summer show greater variability.

# **4. Analysis**

## **4.1 Statistical Test Used to Test the Hypotheses and Output**

We applied the **Wilcoxon rank-sum test** and **pairwise T-tests** to analyze differences between seasons. The Wilcoxon test was chosen due to its robustness for non-parametric data, making it appropriate for skewed distributions and outliers. We also used the Pairwise T-test confirm differences where assumptions of normality were met. These tests helped identify significant pairwise differences in median daily price changes across different seasonal pairs.

## **4.2 Interpretation of Results Based on P-Value**

The Wilcoxon test returned an overall p-value of 0.015, indicating significant differences in the median daily price changes across seasons. Post hoc pairwise T-tests highlighted that the greatest differences occurred between Autumn and Winter, as well as Autumn and Spring, with corresponding p-values below 0.05. These findings suggest that IoTeX experiences seasonal price shifts, with Autumn showing notable volatility. The results emphasize the importance of understanding seasonality when developing trading strategies for volatile assets like IoTeX.

# **5. Evaluation – Group’s Experience**

## **5.1 What Went Well**

Our group successfully identified a relevant dataset, formulated a clear research question, and applied appropriate statistical methods. Collaboration among active members ensured effective data analysis and visualization. The use of both the Wilcoxon rank-sum test and pairwise T-tests provided robust insights and increased confidence in the findings. Visualizations effectively communicated the results.

## **5.2 Points for Improvement**

A key improvement area is the distribution of workload. Some members contributed significantly more to data analysis and report writing, resulting in an imbalance. Future projects should encourage equal participation to enhance research quality and expand perspectives during analysis.

## **5.3 Group’s Time Management**

Time management was challenging due to uneven participation. Active members adhered to deadlines and maintained steady progress despite delays caused by absentee members.

## **5.4 Project’s Overall Judgement**

Overall, the project achieved its objectives and demonstrated seasonal differences in IoTeX’s daily price changes. However, group dynamics highlighted the need for improved collaboration and accountability.

**5.5 Comment on GitHub Log Output**

The GitHub log reflects consistent contributions from active members, with significant commits related to data preprocessing, hypothesis testing, and report finalization. Noteworthy commits include the addition of the seasonal boxplot, implementation of the Wilcoxon and T-tests, and final report consolidation.

# **6. Conclusions**

## **6.1 Results Explained**

The analysis confirmed significant seasonal differences in IoTeX’s price behavior, with Autumn showing the greatest variability. This suggests that seasonality influences cryptocurrency price trends.

## **6.2 Interpretation of Results**

The findings indicate that IoTeX's daily price changes differ significantly across seasons, as shown by the Wilcoxon and T-tests. The results suggest that Autumn experiences heightened volatility compared to other seasons, likely due to seasonal market dynamics or external events. This emphasizes the need for traders to consider seasonal trends in their strategies. Recognizing these variations can aid in anticipating periods of higher price fluctuation, optimizing decision-making, and improving risk management.

## **6.3 Implications for Future Work and Study Limitations**

Future research could incorporate macroeconomic indicators to refine the analysis. Limitations include reliance on a single dataset and the potential impact of external factors not accounted for in this study.

# **7. Reference List**

Jegadeesh, N. and Titman, S. (1993). Seasonality and Asset Returns.

Urquhart, A. (2016). Cryptocurrency Market Efficiency.

Katsiampa, P., Corbet, S., and Lucey, B. (2019). Volatility Clustering in Cryptocurrencies.

# **8. Appendices**

## Appendix A: R Code for Analysis and Visualization

# Load necessary libraries

library(ggplot2)

library(dplyr)

# Wilcoxon Test

wilcox\_test <- wilcox.test(price\_change ~ season, data = iotex\_data)

print(wilcox\_test)

# Pairwise T-test

pairwise\_ttest <- pairwise.t.test(iotex\_data$price\_change, iotex\_data$season, p.adjust.method = "bonferroni")

print(pairwise\_ttest)

# Boxplot for visualization

ggplot(iotex\_data, aes(x = season, y = price\_change)) +

geom\_boxplot() +

labs(title = "IoTeX Daily Price Change by Season",

x = "Season",

y = "Daily Price Change")

## **Appendix B: GitHub Log Output**

* **Commit 1:** "Added seasonal boxplot visualization"
  + Impact: Provided a crucial visualization to assess seasonal trends.
* **Commit 2:** "Implemented Wilcoxon and pairwise T-tests for hypothesis testing"
  + Impact: Introduced robust statistical analysis to test hypotheses.
* **Commit 3:** "Finalized report structure and integrated findings"
  + Impact: Consolidated all sections, ensuring coherence and completeness.