

The Effects of Daylight Savings Time Changes on Market Outcomes

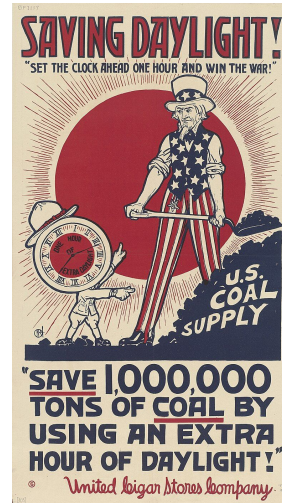
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Daylight Savings Time Overview

- Canada was the first to implement DST in 1908. The US implemented it in 1918 as a wartime measure to add more daylight hours and conserve energy resources
- Studies show that DST has significant effects on sleep, health¹, and car accidents²
- DST is not implemented universally - notably, the USA (except Arizona and Hawaii), Canada, and most European nations undergo DST changes, but the rest of the world does not

[1] Harrison, Y. (2013). The impact of daylight saving time on sleep and related behaviours. *Sleep medicine reviews*, 17(4), 285-292.

[2] Ferguson, S. A., Preusser, D. F., Lund, A. K., Zador, P. L., & Ulmer, R. G. (1995). Daylight saving time and motor vehicle crashes: the reduction in pedestrian and vehicle occupant fatalities. *American Journal of Public Health*, 85(1), 92-95.

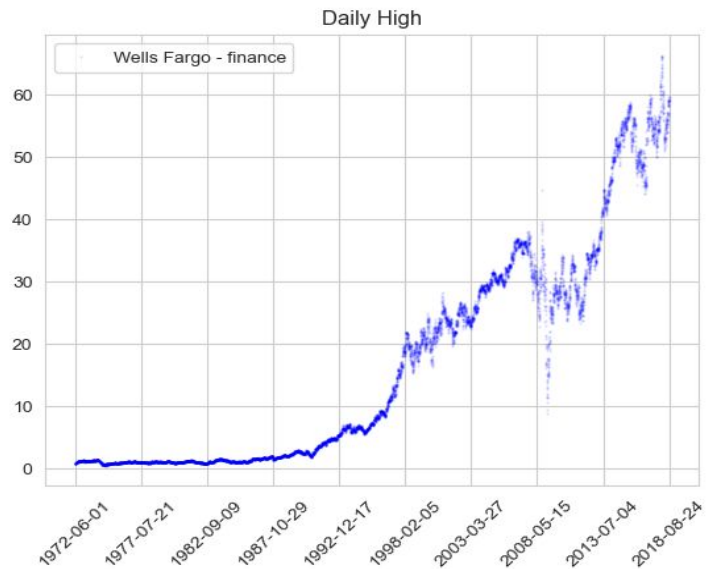
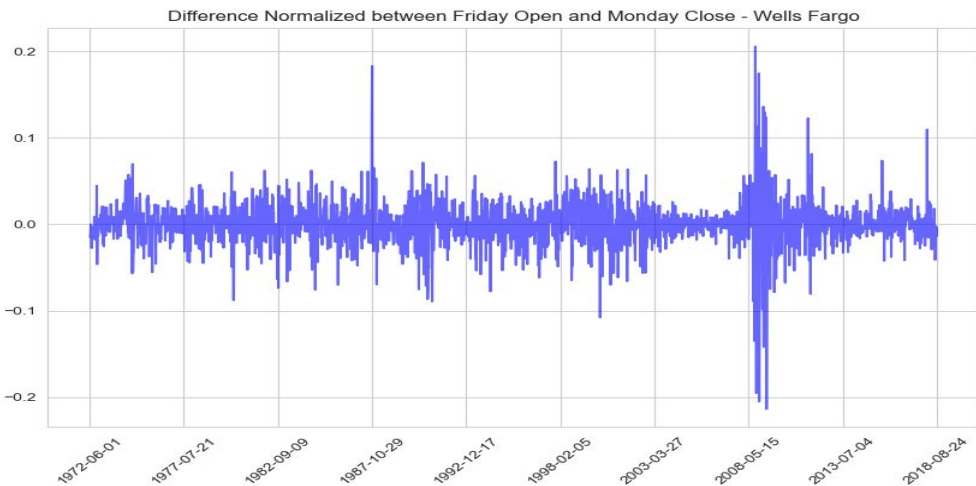


Do DST shifts impact the stock market?

- Kramer, Kamstra, & Levi (2000) study says yes!
- Berument, Dogan, & Onar (2010) disagrees: claims DST effect is not statistically significant, both in returns and in volatility
- These two camps argued over the significance of results for the next few years, and no conclusive answer has been reached

Summary of the Data

- Kaggle data of individual American stocks from 1971-2018¹ and labeled by sector
- Kaggle data of Japanese individual stocks²
- Data description: Date, Open, Close, High, Low, Volume per stock

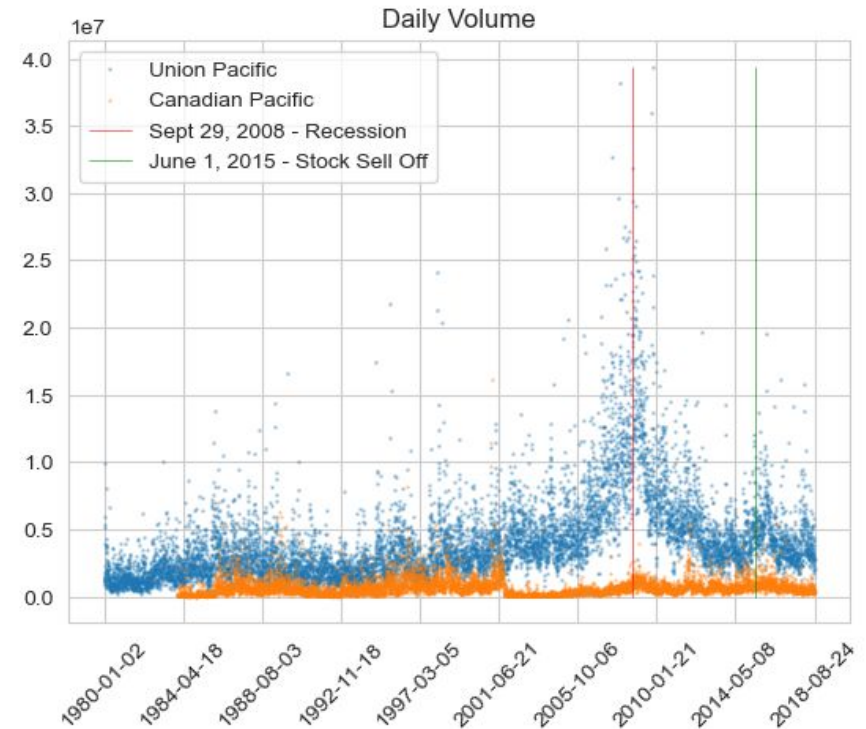


¹<https://www.kaggle.com/datasets/ehallmar/daily-historical-stock-prices-1970-2018>

²<https://www.kaggle.com/datasets/cryptrader/huge-japanese-stock-market-dataset-all-in-one/data>

Preprocessing

- Eliminate repeat rows, making values numeric or datetime objects
- Removing weekend pairs without both Monday and Friday data (eliminates holiday weekends typically)
- Account for Weekend Effect (typically, Friday close is greater than Monday open) and compare the effect between DST and nonDST
- Include high-low difference to indicate volatility



Statistical Methods (T tests and Power Analysis)

Fall

- The DST effect on **weekend returns** is more pronounced in the fall (hour gained) than in the spring (hour lost)
- NASDAQ shows results around the **90%** confidence level
- NYSE shows results around the **70%** confidence level
- Stocks which show strongest DST effects can be picked out to build strategies

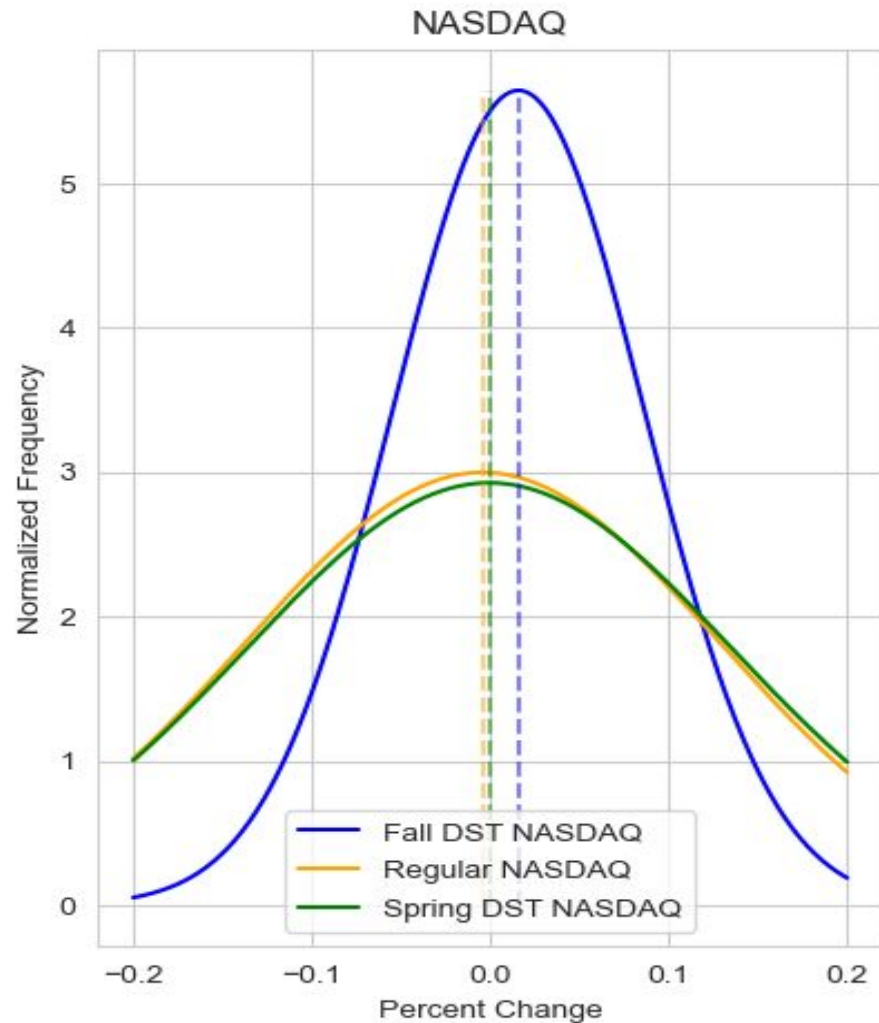
Spring

- The DST effect on ‘**volatility weekend effect**’ is more pronounced in the spring for NYSE
- NASDAQ shows results at the **64%** confidence level
- NYSE shows results at the **97%** confidence level
- Volatility changes can inform strategy, (holding for long-term strategies and taking advantage of fluctuations for day traders)

Weekend Effect on Returns

Fall: $p = 0.1$

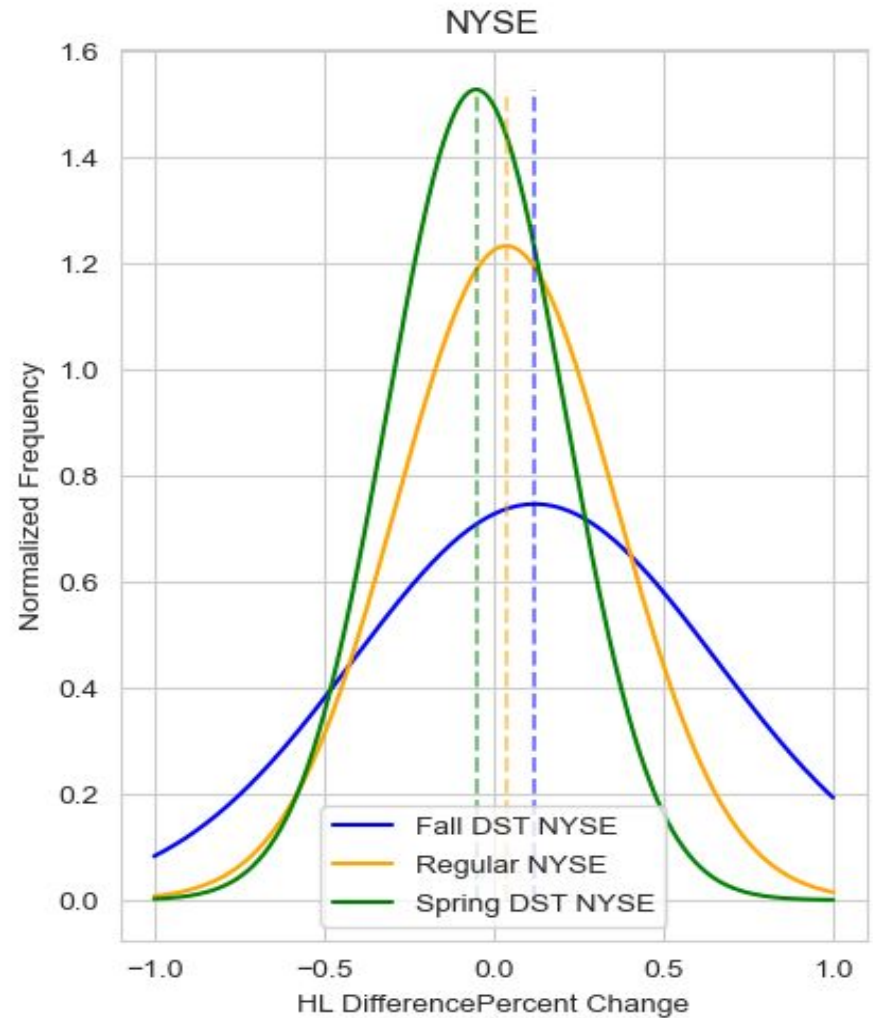
Spring: $p = 0.87$



Weekend Effect on 'Volatility'

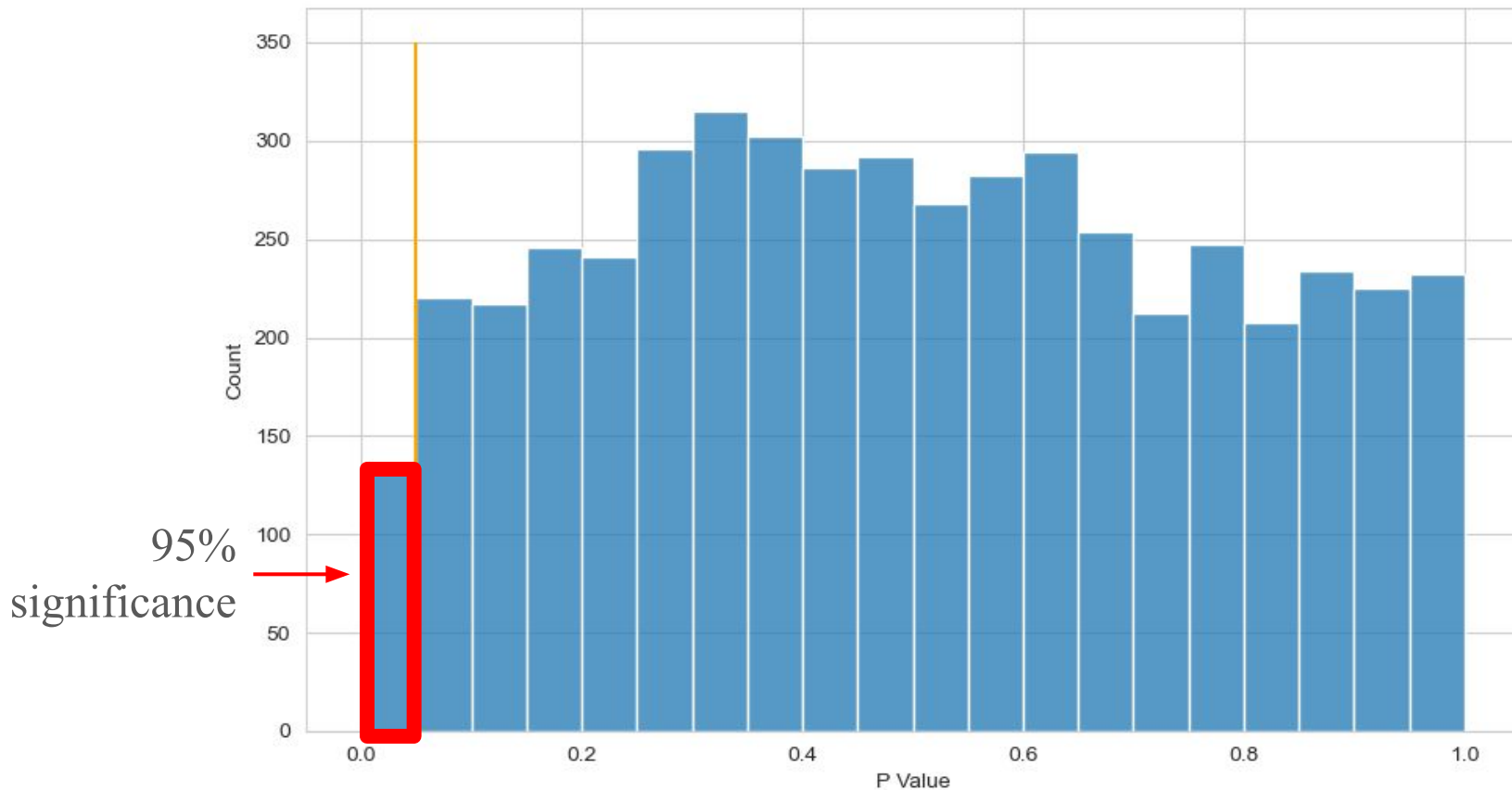
Fall: $p=0.29$

Spring: $p=0.03$

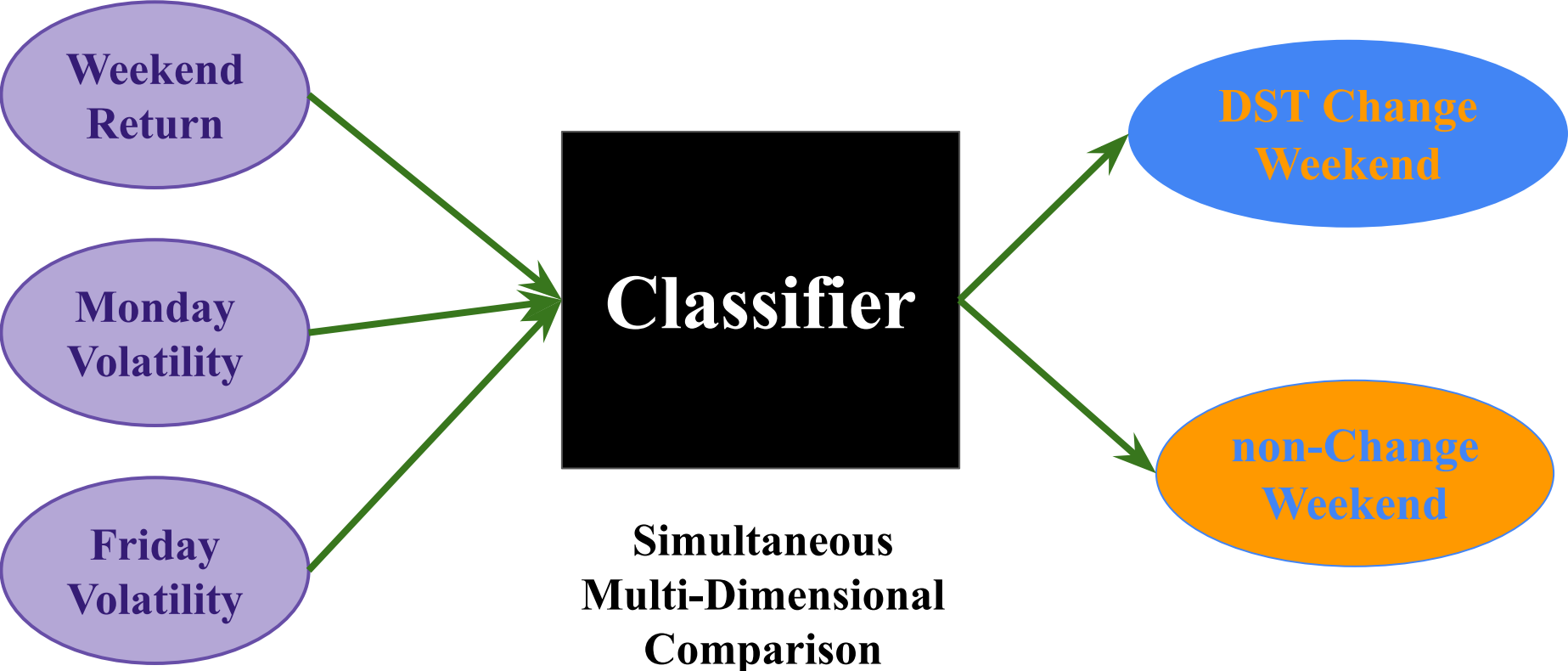


Individual Stock Breakdown (Returns)

T-test P Value Distribution

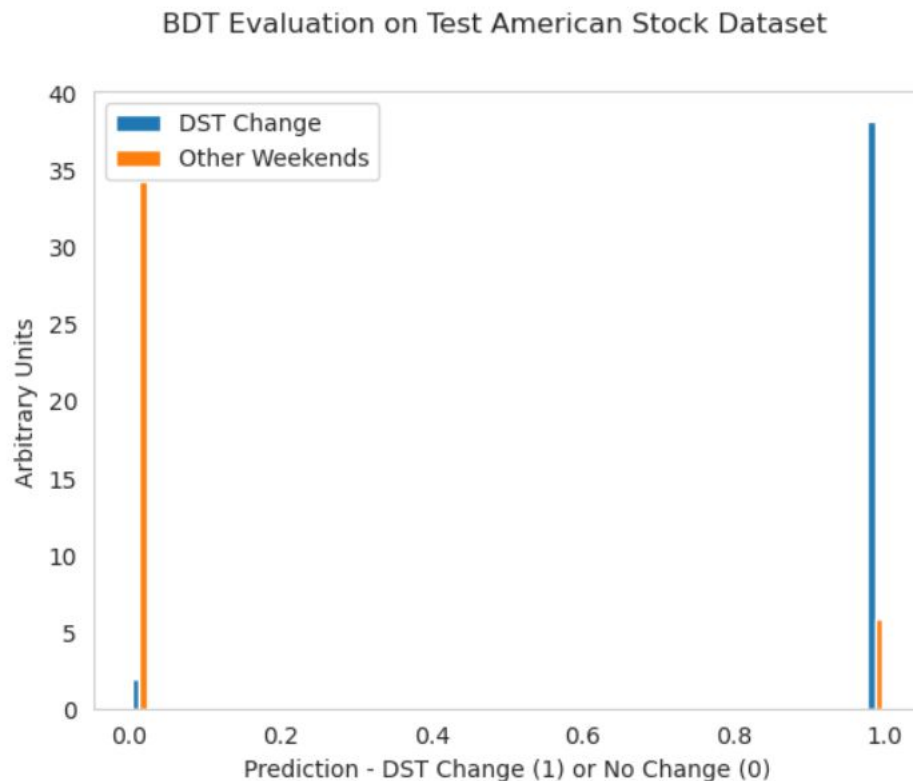


Classification as a Means of Demonstrating Distinction



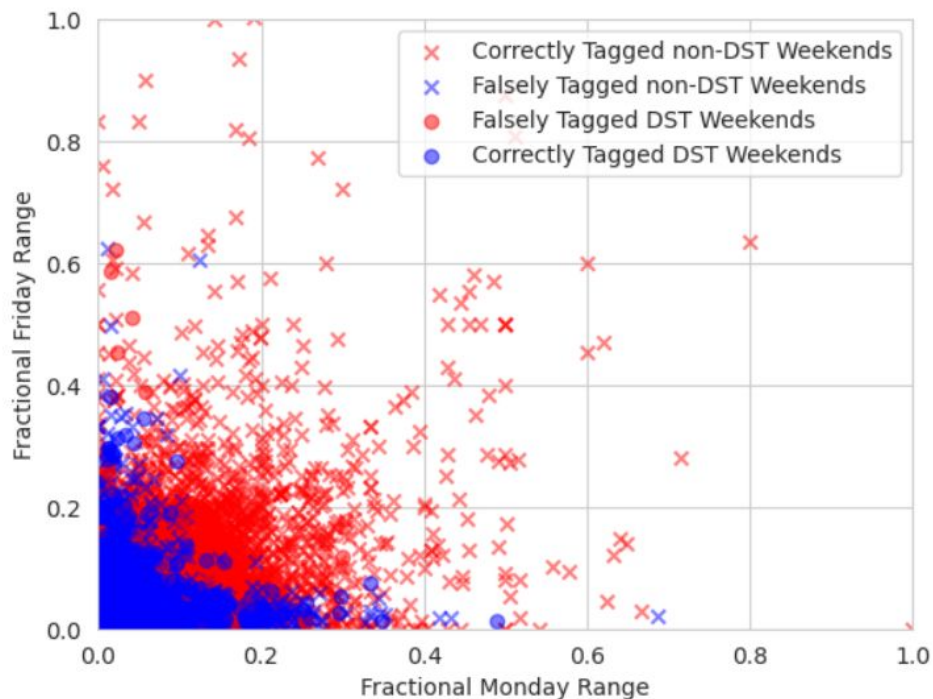
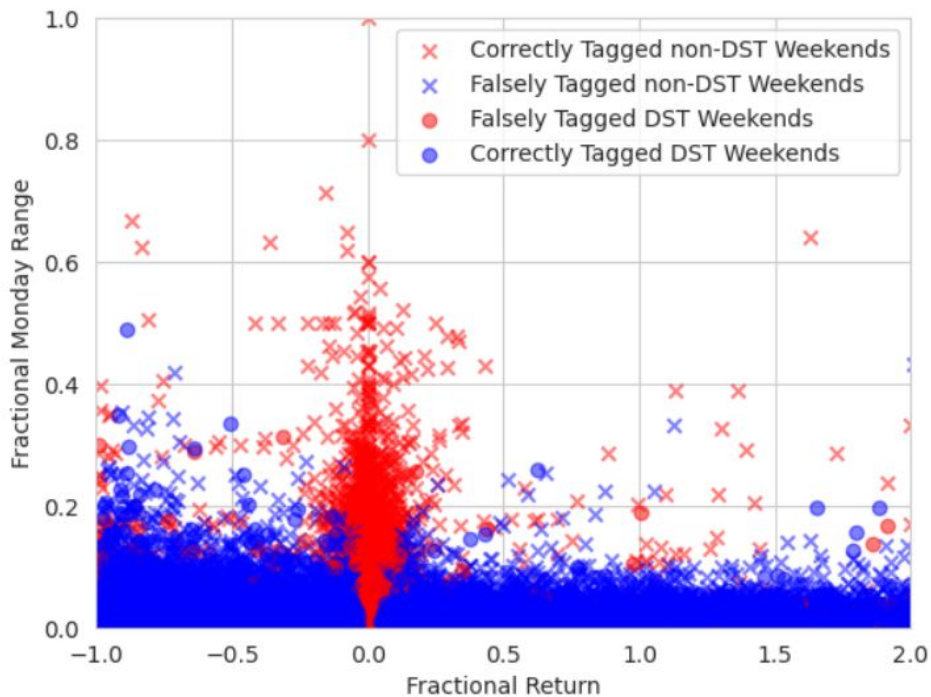
Boosted Decision Tree Classification Performance

- Evaluation on a subset of American Stock weekend data, points not seen in training
- Correct Classification Accuracy for DST-Change Weekends: **95%**
- Correct Classification Accuracy for non-Change Weekends: **85%**
- Far better than random!



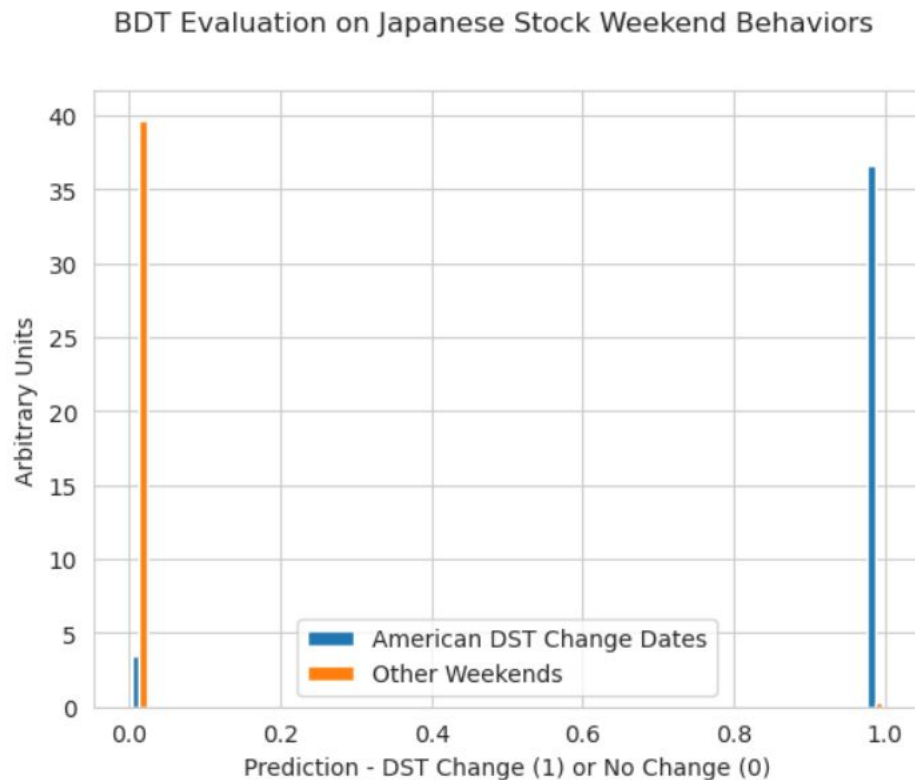
Distributions of Classifier Prediction for Input Features

Predicted DST Change Weekend (blue), Predicted no time change (red)



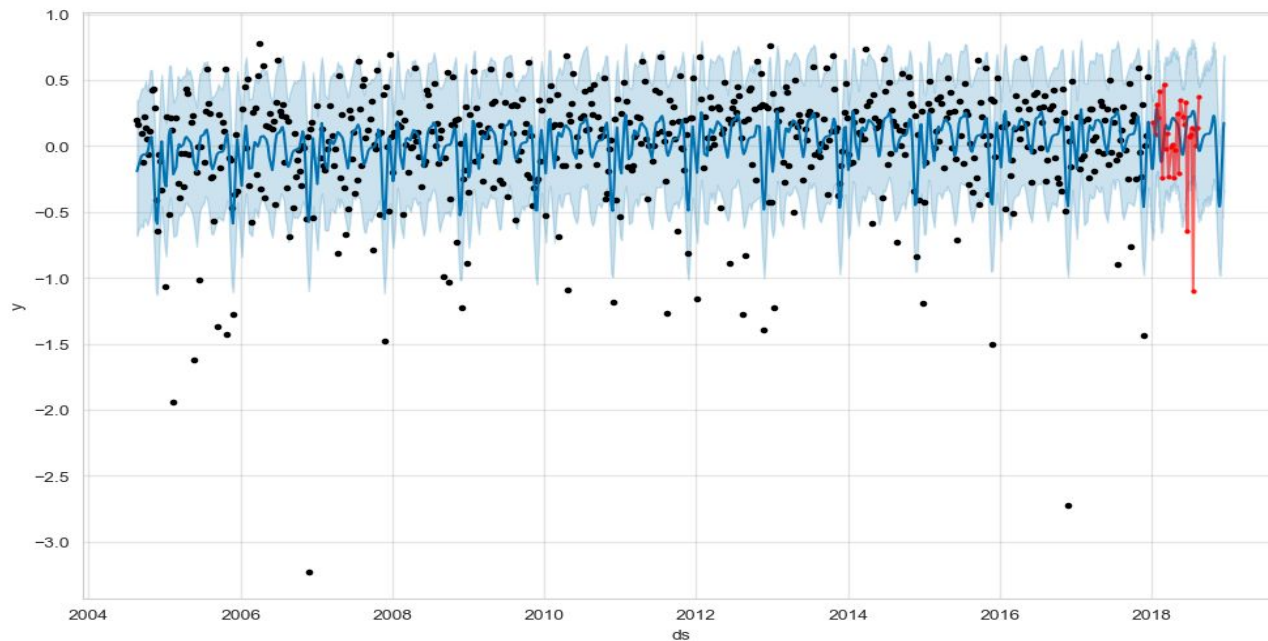
DST Effects on International Markets

- Evaluation of the BDT classifier on Japanese stocks demonstrates that the American time changes correlate with similarly identifiable features in the Japanese stock behavior.
- Accuracy of identifying Japanese stock weekends that align with American DST-change: **91%**
- Accuracy of classifying Japanese stock weekends that do not correspond with dates of the American DST-change: **99%**



Future Study

- Recommendations for market strategy utilizing stocks with significant DST effects
- CRSP dataset (need institutional access) has intraday data
- Forecasting with Prophet



Conclusion

- DST change impacts the market's return and volatility
- International markets are not entirely independent of DST effects
- Fall DST shifts demonstrate a higher average weekend return relative to other weekends
- Spring DST shifts demonstrate an increase in volatility, as measured by the range a stock takes over a day, relative to other weekends
- Individual stocks and composites are affected differently, allowing for a strategy to be developed around those stocks with higher DST effects

References

- Harrison, Y. (2013). The impact of daylight saving time on sleep and related behaviours. *Sleep medicine reviews, 17*(4), 285-292.
- Ferguson, S. A., Preusser, D. F., Lund, A. K., Zador, P. L., & Ulmer, R. G. (1995). Daylight saving time and motor vehicle crashes: the reduction in pedestrian and vehicle occupant fatalities. *American Journal of Public Health, 85*(1), 92-95.
- Kamstra, M. J., Kramer, L. A., & Levi, M. D. (2000). Losing sleep at the market: The daylight saving anomaly. *American Economic Review, 90*(4), 1005-1011.
- Berument, M. H., Dogan, N., & Onar, B. (2010). Effects of daylight savings time changes on stock market volatility. *Psychological Reports, 106*(2), 632-640.

Thank You!

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