Investigating the Lack of Relation Between NFL Fans' Sentiment and Team Performance

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Outline of Presentation

1. **Project Motivation & Modeling Approach**
2. **Data Acquisition**
3. **Analysis Plan & Justification**
4. **Tricky Analysis Decision**
5. **Results & Conclusions**
6. **Next Steps**
7. **References**
8. **Closing Slide**

Project Motivation & Modeling Approach

- The NFL is the highest profiting sports league in the U.S. and one of the largest industries worldwide, making it a top commercial business [1].
- Previous fan engagement research has emphasized the need to study the impact of positive vs negative emotions expressed by fans via social media with various sports teams [2].
    - **Goal**: Investigate whether the sentiments of NFL sports fans are related to the performance of NFL teams in the 2024 season.
    - **Modeling Approach**: Sentiment Analysis using Logistic Regression to predict whether a statistically significant relationship exists between fan sentiment and team performance.

Hypothesis: The sentiment of NFL fans' tweets about certain teams prior to them playing will have a statistically significant relationship with actual game outcomes.

Data Acquisition

Dataset Overview

- **Source:** NFL Twitter Sentiment Analysis dataset from Kaggle
- **Format:** Text data from Twitter (tweets)
- **Size:** 3,701 labeled tweets collected in Nov-Dec 2024

Data Collection & Ethics

- Data collected from publicly available tweets
- No repeated users, ensuring diverse perspectives
- **Teams**: Miami Dolphins, Denver Broncos, Indianapolis Colts, Cleveland Browns, New York Jets, Jacksonville Jaguars, Kansas City Chiefs, and the Detroit Lions.

Bias & Uncertainty Validation

- **Unique User Bias:** Each user contributes only one tweet, limiting sentiment tracking over time
- **Sentiment Classification Accuracy:** The model may misclassify tweets, especially those with sarcasm or nuanced language, thus misrepresenting fans' sentiment

Column Name	Description	Example Value
username	Social media account name of the post author	HireSamCassell
timestamp	Date and time when the post was published (UTC format)	2024-11-29T23:30:57.000Z
text	Raw content/message of the social media post	That's a Cleveland Browns type way to lose a game.
team	NFL team mentioned or referenced in the post	Cleveland Browns
sentiment	Classified emotional tone (positive, negative, neutral) of the post	negative
confidence	Model's certainty score (0-1) in its sentiment classification	0.69503664970398
roberta_raw_outputs	Raw probability scores [negative, neutral, positive] from RoBERTa model	[0.6950366497039795, 0.173924520611763, 0.13103878498077393]

Table 1: Data Dictionary

Analysis Plan & Justification

Analysis Pipeline

- Filtering tweets based on team mentions and sentiment categories
- Calculating average sentiment scores for each team before their game
- Predicted if pre-game sentiment is related to post-game outcomes

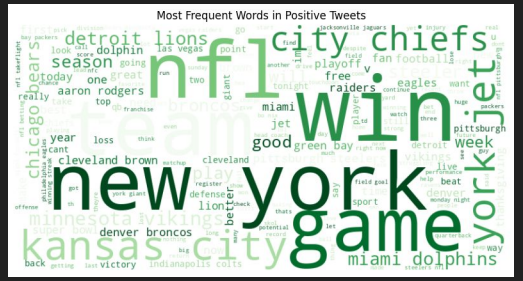

Figure 2: Positive Sentiment Word Cloud

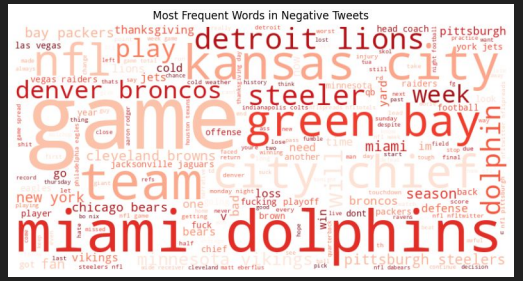

Figure 3: Negative Sentiment Word Cloud

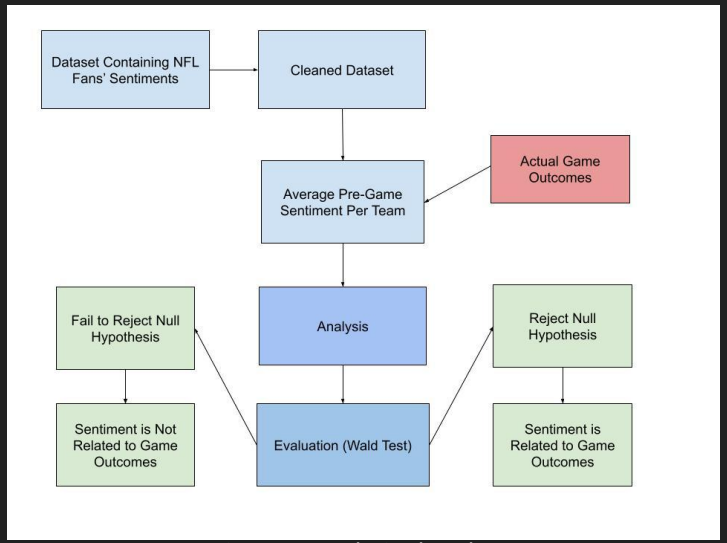

Figure 1: Analysis Flowchart

Challenges & Key Considerations

- Determining the timeframe of tweets to use for analysis
- Sentiment overlap in word analysis (e.g., "game" being both positive and negative)

Validation & Diagnostics

- EDA to check distributions and sentiment trends
- Logistic regression model validation [using p-values (cutoff at 0.05) to determine statistical significance of sentiment-game outcome relationships]

Tricky Analysis Decision

- Because the distribution of tweets over time was very spread out, we had to focus on a very specific range of time to be able to conduct a meaningful analysis
  - The majority of tweets were posted during Week 13 of the NFL season (Nov 28th), so we could only analyze posts occurring before those few games
  - The rest of the weeks did not have enough tweets across the different teams for each game, so we made the difficult decision to not include them as they would add noise to our averages

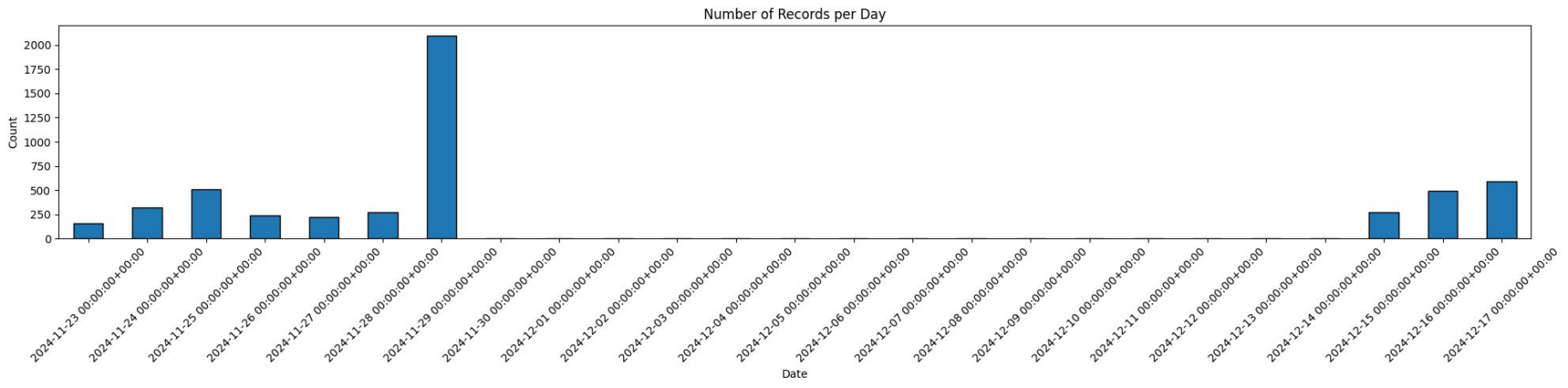

Figure 4: Histogram of Tweets Over Time

Results & Conclusions

- After conducting a logistic regression and performing a Wald test, we obtained a **p-value of 0.312**
  - This value is too high compared to our significance level of 0.05
  - Therefore we fail to reject the null hypothesis: **fan sentiment is not related to game outcomes**
- Results are confirmed by the following additional visualizations:
  - Since sentiment scores range all the way from 1 to -1, there clearly isn't a strong enough consistent relationship

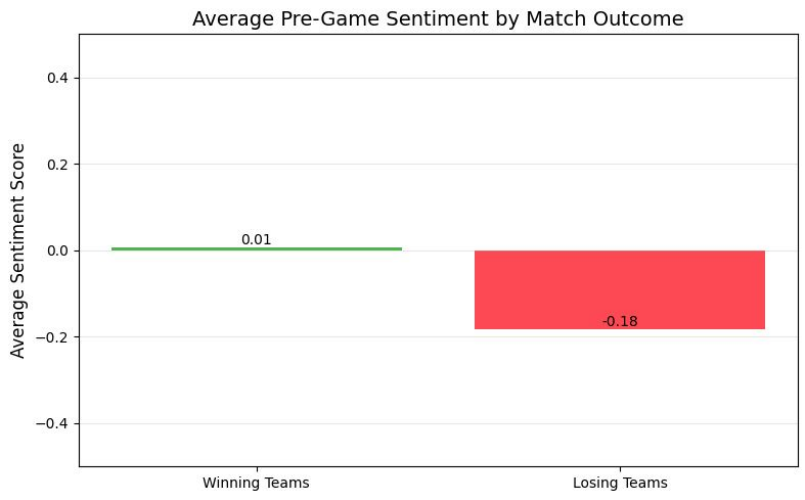

Figure 5: Average Pre-Game Sentiment by Match Outcome

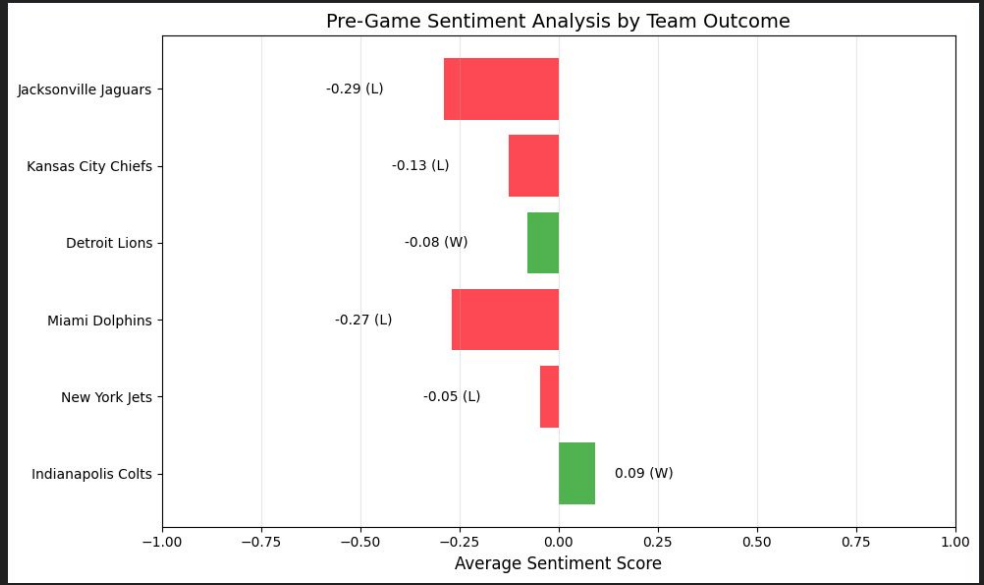

Figure 6: Pre-Game Sentiment Analysis by Team Outcome

Next Steps

1

- We would like to collect more data, as we only had around 2k tweets
- Constrained us to only be able to analyze games for 1 week
- Would be very challenging, as Twitter API is expensive

2

- Assuming we collected many more tweets, we would have sufficient data to analyze fan sentiment across multiple weeks/NFL games
- Would allow us to explore the data extensively by creating additional visualizations and a more accurate analysis for our research question

3

- Another interesting direction of analysis is investigating which specific words are correlated with winning/losing
- Could allow us to lead us to develop predictive models on whether or not teams would win or lose their game

References

[1] C. Gough. “Total revenue of the NFL 2001-2023.” *Statistica*. October, 2024. https://www.statista.com/statistics/193457/total-league-revenue-of-the-nfl-since-2005/.

[2] L. Vale, T. Fernandes. “Social media and sports: driving fan engagement with football clubs on Facebook.” *Journal of Strategic Marketing*, vol. 26, no. 1, pp. 37-55, 2017, July. doi:10.1080/0965254x.2017.1359655.

Most Frequent Words in Comments