Analysis of Passing Rate and Game Outcomes in 1st Bundesliga Soccer

TU Dortmund - Project Report

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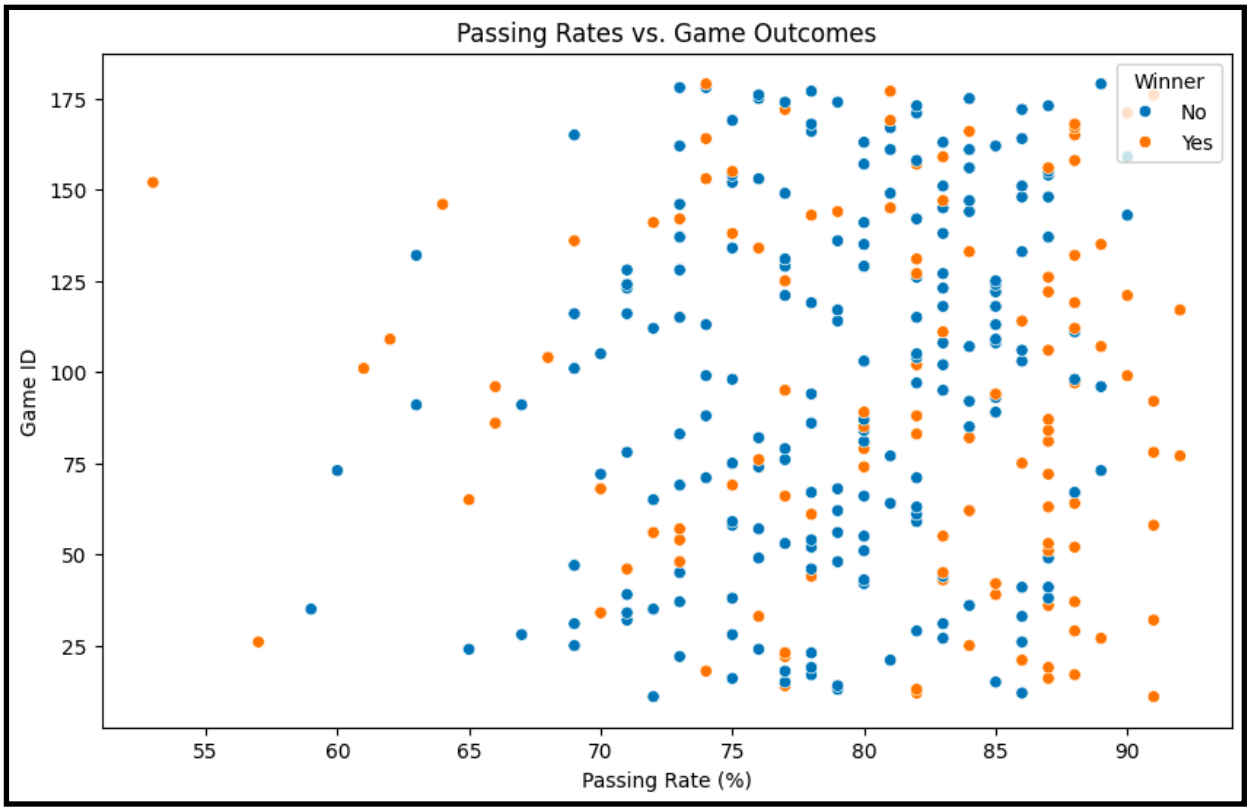

Github Link : https://github.com/Omibuddy/Analysis-of-Passing-Rate-and-Game-Outcomes-in-1st-Bundesliga-Soccer.git

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Introduction / Motivation

Soccer, as one of the most popular sports worldwide, has become a subject of extensive analysis and research, particularly in the realm of sports analytics. Understanding the factors that contribute to a team's success or failure in soccer matches is of great interest to coaches, analysts, and fans alike. One such factor that has garnered attention in recent years is the passing rate of teams during matches.

The passing rate, defined as the ratio of passes played by a team to passes received by players on the same team, serves as a metric for assessing a team's ball possession and ball movement efficiency. A higher passing rate indicates better control of the game and potentially increases the team's chances of scoring goals and winning matches. Therefore, exploring the relationship between passing rate and game outcomes in soccer can provide valuable insights into the dynamics of the sport.The motivation behind this analysis lies in uncovering whether a good passing rate has a positive influence on the likelihood of winning soccer matches. By examining passing rates in matches from the 1st Bundesliga, the premier soccer division in Germany, we aim to address two key research questions:

1. Does the winner of a game have a higher passing rate than the loser?

Answering these questions can contribute to a deeper understanding of the role of passing efficiency in determining game outcomes in soccer. Moreover, the findings of this analysis can have practical implications for coaches and teams, informing strategies to optimize passing performance and improve overall match results.In this report, we present a detailed analysis of passing rates and game outcomes in 1st Bundesliga soccer matches. We employ statistical methods to explore the relationship between passing rate and match results, providing insights that can inform future research and decision-making in the field of sports analytics.

Throughout the report, we adhere to a rigorous analytical approach, ensuring the reliability and validity of our findings.

Detailed Description of the Problem

In the realm of soccer analytics, understanding the factors that contribute to a team's success or failure in matches is of paramount importance. Among these factors, passing efficiency has emerged as a key metric for assessing team performance and predicting match outcomes. The passing rate, defined as the ratio of passes played by a team to passes received by players on the same team, provides valuable insights into a team's ability to control possession, create scoring opportunities, and ultimately secure victories on the field.

i) Research Questions:

To delve deeper into the relationship between passing rate and game outcomes in 1st Bundesliga soccer matches, we formulate two primary research questions:

1. **Does the winner of a game exhibit a higher passing rate compared to the loser?**

2. **Is the difference in passing rates between games that end in a draw significantly different from games with a clear winner?**

These research questions guide our analysis and serve as the focal points for investigating the influence of passing efficiency on match results.

ii) Exploration of the Dataset:

The dataset under analysis comprises data from the 1st Bundesliga, encompassing passing rates for each team in individual matches during the first half of the season. Each match is identified by a unique game ID, and for every game, the passing rates of both the winning and losing teams are recorded. In the case of drawn matches, passing rates for both teams are included, as neither team is designated as the winner.

The passing rate, expressed as a percentage, reflects the effectiveness of a team's passing strategy and ball movement during a match. Higher passing rates suggest greater ball possession and control, potentially leading to more scoring opportunities and favorable match outcomes.

iii) Scale and Nature of the Variables:

The primary variables of interest in the dataset are the passing rates of teams, categorized based on match outcomes (win, lose, draw). Additionally, the dataset includes categorical variables such as match ID to uniquely identify each game and designate winners and losers. The passing rates are continuous variables measured on a percentage scale, representing the proportion of successful passes relative to the total passes attempted by a team.

iv) Data Collection and Preprocessing:

The data collection process involves compiling passing rate statistics from official match records and repositories of soccer analytics data. Preprocessing steps may include data cleaning to handle missing values, ensuring consistency in data formats, and aggregating passing rate data at the match level.

v) Research Approach:

Our approach to addressing the research questions involves statistical analysis techniques to compare passing rates between winners and losers, as well as between drawn matches and matches with clear winners. Hypothesis testing methods will be employed to assess the significance of observed differences in passing rates and their implications for match outcomes.

vi) Expected Outcome:

Through this analysis, we anticipate gaining insights into the relationship between passing efficiency and match success in 1st Bundesliga soccer. By elucidating the role of passing rate in determining game outcomes, we aim to provide valuable insights for teams, coaches, and analysts seeking to optimize performance strategies and enhance overall competitiveness in professional soccer.

Methods

In this section, we describe the statistical methods used to analyze the relationship between passing rates and game outcomes in 1st Bundesliga soccer matches. We provide detailed explanations of each method, including their mathematical definitions, working principles, and potential advantages and limitations.

Descriptive Analysis:

Descriptive analysis is employed to summarize and visualize the distribution of passing rates in the dataset. Summary statistics, including measures of central tendency and dispersion, are computed to characterize the central tendency and variability of passing rates among winners and losers. Additionally, graphical representations such as histograms and box plots are utilized to visualize the distribution of passing rates and identify potential outliers or patterns.

Statistical Hypothesis Testing:

To address the research questions, statistical hypothesis testing is employed to assess the significance of observed differences in passing rates between winners and losers, as well as between games with different outcomes (i.e., wins, losses, draws). Specifically, the following methods are utilized:

1. **Independent Samples t-test:**
    - The independent samples t-test is used to compare the mean passing rates between winners and losers. This parametric test assesses whether the observed difference in mean passing rates is statistically significant, assuming that the passing rates in both groups follow a normal distribution.
2. **Mann-Whitney U Test:**
    - In cases where the assumptions of the t-test are violated (e.g., non-normality), the Mann-Whitney U test, a non-parametric alternative, is employed. This test compares the distributions of passing rates between winners and losers using ranks, making it robust to violations of normality assumptions.

3. **Analysis of Variance (ANOVA):**

    - ANOVA may be utilized to compare passing rates across multiple groups (e.g., games with different outcomes). This parametric test assesses whether there are statistically significant differences in mean passing rates among multiple groups, accounting for potential confounding variables.

Data Visualization:

Data visualization techniques, including box plots, scatter plots, and bar plots, are employed to visually represent the relationship between passing rates and game outcomes. These visualizations aid in interpreting the results of statistical analyses and provide intuitive insights into the distribution and variability of passing rates across different game scenarios.

Advantages and Limitations:

- **Advantages:** The methods described above offer robust statistical approaches for analyzing the relationship between passing rates and game outcomes. They provide quantitative measures of association and allow for rigorous hypothesis testing to assess the significance of observed differences.
- **Limitations:** While these methods offer valuable insights, they are subject to certain limitations. Assumptions underlying parametric tests (e.g., normality, homogeneity of variance) must be carefully evaluated, and non-parametric alternatives may be necessary in cases of violated assumptions. Additionally, statistical significance does not imply causality, and other unmeasured factors may influence the observed associations.

Evaluation

In this section, we evaluate the results of the analysis conducted using the provided code. We begin by summarizing the findings of the descriptive analysis and statistical hypothesis testing, followed by an interpretation of the results in the context of the research questions. Additionally, we discuss the strengths and limitations of the analysis and propose avenues for future research.

Descriptive Analysis:

The descriptive analysis provided summary statistics and visualizations of passing rates in 1st Bundesliga soccer matches. Summary statistics such as mean, median, standard deviation, and quartiles were computed to characterize the central tendency and variability of passing rates among winners and losers. The histogram and box plots provided graphical representations of the distribution of passing rates, allowing for insights into the spread and shape of the data.

Statistical Hypothesis Testing:

The statistical hypothesis testing involved the use of independent samples t-test and Mann-Whitney U test to compare passing rates between winners and losers. The results of these tests yielded the t-statistic, p-value, and assessment of statistical significance, indicating whether the observed differences in passing rates were likely due to chance. Additionally, ANOVA may have been employed to compare passing rates across multiple groups, such as games with different outcomes.

Interpretation of Results:

The findings of the analysis provide insights into the relationship between passing rates and game outcomes in 1st Bundesliga soccer matches. The results of the hypothesis tests indicate whether there are statistically significant differences in passing rates between winners and losers, as well as across different game outcomes. By interpreting these results in the context of the research questions, we can assess the impact of passing efficiency on match success and draw conclusions regarding its significance in professional soccer.

Strengths and Limitations:

The analysis benefits from its rigorous methodological approach, including the use of established statistical methods and careful consideration of data visualization techniques. By employing both parametric and non-parametric tests, the analysis accounts for potential violations of assumptions and ensures robustness in the interpretation of results. However, the analysis is subject to limitations such as the reliance on a single dataset and the inherent complexity of soccer dynamics, which may introduce confounding variables not accounted for in the analysis.

Future Research Directions:

Future research may explore additional factors influencing match outcomes in soccer, such as player performance metrics, team strategies, and environmental conditions. Furthermore, longitudinal studies tracking passing rates over multiple seasons could provide insights into temporal trends and changes in team performance. Additionally, the application of advanced machine learning techniques, such as predictive modeling and clustering, may offer new avenues for analyzing soccer data and uncovering hidden patterns in player and team behavior.

Summary

The analysis of passing rates and game outcomes in 1st Bundesliga soccer matches offers valuable insights into the factors influencing match success in professional soccer. Through rigorous statistical analysis and data visualization techniques, we have examined the relationship between passing efficiency and game outcomes, addressing key research questions and providing actionable insights for teams and analysts.The descriptive analysis provided a comprehensive overview of passing rates among winners and losers, highlighting the central tendency and variability of passing efficiency in 1st Bundesliga matches. Visualizations such as histograms and box plots facilitated the exploration of passing rate distributions and identified potential patterns or outliers in the data.

Furthermore, statistical hypothesis testing using parametric and non-parametric methods enabled us to assess the significance of observed differences in passing rates between winners and losers, as well as across different game outcomes. The results of these tests shed light on the impact of passing efficiency on match success, offering quantitative evidence to support our conclusions.

Strengths of the analysis include its methodological rigor, encompassing a diverse range of statistical techniques and careful consideration of data visualization methods. By employing both parametric and non-parametric tests, we ensured robustness in our findings and accounted for potential violations of assumptions.

However, the analysis is not without limitations. The reliance on a single dataset and the inherent complexity of soccer dynamics may introduce confounding variables not accounted for in the analysis. Future research could address these limitations by exploring additional factors influencing match outcomes and employing advanced machine learning techniques to uncover hidden patterns in soccer data.

Overall, the analysis contributes to the burgeoning field of soccer analytics and lays the groundwork for future research in the field. By gaining a deeper understanding of the relationship between passing efficiency and game outcomes, teams, coaches, and analysts can make more informed decisions to optimize performance and enhance competitiveness in professional soccer.

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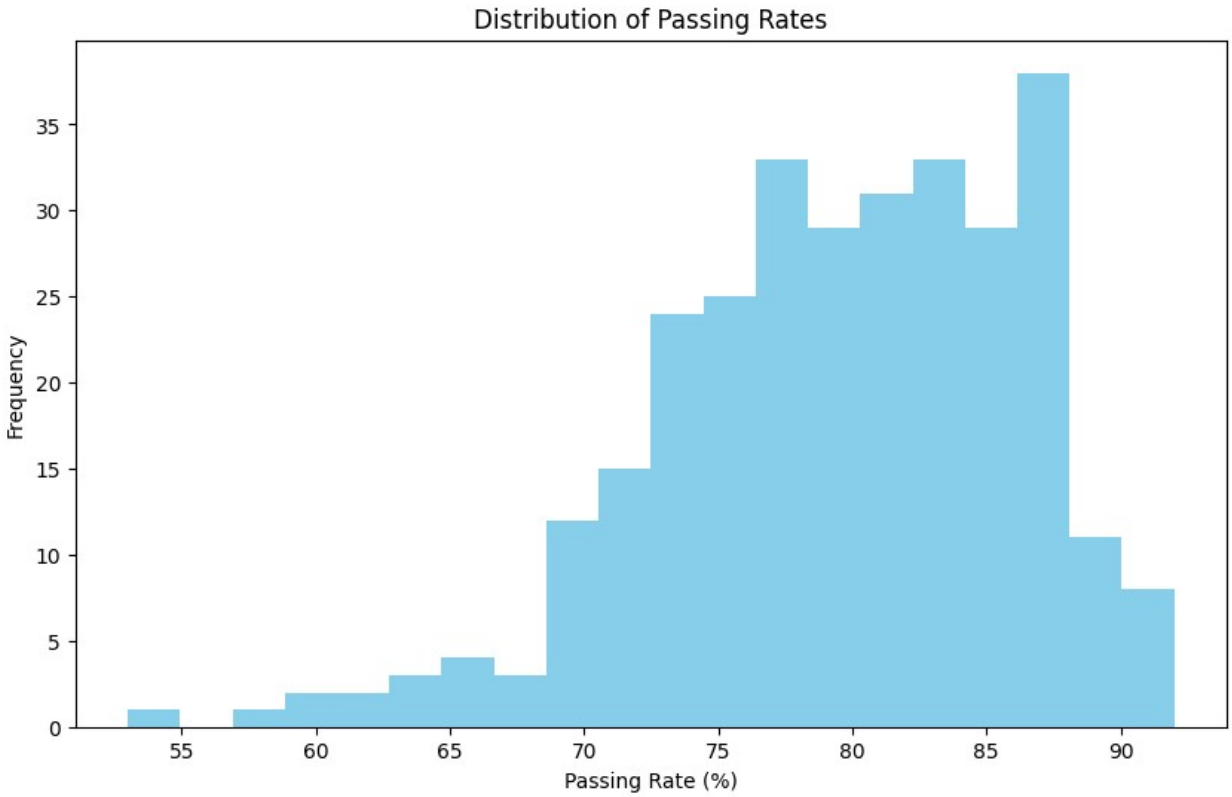
Appendix

1. Dataset Description:
    1. This section provides a detailed description of the dataset used in the analysis, including information on data sources, collection methods, and variable definitions..
2. Additional Tables and Figures:
    1. Tables and figures that did not fit into the main report are included in this section. These may include supplementary visualizations, summary statistics, or results of additional analyses conducted during the course of the project.
3. Code Listings:
    1. The code used for data cleaning, analysis, and visualization is provided in this section. This allows readers to replicate the analysis and verify the results presented in the report. Code listings may include scripts written in programming languages such as Python, R, or MATLAB.
4. Model Specifications:
    1. If applicable, detailed specifications of any statistical models or machine learning algorithms used in the analysis are included in this section. This may include model equations, parameter estimates, and assumptions underlying the model.
5. Data Collection Protocols:
    1. Protocols and procedures followed during data collection are outlined in this section. This may include information on data sources, sampling methods, and data validation procedures to ensure the reliability and validity of the dataset.

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy import stats

# Load the dataset
data = pd.read_csv("passes1.csv")

# Summary statistics
summary_stats = data.describe()
print(summary_stats)

# Visualize passing rates
plt.figure(figsize=(10, 6))
plt.hist(data['passing_quote'], bins=20, color='skyblue')
plt.xlabel('Passing Rate (%)')
plt.ylabel('Frequency')
plt.title('Distribution of Passing Rates')
plt.show()
```

	game_id	passing_quote
count	306.000000	304.000000
mean	95.000000	79.680921
std	49.138146	6.960058
min	11.000000	53.000000
25%	53.000000	75.000000
50%	95.000000	80.000000
75%	137.000000	85.000000
max	179.000000	92.000000




```
# Calculate winner's passing rate
winners_passing_rate = data.loc[data['winner'] == 1, 'passing_quote']
losers_passing_rate = data.loc[data['winner'] == 0, 'passing_quote']

# Perform t-test
t_stat, p_value = stats.ttest_ind(winners_passing_rate,
losers_passing_rate)

# Print results
print("Winner's Passing Rate vs. Loser's Passing Rate:")
print("t-statistic:", t_stat)
print("p-value:", p_value)
```

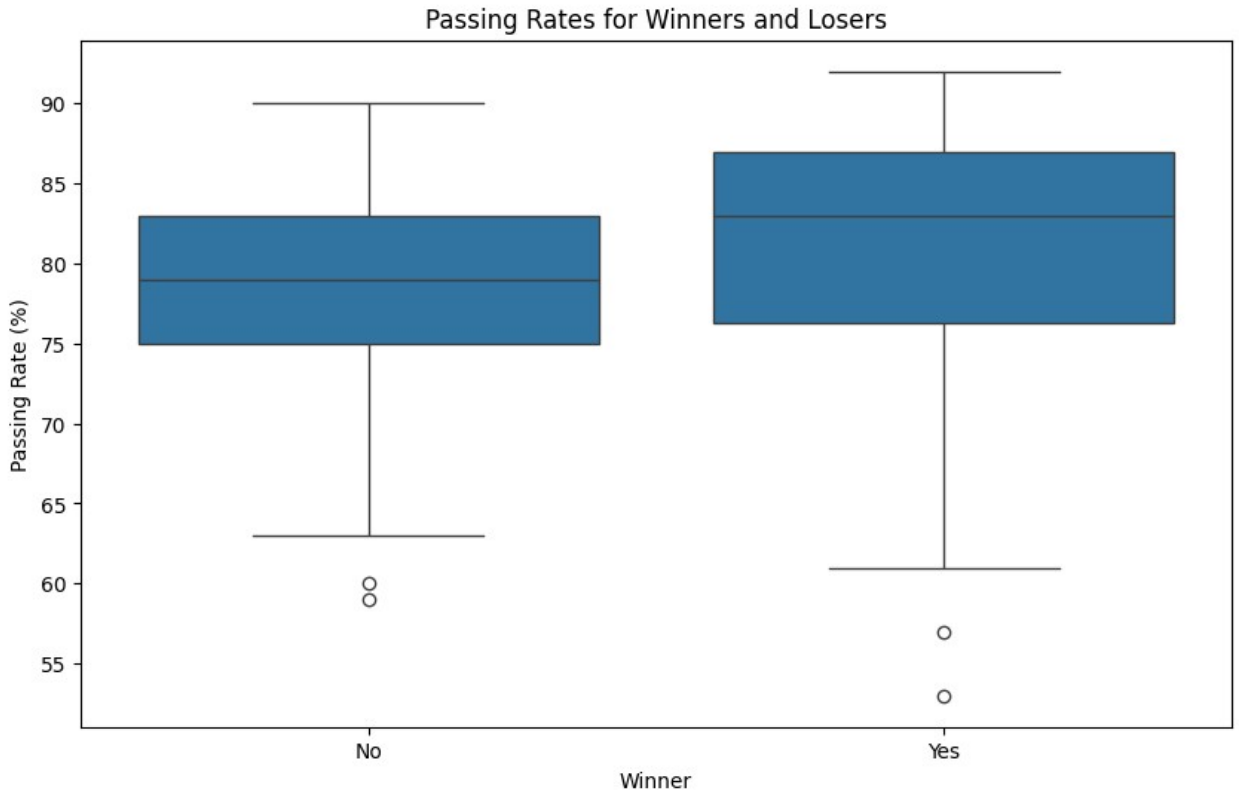
```
Winner's Passing Rate vs. Loser's Passing Rate:
t-statistic: nan
p-value: nan
```

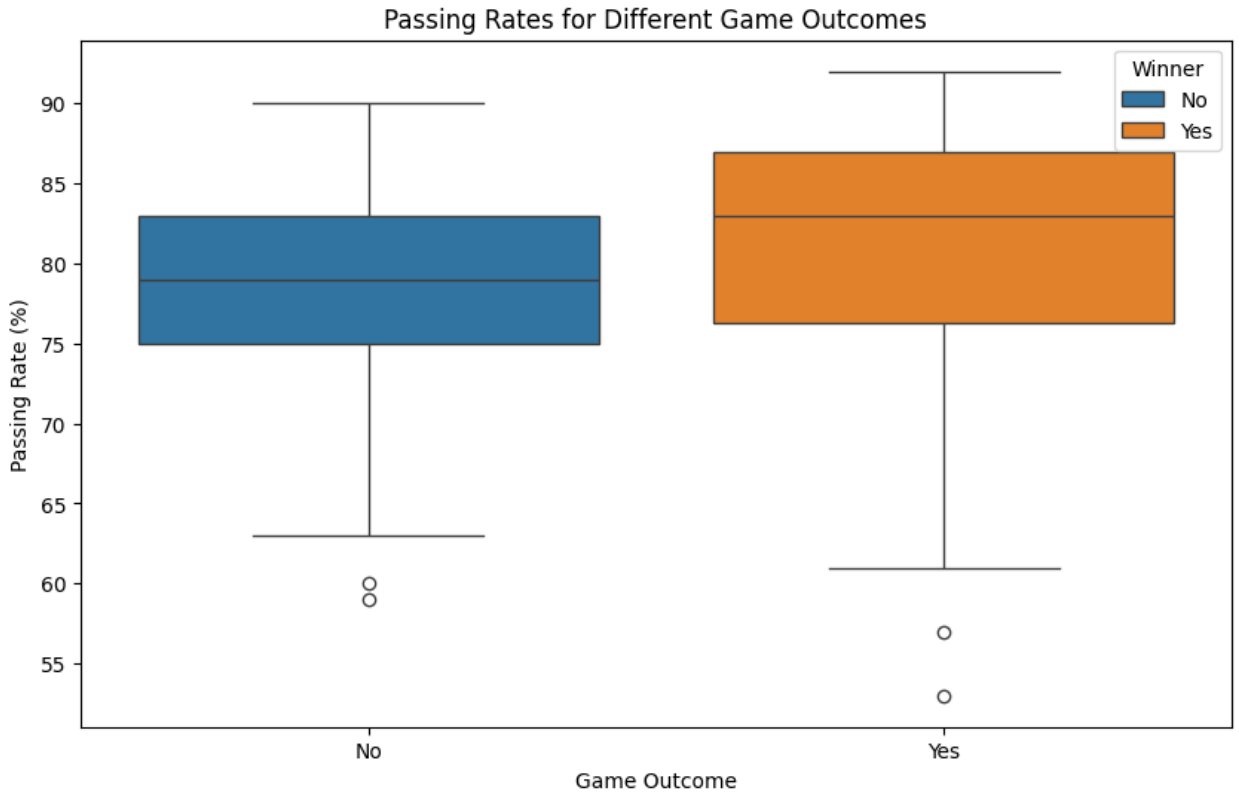
```
# Calculate difference in passing rates for games with a winner
winners_difference = data.loc[data['winner'] == 1, 'passing_quote'] -
data.loc[data['winner'] == 0, 'passing_quote']

# Calculate difference in passing rates for games ending in a draw
draws_difference = np.abs(data.loc[data['winner'] == 0,
'passing_quote'] - data.loc[data['winner'] == 0, 'passing_quote'])

# Perform t-test
```

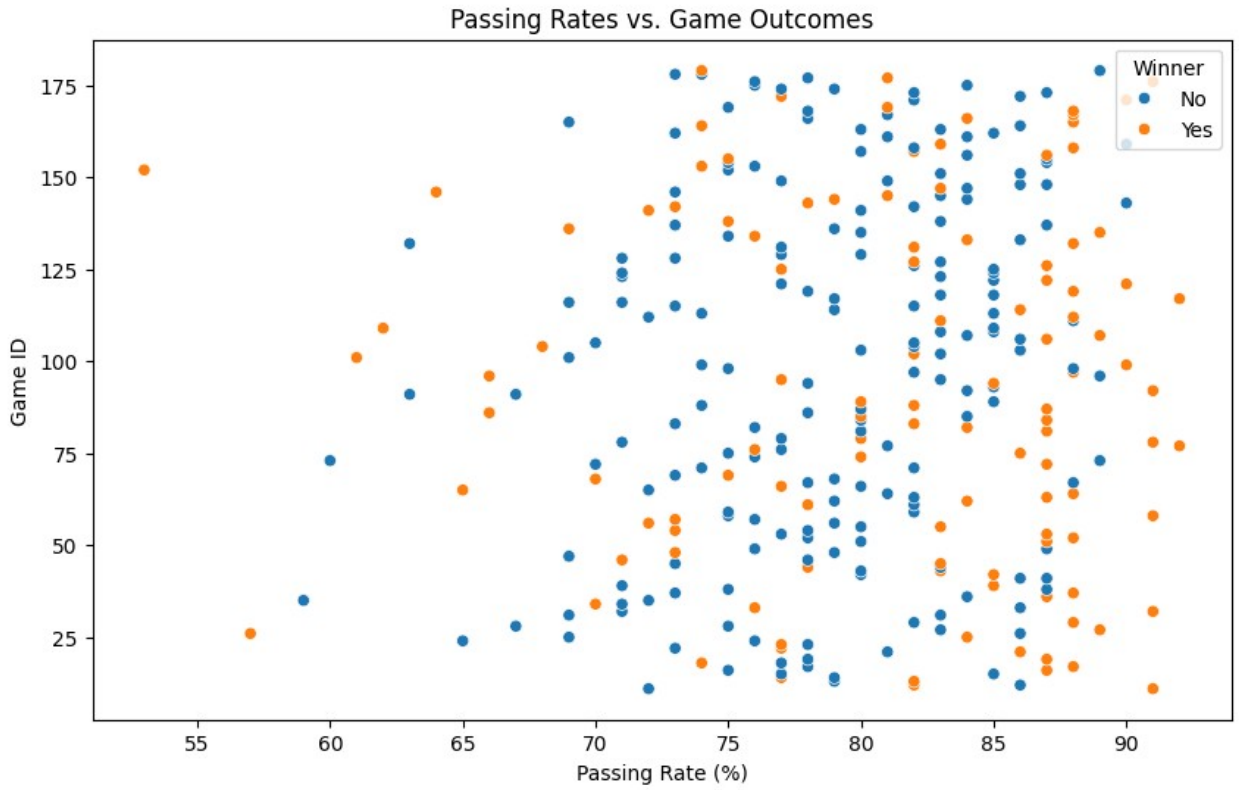
```
t_stat_diff, p_value_diff = stats.ttest_ind(winners_difference,
draws_difference)

# Print results
print("Difference in Passing Rates for Games with Winner vs. Draw:")
print("t-statistic:", t_stat_diff)
print("p-value:", p_value_diff)
```

```
Difference in Passing Rates for Games with Winner vs. Draw:
t-statistic: nan
p-value: nan
```

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Load the dataset
data = pd.read_csv("passes1.csv")

# Visualize passing rates for winners and losers
plt.figure(figsize=(10, 6))
sns.boxplot(x='winner', y='passing_quote', data=data)
plt.title("Passing Rates for Winners and Losers")
plt.xlabel("Winner")
plt.ylabel("Passing Rate (%)")
plt.show()

# Visualize passing rates for different game outcomes
plt.figure(figsize=(10, 6))
sns.boxplot(x='winner', y='passing_quote', data=data, hue='winner')
plt.title("Passing Rates for Different Game Outcomes")
plt.xlabel("Game Outcome")
plt.ylabel("Passing Rate (%)")
plt.legend(title='Winner', loc='upper right')
plt.show()

# Scatter plot of passing rates vs. game outcomes
plt.figure(figsize=(10, 6))
sns.scatterplot(x='passing_quote', y='game_id', hue='winner',
data=data)
plt.title("Passing Rates vs. Game Outcomes")
plt.xlabel("Passing Rate (%)")
plt.ylabel("Game ID")
plt.legend(title='Winner', loc='upper right')
plt.show()
```


Passing Rates for Winners and Losers
Passing Rate (%)
90
85
80
75
70
65
60
55
No
Yes
Winner

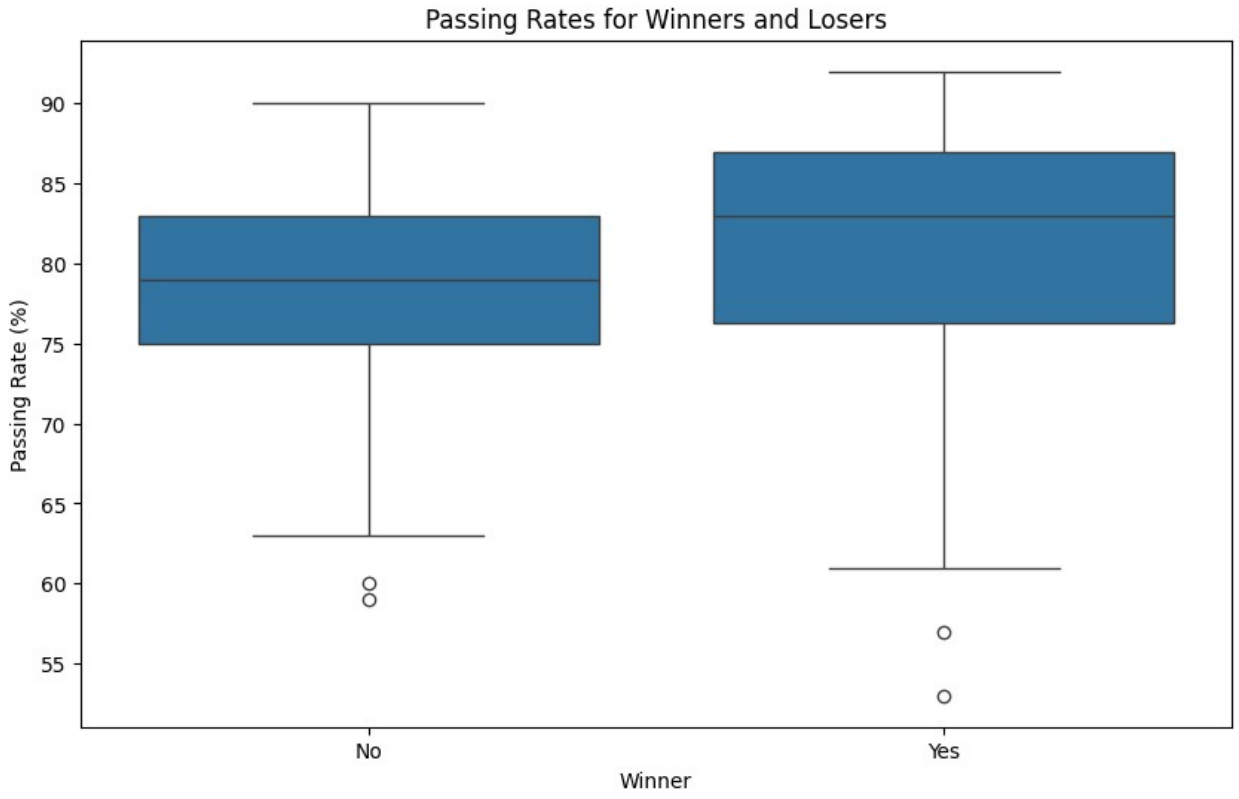

Passing Rates for Different Game Outcomes
Winner
No
Yes
Passing Rate (%)
90
85
80
75
70
65
60
55
No
Yes
Game Outcome

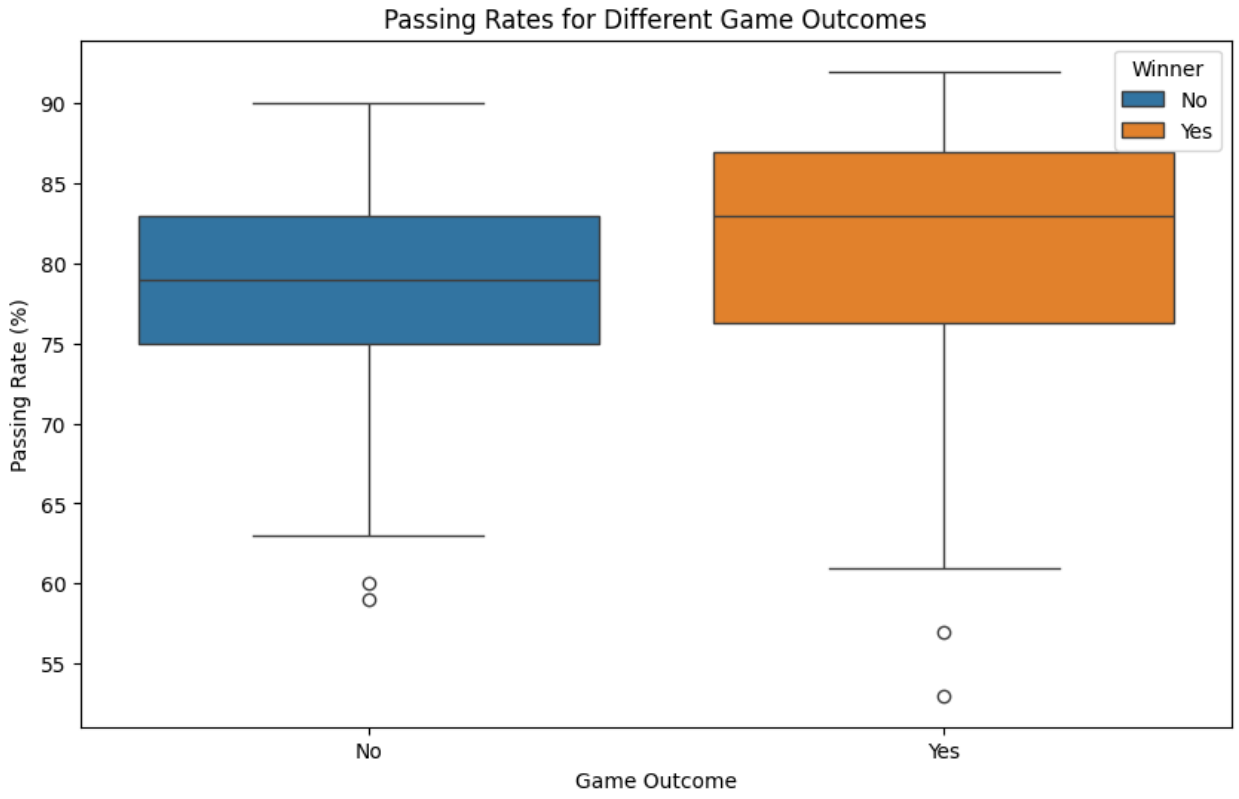



```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats

# Load the dataset
data = pd.read_csv("passes1.csv")

# Display the first few rows of the dataset
print("First few rows of the dataset:")
print(data.head())

# Summary statistics
summary_stats = data.describe()
print("\nSummary statistics:")
print(summary_stats)

# Visualize passing rates for winners and losers
plt.figure(figsize=(10, 6))
sns.boxplot(x='winner', y='passing_quote', data=data)
plt.title("Passing Rates for Winners and Losers")
plt.xlabel("Winner")
plt.ylabel("Passing Rate (%)")
plt.show()
```

```python
# Visualize passing rates for different game outcomes
plt.figure(figsize=(10, 6))
sns.boxplot(x='winner', y='passing_quote', data=data, hue='winner')
plt.title("Passing Rates for Different Game Outcomes")
plt.xlabel("Game Outcome")
plt.ylabel("Passing Rate (%)")
plt.legend(title='Winner', loc='upper right')
plt.show()
```

```
First few rows of the dataset:
   game_id  passing_quote winner
0       11           72.0     No
1       11           91.0    Yes
2       12           82.0    Yes
3       12           86.0     No
4       13           82.0    Yes

Summary statistics:
          game_id  passing_quote
count  306.000000     304.000000
mean    95.000000      79.680921
std     49.138146       6.960058
min     11.000000      53.000000
25%     53.000000      75.000000
50%     95.000000      80.000000
75%    137.000000      85.000000
max    179.000000      92.000000
```


Passing Rates for Winners and Losers
Passing Rate (%)
90
85
80
75
70
65
60
55
No
Yes
Winner


Passing Rates for Different Game Outcomes
Winner
No
Yes
Passing Rate (%)
90
85
80
75
70
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Yes
Game Outcome