DSA 210 Term Project

**NBA TEAM PERFORMANCE ANALYSIS**

Assist/Turnover Ratio as a Predictor of Success

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**WHAT'S IN THIS REPORT?**

This report investigates the statistical and predictive relationship between NBA teams' Assist/Turnover Ratio (AST/TO) and two key team performance metrics: Win Percentage and Points Per Game (PPG). Utilizing both regular season and playoff data from 2000 to 2021 and 2023 ( different time spans between playoffs and regular season data sets ) , we apply statistical hypothesis testing, correlation analysis, and machine learning regression to evaluate whether assist/ turnover ratio as known as ball movement efficiency can explain or predict success in professional basketball.

In the NBA Playoffs there are less and better teams because of that I wanted to compare regular season and playoffs season data as these more focused and better playing teams can have different strategies through regular season and playoffs. Additionally as we have learned lessons evaluating more data creates a less chance related results especially in the machine learning status.

**The study is structured around five key stages:**  
1. Exploratory Data Analysis (EDA)  
2. Understanding the Data & Hypothesis Testing  
3. Visualizing the Data  
4. Statistical Data Analysis  
5. Machine Learning Modeling

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**INTRODUCTION**

The aim of this study is to examine if a team’s ball movement efficiency (AST/TO) influences how many points they score and how often they win. Two different datasets were utilized:

- Regular Season (2000–2023)  
- Playoffs (2000–2021)

We hypothesize that higher AST/TO ratios should correspond to better offensive production (higher PPG) and possibly more victories (Win%). Through correlation and regression analysis, this report uncovers how strongly these relationships exist and whether AST/TO alone can serve as a predictor of team success.

So we want to find weather teams should prioritize and invest in this area in order to achieve more wins and become more successful.

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1. EXPLORATORY DATA ANALYSIS (EDA)

EDA was used to gain an overview of the data and its descriptive properties. Key findings:  
- Regular season teams averaged 23–25 assists, while playoff teams averaged ~20 assists.  
- Turnovers remained stable at 13–14 per game.  
- Scoring was higher in the regular season (~110 PPG) than playoffs (~97 PPG).  
- Win percentages were more variable in the regular season; playoff teams already had higher win rates by default.

Initial conclusion: Teams experience a slight drop in assist numbers and scoring in the playoffs, though turnover rates stay nearly stable. This reinforces AST/TO’s importance as a potential performance indicator.

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1. UNDERSTANDING THE DATA & HYPOTHESIS TESTING

Research Question:  
Is there a statistically significant relationship between a team’s AST/TO ratio and their performance (PPG or Win%)?

Hypotheses:  
- H₀ (Null): No relationship exists between AST/TO and PPG or Win%.  
- H₁ (Alternative): AST/TO is related to the considered performance metrics.

Test Applied:

Pearson correlation was calculated:  
- AST/TO vs PPG: r = 0.670, p < 0.001 → Strong positive relationship  
- AST/TO vs Win%: r = 0.247, p = 0.152 → Weak and statistically insignificant

Interpretation: AST/TO correlates with scoring but does not guarantee wins. Other performance factors matter more in the playoffs (e.g., defense, rebounding, pace).

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1. VISUALIZING THE DATA

Two datasets (regular season and playoffs) were visualized using Python (Matplotlib & Seaborn):

- AST/TO Bar Graph per team  
- Line Plots of Points Per Game and Win %

A graph with green and blue lines

Description automatically generated *The graph shows regular season AST/TO ratio compared to Points and Win Percentage*

A graph of a graph with different colored lines

Description automatically generated with medium confidence*The graph shows playoffs AST/TO ratio compared to Points and Win Percentage*

These visuals confirmed earlier findings:

- Strong trend: high AST/TO = higher scoring  
- Weak/unclear trend: high AST/TO ≠ higher win %

Visual inconsistencies in Win % support the hypothesis that multiple factors impact team success beyond assist efficiency.

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1. DATA ANALYSIS RESULTS

From statistical testing:  
- For PPG, null hypothesis was rejected → statistically significant  
- For Win%, null hypothesis failed to be rejected → not statistically significant

Additional observations:  
- Some high AST/TO teams had low Win %, and vice versa  
- Indicates other elements such as defense, clutch-time performance, or opponent strength may override assist-based efficiency

Conclusion: AST/TO is useful but insufficient for predicting overall success.

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1. MACHINE LEARNING RESULTS

Two linear regression models and heat maps were built and calculated the results combining the scores acquired from both playoffs and regular season data sets.:

Model 1: Predicting Points Per Game - Regular Season and Playoffs

A graph with a red line

Description automatically generated *The graph shows Regular Season AST/TO vs PPG scatter plot predictions vs real values*

A graph with a red line

Description automatically generated *The graph shows Playoffs AST/TO vs PPG scatter plot predictions vs real values*

By combining these two evolutions it is found for PPG vs *AST/TO* :

- R² Score: 0.33  
- Coefficient: +2305 → ~28 PPG increase per +1 AST/TO  
- p-value: < 0.001  
- Conclusion: AST/TO is a good predictor of scoring

Model 2: Predicting Win Percentage – Regular Season and Playoffs

A graph with red squares and a red line

Description automatically generated *The graph shows Regular Season AST/TO vs Win% scatter plot prediction vs real values and heat map combining PPG*

*A graph with red squares and a red and orange dotted line

Description automatically generated with medium confidence The graph shows Playoffs AST/TO vs Win% scatter plot prediction vs real values and heat map combining PPG*

By combining these two evaluations it is found for win % vs *AST/TO* :

- R² Score: 0.08  
- Coefficient: +0.089  
- p-value: 0.023  
- Conclusion: AST/TO is a weak predictor of winning

Machine Learning Insights:  
- Even though we have used two datasets in both AST/TO predicts offensive production but not team success  
- Winning is influenced by multi-dimensional factors (e.g., defense, rebounding, coaching)

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1. CONCLUSION & INSIGHTS

Key Takeaways:  
- AST/TO ratio = strong offensive indicator   
- Weak predictor of win % on its own

Both evaluation found considering whole season ( regular and playoffs)

Limitations:  
- AST/TO doesn’t include defensive metrics so to correlate win % it is not enough by it self  
- Model limited to team-level data (not player-level)

Future Recommendations:  
This project was showed that prioritizing only one offensive metric isn’t enough for winning. Maybe for future combine this AST / TO ratio with a defensive metric like rebounds per game or steals per game we can find correlations with win percentage as winning more games is the ultimate goal for this sport.

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8. FINAL WORDS

This project provided a structured analytical foundation for exploring how ball movement contributes to team success in the NBA. The findings showed that while assist efficiency ( the ratio we used ) drives offensive strength, it is not enough to explain or predict winning.

As I mentioned earlier basketball is a dynamic game with many contributing factors to victory—defensive effort, opponent strength, and situational pressure all interact with ball movement. Thus, while AST/TO is a valuable metric for coaching and scouting as it strongly increases teams offensive strength, a holistic approach remains essential.

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