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The effects of travel distance on MLB performance

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Title: The Effects of Travel Distance on MLB Performance

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Abstract:

Each Major League Baseball (MLB) team travels 40,000 to 50,000 miles annually across the regular season, post-season, and spring training. This research analyzes the relationship between travel logistics and team success. Utilizing ten years of Retrosheet game logs (2014-2023) cross-referenced with MLB stadium coordinates, we performed a series of statistical analyses to evaluate the impact of travel fatigue on game performance in Major League Baseball.

To ensure a balanced comparison, we initially analyzed competitive subsets (Top 10 vs. Top 10 and Top 10 vs. Bottom 10 teams). While a slight positive correlation between away-team travel distance and home-team win percentage was found, these results were not statistically significant. Additionally, sensitivity analyses excluding short-distance travel (under 300, 600 and 900 miles) yielded weak negative correlations ($r=-0.046$ to -0.058), suggesting travel distance alone has a limited impact on performance. However, testing for “travel shock,” revealed a distinct “U-shaped” adaptation curve: team performance drops by 7% during initial travel moves but recovers as teams adapt to prolonged road trips. Mode of transportation also proved critical; teams utilizing jet travel (trips >200 miles) outperformed those using regional bus travel by 2.3% ($p=0.024$). These results suggest that for elite athletes, travel modality and schedule stability are more vital to success than rest alone. This study provides a framework for optimizing professional and collegiate schedules to enhance athlete resilience and organizational performance.

Keywords: Major League Baseball, travel fatigue, sports analytics, athlete performance

I. Introduction

Major League Baseball teams play 162 games in their regular season. This is longer than any other professional sports season in the United States. In tandem to so many games is extensive travel all over the nation. When combining Spring Training, the regular season, and the post-season play, the average MLB team travels 40,000 to 50,000 miles in a given year. This warrants the question: To what extent does travel-related fatigue impact win probability in Major League Baseball (MLB)?

While the grueling 162-game schedule and constant travel from place-to-place creates a measurable “travel shock,” the long-term effects of travel-related fatigue are effectively neutralized by professional logistics and recovery protocols. Our statistical analyses suggest that while performance dips during initial road moves, the “Jet Advantage” and elite resources ensure that team talent is the primary determinant of success in a competition.

II. Literature Review & Background

i. Context (Importance of Travel/Jet Lag Factors)

Research regarding the effects of long travel distance on athletes has been widely studied; however, research specifically focused on the measurement and management of travel fatigue and jet advantage remains limited (Janse van Rensburg et al., 2021). Travel is a significant factor in professional sports, especially baseball, where athletes are required to compete in different locations and time zones with inadequate time to recover (Janse van Rensburg et al., 2021). Studies have shown that long haul travel and jet lag can produce wide-ranging effects due to disruptions in circadian rhythm, autonomic function, hormonal balance, sleep patterns, and overall physiological functioning (Benito et al., 2026). These disruptions can then lead to impacts on performance, illness risk, and injury risk on athletes (Janse van Rensburg et al., 2021). In addition, these factors can impair multiple aspects of athlete performance, including endurance, strength, speed, coordination and sport-specific skills (Benito et al., 2026). Furthermore, long haul travel has been associated with hormonal imbalance, reduced recovery, and decreased readiness to compete, which may contribute to decline in performance metrics across various sports (Benito et al., 2026). However, some studies report mixed or insignificant effects, suggesting that the relationship between travel and performance is not entirely consistent (Benito et al., 2026). These inconsistent findings highlight a gap in existing literature and suggest the need for further investigation into the relationship between travel and athletic performance particularly within professional baseball contexts.

ii. Effect on Performance by Travel

Previous research suggests that overall, total season mileage rarely results in a consistent performance decline for most Major League Baseball teams. A study was conducted over four seasons (2019-2022) to observe how teams are able to adjust to travel demands. The findings proposed that while most teams are able to adapt to travel and prevent on-road conditions from affecting their performance, there are a few exceptions. For example, in 2020, a unique pandemic-shortened season, the Texas Rangers and Houston Astros showed a significant negative gap between their home and road winning percentages (Diaz et al., 2023). The results of this study indicate that pure distance is not a determining factor in home or on-road game success, however, unique seasonal constraints or external, seasonal conditions can yield travel-related performance dips (Diaz et al., 2023).

Further analysis shifts the focus from raw mileage to the physiological impact of “jet lag,” or circadian misalignment. The research concludes that Major League Baseball performance is most significantly affected by eastward travel versus westward travel (Song et al., 2016). When athletes travel eastward, their bodies are forced to “catch up” to a shorter day, however, westward travel has limited impact on the human circadian clock. The study also suggests that specific baseball statistics are impacted more heavily than others. Jet lag most significantly affected defensive performance for both home and away teams, as observed via the number of home runs allowed. Next, jet lag impaired home-team offensive metrics, like slugging percentage, more severely than away-team performance. Finally, the study suggests that home-team advantage is not always consistent, as performance can be hindered if a home game immediately follows an exhausting, long road trip (Diaz et al., 2023). These findings support the need to observe decades of MLB data at a time, as well as look beyond pure mileage and focus on how specific travel logistics affect performance.

III. Methodology

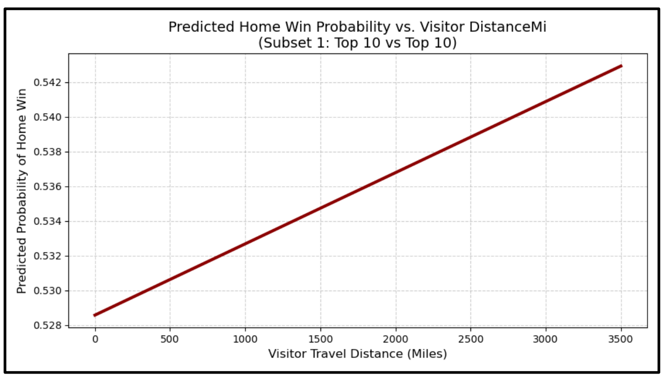
This study utilizes ten years of Retrosheet game log data spanning from 2014 to 2023. The season data was combined with the geographic coordinates of Major League Baseball (MLB) stadiums sourced from ArcGIS, an online database detailing all professional stadium locations.

Data cleaning and analysis were conducted using Python, specifically leveraging the Pandas and Numpy libraries for data manipulation and processing. Travel distances between stadiums were calculated using the Haversine formula and the statistical significance was evaluated through the application of Z-tests.

To ensure that differences in team performance did not influence the results, the dataset was standardized by constructing comparative subsets, including the “Top 10 vs. Top 10” and “Top 10 vs. Bottom 10” teams. This approach acted as statistical control, ensuring that the results were not simply showing that ‘good teams beat bad teams.’ By specifically analyzing where talent was equalized, such as two Top 10 teams competing, travel was the primary variable. If a Top 10 team loses to a Bottom 10 team, results can be inconclusive, as it cannot be said with certainty that travel caused the loss or if it was just a fluke. But if two elite teams are evenly matched and the one that traveled further consistently loses, travel fatigue can be identified as the ‘tie-breaker’ affecting the outcome. This method ensured that any additional ‘noise’ of team standings was filtered out, and the primary focus of the study was the psychological tax of travel.

IV. Results

i. Multi-Season Analysis



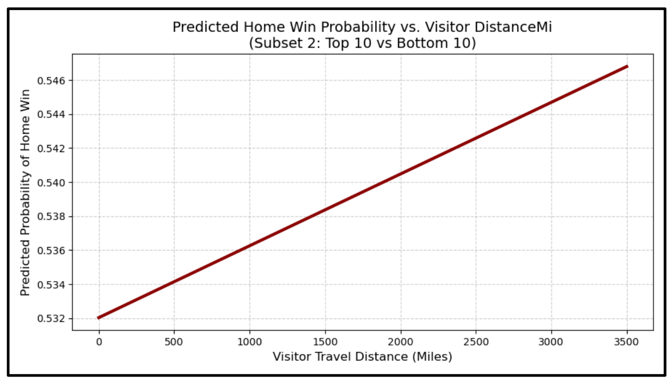


Fig. 1. Multi-season analysis that predicted home win probability as a function of visitor travel distance across competitive matchup. (A) Predicted home win probability versus travel distance for Subset 1 (Top 10 vs. Top 10 teams). **(B)** Predicted home win probability versus visitor travel distance for Subset 2 (Top 10 vs. Bottom 10 teams).

This analysis examines the relationship between pure travel distance and win percentage for Major League Baseball (MLB) teams. In the first graph, the away team's travel distance was compared against the win percentage of the home team, specifically for the top ten MLB teams versus the top ten MLB teams. The results yielded a p-value of 0.8115, indicating that the relationship is not statistically significant. Although a trendline is observed in the graphical representation, the high p-value suggests that travel distance cannot be identified as a determining factor influencing team performance. Therefore, the trendline must be driven by other factors not captured in this analysis.

In the second graph, the analysis compared the top ten teams with the bottom ten teams. This model produced a similarly high p-value of 0.69860, also indicating that the relationship is not statistically significant. However, similar to the first graph there is a visual trendline present but the results do not support a meaningful relationship between travel distance and win percentage. These findings suggest that additional factors beyond travel distance are likely influencing game outcomes.

ii. The U-Shaped Resilience Curve

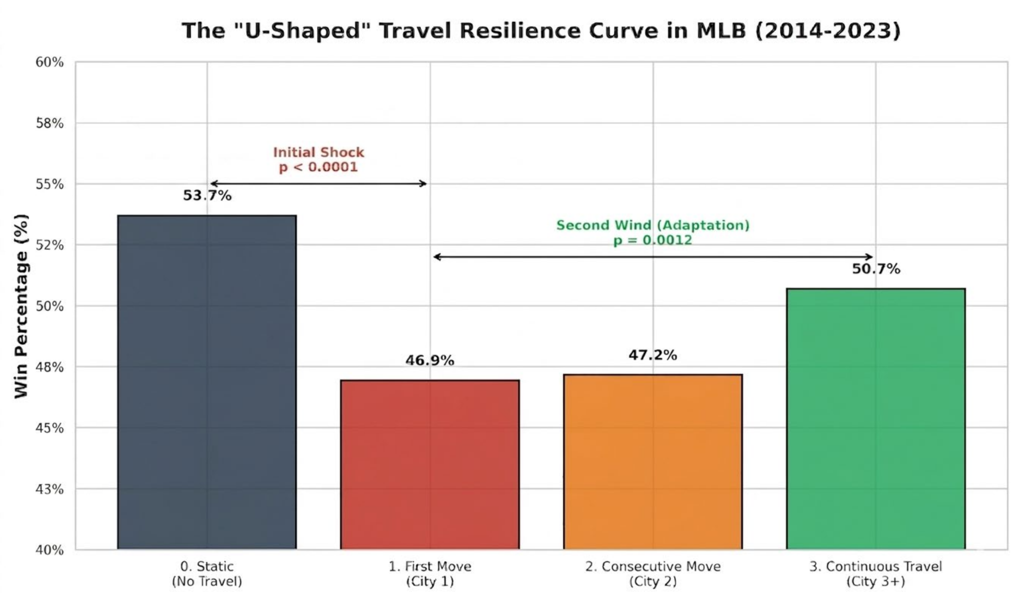


Fig. 2. The U-shaped travel resilience curve in MLB (2014–2023). Visitor win percentage across four travel cities: static (no travel, 53.7%), first move (City 1, 46.9%), consecutive move (City 2, 47.2%), and continuous travel (City 3+, 50.7%). The initial transition from static to traveling results in a significant performance drop ($p < 0.0001$), while win percentage recovers following the third consecutive move ($p = 0.0012$), forming a U-shaped pattern.

Cumulative or "rolling" fatigue was examined to investigate the question of whether more consecutive travel events are associated with changes in team performance. The teams were grouped based on the number of consecutive travel instances, including no travel (static), a single relocation, two consecutive relocations, and three or more consecutive relocations. After the first relocation, a decline in win percentage of approximately 7% was observed, demonstrating an initial "travel shock." The corresponding p-value was below 0.05 confirming that this decrease is statistically significant and that travel had an impact on performance. However, contrary to expectations of continued decline, performance improves with additional consecutive travel. This is confirmed through the p-value of 0.0012 that proves to be statistically significant. These findings reveal that while teams may initially experience a performance decline in performance after travel, they are able to adapt to continued travel demands, ultimately stabilizing and improving performance over extended road sequences.

iii. Distance Threshold

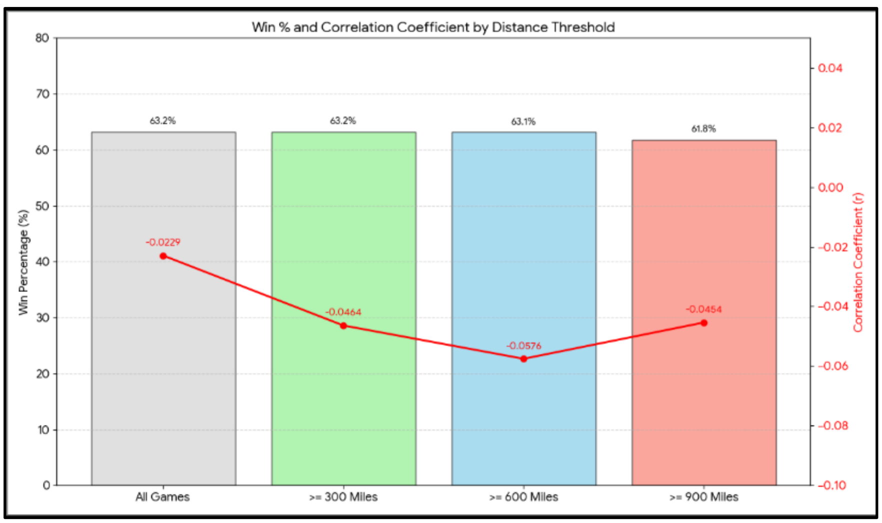


Fig. 3. Win percentage and correlation coefficient by travel distance threshold in MLB. Bars represent win percentage across four distance thresholds: all games (63.2%), trips of 300 miles or more (63.2%), 600 miles or more (63.1%), and 900 miles or more (61.8%). The red line indicates the correlation coefficient (r) between travel distance and win probability at each threshold, with values of −0.0229, −0.0464, −0.0576, and −0.0454 respectively, suggesting no meaningful relationship between travel distance and win probability across thresholds.

This analysis evaluates the relationship between travel distance and win percentage across multiple distance thresholds of 300, 600, and 900 miles. For each threshold, games below the specified distance were excluded, and correlation coefficients were calculated for the remaining observations. The results that were found showed weak negative correlations across all groups (r = -0.046 for distances greater than 300 miles, r = -0.057 for distances greater than 600 miles, and r = -0.045 for distances greater than 900 miles). Overall, these findings suggest that for top performing MLB teams, travel distance does not have a reliable or predictable impact on their likelihood of winning. The small magnitude of the correlation coefficient indicates that any observed relationship is negligible and not practically significant.

iv. The "Jet Advantage"

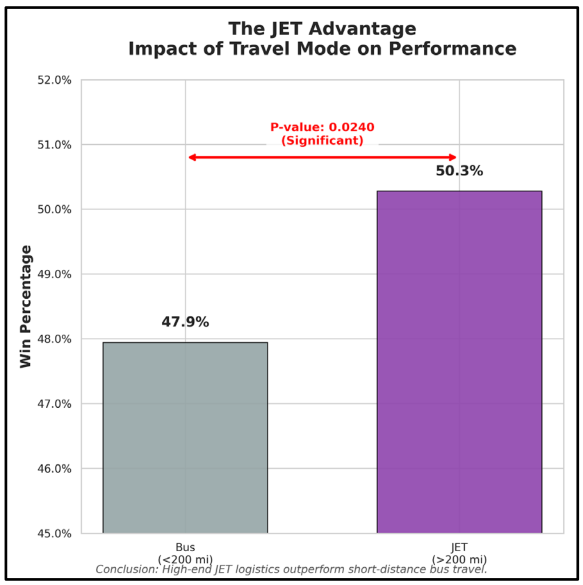


Fig. 4. Impact of travel mode on win percentage in MLB. Win percentage for teams traveling by bus (under 200 miles, 47.9%) compared to those traveling by jet (over 200 miles, 50.3%), demonstrating a significant performance advantage for jet-traveling teams (p = 0.0240).

Following the distance threshold analysis, an additional cutoff of 200 miles was examined. This threshold is particularly important, as Major League Baseball teams typically travel by bus for distances under 200 miles and by jet if mileage is greater than 200. Analysis of team performance across this threshold produced a statistically significant p-value of 0.0240, indicating that mode of travel for Major League Baseball has a measurable impact on team performance.

V. Discussion

The study of pure mileage versus team win percentage yielded no statistically significant results. There is no definitive relationship between how many miles a team travels to their overall performance on the field. However, the quality and mode of travel appear to be much more influential factors. Teams that travel by private jet outperformed those traveling by bus. The travel logistics associated with a specific trip weigh on the athlete far more than the distance itself.

After being static for a series, teams that travel to their next competition undergo an intense "travel shock." Essentially, their bodies and minds struggle to adjust to a new geographic location and fail to recover from the travel journey. This leads to a significant decline in overall win percentage.

However, after several trips pile onto one another, and teams are on the road for several series in a row, their win percentages begin to climb back up. Athletes are able to adapt to on-road conditions, like hotel stays, and mitigate the looming effects of travel fatigue. Therefore, these athletes perform better, and team win percentage is improved.

Raw mileage thresholds showed negligible correlation with game outcomes. This is because these thresholds did not incorporate travel logistics. Travel logistics, such as mode of travel, had a far greater impact on MLB game outcomes than pure mileage.

VI. Conclusions and future work

Major League Baseball teams have successfully neutralized the impact of travel through superior logistics and recovery methods.The 10-season analysis confirms that professional athletes do not suffer from linear mileage fatigue, but rather an initial "Travel Shock" followed by quick acclimation to road routines. While physical distance is a negligible factor, the "Jet Advantage" proves that the quality of travel is a far more significant predictor of performance than the total number of miles covered on a map.

Ultimately, the MLB's use of high-end recovery tools, like private jets, specialized rest schedules, and sports medicine resources, ensure that team talent, rather than travel logistics, remains the primary determinant of success and win percentage.

While the findings suggest that professional athletes are largely resilient to the effects of travel fatigue, an important extension of this work is to examine whether similar patterns hold for college athletes. Unlike professionals, college athletes hold additional factors to consider including academic responsibilities and suboptimal travel and recovery resources. These factors may compound the effects of travel and introduce new performance challenges. Therefore, future research should investigate the presence of the “resource gap” between NCAA and MLB athletes by evaluating whether collegiate teams who lack professional grade travel and recovery tools show a higher sensitivity to travel fatigue than MLB players. In addition the impact of academic stressors, particularly during high-pressure periods such as final examinations weeks, should be quantified to assess how they interact with athletic performance.

Expanding the scope of performance metrics will also provide a more comprehensive understanding of these effects. Rather than relying solely on win-loss records, future analyses should incorporate earned run average (ERA), batting average and other position-specific statistics. Ultimately, this line of research has practical implications for optimizing athletic scheduling in order to enhance athletic resilience and organizational performance across competitive levels.

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