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The relationship between travel and won/loss records and performance measures in Major League Baseball

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THE RELATIONSHIP BETWEEN TRAVEL AND WON/LOSS RECORDS AND PERFORMANCE MEASURES IN MAJOR LEAGUE BASEBALL

by

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ABSTRACT

The Relationship Between Travel and Won/Loss Records and Performance Measures in Major League Baseball

by

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A home advantage in sports has been well documented. However, little research has been conducted to determine exactly why this home advantage exists. This study will attempt to examine the relationship between travel (i.e. number of miles traveled, number of time zones crossed, direction of travel, and game number at home or on the road) and the performance of professional baseball teams (i.e. won/loss, runs scored, hits, errors committed, double plays executed, and runs allowed). Stepwise multiple regression analyses will be used to determine the amount of explained variance in each performance variable attributable to the effects of the travel variables. The implications of these results will be discussed along with possible suggestions for future research in the effects of travel and the home advantage.

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THANK YOU.

CHAPTER 1

INTRODUCTION

The world of sports is becoming increasingly important in our society. For many, the sports section is the first part of the daily newspaper that they pick up every morning. In recent years, many cable channels have adopted an all sports format (ESPN, ESPN2, ESPN+, SportsChannel, SportsChannel+, CNN SportsIllustrated, etc.). Additionally, the money involved in sports has grown exponentially. The cost to acquire a sports franchise has increased to over $200 million dollars. Athletes' salaries have increased to over $10 million a year in baseball (Albert Belle, Gary Sheffield) and in basketball there is a player making $36 million dollars a year (Michael Jordan).

As a result of the increasing costs associated with operating a professional sport franchise, many teams are reporting that they do not make enough money from ticket sales, broadcast revenues, concessions and parking to offset the costs of running their teams. Additionally, today's team owners are finding increased competition from other sports franchises and other entertainment options. Therefore, the pressure to field a consistently competitive team has become more apparent.

A consistently competitive, championship caliber team often draws more support from the community and surrounding metropolitan areas. This support can increase revenue for the team owners in two ways. First, a winning team can generate more attendance, resulting in increased revenue from ticket, concessions, and parking sales.

Secondly, a winning team often generates a larger viewing audience. As a result of this larger viewing audience, the team can charge higher sponsorship fees. Additionally, the team can increase advertising fees for the various arena signage areas such as the scoreboard, outfield walls, and other backdrops in the ballpark.

The pressure remains, therefore, for team management to identify the important factors involved in fielding a high quality team. Obviously, the talent level of the individual players and coaches is of utmost importance. However, there are other factors involved in winning and losing.

One such factor that is consistently mentioned with winning or losing is whether the team is playing at home or on the road. Literature and common folklore have consistently identified that the home team seems to win more often than the team on the road. The media often portrays the fact that the home team has a general advantage, and this is especially evident in pre-evaluations of playoff competitions and championship series. After a victory at home, players often allude to the support of the home crowd as being a factor in their win. Additionally, the Las Vegas sports books often take into account whether the team is at home or on the road in computing their lines and odds.

The prevalence of opinion about this home advantage has led to increased scientific examination of the existence of and the factors relating to the home advantage. The importance of determining whether the home advantage exists is twofold. In the theoretical sense it is of importance to study the individual factors relating to the home advantage and their relative contribution to the home advantage. To the players and owners, it is of importance to understand why this home advantage exists, and possible steps that may be taken to eliminate the home advantage when the team is on the road.

The purpose of this study is to examine the home advantage in professional (Major League) baseball more extensively. Explanations for the home advantage can be categorized into four factors related to the location in which the game is being played. These factors include crowd support, learning or familiarity, differences in rules, and travel (Courneya & Carron, 1992).

Travel is one of the factors most frequently identified as contributing to the home advantage (Schwartz & Barsky, 1977; Palmer, 1978; Edwards, 1979; Varca, 1980; Snyder & Purdy, 1985; Silva & Andrew, 1987; Goldberg, 1988;Courneya & Carron, 1991; Pace & Carron, 1992; Courneya & Carron, 1992; Jehue, Street, & Huizenga, 1993; Adams & Kupper, 1994;Pickens, 1994). These authors propose that fatigue following travel, disruption of routine, and changes in the body's biological processes affect the visiting team to the point that their physical performance is undermined.

Therefore, this study will attempt to isolate the travel factor and measure its relationship with the home advantage. This study will extend previous research and measure the relationship not only with won/loss records at home versus on the road, but will also assess the relationship between travel and the specific performance measures.

CHAPTER 2

REVIEW OF LITERATURE

In the world of sports, players, coaches, the media, and fans speculate about why a particular team wins or why an individual performs well. One of the factors identified as contributing to whether a team wins or loses is the location of the game. Studies of historical and archival data show that the home team is more likely to win. This phenomena has been termed the home advantage and it is seen across almost all team sports and is documented at many levels of competition. The literature indicates that the various explanations for the home advantage fall into four game location factors (Courneya & Carron, 1992). This chapter will review the literature that documents the existence of the home advantage, and then will examine why it has been proposed that this home advantage exists. Finally, in response to the future directions set forth by Courneya and Carron (1992), the study will attempt to isolate the travel factor and measure its effects on the home advantage.

The Home Advantage

In the last two decades, several research studies have addressed the home advantage that seems to exist in all levels of sport. The home advantage refers to the "consistent finding that home teams in sport competitions win over 50% of the

games played under a balanced home and away schedule" (Courneya & Carron, 1992, p.13). Several studies have analyzed and documented the existence of the home advantage in several different sports encompassing different levels of competition.

Baseball

There have been many studies examining the existence of the home advantage in baseball. Studies investigating the impact of the home advantage on won/loss records have reported that the home advantage in professional (Major League) baseball has been approximately 54% (Thorn & Palmer, 1984; Adams & Kupper, 1994). Several other studies have investigated the existence of a home advantage in terms of specific factors (e.g., runs scored, runs allowed). Some studies have investigated the home advantage at different levels of competition (e.g., amateur, collegiate, high school) in the sport of baseball.

The first major study to examine the home advantage in professional baseball was conducted by Schwartz and Barsky (1977) who examined Major League Baseball statistics from the 1971 season. An analysis of this season showed that the home advantage was 53%.

Schwartz and Barsky (1977) also examined some in-depth factors, and the differences in each factor between the home team and visiting teams. In baseball, they found that on average, the home teams were more productive offensively than the visiting team. The home teams rate (per 100 at-bats) was superior in terms of the number of runs scored (11.9 to 10.8), extra base hits (6.7 to 6.3), total number of hits (25.7 to 24.7) and runs as a proportion of hits (45.5 to 42.4).

In 1978, Palmer concurred with the results of Schwartz and Barsky in terms of their baseball findings. Palmer (1978) found that while the home team wins approximately 54% of the time, the home team also tends to score 10% more runs at home than they do on the road. Similarly, batting averages, on-base average, and slugging percentage are higher. Additionally, the earned run average is approximately 10% less for the home team (Palmer, 1978).

In his 1979 study, Edwards reexamined the existence of the home advantage. In his analysis of four Major League Baseball teams during the 1975 season, he found that the home team won 55.6% of the games. In an analysis of the 1982 through 1984 seasons in Major League Baseball, Pollard found that the home advantage had slightly decreased. During this time period, home teams won 53.6%.

In 1990, Irving and Goldstein extended previous research on the home advantage by studying the home advantage in terms of individual performance. They examined whether individuals were more likely to exhibit peak levels of performance at home or on the road. Irving and Goldstein defined peak performance in pitchers as having pitched a no-hitter (a single pitcher not allowing the other team a hit during nine innings, resulting in a win after those nine innings). In their analysis of all the no-hitters thrown, they found that 63% occurred at the home field (Irving & Goldstein, 1990).

In 1990, Courneya extended the study of the home advantage into collegiate baseball. The author studied teams from the Southeastern Conference, the Pacific Ten, and the Big Ten during the 1988 season. An analysis of ten of these teams showed that the home teams won 61.7% of the games (Courneya, 1990).

In 1991, Courneya and Carron again examined the home advantage in baseball, this time examining Double A teams. An examination of the 26 teams during the 1988 season indicated that the home team won 55.1% of the games.

In 1995, Schlenker, Phillips, Boniecki, and Schlenker studied the home advantage in championship series. They analyzed all World Series games played during the period from 1924 to 1993, excluding the World War II years of 1943-1945, and excluding all four game sweeps. Their examination showed that the home team won 58% of the games played. Additionally, in their analysis of the League Championship Series from 1985 to 1993, they found the home advantage to be 54% (Schlenker et al., 1995).

In summary, there have been several studies examining the existence of the home advantage in baseball. The studies have shown that this advantage is approximately 54% in Major League Baseball, with the one study of collegiate baseball (Courneya, 1990) showing a slightly higher home advantage (61.7%).

Basketball

Schwartz and Barsky (1977) again pioneered study of the home advantage in the sport of basketball. They analyzed the winning percentages of five collegiate basketball teams (LaSalle, Pennsylvania, St. Joseph's, Temple, and Villanova) during the period from 1952-1966. They found that these teams won 82% of the games played at their home facilities, 76% of the games played at the Palestra (a nearby arena), 64% of the games played at a neutral site, and 58% of the games played at an opponent's facilities.

Varca (1980) extended this study to another conference within the NCAA. In studying the results of contests played within the Southeastern Conference during the 1977-1978 season, the home advantage was 70%. Additionally, it was found that home

teams had a higher field goal percentage (49.3 to 47.8), a higher free throw percentage (68.7 to 67.0), more steals (6.6 to 5.3), more blocked shots (2.8 to 2.3), more rebounds (37.5 to 34.4), fewer turnovers (15.8 to 16.3), and committed fewer fouls (20.6 to 21.9) (Varca, 1980).

In 1985, Snyder and Purdy reexamined the existence of the home advantage in collegiate basketball. They chose to evaluate inter-conference contests played between the 10 universities of the Mid-American Conference (MAC) during the 1982-1983 season. The authors found that within the MAC, the home advantage was 66%. Additionally, they noted that when the visiting team had traveled more than 200 miles for the contest, the home advantage was 84.6 compared to a home advantage of 58.8% when the visiting team had traveled less than 200 miles (Snyder & Purdy, 1985).

In 1986, Pollard examined the home advantage in the National Basketball Association (NBA). Using archival data from 1981-82 through the 1983-84 season, he found that in the NBA, home teams win 63.3% of the games.

In 1987, Silva and Andrew reexamined the existence of the home advantage in men's collegiate basketball. They chose to analyze all Atlantic Coast Conference games played during the period from 1971-1981. In their examination of the home advantage, they found that the home teams won 65.8% of the games. Additionally, they found that the home teams had higher field goal percentages (50.0 to 47.7), more rebounds (36.6 to 34.2), had fewer turnovers (15.6 to 16.6), and committed fewer fouls (20.0 to 21.3) (Silva & Andrew, 1987).

The home advantage in the Atlantic Coast Conference was reexamined by Pickens in 1994. His study, analyzing the 1990-1991 ACC conference schedule, found

that the home advantage was 68%. This percentage was slightly higher than Silva and Andrew's results in 1987. However, Pickens concurred with the results of Silva and Andrew in that the home team had a higher field goal percentage (47.5 to 45.0), free throw percentage (72.0 to 68.2), more rebounds (36.7 to 35.1), more assists (17.6 to 15.6), and committed fewer turnovers (14.3 to 15.8) (Pickens, 1994).

The study of the home advantage was extended to include an analysis of high school basketball. Gayton and Coombs (1995) examined archival data from four high schools during the period from 1968-1988. During this period, they found that while the teams won 49% of their games played on the road, they won 62% of the games played at their own facilities. Additionally, while scoring an average of 49.8 points per game on the road, these teams scored an average of 61.8 points per game at home (Gayton & Coombs, 1995).

As was seen in baseball, the home advantage was also documented in the sport of basketball. This home advantage was seen in the professional, collegiate, and high school levels (Schwartz & Barsky, 1977; Varca, 1980; Snyder & Purdy, 1985; Pollard, 1986; Pickens, 1994; Gayton & Coombs, 1995). The home advantage calculated by these authors in their studies were all reported at over 62%. This level was slightly higher than the home advantage reported in the sport of baseball.

Football

Although the sport of football (American) has not been as extensively studied as baseball or basketball, several studies have been conducted which document that the home advantage also exists in football (Schwartz & Barsky, 1977; Edwards, 1979;

Pollard, 1986; Jehue, Street, & Huizenga, 1993). The home advantage documented in football ranges from 54.4% to 60%.

Schwartz and Barsky (1977) first examined the existence of the home advantage in football. They found that during the 1971 professional football season, the home team won 58% of the games when excluding tie games. Additionally, in their analysis of collegiate football during the 1971 season, the home advantage was found to be 60% when excluding tie games (Schwartz & Barsky, 1977).

Edwards completed an extensive study on the home advantage in 1979. In examining professional football during the 1974-1976 seasons, he found that the home squad won 54.4% of the games. Furthermore, he found that the home team on average scored more points (21.1 to 18.3) and gave up fewer points (12.3 to 14.0).

In examining collegiate football during the same time period, Edwards (1979) found the home winning percentage to be a statistically significant 58.6%. The home teams on average scored more points (23.1 to 17.6) and allowed fewer points (11.1 to 13.0).

Pollard (1986) examined the home advantage in professional football. His analysis of the 1982 through 1984 seasons in the NFL showed a home advantage of 55%.

Jehue, Street, and Huizenga (1993) reexamined the existence of the home advantage in professional football. They analyzed the records of all professional games played from 1978-1987. The home advantage during this time period for professional football was 56.6%.

Hockey

The home advantage has also been documented in the sport of hockey (Schwartz & Barsky, 1977; Pollard, 1986; McGuire, Widmeyer, Courneya, & Carron, 1992). The home advantage in these studies ranged from 58.3% to 64%. The first analysis of the home advantage in hockey occurred in 1977. Schwartz and Barsky analyzed archival data from the 1971-72 season in the National Hockey League (NHL). They found that the home advantage during this season was 64% of the games when excluding tie scores (Schwartz & Barsky, 1977).

Pollard (1986) also examined the National Hockey League. He analyzed the 1981-82 through 1983-84 seasons in a slightly different fashion. He assessed two points for a win and 1 point for a tie score and calculated the home advantage as number of points scored at home as a percentage of total points scored at home and on the road. His examination revealed that the home advantage was 59.9% (Pollard, 1986).

McGuire, Widmeyer, Courneya, and Carron (1992) also studied the home advantage in the NHL by examining archival data from the 1987-88 season. They found that using Pollard's method of assessing 2 points for a win and 1 point for a tie score, the home teams won 57.3% of the total points available (McGuire et al., 1992). Pace and Carron (1992) analyzed the 1988-89 season in the National Hockey League. When excluding tie games, they found that the home teams won 58.3% of the games (Pace & Carron, 1992).

Other Sports

Several other studies have attempted to examine the home advantage in other sports. Although these studies have found that the home advantage does exist in these other sports, few follow-up studies have been conducted to support these findings.

In 1986, Pollard examined the existence of the home advantage in soccer. In addition to his analysis of Major League Baseball, the National Football League, and the National Hockey League, he also examined the North American Soccer League (NASL) and the Football League in England. (In England, football is equivalent to soccer in the U.S.) In his examination of the 1982-1984 seasons of the NASL, Pollard found the home advantage to be 65.2% (1986). When examining various periods of the Football League in England, Pollard found that the home advantage ranged from 62.5% to 67.9%.

In 1987, Gayton, Mutrie, and Hearns examined the existence of the home advantage in women's intercollegiate basketball. Their study was limited because they only examined the women's basketball team from one school. However, they found that during the 1968-1985 seasons, the University of Southern Maine's home winning percentage was 13.8% higher than its road winning percentage (74.6 % at home, 60.8% on the road). Additionally, the home teams scored more points (62.9 to 48.0). During the 1967-1985 seasons of field hockey, the University of Southern Maine's home winning percentage was 12.9% higher than its road winning percentage (36.8 to 23.9). In softball, the University of Southern Maine's home winning percentage was 12.2% higher than its road winning percentage (58.1 to 45.9) (Gayton, Mutrie, & Hearns, 1987).

Thus far, the existence of the home advantage has been discussed. This advantage has been observed over several sports across a variety of levels of competition. A highlight of the studies discussed previously documenting the existence of the home advantage in sport can be found in Table 1.

Table 1

Home Winning Percentages in Sport

Authors	Sport and level	Seasons	Number of games analyzed	Home team's winning %
Schwartz & Barsky (1977)	Major League Baseball	1947-56	12,320	53.0
		1971	1,880	52.6
	National Football League	1945		59.0
		1950		55.0
		1955		63.0
		1960		55.0
		1965		51.0
		1971	182	57.5
	National Hockey League	1971-71	542	63.7
		1972-73		66.0
	Collegiate Football	1971	910	59.2
Edwards (1979)	National Football League	1974-76	349	54.4
	Collegiate Football	1974-76	577	58.6
	Major League Baseball (4 teams)	1975	288	55.6
Edwards & Archambault (1989)	National Football League	1974-76	349	54.4
	Major League Baseball	1975	288	55.6
	National Hockey League	1986-87		54.0
Varca (1980)	Collegiate Basketball	1977-78	90	70.0
Thorn & Palmer (1984)	Major League Baseball	1900-82	114,631	54.0
Snyder and Purdy (1985)	Collegiate Basketball	1982-83	90	66.0
Pollard (1986)	Major League Baseball	1982-84	6,316	53.6
	National Football League	1982-84	574	55.0
	National Hockey League	1981-84	2,520	61.5
	National Basketball Assoc.	1981-84	2,829	63.3
	North American Soccer	1982-84	512	65.2
Silva & Andrew (1987)	Collegiate Basketball	1971-81	418	65.8
Courneya (1990)	Collegiate Baseball	1988	418	61.7
Courneya & Carron	"AA" Minor League Baseball	1988	1,812	55.1 (1991)
Pace and Carron (1992)	National Hockey League	1987-88	840	58.3

(table continues)

Home Winning Percentages in Sport

Authors	Sport and level	Seasons	Number of games analyzed	Home team's winning %
Jehue, Street, & Huizenga (1993)	National Football League	1978-87		56.6
Gayton & Coombs (1995)	High School Basketball	1968-88	1,489	62.0
Pickens (1995)	ACC Basketball	1990-91	56	68.0
Recht, Lew, & Schwartz (1995)	Major League Baseball	1991-93	1,081	55.9
Schlenker, Phillips, Boniecki, & Schlenker (1995)	MLB World Series	1924-93	346	58.0
	MLB League Series	1985-93	98	54.0

Previous research has documented the existence of the home advantage. Since Schwartz and Barsky's first examination of the home advantage in 1977, a number of explanations for its existence have been proposed. In 1991, Courneya and Carron categorized these explanations and proposed that in terms of game location, there are four factors which influence and/or contribute to the home advantage in sport.

These factors include crowd (in terms of influence, size, and density), learning/familiarity with the facilities, differences in rules for the home and visiting teams, and travel factors (Courneya & Carron, 1991). This review will address these factors more extensively in the following sections. In addition, this paper will address the different styles of play a team uses at home versus when the team is on the road in the discussion of 'differences in rules' factor.

Crowd Support

The importance of crowd factors in contributing to the home advantage has been studied fairly extensively. "The crowd factors explanation is based on the assumption that conditions associated with the audience, including its size, density, supportiveness, and proximity are motivating to the home team and lead to enhanced performance" (Pace & Carron, 1992).

As a tribute to the importance of the crowd, some research notes that the game's location may actually impact how coaches and players approach a game. Pace and Carron (1993) reasoned that many visiting teams altered their normal playing style in order to keep the home crowd out of the game. Likewise, Silva and Andrew (1987) pointed out that coaches "use a pressure defense more often at home in an attempt to rattle the visiting team and immediately involve the crowd" (p. 199). Additionally, several authors pointed out that the officiating may be subconsciously altered in the home team's favor in response to a large, boisterous crowd (Pace & Carron, 1993; Greer, 1983; Varca, 1980).

Schwartz and Barsky (1977) first examined the contribution of the crowd to the home team's advantage. In baseball, for example, they found that the home team's winning percentage increased as attendance increased. When attendance was low, the home advantage was 48%; medium attendance levels saw a home advantage of 55%; and the home advantage increased to 57% when attendance was high (Schwartz & Barsky, 1977).

Home team runs per 100 at-bats follow the same pattern, increasing from 11.0 to 12.1 and 12.7 as attendance increases (1977). This effect is further pronounced when the

home team is clearly superior. These statistics may be misleading, however, since a team with a higher winning percentage normally draws more fans than one with a losing record. Therefore, the higher winning percentage may actually cause the increased attendance, rather than being a result of it.

Pollard (1986) questioned the findings of Schwartz and Barsky. In his study of the four divisions of the Football League in England, Pollard found no corresponding increase in the home advantage as the crowd size or crowd density increased (1986).

However, Schwartz and Barsky (1977) argued that crowd size and/or density was a factor by noting that the presence of the home advantage was most significant in ice hockey and basketball. These are both sports where the audience was situated indoors, the action was sustained over a period of time, and the crowd was intensely involved in cheering. Greer (1983) examined whether an intensely involved crowd affected the level of performance by the home team and visiting team, and which aspects of the game this involvement affected. For two collegiate men's basketball teams, he measured the length of substantive periods of crowd noise, and recorded the reactions of the players following this period of noise. He found that following protest by the home crowd, the home team showed a "consistent period of improvement... accompanied by a decline in visiting team effectiveness" (Greer, 1983, p. 255). After this crowd protest, the home team increased their rate of scoring, and decreased their rate of turnovers and fouls (Greer, 1983). The visiting team, on the other hand, decreased their rate of scoring, and substantially increased their rate of committing fouls (.5 to.9) (Greer, 1983).

Nelson and Carron (1991) interviewed coaches and team captains from five sports in a Division I university. Crowd factors was ranked as the third factor most likely

contributing to the home advantage and the away disadvantage (Nelson & Carron, 1991). Respondents felt that a large home crowd distracted the visiting team, making it harder for them to maintain their concentration, and communicate with their teammates or their coach. These factors frequently resulted in the visiting team making more mistakes (Nelson & Carron, 1991).

The social facilitation theory has been presented as a possible explanation for the decrease in performance seen by the visiting team. Silva and Andrew (1987) explained that the presence of an audience, especially a non-supportive one, can impair the performance of complex or cognitive skills. Other authors have countered this explanation since the audience is also present for the home team, yet their performance is still better than the performance of the visiting team (Edwards, 1979; Varca, 1980; Salminen, 1993). Salminen (1993) notes that in sports, the audience is not content simply to sit and watch, rather they actually try to influence the outcome of the game. Therefore, the social facilitation theory does not seem applicable to sport.

Although the previous research shows that the presence of a crowd does seem to have some sort of effect on the home advantage, no clear mechanism has consistently been identified. For example, does a large home crowd further motivate the home team, allowing it to perform at a higher level, or does the large crowd result in a diminished performance by the visiting team? Although a large crowd seems to make the home team play better, it is also possible that a good home team results in a large and involved crowd. More research into this factor is necessary.

Learning or Familiarity

A second game location factor hypothesized to influence the home advantage has been identified as the learning or familiarity factor (Schwartz & Barsky, 1977; Palmer, 1978; Edwards, 1979; Pollard, 1986; Irving & Goldstein, 1990; Courneya & Carron, 1991; Nelson & Carron, 1991; Courneya & Carron, 1992; Pace & Carron, 1992; Goodman & McAndrew, 1993; Schlenker, et al., 1995; Moore & Brylinsky, 1995). Familiarity with a facility allows the players to unconsciously make decisions based on environmental cues that they have learned well. These authors hypothesize that the visiting team is at a disadvantage in terms of performance because they are less familiar with the home team's facility.

Within all sports, there are differences from facility to facility. In hockey, while the physical dimensions are standard, the softness of the ice, which affects the speed of play, differs from arena to arena (Pollard, 1986). In football, some stadiums are domed and allow for controlled climates while others are open to the changing weather conditions (Edwards, 1979). Additionally, some football fields utilize artificial turf, which often results in a different style of play than the fields that have natural grass (Edwards, 1979).

In basketball, the type of floor and how it is laid often results in the liveliness of bounce it creates with the ball (Edwards, 1979). Additionally, the tightness of the rims differs from arena to arena, therefore affecting the bounce of the ball on the rim.

In all of the sports outlined, however, the dimensions of the playing surfaces are standardized. This standardization is not seen in baseball facilities. In baseball, some fields are domed, while others are open-air. Some fields use artificial turf, whereas others utilize natural playing surfaces. The height and distance of the home run fences

vary from stadium to stadium (Edwards, 1979). The situation of the fields in terms of sun and wind exposure vary from one stadium to another. In Wrigley Field, for example, if the wind is off the lake, it is very unlikely that many home runs will be hit. The angles and surfaces of the walls differ from field to field, altering how players might go about playing a ball off the wall (Schwartz & Barsky, 1977; Schlenker et al., 1995). Again, in Wrigley Field, the ivy of the outfield walls make it difficult to accurately predict how the ball will play off these walls. Additionally, different levels of elevation affect play. The Colorado Rockies are known for having high scoring home games, which may be partly explained by the thinner air due to Denver's elevation.

Baseball fields also differ in the average number of runs they give up through the years. In analyzing the different Major League ballparks, Palmer (1978) calculated the rates in scoring that each park allowed. This was achieved by taking the average number of runs scored at home by both teams and dividing this number by the average number of runs scored by both teams on the road. Palmer's study found that some parks allowed a higher rate of scoring than others (1978). For example, compact Wrigley Field offered by far the highest rate of scoring (128) and allowed far more runs than either Chavez Ravine or Anaheim Stadium, which at a rate of 88, allowed the lowest rate of scoring (Palmer, 1978).

In addition to these different aspects of the fields seen in baseball, it is also easier to manipulate these aspects towards the particular tendencies of the home team. If the home team batters enjoy a darker hitting backdrop, the backdrop can be repainted. If there is a slow third baseman, the grass can be kept longer in this area in order to slow the ball down (Schwartz and Barsky, 1977; Schlenker et al., 1995). Additionally, if the home

team has relatively fast baserunners, the basepaths can be watered lightly to encourage stealing. If the opponent team has the baserunning advantage, however, the paths can be watered more heavily to discourage them from stealing (Schwartz & Barsky, 1977).

In 1977, Schwartz and Barsky first argued the role of familiarity in determining the home advantage. They hypothesized that if learning or familiarity was substantive in contributing to the home advantage, then the home advantage would be most significant in the sports where there was the most discrepancies in field dimensions (Schwartz & Barsky, 1977). They argued, therefore, that the home advantage would be most significant in the sport of baseball. However, this was not the case: in baseball the home advantage was 53%; in professional football the home advantage was 58%; and in professional hockey, the home advantage was 64% (Schwartz & Barsky, 1977). Therefore, they ruled out learning or familiarity as a contributor to the home advantage.

It is possible, however, that Schwartz and Barsky erred in dismissing familiarity as a possible explanation for this reason. Although the field dimensions and particularities of each field vary the most in the sport of baseball, this factor may be offset by the fact that in baseball the players play on every opponents' field at least four times during the season (except in interleague where they play at least two games on their opponents' turf). Additionally, they often spend three consecutive days at this same facility. These additional factors may negate the influence of familiarity on the home advantage in baseball. Therefore, further analysis to determine whether learning or familiarity is a contributor is warranted before this factor is completely ruled out.

Pollard, however, concurred with Schwartz and Barsky's (1977) reasoning. In his study of the Football League in England, Pollard found that the teams playing on

significantly smaller or larger than average playing fields did not show a corresponding higher home advantage than those teams which had more standardized dimensions (1986). However, it is possible that it is the more subtle effects of familiarity that actually contribute to the home advantage (Pollard, 1986). For example, the situation, alignment, and pitch of the stadium and stands may affect how well visiting teams play in other facilities. Since these factors weren't measured, it is possible that these issues of familiarity may effect the home advantage. Further study is warranted.

Through interviews with a Division I university's head coaches and team captains, Nelson and Carron (1991) found that these individuals felt that facility familiarity was the number one reason in explaining the home advantage. Additionally, these individuals felt that facility familiarity was the number two ranked reason for their disadvantage on the road (Nelson & Carron, 1991).

In 1995, Moore and Brylinsky studied the effects of familiarity or learning on the home advantage. During the 1992-93 men's and women's basketball season, the teams from Western Michigan University were forced to play at five different facilities while their new home facility was being constructed. While still playing in their immediate area, the teams were not familiar with the particularities of the courts. However, Moore and Brylinsky found that even when playing on unfamiliar 'home' courts, the teams' home advantage was still present. The authors therefore dismissed the importance of learning and familiarity on the home advantage (Moore & Brylinsky, 1995).

The effect of familiarity on the home advantage, therefore, is mixed. Although many individuals feel that unfamiliarity with a facility would affect their ability to win,

no empirical studies have shown this to be true. Therefore, other aspects relating to the home advantage have been explored.

Rules

Several authors have proposed that the home advantage may somehow be correlated with the fact that there are rules to which the visiting team adheres that are different that from those of the home team (Schwartz & Barsky, 1977; Varca, 1980; Silva & Andrew, 1987; Courneya & Carron, 1991; Courneya & Carron, 1992; Pace & Carron, 1992; Schlenker, et al., 1995). Related to this aspect is the fact that teams often use different tactics when they are on the road versus when they are at home (Pollard, 1986; Varca, 1980; Silva & Andrew, 1987).

In baseball, for example, there is a difference in the rules between the home and visiting teams. The home team gets 'last bats'; the home team gets to bat last in every inning and therefore they get the last batting opportunity of the game.

Several authors have proposed that this 'last bats' rule is related to the home advantage (Silva & Andrew, 1987; Courneya & Carron, 1990; Courneya & Carron, 1991; Courneya & Carron, 1992). To date, however, there has been only one study that examined whether rules were a factor in determining the home advantage.

In 1990, Courneya and Carron examined whether the "last bats" of the home team contributed to the home advantage. They negated the effect of crowd support by examining recreation slo-pitch softball games that did not draw very many fans. Familiarity was controlled by playing at a neutral site which neither team knew very well. Travel distances were relatively equal for each team.

The teams played each other in a double header format with each team alternating the 'home' designation and having last bats. Courneya and Carron (1990) found that no differences in the winning percentages between batting first versus batting last. Therefore, they dismissed rules as a contributing factor to the home advantage.

The differences in rules can also be seen in hockey. In the last period, the home team gets the last line change which can result in fresher players during the final moments of a game. It has been proposed that in a close game, this rule may contribute to the home advantage (Courneya & Carron, 1991). However, no studies have actually investigated this factor in hockey.

Other studies have proposed, but not actually measured, the hypothesis that special tactics used may (1) contribute to the home advantage, or (2) mediate the effects of the other factors on the home advantage.

In soccer, for example, Pollard (1986) proposed that "most professional soccer teams adopt an initial cautious and defensive approach when playing away from home" (p. 247). The same can be shown in basketball. Varca (1980) noted that many coaches in the Southeastern Conference relied more heavily on the zone defense when they are on the road. Conversely, coaches in the Atlantic Coast Conference stated that they were more likely to use a pressure defense early in the game when playing at home in an effort to disturb the visiting team's concentration (Silva & Andrew, 1987).

The difference in philosophy of play can also be seen in baseball. In the situation where the teams are tied in the ninth inning, this rule often changes the way that teams approach hitting and running. The visiting team approaches a tie in the ninth inning by going for the win rather than the tie. The visiting team, therefore, is more likely to take

chances by initiating the hit and run, steal, or suicide squeeze play. The home team, however, often plays more conservatively, since it realizes that regardless of what the visiting team does the next inning, they still have their last bats to make up the difference. Therefore, the home team often opts to wait for a hit rather than chancing a hit and run or a steal.

Although several authors have highlighted the possibility that rules or special tactics used may contribute to the home advantage in sport, there has been only one study that has actually tried to measure this factor. Therefore, more study is warranted using a larger sample size and different levels of competition in both hockey and baseball.

Travel

Perhaps the most frequently mentioned factor related to the home advantage is travel. It has been hypothesized that travel factors (jet lag, fatigue, disruption of routine) contribute to the advantage the home team enjoys (Schwartz & Barsky, 1977; Snyder & Purdy, 1985; Pollard, 1986; Silva & Andrew, 1987; Courneya & Carron, 1991; Pace & Carron, 1992; Courneya & Carron, 1992; Jehue, Street, & Huizenga, 1992; Recht, Lew, & Schwartz, 1995;Goldberg, 1988; Marks & Mervis, 1981; O'Connor, et al., 1991; Hill, et al., 1993; Winget, DeRoshia, & Holley, 1985; Schlenker et al., 1995).

There are several ways in which it has been proposed that travel affects the home advantage. Some authors have proposed that the athletes become fatigued and do not perform up to their potential as a result of long distance travel (Schwartz & Barsky, 1977; Courneya & Carron, 1991; Courneya & Carron, 1992; Pace & Carron, 1992). Other authors have alluded to the possibility that travel leads to a disruption of routine: the athletes aren't sleeping in their own beds, their schedules are more controlled, and they

are away from friends and family (Edwards, 1979; Schlenker et al., 1995). Still others believe that travel leads to an alteration of the biological systems leading to a condition commonly known as jet lag (O'Connor, et al., 1991;Winget, et al., 1985).

Early studies dismissed the idea that travel factors contribute to the home advantage. Schwartz and Barsky (1977) reasoned that the home advantage should be most significant in the sport of baseball where the players spend the most time on the road (1977). However, they found that this is not the case as baseball is associated with the least home advantage out of the major professional sports. The home advantage in baseball is 53% compared to 58% in football and 64% in hockey (Schwartz & Barsky, 1977). Schwartz and Barsky (1977) also reasoned that if travel was a significant factor in the home advantage than this advantage would be more pronounced at the end of the season when fatigue and injuries accumulate. Again this reasoning went unsupported, as there was no significant difference in the home advantage when the season was split into two halves (Schwartz & Barsky, 1977).

When Schwartz and Barsky dismissed travel as a contributor to the home advantage based on the fact that the home advantage was not more pronounced in the latter part of the season, they did not account for one significant argument. They suggested that "the advantage would be more pronounced as the season progresses and the effects of injuries and physical wear and tear accumulate and become aggravated by travel" (1977, p. 650). However, a baseball roster is composed of 25 players (40 during September), allowing backup players for each position. This allows the normal starters periodic rest should they become worn down or injured. Additionally, should a player receive a significant injury, he may be placed on the injured reserve list and another

player may be added to the roster in his place. Therefore, Schwartz and Barsky may have been too quick in dismissing the possibility that travel is related to the home advantage.

Pollard (1986) also dismissed the travel factor in explaining the home advantage. He reasoned that since travel has become faster and more comfortable in the last two decades, that there should be a significant decrease in the home advantage when compared to an earlier period. Yet in comparing the home advantage since the 1940's, no significant decline has occurred (Pollard, 1986).

Despite the dismissal of travel as determinant of the home advantage by these earlier researchers, many have sought to further study the effects of travel on performance. In 1988, Goldberg investigated whether 'jet lag' affected the divisional races in major league baseball. He found that the top teams in each division were the ones who traveled the least; the top teams in the American League traveled 16% less than the bottom teams, and the top teams in the National League traveled 10% less than the bottom teams (Goldberg, 1988). Additionally, in the first game of each series, Goldberg found that the team that had traveled the lesser distance won 36% more of the games (1988).

In their 1991 study, Nelson and Carron interviewed the head coaches and team captains in a Division I university. They found that travel was the number one factor cited by these individuals as contributing to the away disadvantage (Nelson & Carron, 1991). Additionally, they found that the absence of travel was the second most identified factor contributing to the home advantage (Nelson & Carron, 1991).

Although some studies still focus primarily on the effect of travel on won/loss records (Pace and Carron, 1992; Courneya and Carron, 1990), some systematic research

has examined the underlying physiological effects of long distance travel (Jehue, Street, & Huizenga, 1992; Recht, Lew, & Schwartz, 1995; Goldberg, 1988; Marks & Mervis, 1981; O'Connor, et al., 1991; Hill, et al., 1993; Winget, DeRoshia, & Holley, 1985). It has been suggested that jet lag and other factors of travel contribute to the home advantage by altering the individual's circadian rhythm.

The circadian rhythms are "daily cycles of physical and psychological parameters such as body temperature, blood cortisol levels, and alertness. Each parameter peaks and ebbs at a characteristic time each day" (Jehue, Street, & Huizenga, 1993, p. 127). The existence of circadian rhythms has been well documented. In their study, Hill and Smith (1991) concluded, "much of the variation in anaerobic power and capacity across the four tests could be explained by the time of day—there was a circadian rhythm in anaerobic power and capacity"(p. 86). Haymes and Wells (1986) also identified the existence of circadian rhythms from rectal temperature.

In their comprehensive overview of circadian rhythms in athletic performance, Winget et al. (1985) identified several other circadian rhythms. Cognitive functions such as long term memory recall follow a specific rhythm, as does pain perception and tolerance. "Self-rated mood, well-being, vigor, alertness, and minimal fatigue" also follow a specified rhythm (Winget et al., 1985, p. 503). Arousal levels follow a prescribed rhythm and are associated with the rhythms of peak strength and reflex/ reaction time. The rhythm of body temperature identified above contributes to the circadian rhythms of: rate of oxygen delivery and carbon dioxide removal, the relative impact of exercise on cardiovascular function, metabolic rate, nerve conduction velocity, enzyme action and maximum VO_2 (Winget et al., 1985).

Traveling across time zones may disrupt the body's circadian rhythm, since the external cues such as light and darkness may interrupt or disorient the body's sleep/wake schedule. This condition, known commonly as 'jet lag', is characterized by "disturbances of sleep, generalized feelings of malaise, and reduced performance capabilities" (Hill, Hill, Fields, & Smith, 1993). "Other symptoms include gastrointestinal disturbances, headache, loss of appetite, and impaired peripheral vision" (Haymes & Wells, 1986, p.123).

Hill, Hill, Fields, and Smith (1993) investigated the effect of travel on athletes and non-athletes making transatlantic trips. They found that for at least one day, both athletes and non-athletes showed a reduction in vigor, and an increase in fatigue and confusion. Additionally, strength data showed decreased peak power and speed of movement. They concluded that 'jet lag' indeed affected several states related to athletic performance and may be a factor in the home advantage when crossing the Atlantic (Hill, Hill, Fields, & Smith, 1993).

In a study of military personnel, O'Connor and Morgan (1990) found that long distance travel had several effects on sleepiness, fatigue, muscle soreness, and irritability. The following effects were reported (O'Connor & Morgan, 1990):

- Increased fatigue and sleepiness
- Weakness
- Performance decrements of 8-12% in the 270m sprint
- Performance decrements of 8-9% in the .8km run
- Mean reduction in peak torque of 13.3% (muscular endurance)

In their study of the effect of travel across time zones on measures related to sport performance, Hill et al. (1993) found that several capacities were reduced. A loss of vigour, an increase in fatigue, and an increase in confusion were reported and observed in

athletes and non-athletes alike. A disruption in sleep patterns was observed, and a decrease in peak power was measured (Hill et al., 1993).

Although much of the research has focused on the physiological processes underlying jet lag, the effect of travel on performance has been measured as well. As previously mentioned, Goldberg investigated whether 'jet lag' affected the divisional races in major league baseball (1988). He found that the top teams in each division were the ones who traveled the least. Additionally, in the first game of each series, Goldberg found that the team that had traveled the lesser distance won more of the games (1988).

In 1992, Pace and Carron expanded on this research. They looked at such factors as the number of time zones crossed, distance the teams traveled, and the game number of the road trip the visiting team was on. They found that early in road trips the visiting team was less successful; however, once they got used to the routine on the road, they tended to have more success (Pace & Carron, 1992). Overall, they found that the effect of travel on the home advantage was minimal (Pace & Carron, 1992).

In 1993, Courneya and Carron took this research one step further. They added the factors of series game number, length of home stand, and home travel to Pace and Carron's (1992) variables. Their study differed, however, in that they measured the effect on Double A baseball teams, who experience much worse travel conditions.

In their study, Courneya and Carron found that the only factor related to home advantage was the length of the visitor's road trip. As the visitor's road trip got longer and the home team's home stand got longer, the home team won a greater amount of the time (Courneya & Carron, 1992). However, they concluded that even though a statistically significant relationship was found between the length of the homestand and

the outcome of the game, travel was not justified as a meaningful contributing factor to the home advantage since this analysis included relatively few observations (Courneya & Carron, 1992).

Several other studies have examined the effect of travel in other sports. Jehue, Street, and Huizenga (1993) analyzed the effect of time zone travel in professional football. They hypothesized that when a team traveled across time zones, it was difficult for the body to adjust. Additionally, time zone changes often mean changes in the time the game is played for the players crossing time zones. For example, when an East Coast team plays at a West Coast team at 7:00 p.m. local time, the East Coast players are actually beginning play at 10:00 p.m. in terms of the time that their bodies think it is. The game may not be finished until after 1:00 a.m., relative time.

Jehue, Street, and Huizenga (1993) found that 'jet lag' may affect NFL win/loss records, specifically noting the fact that West coast teams showed a high winning percentage. They explained that this was due to the fact that it was easier for the body to adjust to games played earlier in the day than to games played later than usual.

The research to date has been mixed on whether travel as a game location factor influences the home advantage. Therefore, more systematic research is warranted. Pollard's argument (1986) that travel is more comfortable these days does not explain the fact that jet lag and a disruption of normal routine do still occur. Schwartz and Barsky's argument (1977) that the home advantage should be more pronounced later in the season may not take into account the fact that today's athletes are better conditioned, stronger, and able to withstand long arduous playing seasons. This argument also does

not account for the excellent care athletes are given, from nutritionists, strength and conditioning coaches, and athletic trainers.

The arguments set forth do not seem to rule out the relationship between travel factors and the apparent home advantage. Therefore, this study will attempt to examine the effects of travel on the home advantage in Major League Baseball.

Little systematic research has been conducted on the relationship between travel and the home advantage. Furthermore, those studies that have examined this research question have focused solely on the relationship between travel and the won/loss records of the home and visiting teams. This study will further develop this analysis by examining relationship between the individual travel factors and the specific performance measures.

There are several reasons why the relationship between travel and performance have been and should continue to be studied. In the theoretical sense, it is of interest to further examine why home teams seem to win a higher percentage of games than their visiting counterparts. For example, what specific area does travel have a relationship with—offensive factors, defensive factors, or both? Furthermore, when is this relationship most significant—during the early part of a road trip, or does the relationship become more pronounced as the road trip lengthens? Similarly, does the advantage for the home team become more significant the longer a homestand continues?

This research question is also of significance to baseball personnel. Some teams, due to their location, have to travel longer distances more frequently than others. The Seattle Mariners are situated relatively longer distances from their divisional opponents than the New York Yankees are. The longest distance New York has to travel to play

divisional opponents is to Detroit (649 miles). The longest distance the Mariners have to travel is to Arlington, TX (2131 miles). In fact, the shortest distance the Mariners have to travel to play a divisional opponent is to Oakland (810 miles)! If research should show that travel significantly affects a team's ability to win, the commissioner's office may need to revise the schedule to make it more fair to the Mariners and other such teams that have to travel longer distances (e.g., Florida Marlins).

Similarly, if this investigation shows the relationship between travel and a specific performance measure is meaningful, steps can be taken by the team's manager to minimize this relationship. For example, if the number of errors committed is found to be statistically explained by the number of miles traveled the previous night, but offensive production is found to be unaffected, a manager has several options by which to negate the disadvantage. He may choose to sit the offensive superstar who is normally weak defensively in favor of a steady, stable defensive player who is not as strong offensively.

The purpose of this study was to examine the relationship between travel and won/loss records and performance measures in Major League Baseball. A home advantage has been documented in several pieces of literature; however, no single factor has emerged as the singular reason. Based on the literature reviewed, it is suggested that the individual and team's ability to play up to their full potential may be affected by long distance travel, the number of time zones crossed, the number of days spent on the road, or a combination of all three. These effects may in turn lead to the home advantage, or at least contribute to its existence.

This study examines the 1997 Major League Baseball Season to determine whether a relationship exists between the travel factors and won/loss records, offensive performance measures, or defensive performance measures. The study is in response to the future research directions identified by Courneya and Carron (1992). This study attempts to isolate the various travel factors and assess their contribution to the differences found in the various performance measures in home and visiting teams.

The first research question examined in this study will be the relationship between the location of the game and won/loss records in Major League Baseball? The second research question examines the relationship between the miles traveled the day before, number of time zones crossed the day before, direction of travel, and number of game at home or away and the number of runs scored in Major League Baseball? The third research question assesses the relationship between the miles traveled the day before, number of time zones crossed the day before, direction of travel, and number of game at home or away and the number of hits generated in Major League Baseball? The fourth research question examines the relationship between the miles traveled the day before, number of time zones crossed the day before, direction of travel, and number of game at home or away and the number of errors committed in Major League Baseball? The fifth research question assesses the relationship between the miles traveled the day before, number of time zones crossed the day before, direction of travel, and number of game at home or away and the number of runs allowed in Major League Baseball? The sixth research question examines the relationship between the miles traveled the day before, number of time zones crossed the day before, direction of travel, and number of game at home or away and the number of double plays executed in Major League Baseball? The

seventh research question examines the effect of miles traveled the day before, number of time zones crossed the day before, direction of travel, and number of game at home or away on the outcome of games in Major League Baseball?

The performance measures examined in this study will include offensive and defensive determinants. Performance measures of won/loss record (outcome), total number of runs scored, total number of hits, number of double plays turned, number of runs allowed, and total number of errors will be examined.

CHAPTER 3

METHOD

The 1997 Major League Baseball season presented a unique opportunity to further study the relationship between travel and performance measures in Major League Baseball. In 1997, the concept of interleague play was introduced. With this new schedule, each Major League team played between 10 and 12 games against teams in the other league.

In 1997, teams played interleague opponents in their same respective divisions. Teams in the American League East played teams in National League East, teams in the American League Central competed against teams in the National League Central, and teams in the American League West went up against teams in the National League West. For example, the National League West San Diego Padres competed against the American League West Seattle Mariners, the Texas Rangers, The Oakland Athletics, and the Anaheim Angels. The American League Central Minnesota Twins played the National League Central Chicago Cubs, Cincinnati Reds, Pittsburgh Pirates, St. Louis Cardinals, and the Houston Astros. The National League East Florida Marlins contended with the American League East Baltimore Orioles, Boston Red Sox, New York Yankees, Detroit Tigers, and the Toronto Blue Jays.

As a result of these interleague contests, the normal scheduling of three game series was altered. Instead, many teams played multiple two game series. This new scheduling resulted in an increase in travel, and decrease in the number of days between traveling, and an increase in the time spent actually traveling. Therefore, the 1997 Major League Baseball season presented a unique opportunity to further study the relationship between travel and the performance measures in baseball.

Sample

Archival data was collected on Major League Baseball games played from May 1, 1997 through August 31, 1997. Games played during April were omitted due to the particularly inclement weather presented during the first month of the 1997 season. Performance variables were often affected due to the inclement weather, thus affecting the rest of the data and data analysis. Any games that were rescheduled and played from May 1 through August 31 were counted and analyzed as if they had been scheduled at that date from the start.

Major League rosters increase from twenty-five to forty players on September 1. Many teams choose to bring up their younger players in order for them to get some experience at the Major League level. Teams that see their likelihood of advancing to the playoffs as impossible or unlikely often opt to play these younger players on a more regular basis. As a result, these inexperienced players often do not put up statistics comparable to the regular players they replace. Therefore, the games from September 1 through September 30 were also omitted.

Data Collection

Data for each of the 1,539 games played during this time span were collected from the Baseball Server Website on the World Wide Web. Statistics from this website are generated from Baseball Weekly box scores and were assumed to be correct and accurate.

Coding of Dependent Variables

There were several dependent variables measured in this study. First was whether the home and visiting teams won or lost. Additionally, several performance measures were analyzed. Each of these performance measures are components that affect the outcome of the game (win/loss). These performance measures for each team (home/visiting) analyzed included:

- Outcome of the game
- Total number of hits
- Total number of runs
- Total number of errors committed
- Total number of double plays (defensive play resulting in two outs from one at-bat)
- Total number of runs allowed

Coding of Independent Variables

The first independent variable examined was the location of the game. Teams were designated either as playing at home (coded as 0) or playing on the road (coded as 1). There were a few exceptions during interleague play. In some cases the teams playing each other both represented the same city or same metropolitan area. The players on these teams stayed in their own homes and used their own mode of transportation to the field. Therefore both teams were coded as playing at home as this study was

designed to measure the effects of travel and not the home advantage per se. Cases where the Anaheim Angels played the Los Angeles Dodgers, the Chicago White Sox played the Chicago Cubs, the New York Yankees played the New York Mets, and the Oakland Athletics played the San Francisco Giants were coded using this exception.

The second independent variable investigated was the amount of distance traveled the day before the game. Home team travel distance was zero. Teams that were on the road but did not change locations the day before were assumed to have zero distance traveled also. If a team on the road had an off-day between series, their travel distance was also assumed to be zero on the first day of the new series. In all likelihood they traveled to the new city the night following the last game of the series and had an entire day to adjust. Distance traveled was measured in air miles, since in almost all cases, this was the mode of travel.

The third independent variable examined was the number of time zones crossed the day before the game. Again, the previous section notes apply, as many of the same conditions exist.

The fourth independent variable investigated was the direction of travel. Direction of travel was coded only if time zones were crossed. If no time zones were crossed, the direction of travel was coded as '0'. Otherwise, direction of travel was coded either as '1' (eastward travel) or '-1' (westward travel).

The fifth independent variable examined was the number of days spent on the road or at home. The coding for this variable for the first game played at home following travel the previous night would be zero. However, if the team returned home and had an off day before their first home game, this value would be one. The same applies to teams

on the road; however it is unlikely that a team would go on the road before it was necessary.

In terms of off days during a home stand or a road trip, off days were counted as a regular day on the road. For example, if a team was on the road for three days, had an off day, and began the second series on the road on the fifth day, the value of this variable would be five. The same applies to days off at home—they are still counted as a day at home.

Data Analysis

Once the data was collected, it was prepared for analysis. The data was first sorted by location. This sort by location was done to separate the data for series played at home and series played on the road. There was the possibility that as teams spent more time on the road, their performance levels may decrease, while the longer they played at home, their performance levels would increase. There was concern, then, that if left unsorted for location, these effects would cancel each other out.

Once the data was sorted, a stepwise multiple regression analysis was performed in order to determine the amount the independent variables contributed to the variance in the dependent variables. The first research question examined the relationship between the location of the game and the won/loss records. The independent variable is the location of the game (home or away), and the dependent variable was the outcome of the game.

The second research question examined the relationship between the number of miles traveled the night before, time zones crossed, direction of travel, and game number at home or away and the number of runs scored. The independent variables were the

travel factors and the dependent variable was the number of runs scored. The relationship between these travel factors and the number of runs each individual team scored was also examined.

The third research question examined the relationship between the number of miles traveled the night before, time zones crossed, direction of travel, and game number at home or away and the number of hits generated. The independent variables were the travel factors and the dependent variable was the number of hits generated. The relationship between these travel factors and the number of hits each individual team generated was also examined.

The fourth research question examined the relationship between the number of miles traveled the night before, time zones crossed, direction of travel, and game number at home or away and the number of errors committed. The independent variables were the travel factors and the dependent variable was the number of errors committed. The relationship between these travel factors and the number of errors each individual team committed was also examined.

The fifth research question examined the relationship between the number of miles traveled the night before, time zones crossed, direction of travel, and game number at home or away and the number of runs allowed. The independent variables were the travel factors and the dependent variable was the number of runs allowed. The relationship between these travel factors and the number of runs each individual team allowed was also examined.

The sixth research question examined the relationship between the number of miles traveled the night before, time zones crossed, direction of travel, and game number

at home or away and the number of double plays executed. The independent variables were the travel factors and the dependent variable was the number of double plays executed. The relationship between these travel factors and the number of double plays each individual team executed was also examined.

The seventh research question examined the relationship between the number of miles traveled the night before, time zones crossed, direction of travel, and game number at home or away and the outcome of the games. The independent variables were the travel factors and the dependent variable was the outcome of the game. The relationship between these travel factors and the outcome of each individual team's games was also examined.

There was a rationale for conducting multiple regression analyses for each individual team in addition to the composite analysis. Since some teams had a winning record both at home and on the road, and some teams generally lost wherever they played, there was concern that the individual team statistics of the good teams and bad teams would cancel each other out. This additional analysis allowed further investigation into the relationship between the travel factors and won/loss records and performance measures of each individual team. These additional multiple regression analyses involved the same independent and dependent variable as the analyses run on all of the teams together.

CHAPTER 4

RESULTS AND DISCUSSION

This study sought to examine the relationship between travel and several performance measures in Major League Baseball during the 1997 season. This chapter presents the results of an analysis of the existence of the home advantage during this period. Additionally, it presents the contribution of travel factors to the variance in won/loss records and each of the performance measures.

The Home Advantage

The home advantage for all Major League Baseball teams playing between May 1, 1997 and August 31, 1997 was calculated to be 53.25%. This figure, as explained earlier, coded some teams who played at an opponent's park as playing at 'home'. However, this coding involved only 10 data points out of 3,078 and therefore was relatively inconsequential.

This calculated home advantage for Major League Baseball is similar to the historical home advantage found in baseball of 54% (Thorn & Palmer, 1984). Additionally, this study's calculated home advantage of 53.25% is similar to the advantage found by Schwartz and Barsky (53%, 1977), Palmer (54%, 1978), Edwards (55.6%, 1979), and Pollard (53.6%, 1986).

The home advantage was determined by calculating each team's won-loss record at home and away. Winning percentages were then determined from this calculation. The home advantage was concluded to be the difference between the individual team's winning percentage at home and the team's winning percentage on the road.

The results of the calculation of home and away winning percentages and the differences between these figures (the 'home advantage') is summarized in Table 2. The totals for all of the teams are also highlighted. Careful inspection of the Table will show that there were more games played at home than on the road. This inconsistency is actually evident because of the interleague games between the Angels and Dodgers, Athletics and Giants, White Sox and Cubs, and Yankees and Mets. These games all involved two teams who were both essentially playing at 'home' for the purposes of measuring travel effects. The players stayed at their own residences, and little or no travel was involved in driving to the opponents' field. Therefore, both teams were coded as playing at home, and therefore the disparity exists.

In looking at the individual records, the difference between the home winning percentages and the away winning percentages (the 'home advantage') ranged from -9.09% (teams that actually had a higher away winning percentage) to 24.76%. The average difference in the home winning percentages and the away winning percentages was calculated to be 6.62%. In all, 23 out of the 28 teams had a higher winning percentage at home than they did on the road.

Table 2

The Difference Between Home and Away Winning Percentages

Team	Home record	Home win %	Away record	Away win %	Difference Between home WP & away WP	Overall record
Angels	33-22	60.00%	28-29	49.12%	10.88%	61-51
Astros	30-24	55.56%	24-31	43.64%	11.92%	54-55
Athletics	22-32	40.74%	18-39	31.58%	9.16%	40-71
Bluejays	28-29	49.12%	26-28	48.15%	0.97%	54-57
Braves	30-23	56.60%	35-21	62.50%	-5.90%	65-44
Brewers	34-23	59.65%	21-32	39.62%	20.03%	55-55
Cardinals	29-29	50.00%	23-30	43.40%	6.60%	52-59
Cubs	30-26	53.58%	17-35	32.69%	20.89%	47-61
Dodgers	37-20	64.91%	28-26	51.85%	13.06%	65-46
Expos	28-25	52.83%	25-32	43.86%	8.97%	53-57
Giants	31-26	54.39%	27-29	48.21%	6.18%	58-55
Indians	32-26	55.17%	27-22	55.10%	0.07%	59-48
Mariners	31-23	57.41%	27-28	49.09%	8.32%	58-51
Marlins	30-21	58.82%	34-24	58.62%	0.20%	64-45
Mets	33-22	60.00%	27-26	50.94%	9.06%	60-48
Orioles	32-23	58.18%	37-18	67.27%	-9.09%	69-41
Padres	27-27	50.00%	29-30	49.15%	0.85%	56-57
Phillies	25-28	47.17%	18-37	32.73%	14.44%	43-65
Red Sox	28-32	46.67%	27-25	51.92%	-5.25%	55-57
Rockies	33-25	56.90%	18-38	32.14%	24.76%	51-63
Royals	24-36	40.00%	19-32	37.25%	2.75%	43-68
Tigers	30-26	53.57%	22-30	42.31%	11.26%	52-56
Twins	24-32	42.86%	21-31	40.38%	2.48%	45-63
White Sox	33-21	61.11%	26-29	47.27%	13.84%	59-50
Yankees	32-22	59.26%	32-19	62.75%	-3.49%	64-41
Totals	827-726	53.25%	712-813	46.69%	46.69%	1539-1539

There were five teams who were more successful on the road than they were at home. Out of these five teams, three of them went on to win their respective division or qualify as a wild card participant in the playoffs (Braves, Orioles, and Yankees). These teams tended to win both on the road and at home. Of the remaining two teams, the Rangers won on the road only .22% more often than they won at home, and, in their case, it was more a matter of playing more often on the road (25-32) than at home (24-31). As for the Red Sox, which won more often on the road by 5.25%, this may be accounted for by the fact that they play in a stadium which is notorious for being difficult to play in regardless if you are the home team or a visitor. Additionally, the Red Sox started the month of May with an extended streak of losses, many of which happened to occur at home.

This study has shown that the data collected during the period of May 1, 1997 through August 31, 1997 in Major League Baseball is consistent with data compiled in other studies in terms of the existence of the home advantage. The 53.25% home advantage calculated by this study is consistent with other authors' findings in Major League Baseball (Thorn & Palmer, 1984; Schwartz & Barsky, 1977; Palmer, 1978; Edwards, 1979; Pollard, 1986). Therefore, this data will now be examined to examine the effects that travel has on the individual performance measures.

The next section will concentrate on determining the contribution that the travel factors have in explaining the variance in the performance measures. Specifically, the relationship between the miles traveled, time zones crossed, direction of travel, and game number at home or on the road have and the won/loss records and performance measures will be calculated.

Table 3

Home and Away Composite R-Square Values

Independent Variables	Runs	Hits	Errors	Allowed	Double Plays	Outcome
			Home			
Miles traveled	ns	ns	ns	ns	ns	ns
Time Zones Crossed	.0027	.0036	ns	ns	ns	ns
Direction of Travel	ns	ns	ns	ns	ns	ns
Game Number at Home	.002	.0015	ns	.0014	ns	ns
			Away			
Miles traveled	ns	ns	ns	ns	ns	ns
Time Zones Crossed	ns	ns	ns	ns	ns	ns
Direction of Travel	ns	ns	ns	ns	ns	ns
Game Number on road	ns	ns	ns	ns	.0015	ns

The Relationship Between Travel and Performance

A stepwise multiple regression was performed on the sorted data (sorted by location) to determine the relationship between the various travel factors (miles traveled, time zones crossed, direction of travel, and game number at home or on the road) and each of the performance measures (outcome, runs, hits, errors, double plays, and runs allowed). These analyses sought to determine the percentage that each of the travel factors, acting alone or in conjunction with each other, had on the each of the performance measures.

From the data generated by the stepwise multiple regression analysis, the R-square value was determined. This value shows what percentage of the variance in each

of the dependent variables (performance measures) can be accounted for by the independent variables (travel factors). Each independent variable is considered alone and in conjunction with each other variable to determine whether its contribution meets the .1500 criteria for entry into the model.

The results of the multiple regression analysis performed on all of the teams together is presented in Table 3. This table summarizes the R-square values for the relationship between each of the travel factors and each of the performance measures.

The Relationship Between the Travel Factors and Runs Scored

The first performance measure examined was the number of runs scored by all of the teams sorted by location. At home, the R-square value for the independent variables of time zones crossed and the game number at home was calculated at 0.0051. In other words, these two independent variables accounted for .51% of the variance seen in the number of runs the teams scored. No other independent variable met the criteria for entry into the model. On the road, no independent variables met the criteria for entry into the model.

Further investigation into the relationship between travel and the number of runs scored for each individual team showed slightly higher R-square values. Table 4 summarizes the results of the independent variables on the number of runs each team scored both at home and on the road. Independent variables not shown did not meet the criteria for entry into the model. Teams not shown did not have any independent variable meet the criteria for entry into the model.

Even though the variance in the number of runs scored was often explained by the travel factors, the amount of variance explained by these factors was relatively low. The

Table 4

Stepwise Procedure for Runs Scored

Team & Location	Independent Variables	R-square Value
Angels at home	miles and game number	.272
Angels on the road	miles	.058
Astros at home	miles	.045
Athletics on the road	direction	.082
Braves on the road	game number	.049
Brewers at home	zones crossed	.074
Brewers on the road	miles	.045
Cardinals on the road	direction	.043
Cubs at home	direction	.038
Expos at home	direction	.046
Indians at home	zones crossed	.080
Mariners at home	miles	.055
Marlins at home	miles	.056
Marlins on the road	direction and miles	.106
Padres on the road	zones crossed and miles	.083
Phillies at home	game number and miles	.138
Reds on the road	zones crossed	.106
Red Sox at home	game number	.068
Red Sox on the road	direction	.078
Rockies on the road	direction	.067
Royals at home	game number	.066
Royals on the road	zones crossed	.058
White Sox at home	game number	.075
White Sox on the road	game number and direction	.091
Yankees on the road	game number, direction, miles	.189

R-square values calculated for the stepwise multiple regression for runs scored for each team ranged from .036 to .272. In other words, at best, the travel factors only explained 27.2% of the variance in the number of runs scored. For example, for the Angels playing at home, the number of miles traveled the night before, in conjunction with the game number in the series, accounted for 27.2% of the variance in the number of runs scored.

In application, this is not a very meaningful explanation for the variance seen in the number of runs the Angels score at home.

The same can be said for the other R-square values generated for the stepwise multiple regression procedure for runs scored. Although in 25 cases the independent variables met the .1500 criteria for entry into the model, they did not adequately explain the variance seen in the number of runs scored by the teams.

The Relationship Between Travel and Hits

The second dependent variable analyzed for all of the teams combined was the number of hits each team had. At home, the R-square value for the independent variables of game number at home and the time zones crossed was calculated to be .00363. In other words, the game number at home and the number of time zones crossed the previous night accounted for 0.36% of the variance seen in the number of runs the teams had. No other independent variables met the criteria for entry into the model. On the road, no variables met the criteria for entry into the model.

Further investigation into the relationship between the travel factors and the number of hits the individual teams had yielded slightly higher R-square values. Table 5 summarizes these results. Any independent variable not shown did not meet the criteria for entry into the model. Any team not presented didn't have any independent variable meet the criteria for entry.

As was the case with the amount of runs the team scored, the R-square results for the stepwise multiple regression procedure for hits was relatively low. These values ranged from .041 to .207. In other words, at best, the independent variables could only explain 20.7% of the variance seen in the number of runs a team scored. For example, in

Table 5

Stepwise Procedure for Number of Hits

Team & Location	Independent Variables	R-square Value
Angels at home	miles	.207
Astros at home	miles	.045
Athletics on the road	direction and zone	.104
Blue Jays on the road	game number	.049
Braves on the road	game number and miles	.156
Cardinals at home	miles	.045
Cubs at home	direction	.047
Cubs on the road	miles	.049
Mariners on the road	miles and zones crossed	.104
Mets on the road	game number and zones crossed	.094
Orioles on the road	direction	.044
Padres at home	direction	.041
Phillies at home	game number and miles	.100
Phillies on the road	game number	.068
Pirates on the road	game number	.046
Rangers at home	game number	.048
Reds on the road	time zones crossed	.175
Red Sox at home	game number	.036
Red Sox on the road	direction	.078
Tigers at home	zones crossed	.047
White Sox at home	game number	.103
Yankees on the road	game number	.155

terms of the number of hits the Angels had at home, the number of miles traveled the night before could only explain 20.7% of the variance. Again, this value is not a meaningful explanation for the variance seen in the number of hits each team has.

The rest of the R-square values calculated by the stepwise multiple regression procedure for hits were all below .200. The travel factors in the other cases do not explain more than 20% of the variance seen in the number of hits each team had.

Table 6

Stepwise Procedure for Errors

Team & Location	Independent Variables	R-square Values
Angels at home	direction and miles	.155
Astros at home	game number	.044
Athletics at home	miles	.079
Blue Jays at home	game number	.080
Blue Jays on the road	miles	.063
Brewers at home	game number	.043
Brewers on the road	miles	.053
Dodgers at home	game number	.044
Dodgers on the road	game number	.080
Giants on the road	direction	.044
Mets at home	game number	.050
Padres at home	miles	.067
Phillies at home	game number	.058
Pirates at home	game number, zones, direction	.187
Pirates on the road	game number and miles	.117
Rangers at home	miles	.039
Rangers on the road	game number	.051
Red Sox on the road	miles	.091
Royals on the road	game number	.067
Tigers on the road	game number	.052
Yankees on the road	game number	.084

The Relationship Between Travel and Errors Committed

The number of errors committed was the next performance variable examined. A stepwise multiple regression analysis showed that no independent variables met the criteria for entry into the model at home or on the road.

When examining the teams individually, however, there were 21 cases in which dependent variables met the criteria for entry into the model. Table 6 summarizes these results.

As had been seen earlier in the case of runs scored, the independent variables had relatively little power in explaining the variance in the team's rate of committing errors. The R-square values for the 21 cases shown above range from .044 to .187. In other words, at best, the independent variables of travel factors could only explain 18.7% of the variance in the number of errors the teams committed. These values are relatively small and are relatively meaningless in explaining the errors committed by the teams.

The Relationship Between Travel and Runs Allowed

The number of runs allowed by all of the teams was the next independent variable being examined. At home, for the travel factor of the game number at home, the R-square value was calculated to be .00135. In other words, the game number at home could explain 0.13% of the variance seen in the number of runs allowed. No other independent variable met the criteria for entry into the model at home. On the road no variable met the criteria for entry into the model.

Further analysis into the relationship between the travel factors and the number of runs the individual teams scored showed slightly higher calculated R-square values. Table 7 summarizes these results.

The variance in the number of runs allowed was not substantially explained by the travel factors. Although in 20 cases at least one variable met the .1500 criteria for inclusion, the R-square values only ranged from .044 to .188. In other words, in the most substantial of the cases, the travel factors only accounted for 18.8% of the variance seen in the number of runs the teams allowed. In scientific analysis, this value does not meaningfully explain the variance seen in this performance measure.

Table 7

Stepwise Procedure for Runs Allowed

Team & Location	Independent Variables	R-square Value
Angels at home	zone	.080
Angels on the road	miles	.052
Astros at home	game number and miles	.089
Astros on the road	direction	.093
Blue Jays at home	game number	.066
Braves on the road	game number	.137
Cardinals at home	zone	.094
Cardinals on the road	miles	.061
Expos at home	game number	.060
Indians on the road	miles	.044
Mariners at home	miles	.052
Marlins on the road	direction	.163
Mets at home	game number	.047
Orioles at home	game number	.181
Padres at home	game number	.042
Rangers at home	zones crossed	.087
Royals on the road	direction and miles	.124
Tigers on the road	game number	.077
White Sox on the road	game number and miles	.188
Yankees on the road	miles and game number	.140

The Relationship Between Travel and Double Plays Executed

The number of double plays executed was the next dependent variable investigated for all of the teams. On the road, the only independent variable which met the criteria for entry into the model was that of the game number on the road. The R-square value calculated was .00152. In other words, the number of games spent on the road accounted for 0.15% of the variance seen in the number of double plays the teams executed. At home, no dependent variable met the criteria for entry.

Table 8

Stepwise Procedure for Double Plays

Team & Location	Independent Variables	R-square Values
Angels on the road	zones crossed	.073
Astros at home	game number and zones crossed	.272
Astros on the road	miles	.067
Blue Jays at home	direction and zones crossed	.331
Cardinals at home	miles and direction	.279
Indians on the road	direction	.085
Mariners on the road	miles	.095
Mets on the road	miles and zones crossed	.177
Orioles at home	miles	.073
Orioles on the road	direction and game number	.137
Pirates at home	direction	.058
Pirates on the road	direction	.073
Rockies at home	direction	.046
Rockies on the road	direction	.041
Tigers at home	zones crossed	.039
Tigers on the road	direction	.062
White Sox on the road	game number	.075
Yankees at home	zones crossed	.106

Further investigation into the relationship between the travel factors and the number of double plays executed showed the highest R-square values calculated. Table 8 summarizes these results.

As can be seen in Table 8, the amount that the travel factors explain the variance in the number of double plays executed in most cases is still not very large. However, this performance measure has the highest R-square value of .331. When the Blue Jays play at home, 33.1% of the variance in the number of double plays they execute can be explained by the direction of travel, and time zones crossed the night before. In other words, upon returning home, they tend to execute more double plays (slope is positive). Additionally, this performance measure includes the next two highest R-square values of

.279 and .272. These values are starting to reach the point where they are considered meaningful in social science research.

The Relationship Between Travel and the Outcome of the Games

The next performance measure on all of the teams together was the outcome of the game (won/loss). A stepwise multiple regression analysis showed that no independent variables met the criteria for entry into the model at home or on the road.

When examining the teams individually, however, there were 13 cases in which dependent variable(s) met the criteria for entry into the model. Table 9 summarizes these results.

This performance measure not only presented the fewest cases in which an R-square value was reported, but it also showed the lowest reported R-square values. The R-square values for the stepwise regression analysis of the outcome of the game ranged from .046 to .111. At best, the travel factors only accounted for 11.1% of the variance seen in the outcome of the game. These values are not meaningful in scientific terms. At the least, 88.9% of the variance in the outcome of the game was unexplained.

Analysis of the data reveals that the independent variables of miles traveled, time zones crossed, direction of travel, and game number at home or on the road do not account for very much of the variance in any of the dependent variables. The calculated R-square values for all of the teams together ranged from .0013 to .0036. The calculated R-square values for the teams examined individually ranged from .036 to .331. Although five cases reported R-square values above .25, little meaningful variance in the performance measures was explained by the travel factors.

Table 9

Stepwise Procedure for Outcome

Team & Location	Independent Variables	R-square Values
Athletics on the road	game number and direction	.083
Cardinals on the road	game number	.055
Cubs on the road	direction	.090
Dodgers at home	direction	.054
Expos at home	game number	.052
Expos on the road	zones crossed	.046
Indians at home	miles	.087
Marlins on the road	direction	.111
Reds on the road	miles	.107
Rockies at home	direction	.054
Royals at home	game number	.054
White Sox at home	game number and direction	.091
Yankees at home	miles	.053

Discussion

The results presented in this study are similar to the results uncovered by other researchers, both in terms of the existence of the home advantage and the relative insignificance of travel on the home advantage. This study's calculated home advantage of 53.25% for Major League Baseball is similar to the historical home advantage found in baseball of 54% (Thorn & Palmer, 1984). Additionally, this study's calculated home advantage is similar to the advantage found by Schwartz and Barsky (53%, 1977), Palmer (54%, 1978), Edwards (55.6%, 1979), and Pollard (53.6%, 1986).

The independent variables examined in the present study failed to account for any meaningful explanation for the variance in the dependent variables with the exception of the five cases in which the R-square values for the individual teams were above .25. The

R-square values calculated ranged from .036 to .331. At best, the travel factors accounted for 33.1% of the variance.

For the four cases in which the R-square value was calculated to be above .25, however, there may be some meaning and application to these findings. The direction of travel and number of time zones crossed accounted for 33.1% of the variance in the number of double plays the Blue Jays turned at home. The number of miles traveled the night before and the direction of travel accounted for 27.9% of the variance in the double plays executed by the Cardinals at home. The number of miles traveled the night before and the game number at home accounted for 27.2% of the variance seen in the number of runs the Angels scored at home. The game number at home and the time zones crossed accounted for 27.2% of the variance in the number of double plays the Astros executed at home.

These four cases show that although much of the variance remains unexplained by the travel factors, there is some degree of a relationship between the travel factors and the performance measures. Although these factors may be working in conjunction with the other facets of the game, there is some relationship between arriving home and being at home and the number of double plays the Astros, Cardinals, and Blue Jays executed. Additionally, there is some degree of a relationship between arriving at home and being at home and the number of runs the Angels scored.

However, these results must be interpreted with some caution. Even though the R-square values for these cases were found to have some meaning in explaining the variance in the performance measures, it is also possible that the error rate was inflated as a result of the numerous analyses.

At best, there was a minor degree of a relationship between the travel factors and performance measures. Travel was found to be a minor factor in explaining the variance in the won/loss records, runs scored, hits, errors committed, number of runs allowed, or double plays executed. The travel factors were even less meaningful when the teams were analyzed together. It is possible that values of the performance measures for the teams that were dominant wherever they played canceled out the values of the performance measures for the teams that performed inadequately wherever they played. It is also possible that the increased number of observations analyzed when examining all of the teams together resulted in an even further inflated the error rate.

Obviously there were other variables not measured by this study which contribute to the home advantage specifically, and the overall question of why exactly one team wins and the other loses. The following sections will examine the specific performance measures individually.

In looking at the relationship between travel and an individual teams' performance measures, the variables of runs scored and hits generated are considered together. The variance in the amount of runs scored was significant in 25 cases; the variance in the number of hits generated was significant in 22 cases. Most of the time a team that generates more hits also generates more runs. Therefore these variables were considered together.

In terms of the relationship between travel and the number of runs scored, the travel factors examined in this study accounted for between 3.6% and 27.2% of the variance. Even at the high end of 27.2%, the amount of explained variance is still relatively insignificant since 72.8% of the variance still remains unexplained.

In the case of the number of hits a team generates, the amount of variance explained by the travel factors ranged from 4.1% to 20.7%. As was the case with the number of runs the teams generated, the amount of explained variance for hits was relatively insignificant since at least 79.3% of the variance in the number of hits a team generates still remains unexplained.

There are many reasons that the travel factors may not substantially explain the variance in the number of runs scored or the number of hits a team generates. Baseball is a complex sport in which many factors coincide to determine how well the individual players and the team as a whole perform. For example, in most cases, scoring runs depends on generating hits in a timely basis. Players tired from the previous night's long trip may affect whether the players can generate these hits. This case would support the contention that travel plays a role in determining how well the players execute. However, if the players had spent the previous night out on the town, and as a result did not get enough sleep, this may also cause a decline in performance levels. Similarly, a fight with a family member the previous night may also affect a player's mindset. Whether the players were drinking the night before may also impact their effectiveness in generating hits or scoring runs. Since this study was not able to control for whether the players behaved themselves and got an adequate night's rest on the road or at home, this factor may also influence the study and affect the impact of the travel factors on the home advantage.

Other factors also come into play. Surely the quality of the opposing teams and the opposing pitchers must also be considered. This study failed to do that, relying on the generalization that all of the teams will face each other's best and worst pitchers at one

time or another. However, often this is not the case. A National League team that repeatedly faces Greg Maddux, Livan Hernandez, Kevin Brown, and the likes, will have difficulty generating runs regardless of whether they traveled the night before or whether they were playing at home or on the road. It is much easier to generate a lot of runs and hits against a pitching-poor team than against teams with quality pitching.

Another factor that affects how many runs and hits a team has may be which pitcher in the rotation that you face. Consistently meeting the third, fourth, or fifth starters makes scoring runs easier than constantly facing a team's first or second starters.

Related to the quality of the pitching is the factor of whether an opposing team has left-handed or right-handed pitching. A team with several lefties can often dominate teams consisting primarily of right-handed power hitters. This factor also could impact the number of runs and hits a team generates. Similarly, the type of pitches the rotation is capable of throwing may affect how many runs and hits the opposing team generates. A primarily breaking-ball pitcher generates a lot of ground balls, making it difficult to hit home runs. Also, with a breaking-ball pitcher, a slight mistake often is not costly, resulting in a hit rather than a home run.

Another factor which comes into play is when particular hits occur. Often the teams that are most successful and score the most runs are those which can get a hit at a crucial time in order to generate a run or prolong an inning. Whether this is skill, a breakdown in the opposition, or luck, sometimes the number of runs generated by a team has more to do with execution in critical situations. Travel may impact the ability for a player to come through in a critical situation; however, perhaps there are other factors

which must be observed more closely in trying to single out travel as a determinant of the number of runs a particular team generates.

Obviously, many other factors interact to explain the variance seen in the number of runs scored and the number of hits generated. The travel factors were insufficient in explaining this variance.

In terms of the effects of travel on the number of errors committed, the travel factors examined in this study accounted for between 4.4% to 18.7% of the variance. Even at the high end of 18.7%, the amount of explained variance is still relatively insignificant since 81.3% of the variance still remains unexplained.

As was explained in the number of runs scored and hits generated, there are many other factors that need to be considered in determining how many errors a team commits. Obviously, the players' mindset is of utmost importance. Letting one's mind wander just for one second to the fans in the stand, the evening's future activities, or previous events can result in the player misreading or misplaying a ball. This error made by an individual may affect the team as a whole, resulting in an additional run (or runs) being scored that inning.

The number of errors a team commits may also depend on the individual players' playing experience. Young players dealing with the pressures of a rookie season may be more likely to make mistakes. Also, young players are often not as ready to deal with raucous fans or the imposing media. This may lead to a decline in their confidence level, leaving the player more prone to making an error. Therefore, a team composed mainly of younger players may make more errors, generate less runs, and allow more runs to score against them.

In terms of the effects of travel on the number of runs allowed, the travel factors examined in this study accounted for between 4.4% and 18.8% of the variance. Even the explained variance of 18.8 is still relatively insubstantial since 81.2% of the variance still remains unexplained.

As was the case with the number of runs scored and the number of hits generated, there are many other factors which interact to explain the variance in the number of runs allowed. Many of the factors lie within the team's pitching—how well they are prepared mentally and physically, whether they are left-handed, what types of pitches they can throw.

The quality of the opposition must also be taken into account. Facing a weaker hitting line-up can allow the pitcher to dominate. However, facing strong lineups consistently increases the likelihood that the number of runs allowed will be high.

As was the case with the other performance measures examined, there are many other factors which come into play in determining the variance. In trying to separate and determine the relationship, therefore, researchers need to find a way to control for these other factors.

In terms of the relationship between travel and the number of double plays executed, the travel factors examined in this study accounted for between 3.9% and 33.1% of the variance. The majority of the values were relatively meaningless. However, three cases presented R-square values above 25% (Blue Jays, Cardinals, and Astros) which is at the lower end of being meaningful. The analysis data indicates that arriving home or being at home influences the number of double plays these teams

execute. Although the travel factors do in fact influence the variance seen in the number of double plays executed, they still fail to explain over two-thirds of the variance.

Interestingly, the relationship was most significant in explaining the variance of the number of double plays executed. In three cases the R-square value was greater than .200. This is especially interesting because this performance measure showed relatively little range. The number of double plays executed ranged from 0 to 4.

However, the fact remains that the travel factors failed to explain almost 70% of the variance. Double plays are a difficult variable to measure since so many factors must be evident before a team is even able to attempt to execute it. First, there needs to be a runner on base. Next, there needs to be less than 2 outs. Third, the opposing player must hit the ball into a situation where a double play might even be executed (fly-ball with the option of throwing a runner out, ground ball second-to-first, or a line drive that catches a player of the bag). So many factors need to be present just for this event to occur, that it is surprising that the travel factors account for as much of the variance that they do.

In terms of the relationship between travel and the outcome of the game, the travel factors examined in this study accounted for between 4.6% to 11.1% of the variance. Even at the high end of 11.1%, the amount of explained variance is still relatively insubstantial since 88.9% of the variance still remains unexplained.

The amount of variance that the travel factors accounted for was the least for the performance measure of the outcome of the game. Also, the outcome of the game presented the fewest number of cases in which the travel factors even met the .1500 criteria for inclusion into the stepwise regression analysis.

There can be many explanations for the outcome of the game being least significantly affected by the travel factors. Not only does the outcome of the game depend on all of the player and game factors looked at in the above variables, the outcome also depends on each of the individual variables as well.

Often times, a single player playing at below his potential for any of the above mentioned reasons may not result in a team's losing the game. However, if the team was facing a tough pitcher, and they themselves were putting out their fifth starter, all of these variables might then interact and cause the team to lose. There are so many variables interacting to determine the outcome of the game that the fact that travel factors account for less of the variance in this variable that the others is not surprising. In fact, the failure of travel factors to account for the variance in the outcome of a game in this study is supported by similar findings in another study.

In 1991, Courneya and Carron examined the relationship between season game number, length of home stand, length of visitor's road trip, whether the team traveled the night before, and whether the visiting team traveled the night before. A forced-entry multiple regression analysis was used to determine the amount of variance in whether the home team won or loss. The independent variables in Courneya and Carron (1991) were found to account for less than .5% of the variance in the outcome (won or loss). When including all possible two-way interaction effects and the main effects, only 1.2% of the variance was explained.

The present study reported a slightly lower relationship for the independent variables for all of the teams analyzed together than the Courneya and Carron study (1991) reported. However, it may be of some importance that the present study reported

a higher relationship for the independent variables than the Courneya and Carron (1991) study when analyzing the teams individually. In the Courneya and Carron (1991) study, the authors looked at the outcomes of all the teams together. This allowed one specific team that was dominant on the road to cancel out any advantage another team (or teams) had at home. It was for this reason that this study also sorted the data by team. By sorting the data, any effects of a dominant team would not affect the other teams' data and findings.

Still, however, travel was found to be a minor factor in explaining why an individual team won or lost, how many runs it scored, how many hits it had, errors it committed, number of runs it allowed, or double plays it executed. Obviously there were other variables not measured by this study which contribute to the home advantage specifically, and the overall question of why exactly one team wins and the other loses.

Major League Baseball is a game played by highly trained individuals; however, there are many opportunities for external and internal factors to affect how well a particular team plays. As the team depends on at least 9 players, and often more depending on substitutions and pitching changes, there are many player factors that contribute to whether a team is going to win or lose. Additionally, there are many game factors such as strength of opposition, timing of key plays, etc. Many times these factors are difficult or near impossible to measure. This study was not able to control for all of the various factors that go into determining how well a team plays: whether it wins or loses, how many runs it scores, hits it generates, errors it commits, runs it allows, or double plays it executes.

Future Directions

It is clear that there are many factors affecting the performance measures and outcome in the game of baseball. This study was not able to find a meaningful explanation for the variance seen in the won/loss records and the performance measures for each team. Obviously there are many other factors that need to be accounted for or controlled for which were not addressed in this study.

This study, however, did document the historical finding that the home team in Major League Baseball wins 54% of the time. A home advantage does exist. However, the travel factors, as measured here, did not adequately explain the variance seen in the won/loss records and the performance measures.

Perhaps the reason for not finding substantial explanation for the variance was that the nuances of travel contribute to the home advantage. Perhaps it is not the miles traveled, but the disruption of routine which gives the home team an advantage. The disruption of routine was not measured in this study. Therefore, a comprehensive field study involving comprehensive observation of habits on the road as compared to at home is warranted. This would involve an extensive multivariate analysis to be performed in order to try to explain the home advantage, the effects of travel, and the variance seen in the won/loss percentages, hits, runs, errors, runs allowed, and double plays executed.

Additionally, although the disruption of circadian rhythms was presented as a possible explanation for the home advantage, this factor was also not measured in this study. Perhaps to more fully understand the effects of travel, a comprehensive biological study examining these rhythms needs to be conducted.

Another alternative study may investigate the players' perceptions of the effects of travel. Although travel may not have any effects, perhaps the player's perception of travel effects may contribute to the home advantage. This study would involve extensive interviewing of the players' habits and perceptions both at home and on the road.

Further study into this area is warranted. Perhaps in spending time examining one particular team, researchers can determine the variables that need to be measured in trying to explain the variance seen in the performance measures. Additionally, perhaps individual studies can look at the different emotional, biological, or behavioral patterns of the individual players at home as compared to on the road. Regardless, further study in order to understand how and why the home advantage exists, and whether travel actually is a contributing factor, is warranted.

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IMAGE EVALUATION
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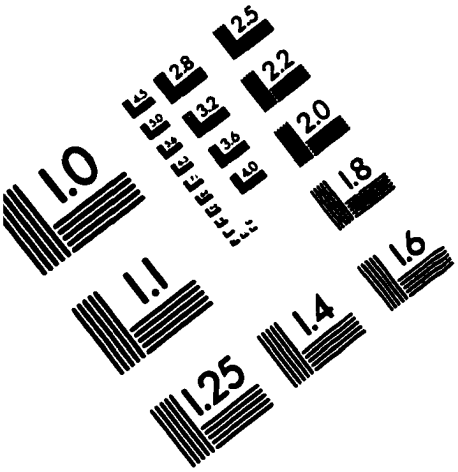

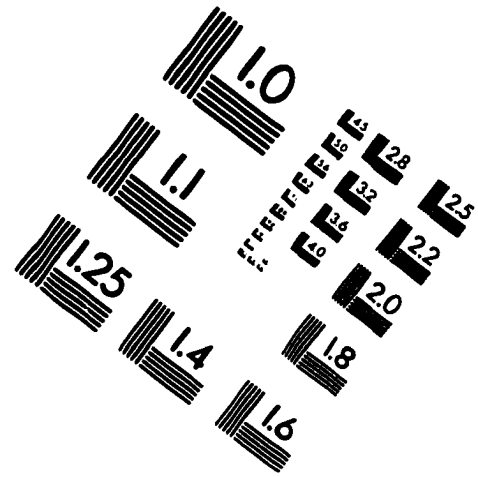

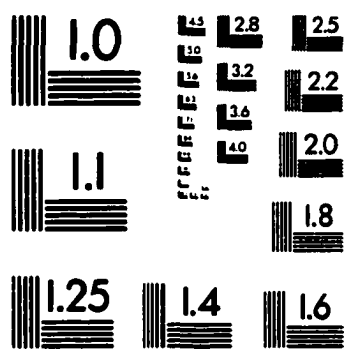

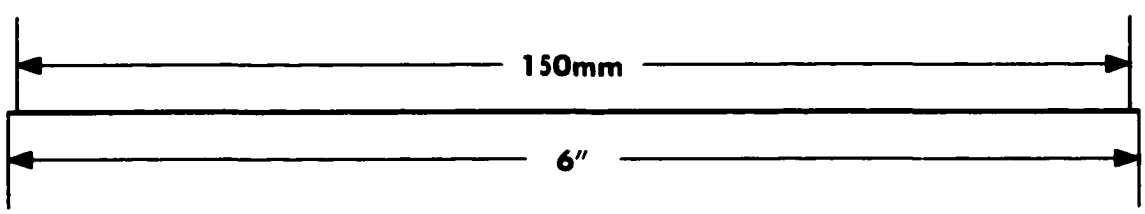

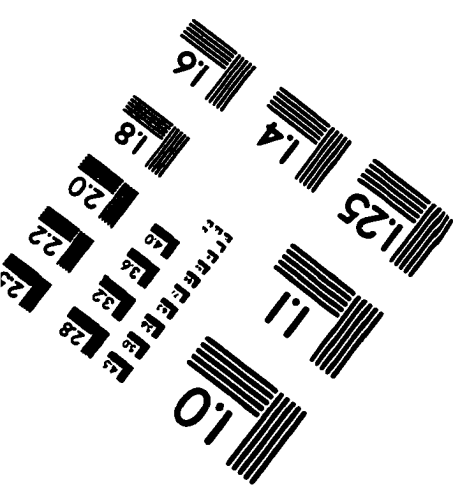

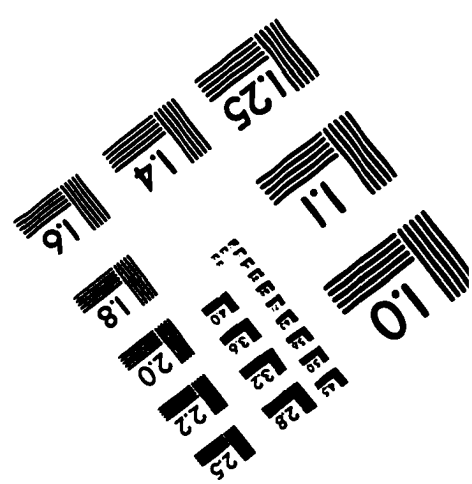

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