Football Betting Trends

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Acknowledgements

I would like to take this time to thank all of those who have contributed to my learning the past four years. This includes my parents, family, friends, and all of my professors who have assisted me in my academic endeavors. In addition, I would like to send a special thanks to Dr. Kelly Cline who has been my academic advisor during my time spent at Carroll College. Finally, I would especially like to thank Dr. Holly Zullo for advising me this past year as I worked on this thesis as well as my two thesis readers, Professor Philip Rose and Dr. Richard Lambert.
Abstract

This thesis examines multiple aspects of sports betting within the NFL. The purpose of this thesis was to determine whether or not a statistical advantage existed between general betting trends and whether or not these trends yielded favorable outcomes in the long run. In this thesis all of the NFL games from the 2009 season are placed into three ranges according to their corresponding point spreads. This thesis then uses a binomial test to check whether advantages existed by betting on the favorite or underdog. Money-line bets are also examined and the competitiveness of these games is based on the previously created point spread ranges. Within these money-line bets this thesis tests for statistical advantages by betting on either the favorite or the underdog from one point spread range to another. It also tests whether or not any of these bets would prove to be beneficial in the long run. In addition, this thesis examines the probabilities of coming out even by making a select few bets in a particular range. From these tests the results show that there was very little difference from one betting trend to another, and that most of them resulted in a net loss. However, the results suggest that in order to turn a profit gambling, more sophisticated trends must be used as well as focusing time and attention on the less obvious aspects of sports betting.
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Chapter 1: Introduction

People are constantly looking for ways to increase their wealth as fast as possible, with as little work as possible. One of the most common ways in which this is done is through gambling. Though I am not much of a gambler, I have always been interested in various forms of sports gambling such as point spreads, money-lines, and fantasy football. By simply viewing the odds of any particular game it is easy to predict which team is most likely to win. Also, it can be enjoyable to occasionally place small bets based on the gambler’s knowledge of a particular event. Nonetheless, there are plenty of gamblers who constantly engage in these financial risks over the course of many years. However, as seen by the wealth of money present in Las Vegas casinos, most gamblers’ attempts prove to be futile. Many gamblers believe that placing a bet on the favorite will yield a favorable outcome. While this is most likely the case for a single bet, I was curious to determine the long-term effect of following this trend in both point spreads and money-line bets for the sport of football. I also chose to study the effects of placing a bet on the underdog for a lengthy time period. Not only did I study the effects of simply betting on the favorite or underdog, but I also incorporated whether a team was a slight favorite or the favorite by a large margin. In addition, I tested whether or not a statistical advantage existed from one betting trend to another. Finally, instead of continuing to study long-term results I calculated the probability of coming out even in certain betting scenarios. This study allowed me to predict long-term outcomes of placing multiple bets as well as whether or not it is financially wise to continually practice any of my chosen trends.
Chapter 2: Point Spreads

In today's sports betting world one of the most popular bets revolves around point spreads. Point spread bets are made in a variety of different sports and differ amongst them. When examining the point spreads for a particular football game there are two teams listed with a corresponding value next to them. For example, a particular spread appeared on scoresreport.com during week 6 of the 2009 NFL season.

Ravens +3
Vikings -3

When examining point spreads, the team that has a negative value next to their name is the favorite to win the game. Therefore, the Vikings were the favorite to win the game listed above. If someone were to bet on the Vikings, they would have to win by more than three points in order to win the bet. In addition, if a bet was placed on the Ravens then they would have to lose by less than three in order to win the bet. Therefore, it can be easily seen that if the underdog wins the game the spread is automatically covered. Conversely, if the favorite loses their spread is not covered. In the game above, the Vikings were victorious by a score of 33-31. Even though the Vikings won, they did not cover their spread of three points. As a result, the winning bets for this spread went to those who placed money on the Ravens.

Sometimes spreads are denoted with a “pk” next to both games. This indicates that there is no clear favorite and someone placing a bet needs only to pick the winner of the game to win the bet. Though most games yield a clear winner after the point spreads are considered, some games result in a tie when the spreads are taken into account. Typically, when this occurs the person making the bet gets their money back or makes their next bet for free. However, the result of a tie varies from one betting organization to the other.
For my study on point spreads I wanted to try to find a betting strategy that yielded a statistically significant higher winning percentage than others. For this test I studied three different ranges of point spreads. These ranges are depicted in Table 1:

| Range 1 | (pk-3.5 where 3.5 is inclusive) |
| Range 2 | (3.5-7 where 7 is inclusive but 3.5 is not) |
| Range 3 | (Any spread greater than 7) |

Table 1: Point Spread Ranges

I chose the ranges listed above because these ranges portray a game’s relative competitiveness well. To study these particular ranges of point spreads I created a spreadsheet that listed every game from the 2009 season and the corresponding spread (Appendix A). The spreads were collected from various online sources ([1],[2],[3],[5],[7]).

Even though my choice of the 2009 season was not truly random, I am confident that the results will produce an accurate portrayal of what would be expected for any randomly chosen season. Once I had recorded all of the point spreads into a spreadsheet, I then sorted all of the games into the aforementioned ranges in a different spreadsheet. This resulted in 94 games in Range 1, 72 games in Range 2, and 90 games in Range 3 for a total of 256 games. Once this spreadsheet was complete I calculated the winning percentage of each range assuming a bet had been placed on the betting favorite. For games with no favorite, I assumed the home team was the favorite. From Range 1 the favorite yielded a winning bet 45 times out of 94 games, a winning percentage of 47.87%. Range 2 yielded winning bets while betting on the favorite 31 times out of 72 games (43.01% win percentage). Finally, Range 3 favorites yielded wins on 44 of the 90 total games (48.89% win percentage). To see if there was any statistically significant advantage from one range of spreads to another I chose to perform a binomial test on my data.
To compare my data I chose a null hypothesis that stated all of the ranges yielded a 50% chance of winning if a bet was placed on the favorite. This allows for a 50% chance of losing. Therefore, my null hypothesis was:

\[ H_0: P(\text{winning}) = 0.5 = P(\text{losing}) \]

Conversely, my alternative hypothesis was:

\[ H_A: p(\text{winning}) \neq 0.5 \]

For this study, as mentioned earlier, I chose to perform a binomial test. More specifically, I chose to use the normal approximation to the binomial test. In order to use the normal approximation the total sample size multiplied by the expected probability (0.5) must be greater than 10. This requirement was easily satisfied, as my smallest sample for any range was 72 games. The resulting product for this range is 36, thereby satisfying the aforementioned requirement. For this study I chose to use an \( \alpha \) value of 0.05. Using this value of \( \alpha \), I was able to find a range of values that would not lead to a rejection of the null hypothesis as shown below.

\[-1.96 \leq z \leq 1.96\]

In the range depicted above, \( z \) is the test’s resulting test statistic. Any test statistic outside this range would lead to a rejection of \( H_0 \). This rejection range is known as the “critical region.” To calculate the corresponding test statistic for all three of my point spread ranges I used Eqn. 1.

\[
z = \frac{x - p}{\sqrt{pq/n}} \quad \text{Eqn. 1}\]

In Eqn. 1 portrayed above, \( x \) is the number of winning bets per category while \( n \) is the sample size of the respective range. \( p \) is the is the expected probability of winning, which I assumed to be 0.5. In addition, \( q \) is the probability of losing, which is also 0.5. Using this equation I was able to calculate the test statistic for Range 1, Range 2, and Range 3. These calculations are displayed in Table 2.
Table 2: Binomial Test Statistics

None of the three test statistics shown above are in the rejection region. As a result, there is not sufficient statistical significance from any of the point spread ranges to warrant a rejection of the null hypothesis. I therefore conclude that over the course of time it is highly likely that no one range is statistically different from breaking even.

While my calculations depicted no apparent advantage by betting on certain point spread ranges, I decided to check whether or not a betting advantage existed by simply betting on either the home or away team. My null hypothesis once again claimed that there was no statistical advantage by betting for either the home or away team as shown below.

\[ H_0: P(\text{home}) = 0.5 = P(\text{away}) \]

Conversely, my alternative hypothesis was:

\[ H_1: p(\text{home}) \neq 0.5 \]

Instead of examining my entire spreadsheet of 256 games, I instead chose to study thirty randomly chosen games. The Central Limit Theorem assures that this sample size will provide an accurate result, in comparison to using the entire sample. To ensure randomness, I used Excel’s “RANDBETWEEN(bottom,top)” command. In Excel’s command I set my bottom and top values at 0 and 256 respectively. Then, using the website www.nfl.com, I was able to check how many of the aforementioned thirty games were won by the home team. I found that the home team was victorious in fourteen of the games, with the away team winning in the remaining sixteen. For this test I also used an \( \alpha \) value of 0.05, which once again resulted in a
rejection range of any test statistic greater than 1.96 or less than -1.96. Using Eqn. 1, I calculated the corresponding test statistics for betting on both the home and away teams. The calculations and their corresponding results are displayed in Table 3.

<table>
<thead>
<tr>
<th>Bet Home</th>
<th>Bet Away</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\frac{14}{30} - 0.5}{\sqrt{\frac{0.5 \times 0.5}{30}}} = -0.37$</td>
<td>$\frac{\frac{16}{30} - 0.5}{\sqrt{\frac{0.5 \times 0.5}{30}}} = 0.37$</td>
</tr>
</tbody>
</table>

Table 3: Binomial Test Statistics for Home and Away Bets

Once again, neither test statistic warrants a rejection of the null hypothesis. It can therefore be suggested that there is no statistical difference from breaking even by betting on the home or away team.

So far I had found no statistically significant advantage by betting on certain point spread ranges, or by simply betting on the home or away teams. Since all point spread ranges yielded very similar results I decided to calculate a confidence interval on the average margin of victory for the favorite. Though this interval does not portray a particular betting trend, it still provides additional insight into point spreads that could prove useful. Once again I used Excel’s “RANDBETWEEN” command to choose thirty random games from my spreadsheet. Then, I was able to find the margin of victory for both the favorite and underdog [4]. In my spreadsheet a win was denoted with a positive numerical margin, while a loss yielded a negative margin. After researching the data I calculated a sample mean of 5.83. For my confidence interval I once again used an $\alpha$ value of 0.05 which corresponds to a confidence level of 95%. To calculate this confidence interval I used Eqn. 2, as shown below.

$$\overline{x} - z_{\alpha/2} * s_{\overline{x}} \leq \mu \leq \overline{x} + z_{\alpha/2} * s_{\overline{x}} \quad \text{Eqn. 2}$$
In Eqn. 2  $$\bar{x}$$ is the sample mean which, as noted earlier, equals 5.83 and $$z_{\alpha / 2}$$ is the z-score that corresponds to my 95% confidence level, which in this case equals 1.96. Finally, $$s_{\bar{x}} = \frac{s}{\sqrt{n}}$$ where n is my sample size of thirty and s is my sample standard deviation of 14.59. Substituting these values into Eqn. 2 yielded the following results.

$$5.83 - 1.96 \times \frac{14.59}{\sqrt{30}} \leq \mu \leq 5.83 + 1.96 \times \frac{14.59}{\sqrt{30}}$$

$$0.48 \leq \mu \leq 11.18$$

This confidence interval allows me to conclude that I can be 95% confident that the favorite’s average margin of victory lies in this range. The large interval is most likely a result of the sample’s large deviation. Unfortunately, this range encompasses all of the point spread ranges from Table 1, thus providing no advantageous insight into point spread bets.
Chapter 3: Money-lines and Point Spread Ranges

In addition to point spreads another common type of bet is known as a money-line bet. When examining the money-line of a particular game, the two teams are listed with a corresponding value next to them. The team with the negative value listed next to them is the favorite to win the game while the team with the positive value is the underdog. Occasions occur when both teams have an identical negative value next to them. When this is the case neither team is the favorite. If both teams have negative values that differ then the most negative value correlates to the favorite. Unlike point spreads, money-line bets are straight-up bets, meaning you strictly bet on the winner or loser. A particular money-line appeared on www.sports-odds.com ([3]) during week 1 of the 2009 NFL season.

Dolphins 180
Falcons -220

In this particular money-line the Falcons were the favorite to win the game. The corresponding values refer to the amount of money a bet would yield depending on which team was picked to win. For example, a bet of $100.00 would have to be placed on the Dolphins to win $180.00. However, in order to win $100.00 by betting on the Falcons a bet of $220.00 would have to be made. For this particular game, this ratio would stay the same for all bet values. For instance, in order to win $10.00 on the Falcons one would have to risk $22.00. I was curious to see if one could be successful by betting on money-lines using the previous point spread categories depicted in Table 1. Therefore, using numerous online websites ([1],[3],[5]) I found all of the money-lines from the 2009 season and sorted them according to their corresponding point spread categories (Appendix B).

I first chose to test if one’s average winnings in the long-run were better from one point spread range to the next by placing all bets on the favorite. To do this I found the return, or loss, of each game assuming the bet was placed on the favorite. In Range 1 the average gain was -
0.307 (a loss of $0.307) and Ranges 2 and 3 yielded average gains of -0.648 and -0.631 respectively. Since I was examining long-term averages from one sample to the next, I decided to start by using a one-sample z test with an \( \alpha \) value of 0.05. I assumed that in the long-run one would average no return and no losses by betting on the favorite. My alternative hypothesis stated that in the long-run there would be a net loss. Therefore, my null hypothesis and alternative hypothesis were:

\[
H_0: \mu = 0 \\
H_A: \mu < 0
\]

To calculate the corresponding test statistics I used Eqn. 3. Since all of my sample sizes were over thirty I was once again able to assume normality based on the Central Limit Theorem.

\[
z = \frac{\bar{x} - \mu}{\frac{s_d}{\sqrt{n}}}
\]  
Eqn. 3

In Eqn. 3, \( \bar{x} \) is the sample mean, \( s_d \) is the sample standard deviation and \( n \) is my sample size.

Since this was a one-tailed test an \( \alpha \) value of 0.05 corresponded to the following critical range:

\[z \leq -1.64\]

The calculated test statistics for each range are displayed in Table 4.

<table>
<thead>
<tr>
<th>Range 1</th>
<th>Range 2</th>
<th>Range 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{-0.307 - 0}{\frac{1.123}{\sqrt{94}}} = -2.61 )</td>
<td>( \frac{-0.648 - 0}{\frac{1.464}{\sqrt{94}}} = -3.73 )</td>
<td>( \frac{-0.631 - 0}{\frac{2.356}{\sqrt{91}}} = -2.56 )</td>
</tr>
</tbody>
</table>

*Table 4: Z Test Test-Statistics of Money-line Bets (Betting on Favorite)*

All three of the ranges yielded test statistics that warranted a rejection of the null hypothesis. This test suggests that simply betting on the favorite from one range to another will result in an average long-term loss. I also noted the probability of winning any given money-line
bet from one range to the other by placing a bet on the favorite. The respective winning probabilities from range to range for both the favorite and the underdog are shown in Table 5. I am confident that these probabilities are extremely close to the actual probabilities due to my large sample sizes.

<table>
<thead>
<tr>
<th></th>
<th>Range 1</th>
<th>Range 2</th>
<th>Range 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favorite</td>
<td>56.4%</td>
<td>66.2%</td>
<td>84.6%</td>
</tr>
<tr>
<td>Underdog</td>
<td>43.6%</td>
<td>33.8%</td>
<td>15.4%</td>
</tr>
</tbody>
</table>

*Table 5: Money-line Winning Probabilities*

Before moving on to other tests I decided to perform the same calculations assuming that a bet had been placed on the underdog. Even though the probabilities of winning any given bet are less, a winning bet yields a much larger return compared to a winning bet from betting on the favorite. I also noted that the probability of winning a Range 1 bet assuming a bet was made on the favorite was not over 50% by much. This led me to believe that I may see a statistically significant advantage by betting on the underdog in Range 1. The resulting sample averages were as follows: Range 1 had an average return of 0.038, Range 2 had an average return of 0.084, and finally Range 3 had an average return of $-0.174$. Ranges 1, 2, and 3 had sample standard deviations of 1.198, 1.542, and 2.068 respectively. As I expected, Range 1 yielded an average positive return and I was surprised to see that Range 2 had an even higher return than Range 1. However, due to the low probability of winning a bet in Range 3 the average return was negative. For this test I used the same null and alternative hypothesis as I used for the bets on the favorite. Once again I used an $\alpha$ value of 0.05. I used a one-tailed test which resulted in the following region that would fail to reject my null hypothesis.

$$-1.64 \leq z$$

I then used Eqn. 3 to calculate each range’s test statistic assuming a bet was placed on the underdog. The results are in Table 6.
Unlike the test statistics depicted in Table 4, none of the resulting test statistics in Table 6 warrant a rejection of the null hypothesis. While the test statistics that corresponded to betting on the favorite suggested a long term negative average, the test statistics from betting on the underdog do not indicate that there is a long-term average loss. Therefore, I conclude that it may be possible to at least break even even by betting on the underdog.

Even though the one-sample z test did not demonstrate any statistically significant difference regarding the underdog bets, I knew that there existed a much more efficient method to check for a difference between the underdog bets. This test is known as an analysis of variance (ANOVA). I used this test for this scenario to determine if there was a significant difference between the underdog means. In general, the ANOVA test is a technique that uses sample information to test hypothesis regarding differences among population means. This would allow me to analyze if it was actually more efficient to bet on either Range 1 or 2, as opposed to Range 3. My null and alternative hypotheses for this test were as follows.

$H_0: \mu_1 = \mu_2 = \mu_3$

$H_A: \text{None of the means are equal}$

To perform this test I first chose thirty random bet-return values from all three ranges. I once again used the “RANDBETWEEN” command in Excel to ensure randomness. This yielded a table with thirty rows and three columns. The columns were titled Range1, 2 and 3. For this calculation I used Excel’s Data Analysis feature. Since the only variation between my samples

<table>
<thead>
<tr>
<th>Range 1</th>
<th>Range 2</th>
<th>Range 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{0.038-0}{\sqrt{\frac{1.198}{30}}} = 0.30$</td>
<td>$\frac{0.084-0}{\sqrt{\frac{1.542}{30}}} = 0.52$</td>
<td>$\frac{-0.174-0}{\sqrt{\frac{2.068}{30}}} = -0.80$</td>
</tr>
</tbody>
</table>

Table 6: Z Test Test-Statistics of Money-line Bets (Betting on Underdog)
was the point-spread values, I used the Single Factor ANOVA test. For this test my \( \alpha \) value was 0.05. Excel’s ANOVA output is shown in Table 7.

**Table 7: ANOVA Test Results for Underdog Average Returns**

As portrayed in Table 7, the averages for all three ranges have changed from the previous values of 0.038 (Range 1), 0.084 (Range 2), and -0.174 (Range 3). This change resulted from my random selection of thirty games in each range, as opposed to calculating the averages from all the games in each range. However, the ANOVA test checks for a significant difference between the means from one group to another; therefore this did not concern me. Also, since I chose thirty games from each range I was confident the results would still be accurate. In the table titled ANOVA “SS” is the sum of the squares, “df” is the degrees of freedom, “MS” stands for Mean Square, “\( F \)” is the F test-statistic, and “\( F \) crit” is the critical F value. The formula for a one-way ANOVA F test-statistic is defined in Eqn. 4.

\[
F = \frac{\text{variance between groups}}{\text{variance within groups}} \quad \text{Eqn. 4}
\]

By examining Table 7 it can be seen that the critical value for this test is 3.10. This means that in order to reject the null hypothesis the F test statistic would need to be greater than this value. Since the value of \( F \) is 2.55 I cannot reject the null hypothesis. As a result, I
conclude that betting on the underdog in one particular range will not result in a statistically significant advantage from one range to the other.

As seen in Table 6, none of my underdog bets warranted a rejection of my null hypothesis, while in contrast, Table 4 displayed results which did warrant a rejection. Due to these results, I chose to test whether or not there was a significant difference between the means of the “underdog” ranges and the means of the “favorite” ranges. To do this I used the “difference between means” test. An $\alpha$ value of 0.05 was used for this test. For this test I compared the underdog Range 1 mean with Ranges 1, 2, and 3 from the favorite bets. I would perform the same test for underdog Ranges 2 and 3. Since I was testing if the means of the underdog bets were larger than those of the favorite bets I used a one-tailed test. The null hypothesis, alternative hypothesis, and critical region for this test are as follows:

$$H_0: \mu_{U1} - \mu_{F1} = 0$$

$$H_A: \mu_{U1} - \mu_{F1} > 0$$

$$z \geq 1.64$$

In my null hypothesis, $\mu_{U1}$ stands for the mean of the underdog from Range 1. Similarly, $\mu_{F1}$ corresponds to the mean of the favorite from Range 1. The same notation will be used throughout the test for Ranges 2 and 3. To calculate a test statistic for this method I used Eqn. 5.

$$z = \frac{(\bar{x}_{U1} - \bar{x}_{F1}) - (\mu_{U1} - \mu_{F1})}{\sigma_{\bar{x}_{U1}-\bar{x}_{F1}}} \quad \text{Eqn. 5}$$

The denominator term $\sigma_{\bar{x}_{U1}-\bar{x}_{F1}}$ is defined below in Eqn. 6.

$$\sigma_{\bar{x}_{U1}-\bar{x}_{F1}} = \frac{\sigma_{U1}^2}{n_{U1}} + \frac{\sigma_{F1}^2}{n_{F1}} \quad \text{Eqn. 6}$$
For this test I randomly chose thirty values from each of the three Ranges for both the favorite and underdog. Since my samples sizes were at least thirty I was able to use the sample standard deviations instead of \( \sigma \). Table 8 portrays the test statistics of all nine calculations.

<table>
<thead>
<tr>
<th>Range U1 &amp; Range F1</th>
<th>Range U1 &amp; Range F2</th>
<th>Range U1 &amp; Range F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.939 = \frac{(0.023 - -0.269) - (0)}{0.312} )</td>
<td>( 1.69 = \frac{(0.023 - -0.564) - (0)}{0.346} )</td>
<td>( 1.59 = \frac{(0.023 - -0.603) - (0)}{0.395} )</td>
</tr>
<tr>
<td>Range U2 &amp; F1</td>
<td>Range U2 &amp; F2</td>
<td>Range U2 &amp; F3</td>
</tr>
<tr>
<td>( 0.395 = \frac{-0.132 - -0.269 - (0)}{0.348} )</td>
<td>( 1.14 = \frac{-0.132 - -0.564 - (0)}{0.379} )</td>
<td>( 1.11 = \frac{-0.132 - -0.603 - (0)}{0.424} )</td>
</tr>
<tr>
<td>Range U3 &amp; F1</td>
<td>Range U3 &amp; F2</td>
<td>Range U3 &amp; F3</td>
</tr>
<tr>
<td>( -1.38 = \frac{-0.693 - -0.269 - (0)}{0.307} )</td>
<td>( -0.378 = \frac{-0.693 - -0.564 - (0)}{0.342} )</td>
<td>( -0.231 = \frac{-0.693 - -0.603 - (0)}{0.391} )</td>
</tr>
</tbody>
</table>

Table 8: Difference between Means Test Statistics

When comparing Range U1 with Range F2 a test statistic of 1.69 resulted from the calculation. This warrants a rejection of my null hypothesis and suggests that it is better to bet in Range U1 than Range F2. None of the other calculations yielded a significant difference between samples.

By examining my results regarding point spreads and money-line bets I inferred that it is difficult to come out ahead by simply betting the same way every time over the course of a season or many years. The binomial test on point spread ranges suggested that there was no advantage by betting on any one range of point spreads. However, using the point spreads to make money-line bets may lead to favorable outcomes in the long-run. Though betting on the favorite suggested long-term losses in all three ranges, betting on the underdog suggested that it is possible to break even and maybe even come out ahead. Though I could have continued to test trends regarding long-term averages I am confident I would continue to see results
similar to those I had already calculated. I therefore chose to study the probabilities of at least breaking even by making a select few bets.
Chapter 4: Range-by-Range Probabilities

While many avid gamblers choose to consistently place bets over the course of many years, a different breed of gamblers exist who limit their risk-taking to a select few events. A particular event in which these financial risks are extremely prominent is a vacation to Las Vegas. While at Las Vegas, sports enthusiasts often place many bets at once in hopes of a quick return. As a result, I chose to compare the money-lines of the various Table 1 ranges in terms of probabilities. This study would allow a gambler to decipher which range had the best chance of breaking even on a select few bets over the course of a single weekend or select few weekends. For this study I assumed the bet-placer would be willing to risk one-thousand dollars and make ten equal bets of one-hundred dollars apiece. All ten bets would be placed on either the favorite or the underdog from one specific point-spread range. However, whether or not they break even would be determined by the money-line odds.

From Table 5 I knew that the favorite was victorious 56.4% in Range 1, 66.2% of the time in Range 2, and 84.6% of the time in Range 3. Due to my large sample sizes from one range to another I was confident that these percentages were accurate depictions of the actual probabilities, and were therefore sufficient to incorporate into my study. I calculated both the average return one would receive had they bet on the favorite as well as the underdog from one range to another. As noted earlier, a select few instances occurred in which both teams were designated a negative money-line value. This indicates that neither team is the favorite. Had I incorporated these negative values into the underdog average I am confident it would provide an inaccurate depiction of the average return. This was a result of my proposed betting scenario in which a bet is being made on a clear favorite. As a result, I did not include these select few games in this study. The resulting average returns for successful bets from range to range are shown in Table 9.
Using these values I then calculated the number of bets out of ten a gambler would have to win to break even. In order to calculate this number I solved Eqn. 7 for \( x \). In Eqn. 7, \( x \) is the required number of winning bets to break even and \( r_r \) is the corresponding range return depicted in Table 9.

\[
x + x \cdot r_r - (10 - x) = 10
\]

Eqn. 7

I based Eqn. 7 on ten one-dollar bets. This same equation can be applied to my previously suggested scenario of ten one-hundred dollar bets. In Eqn. 7, the first \( x \) was used to account for winning the dollars back that were bet. The term \( x \cdot r_r \) was used to represent the money won as a result of the bet’s average return. Finally, the term \( (10 - x) \) represents the dollars lost as a result of the losing bets. To further illustrate how this equation works I chose to show an example. For my example I assumed that the better bet on the favorite in Range 1 and won six of the bets. Assuming the better began with ten dollars, the calculation to find the resulting amount is shown below:

\[
\frac{1}{\text{bet}} (6 \text{ bets won}) + \frac{1}{\text{bet}} (6 \text{ bets won} \cdot .596) - \left(10 - \frac{1}{\text{bet}} 6 \text{ bets won}\right) = 5.58
\]

Since each bet was in the magnitude of one dollar, this gambler would have left with $5.58, in contrast to arriving with $10.00.

The values of \( x \) that satisfied Eqn. 7 for the respective scenarios are shown below in Table 10.
This study focuses on a discrete number of bets. Therefore, the ceiling of each of the values in Table 10 was applied in order for this study to be realistic. For instance, in this scenario it is impossible to win 7.7 bets. The adjusted values that would be used for the rest of the study are shown in Table 11.

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Table 10: Number of Winning Bets Required to Break Even from Range to Range

To calculate the probability of breaking even on ten underdog or favorite bets from any particular range I used the Binomial Probability Equation expressed below in Eqn. 8.

\[
P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k} \quad \text{Eqn. 8}
\]

In Eqn. 8, \( k \) is the number of successes, \( n \) is the number of trials, and \( p \) is the probability of the event occurring. Finally, Eqn. 9 shows the calculation of the term \( \binom{n}{k} \).

\[
\binom{n}{k} = \frac{n!}{k!(n-k)!} \quad \text{Eqn. 9}
\]

As an example calculation I assumed a bet was placed on the favorite in Range 1. This means that of the ten bets, at least eight would need to be victorious to come out even. The probability of at least eight victories is equal to the sum of the probability of winning eight, nine, and ten times. This notation is shown below.

\[
P(\geq 8) = P(X = 8) + P(X = 9) + P(X = 10)
\]
Therefore, I used Eqn. 8 and Eqn. 9 to calculate the three probabilities portrayed above and then calculated the sum of the three. For instance, to find calculate the probability of the $P(X = 8)$ term I began by finding the value of $\binom{n}{k}$. This calculation is shown below:

$$\binom{n}{k} = \frac{10!}{k!(10-k)!} = 45$$

Next, I substituted this value into Eqn. 8. In addition, from Table 5 I knew that the probability of the favorite winning in Range 1 was 56.4%. Therefore, using this value of $p$ I was able to finish the calculation as shown below:

$$P(X = 8) = 45 \times 0.564^8 (1 - 0.564)^{10-8} = 0.0876$$

Using these same calculations I found that $P(X = 9) = 0.0252$ and $P(X = 10) = 0.0033$. Adding these three values resulted in a value of .116. This result means that by betting on the favorite in Range 1 ten times the better would come out even 11.6% of the time. Using this technique I calculated the probabilities for the remaining ranges. Table 12 shows the probabilities of breaking even for all of the remaining scenarios.

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*Table 12: Probabilities of Breaking Even from Range to Range*

From my results it is apparent that it is unwise to place ten bets of equal value in any of the specific ranges listed above while betting on strictly the underdog or favorite. However, betting on the underdog in any range has a higher probability of breaking even than any of the favorite probabilities.
Chapter 5: Conclusion and Future Work

By examining my results I realized that the majority of my tests did not portray a statistically significant advantage from one trend to another. For instance, my binomial test on point spread ranges showed no advantage by betting on the favorite from one range to another. Similarly, there was no advantage present when betting on the home team in comparison to the away team. Next, I chose to use my point spread ranges as a means to gauge the predicted competitiveness of individual games and thus apply it to money-line bets. From these tests I found that the only statistical advantage occurred when betting on the underdog in Range 1 compared to the favorite in Range 2. Finally, when examining ten individual bets I learned that it is more favorable to bet on the underdog in any of the ranges than the favorite.

Though I did not find much of a statistical advantage from one trend to the other, I indirectly learned ways that are almost certain to produce a net loss. For instance, by continually betting on the favorite in money-line bets a net loss is almost certain. However, it is plausible that a gain may result from betting on the underdog. In addition, by betting on strictly the favorite or underdog on a select few individual bets, the probability of breaking even was at best roughly 25%. These tests further show that a lackadaisical approach to sports betting will, more often than not, result in losing money. This is due to the fact that the sports betting industry is constantly studying general betting trends and adjusting the betting lines to optimize their profit. However, this industry cannot fully study every trend or sport in depth. For instance, while a casino can study NCAA basketball as a whole, they cannot possibly be as knowledgeable of a certain conference as a gambler who devotes all of his interest into gambling within that particular conference. This same gambling approach can be applied to many aspects of numerous sports.
Through these tests I was able to ensure that it is difficult to beat the odds by betting on common gambling trends. This gives more credence to my idea that this industry devotes a large portion of their time to examining the specific trends that I tested. I am confident that more complex trends focused on individual conferences and teams will yield a statistical advantage in comparison to those I studied, and most likely a favorable return. As a result, with more time I plan on studying the effects of betting on these complex trends. Also, in the future I plan on running simulations on the tests I performed to compare my results to the simulations.
References


### Appendix A

#### Week 1
- **Giants** vs **Texans**
- **Dolphins** vs **Bengals**
- **Chiefs** vs **Packers**
- **Browns** vs **Panthers**
- **49ers** vs **Steelers**

#### Week 2
- **Giants** vs **Bengals**
- **Chargers** vs **Packers**
- **Rams** vs **Bears**
- **5** vs **Packers**
- **Rams** vs **Steelers**

#### Week 3
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 4
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 5
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 6
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 7
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 8
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 9
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 10
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 11
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 12
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- **Bears** vs **Packers**
- **5** vs **Packers**
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- **Panthers** vs **Bears**

#### Week 13
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 14
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
- **5** vs **Packers**
- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 15
- **Giants** vs **Chargers**
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- **Panthers** vs **Bears**

#### Week 16
- **Giants** vs **Chargers**
- **Bears** vs **Packers**
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- **Steelers** vs **Bengals**
- **Panthers** vs **Bears**

#### Week 17
- **Giants** vs **Chargers**
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- **Panthers** vs **Bears**

#### Week 18
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#### Week 19
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#### Week 20
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#### Week 21
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