**NFL Point Spreads and Game Scores**

Review of inference for means and proportions

The **NFLPointspread.csv** dataset has information on scores and point spreads from all regular season National Football League (NFL) games in the 2023 and 2024 season. The point spread is a mechanism to make it hard to predict the “winner” of any game by adding a pre-determined number of extra points to what is perceived to be the weaker team’s (the *underdog*) score. In order to “win against the points” (or *cover*), the favored team must win by more points than the point spread. If the underdog wins the game outright or finishes within the point spread of the winner’s score, they win against the points.

**Example**: The Kansas City Chiefs played at the Buffalo Bills in week #12 of the 2024 season and Buffalo was a 2.5 point favorite. The final score was Buffalo 30 - Kansas City 21, so Buffalo won against the points. If Kansas City had scored one more touchdown to make the score 30-28, they would have covered the 2.5 spread.

In theory, the point spread makes the game a toss up, so either team has a 50% chance of winning. In practice, the point spreads are often chosen to try to get an equal amount of action on either side of the bet. We use point spreads from ESPN's Pigskin Pick'em Game which are all in "half points" (1.5, 2.5, etc.) so there is always a "winner" against the points.

How well do the point spreads do at predicting the actual game outcomes? Do they properly account for any home field advantage? These sorts of questions are the topic of this worksheet. For each question your initial task is to identify the appropriate inference procedure needed to investigate this question using the **NFLPoints.csv** data. The procedure might

* Be a confidence interval or hypothesis test
* Use means or proportions
* Deal with one or two samples (or paired data)

Hints: A question about estimating how the size of some quantity would generally involve a confidence interval while a yes/no question often signals a test. Think about whether the relevant variables are quantitative or categorical to help decide between inference for means or proportions. Warning – at least one question should not need statistical inference!

Data in **NFLPoints.csv** for 544 regular season NFL games in 2023 and 2024

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| **Variable** | **Description** |
| *FavScore* | Points scored for the favored team |
| *Favorite* | Team name for the favored team |
| *Pts* | Point spread |
| *Underdog* | Team name for the underdog team |
| *DogScore* | Points scored by the underdog team |
| *FavCover* | 1=Favorite wins against the spread, 0=Underdog covers |
| *FavDiff* | Favorite’s score minus underdog’s score |
| *FavWin* | Favorite wins the game outright |
| *HomeDog* | 1=Home team is the underdog, 0=Away team is the underdog |
| *HomeScore* | Points scored for the home team |
| *AwayScore* | Points scored for the away team |
| *HomePts* | Point spread for the home team (negative is a home underdog) |
| *HomeCover* | 1=Home team covers the spread, 0=Away team covers |
| *HomeDiff* | Home team score minus Away team score |
| *HomeWin* | Home team wins the game outright |
| *Week* | Week of the regular season (1-18) |
| *Year* | Year of the season (2023 or 2024) |

Source: ESPN’s Pigskin Pick’em game for 2023 and 2024

**20 Questions:**

1. What proportion of the time does the favored team actually win the game outright?
2. Is the chance the favorite covers the spread discernibly different from 0.50?
3. How different is the average point spread when the favored team is playing at home as compared to the favorite playing on the road?
4. Many football fans say that the home field advantage is about a field goal (three points). Is the average home margin (*HomeDiff*) discernibly different from three points?
5. Is there convincing evidence that the average point spread assigned to the home team (*HomePts*) is different from three points?
6. Estimate the mean difference between the point spread (*Pts*) and the actual margin for the favored team (*FavDiff*). Note that the margin will be negative if the favored team loses.
7. Is there convincing evidence that point spreads (Pts) tend, on average, to underestimate the margin for the favored team (*FavDiff*)?
8. What is the average absolute value of the difference between the point spread (*Pts*) and the actual game margin (*FavDiff*)?

Do point spreads get more accurate as the season goes along? Address this in two ways:

1. Is the proportion of games where the favored team wins higher during the second half of the season (weeks 10-18) than the first half of the season (weeks 1-9)?
2. Refer to the absolute value of the difference between the point spread (*Pts*) and the actual game margin (*FavDiff*) from question #8. Is the average discrepancy smaller in the second half of the season than the first half?
3. Some fans say they avoid choosing a favorite when the spread is double digits (more than 10 points). Is the proportion of favorites who cover discernibly less than 0.50 when the spread is more than ten points?
4. How often is the away team favored to win the game?
5. Is the mean number of points scored by the favored team higher in 2024 than in 2023?
6. What is the average number of points scored by the winning team in NFL games?
7. The weather is often more of a factor later in the season. How much does the mean number of points scored (both teams combined) compare between the first half of the season (weeks 1-9) and the second half (weeks 10-18)?
8. The most common scoring events in football are a field goal (3 points) and a touchdown with an extra point (7 points). What proportion of point spreads are within ½ point of either 3 or 7 (i.e., 2.5, 3.5, 6.5, or 7.5)?
9. How much more (or less) often do favorites cover the spread when playing at home vs. on the road?
10. How often does the favorite win the game, but fail to cover the point spread?

Is there a home field advantage? Address this in two ways:

1. Compare the mean points scored by home teams to the mean points scored by away teams.
2. Use how often the home team wins the game outright.