NFL Point Spreads and Game Scores - Answers

Review of inference for means and proportions

20 Questions:

1. What proportion of the time does the favored team actually win the game outright?

   CI for a proportion (one sample)

   $$\hat{p} = \frac{370}{544} = 0.680$$

   We are 95% sure that the proportion of times the favored team wins the game is between 0.641 and 0.719.

2. Is the chance the favorite covers the spread discernibly different from 0.50?

   Test for proportion (one sample)

   $$\hat{p} = \frac{293}{544} = 0.539$$

   $z = 1.80$, p-value=0.072. At a 5% significance level we do not have convincing evidence that the proportion of times the favorite covers the spread is 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?

   CI for a difference in means (two samples)

   $$\bar{x}_H - \bar{x}_A = 5.12 - 4.18 = 0.94$$

   We are 95% sure that the average point spread when the home team is favored is between 0.44 and 1.44 more than when the road team is favored.

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?

   Test for a mean (one sample using *HomeDiff*) OR

   Test for two means (paired data., using *HomeScore* and *AwayScore*)

   $$\bar{x}_{HD} = 1.912$$

   t=-1.74. p-value=0.083. At a 5% significance level we do not have convincing evidence that the mean home margin is different from 3 points.

5. Is there convincing evidence that the average point spread assigned to the home team (*HomePts*) is different from three points?

   Test for a mean (one sample)

   $$\bar{x}_{HP} = 1.480$$

   t=-6.51. p-value≈0.000. We have very strong evidence have that average point spread assigned to the home team is less than 3 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.

   CI for difference in means (paired data)

   $$\bar{x}_D = -1.05$$

   We are 95% sure that the mean point spread is between 2.16 points less and 0.05 points more than the actual margin for the favored team.

7. Is there convincing evidence that point spreads (*Pts*) tend, on average, to underestimate the margin for the favored team (*FavDiff*)?

   Test for a difference in means (paired data)

   $$\bar{x}_D = -1.05$$

   t=-1.87, p-value≈0.031. At a 5% level we have enough evidence to conclude that the mean point spread is less than the mean actual margin for the favored team.

8. What is the average absolute value of the difference between the point spread (*Pts*) and the actual game margin (*FavDiff*)?

   CI for a mean (one sample)

   $$\bar{x}_{AD} = 10.03$$

   We are 95% sure that the average distance from the point spread to the actual game margin is between 9.31and 10.75 points.

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

9. 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)?

   Test for a difference in proportions (two samples)

   $$\hat{p}_2 - \hat{p}_1 = \frac{189}{270} - \frac{181}{274} = 0.700 - 0.661 = 0.039$$

   z=0.99, p-value=0.162. We do not have convincing evidence that the proportion of games predicted correctly by the point spread is higher in the second half of the season than in the first half.

10. 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?

    Test for a difference in means (two samples)

    $$\bar{x}_1 - \bar{x}_2 = 10.40 - 9.65 = 0.75$$

    t=1.03, p-value=0.152. We do not have convincing evidence that the mean absolute difference between the point spreads and actual game margins is smaller in the second half of the season than in the first half.

11. 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?

Test for a proportion (one sample)

$$\hat{p} = \frac{18}{34} = 0.529$$

The sample proportion of big spreads where the favorite covers is bigger than one-half, so there will not be evidence to conclude that this proportion is less than 0.50. Based on this sample, the advice to avoid favorites with double digit point spreads is not reasonable.

12. How often is the away team favored to win the game?

CI for a proportion (one sample)

$$\hat{p} = \frac{213}{544} = 0.392$$

We are 95% sure that the proportion of times the away team is favored to win is between 0.351 and 0.433.

13. Is the mean number of points scored by the favored team higher in 2024 than in 2023?

No statistical inference needed. We know the means in 2023 and 2024 exactly!

$\mu_{2023} = 23.90$ and $\mu_{2024} = 26.29$. so the mean points scored by the favorite is higher in 2024 than n 2023.

14. What is the average number of points scored by the winning team in NFL games?

CI for a mean (one sample)

$$\bar{x}_W = 27.86$$

We are 95% sure that the mean points scored by the winning team in NFL games is between 27.13 and 28.58 points.

15. 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)?

CI for a difference in means (two samples)

$$\bar{x}_2 - \bar{x}_1 = 45.0 - 43.8 = 1.20$$

We are 95% sure that the mean combined points scored by both teams in NFL games in the second half of the season is between 1.05 less and 3.46 more than in the first half of the season.

16. 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)?

CI for a proportion (one sample)

$$\hat{p} = \frac{308}{544} = 0.566$$

We are 95% sure that the proportion of times the point spread is within one-half point of 3 or 7 is between 0.525 and 0.608.

17. How much more (or less) often do favorites cover the spread when playing at home vs. favorites on the road?

CI for a difference in proportions (two samples)

$$\hat{p}_H - \hat{p}_A = \frac{173}{331} - \frac{120}{213} = 0.523 - 0.563 = -0.040$$

We are 95% sure that the proportion of times that home favorites cover the spread is between 0.126 less and 0.045 more than the proportion of road favorites that cover.

18. How often does the favorite win the game, but fail to cover the point spread?

CI for a proportion (one sample)

$$\hat{p} = \frac{77}{544} = 0.142$$

We are 95% sure that the proportion of times the favorite wins the game but fails to cover the spread is between 0.112 and 0.171.

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

19. Compare the mean points scored by home teams to the mean points scored by away teams.

Test for a difference in means (paired data using *HomeScore* and *AwayScore*) or

Test for a single mean (using *HomeDiff*)

$$\bar{x}_D = 1.91$$

t=3.05, p-value≈0.001. We have strong evidence that the mean points scored by home teams is more than the mean points scored by away teams.

20. Use how often the home team wins the game outright.

Test for a proportion (one sample)

$$\hat{p} = \frac{295}{544} = 0.542$$

z=1.97, p-value=0.024. At a 5% level, we do have enough evidence to conclude that the proportion of times the home team wins in the NFL is bigger than 0.50, so there appears to be a home field advantage.