# MAT 243 Project Two Summary Report

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## Introduction: Problem Statement

The Chicago Bulls are considered one of the best NBA teams during the 1990s, mainly due to the fact that they won the championship 3 years in a row – TWICE! The second threepeat happened during the 1996-1998 seasons. This period also coincides with Michael Jordan’s return to the Bulls. Because of the 2 threepeats and the return of one of the top NBA players, comparing another NBA team to this high performing team can be quite illuminating.

For this comparative analysis the 2013-2015 San Antonio Spurs were selected. The Spurs won a championship, placed second, and finished 6th within this period. However, earlier in the 2000s the Spurs placed first or second 4 out of 5 years. So how does a post-Tim Duncan/David Robinson Spurs compare to a Michael Jordan-era Bulls – this analysis attempts to answer that.

The main metrics used to compare the teams will be points scored in a game and the Elo “…a simple measure of strength based on game-by-game results” (FiveThirtyEight, 2022). The higher an Elo rating the better a team has performed. Silver and Fischer-Baum (2015) have created this table to illustrate the range of Elo values for the NBA:

Table

Description automatically generated

**Figure 1: NBA Elo Ratings Brackets (Silver and Fischer-Baum, 2015)**

## Introduction: Your Team and the Assigned Team

**Table 1. Information on the Teams**

|  | **Name of Team** | **Assigned Years** |
| --- | --- | --- |
| 1. Yours | San Antonio Spurs | 2013 - 2015 |
| 2. Assigned | Chicago Bulls | 1996 - 1998 |

## Hypothesis Test for the Population Mean (I)

The management team has suggested that the Spurs’ mean Elo (*µ*) is greater than 1340. To test this the null hypothesis (*H0*) and alternative hypothesis (*Ha*) are created and shown below:

*H0: µ = 1340*

*Ha: µ > 1340*

The Spurs’ mean Elo score is 1685.42, but to determine if this difference is statistically significant a one sample T-test is used in comparison to the value of 1340.

The T-test will attempt to determine if the data distributions have the same mean and if they are different, numerically, to what level of confidence does this difference continue to exist.

Table 2 shows the results of the T-test.

**Table 2: Hypothesis Test for the Population Mean (I)**

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | 168.11 |
| P-value | 2.2493 E-255 |

Management is curious if the hypothesis can survive to a 5% (α = 0.05) level of significance and it can. The one-tailed P-value is much smaller than 5% (2.2493 E-255 << 0.05).

This means the null hypothesis may be rejected and management may be confident that the Spurs’ mean Elo of 1685.42 is greater than the “critically low skill level” of 1340.

## Hypothesis Test for the Population Mean (II)

Management team has suggested that the Spurs’ mean score (*µ*) is less than 106. Using this idea, the null hypothesis (*H0*) and alternative hypothesis (*Ha*) are show below:

*H0: µ = 106*

*Ha: µ < 106*

The Spurs’ mean score is 103.85 but to determine if this difference is statistically significant, and the sample distribution can survive the null hypothesis a one sample T-test is used comparison to the value of 106. Table 3 shows the results of the T-test.

**Table 3: Hypothesis Test for the Population Mean (II)**

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | -3.02 |
| P-value | 0.0014 |

Management is curious if the hypothesis is valid to a 1% level of significance and it is valid, i.e., the p-value is smaller than 1% (0.0014 << 0.01).

This means the null hypothesis may be rejected and management may be confident that the Spurs’ mean score of 103.85 is less than 106 points.

## Hypothesis Test for the Population Proportion

Management further believes that the win percentage (*p*) when scoring more than 102 points is 90% (*p0*). The actual win percentage when scoring more than 102 points is 88.55%. To test if this difference is significant the following null and alternative hypotheses are created:

*H0: p = p0 | p0 = 0.9*

*Ha: p ≠ p0*

This allows us to test if the population proportion (*p*) is equal to or different from the hypothesized proportioned (*p0*) (90%).

**Table 4: Hypothesis Test for the Population Proportion**

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | -0.55 |
| P-value | 0.5800 |

It was already shown that Spurs’ win percentage was not 90% but rather 88.55%. However, management wanted to see if this was significant at a 95% confidence level (α = 0.05). Because the two-tailed P-value is greater than alpha (0.58 >> 0.05), the null hypothesis cannot be rejected and management can conclude that the win percentage when scoring greater than 102 points is statistically similar to 90%.

## Hypothesis Test for the Difference Between Two Population Means

As mentioned in the introduction the 1996-1998 Bulls are considered one of the greatest teams from the 90’s. How do the Spurs compare to the Bulls and can management’s claim that “…the skill level of [the Spurs] in 2013-2015 is the same as the skill level of the Bulls in 1996 to 1998” hold up to scrutiny? The teams’ average Elo scores (*µ*) will be utilized to make the comparison.

The null (both teams have the same Elo score) and alternative hypothesis (the Elo scores are not the same) are shown below:

*H0: µSpurs = µBulls*

*Ha: µSpurs ≠ µBulls*

The Bulls had a mean Elo score of 1739.8 and the Spurs 1685.42. While these are not numerically the same the statistical relevance is shown in Table 5.

**Table 5: Hypothesis Test for the Difference Between Two Population Means**

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | 14.04 |
| P-value | 7.0513 E-38 |

As mentioned, the Spurs and Bulls do not have the same Elo scores and management should consider their assertion of sameness to be wrong. That is, at a 99% confidence level (α = 0.01) the null hypothesis should be rejected (7.0513 E-38 << 0.01) and the Elo scores should not be considered the same.

## Conclusion

In further exploration of the performance of the 2013-2015 San Antonio Spurs four new comparisons are explored: average Elo score compared to a critically low value; average score compared to that of a high performing team; win percentage when scoring more than 102 points; Elo score compared to that of a high performing team, i.e., the 1996 – 1998 Chicago Bulls.

First, the Elo score for the Spurs was compared to that of a theoretical underperforming team, i.e., 1340. Management may be confident that the Spurs’ mean Elo of 1685.42 is greater than the “critically low skill level” of 1340.

Second, the average score of the Spurs was measured to see if it was actually below 106 points. Management may be confident that the Spurs’ mean score of 103.85 is statistically dissimilar from 106 points.

Third, the win percentage of the Spurs was computed when scoring greater than 102 points – which management believes to be 90%. Management may rest assured that the win percentage when scoring more than 102 points is statistically similar to 90%.

Lastly, the Spurs were compared to the high performing 1996-1998 Bulls. The Spurs and Bulls do not have the same Elo scores and management is wrong to believe they are.

Practically, this report shows that the 2013-2015 Spurs are a team performing better than the lowest performing teams, have a mean score less than those of the top teams, but have a large win percentage when scoring 102 points and more. However, the high performing Spurs cannot match the Elo score of the more successful Bulls.

## Citations

FiveThirtyEight. (2022, June 17). *The complete history of the NBA*. <https://projects.fivethirtyeight.com/complete-history-of-the-nba>

Hobbs, B. (2022). *MAT 243 project one summary report*. [Unpublished report]. SNHU.

Silver, N. and Fischer-Baum, R. (2015, May 21). *How we calculate NBA Elo ratings*. FiveThirtyEight. <https://fivethirtyeight.com/features/how-we-calculate-nba-elo-ratings/>