# MAT 243 Project Two Summary Report

Tyler Ellis

Tyler.Ellis1@snhu.edu

Southern New Hampshire University

## Introduction: Problem Statement

Professional basketball is a highly competitive sport which demands teams utilize every advantage they can find. Knowing this, the powers that be have looked to using team data to highlight area's of improvement. We identified an extensive historical dataset that might serve as the key for enhancing our team's effectiveness. The primary challenge is determining the validity of various performance statistics presented by our team's coach and leadership.  
  
 To address this, we will look deeper into this dataset, focusing on particular metrics spanning various seasons and analyzing our results against standard expectations and competitor teams. Our analytical toolset will consist of an array of statistical formulas, with a focus on statistical analysis and hypothesis testing. The intention of this in-depth evaluation is to present the coaching staff with strong, statistically supported information, enabling them to make significant adjustments that will enhance the team's overall performance in coming seasons.

## Introduction: Your Team and the Assigned Team

Table 1. Information on the Teams

|  | **Name of Team** | **Years Picked** |
| --- | --- | --- |
| 1. Yours | The Celtics | 2013-2015 |
| 2. Assigned | The Chicago Bulls | 1996-1998 |

## 

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

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | 28.05  \*Round off to 2 decimal places. |
| P-value | 0.0  \*Round off to 4 decimal places. |

Hypothesis testing is an effective tool in statistics which is used to validate statements pertaining to a population based on samples of data. When analyzing our basketball team's performance, we utilized this method to assess whether our team's average relative skill level went above a critical low threshold of 1340. To do so, we constructed two hypotheses. The null hypothesis (), which argues that our team's average skill level is precisely 1340. Contrarily, the alternative hypothesis () takes a more positive stance, arguing that our team's average skill level exceeds this limit.  
   
 Given the importance of this claim, we took a precautionary approach, assigning a 5% level of significance for the analysis. This suggests that we were willing to accept the probability of 5% of misinterpreting the null hypothesis even if it proved to be true. We obtained a test statistic of 28.05 and a p-value of 0.0 after running the test. We rejected the null hypothesis since the p-value was less than our 5% significance threshold. Therefore, the data strongly suggests management's assertion: our team's average relative skill level is statistically much better than the critical low of 1340.  
   
 Rejecting the null hypothesis and siding with the alternative hypothesis has serious consequences. It confirms management's perception that our team's talent level is above the crucial low, delivering a boost to morale and justifying any training or player development investments. Beyond the numbers, the practical value of this result lies in making decisions. Management can be confident that minimal adjustments in team structure or strategies will be needed immediately based primarily on skill levels. However, while we showed that the team's skill level is over the critical threshold, ongoing improvement is always the end goal. Additionally, while skill level is essential, it is only one element of a layered methodology for building the perfect team.

## Hypothesis Test for the Population Mean (II)

To test the coach's hypothesis, we will establish our statistical hypotheses: Null Hypothesis: The average number of points scored by our team is equal to 106.   
  
Ho:μ=106  
  
Alternative Hypothesis : The average number of points scored by our team is less than 106.   
  
Ha:μ<106

* 1. We have a significance level of 0.01. We generated the test statistic using the data provided. We applied the t-test for just one mean since the population standard deviation for points scored was not provided. The test statistic was calculated to be -11.62, with a p-value of 0.0. Really the p-value was so small that when even rounding to the 4th place after the decimal, it was was still 0.0000.
  2. We have enough data to reject the null hypothesis in favor of the alternative hypothesis based on the calculated p-value of 0.0000, which is less than our significance level of 0.01. This shows that data confirms up the coach's assessment that the team averaged less than 106 points during 2013 - 2015.

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

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | -11.62 |
| P-value | 0.0000 |

The data supports the coach's theory about the teams ability to score. Rejecting the null hypothesis means that the team's average points scored were significantly less than 106 points. This may reinforce the need for better training, recruiting higher caliber players, or changing game strategies to produce more scoring chances. The test stresses the value of data in decision-making by reinforcing the importance that actions and measures are based on data and facts rather than primarily on intuition or guesswork. It is also important for the coaching staff to review the results and make decisions on the next steps to improve the team going forward.

## Hypothesis Test for the Population Proportion Hypothesis testing is a statistical method for making predictions about a population or group based on sample data. When it comes to assessing reports about a population's statistics, the approach involves comparing the observed statistic from the sample to the claimed stat to calculate if the difference observed is significantly different. Hypothesis testing can be broken down into 4 sections; Null Hypothesis, Alternate Hypothesis, level of significance, and your test statistic and p-value. :

* 1. Null Hypothesis:
     1. Statistical Notation: H0:p=0.90
     2. Translation(description) : The proportion of games that team wins when scoring 102 or more points is 0.90.
  2. Alternative Hypothesis:
     1. Statistical Notation: H1:p≠0.90 H1 :p=0.90
     2. Translation(description) : The proportion of games that your team wins when scoring 102 or more points is not 0.90.
  3. Level of Significance:
     1. a = 0.05
  4. Test Statistic and P-value:
     1. Test Statistic: -6.63
     2. P-Value: 0.0

Table 4: Hypothesis Test for the Population Proportion

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | -6.63  \*Round off to 2 decimal places. |
| P-value | 0.000  \*Round off to 4 decimal places. |

* We reject the null hypothesis since the p-value is less than the level of significance. This means that there is enough data to suggest that the percent of games won by the team while scoring 102 or more points does not equal 0.90. The sample percent was 0.679, which varies greatly from the indicated percentage of 0.90.

The data does not support the management's claim that the teams wins 90% of games when scoring 102 or more points. The sample's observed percentage was 0.679, which is significantly lower than the claimed 0.90. The difference may call for an analysis of team plans, training methods, and even game data analysis. If management's assessments or strategies were based on a 90% win record while scoring 102 or more points, they may need to be reassessed.

## Hypothesis Test for the Difference Between Two Population Means

Hypothesis testing is a statistical method for making predictions about a population or group based on sample data. When it comes to assessing reports about a population's statistics, the approach involves comparing the observed statistic from the sample to the claimed stat to calculate if the difference observed is significantly different.

* The difference between two means is used to test hypotheses about populations. There are two types of hypotheses. First, there is the null hypothesis, which suggests no variation. The second is the alternate hypothesis, which suggests that there is a difference. A significance threshold is determined, which is usually 0.05 or 0.01. After data is collected and analyzed, a test statistic determines the difference between sample means. This generates a P-value, that indicates the chance of observing the sample data under the null hypothesis. If the P-value is less than the level of significance, the hypothesis is rejected. This suggests that the population values are significantly different. Alternatively, we can determine that there doesn't seem enough evidence to reject the null hypothesis. Hypothesis testing, basically, analyzes whether sample data verifies a certain population claim.

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

| **Statistic** | **Value** |
| --- | --- |
| Test Statistic | 53.41 |
| P-value | 0.0000 |

* We reject the null hypothesis based on the P-value, which is significantly low. This indicates there is statistically significant data that the observed difference between sample means is not related to mere chance and probably indicates an actual variation between population means.
* When the null hypothesis is rejected, it suggests there is significant variation between the two groups being analyzed. This may suggest that any particular action, therapy, or condition has an obvious influence. It questions the status norm or current understanding of the two groups' connection.

## Conclusion

Multiple analytical tests were performed during the analysis of the Boston Celtics' statistics from 2013 to 2015. First, a t-test was implemented to see if the Celtics' average relative skill level was significant greater than 1340. The result led to the null hypothesis being dismissed. This indicated that the Celtics' average skill level was significantly higher than 1340. A second t-test was performed to see if the team scored less than 106 points per game during this time period. This result led to the null hypothesis being rejected again, showing that the team scored considerably less than 106 points on average. The team's data then put through a probability test to see if they won 90% of their games when scoring more than 102 points as they claimed. The results disproved this claim, indicating that the real percentage was approximately 67.9%. A two-tailed t-test was implemented to compare the teams' relative skill level from 2013 to 2015 to the Chicago Bulls' from 1996 to 1998. The results revealed a significant variance in skill levels between the two teams. The Bulls ended up having a higher average ability level.  
  
 The analyses provide valuable insights into the teams performance and skill level when compared to the previous benchmarks and other historical teams. The statistics reveal that, while the teams' relative skill level was greater than 1340, and that their average points scored per game were less than the standard of 106. This might indicate a greater need to use a more cautious strategic decisions made through the years. Given that the team did not win 90% of their games while scoring above 102 points suggests that high-scoring games were not an absolute guarantee for the team. This is important and highlights the importance of other factors like defense when moving forward. A comparison to the Chicago Bulls from 1996-1998 emphasizes the Bulls' talent level during that period.

## Citations

*zyBooks. (2023). Module 1: escriptive Statistics and Probability. MAT-243.* [*https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/1/*](https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/1/)  
*zyBooks. (2023). Module 2: Probability Distributions. MAT-243.* [*https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/2/*](https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/2/)  
*zyBooks. (2023). Module 3: Confidence Intervals and Hypothesis Testing. MAT-243.* [*https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/3/*](https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/3/)

*zyBooks. (2023). Module 4: Hypothesis Testing with Two Populations. MAT-243.* [*https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/4/*](https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/1/)  
*zyBooks. (2023). Module 5: Linear Regression. MAT-243.* [*https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/5/*](https://learn.zybooks.com/zybook/MAT-243-J1254-OL-TRAD-UG.23EW1/chapter/2/)