# MAT 243 Project One Summary Report

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## Introduction: Problem Statement

The Celtic’s coach and management team have requested a study of the distributions of Average Relative Skill, a key performance indicator (KPI) represented by elo\_n in the NBA dataset provided to make key decisions to improve the performance of the team. Descriptive statistics and data visualization techniques will be used to study and report how the Celtics compares to the Bulls to determine how we can improve performance.

Various graphing techniques, including histograms, scatterplots, and boxplots, will be used to visualize the data. The mean of elo\_n, as well as the confidence interval, will be calculated at the 95% confidence level. In addition, the probability that other teams have an elo\_n less than the Celtics will be calculated.

## Introduction: Your Team and the Assigned Team

The Celtics has commissioned the study, based on an NBA-provided data set, to perform the performance of their team relative to other NBA teams. They have specifically requested a comparison of 2013-2015 to the Bull’s for the period of 1996-1998.

Table 1. Information on the Teams

| **Name of Team** | **Assigned Years** |
| --- | --- |
| Celtics | 2013-2015 |
| Bulls | 1996-1998 |

## Data Visualization: Points Scored by Your Team

Data visualization was used to describe the data in a human-friendly manner that allows a visual inspection of data, and how related data relate and compare. A Histogram of points scored by the Celtics showing the frequency of points scored per game was used to show to easily identify visually which had the most frequency - which is centrally distributed in a normal distribution – showing that the number of points scored in most games fall around 100.

Chart, histogram

Description automatically generated

## Data Visualization: Points Scored by the Assigned Team

A histogram was provided for the same data (for the established period of 1998-1998) for the Bulls to simplify the visual comparison of the two teams. It too is centrally distributed in a normal distribution – showing that the number of points scored in most games fall around 105-although they have a high frequency of at the 110 mark as well – which would tend to skew the mean higher. Overall the Bulls, 1996-1998, appear to have scored more points per game than the Celtics, 2013-2015.

Chart, histogram

Description automatically generated

## Data Visualization: Comparing the Two Teams

Using data visualization a comparison can be made between different data sets as long as the underlying data is measuring the same thing, using the same methods, and using the same scale. Although the histograms created allowed a basic comparison of data, a boxplot was created with side-by-side visualizations for the Celtics, 2013-2015, and the Bulls, 1996-1998, to compare the overall trend of the data. Viewing the data in this manner confirms our initial impression that the Bulls score more points, on average, per game than the Celtics- a mean score of approx. 105 vs. 100. It also shows that the Bulls have a much larger range of values that are not considered outliers.

**Chart, box and whisker chart

Description automatically generated**

## Descriptive Statistics: Relative Skill of your Team

Statistics were generated for the Relative Skill of the Celtics for the period 2013-2015 for the mean, median, variance, and standard deviation. These statistics are used to show the central tendency (using mean and median) of data within a data set by describing how far data points lie from the mean (the variance), and how close to the mean most of the values lie (standard deviation).

In general, our data does not have a significant skew, it has a clear bell shape. This allows us to confidently use the standard properties associated with a normal distribution. The mean and the median are very close, indicating that the mean is a fairly accurate representation of the central tendency within our data.

The Mean indicates the “average” Relative Skill of the Celtics, with roughly half of all scores higher than the mean of 1456.78, and half are lower. The variance is the square of the sum of the differences of all values within the set and the mean, 4246.40 – is used to calculate the standard deviation by taking its square root. With a standard deviation of 65.16, 68% (one standard deviation) of all values are between 1391.62 and 1521.94, and 95% (two standard deviations) of all values are between 1326.46 and 1587.10.

Table 2. Descriptive Statistics for Relative Skill of the Celtics

| **Statistic** | **Value** |
| --- | --- |
| Mean | 1456.78 |
| Median | 1451.9 |
| Variance | 4246.40 |
| Standard Deviation | 65.16 |

## Descriptive Statistics: Relative Skill of the Assigned Team

The mean and the median are quite close in value, indicating that the mean is an appropriate representative of the central tendency of the data set. Overall the data is bell shaped, although very slightly left skewed. The Mean indicates the “average” Relative Skill of the Bulls, with roughly half of all scores higher than the mean of 1739.80, and half are lower. The variance is the square of the sum of the differences of all values within the set and the mean, 2651.55 – is used to calculate the standard deviation by taking its square root. With a standard deviation of 51.49, 68% (one standard deviation) of all values are between 1688.31 and 1791.29, and 95% (two standard deviations) of all values are between 1636.82 and 1842.78.

Comparing these statistics for the Celtics and the Bulls, we see that the Bulls outperformed the Celtics according to the elon\_n score, on average, by 283.02 points, with a significantly smaller variance and standard deviation indicating that the values are much more tightly packed around the mean.

Table 3. Descriptive Statistics for Relative Skill of the Bulls

| **Statistic** | **Value** |
| --- | --- |
| Mean | 1739.80 |
| Median | 1751.23 |
| Variance | 2651.55 |
| Standard Deviation | 51.49 |

## Confidence Intervals for the Average Relative Skill of All Teams in Your Team’s Years

In general, a confidence interval is given to show what range of values can be expected in a given confidence level. From our analysis, there is a 95% likelihood that the Celtics’ score in any given game will fall within the range of 1502.02 to 1507.18. and a 33.6% chance that another team will have a lower score. This means that 66.4% of NBA teams likely have a higher score. Given different confidence levels, the interval would be smaller with a smaller level, with a larger range for a higher level.

Table 4. Confidence Interval for Average Relative Skill of Teams in Your Team’s Years

| **Confidence Level (%)** | **Confidence Interval** |
| --- | --- |
| 95% | (1502.02,1507.18) |

## Confidence Intervals for the Average Relative Skill of All Teams in the Assigned Team’s Years

From our analysis, there is a 95% likelihood that the score in any given game for all teams in 1996-1998 will fall within the range of 1487.66 to 1493.65 and a 97.3% chance that the Bulls will score higher than any other team. This means that there is only a 2.7% chance of the Bulls being outscored by another team. Given different confidence levels, the interval would be smaller with a smaller level, with a larger range for a higher level.

Table 5. Confidence Interval for Average Relative Skill of Teams in Assigned Team Years

| **Confidence Level (%)** | **Confidence Interval** |
| --- | --- |
| 95% | (1487.66, 1493.65) |

## Conclusion

We can conclude that the Bulls outperformed, based on the elon\_n score, in each game, on average, the Celtics in the respective years of reference – 1996-1998 and 2013-2015, respectively, by 283 points. To increase performance to the levels seen in the Bulls 1996-1998, the Celtics need to make significant improvements in offense and defense to improve these statistics going forward. There is a great deal of work that needs to be done to get into the top tier given that currently only 33% of other teams, during 2013-2016, have lower elon\_n scores than the Celtics, compared with only 97% of teams that had lower elon\_n scores than the bulls in 1996-1998. Significant investments may be warranted in training or acquiring talent with a strong history of success.