Four Missed Free Throws in a Row: Why Nick Anderson May Have Gotten Unlucky in Game 1 of the 1995 NBA Finals

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Project Overview

In Game 1 of the 1995 NBA Finals, the Orlando Magic were leading the Houston Rockets by three points with just a few seconds left in the game. Nick Anderson, a career 67% free throw shooter, was fouled and sent to the free throw line for two shots. To the surprise of many, Anderson missed both of the two free throws. Fortunately for the Magic and their fans, Anderson obtained the offensive rebound after the second miss. The Rockets fouled him again, which gave Anderson two more free throws in an attempt to put the game away. Unfortunately, Anderson missed the third and fourth free throws as well, which kept the Rockets in the game. Houston tied the game, forced overtime, and won Game 1 in the extra period. After winning Game 1, the Rockets went on to win the entire series over the Orlando Magic.

Naturally, many sports fans placed a lot of the blame for the entire series on Nick Anderson's shoulders. In all likelihood, the Magic would have won Game 1 if Anderson made just one of the four free throws he attempted late in the game. As many fans point out, the entire series may have played out differently if the Magic were able to close out Game 1. Due to the high pressure of the situation, many sports fans claim that Nick Anderson choked in the final moments of Game 1 of the 1995 NBA Finals. This project uses a Bayesian approach to investigate that exact question. How likely is it that Nick Anderson choked, rather than being unlucky?

Bayes' Theorem

The specific Bayesian approach used for this project is called Bayes' Theorem. This formula, shown below in Equation 1, calculates the probability of a specific hypothesis being true given observed data. This is different from the Frequentist approach, which instead focuses on the probability of the observed data given the hypothesis.

$$\mathrm{P(H \mid Data)} = \frac{\mathrm{P(H) * P(Data \mid H)}}{\mathrm{P(Data)}} \tag{1}$$

For this problem, there were two different scenarios considered: either Anderson choked or he got unlucky. Therefore, the denominator has two terms in order to consider these two outcomes. Equation 2 below shows an updated version of Bayes' Theorem, which allows for consideration of both of the two potential conclusions.

$$\mathrm{P(H_0 \mid Data)} = \frac{\mathrm{P(H_0) * P(Data \mid H_0)}}{\mathrm{P(H_0) * P(Data \mid H_0) + P(H_\alpha) * P(Data \mid H_\alpha)}} \tag{2}$$

Hypotheses

As seen in Equation 2, null and alternative hypotheses had to be chosen for this problem. For this specific version of the project, the null hypothesis is that Nick Anderson did NOT choke during the final moments of Game 1 of the 1995 NBA Finals. Of course, this means that the alternative hypothesis is that he did choke. It is important to note that these hypotheses can be switched around and the results would be the same. Equation 3 below shows the updated form of Bayes' Theorem with these null and alternative hypotheses. The observed data is the fact that Anderson missed four free throws in a row.

$$\mathrm{P(No\ Choke\ |\ 4\ Missed\ FTs)} \\ = \frac{\mathrm{P(No\ Choke)} * \mathrm{P(4\ Missed\ FTs\ |\ No\ Choke)}}{\mathrm{P(No\ Choke)} * \mathrm{P(4\ Missed\ FTs\ |\ No\ Choke)} + \mathrm{P(Choke)} * \mathrm{P(4\ Missed\ FTs\ |\ Choke)}} \tag{3}$$

Prior Probabilities

This specific use of Bayes' Theorem requires prior probabilities, which are initial probabilities assigned to outcomes before any data is observed. For this project, it was considered reasonable that 15% of the players would have choked in Anderson's situation. This became the prior probability of the alternative hypothesis occurring.

The outcomes of the null and alternative hypotheses are complements to each other, due to the sample space being only two events (choke and no choke). This means that the prior probabilities of these two events must add up to 100%. Considering 15% was the prior probability of a player choking, 85% was then the prior probability of a player in Anderson's situation not choking. This became the prior probability of the null hypothesis occurring. Equation 4 below shows the updated formula with these prior probabilities expressed as decimals.

$$\mathrm{P(No\ Choke\ |\ 4\ Missed\ FTs)} \\ = \frac{0.85 * \mathrm{P(4\ Missed\ FTs\ |\ No\ Choke)}}{0.85 * \mathrm{P(4\ Missed\ FTs\ |\ No\ Choke)} + 0.15 * \mathrm{P(4\ Missed\ FTs\ |\ Choke)}} \tag{4}$$

Conditional Probabilities

The final two probabilities needed in order to answer the research question are the two conditional probabilities. These probabilities represent the likelihood that Anderson missed four free throws in a row, given the fact that he was choking or was not choking. This probability was easy to solve for in the case of the null hypothesis, which is that Anderson did NOT choke. With Anderson's career free throw percentage being 67%, the binomial distribution was used to find the likelihood of four misses in a row. It is important to note that this distribution assumes that the four free throws are independent of each other, which is known to not be completely true. Therefore, the probabilities calculated using the binomial distribution are just estimates. Equation 5 below shows the use of the binomial distribution in Excel for the conditional probability that Anderson missed four free throws in a row given that he was not choking. With a success considered a successfully made free throw, and the observed number of successes being zero, the first conditional probability was 1.19%.

$$\mathrm{P(4\ Missed\ FTs\ |\ No\ Choke)} = \mathrm{BINOM.DIST(0, 4, 67\%, TRUE)} = 1.19\% \tag{5}$$

The conditional probability for Anderson missing four free throws in a row given that he was choking was also solved for using the binomial distribution. First, Anderson's free throw percentage needed to be estimated for the event that he was choking. For this project, it was considered reasonable that Anderson's free throw percentage would have been just 50% if he were actually choking. This is notably subjective; it is up to the statistician to determine this probability based on their basketball knowledge. Equation 6 below shows the conditional probability of four missed free throws in a row given the alternative hypothesis that Anderson did choke. This second conditional probability was 6.25%.

$$\mathrm{P}(4\text{ Missed FTs} \mid \text{Choke}) = \mathrm{BINOM.DIST}(0, 4, 50\%, \mathrm{TRUE}) = 6.25\% \qquad (6)$$

Posterior Probabilities

Finally, the posterior probabilities for each hypothesis were calculated. These probabilities are the likelihood of the specific hypothesis given the data of four missed free throws in a row. Equation 7 below shows the probability that Anderson did not choke, given the fact that he missed four free throws in a row.

$$\mathrm{P}(\text{No Choke} \mid 4\text{ Missed FTs}) = \frac{0.85 * 0.0119}{0.85 * .0119 + 0.15 * 0.0625} = \frac{0.010115}{0.010115 + 0.009375} = \frac{0.010115}{0.01949} \approx 51.9\% \qquad (7)$$

The probability that Anderson did NOT choke given the four missed free throws in a row was estimated to be 51.9%. The other posterior probability, the probability that Anderson did choke given the four missed free throws, is the complement to the other posterior probability. This means that the probability that Anderson did choke given the four missed free throws in a row was estimated to be 48.1%.

Conclusion

By using prior probabilities, the expectations for a player in Nick Anderson's situation were considered in the analysis. The probability that Nick Anderson choked in the final moments of Game 1 of the 1995 NBA Finals was estimated to be 48.1%. This means that the probability of Anderson getting unlucky was 51.9%. These two probabilities suggest that many NBA fans who claim that Anderson choked may actually be wrong.

As mentioned above, this project contained some subjectivity to it. The hypotheses, prior probabilities, and estimated free throw percentage during a choke could all be modified for a Bayesian approach such as this one. Future research studies can be performed to optimize these hypotheses and estimates in order to be more confident in the true probabilities of Anderson choking or being unlucky in the final moments of Game 1 of the 1995 NBA Finals.