Does success breed success in basketball?

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Introduction & Background Information:

When I play basketball, there are matches where I feel that when I play well and start scoring my shots, I find that it is more likely for me to land the next shot because I feel more confident in my own ability in basketball. Conversely, there are also matches when I feel like I am playing horribly at the start of the match, missing several of my shots; I would find that I tend to overthink my next few shots and miss them as the game continues.

Basketball players and other sports athletes alike believe that there is some sort of momentum behind players' performances. If a player performs exceptionally at the start of a match, it can be expected for them to continue the performance for the rest of the match, as there is no reason why they should stop and play at a lower standard. Many basketball players attribute it to psychology, that when players play well, their confidence increases and this increases the likelihood of succeeding in scoring another shot. This can also be called the 'snowball' effect, where a small initial success can grow and develop into a series of successes because of the momentum gained from the initial success. Psychologically, this makes sense as increased confidence means decreased doubt behind shooting, which makes players perform better. The question that I am looking to investigate is whether or not mathematics can support this theory and hypothesis - whether or not it is simply the effect of "clustering illusion" as a logical fallacy which causes us to mistakenly deduce conclusions, or whether or not statistics can be used as evidence to indeed prove that success can be used to predict future success.

Figure 1: Picture of myself shooting a basketball

Hypotheses:

The null hypothesis is the hypothesis that is presumed to be true unless there is significant statistical evidence to suggest that it is not true, denoted by H_0. Conversely, the alternative hypothesis is the hypothesis proposed which suggests the null hypothesis is false, denoted by H_1. Through the background information and theory, I present my null and alternative hypotheses as:

H_0 : Given a success, the likelihood of another success is the same as the usual likelihood of success.
This would suggest that the successes of both shots are independent from each other. As such where A is the event of an initial success and B is the event of a final success:
$P(A \cap B) = P(A) \times P(B)$

H_1: Given a success, the likelihood of another success is greater than the usual likelihood of success.
This would suggest that the successes of the final shot is dependent on the prior shot, increasing in likelihood if the first shot was a success:
$P(B \mid A) > P(A) \times P(B)$

Methodology:

To limit the effect of human error in the investigation, I will be investigating free throw attempts and percentages (FT), as these are shots that are consistent across all levels of basketball, as players are given the same time period to shoot and the same distance from the basketball hoop. This controls a lot of the variables including defensive pressure, therefore the trials would be a fair test, making it easier and more suitable in my investigation to compare players to each other as well as each shot attempt to each other.

In my investigation, it would be unrealistic to attempt to investigate the whole population of basketball players for the effect of “success breeding success”, thus I will be taking a sample from several NBA players as well as first-hand primary data. This will be my sample population, denoted as *n*. However, I am assuming that the results of this investigation can be applied to the basketball player population, so I will be assuming that the Central Limit Theorem applies. I will also be assuming that the data for free throws follows a normal distribution, the probability against the frequency of a successful shot.

I will conduct a paired one-tailed t-test for my investigation because I am comparing the probability of the success of a shot given a previous success against the player’s overall career free throw percentage. This is because if the percentage for a success given a previous success is significantly greater than the player’s overall career free throw percentage, this is enough evidence to suggest that there is a phenomenon of “success breeding success” in the sport of basketball.

The t-test can be evaluated as:

$$T = \frac{\overline{X}_n - \mu}{S_{n-1}/\sqrt{n}} \sim t_{n-1}$$

$\overline{X}_n$ will be defined as the mean across the sample of basketball players in my data for the likelihood of a free throw being scored given a prior success. Similarly, μ will be defined as the mean across the true population of basketball players for the likelihood of a free throw being scored given a prior success.

S_{n-1} would usually be replaced by σ, which is the population standard deviation, however since we do not know the value of σ of the true population of basketball players, I will be using S_{n-1} as it is a suitable approximation of σ, since S^2_{n-1} is an unbiased estimator of σ^2 (Fannon, Kadelburg, Woolley and Ward, 2013), whereby it equally underestimates and overestimates σ^2. σ^2 is defined as the variance across the true population of basketball players, from the mean. It is a statistical measure that evaluates how spread out the data points are away from the mean, as such on average how much that the data points vary from the mean.$\sqrt{n}$ is simply the square root of the number of players in the sample.

S_{n-1} as the unbiased estimator of standard deviation can be evaluated as followed:

$$S_{n-1} = \sqrt{\frac{n}{n-1}} S_n$$

S_n is the sample's standard deviation, and is formulated as:

$$S_n = \sqrt{\frac{\Sigma x^2}{n} - \overline{x}_n}$$

I will be comparing the p-value of my data with the significance level to discuss the results. The p-value is the "probability of the observed test statistic, or more extreme, occurring when H_0 is true" (Fannon, Kadelburg, Woolley and Ward, 2013). The significance level is the point at which we assume H_0 is true; if the p-value of the investigation exceeds this point, then H_0 is considered unlikely, leading to the rejection of the null hypothesis. The significance level is usually set at 0.05, or 5%, which means that there is only a 5% chance of drawing a wrong conclusion from a set of anomalous results, which means therefore, a 95% chance that the conclusion to make will be true, so I will be using this significance level in my investigation.

Mathematical Analysis

Data Collected

I have collected free throw data for the NBA Finals Series of the 2018-2019 season. The free throws attempted and made by all of the players were compiled by myself from ESPN.com into a table, rounded to 3 significant figures. I have only chosen players that have had more than 5 free throw attempts which had initial successes so that my data is more reliable and accurate. I also collected data for my own free throws, as well as several of my friends in a training session to compare our own performances with these players. I gathered data for the same number of people so that it was consistent, and I will assume the free throw percentage of my friends and I in the training session can also be referred to as our career free throw percentages. Table 1 shows this processed data and the raw data can be found in the appendices.

Player	Given a success, probability for another success	FT attempts, given the first shot success	Career FT %
Draymond Green	88.9%	8/9	70.6%
Stephen Curry	94.7%	18/19	90.5%
Marc Gasol	91.7%	11/12	77.7%
Pascal Siakam	75.0%	6/8	74.3%
Kawhi Leonard	94.7%	18/19	84.8%
Kyle Lowry	75.0%	6/8	80.5%
Personal Data			
Isaac Hua	77.8%	7/9	52.5%
Samuel Oswell	80.0%	8/10	67.5%
Louis Kong	85.7%	12/14	72.5%
Ian Tan	77.8%	7/9	50.0%
James Kim	84.2%	16/19	42.5%
Cho Ster	62.5%	5/8	42.5%

Table 1: NBA Players & Personal Free Throw Data

With this data, I have drawn up two graphs to compare between player career free throw percentages and their free throw percentages given that the first attempt was a previous success. They can be seen on the next page, where Figure 1 is the graph for NBA players while Figure 2 is the graph for myself as well as my friends' free throws.

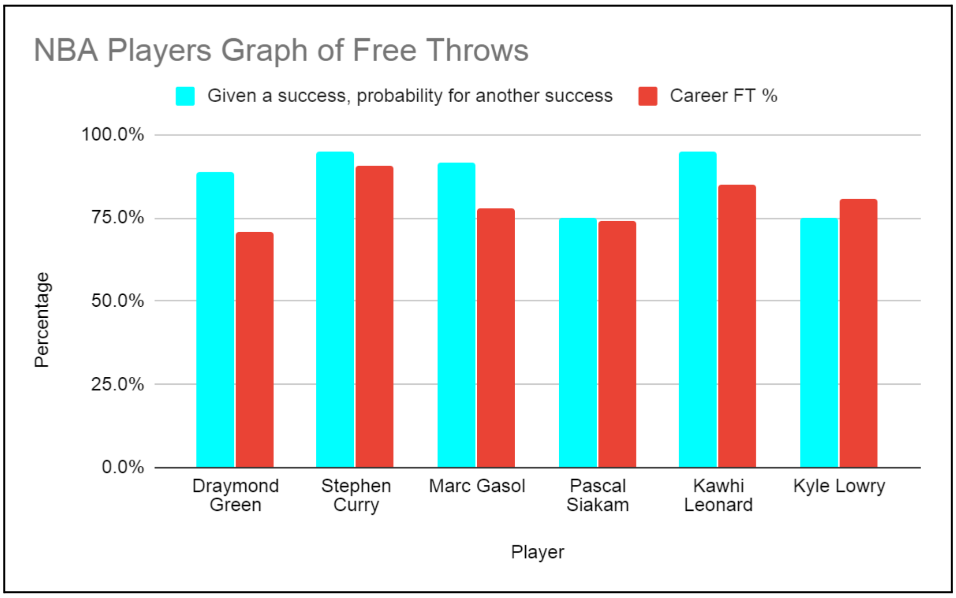

Figure 2: Graph of NBA Players' Free Throws

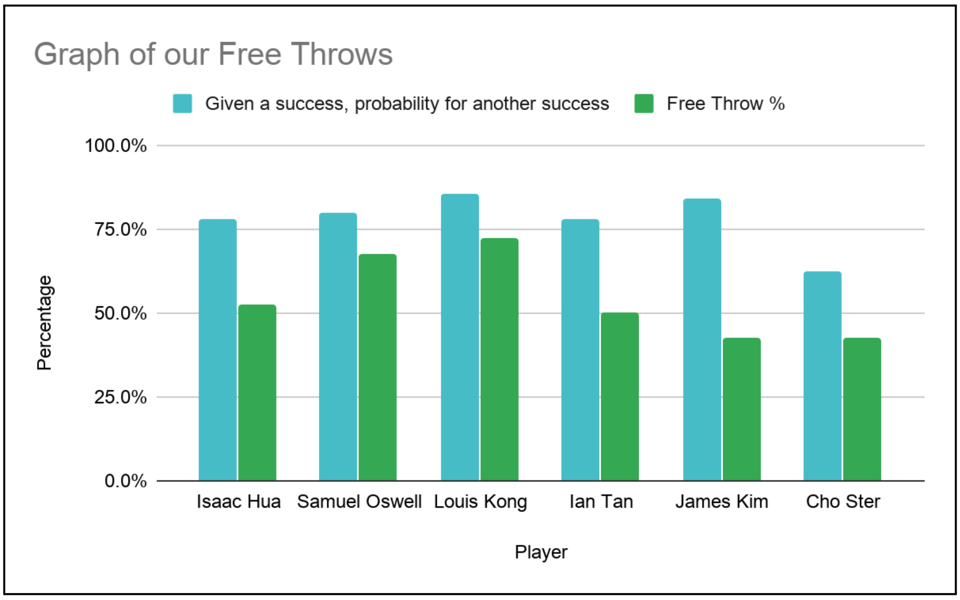

Figure 3: Graph of My Friends and My Free Throws

As shown in both Figure 2 and 3, there is a consensus that our alternative hypothesis should be correct, because the probability of a success given the first shot was a success is higher than the player's career free throw percentage, across both sets of data except for Kyle Lowry. However, this may boil down to a smaller sample size, as our data may not be statistically significant enough to actually state that the alternative hypothesis is true. T-testing will be done to further investigate whether we can reject our null hypothesis and accept our alternative hypothesis.

Hypothesis Testing with t-test

I will denote “given a success, probability for another success” by α and “career FT%” by β

Let variable $X = \alpha - \beta$

$X \sim N(\mu, \sigma^2)$, so X is normally distributed with a population mean of μ and a variance of σ^2.

My hypotheses are, where μ_X is the population mean for variable X:

$H_0 : \mu_X = 0$

$H_1 : \mu_X > 0$

Next, I will have to use the t-test formula, which is:

$$T = \frac{\overline{X}_n - \mu}{S_{n-1}/\sqrt{n}} \sim t_{n-1} \text{ when substituted by the data in Table 1, } \frac{\overline{X}_n - 0}{S_{n-1}/\sqrt{6}} \sim t_5$$

T-Test for NBA Players

Player	Green	Curry	Gasol	Siakam	Leonard	Lowry
$\alpha - \beta$	18.3	4.2	14.0	0.7	9.9	-5.5

Table 2: X values for the different NBA players

Using Table 1’s values, I have constructed Table 2. To find $\overline{X}_n$, it is simply the mean of all the values for X, so it can be evaluated as:

$$\frac{(18.3 + 4.2 + 14.0 + 0.7 + 9.9 - 5.5)}{6}$$ which is equal to **6.93** (rounded to 2 d.p.)

To find S_{n-1}, simply use the formula, substituting for our values:

$$S_{n-1} = \sqrt{\frac{6}{5}} \times S_n$$

$$S_n = \sqrt{\frac{\Sigma x^2}{n} - \overline{x}_n}$$ where Σx^2 is needed.

This is the sum of all X values squared, therefore using our X values:

$(18.3)^2 + (4.2)^2 + (14.0)^2 + (0.7)^2 + (9.9)^2 + (-5.5)^2$ which is equal to **677.28**

Thus, S_n is:

$$\sqrt{\frac{677.28}{6} - (6.93)^2}$$ which is equal to **8.05**.

Therefore, S_{n-1} is:

$$\sqrt{\frac{6}{5}} \text{x} \sqrt{\frac{677.28}{6} - (6.93)^2}$$ which is equal to **8.82**.

As a result, using exact values for the formula, our T value is as follows:

$$\frac{6.93 - 0}{8.81/\sqrt{6}}$$ which is equal to **1.92**.

To determine the p-value, I will be using my graphical display calculator Ti-84 Plus CE. I will be using the t-distribution cumulative function, shown below as Figure 4, to find the area of the t-distribution curve to the right of my T value, which is 1.92, as shown in Figure 5 where I substituted my values into the tcdf calculator function.

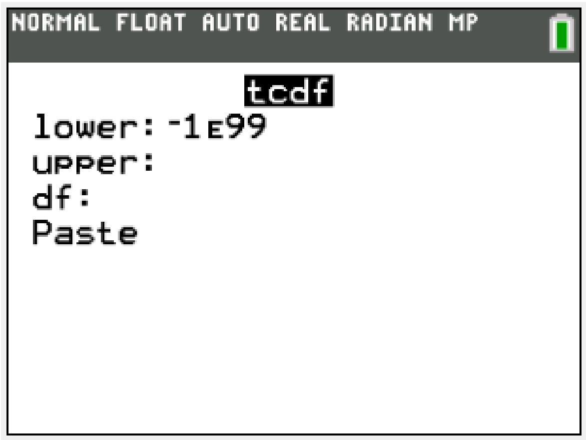

Figure 4: T-Distribution Cumulative Function

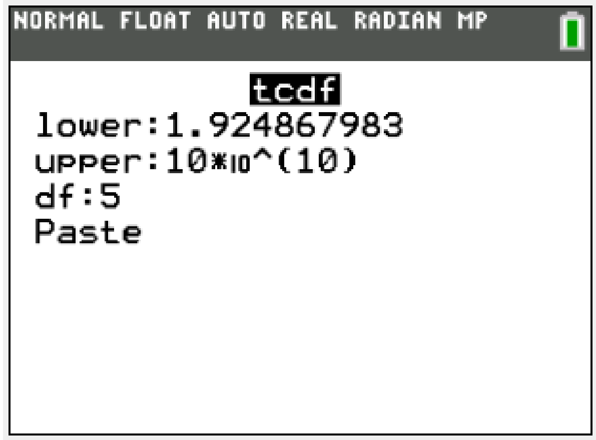

Figure 5: TCDF Substitutions

I am using a lower bound of 1.92 since we are doing a right-tailed, t-test. The upper bound should be infinity, however, with my calculator, I simply used 10×10^{10} as I could not enter infinity. My degree of freedom is 5 as it is 1 less than the number of players in the sample. This gives me a p-value of: **0.0561**, rounded to 3 significant figures.

I am using a significance level of 0.05, therefore in the comparison between my p-value and my significance level, $0.0561 > 0.05$. This means that my p-value is greater than my significance level. This means that the test shows that my p-value is not statistically significant enough to reject my null hypothesis, therefore we reject the alternative hypothesis and accept the null hypothesis of H_0 for the NBA player data set, with $\mu_X = 0$

T-Test for Myself and My Friends

I have calculated the X values for the different players between myself and my friends using Table 1, tabulating them to Table 3 below.

Player	Isaac	Sam	Louis	Ian	James	Cho
$\alpha - \beta$	25.3	12.5	13.2	27.8	-3.3	20.0

Table 3: X values for the different players

To find values to substitute into the t-test formula, my methodology was the same as for the t-test for NBA players.

Finding $\overline{X}_n$:

$$\frac{(25.3 + 12.5 + 13.2 + 27.8 - 3.3 + 20)}{6}$$ which is equal to **15.92** (rounded to 2 d.p.)

Σx^2 is evaluated as:

$(25.3)^2 + (12.5)^2 + (13.2)^2 + (27.8)^2 + (-3.3)^2 + (20)^2$ which is equal to **2154.31**

Thus, S_n is:

$$\sqrt{\frac{2154.31}{6} - (15.9)^2}$$ which is equal to **10.28**.

Therefore, S_{n-1} is:

$$\sqrt{\frac{6}{5}} \times \sqrt{\frac{677.28}{6} - (6.93)^2}$$ which is equal to **11.26**.

As a result, using exact values for the formula, our T value is as follows:

$$\frac{15.92 - 0}{11.26/\sqrt{6}}$$ which is equal to **3.46**.

Using my calculator again with the tcdf calculator function, I input my T value as the lower bound, which is 3.16, and I used 10×10^{10} as the upper bound again. My degree of freedom is still 5 as it is 1 less than the number of players in the sample. This gives me a p-value of: **0.00901**, rounded to 3 significant figures.

I am still using a significance level of 0.05, therefore in the comparison between my p-value and my significance level, $0.00901 < 0.05$. The fact that my p-value is actually less than my significance level shows that my p-value is statistically significant enough to reject my null hypothesis. Therefore, we reject my null hypothesis and accept the alternative hypothesis of H_0 for myself and my friends, with $\mu_X > 0$

Alternative T-Test for Myself and My Friends

Based on these results so far, the effect of success breeding success is likely to be true. This made me question whether or not the inverse relationship is true, where a prior failure will lead to more failure, because of the opposite reason - a loss in confidence. My null hypothesis will be that the probability for failure for a shot given a prior failure will be the same as the probability for a failure, which suggests the independent nature of the shots. My alternative hypothesis is that the probability for failure for a shot given a prior failure will be greater than the probability for a failure of a shot going inside the basketball hoop.

Thus, to truly see if this works, I will perform another t-test for this within the same data set for myself and my friends, but investigating another relationship. Using the same results, I have processed Table 4 below.

Player	Given a failure, probability for another failure	Amount of failures given a prior failure	100% - FT %
Isaac Hua	54.5%	6/11	47.5%
Samuel Oswell	30.0%	3/10	32.5%
Louis Kong	50.0%	3/6	27.5%
Ian Tan	63.6%	7/11	50.0%
James Kim	100.0%	1/1	12.5%
Cho Ster	66.7%	8/12	57.5%

Table 4: Failures in Free Throws Data

I will make the same assumptions as I have for the previous t-tests, and I will redefine some variables.

I will denote “given a failure, probability for another failure” by γ and “100% - FT%” by δ. Let variable $Y = \gamma - \delta$.

Y ~ N(μ, σ^2), so *Y* is normally distributed with a population mean of μ and a variance of σ^2.

My hypotheses are, where μ_X is the population mean for variable *X*:

$H_0 : \mu_X = 0$

$H_1 : \mu_X > 0$

Using γ and δ, I evaluated the Y values for the different players, tabulating them into Table 5 which is below.

Player	**Isaac**	**Sam**	**Louis**	**Ian**	**James**	**Cho**
γ - δ	7	-2.5	22.5	13.6	87.5	9.2

Table 5: Y values for the different players

Finding values for the t-test formula, I used a similar methodology to the previous t-tests.

Finding $\overline{X}_n$:

$$\frac{(7 - 2.5 + 22.5 + 13.6 + 87.5 + 9.2)}{6}$$ which is equal to **22.88** (rounded to 2 d.p.)

Σx^2 is evaluated as:

$(7)^2 + (-2.5)^2 + (22.5)^2 + (13.6)^2 + (87.5)^2 + (9.2)^2$ which is equal to **8487.35**

Thus, S_n is:

$$\sqrt{\frac{8487.35}{6} - (22.88)^2}$$ which is equal to **29.85**.

Therefore, S_{n-1} is:

$$\sqrt{\frac{6}{5}} \times \sqrt{\frac{8487.35}{6} - (22.88)^2}$$ which is equal to **32.70**.

As a result, using exact values for the formula, our T value is as follows:

$$\frac{22.88 - 0}{32.7/\sqrt{6}}$$ which is equal to **1.71**.

Using my calculator again with the tcdf calculator function, I input my T value as the lower bound, which is 1.71, and I used 10×10^{10} as the upper bound again. My degree of freedom is still 5 as it is 1 less than the number of players in the sample. This gives me a p-value of: **0.0736**, rounded to 3 significant figures.

I will still be using a significance level of 0.05. In the comparison between my p-value and my significance level, $0.0736 > 0.05$. This means that my p-value is greater than my significance level. This means that the test shows that my p-value is not statistically significant enough to reject my null hypothesis, therefore we reject the alternative hypothesis and accept the null hypothesis of H_0 for the NBA player data set, with $\mu_X = 0$

This means that within the data set that includes myself and my friends, there is not enough evidence to suggest that given a prior failure of a shot, the probability of another failure is not statistically significant enough to make a conclusion that there is such an effect where failure leads to more failure.

Conclusions

Through my investigation, I found that for NBA players, my p-value is not statistically significant enough to prove that the alternative hypothesis is true for them, however I found that for myself and as well as for my friends, my p-value is statistically significant enough to reject the null hypothesis and accept the alternative hypothesis. This is good evidence to suggest that success does indeed breed success in basketball, because the p-value for my personal data set was 0.00901 which was very very low. Additionally, for the NBA players, the p-value of 0.0561 is indeed greater than the significance level of 0.05, however, the difference is very small. This means that it could still be likely that NBA players have this effect where they succeed more in their prior shots given an initial success in a shot, but I cannot make that conclusion given that I have used a significance level of 0.05.

My results found that given a prior success in a free throw, it is more likely to score the next free throw, proving that this effect is not only psychological but can also be supported mathematically via statistics and hypothesis testing. This is important because it means that basketball players who are particularly successful at landing shots in succession in a game, should continue to attempt more shots instead of passing to take advantage of “success breeding success”, since they statistically perform better due to this effect.

Conversely, however, I found that at least for the data set that includes myself and my friends, my p-value is not statistically significant enough to prove that failure will lead to more failure. The p-value is 0.0736 which is greater than the significance level of 0.05. This could mean that even if we are met with an initial failure, we should keep attempting shots as there is little evidence to suggest that our next shot is dependent on the failure of our initial shot. This means that my assumption that when I miss a shot, I tend to miss my next few shots, is false because it is not supported statistically and I may only be focusing on certain shots and patterns when I play basketball matches.

Evaluation

However, there are some limitations and flaws in my investigation. The most obvious flaw is that I have a small sample size, as I only used the NBA Finals Series of the 2018-2019 season to record my results, without considering other NBA players. This could mean that the Central Limit Theorem could possibly not apply to my investigation, because I do not have a large enough sample size to apply across the true population of basketball players. Furthermore, this is the NBA Finals where it is the best of the best basketball players in the world.

These players by definition are outliers as they are the best in their profession, significantly exceeding the average abilities of any ordinary basketball player. This means that the effect of “success breeding success” may not be that clear for my results because these NBA players have a high probability for success anyway, which means that the “streak-y” nature of players can be attributed to their skill. This is similar to the effect of “failure leading to more failure” for myself and my friends, where we at an intermediate level of playing basketball, so the probability for failure is the same as the probability for failure given an initial failure, because we have a relatively high probability for failure anyway.

Similarly, I also had a small sample size for personal data, as I only collected data for six players in order to keep it consistent for the NBA player data set. This could be anomalous as not everyone has the same skill set and basketball players all have different levels of experiences. Thus, with a larger data set, these anomalous results could have a smaller effect, as well as enabling me to investigate “failure leading to more failure” for NBA players too, where basketball players get “cold” and lose confidence in their abilities.

Additionally, I myself have the largest X value of 25.3 which was one of the highest across the two data sets, and I only recorded results in a single training session, so it could mean that I was simply feeling particularly “streak-y” where I would tend to make shots if I made the prior shot, because I could have been actively thinking about this investigation which could have skewed the results. This argument could also be applied to my friends as I told them about my investigation, as they also have very high X values. Additionally, this is only one game series and one training session, it could be possible that on another given game, the effect of success breeding success would not be observed in the basketball players.

In addition to this, basketball is a game of a wide variety of shots and situations. A free throw simulates a controlled environment which is unrealistic because basketball games have defenders who pressure the shooter, psychological pressures such as spectators and hecklers, as well as a larger choice of shots with three-pointers and dunks. Only comparing free throws is not representative of the whole game of basketball, so it would have been better had I compared a different selection of basketball shots.

With more time, I would hope to make my data more reliable by accumulating a larger sample size with more basketball players, as well as over a longer period of time with more repeats so that my data can stay consistent. However, I am overall happy with the investigation as I had to think creatively to find approximations for values which I did not have, such as S_{n-1} in replacement of true standard deviation, as well as having to learn an entirely new topic of hypothesis testing and statistical tests.

Appendices

Appendix 1: NBA Player Free Throw Data

NBA Finals 2019 Game 1, Scotiabank Arena			
FT Attempt Number	First one made?	Second one made?	Player
1	Y	Y	Stephen Curry
2	Y	Y	Marc Gasol
3	Y	Y	Shaun Livingston
4	Y	Y	Norman Powell
5	Y	Y	Demarcus Cousins
6	Y	Y	Kawhi Leonard
7	Y	Y	Kyle Lowry
8	N	N	Fred Van Vleet
9	Y	Y	Draymond Green
10	Y	Y	Draymond Green
11	Y	Y	Marc Gasol
12	Y	Y	Stephen Curry
13	Y	Y	Draymond Green
14	Y	Y	Pascal Siakam
15	Y	Y	Kawhi Leonard
16	Y	Y	Stephen Curry
17	Y	Y	Stephen Curry
18	Y	Y	Stephen Curry
19	N	Y	Kawhi Leonard
20	Y	Y	Kawhi Leonard
21	Y	Y	Fred Van Vleet
22	Y	Y	Klay Thompson
23	Y	N	Demarcus Cousins
24	N	Y	Serge Ibaka
25	N	Y	Kevon Looney
26	Y	Y	Marc Gasol
27	N	Y	Kawhi Leonard
28	Y	Y	Fred Van Vleet
NBA Finals 2019 Game 2, Scotiabank Arena			
FT Attempt Number	First one made?	Second one made?	Player
1	Y	Y	Marc Gasol
2	Y	N	Klay Thompson

3	Y	Y	Kyle Lowry
4	Y	Y	Draymond Green
5	Y	Y	Draymond Green
6	Y	Y	Stephen Curry
7	Y	N	Draymond Green
8	Y	Y	Kawhi Leonard
9	Y	Y	DeMarcus Cousins
10	Y	Y	DeMarcus Cousins
11	Y	Y	Kawhi Leonard
12	N	Y	Pascal Siakam
13	Y	Y	Stephen Curry
14	Y	Y	Kawhi Leonard
15	Y	Y	Stephen Curry
16	Y	Y	Kawhi Leonard
17	Y	Y	Shaun Livingston
18	Y	N	Pascal Siakam
19	N	Y	Kyle Lowry
20	Y	Y	Kawhi Leonard
NBA Finals 2019 Game 3, Oracle Arena			
FT Attempt Number	First one made?	Second one made?	Player
1	Y	Y	Kyle Lowry
2	Y	Y	Marc Gasol
3	Y	Y	Kawhi Leonard
4	Y	Y	Kawhi Leonard
5	Y	Y	Stephen Curry
6	Y	Y	Shaun Livingston
7	Y	Y	Pascal Siakam
8	Y	Y	Serge Ibaka
9	Y	Y	Draymond Green
10	Y	Y	Stephen Curry
11	Y	N	Stephen Curry
12	Y	Y	Stephen Curry
13	Y	Y	Marc Gasol
14	N	Y	Kawhi Leonard
15	Y	Y	Kawhi Leonard
16	Y	Y	Kawhi Leonard
17	Y	N	Andre Iguodala
18	Y	N	Jonas Jerebko
19	Y	Y	Stephen Curry

20	Y	Y	Jonas Jerebko
NBA Finals 2019 Game 4, Oracle Arena			
FT Attempt Number	First one made?	Second one made?	Player
1	Y	N	Pascal Siakam
2	Y	Y	Kawhi Leonard
3	Y	Y	Draymond Green
4	N	N	Alfonzo McKinnie
5	Y	Y	Kyle Lowry
6	Y	Y	Marc Gasol
7	Y	Y	Kyle Lowry
8	Y	Y	Pascal Siakam
9	Y	Y	Stephen Curry
10	Y	Y	Kawhi Leonard
11	N	Y	Stephen Curry
12	Y	Y	Kawhi Leonard
13	Y	Y	Shaun Livingston
14	Y	Y	Draymond Green
15	Y	Y	Stephen Curry
16	N	N	Kevon Looney
17	Y	N	Andre Iguodala
18	Y	Y	Kawhi Leonard
19	Y	Y	Pascal Siakam
NBA Finals 2019 Game 5, Scotiabank Arena			
FT Attempt Number	First one made?	Second one made?	Player
1	Y	N	Marc Gasol
2	Y	Y	Marc Gasol
3	N	Y	Kawhi Leonard
4	Y	Y	Serge Ibaka
5	Y	Y	Kevin Durant
6	Y	Y	Fred VanVleet
7	Y	Y	Serge Ibaka
8	Y	N	Serge Ibaka
9	Y	Y	Kawhi Leonard
10	Y	N	Kyle Lowry
11	N	N	DeMarcus Cousins
12	Y	Y	Stephen Curry
13	Y	Y	Marc Gasol
14	N	Y	Klay Thompson

15	Y	Y	Marc Gasol
16	N	Y	Kawhi Leonard
17	N	Y	DeMarcus Cousins
NBA Finals 2019 Game 6, Oracle Arena			
FT Attempt Number	First one made?	Second one made?	Player
1	Y	Y	Stephen Curry
2	Y	N	Kyle Lowry
3	N	Y	Marc Gasol
4	Y	Y	Stephen Curry
5	Y	Y	Kyle Lowry
6	Y	Y	Klay Thompson
7	Y	Y	Fred VanVleet
8	Y	N	Andre Iguodala
9	N	N	Andre Iguodala
10	N	Y	Serge Ibaka
11	Y	Y	Klay Thompson
12	Y	Y	Pascal Siakam
13	Y	N	Kawhi Leonard
14	N	Y	Kyle Lowry
15	N	Y	DeMarcus Cousins
16	Y	Y	Marc Gasol
17	Y	N	DeMarcus Cousins
18	N	Y	Pascal Siakam
19	N	Y	DeMarcus Cousins
20	Y	Y	Stephen Curry
21	Y	Y	Kawhi Leonard

Appendix 2: Myself and My Friends Free Throw Data

Isaac		
FT Attempt Number	First one made?	Second one made?
1	N	N
2	N	N
3	N	Y
4	Y	Y
5	Y	N
6	Y	Y

7	Y	N
8	N	Y
9	N	Y
10	N	N
11	N	N
12	Y	Y
13	Y	Y
14	Y	Y
15	N	N
16	Y	Y
17	N	Y
18	N	Y
19	Y	Y
20	N	N
total fta	PROB	
21/40	7/9	
Sam		
FT Attempt Number	First one made?	Second one made?
1	Y	Y
2	Y	N
3	N	Y
4	N	Y
5	N	Y
6	Y	Y
7	N	Y
8	N	N
9	N	Y
10	Y	Y
11	N	Y
12	Y	Y
13	Y	Y
14	N	N
15	N	Y
16	Y	Y
17	Y	N
18	Y	Y
19	Y	Y

20	N	N
TOTAL FTA	PROB	
27/40	8/10 probability	
Louis		
FT Attempt Number	First one made?	Second one made?
1	Y	Y
2	Y	Y
3	Y	Y
4	N	N
5	Y	N
6	Y	Y
7	Y	Y
8	Y	Y
9	N	Y
10	Y	Y
11	N	N
12	Y	Y
13	Y	Y
14	Y	N
15	N	Y
16	Y	Y
17	N	Y
18	N	N
19	Y	Y
20	Y	Y
TOTAL FTA	PROB	
29/40	12/14	
Tan		
FT Attempt Number	First one made?	Second one made?
1	N	N
2	N	N
3	N	N
4	N	N
5	Y	Y
6	Y	N
7	N	Y

8	N	Y
9	Y	Y
10	Y	N
11	Y	Y
12	N	N
13	Y	Y
14	Y	Y
15	Y	Y
16	N	Y
17	Y	Y
18	N	N
19	N	N
20	N	Y
TOTAL FTA	PROB	
20/40	7/9	
James		
FT Attempt Number	First one made?	Second one made?
1	Y	Y
2	Y	Y
3	Y	N
4	Y	N
5	Y	Y
6	Y	Y
7	Y	Y
8	Y	Y
9	Y	Y
10	Y	Y
11	Y	Y
12	Y	Y
13	N	N
14	Y	Y
15	Y	Y
16	Y	N
17	Y	Y
18	Y	Y
19	Y	Y
20	Y	Y

TOTAL FTA		
35/40	16/19	
Cho		
FT Attempt Number	First one made?	Second one made?
1	N	N
2	N	N
3	Y	Y
4	N	N
5	Y	Y
6	N	N
7	Y	N
8	N	Y
9	Y	Y
10	Y	Y
11	N	Y
12	N	N
13	Y	N
14	N	Y
15	N	N
16	N	Y
17	Y	Y
18	N	N
19	N	N
20	Y	N
TOTAL FTA	PROB	
17/40	5/8	

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