



The Impact of Stephen Curry on 3- pointers in NBA: A Statistical Study

IE- 6200 Team Project

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December 9, 2021

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I. ABSTRACT

Stephen Curry is a professional basketball player for the Golden State Warriors of the National Basketball Association (NBA). He is popularly known as the '3-pointer god' and widely regarded as the most excellent shooter in NBA history with a track record of 7 All-star selections, 2 MVP awards, and 3 NBA championships. A three-point field goal in a basketball game is scored from a designated arc surrounding the basket beyond the three-point line. A successful attempt is worth three points, in contrast to the two points awarded for field goals made within the three-point line and the one point for each made free throw. Before Stephen's arrival, 3-point shots had an average increase of 1.31% each season, and post his arrival, the average increase was 6.70%. We have used a time graph, histogram, and ANOVA (1996-2020) to analyze the trend of 3 points shooting from over 30 NBA teams and Stephen Curry's contribution to the Golden State Warriors before and after his arrival to the NBA.

II. METHODOLOGY

The data analysis for 3-point shooting is made by selecting 30 NBA teams within 1996-2020. The four main factors that we focus on are

- 3- pointers scored
- 3- pointers attempted
- 3-pointers field goal percentage and
- Share of 3- pointers in total points

We developed a p-diagram to better understand the factors which come into play while shooting a 3 pointer. We considered several factors such as the control, noise, and input/output factors. A time-series graph is plotted to determine the trends of 3-point shooting before and after Stephen Curry's arrival. He was made the role player in the year 2011, and since then, we can notice the exponential increase in the four parameters mentioned above. Time series analysis is mainly used to discover a pattern in the historical data and then extrapolate the pattern into the future of the 30 NBA teams between the time frame 1996-2020. Time series include trend, cyclical, seasonal, and irregular components. Histograms are created to identify the distribution and consistency of data, and through these, we could conclude that cumulative distribution is best suited for our data set. We used ANOVA single factor testing to compare the variances of each of the datasets concerning one another. These graphs enabled us to analyze the trend of 3-point shooting before and after the arrival of Stephen Curry in the NBA.

III. P- DIAGRAM

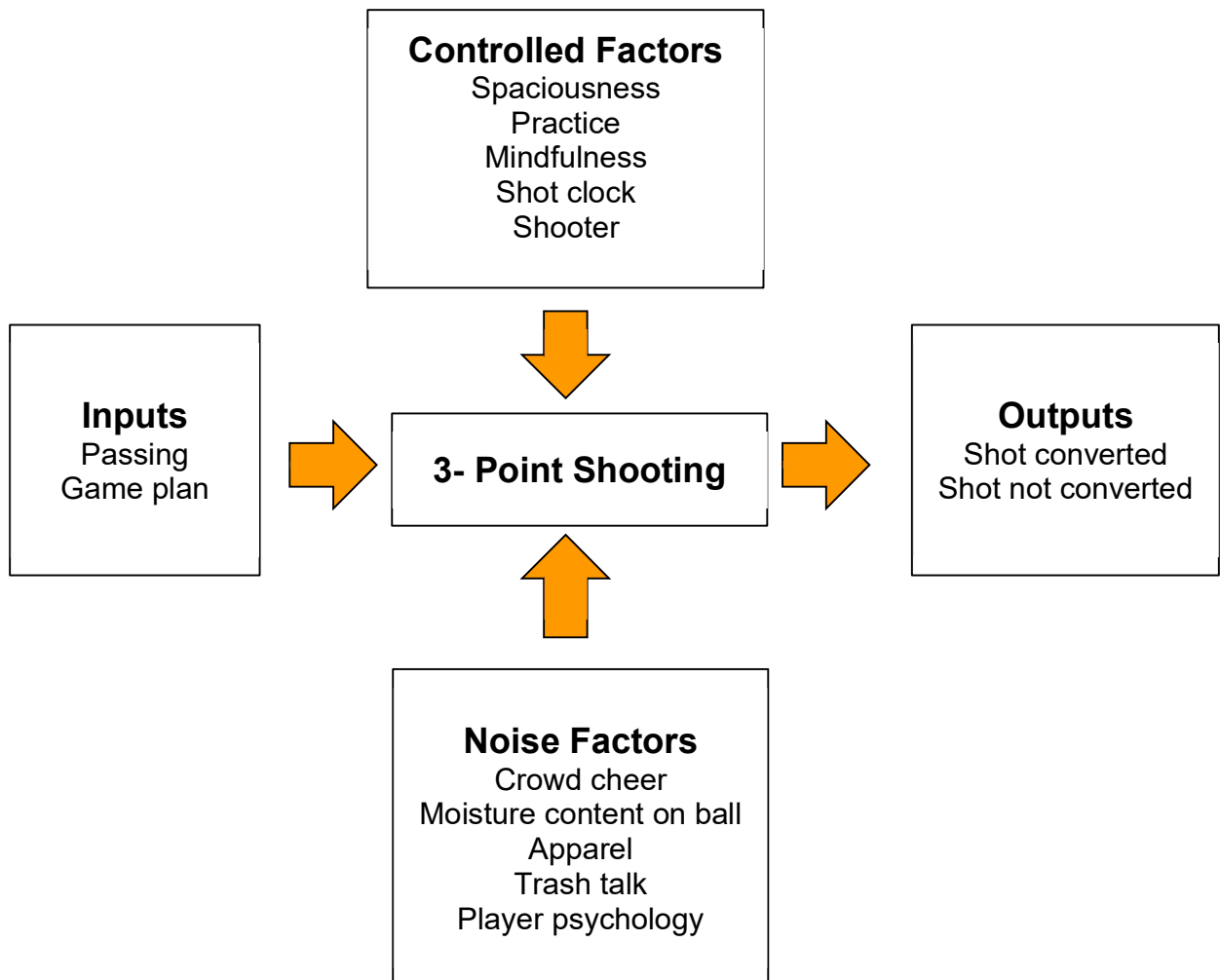


Fig. 1: P- Diagram for 3- Pointers in Basketball

IV. DATA

Years	NBA			
	3PM	3PA	3P%	3P% share in TP*
1996-97	6.04	16.79	35.96	18.74
1997-98	4.40	12.71	34.38	13.89
1998-99	4.45	13.17	33.62	14.55
1999-00	4.84	13.72	35.29	14.85
2000-01	4.84	13.71	35.18	15.278
2001-02	5.21	14.75	35.18	16.33
2002-03	5.13	14.68	34.66	16.145
2003-04	5.18	14.92	34.55	16.63
2004-05	5.6	15.75	35.32	17.22
2005-06	5.73	15.98	35.69	17.64
2006-07	6.07	16.94	28.1	18.37
2007-08	6.56	18.11	36.02	19.63
2008-09	6.65	18.13	36.54	19.95
2009-10	6.44	18.14	35.28	19.16
2010-11	6.46	18.01	35.63	19.40
2011-12	6.41	18.39	34.72	17.03
2012-13	7.16	19.97	35.76	21.82
2013-14	7.74	21.54	35.88	22.93
2014-15	7.9	22.4	34.9	23.5
2015-16	8.5	24.1	35.3	24.8
2016-17	9.7	27	35.7	27.4
2017-18	10.5	29	36.2	29.6
2018-19	11.4	32	35.6	30.6
2019-20	12.2	34.1	35.8	32.7

*TP – Total Points

Table 1: Dataset for years 1960-2020 in NBA

V. DESCRIPTIVE STATISTICAL DATA

Values for different statistical unknowns were calculated using the data analysis function in Excel, for each of the four criteria. The values were calculated at 95% confidence levels, based on individual seasonal data.

3PM	
Mean	6.880991
Standard Error	0.44312
Median	6.423334
Mode	#N/A
Standard Deviation	2.170834
Sample Variance	4.712518
Kurtosis	0.629422
Skewness	1.168903
Range	7.796552
Minimum	4.403448
Maximum	12.2
Sum	165.1438
Count	24
Largest(1)	12.2
Smallest(1)	4.403448
Confidence Level(95.0%)	0.916663

3PA	
Mean	19.33326
Standard Error	1.217736
Median	18.05834
Mode	#N/A
Standard Deviation	5.965665
Sample Variance	35.58916
Kurtosis	0.716973
Skewness	1.221871
Range	21.38621
Minimum	12.71379
Maximum	34.1
Sum	463.9983
Count	24
Largest(1)	34.1
Smallest(1)	12.71379
Confidence Level(95.0%)	2.51908

3P%	
Mean	35.35394
Standard Error	0.132639
Median	35.32807
Mode	#N/A
Standard Deviation	0.649793
Sample Variance	0.422231
Kurtosis	0.956699
Skewness	-0.7151
Range	2.92609
Minimum	33.61724
Maximum	36.54333
Sum	848.4946
Count	24
Largest(1)	36.54333
Smallest(1)	33.61724
Confidence Level(95.0%)	0.274384

3P% each game	
Mean	21.08563
Standard Error	1.231528
Median	19.28383
Mode	#N/A
Standard Deviation	6.033231
Sample Variance	36.39988
Kurtosis	-0.04846
Skewness	0.965475
Range	21.06347
Minimum	13.87586
Maximum	34.93933
Sum	506.0552
Count	24
Largest(1)	34.93933
Smallest(1)	13.87586
Confidence Level(95.0%)	2.54761

Table 2: Descriptive Statistics values for 3PM, 3PA, 3P% and 3P% in each game

VI. TIME SERIES

The time series plots show the increasing trend of 3- pointers scored, 3- pointers attempted, 3-pointers field goal percentage and the share of 3- pointers in total points respectively, for the 1996-2020 period. The x- axis represents individual seasons, whereas the y- axis shows the average points by all NBA teams in the corresponding season.

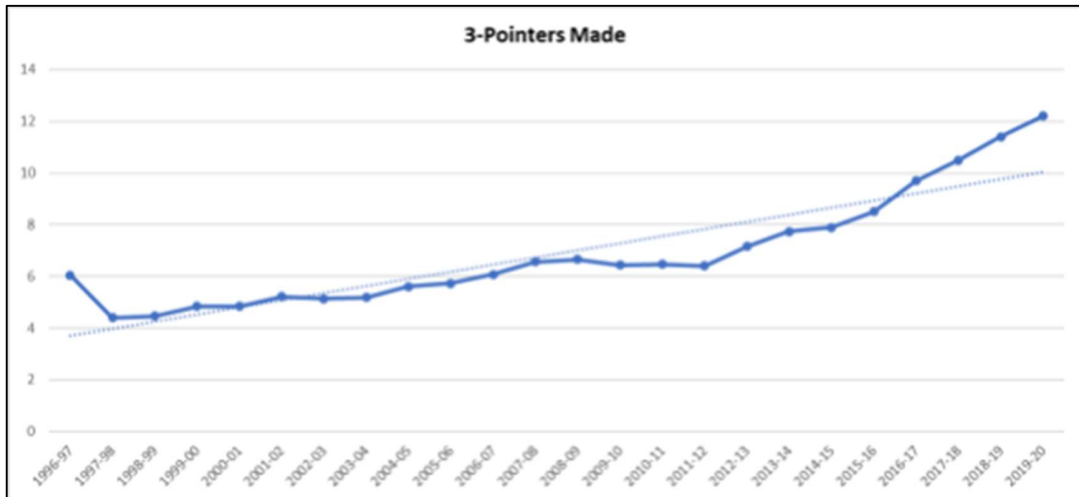


Fig. 2: Time series plot for 3- pointers made

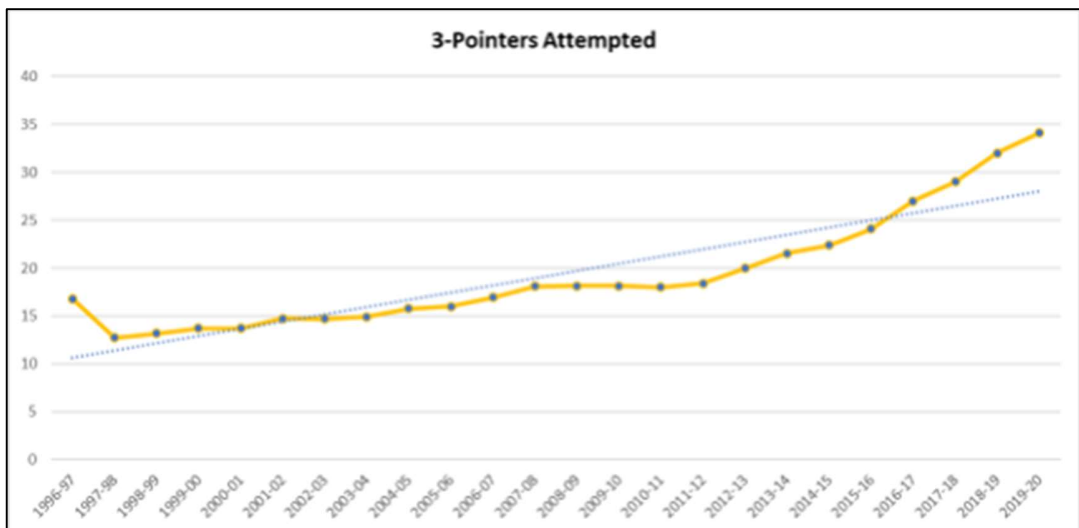


Fig. 3: Time series plot for 3- pointers attempted

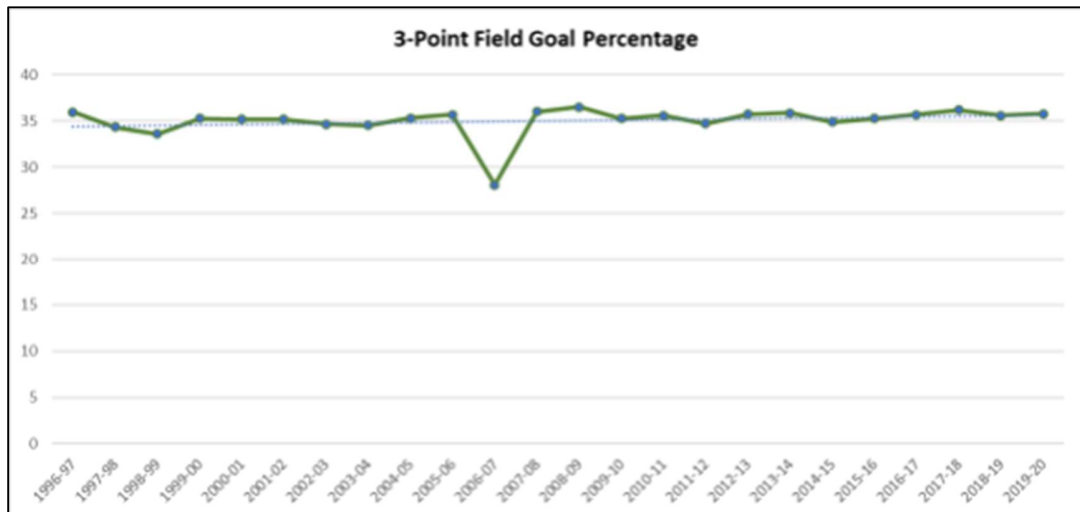


Fig. 4: Time series plot for 3- point field goal percentage

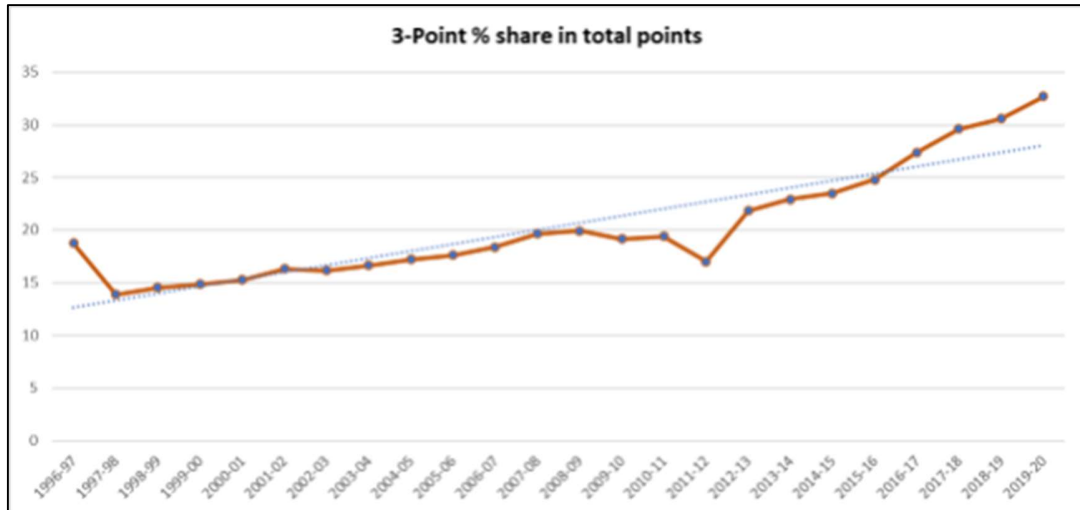


Fig. 5: Time series plot for 3- point % share in total points

VII. BOX PLOT

The box plots show the variation of mean and medium in 3- point shooting across the NBA before and after the arrival of Stephen Curry. In this case, we note through concentration of boxes that post arrival of Stephen Curry, 3- point shooting has increased in terms of conversion, attempts and share in total points. There has also been a drastic improvement in shooting accuracy.

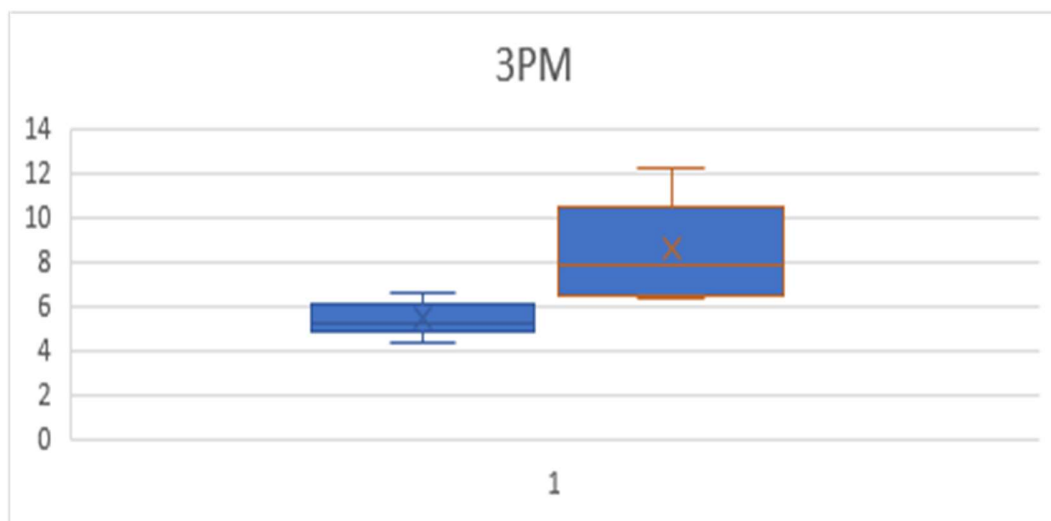


Fig. 6: Box plot for 3- pointers made

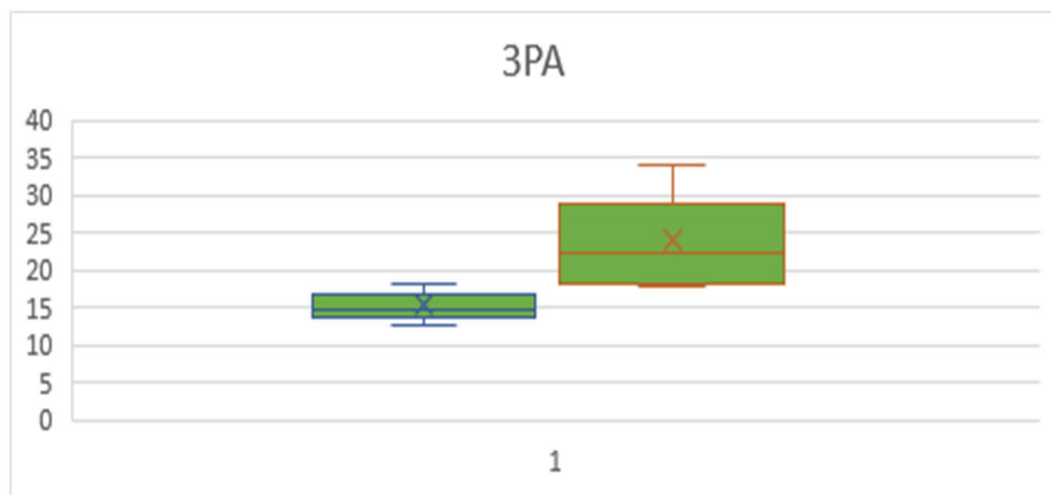


Fig. 7: Box plot for 3- pointers attempted

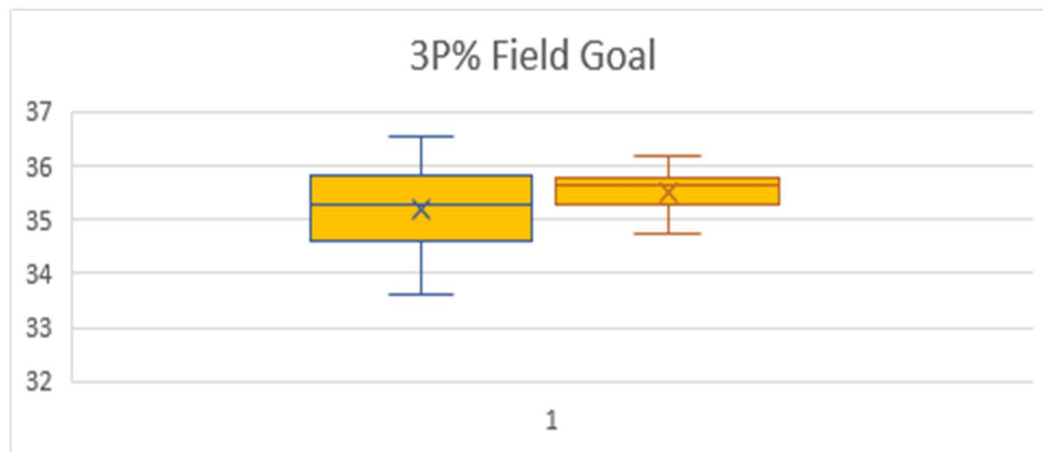


Fig. 8: Box plot for 3- point % in field goals

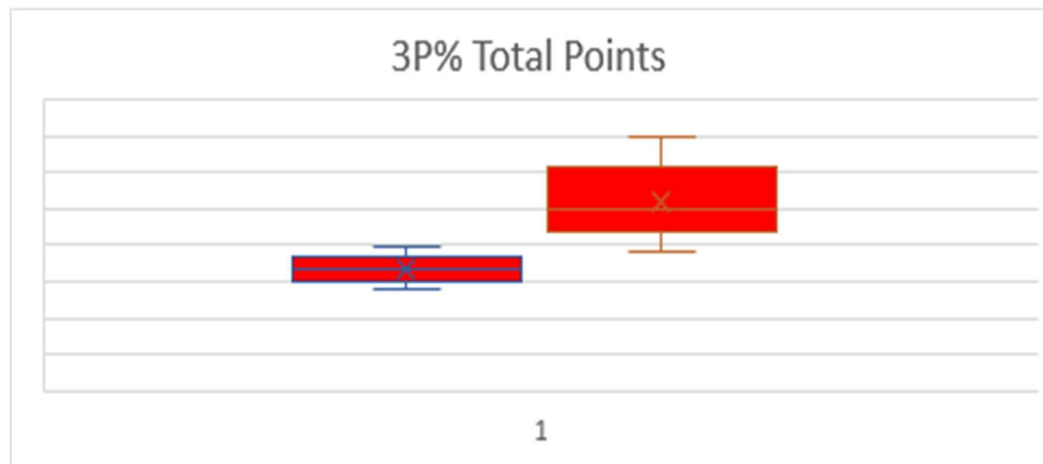


Fig. 9: Box plot for share of 3- point % in total points

VIII. Histogram

A histogram was plotted for each of the four criteria to depict the trend throughout the years.

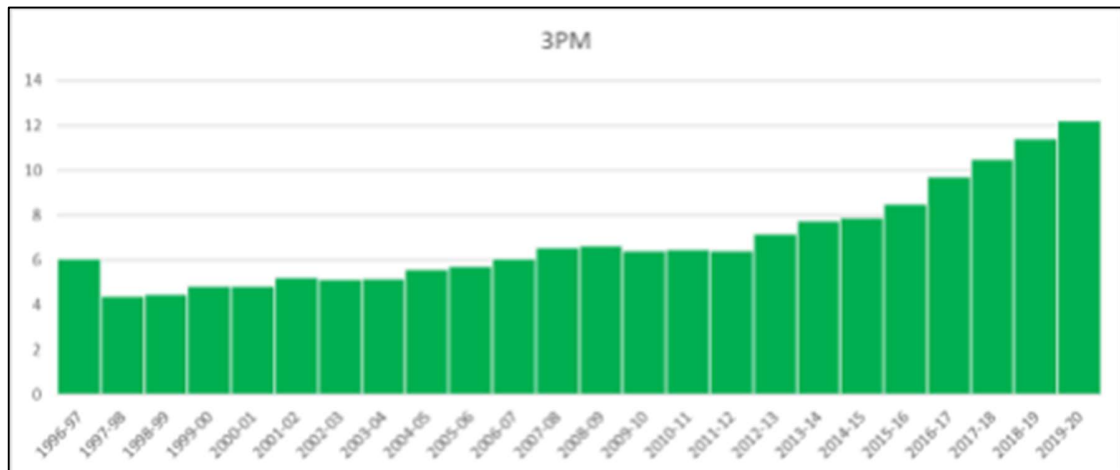


Fig. 10: Histogram for 3- pointers made vs season

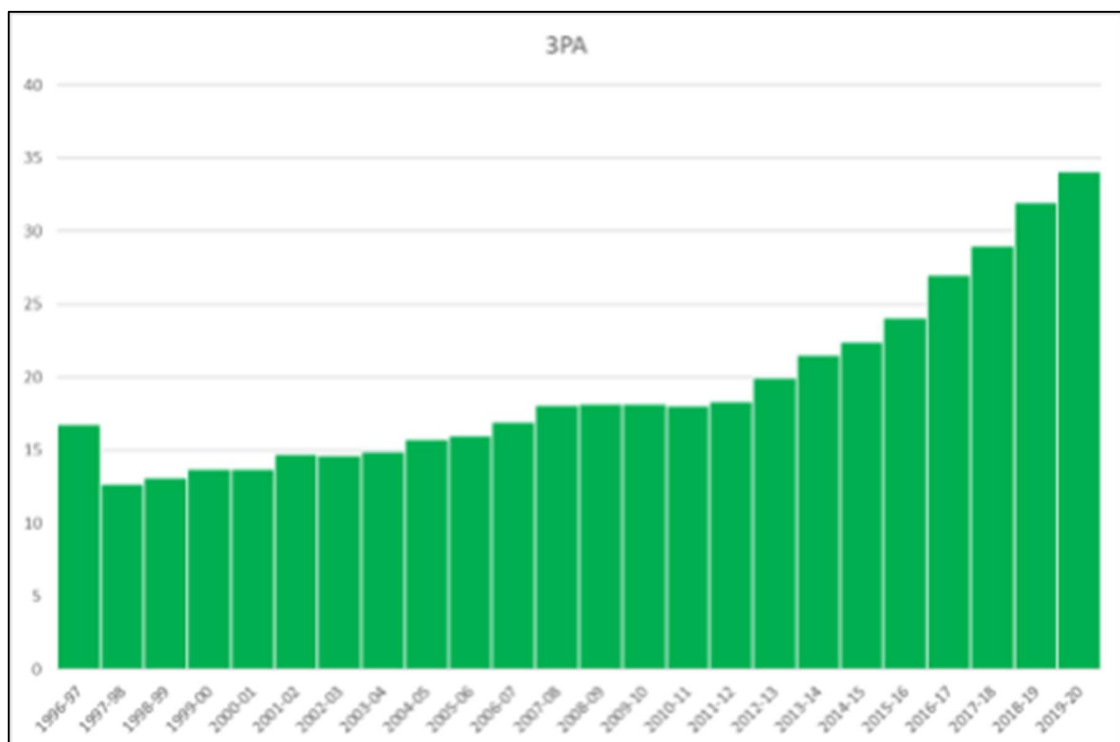


Fig. 11: Histogram for 3- pointers attempted vs season

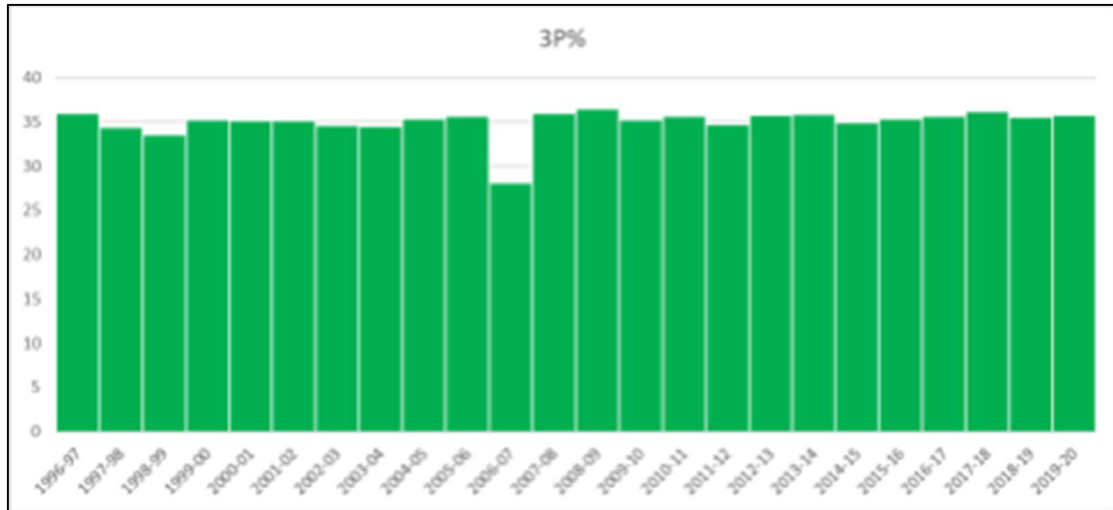


Fig. 12: Histogram for 3- point % vs season

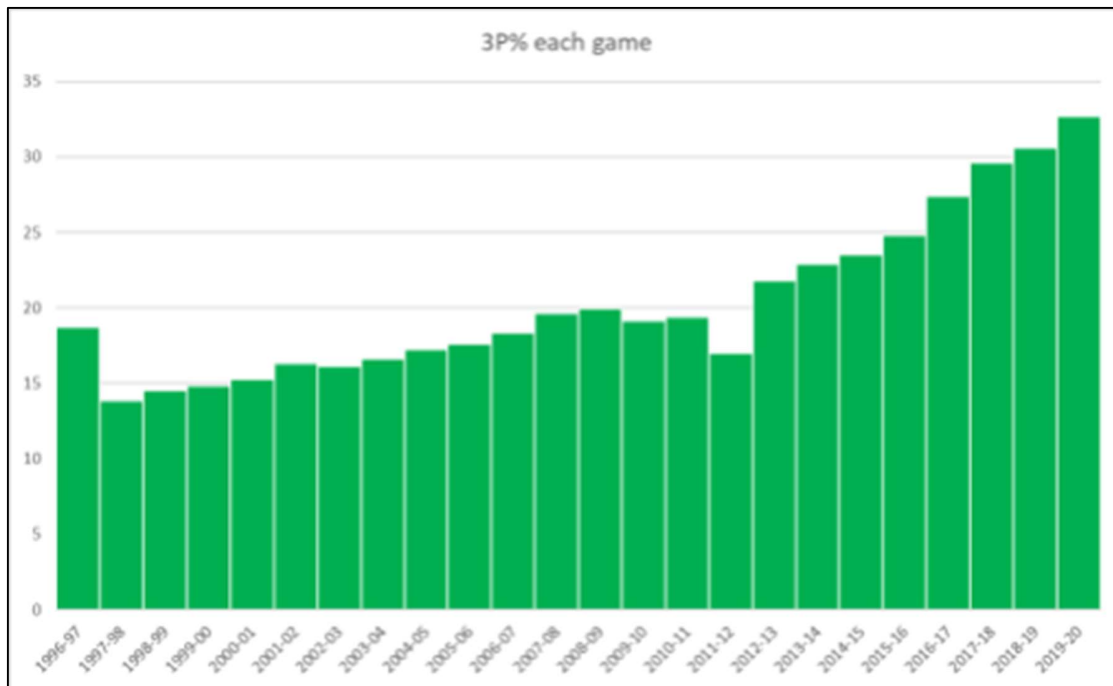


Fig. 13: Histogram for share of 3P % in total points vs season

IX. t-Test (Hypothesis Testing)

The above t-tests indicate 3 PM, 3PA, and 3P percentage share in each game that have values of $P < 0.05$, leading us to reject the hypothesis that data is normally distributed. The testing was done on 2 sets of data before and after Steph Curry was predominant. Whereas the t-test for 3 point percentage field goals has a value of $P = 0.229009$, which is more than 0.05, pointing that the data is following a normal distribution.

	<i>3PM (Before)</i>	<i>3PM (After)</i>
Mean	5.440548175	8.583333273
Variance	0.548365666	4.295649036
Observations	13	11
Hypothesized Mean Difference	0	
df	12	
t Stat	-4.777750695	
P(T<=t) one-tail	0.00022514	
t Critical one-tail	1.782287556	
P(T<=t) two-tail	0.000450281	
t Critical two-tail	2.17881283	

Table 3: t-test for 3- pointers made before and after Steph Curry

	<i>3PA (Before)</i>	<i>3PA (After)</i>
Mean	15.33551	24.05788
Variance	3.21625	32.66471
Observations	13	11
Hypothesized Mean Difference	0	
df	12	
t Stat	-4.86311	
P(T<=t) one-tail	0.000195	
t Critical one-tail	1.782288	
P(T<=t) two-tail	0.000389	
t Critical two-tail	2.178813	

Table 4: t-test for 3- pointers attempted before and after Steph Curry

	<i>3P% (Before)</i>	<i>3P% (After)</i>
Mean	35.21028	35.52373
Variance	0.602038	0.190146
Observations	13	11
Hypothesized Mean Difference	0	
df	19	
t Stat	-1.24294	
P(T<=t) one-tail	0.114505	
t Critical one-tail	1.729133	
P(T<=t) two-tail	0.229009	
t Critical two-tail	2.093024	

Table 5: t-test for 3- point % before and after Steph Curry

	<i>3P% each game (Before)</i>	<i>3P% each game(After)</i>
Mean	16.86112	26.07824
Variance	3.782444	28.56151
Observations	13	11
Hypothesized Mean Difference	0	
df	12	
t Stat	-5.42422	
P(T<=t) one-tail	7.70E-05	
t Critical one-tail	1.782288	
P(T<=t) two-tail	0.000154	
t Critical two-tail	2.178813	

Table 6: t-test for 3- point % share in total points before and after Steph Curry

X. ANOVA

Anova: 3PM						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
3PM	13	70.72713	5.440548	0.5483657		
3PM	11	94.41667	8.583333	4.295649		
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	58.85104	1	58.85104	26.136547	4.02E-05	4.300949502
Within Groups	49.53688	22	2.251676			
Total	108.3879	23				

Table 7: ANOVA for 3- pointers made before and after Steph Curry

Conclusion: P value< 0.05,
Null hypothesis Rejected

Anova: 3PA						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
3PA	13	199.3616	15.33551	3.2162502		
3PA	11	264.6367	24.05788	32.664711		
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	453.3087	1	453.3087	27.304603	3.06E-05	4.300949502
Within Groups	365.2421	22	16.60191			
Total	818.5508	23				

Table 8: ANOVA for 3- pointers attempted before and after Steph Curry

Conclusion: P value< 0.05,
Null hypothesis Rejected

Anova:3P%						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
3P%	13	457.7336	35.21028	0.6020377		
3P%	11	390.761	35.52373	0.1901459		
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.585412	1	0.585412	1.4112624	0.2475144	4.300949502
Within Groups	9.125912	22	0.414814			
Total	9.711323	23				

Table 9: ANOVA for 3- point% before and after Steph Curry

Conclusion: P value> 0.05,
Null hypothesis is accepted

Anova: 3P% share in each game						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
3P% each game	13	219.1945	16.86112	3.7824444		
3P% each game	11	286.8607	26.07824	28.561515		
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	506.1927	1	506.1927	33.643771	7.78E-06	4.300949502
Within Groups	331.0045	22	15.04566			
Total	837.1972	23				

Table 10: ANOVA for 3- point % share in total points before and after Steph Curry

Conclusion: P value< 0.05,
Null hypothesis Rejected

XI. RESULTS AND DISCUSSIONS

- ANOVA is conducted to evaluate the significance of Stephen Curry on the variation of 3-point shooting across the NBA. After performing the one-way ANOVA for 3-point shooting using MS EXCEL, we found that the p-value is minimal for three parameters which are 3 Pointers made, 3-pointers attempted, and percentage share of 3-pointers in total points, almost equivalent to 0. Since $0 < 0.05$ (α value), we reject the null hypothesis and accept the alternate hypothesis that at least one mean value is different.
- On the other hand, a single ANOVA test conducted on a 3-pointer field goal percentage gave us a p-value of $0.248 > 0.05$ (α value), accepting the null hypothesis and indicating that the mean is almost similar.
- The influence of Stephen Curry on 3-point shooting across the leagues was predominantly noticed starting season 2012-13, mainly coinciding with his elevation as a role player for the Golden State Warriors which involved more ball handling, game time and freedom to shoot 3-pointers.
- Before 2012-13 growth in 3-point shooting was stagnant for more than 3 seasons indicating the influence of noise factors such as injuries, rookie season, and less game time.

XII. SCOPE OF WORK:

The study of variation predominantly risen in 3-point shooting over the past 24 years regarding Stephen Curry's impact can substantially affect the NBA teams, basketball analysts, and fans. The exponential rise in 3-point shooting and its consideration in game plans draw considerable inspiration from Stephen Curry's heroics. Going by the trend, teams have started giving more importance to 3-point shooting in their game plan during the 2015-2016 season. No significant rise in accuracy can be noticed from the 3-point field goal percentage since players were given more freedom to shoot the same. The analysis of 3-point shooting regarding Stephen Curry's impact paves the way for evaluating the 3-point shooting across the NBA.

XIII. REFERENCES

- 1) https://www.nba.com/stats/teams/traditional/?sort=W_PCT&dir=-1
- 2) https://en.wikipedia.org/wiki/Stephen_Curry
- 3) <https://www.basketball-reference.com/players/c/curryst01.html>