NBA PROJECT
FINAL PRESENTATION

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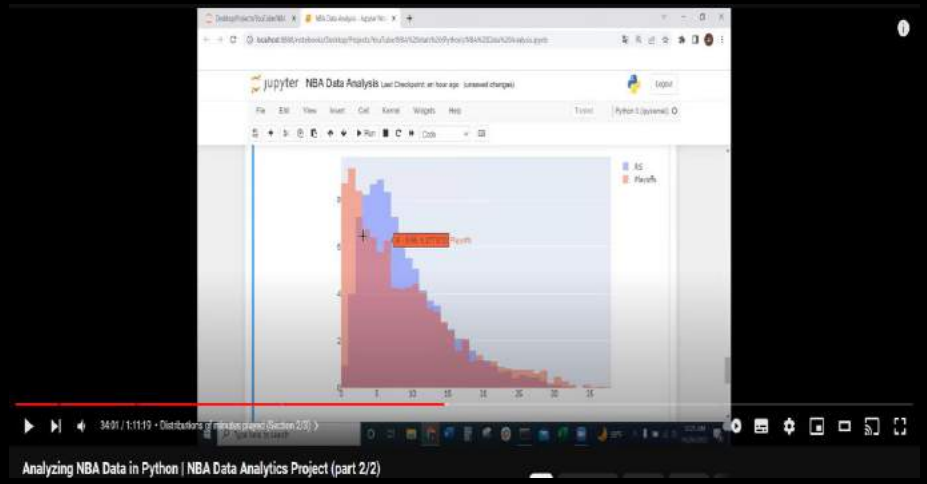
RESEARCH QUESTIONS

- RQ1: Who is the greatest scorer, playmaker, and defender in NBA history?
- RQ2: What factors impact draft/trade strategies the most?
- RQ3: Has the level of the NBA gotten better or worse?
- RQ4: Which performance stats contribute to determining a team's success the most?

RELATED WORK



Analyzing NBA Data in Python | NBA Data Analytics Project (part 2/2)

NBA Sports Betting Using Machine Learning 🏀

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Cleveland Cavaliers vs Brooklyn Nets (58.7%): UNDER 225.5 (72.3%)
Indiana Pacers (73.0%) vs Dallas Mavericks: UNDER 219.5 (58.6%)
Philadelphia 76ers (51.5%) vs Boston Celtics: UNDER 221.5 (64.7%)
Atlanta Hawks (85.1%) vs Detroit Pistons: UNDER 220 (59.3%)
Toronto Raptors vs Miami Heat (52.1%): UNDER 222 (57.0%)
Minnesota Timberwolves vs Orlando Magic (58.5%): OVER 218 (50.1%)
Houston Rockets vs Phoenix Suns (80.9%): UNDER 218 (62.1%)
Golden State Warriors vs San Antonio Spurs (51.7%): OVER 228.5 (50.6%)
LA Clippers (98.0%) vs Sacramento Kings: OVER 230 (75.1%)
Portland Trail Blazers (59.9%) vs Memphis Grizzlies: UNDER 223 (61.0%)
```

A machine learning AI used to predict the winners and under/overs of NBA games. Takes all team data from the 2007-08 season to current season, matched with odds of those games, using a neural network to predict winning bets for today's games. Achieves ~69% accuracy on money lines and ~55% on under/overs. Outputs expected value for teams money lines to provide better insight. The fraction of your bankroll to bet based on the Kelly Criterion is also outputted. Note that a popular, less risky approach is to bet 50% of the stake recommended by the Kelly Criterion.

NBA-analytics

Short, offhand analyses of the NBA

Note: All stats are from stats.nba.com, unless noted.

Topics Covered

- Underrated Assisters
- Consistent Players
- Why is Miami the worst team at drives?
- Which teams run the wrong plays?
- Shot Clock Analysis
- Westbrook Rebounding
- Defender distance
- Aging player's efficiency
- Steal efficiency
- Timeout Conversion
- Rim Protection
- Tanking
- Empirical Bayes estimation of NBA statistics
- James-Stein estimation of NBA statistics
- Player Efficiency Rating (PER)

DATASET(S)

player_data(2630 players)

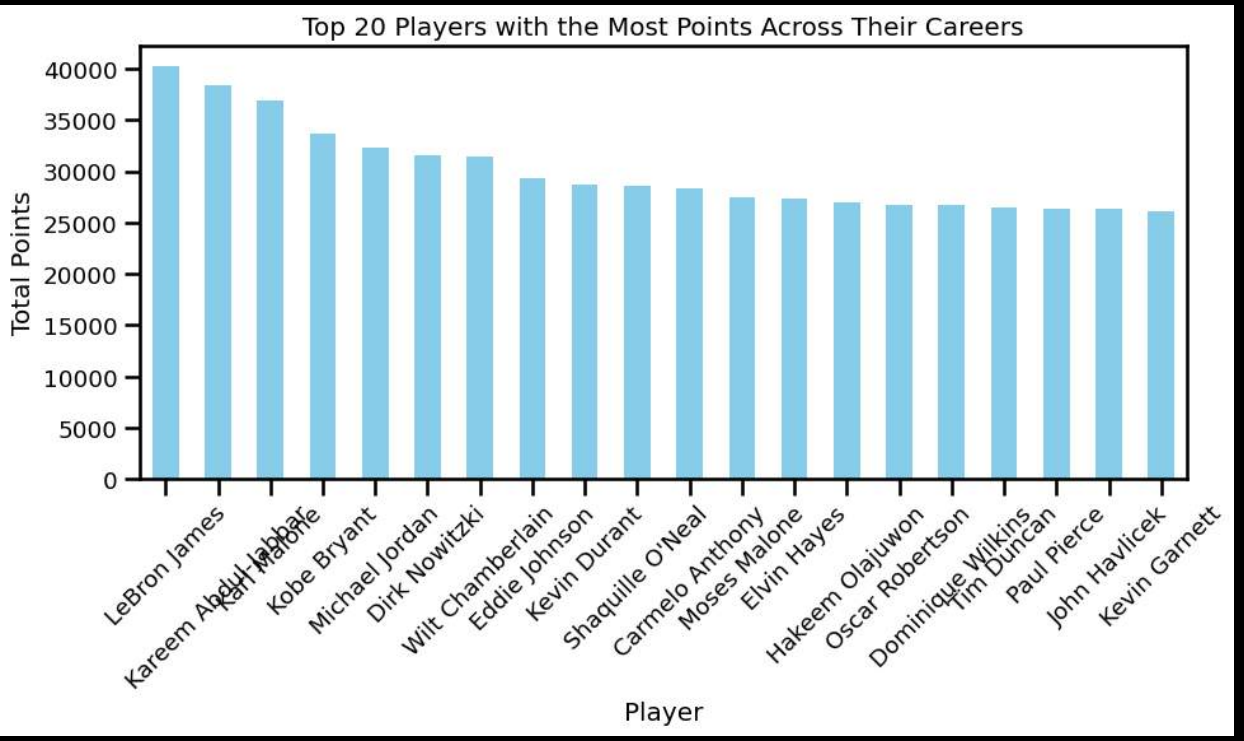
team_data(30 teams)

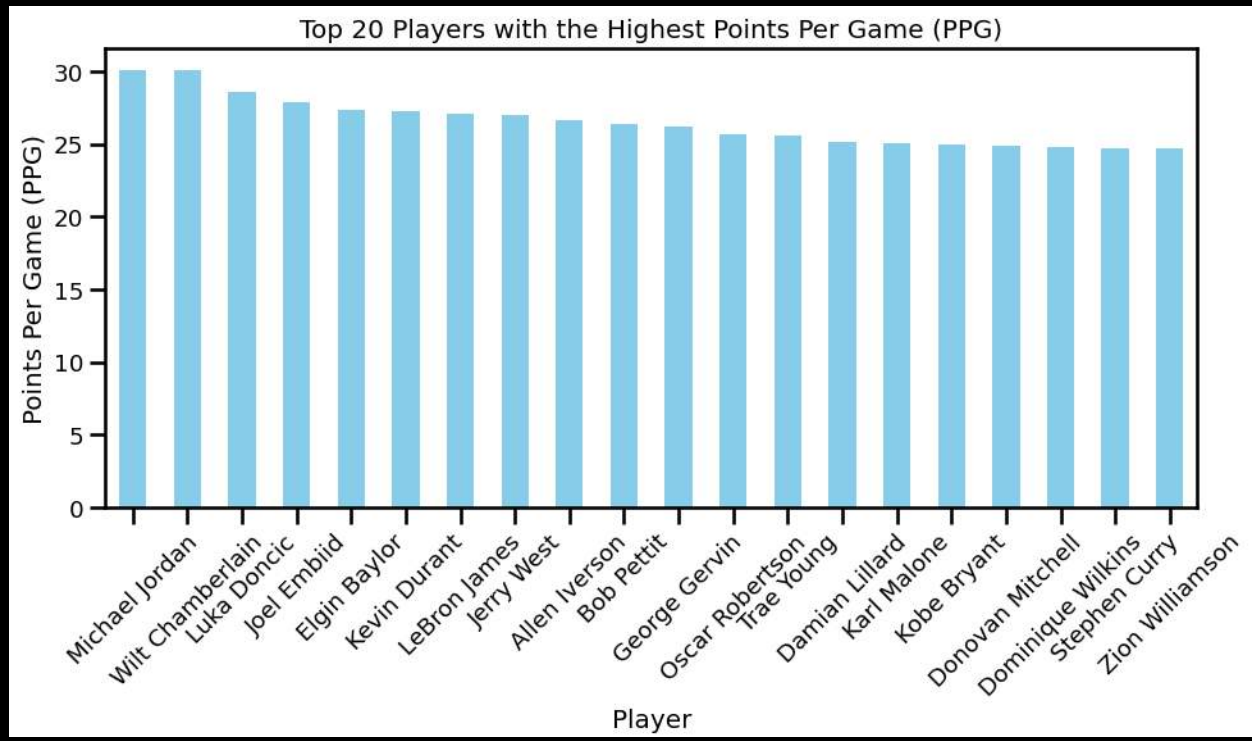
draft/trade_data(5000 trades/drafts)

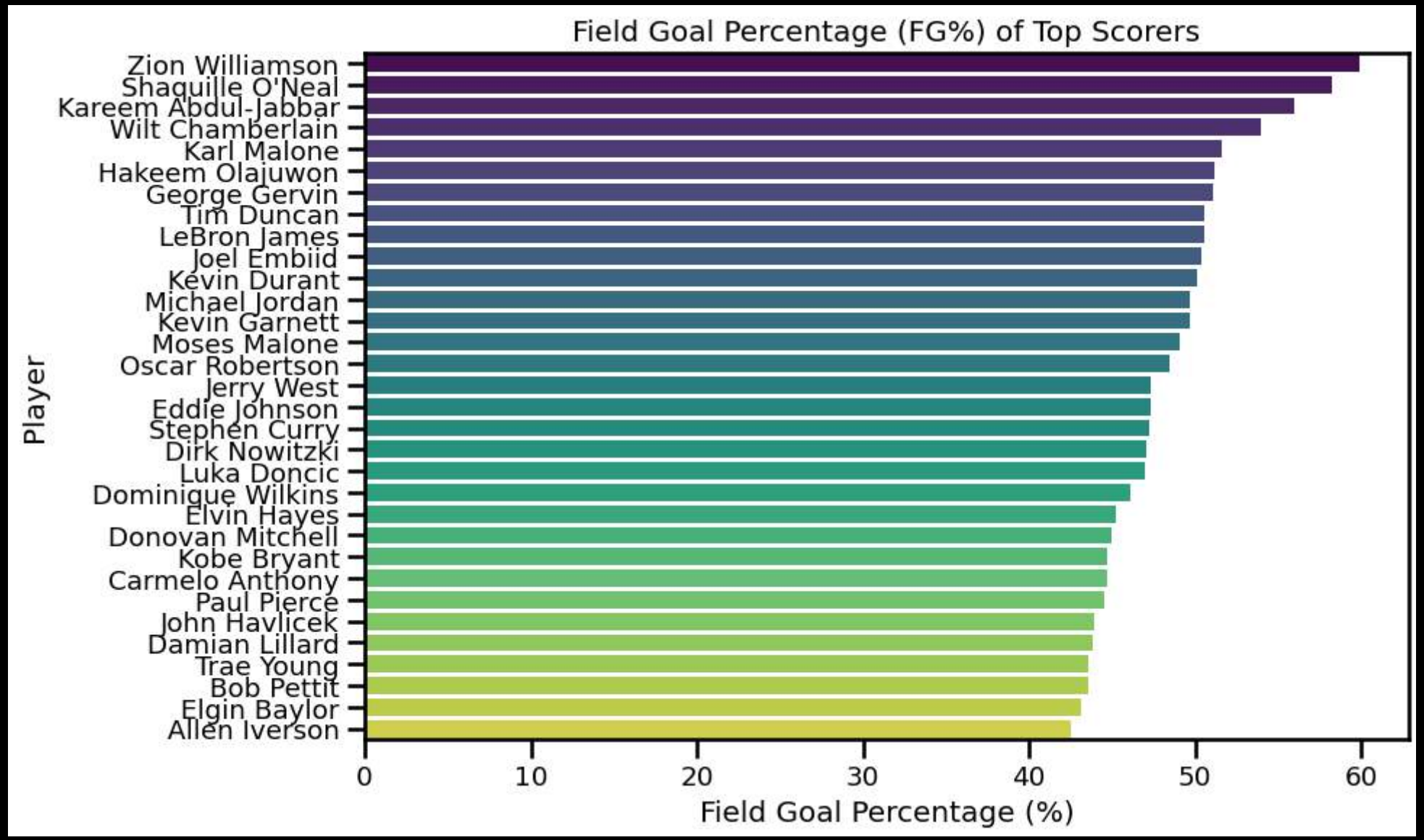
boxScore_data(1307 games)

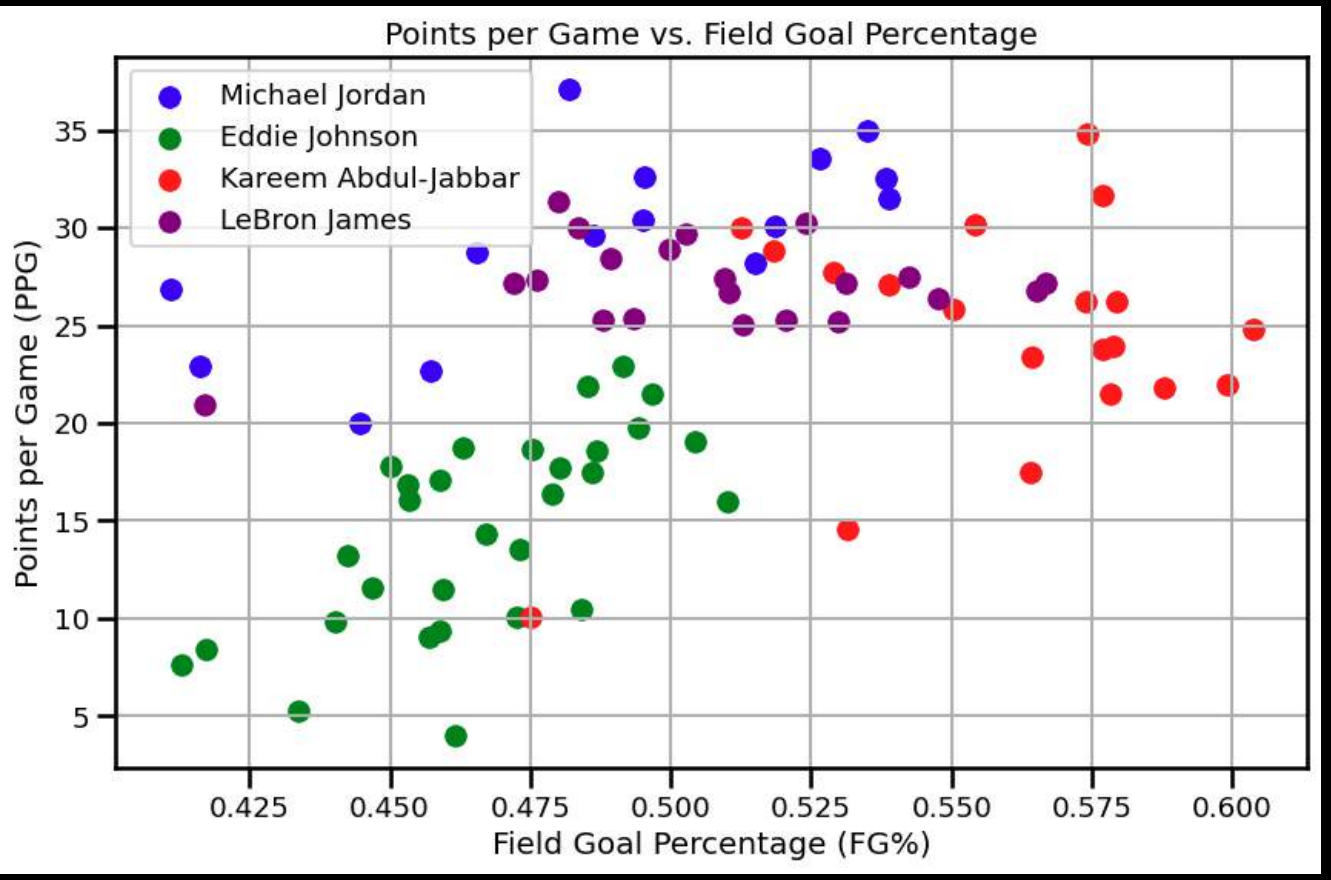
RQ1 : WHO IS THE BEST SCORER, PLAYMAKER, AND DEFENDER OF ALL TIME?

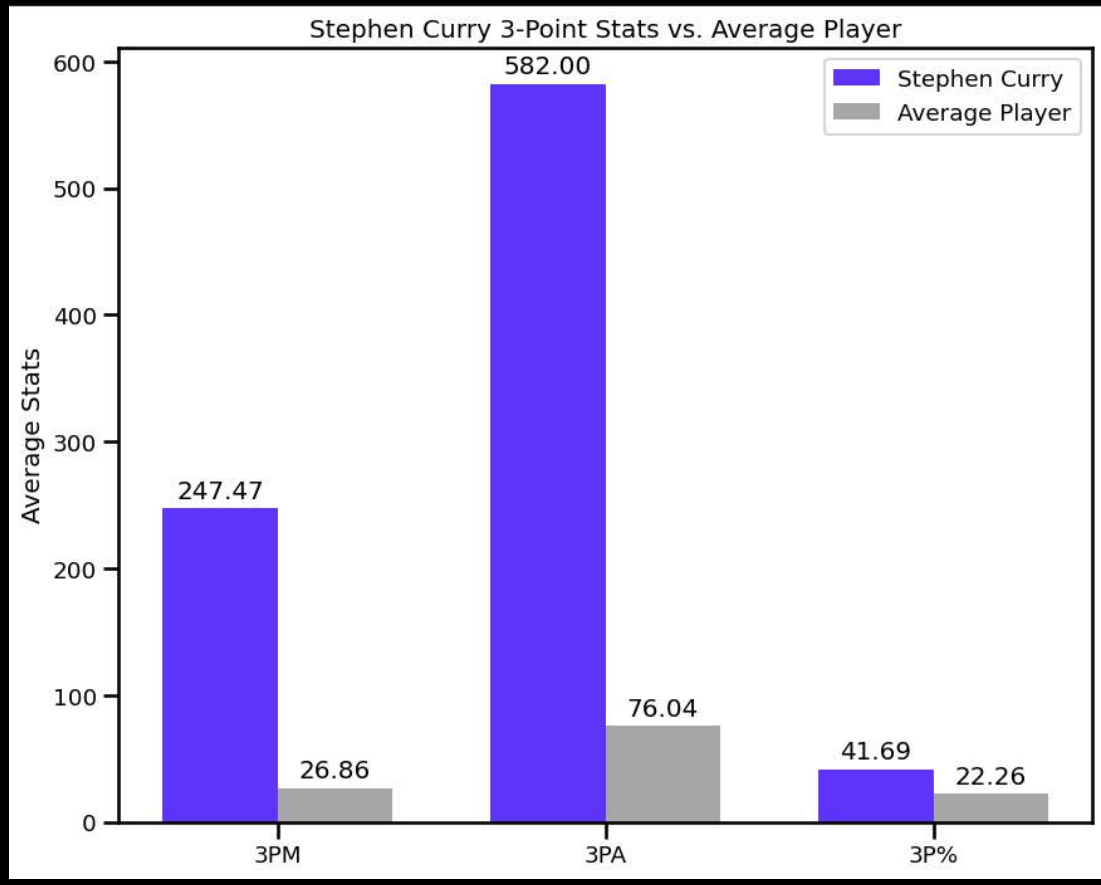
SCORERS


Top 20 Players with the Most Points Across Their Careers
Total Points
40000
35000
30000
25000
20000
15000
10000
5000
0
LeBron James
Kareem Abdul-Jabbar
Karl Malone
Kobe Bryant
Michael Jordan
Dirk Nowitzki
Wilt Chamberlain
Eddie Johnson
Kevin Durant
Shaquille O'Neal
Carmelo Anthony
Moses Malone
Elvin Hayes
Hakeem Olajuwon
Oscar Robertson
Dominique Wilkins
Tim Duncan
Paul Pierce
John Havlicek
Kevin Garnett
Player


Top 20 Players with the Highest Points Per Game (PPG)
Points Per Game (PPG)
30
25
20
15
10
5
0
Michael Jordan
Wilt Chamberlain
Luka Doncic
Joel Embiid
Elgin Baylor
Kevin Durant
LeBron James
Jerry West
Allen Iverson
Bob Pettit
George Gervin
Oscar Robertson
Trae Young
Damian Lillard
Karl Malone
Kobe Bryant
Donovan Mitchell
Dominique Wilkins
Stephen Curry
Zion Williamson
Player

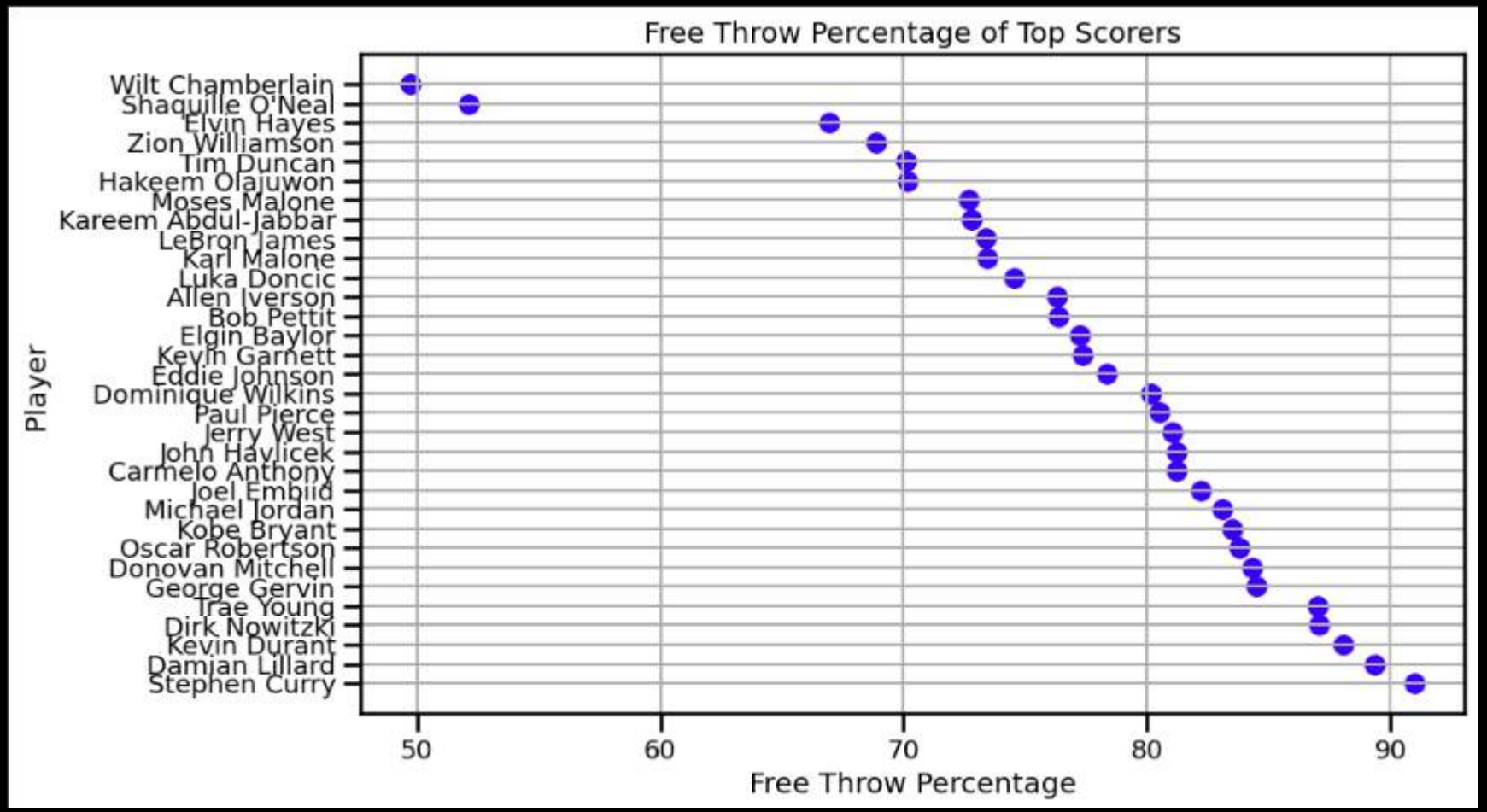

Field Goal Percentage (FG%) of Top Scorers
Zion Williamson
Shaquille O'Neal
Kareem Abdul-Jabbar
Wilt Chamberlain
Karl Malone
Hakeem Olajuwon
George Gervin
Tim Duncan
LeBron James
Joel Embiid
Kevin Durant
Michael Jordan
Kevin Garnett
Moses Malone
Oscar Robertson
Jerry West
Eddie Johnson
Stephen Curry
Dirk Nowitzki
Luka Doncic
Dominique Wilkins
Elvin Hayes
Donovan Mitchell
Kobe Bryant
Carmelo Anthony
Paul Pierce
John Havlicek
Damian Lillard
Trae Young
Bob Pettit
Elgin Baylor
Allen Iverson
Player
0
10
20
30
40
50
60
Field Goal Percentage (%)





Each dot above represents a season that the player played

player_name	three_point_pct
Stephen Curry	0.416933
Kevin Durant	0.395706
Dirk Nowitzki	0.374714
Damian Lillard	0.368750
Paul Pierce	0.368105
Donovan Mitchell	0.366286
Zion Williamson	0.362000
Trae Young	0.352667
LeBron James	0.347143
Carmelo Anthony	0.345300
Allen Iverson	0.344882
Luka Doncic	0.344000
Joel Embiid	0.343750
Kobe Bryant	0.317700
Eddie Johnson	0.297857
Michael Jordan	0.283933
Bob Pettit	0.273773
Oscar Robertson	0.273773
John Havlicek	0.273773
Jerry West	0.273773
Elgin Baylor	0.273773
Wilt Chamberlain	0.273773
Dominique Wilkins	0.273188
George Gervin	0.263000
Kevin Garnett	0.207136
Karl Malone	0.201158
Elvin Hayes	0.146200
Tim Duncan	0.138474
Hakeem Olajuwon	0.100611
Moses Malone	0.100312
Kareem Abdul-Jabbar	0.033300
Shaquille O'Neal	0.025000



SO….WHO IS THE GREATEST SCORER OF ALL TIME?

KEVIN DURANT

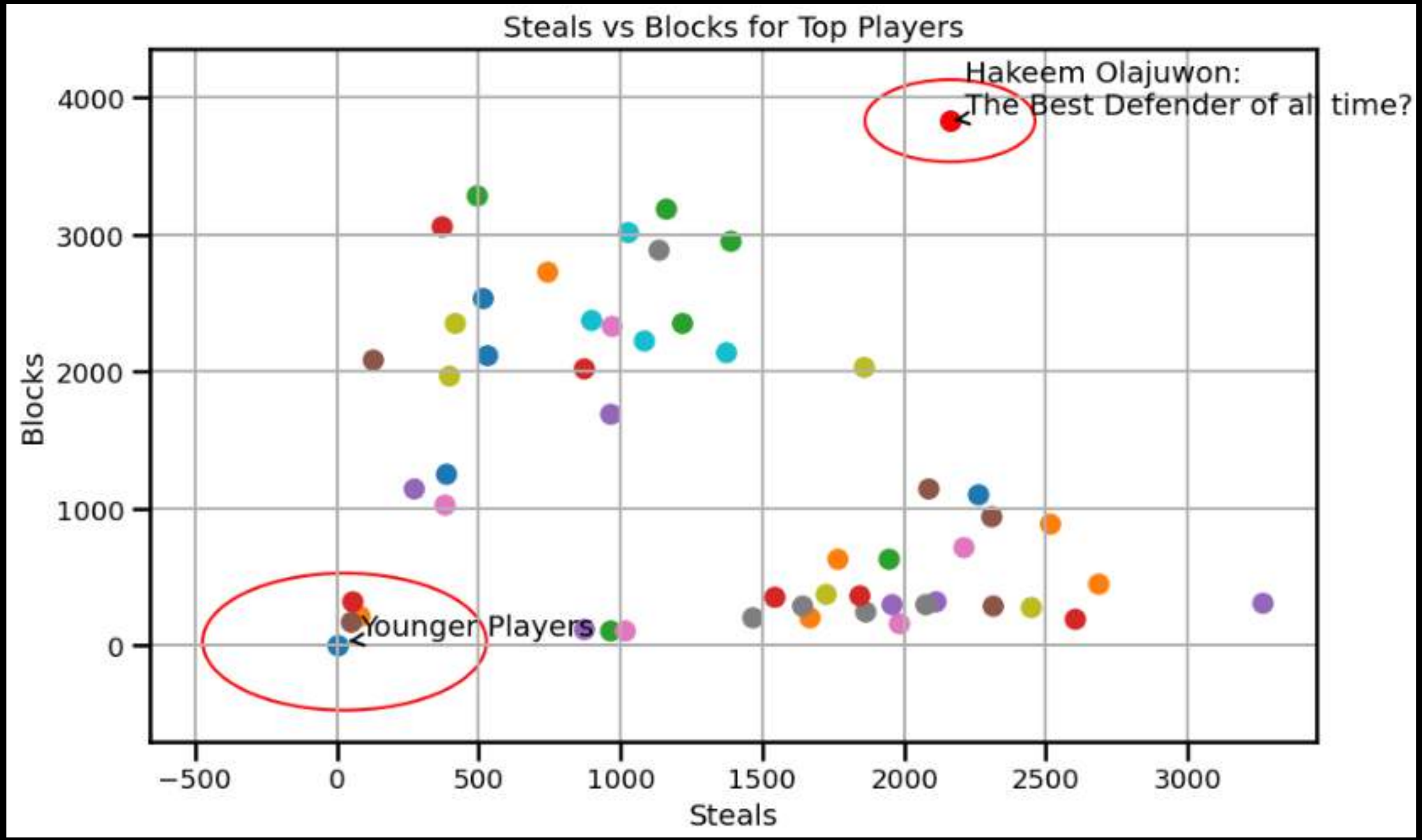
DEFENDERS

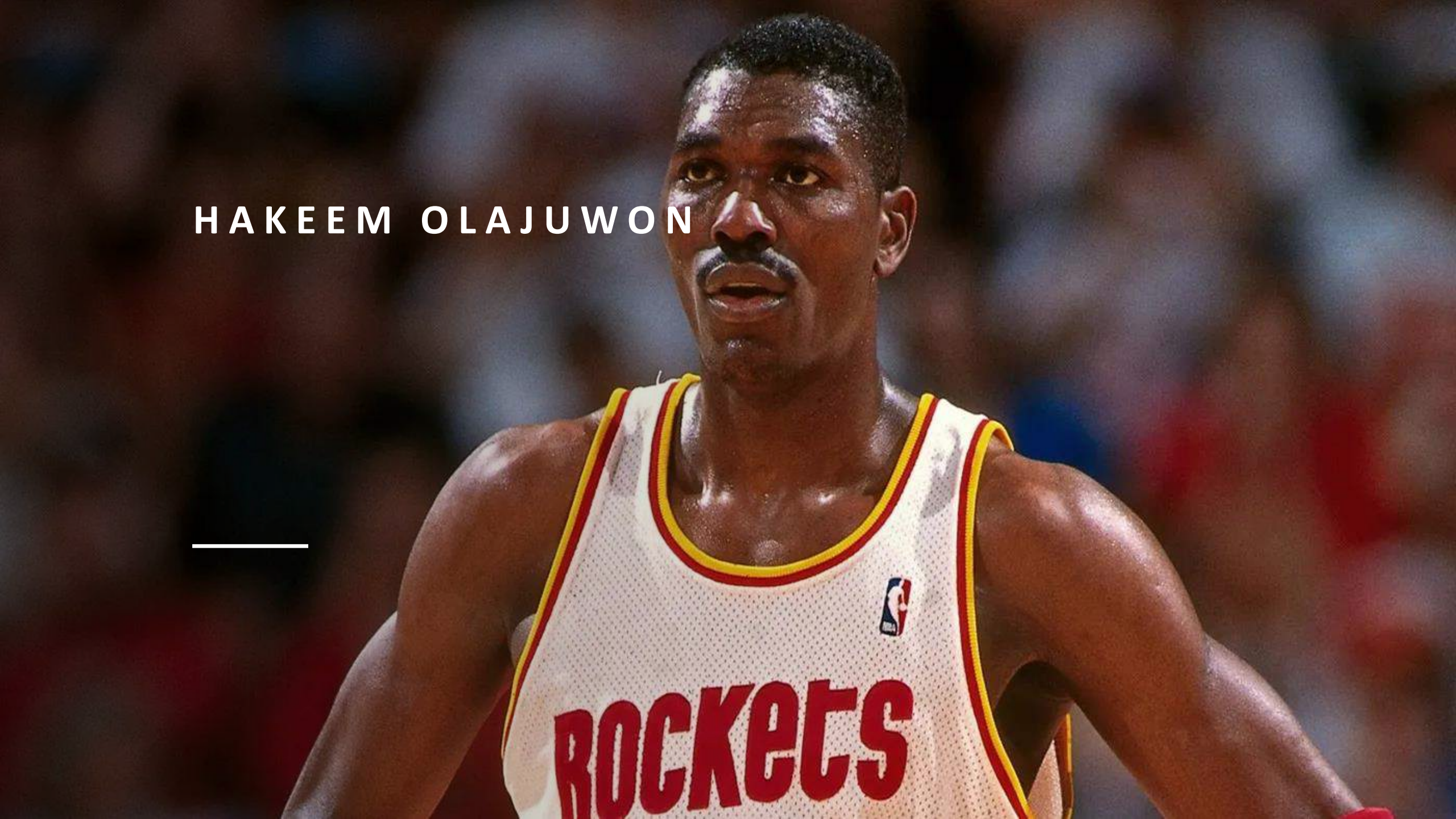
player_name	steals
John Stockton	3265.0
Jason Kidd	2684.0
Chris Paul	2600.0
Michael Jordan	2514.0
Gary Payton	2445.0
Maurice Cheeks	2310.0
Scottie Pippen	2307.0
LeBron James	2262.0
Clyde Drexler	2207.0
Hakeem Olajuwon	2162.0
Alvin Robertson	2112.0
Karl Malone	2085.0
Mookie Blaylock	2075.0
Allen Iverson	1983.0
Derek Harper	1957.0
Kobe Bryant	1944.0
Isiah Thomas	1861.0
Kevin Garnett	1859.0
Russell Westbrook	1841.0
Andre Iguodala	1765.0

	Player	SPG
0	Alvin Robertson	2.711168
1	Micheal Ray Richardson	2.631295
2	Michael Jordan	2.345149
3	Mookie Blaylock	2.334083
4	Lafayette Lever	2.215426
5	Slick Watts	2.199085
6	John Stockton	2.170878
7	Allen Iverson	2.169584
8	Maurice Cheeks	2.098093
9	Chris Paul	2.058591
10	Clyde Drexler	2.032228
11	Ralph Jackson	2.000000
12	Renaldo Major	2.000000
13	Gus Williams	1.985455
14	Scottie Pippen	1.958404
15	Johnny Moore	1.955769
16	Ron Lee	1.939732
17	Nate McMillan	1.939698
18	Jason Kidd	1.929547
19	Magic Johnson	1.902870

player_name	blocks
Hakeem Olajuwon	3830.0
Dikembe Mutombo	3289.0
Kareem Abdul-Jabbar	3189.0
Mark Eaton	3064.0
Tim Duncan	3020.0
David Robinson	2954.0
Patrick Ewing	2895.0
Shaquille O'Neal	2732.0
Tree Rollins	2542.0
George Johnson	2374.0
Robert Parish	2361.0
Alonzo Mourning	2356.0
Marcus Camby	2331.0
Dwight Howard	2228.0
Ben Wallace	2137.0
Shawn Bradley	2119.0
Manute Bol	2086.0
Kevin Garnett	2037.0
Larry Nance	2027.0
Theo Ratliff	1968.0

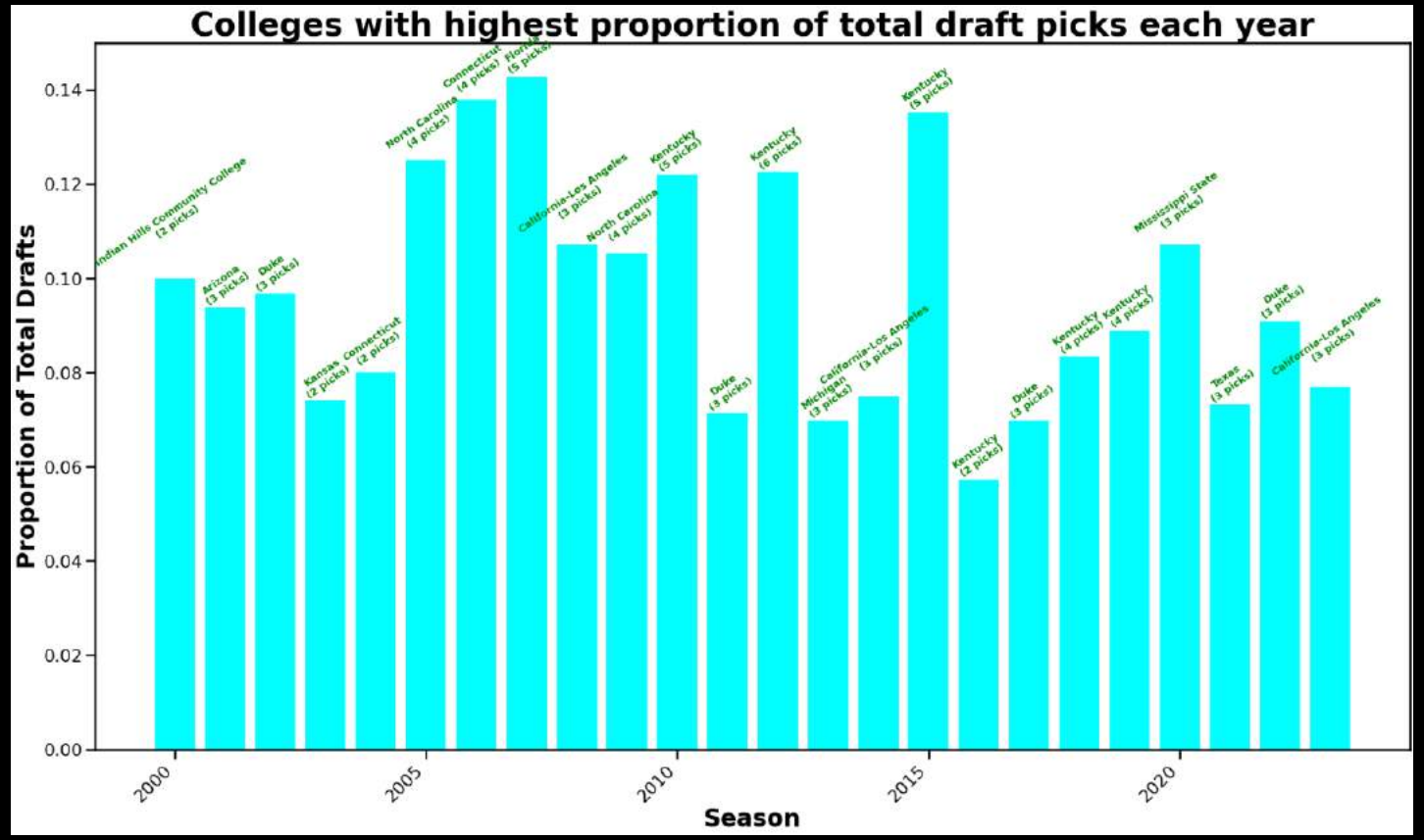
	Player	BPG
0	Mark Eaton	3.501714
1	Victor Wembanyama	3.430769
2	Manute Bol	3.342949
3	Hakeem Olajuwon	3.093700
4	David Robinson	2.992908
5	Alonzo Mourning	2.811456
6	Dikembe Mutombo	2.750000
7	Shawn Bradley	2.546875
8	Patrick Ewing	2.432773
9	Theo Ratliff	2.429630
10	Chet Holmgren	2.397260
11	Marcus Camby	2.395683
12	Walker Kessler	2.375000
13	Anthony Davis	2.319616
14	Shaquille O'Neal	2.263463
15	Hassan Whiteside	2.236791
16	Myles Turner	2.223404
17	Bill Walton	2.209402
18	Larry Nance	2.203261
19	Tree Rollins	2.198962


Steals vs Blocks for Top Players
Hakeem Olajuwon:
The Best Defender of all time?
Younger Players
Blocks
Steals
4000
3000
2000
1000
0
−500
0
500
1000
1500
2000
2500
3000

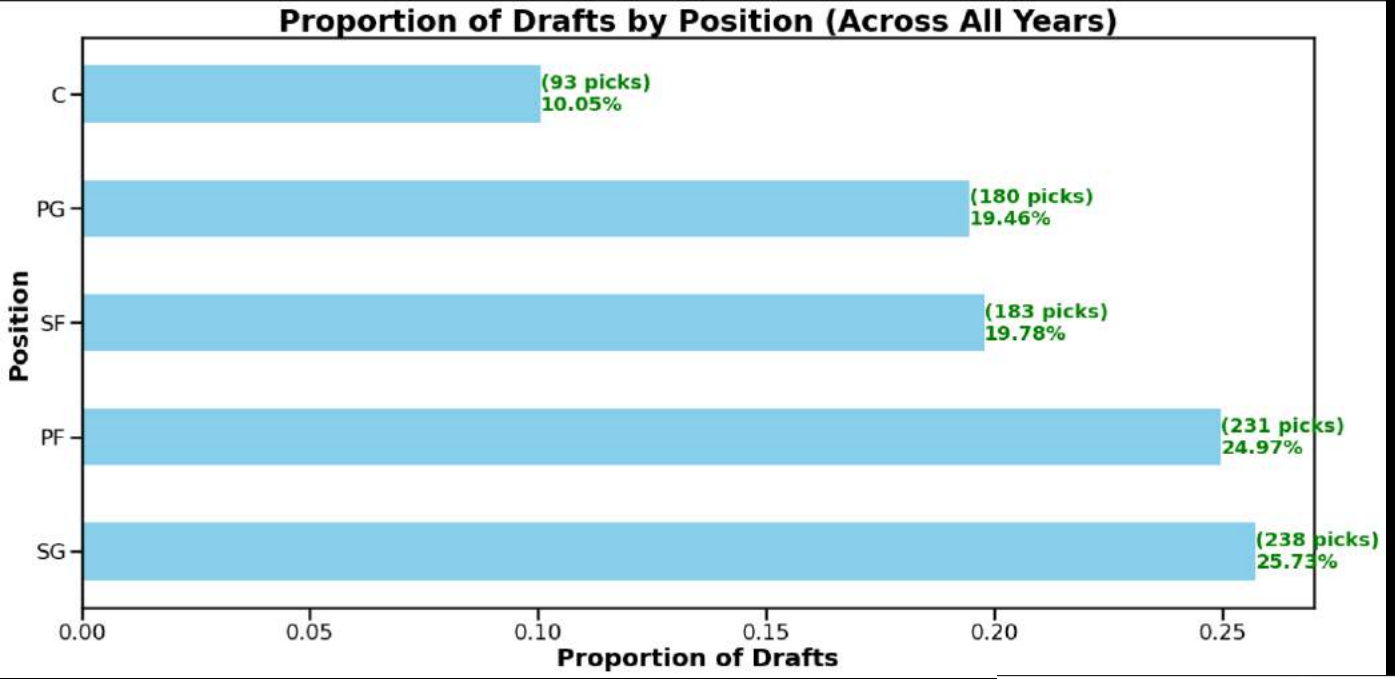

HAKEEM OLAJUWON
Rockets

RQ2: WHAT FACTORS INFLUENCE DRAFT/TRADE STRATEGIES THE MOST?

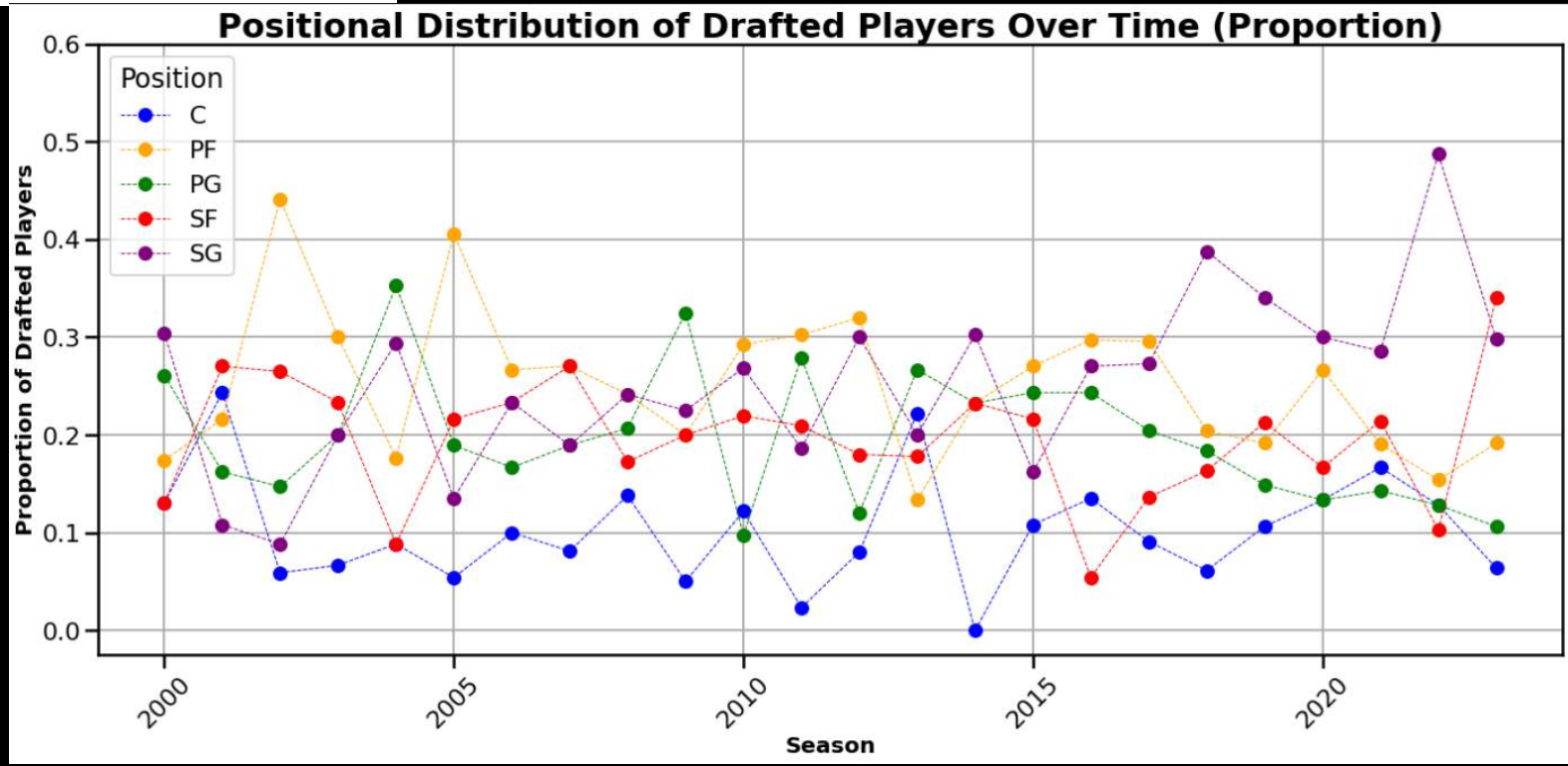
DO TEAMS ONLY DRAFT FROM CERTAIN COLLEGES?



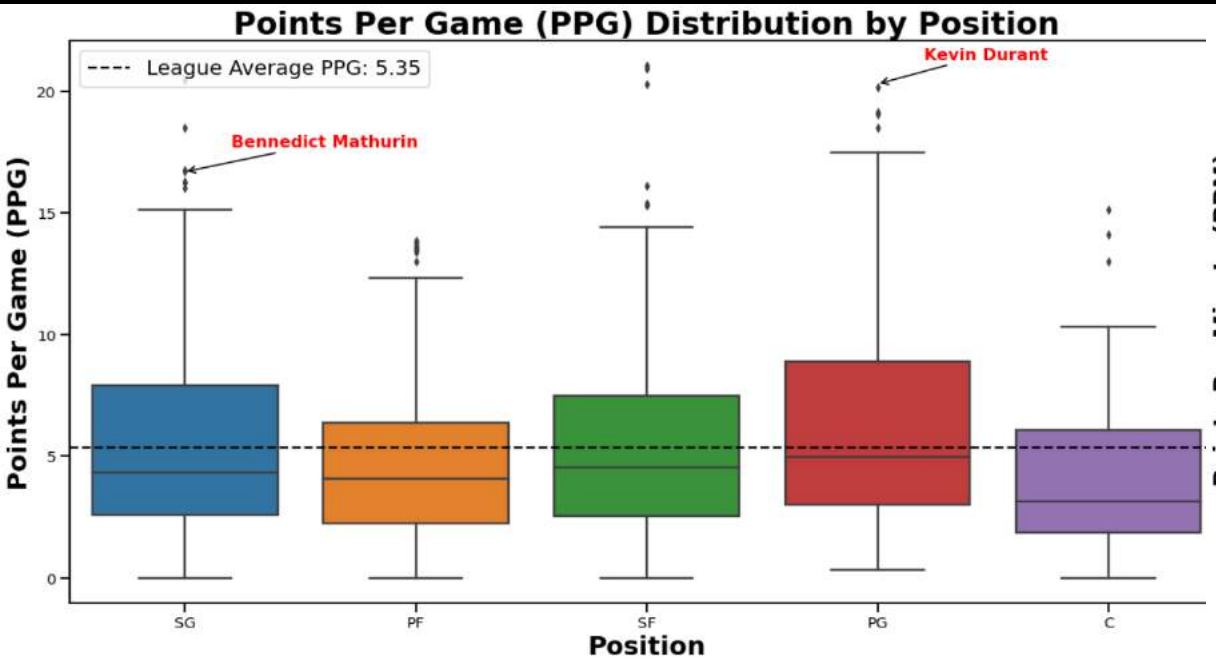
Kentucky	6
Duke	4
California-Los Angeles	3
Connecticut	2
North Carolina	2
Indian Hills Community College	1
Arizona	1
Kansas	1
Florida	1
Michigan	1
Mississippi State	1
Texas	1

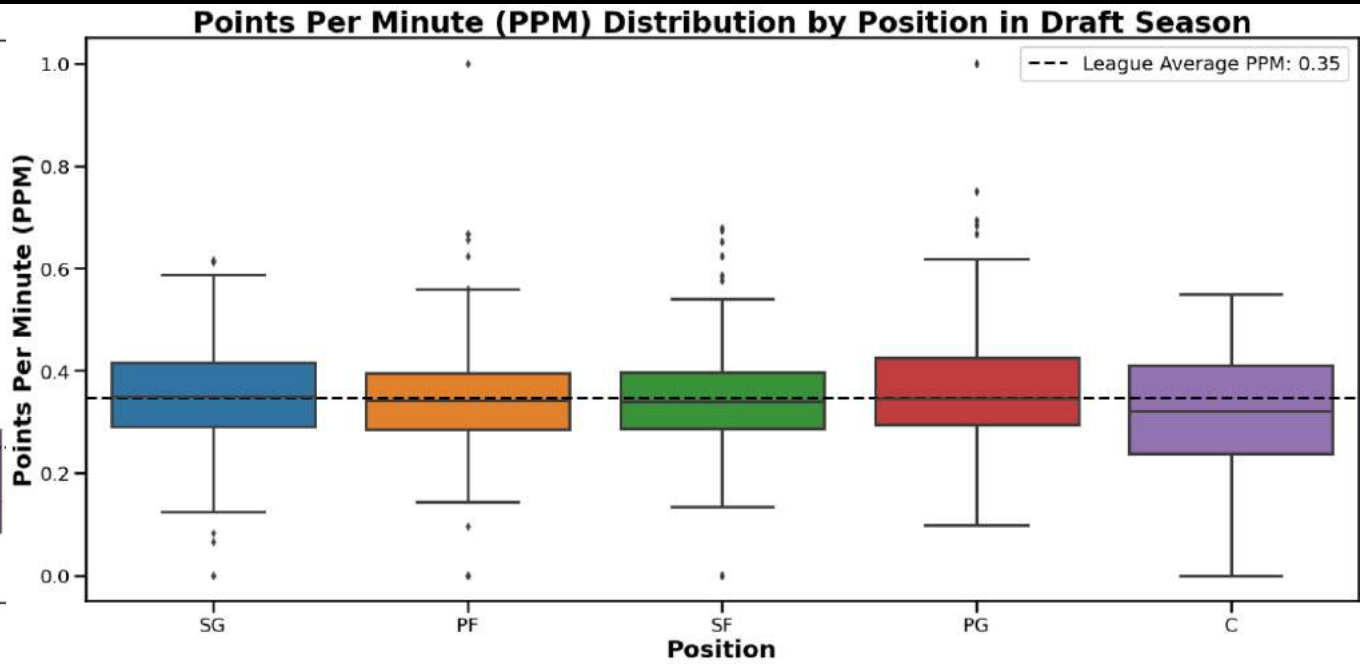


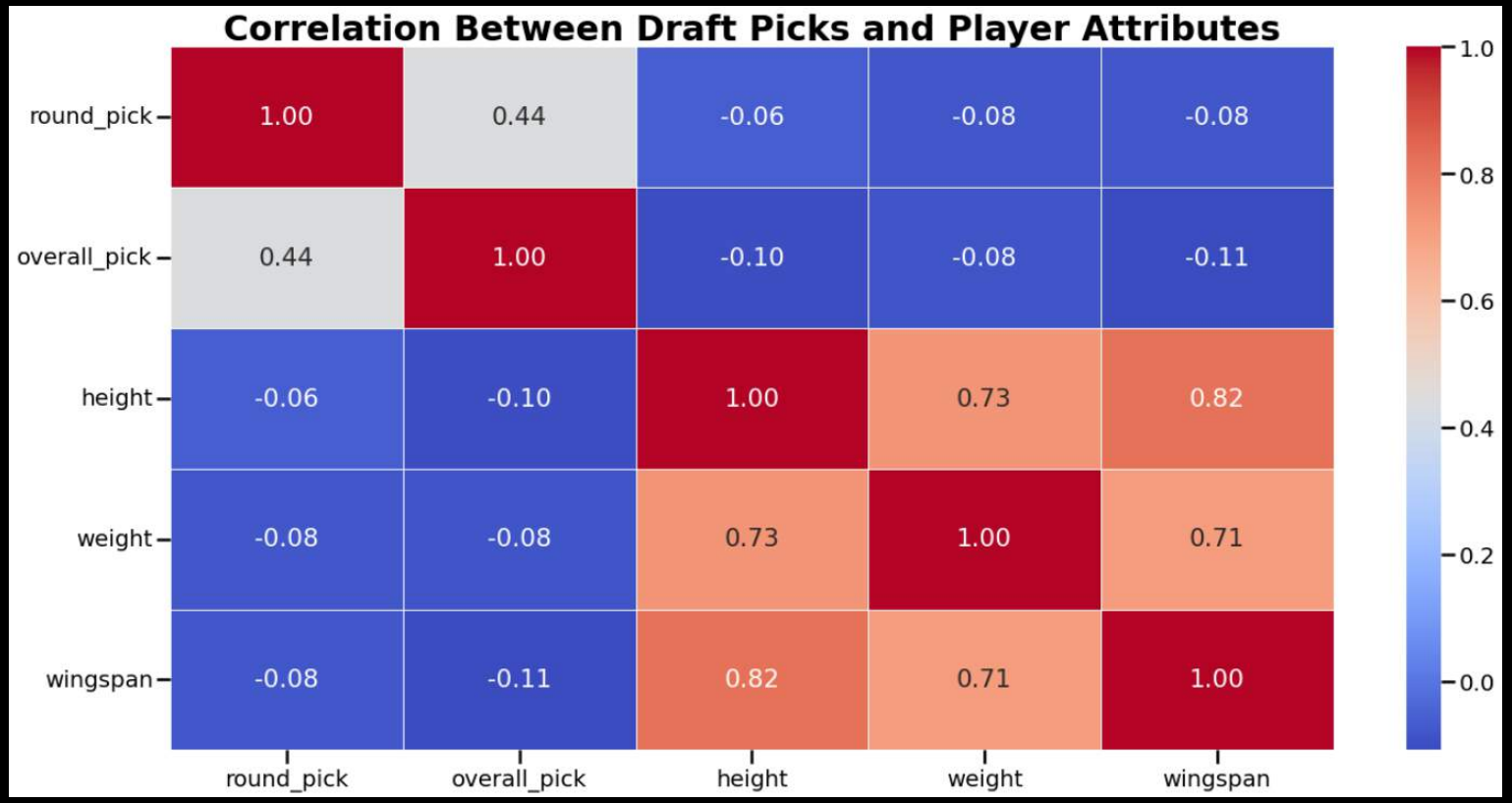
ARE SOME POSITIONS MORE POPULAR THAN OTHERS?



AVERAGE PERFORMANCE OF PLAYERS FROM EACH POSITION







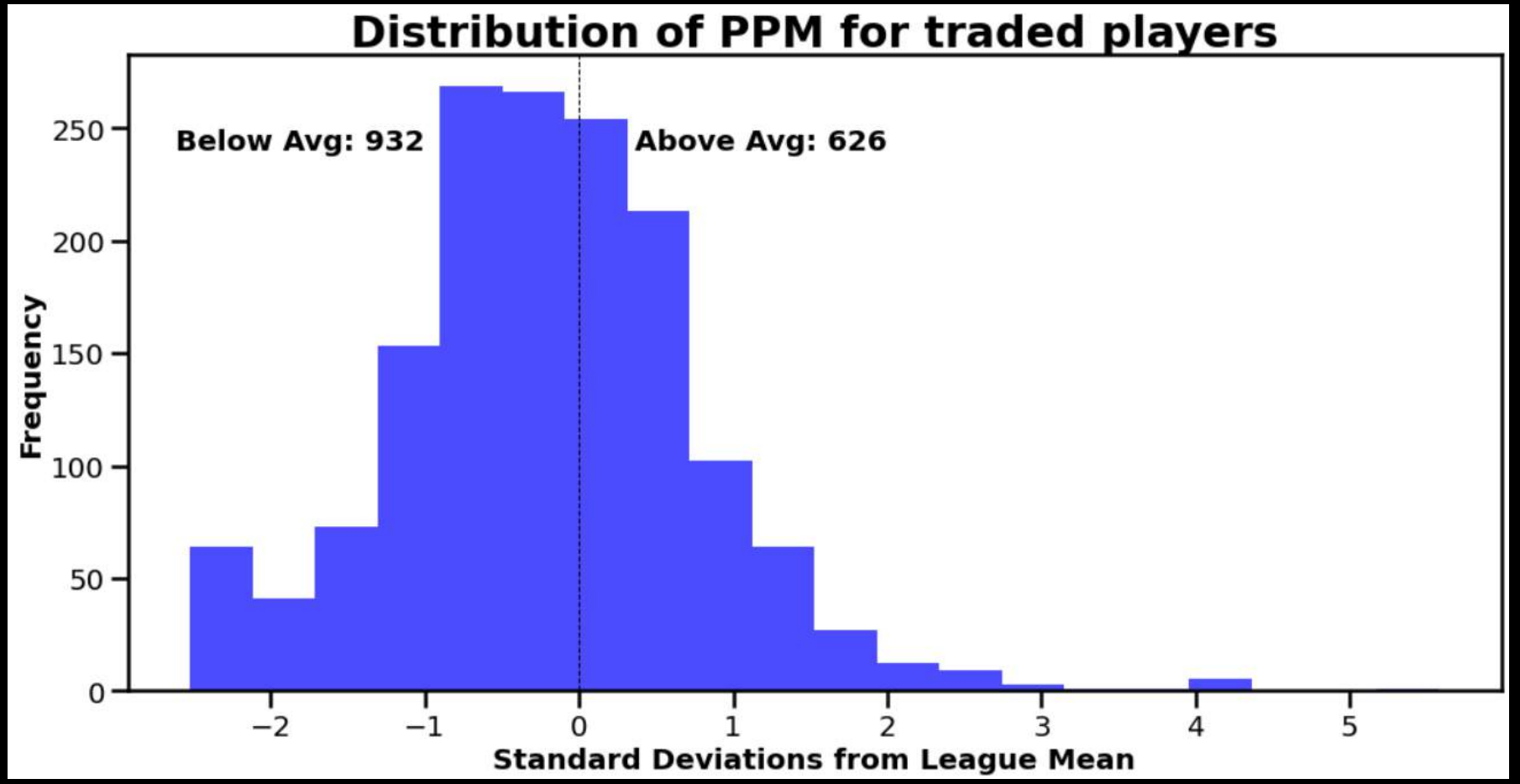
CONCLUSIONS :

1) colleges alone may not be sufficient indicators for optimizing draft strategies.

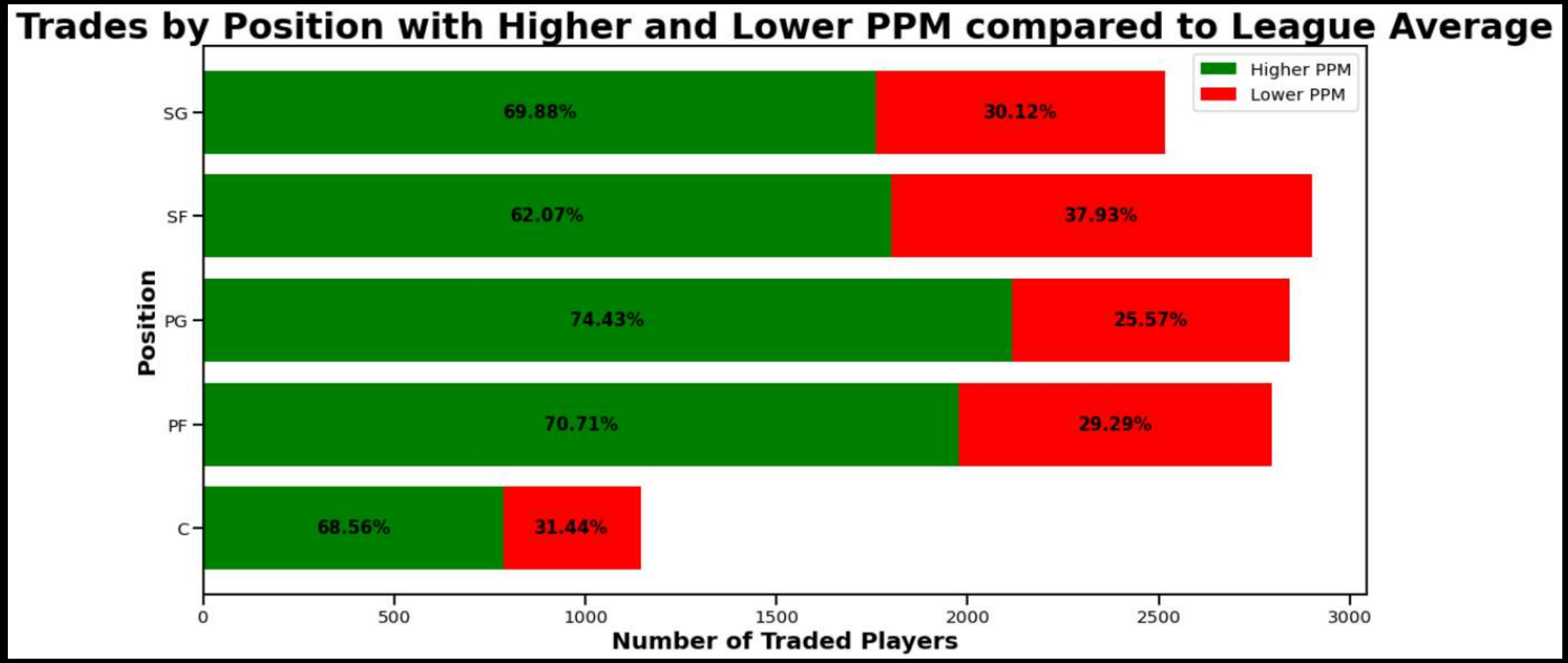
2) Positional analysis helps teams identify undervalued talent, maximize on-court efficiency, and build a balanced roster capable of competing at a high level in the NBA.

3) while physical attributes may be considered during the evaluation process, they do not necessarily dictate a player's draft/round pick

ARE PLAYERS PERFORMING GOOD OR BAD TRADED?



DISTRIBUTION OF TRADES BY POSITION



C O N C L U S I O N

1) Contrary to expectations, a significant proportion of players traded to different teams have a PPM higher than the league average.

2) Centers (C) consistently emerge as the least traded position, while Small Forwards (SFs) and Point Guards (PGs) are the most frequently traded positions

3) Other Considerations :

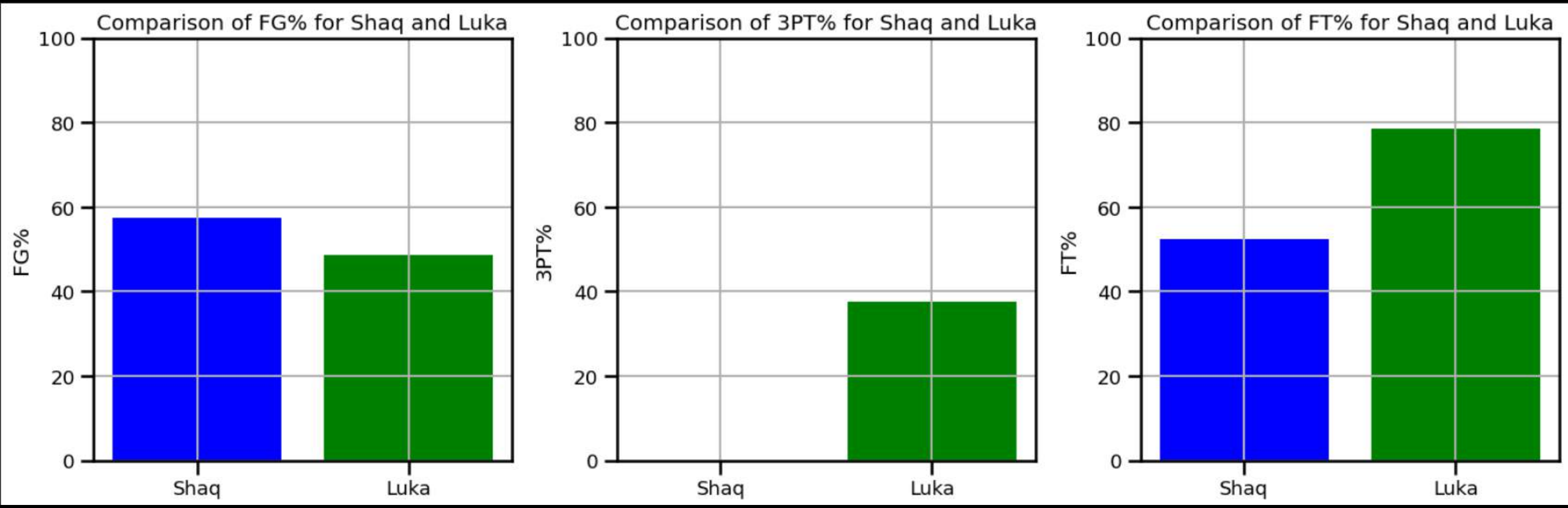
->Team Chemistry

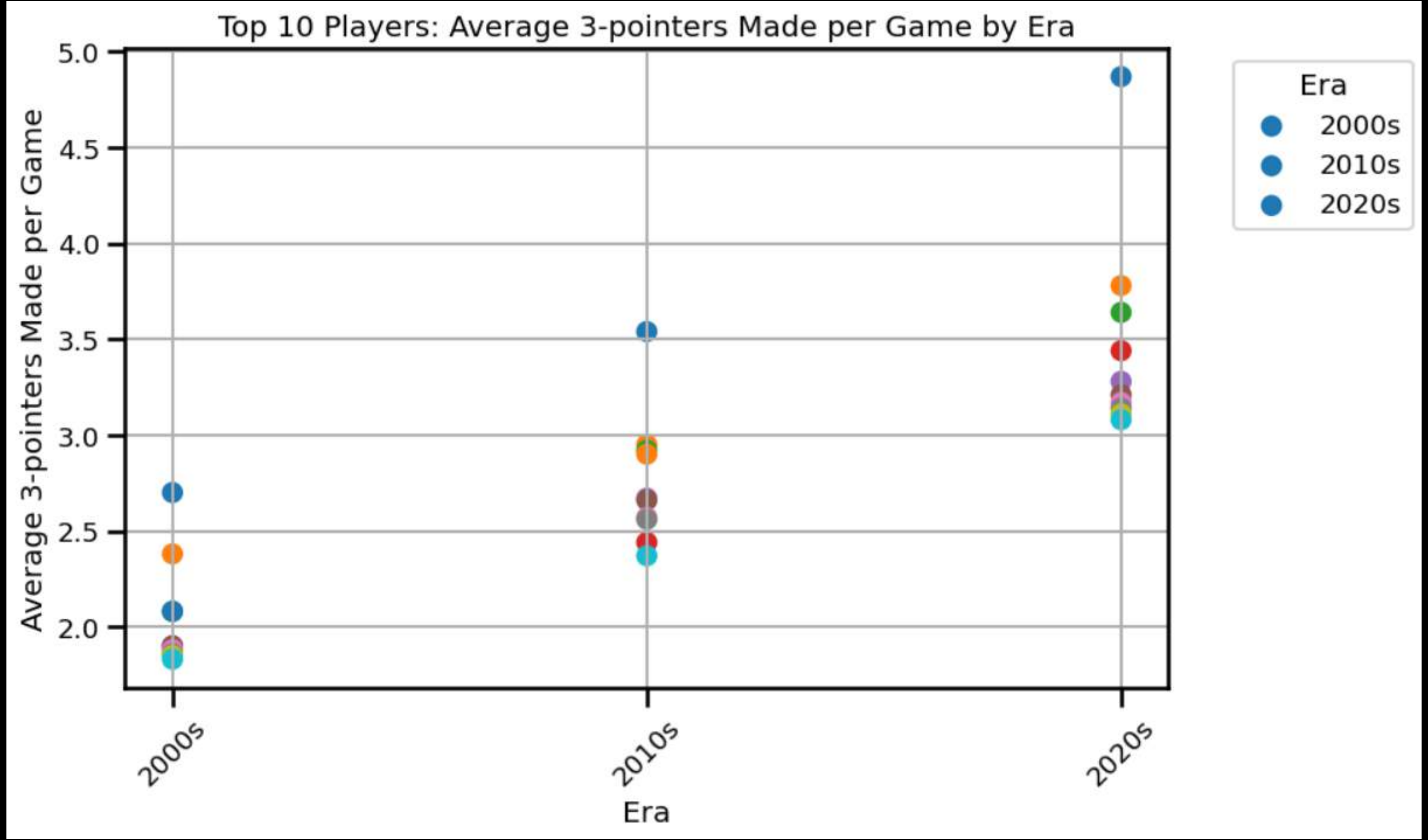
->Model to predict trade outcomes

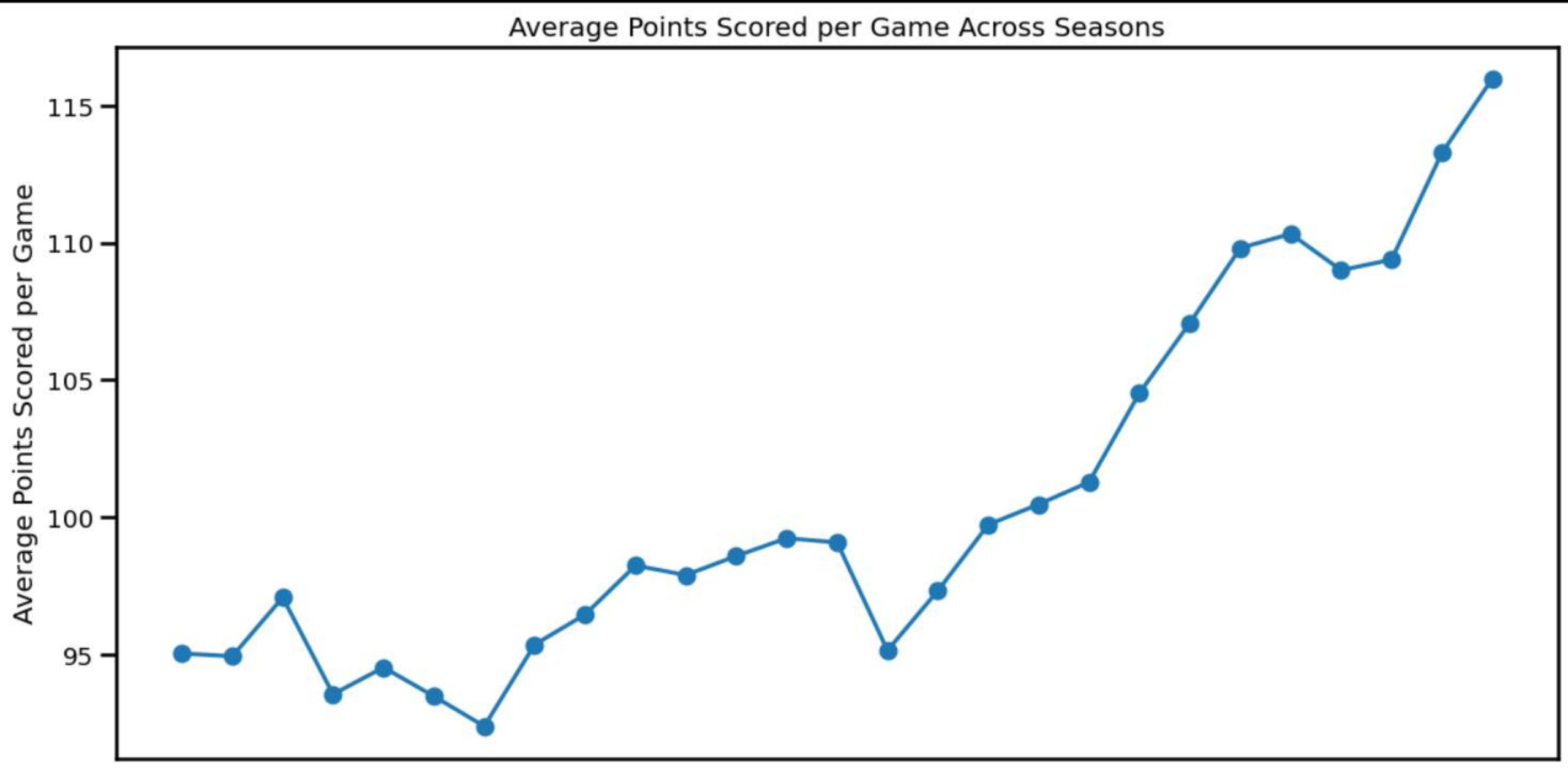
RQ3: HAS THE LEVEL OF THE NBA GOTTEN BETTER OR WORSE

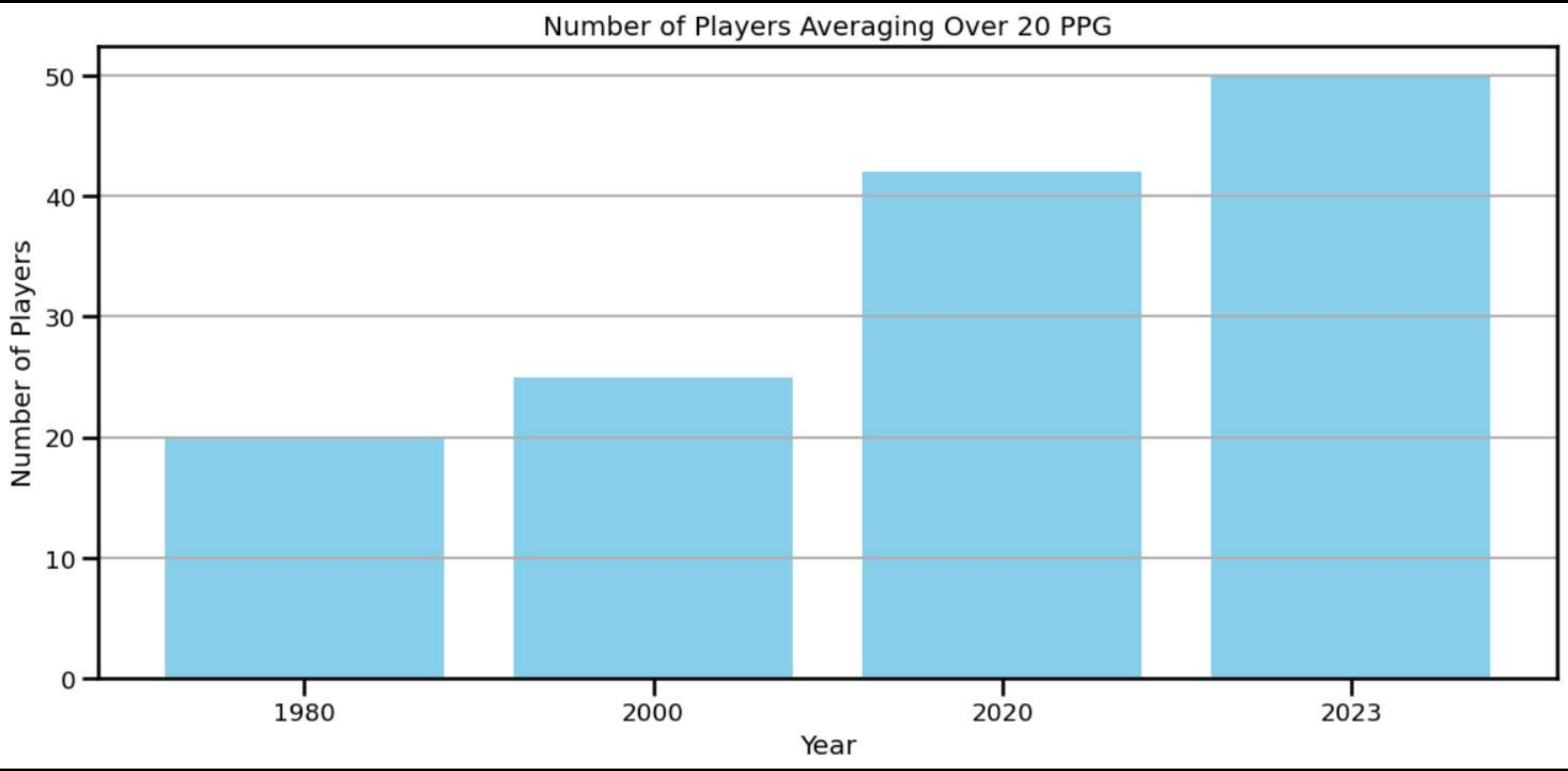
NBA PLAYERS
BEFORE THE GLOW UP

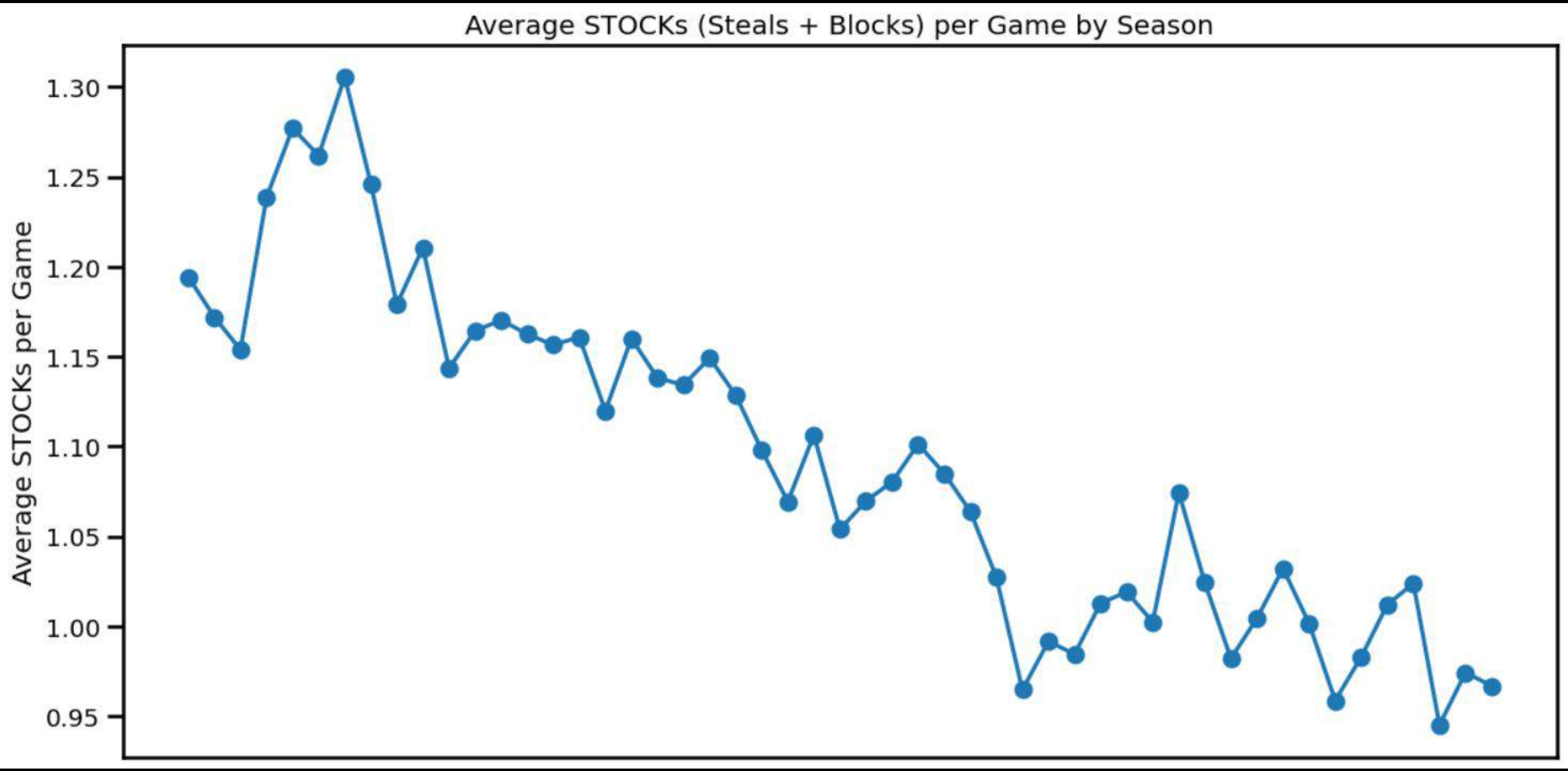
SCORING


Comparison of FG% for Shaq and Luka
FG%
100
80
60
40
20
0
Shaq
Luka
Comparison of 3PT% for Shaq and Luka
3PT%
100
80
60
40
20
0
Shaq
Luka
Comparison of FT% for Shaq and Luka
FT%
100
80
60
40
20
0
Shaq
Luka


Top 10 Players: Average 3-pointers Made per Game by Era
Average 3-pointers Made per Game
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2000s
2010s
2020s
Era
Era
2000s
2010s
2020s

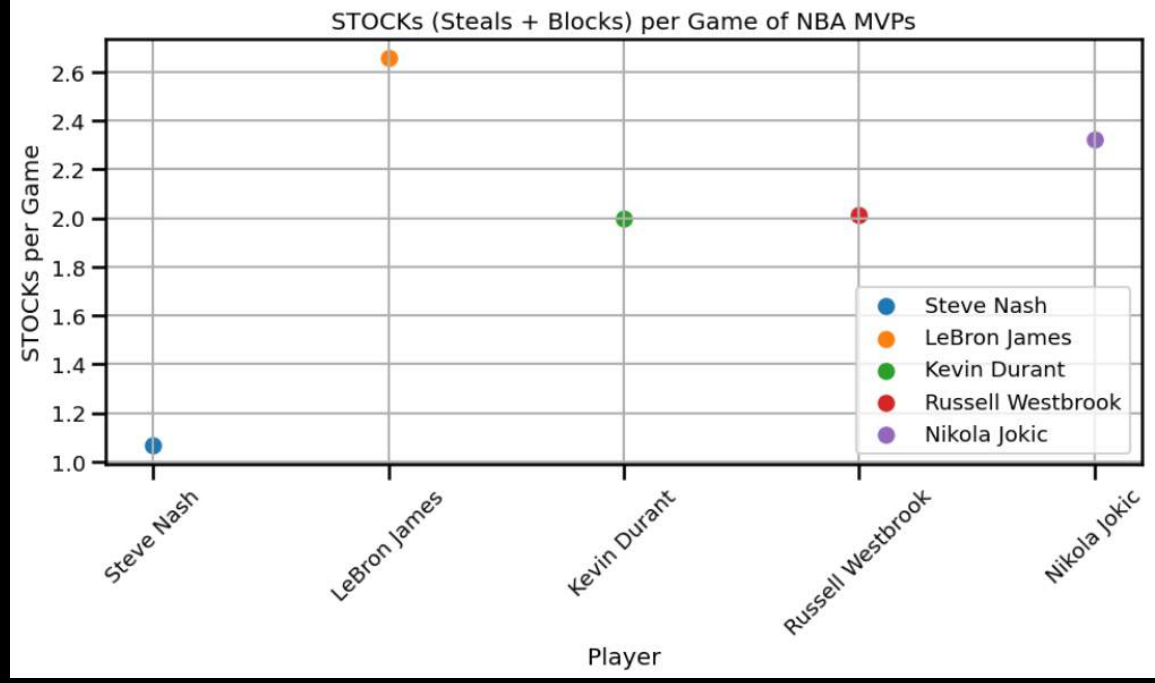

Average Points Scored per Game Across Seasons
Average Points Scored per Game
115
110
105
100
95

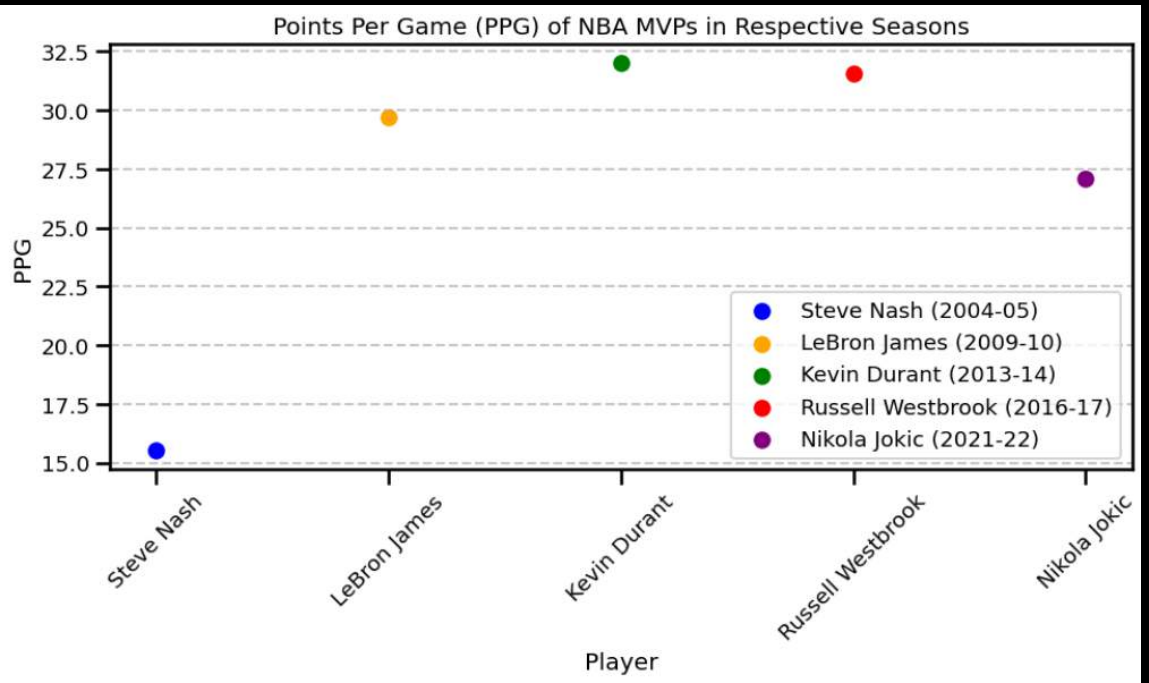

Number of Players Averaging Over 20 PPG
Number of Players
0
10
20
30
40
50
1980
2000
2020
2023
Year

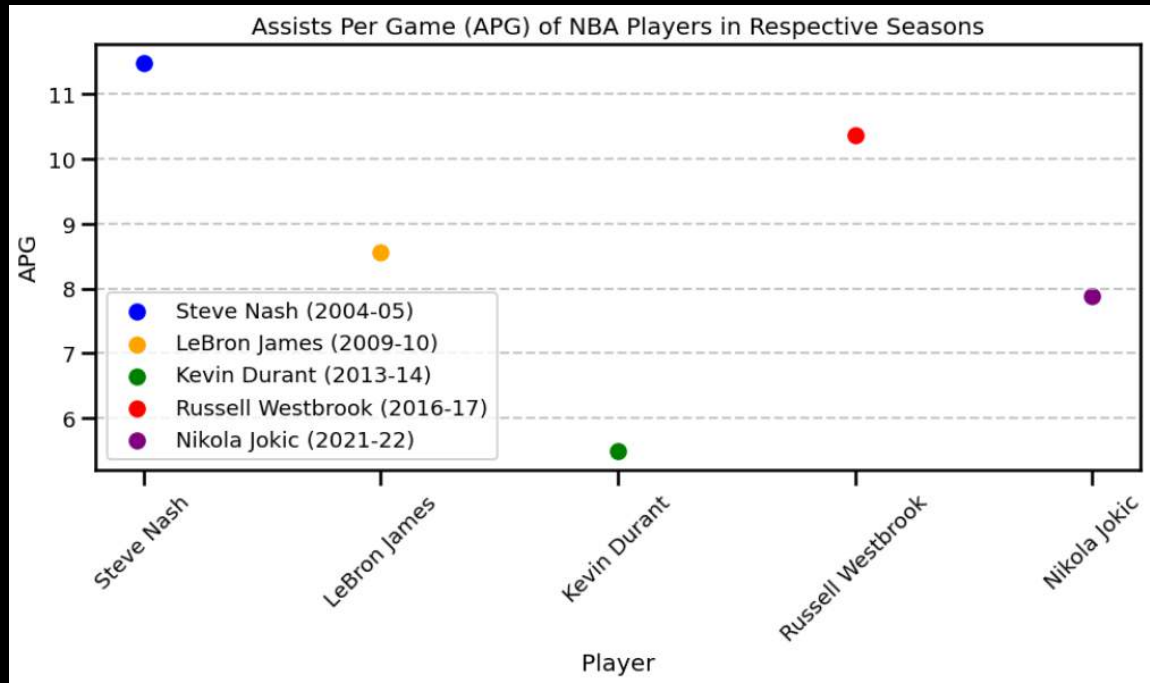

Average STOCKs (Steals + Blocks) per Game by Season
Average STOCKs per Game
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95

STEVE NASH CASE STUDY

```
Steve Nash's PPG in the 2004-05 season: 15.533333333333333
Steve Nash's FG% in the 2004-05 season: 50.2 %
Average PPG of the top 5 scorers in 2004-05 season: 27.803807446939025
Average FG% of the top 5 players by PPG in the 2004-05 season: 45.0 %
Steve Nash's 3PT% in the 2004-05 season: 43.1 %
Average 3PT% of the top 5 players by PPG in the 2004-05 season: 36.44 %
```







```
Number of players with higher PPG than Steve Nash's 2005 season:
2010: 67
2015: 62
2020: 82
2024: 92
```

```
Number of players with higher FG% and higher PPG than Steve Nash's 2005 season:
2010: 16
2015: 7
2020: 15
2024: 26
```

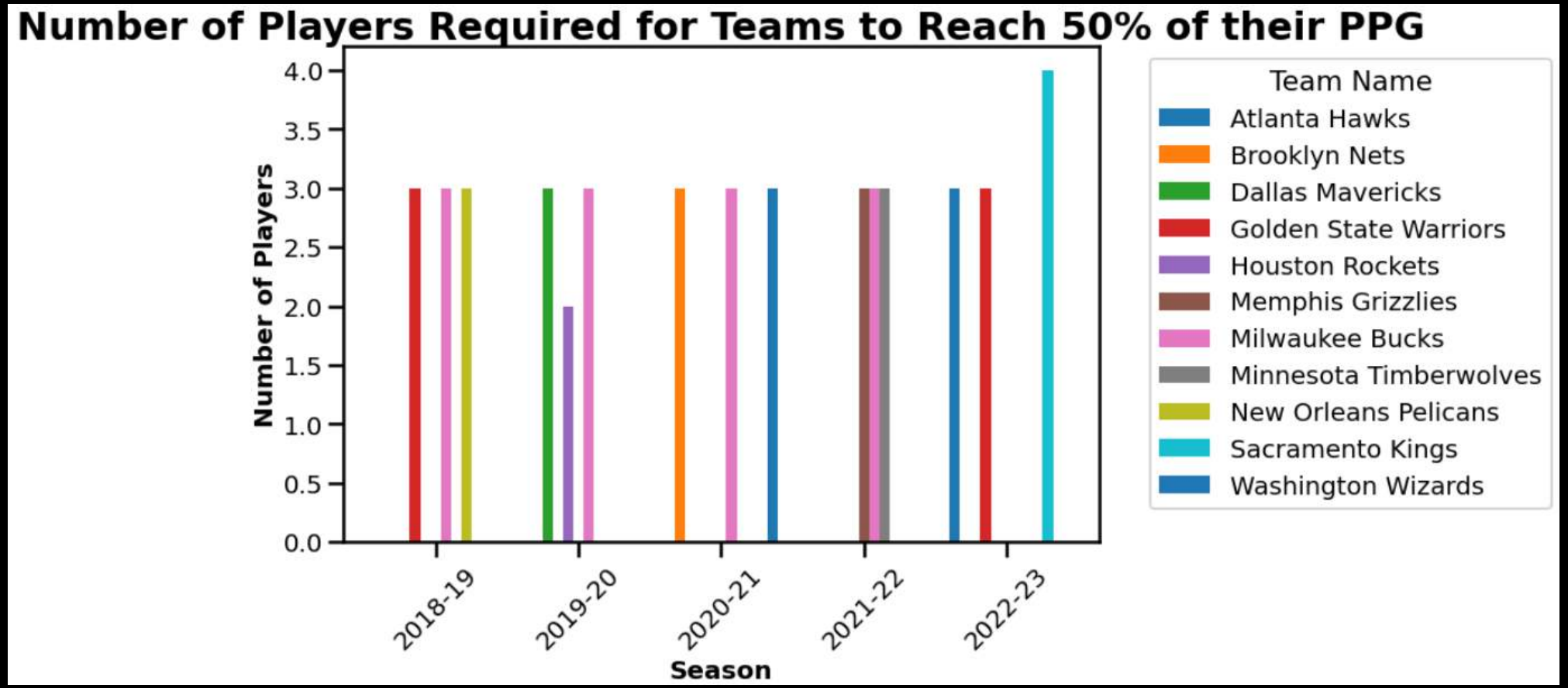
```
Number of players with higher APG than Steve Nash's 2005 season:
2010: 0
2015: 0
2020: 0
2024: 0
```

```
Number of players with higher AST/TO ratio than Steve Nash's 2005 season (minimum 5 APG):
2010: 3
2015: 3
2020: 1
2024: 12
```

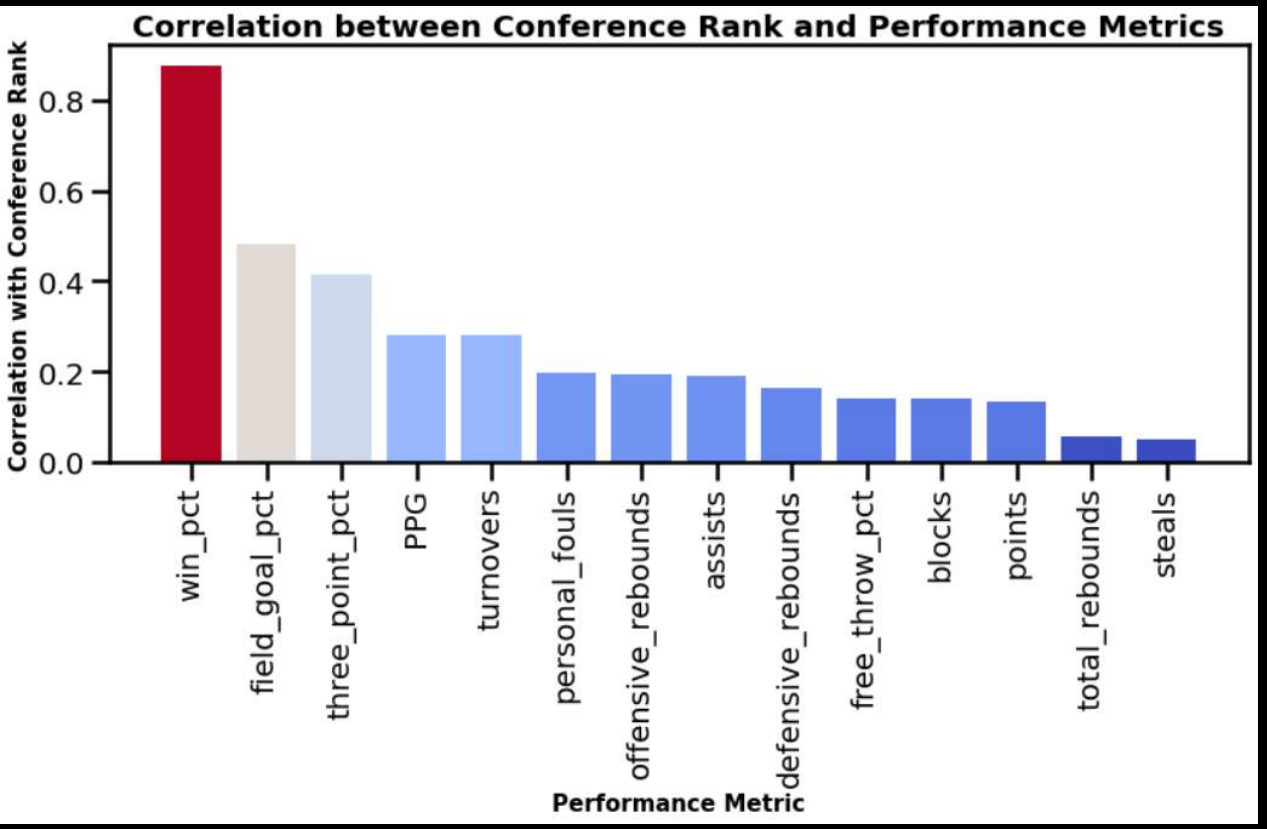
```
Number of players with higher STOCKs than Steve Nash's 2005 season:
2010: 204
2015: 215
2020: 239
2024: 249
```

RQ4 : WHICH PERFORMANCE STATS CONTRIBUTE TO DETERMINING A TEAM'S SUCCESS THE MOST?

DO ALL PLAYERS CONTRIBUTE EQUALLY TO A TEAM'S SUCCESS?



CAN WE PREDICT A TEAM'S SUCCESS?



- As expected, **'win_pct'** , **'field_goal_pct'** and **'three_point_pct'** seem to have the strongest correlation with **'conference_rank'**
- surprising to see features like **'PPG'** and **'points'** have such a low correlation

```
Mean Absolute Error: 1.3443824397725O9
Mean Squared Error: 2.937034725051422
R-squared: 0.8418432518256858
```

- Overall, the evaluation metrics suggest that the linear regression model performs reasonably well
- However, there are still a few limitations to consider

TEAM PERFORMANCE AGAINST SPECIFIC OPPONENTS

team_performance_2000_to_2011

✓ 0.0s

	team_name	opponent_name	games_played	wins	losses	avg_points_scored	avg_field_goal_pct	win_pct	loss_pct
0	Atlanta Hawks	Boston Celtics	13	5	8	95.846154	0.451538	0.384615	0.615385
1	Atlanta Hawks	Brooklyn Nets	15	3	12	94.000000	0.441067	0.200000	0.800000
2	Atlanta Hawks	Charlotte Hornets	19	14	5	95.473684	0.466789	0.736842	0.263158
3	Atlanta Hawks	Chicago Bulls	11	6	5	98.090909	0.433364	0.545455	0.454545
4	Atlanta Hawks	Cleveland Cavaliers	19	8	11	92.578947	0.452368	0.421053	0.578947
...	...	...	...	...	...	...	...	...	...
868	Washington Wizards	Portland Trail Blazers	9	4	5	88.444444	0.434000	0.444444	0.555556
869	Washington Wizards	Sacramento Kings	6	2	4	97.166667	0.431333	0.333333	0.666667
870	Washington Wizards	San Antonio Spurs	11	4	7	91.181818	0.434818	0.363636	0.636364
871	Washington Wizards	Toronto Raptors	18	10	8	96.333333	0.444667	0.555556	0.444444
872	Washington Wizards	Utah Jazz	4	3	1	95.750000	0.407250	0.750000	0.250000

873 rows × 9 columns

team_performance_2011_to_2023

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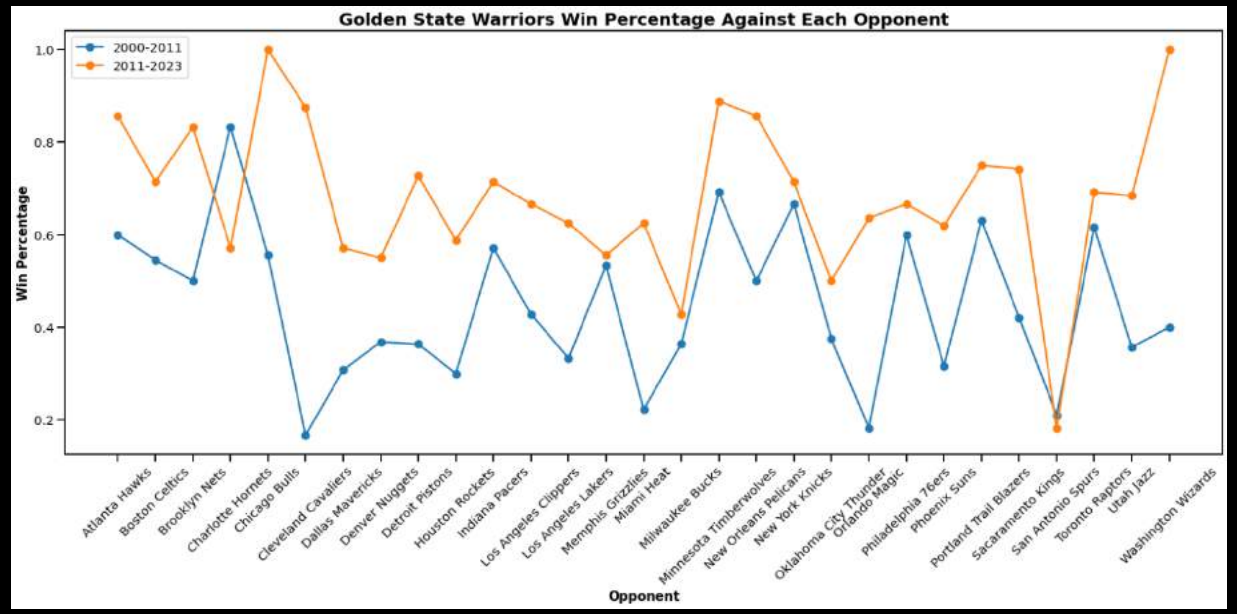
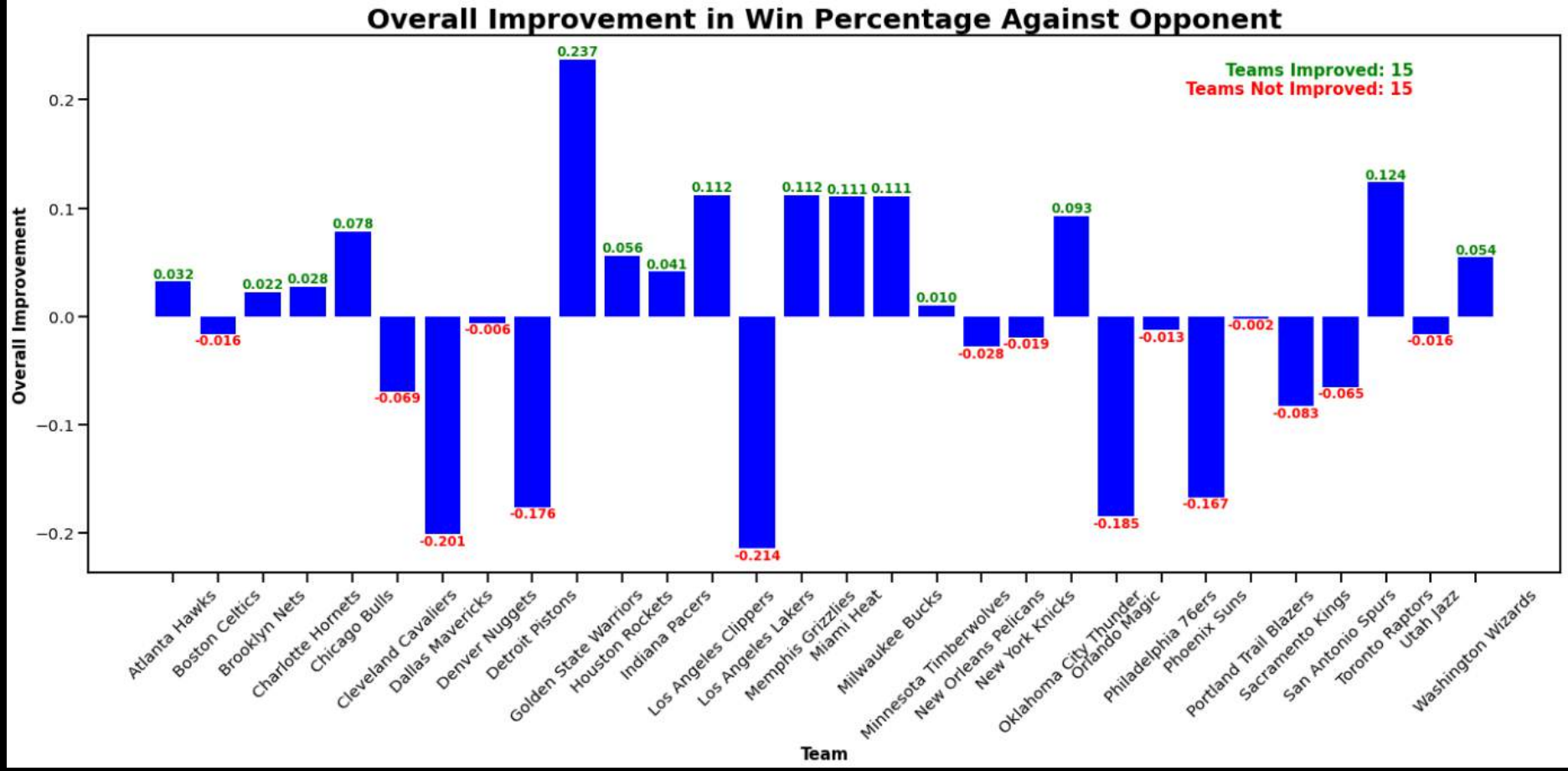
	team_name	opponent_name	games_played	wins	losses	avg_points_scored	avg_field_goal_pct	win_pct	loss_pct
0	Atlanta Hawks	Boston Celtics	12	5	7	102.666667	0.458750	0.416667	0.583333
1	Atlanta Hawks	Brooklyn Nets	16	5	11	108.750000	0.446688	0.312500	0.687500
2	Atlanta Hawks	Charlotte Hornets	25	15	10	105.240000	0.458600	0.600000	0.400000
3	Atlanta Hawks	Chicago Bulls	16	6	10	100.687500	0.437500	0.375000	0.625000
4	Atlanta Hawks	Cleveland Cavaliers	25	14	11	109.320000	0.467040	0.560000	0.440000
...	...	...	...	...	...	...	...	...	...
865	Washington Wizards	Portland Trail Blazers	5	3	2	105.800000	0.447200	0.600000	0.400000
866	Washington Wizards	Sacramento Kings	9	5	4	111.222222	0.481889	0.555556	0.444444
867	Washington Wizards	San Antonio Spurs	10	2	8	101.700000	0.455400	0.200000	0.800000
868	Washington Wizards	Toronto Raptors	18	3	15	98.888889	0.430944	0.166667	0.833333
869	Washington Wizards	Utah Jazz	7	3	4	96.857143	0.444286	0.428571	0.571429

870 rows × 9 columns





Conclusions :

- Team success in sports is intricately tied to star player performance, team metrics, and performance against specific opponents
- While these factors certainly do influence a team's success, there are additional elements that may impact outcomes

THANK YOU