

# Analysis of NBA Player Salary using Linear Regression Analysis

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**Abstract.** The National Basketball Association (NBA) is one of the major professional sports leagues in the United States. As times change, the NBA has a growing commercial value, and players have increasing salaries. The problems of salaries and contracts existed since the start of the NBA, inappropriate value of contracts between players and teams fail to reach an agreement. This paper uses the players' data from the Entertainment and Sports Programming Network (ESPN) over the 2022-2023 regular season. The player field average data such as average points and ages will be the variables used to find out the player's salary, linear regression model will be used for analysis. The outcome will indicate the important factors used and to take into consideration by teams about the salary of players. This paper found that the player's salary is strongly related to their points per game and average field goals made which meet the playing style of the current basketball market.

**Keywords:** National basketball association; player salary; salary cap; linear regression.

## 1. Introduction

The National Basketball Association (NBA) has developed its commercial value as a basketball league which attracts lots of top basketball players from all over the world trying to join it. Whether to reach the purpose of championships or business, the league and teams will sign contracts with star players with high salaries. The viewership of NBA Playoffs in every season in recent years has been significantly affected by the pandemic. According to the research and statistics from sports media, the 2019-2020 season was the least-watched playoff over 11 seasons, and the 2020-2021 season had about a 35% increase compared with the 2019-20 season [1]. In the 2022-2023 season which just finished, it gained an average of \$5.47 million viewers per game across several platforms which was the most viewed in the past five years [2]. Since the NBA "bubble" project was launched to isolate the players, all games were moved to online. This strongly influenced the viewership and the salaries of players and the income of the league and teams. Moreover, the performance of NBA players changed somewhat.

Comparing the players' salaries, Stephen Curry in the Golden State Warriors will make at least \$51.9 million in the 2023-24 season, and Kevin Looney who is a teammate of Stephen Curry will make \$7.5 million [3, 4]. These are depended on their statistics each game and the benefits they could bring to the team. Stephen Curry as a superstar player can ensure the viewership and the rank of the team will get a top salary contract, but Kevin Looney's role was to assist the team for the championship, therefore he will get a related lower salary contract. The salary and the contract of a player will be determined by a variety of other factors. External factors are revenue sharing from the league, collective bargaining agreement, global appeal and market; some internal factors are players' talent, career span (age), performance (i.e., points, rebounds, assists, blocks, shooting percentage, fouls per game. etc.) [5]. Make a comparison between two players with similar statistics but in different teams, Jamal Murray and Tyler Herro, who are both Point Guard and have similar statistics in the 2022-2023 regular season and played for the Denver Nuggets and Miami Heat respectively [6]. Jamal Murray earned \$31 million, and Tyler Herro earned \$5.7 million in that season, in the 2023-2024 season, they will be \$34 million and \$27 million respectively [7]. This is because the Denver Nuggets had just won the championship which let Jamal Murray who played an important role in the finals earn more money, Tyler Herro won second place in the season and will earn less money than the champion. Compared with Tyrese Maxey who played in the Philadelphia 76ers that lost the game

in the east semifinal, will only get \$4.3 million in the 2023-2024 season [8]. The achievement of players and their teams can also become a significant factor to be considered for the contract and salary.

The salary cap is a rule that places a limit on the amount of money that a team can spend on players' salaries. For the 2022-23 season, the salary cap was set at \$123.655 million, for the 2023-24 season, the salary cap will increase to \$136.021 million which increased by 10% [9]. The more salary that the team gives to a player, the fewer transactions the team will make. With the 2023 NBA drafts and some trades had been done, team Houston Rockets has the most remain space for salary cap which is \$59.8 million for a big move. Utah Jazz and San Antonio Spurs also have enough space for a big move, both of them have more than \$35 million remain in the salary cap [10]. This paper is to explore the relationship between the salaries of NBA players and several factors and predicts the trades between teams with a linear regression model.

## 2. Method

### 2.1. Data Source and Description

To ensure the accuracy and authority of resources and data, this paper uses the website Entertainment and Sports Programming Network (known as ESPN) and the NBA section for the data collection. ESPN is an American international sports channel which contains the data statistics of 25 sports events in America including NFL, MLB, NCAAF and NBA. Indicators Description

Table 1 demonstrates the names and symbols of 28 indicators that will be used in the study.

**Table 1.** Names, Symbols and Range of Players Statistics

Name of Indicator	Symbol	Range
Age	AGE	[19,42]
Career Length	CRL	[1,20]
Position	POS	N/A
Game Played	GP	[0,82]
Minutes Per Game	MIN	[1,41]
Points Per Game	PTS	[0.4,33.1]
Average Field Goals Made	FGM	[1.1,11.2]
Average Field Goals Attempted	FGA	[2.1,22.2]
Field Goal Percentage	FG%	[37.7,70.5]
Average 3-Point Field Goals Made	3PM	[0,4.9]
Average 3-Point Field Goals Attempted	3PA	[0,11.4]
3-Point Field Goal Percentage	3P%	[29.8,49.4]
Average 2-Point Field Goals Made	2PM	[0,10.5]
Average 2-Point Field Goals Attempter	2PA	[0,17.8]
2-Point Field Goal Percentage	2P%	[0,100]
Average Free Throws Made	FTM	[0.2,10]
Average Free Throws Attempted	FTA	[0.2,12.3]
Free Throw Percentage	FT%	[54.1,93.4]
Effective Field Goal Percentage	EFG%	[0,100]
True Shooting Percentage	TS%	[0,106.4]
(Offense/Defense) Rebounds Per Game	REB	[0.2,12.5]
Assists Per Game	AST	[0.1,10.7]
Steals Per Game	STL	[0.1,3]
Blocks Per Game	BLK	[0,3]
Turnovers Per Game	TO	[0.3,4.1]
Fouls Per Game	PF	[0,3.7]
Double Double	DD2	[0,65]
Triple Double	TD3	[0,29]
Plus-Minus	+/-	[-29,9.3]

The website contains the statistics of every player’s career information in the NBA such as their fielding stats and their annual salaries or contracts. For the credibility and reliability of the data source, some of the datasets in Kaggle and Statista will be used for discussion and analysis. Indicators (Variables) list in Table 1 are the NBA players’ basic play data to be considered every season and year. These data will be analysed and explore the relationship with the salaries of players.

**2.2. Method Introduction**

The relationship between the indicators and players’ salaries can be modelled using the multiple linear regression model, the linear predictor functions are used for modelling.

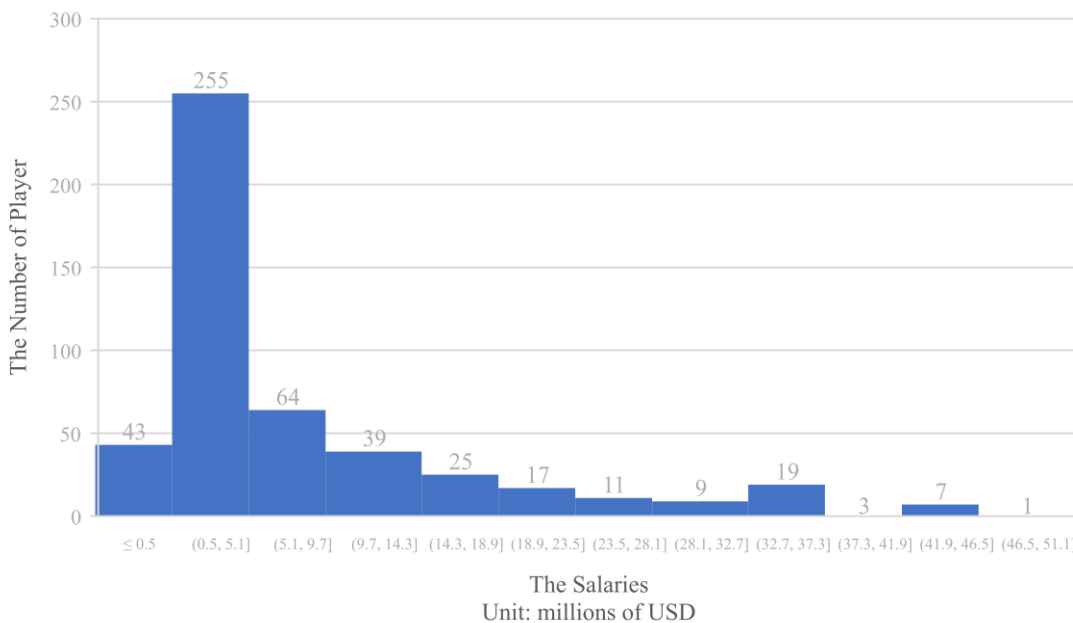
$$f(i) = \beta_0 + \beta_1x_{i1} + \dots + \beta_px_{ip} + \epsilon_i \tag{1}$$

Where  $x_{ik}$  (for  $k=1, \dots, p$ ) is the value of the explanatory variable for the data point;  $\beta_0, \dots, \beta_p$  are the regression coefficients indicate the relative effect of the variable on the outcome;  $\epsilon_i$  is an error variable.

**3. Results and Discussion**

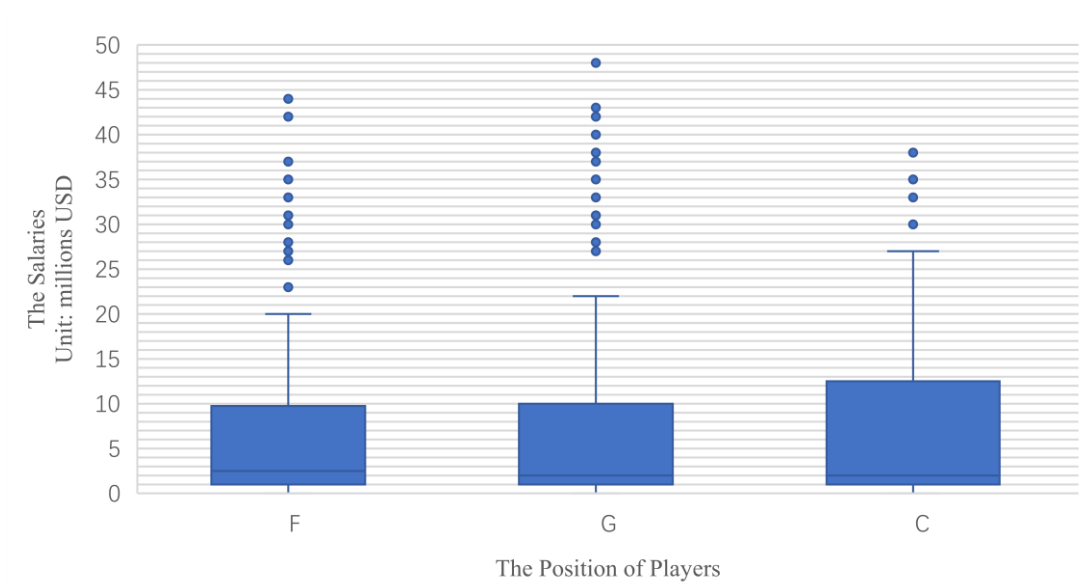
**3.1. Descriptive Statistical Analysis**

As shown in Figure 1, the range of salaries that players earn is very large, and the distribution of their salaries is very intense. The highest salary is led by Stephen Curry with \$48.07 million which is also the only player who earns more than \$45 million, the median of salaries is only \$2.92 million. More than 86% of players earn less than \$20 million, and only 39 players have \$30 million which is 8% of NBA players. There are 255 players earn between 500 thousand and 5.1 million dollars, they have a very large difference between the top salaries in the league.



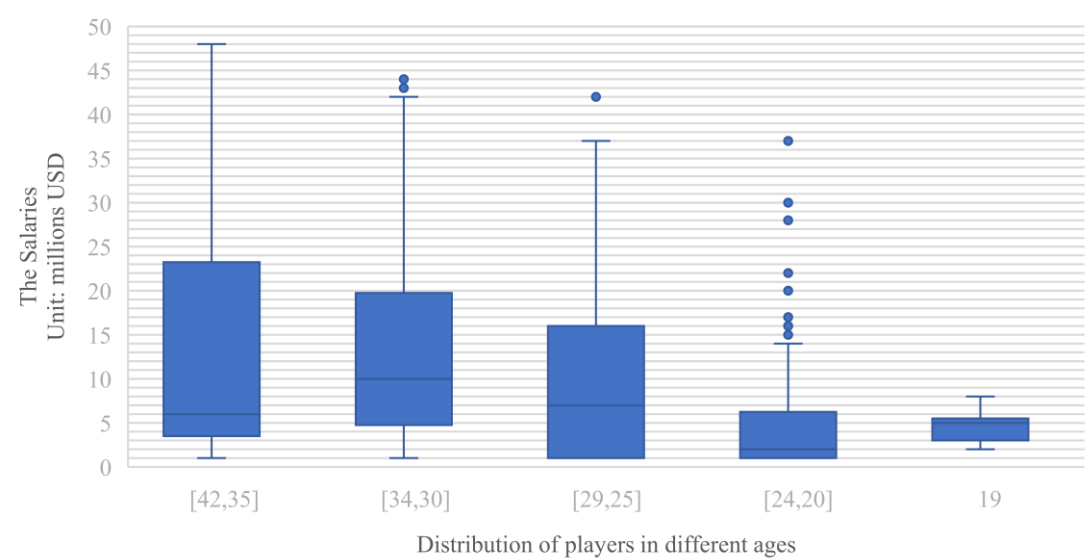
**Fig. 1** The Histogram of Players’ Salaries Distribution

As shown in Figure 2, the relationship between the positions of players doesn’t show a huge difference in different positions. However, the centre has a larger range of salary than the (power/small) forward and (point/shooting) guard. As the number of players on small forward and power forward are combined as forward, point guard and shooting guard are combined as a guard, therefore both positions have more population than the centre. The (point) guard has the player with the highest salary which is Stephen Curry.



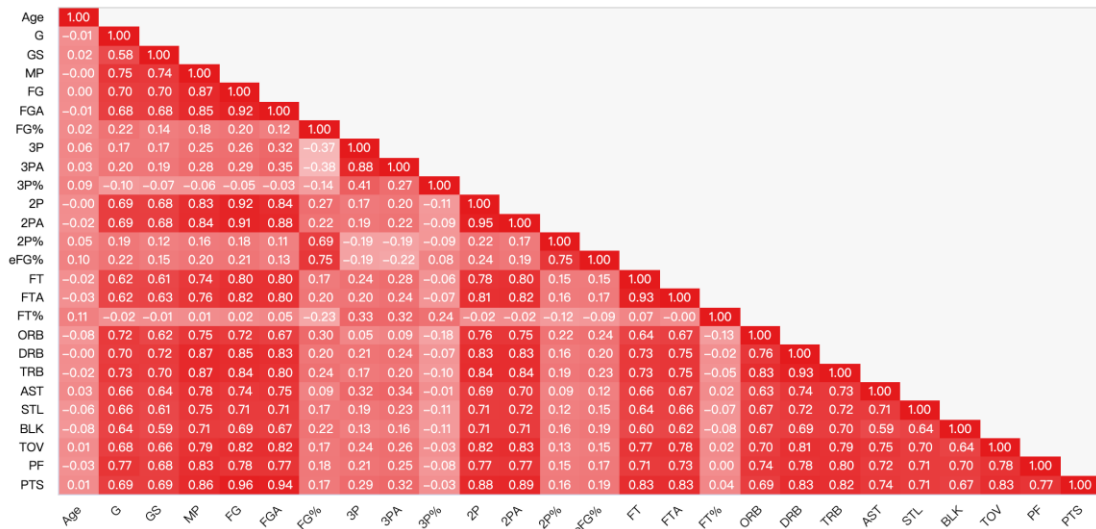
**Fig. 2** The Box Graph of Players' Salaries at Different Positions

The age of players is an important factor that influences the salaries of players. From the box graph, players with 25-34 years old have higher average salaries than other age intervals, as the players are in the golden age of sports. Their performances and physical states are at the peak of their professional career. Players aged between 42 and 35 have a large range in salary. Players such as Stephen Curry and LeBron James who are 35 and 38 years old get a salary of \$48 and \$44 million respectively. This is because of their excellent performance on the field and the benefits they bring to the league and their team. There are a few players with age under 25 who have high salaries, but most of them earn less than \$10 million. More time is needed for those players to prove themselves.



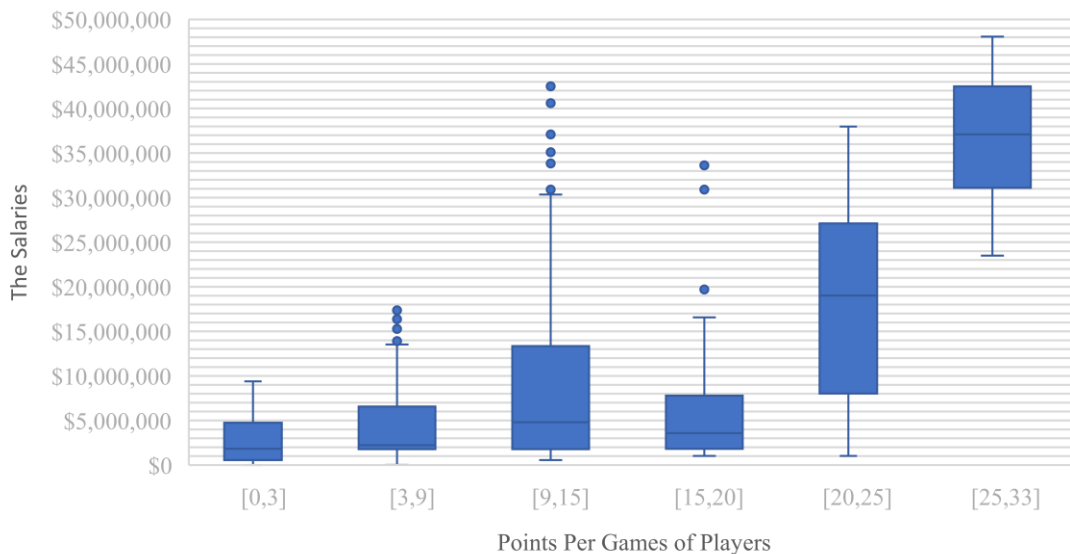
**Fig. 3** The Box Graph of Players' Salaries at Different Ages

Fig 4 shows the relationship of 26 types of field data with 500 players. From the diagram, a conclusion can be drawn that the points per game for the players are in a strong positive correlation with the 2-point shots attempted and minutes played. The more 2-point shots attempted led to more free throws and more scores, and the more time a player plays on the field can have more shots attempted.



**Fig. 4** The Correlation Coefficient Diagram of 26 Types of Field Data

Fig 5 shows the relationship between the players’ salaries and Points Per Game (PTS). From the graph, it shows that the player with higher PTS can have higher salaries. There are some exceptions for players who have PTS between 3 to 15, as some of them have higher salaries than the players who have more PTS. This is because of the Rebounds per game (RB) and Steels per game (STL) which make them outstanding in defence.



**Fig. 5** The Box Graph of Players’ Salaries with the distribution of PTS

### 3.2. Regression Modelling Results

In order to find out the detailed correlation between NBA players’ salaries and their performance per game, this paper uses linear regression analysis to find out the relevance of different factors.

In table 2, B and Standard Error below the Unstandardised Coefficient are regression coefficient values, and Beta below the Standardised Coefficient is the regression coefficient value when the constant is zero. The t and p are used to calculate and determine the statistical significance of the variables. VIF and Tolerance below the Collinearity are used to determine the covariance. From the table, the R-squared value is 0.234 which means that the variables (average fielding stat.) can affect 23.4% of the players’ salaries. F-test value shows that the model doesn’t pass the F-test which states that the variables don’t have a significant influence on the players’ salaries.

**Table 2.** Linear Regression Analysis Results

	Unstandardised Coefficient		Standardised Coefficient	t	p	Collinearity diagnostics	
	B	Standard Error	Beta			VIF	Tolerance
Constant	-1224.639	832.310	-	-1.471	0.145	-	-
POS	5.559	9.792	0.095	0.568	0.572	2.677	0.374
GP	-1.405	0.960	-0.216	-1.463	0.148	2.083	0.480
MIN	-5.558	6.537	-0.141	-0.850	0.398	2.627	0.381
PTS	127.168	179.032	5.511	0.710	0.480	5733.364	0.000
FGM	-428.730	367.840	-6.204	-1.166	0.248	2698.300	0.000
FGA	84.465	49.429	2.412	1.709	0.092	189.716	0.005
FG%	31.151	15.552	1.346	2.003	0.049	42.983	0.023
3PM	-221.809	197.487	-1.962	-1.123	0.265	290.778	0.003
3PA	40.859	38.357	0.890	1.065	0.290	66.537	0.015
3P%	2.023	4.089	0.097	0.495	0.622	3.651	0.274
FTM	-152.356	173.950	-2.648	-0.876	0.384	870.646	0.001
FTA	23.820	41.725	0.496	0.571	0.570	71.855	0.014
FT%	1.327	1.912	0.132	0.694	0.490	3.465	0.289
REB	-21.279	14.331	-0.458	-1.485	0.142	9.073	0.110
AST	-20.571	12.264	-0.415	-1.677	0.098	5.819	0.172
STL	35.428	41.651	0.108	0.851	0.398	1.537	0.651
BLK	10.737	30.956	0.051	0.347	0.730	2.034	0.492
TO	8.281	30.782	0.059	0.269	0.789	4.509	0.222
DD2	2.057	2.190	0.270	0.940	0.351	7.886	0.127
TD3	-1.837	4.938	-0.060	-0.372	0.711	2.503	0.400
R2			0.234				
Adjust R2			0.024				
F			F (20,73)=1.112, p=0.357				
D-W Value			1.947				

#### 4. Conclusion

This study aims to investigate the correlation between basketball players' on-court performance metrics and their salary compensation to predict teams' economic salary space and players' future salaries. Using data from the 2022-2023 NBA season, regression analyses were conducted using per-game data as the independent variable and player salary as the dependent variable. Descriptive statistics and linear regression were performed and found that there was a problem of multicollinearity between the independent variables, which is opposite to the results from the diagrams and graphs between players' salaries and their statistics. From the relations obtained from the graphs, shooting efficiency (e.g. PTS, 3PA, 2PA) and defence ability (e.g. REB, STL, BLK) have a significant impact on the players' salaries.

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