

2021-2022 NBA Season Full Statistical

Analysis

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Introduction to NBA 2021-2022 Season Comprehensive Analysis:

The 2021-2022 NBA season was an extremely important time for the National Basketball Association to make a resilient comeback. It was taking place after emerging from the unprecedented challenges of the COVID-19 pandemic, and players had to put their health on the lines to provide a show for the fans. This season was exceptionally special due to the unexpected NBA Championship winners at the end of the season and thrilling up and down storylines. The following dataset provided will be subsets of a much larger database for the entire season. The datasets will provide a comprehensive examination of team and player performance, with a closer look at championship 'contender' teams in order to grasp what made the top teams so successful.

Starting off, there is an 82-game regular season in which teams compete for a playoff spot and personal accolade awards. Amongst the top NBA players and fans, there is a recognition that players do not take these games very seriously since the schedule is so condensed and hectic. The games that really 'matter' are in the playoffs with much less data to be covered in these games. The playoffs are broken into four separate series which include 16 teams and start at the first round all the way up until the NBA finals. All of these series are the best of seven and is a big reason why these series attract so much attention since normally the better team usually wins unlike the NFL in which it is a single elimination format.



This is a display of the 2022 NBA Playoff Bracket.

In the modern NBA, there are simply too many statistics being tracked to simply fit into one database. The main data we will be looking at is the player statistics for the entire league. These statistics are broken into several categories which include Points (**PTS**), Rebounds (**REB**), **Offensive REB** and **Defensive REB**, Assists (**AST**), Steals (**STL**), Blocks (**BLK**), Turnovers (**TO**), Field Goals Made (**FGM**), Field Goals Attempted

(**FGA**), Field Goal Percentage (**FG%**), Three-Point Field Goals Made (**3PM**), Three-Point Field Goals Attempted (**3PA**), Three-Point Percentage (**3P%**), Free Throws Made (**FTM**), Free Throws Attempted (**FTA**), Free Throw Percentage (**FT%**), Minutes Played (**MIN**), Personal Fouls (**PF**), and Plus/Minus (**+/-**). These different categories are the traditional statistics that have been around since the commencement of the NBA. With the modern age of technology, nowadays there are hundreds more statistics tracked each game and also include rankings of every team in each category.

A further breakdown might be necessary of these different categories in case the reader is unfamiliar with the sport. Points are the total points scored by a player or a team into the basket, rebounds are collected off missed shots, and assists are when a pass is made, and it leads to a successful basket. Moving forward, steals are collected by forcing turnovers (possessions lost to the opponent) by taking the ball away. Blocks are shots which are denied by the opponent while the ball is in the air towards the basket. A field goal attempt means when a player tries to shoot the basketball into the hoop, and a three-point field goal attempted is a shot attempt behind the three-point line.

Top Storylines for the 2021-2022 NBA Season

Now that the reader has established a basic understanding of the format of an NBA season, let's move forward to some of the top storylines about this year before we dive into the data. One of the most intriguing storylines of this season was NBA star Kyrie Irving's interesting decision to not take the COVID-19 vaccination. The NBA was extremely strict in this regard, and the Brooklyn Nets did not allow him to play because of this decision. This made headlines due to the fact that if Kyrie was allowed to play, the Nets had one of the strongest rosters ever assembled with co-stars Kevin Durant and James Harden alongside forming a formidable Big Three. Moving on, many believed that Giannis Antetokounmpo was going to takeover the entire league. The previous season he had won the NBA championship and had averaged a historic stat-line.

Another top storyline involved the dynastic Golden State Warriors who had fallen off the top of the mountain after securing three NBA championships before this season in the last six years. One of their star players, Klay Thompson, was out for over two years with an ACL and Achilles injury, and Kevin Durant had left their team. Many of the top sports analysts did not see this team contending whatsoever and had written them off. Before the season on one of the top news networks in the world, ESPN, there were pre-season predictions of the league's best contenders. When discussing this topic, an expert on the NBA, Kendrick Perkins was asked about how many more titles the Golden State Warriors will win for the rest of Steph Curry's career. He answered very enthusiastically with a glaring zero. This statement became especially ironic due to the

surprise ending of the season with Golden State winning the NBA finals.



On the left is Kendrick Perkins before the 2021-2022 season on ESPN mocking the question and confidently counting out the Warriors, and on the right is Steph Curry, NBA Finals MVP, at the post-game conference remembering this talk on ESPN right after the win. The entire NBA world found this to be especially hilarious and iconic and did not expect Steph Curry to hold on to something said from that long ago. This picture highlights the unlikeliness of the Warriors winning this championship and a great life lesson to never let the opinions of others affect your own self-belief. The passion and confidence Steph Curry plays with on the court is something anyone can admire and learn to apply into their own lives with their own hobbies or jobs. What makes the Warriors different from other organizations is how they believe to play with a certain sense of joy and freedom. They always emphasize the importance of believing in each other, and the significance of positive vibes oozing through the team. Many people let life's adversities and struggles constantly bring them down into a negative mood which often hinders performance. However, as seen by the Golden State Warriors' success, facing these struggles and staying positive will always yield better results no matter how tough it looks.

Let's move on to utilizing the dataset for some problems.

Problem 1

Let's find out the probability each team has in the Western Conference of the NBA to make the playoffs. The Western Conference contains fifteen of the most talented basketball teams in the world.

A. Define the sample space (of the Western Conference) S by use of set notation:

$$S = \{(DAL), (DEN), (GSW), (HOU), (LAC), (LAL), (MEM), (MIN), (NOP), (OKC), (PHX), (POR), (SAC), (SAS), (UTA)\}$$

B. Determine the probability of the Golden State Warriors (GSW) making the NBA playoffs assuming each team has an equal opportunity.

$$P(GSW) = \frac{\text{\# of outcomes in which GSW make the playoffs}}{\text{Total \# of Teams in } S}$$

Since there are 15 teams in the Western Conference, and the GSW are only one it is solvable by doing the following. Let event A be a subset where GSW is included in the 8 teams making the NBA playoffs in the Western Conference.

$$P(GSW) = \frac{{}_A(14)}{{}_S(15)} = P(A) = 8/15 \text{ or } 53.33\% \text{ under a pre-}$$

season prediction.

C. If we assume all teams have an equal chance of making the playoffs, find the probability of the GSW missing the playoffs.

$$P(\text{GSW misses playoffs}) = 1 - P(\text{GSW makes playoffs})$$

$$P(\text{GSW makes playoffs}) = 8/15$$

$$\text{Thus, } P(\text{GSW misses playoffs}) = 1 - 8/15 = 7/15 \text{ or approximately } 46.67\%.$$

Problem 2

Assume the GSW have made the playoffs and now enter to face their first opponent, the Denver Nuggets (DEN). The Denver Nuggets are missing one of their key star players, Jamal Murray, so the chances of them beating the GSW in a 7-game series are very slim. Let's assume that event $B = \text{DEN wins the series}$, and $P(B) = 0.2$. Let event A be GSW winning the series.

- a. Write the expression for $P(\text{GSW}|A)$ in terms of conditional probability.

$$P(\text{GSW}|A) = \frac{P(\text{GSW} \cap A)}{P(A)}$$

- b. Calculate the conditional probability of $P(\text{GSW}|A)$

$$P(\text{GSW}|A) = \frac{P(\text{GSW} \cap A)}{P(A)} = \text{Since we are given } P(B) = 0.2, 1 - P(B) = \mathbf{0.8}$$

- c. Calculate the conditional probability $P(\text{DEN}|B)$

$$P(\text{DEN}|B) = P(\text{DEN} \cap B) / P(B) = \mathbf{0.2}$$

Problem 3

Let's consider the second round of the Western Conference NBA playoffs in which four teams are now fighting to advance to the Western Conference Finals. In the year 2022, the four teams which made the second round were the GSW, MEM, PHX, and DAL. The probability of each team advancing to the next round is $P(\text{GSW}) = 0.4$, $P(\text{MEM}) = 0.3$,

$P(\text{PHX}) = 0.2$, $P(\text{DAL}) = 0.1$. Furthermore, the probability of each team advancing to the following round if they win the first game in the series is:

$$P(\text{Win}|\text{GSW}) = 0.7$$

$$P(\text{Win}|\text{MEM}) = 0.6$$

$$P(\text{Win}|\text{PHX}) = 0.8$$

$$P(\text{Win}|\text{DAL}) = 0.5$$

Write the expression using the law of total probability for the event A (Each team wins the first game of their second round series) in terms of the event B and the conditional probability of advancing to the following round.

$$P(A) = P(\text{Win}|\text{GSW}) \times P(\text{GSW}|B) + P(\text{Win}|\text{MEM}) \times P(\text{MEM}|K) + P(\text{Win}|\text{PHX}) \times P(\text{PHX}|K) + P(\text{Win}|\text{DAL}) \times P(\text{DAL}|K)$$

$$P(A) = (0.7 \times 0.4) + (0.6 \times 0.3) + (0.8 \times 0.2) + (0.5 \times 0.1)$$

$$P(A) = .28 + 0.18 + .16 + 0.05 = 0.67 = P(A)$$

Thus, the total probability that a team wins the first game of their second-round series is 67%.

Problem 4

In an NBA series, there are 4 scheduled games on a team's home floor and 3 games on the oppositions arena depending on whatever team has the better regular season record. Let's find out whether or not the home team has an advantage in these games.

Is the probability of the Golden State Warriors winning the game and the game being played in their own home arena independent?

- Let $P(A) = 0.70$ and be the probability of the Warriors winning the game.
- Let $P(B) = 0.60$ (The probability of the game being played in the Oracle arena)
- $P(A \cap B) = 0.65$ (Probability of the Warriors winning and the game being inside their own arena)

$$P(A \cap B) = P(A) \times P(B)$$

$$0.65 = 0.70(0.60)$$

$$0.65 \neq 0.42$$

The formula to check for an independent event was used, and it is fair to conclude that these events are not independent.

Problem 5

In the 2022 NBA Playoffs, the Golden State Warriors played a total of four different series during the run. The probability of GSW winning any individual series was 0.5.

What is the probability that the Warriors will win *at least* 2 series in their playoff run?

Since the number of trials are fixed, and each observation is independent it is fair to use the binomial distribution to solve this problem.

- $P = 0.5$ (Probability of GSW winning any given series)
- $N = 4$
- $X = \#$ of series won by GSW

By use of the binomial distribution formula,

$$P(X \geq 2) = P(X = 2) + P(X = 3) + P(X = 4)$$

$$P(Y = 2) = \binom{4}{2} 0.5^2 (1 - 0.5)^{4-2} = 0.375$$

$$P(Y = 3) = \binom{4}{3} 0.5^3 (1 - 0.5)^{4-3} = 0.25$$

$$P(Y = 4) = \binom{4}{4} 0.5^4 (1 - 0.5)^{4-4} = 0.0625$$

$$P(X \geq 2) = 0.375 + 0.25 + 0.0625 = \mathbf{0.69}$$

It is important to note that since the key words at least were used in the original question this made us do extra work in the problem and find out the probability of $P(Y=3)$, and $P(Y=4)$ to add them to $P(Y=2)$.

Problem 6

Suppose a team has won their playoff round. What is the probability that this team is the Golden State Warriors (GSW)?

Consider event A that the Golden State Warriors win their playoff round.

Consider Event B that a team wins a playoff round.

Bayes Rules:

$$P(B|A) = \frac{P(A|B) P(B)}{P(A)}$$

$P(A|B)$ is the probability that the team is GSW given that a team has won the playoff round.

$P(B|A)$ is the probability that a team has won the playoff round given that GSW won.

$P(A)$ is the probability that GSW wins the playoff round.

$P(B)$ is the probability that any team wins the playoff round.

Substituting Bayes' Rule:

$$P(GSW|B) = \frac{P(B|GSW) P(GSW)}{P(B)} = \frac{1 * 0.8}{1} = 0.8$$

Problem 7

During the 2022 NBA playoffs, the Golden State Warriors had 8 players available on their bench, including Jordan Poole, Gary Payton II, Otto Porter Jr., and others. The coaching staff wanted to explore all possible orders in which these bench players could be substituted into the game. *How many different ways can the Warriors arrange the order of their 8 bench players for substitutions?*

To calculate the total number of arrangements, let's use the factorial formula since the order matters.

$$n! = n * (n - 1) * (n - 2) \dots 1$$

Here, $n = 8$ (the number of bench players)

$$8! = 8 * 7 * 6 * 5 * 4 * 3 * 2 * 1 = 40,320 \text{ different ways for substitutions.}$$

Problem 8

During the 2022 NBA playoffs, the Golden State Warriors had 12 players available on their roster. Steve Kerr, the head coach, needed to decide out of these 12 players, the Warriors needed to select **5 players** for the starting lineup. The order in which they are selected does not matter.

- a) How many different ways can the Warriors choose their starting 5 players?
- b) Once the 5 starters are chosen, Steve Kerr wants to decide in which **specific order** the 5 starting players will enter the court for introductions. How many different orders are possible for these 5 players?

For Part A where order does not matter, we use the combination formula.

$$C_r^n = \frac{P_r^n}{r!} = \frac{n!}{r!(n-r)!}$$

- $n = 12$ (total players available)
- $r = 5$ (players to choose)

$$C(12,5) = \frac{12!}{5!(12-5)!} = 792$$

There are **792** ways to choose 5 players for the starting lineup.

- For part B, since order matters, we implement the permutation formula.

$$P(n,r) = n!$$

Where $n = 5$ (the chosen players)

$$P(5) = 5! = 5 * 4 * 3 * 2 * 1 = 120$$

There are 120 different orders for the chosen 5 players to enter the court.

Problem 9

In the 2022 NBA playoffs, there are 16 total teams, including the Golden State Warriors (GSW), the Phoenix Suns (PHX), and the Dallas Mavericks (DAL). Let's assume the league is conducting random fan giveaways to 4 out of the 16 playoff teams, where each selected team receives limited-edition merchandise to distribute. The hypergeometric distribution can be used to model the probability of specific outcomes in this selection process.

Let K = The number of selected teams in the giveaway that include the Golden State Warriors

- Let N = The total number of teams eligible for the giveaway (16)
- Let n = the number of teams selected in the giveaway (4)
- Let k = the specific number of times the Golden State Warriors are selected for the giveaway.

Given $K = 1$, There is only 1 instance of GSW in the 16 teams

- a) Find the probability that the GSW are not selected at all
- b) Find the probability that GSW are selected once

$$P(K = k) = \frac{\binom{K}{k} * \binom{N - K}{n - k}}{\binom{N}{n}}$$

- 1) Case $K = 0$, GSW is not selected

$$P(K = 0) = \frac{\binom{1}{0} \binom{15}{4}}{\binom{16}{4}}$$

$$P(K = 0) = \frac{1 * 1365}{1820} = 0.750$$

- 2) Case $K = 1$: GSW is selected once.

$$P(K = 1) = \frac{\binom{1}{1} \binom{15}{3}}{\binom{16}{4}}$$

$$P(K = 1) = \frac{1 * 455}{1820} = 0.250$$

Problem 10

During the 2022 NBA playoffs, Golden State Warriors star Stephen Curry has a free throw shooting percentage of 90%. This means that the probability that Curry makes a free throw on any given attempt is $P(\text{Make}) = 0.9$, and the probability that he misses is 0.1. Find the probability distribution of the number of attempts it takes for him to make his first successful free throw. Calculate $P(X = 1)$, the probability that Curry makes his first successful free throw on the first attempt. And calculate $P(X = 2)$, the probability that Curry makes his first successful free throw on the second attempt.

- This question will require use of the geometric distribution, which is used when we want to count the number of trials until the first success, with each trial being independent.

$$p(y) = q^{y-1}p$$

$p = 0.9$, $1 - p = 0.1$, k = number of attempts it takes to make the first successful free throw

$$P(X = 1) = (1 - 0.9)^{1-1} * 0.9 = 1 * 0.9 = 0.9$$

The probability that Curry makes his first successful free throw on the first attempt is 90%.

- Calculate $P(X = 2)$, which requires Curry to miss the first attempt and then make the second one.

$$P(X = 2) = (1 - 0.9)^{2-1} * 0.9 = 0.09$$

It is safe to conclude that the probability in which Curry makes his first successful free throw on the second attempt is 9%. This is a testament to his accuracy and status around the league as the greatest shooter.

Problem 11

During the 2022 NBA playoffs, the Golden State Warriors had 12 active players on the roster. Amongst these, 6 of them were classified as clutch scorers, meaning they scored in critical moments of a close game. Let's suppose Steve Kerr selects 5 players to finish a close game during the 4th quarter. What is the probability that exactly 3 clutch scorers are in the lineup during that time?

This problem requires the hypergeometric distribution formula since we are selecting a number of successes (clutch scorers) from a population without replacement.

Hypergeometric Formula:

$$p(y) = \frac{\binom{r}{y} \binom{N-r}{n-y}}{\binom{N}{n}}$$

Let $N = 12$, total number of players

$r = 6$, total number of clutch players, $n = 5$ (players selected), and $y =$ number of clutch players selected. To find the probability of selecting exactly 3 clutch scorers we must set

$y = 3$ and plug our variables into the formula.

$$P(Y = 3) = \frac{\binom{6}{3} * \binom{12-6}{5-3}}{\binom{12}{5}}$$

$$P(Y = 3) = \frac{20 * 15}{792} = 0.3788$$

It is safe to conclude that the probability of selecting exactly 3 clutch scorers is 37.88%.

Problem 12

During the 2022 NBA playoffs, the Golden State Warriors were one of the league's best three-point shooting team. They would make 15 three-pointers per game during their run. What is the probability that the Warriors will make exactly 18 three-pointers in a playoff game?

The Poisson probability mass function is:

$$p(y) = \left(\frac{\lambda^y}{y!} \right) e^{-\lambda}$$

Y: The number of events (3-pointers made).

$\lambda=15$: The average number of 3-pointers made per game.

y: The specific number of 3-pointers for which the probability is calculated.

$e \approx 2.71828$: The base of the natural logarithm.

Probability of Making Exactly 18 Three-Pointers ($y = 18$):

$$P(Y = 18) = \frac{15^{18} e^{-15}}{18!}$$

$$P(Y = 18) = 0.1836$$

Problem 13

During the 2022 NBA playoffs, the Golden State Warriors averaged roughly 112 points per game, with a standard deviation of 8 points per game. Let the points scored per game by the Warriors be represented as a random variable X. What is the minimum proportion of playoff games in which the Warriors scored between 96 and 128 points?

$$P(|Y - \mu| < k\sigma) \geq 1 - \frac{1}{k^2}$$

1) The range 96 and 128 represents k standard deviations from the mean.

Calculate k

$$k = \frac{128 - 112}{8} = 2$$

Therefore, the range is within $k = 2$ standard deviations from the mean. By utilizing Tchebysheff's Theorem:

$$1 - \frac{1}{2^2} = 1 - \frac{1}{4} = 0.75$$

This means at least 75% of the games had points scored between 96 and 128.

Problem 14

During the 2022 NBA Playoffs, the points scored by the Golden State Warriors (X) followed a continuous probability distribution over the interval [100,130]. The probability density function is defined as:

$$f(x) = \begin{cases} \frac{1}{30} & , 100 \leq x \leq 130 \\ 0, & \end{cases}$$

The cumulative probability for a continuous random variable is calculated using the integral of the PDF:

$$P(a \leq X \leq b) = \int_a^b f(x)dx$$

What is the probability that the warriors scored between 110 points and 120 points in a single playoff game?

$$P(110 \leq X \leq 120) = \int_{110}^{120} f(x)dx$$

The integral of a constant c is $c * x$

Evaluate the limits:

$$P(110 \leq X \leq 120) = \frac{1}{30} * (120 - 110) = \frac{1}{30} * 10 = \frac{10}{30} = 0.3333$$

The probability that the Warriors score between 110 and 120 points is 33.33%.

Problem 15

During the 2022 NBA Playoffs, The Golden State Warriors, led by stars Stephen Curry, Klay Thompson, and Draymond Green, had a remarkable championship run. Let's consider the following probability scenario:

A : Stephen Curry scores 25 or more points

B : The Warriors win the game.

C : Draymond Green records a triple-double

Using data from the 2022 playoffs, Curry scored 25+ points in 12 out of 18 games. The Warriors won 14 out of 18 games, Draymond Green recorded a triple-double in 3 out of the 18 playoff games.

To solve this problem, we must utilize the individual probabilities, conditional probabilities, and then the joint probability function to find the final answer.

$$P(A) = \frac{2}{3} \text{ (Curry scoring 25+ points)}$$

$$P(B) = \frac{7}{9} \text{ (Warriors winning)}$$

$$P(C) = \frac{1}{6} \text{ (Draymond triple – double)}$$

Assuming the events are not independent, we now use the multiplication rule of probability:

$$P(A \cap B \cap C) = P(A) * P(B|A) * P(C|A, B)$$

$$P(A \cap B \cap C) = \frac{2 * 5 * 1}{3 * 6 * 5} = \frac{1}{9}$$

The joint probability that Curry scores 25+ points, the Warriors win, and Draymond records a triple-double in a single playoff game is 11.1%. This statistic also highlights the exceptional performance of the Warriors during this run.

Problem 16

Historical data from the 2022 NBA Playoffs indicates that the time between Stephen Curry's successful 3-point shots follows an exponential distribution. Assume the mean time between successful 3-point shots is 8 minutes. If Curry successfully made a 3-point shot at the start of a quarter, what is the probability that he makes another successful 3-point shot within that same quarter (12 minutes total)? What is the variance of the time between Curry's successful 3-point shots?

This problem will require the Exponential Distribution Formula.

$$f(y) = \begin{cases} \frac{1}{\beta} e^{-\frac{y}{\beta}} & , 0 \leq y \leq \infty \end{cases}$$

The probability of Curry making a successful 3-point shot within a specific interval [a,b] is given by:

$$P (a \leq Y \leq b) = \int_a^b f(y)dy = \int_a^b \frac{1}{8} e^{-\frac{y}{8}} dy$$

For step 2, we want the probability that Curry makes another 3-point shot within 12 minutes of his first shot and then solve the integral.

$$P (0 \leq Y \leq 12) = \int_0^{12} \frac{1}{8} e^{-\frac{y}{8}} dy$$

We must factor out the $\frac{1}{8}$, and to integrate we must use u substitution. Let $u = \frac{y}{8}$

The limit will change when $y = 0$, $u = 0$, and when $y = 12$, $u = 12/8 = 1.5$

$$P(0 \leq Y \leq 12) = \frac{1}{8} \int_0^{1.5} e^{-u} * 8 du$$

$$P(0 \leq Y \leq 12) = \int_0^{1.5} e^{-u}$$

$$\int e^{-u} du = -e^{-u}$$

$$P(0 \leq Y \leq 12) = [-e^{-u}]_0^{1.5} = -e^{-1.5} + e^0$$

$$P(0 \leq Y \leq 12) = 1 - e^{-1.5}$$

$$P(0 \leq Y \leq 12) = 1 - 0.2231 = 0.7769$$

The probability that Steph Curry will make another successful 3-point shot within 12 minutes is approximately 77.69%.

For step B, to find the variance of an exponential distribution is fairly simple and we need to square the mean. Since the mean was given as 8, the variance of the time between Curry's successful 3-point shots is **64 minutes**.

Conclusion

This paper explores the statistical analysis of the Golden State Warriors' 2022 playoff campaign, using data-driven techniques to uncover insights into their performance. The goal is to apply statistical methods to understand the factors that contributed to their championship run, with an emphasis on probability distributions, performance metrics, and game outcomes.

Using a range of statistical tools, we examine how specific elements of the Warriors' play, such as scoring consistency and defensive strategies, influenced their chances of winning. By modeling various scenarios, we uncover how the team's strengths, as well as moments of critical decision-making, contributed to their success.

Through this analysis, we focus on the application of statistical approaches in sports, showcasing how they can provide clarity on team dynamics and individual contributions. The use of analytics in the NBA has grown rapidly, and almost every team has adapted to shooting more three-pointers since the data suggests doing so. This report highlights how the use of these powerful equations can help teams get a competitive edge over their opponents. The Warriors' remarkable playoff journey serves as a testament to how both numbers and team spirit combine to produce a championship-level performance.

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