The Art of Free Throws:

A Data-Driven Perspective

We were provided with a dataset of over 620,000 rows of free throw data covering professional basketball players from the season starting in 2006 to the season starting in 2015.

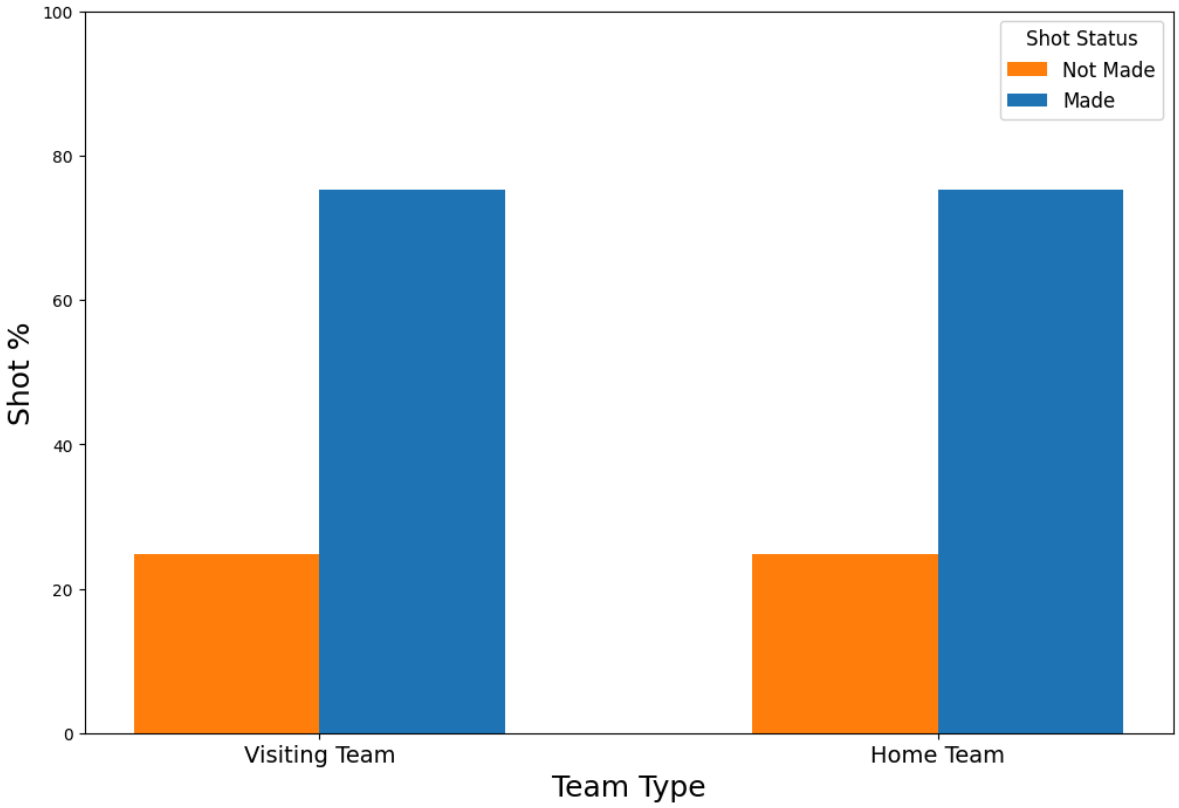
The data covers 32 teams (two of which have disbanded) with 1,098 players. Each game consists of four 12-minute periods, and a tied score at the end of the scheduled periods can trigger up to four overtime rounds (although the usual number of overtime rounds is less). Free throws are awarded to a team when the opposing team commits a foul, and up to three free throws can be awarded, although usually the number is one or two.

Here are the questions we sought to answer:

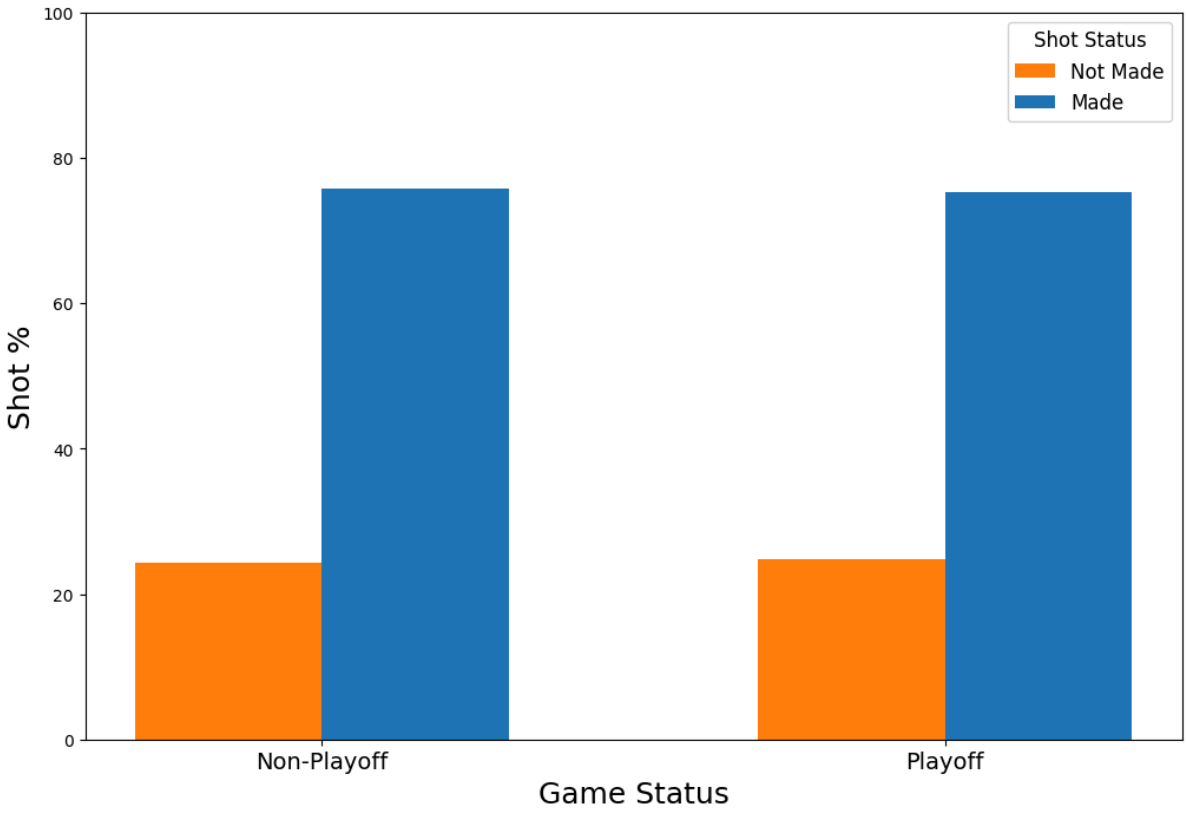
- What is the impact of home vs away on free throws?
- What is the impact of playoffs on free throws?
- What is the impact of how far into the game we are (in minutes) on free throws?
- Which players seem to be especially consistent in all situations? Meaning they always make/miss at about the same rate, regardless of any factors.
- How important are free throws in terms of winning/losing the game?

On average, over the entire dataset, about 76% of shots were made. Around 42,000 of the total 620,000 free throws were made in playoff games, and the 76% success rate was sustained within those playoff games. In about 50% of the games, the home team won.

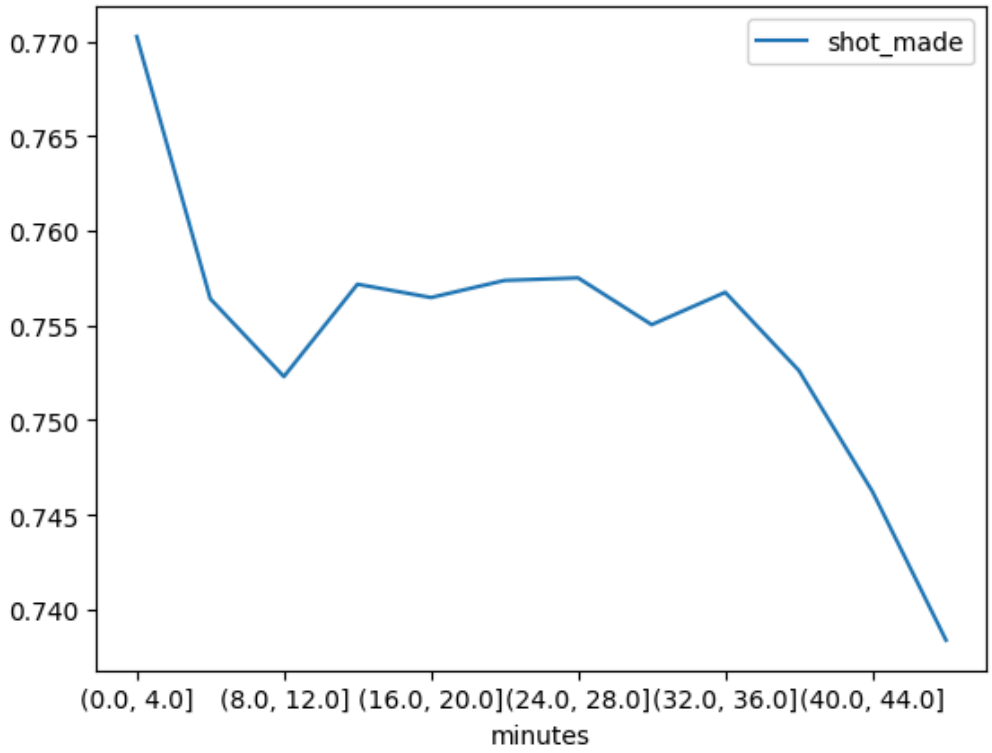
When we looked at the success of free throws from home team players vs. visiting team players, we didn't see a difference.



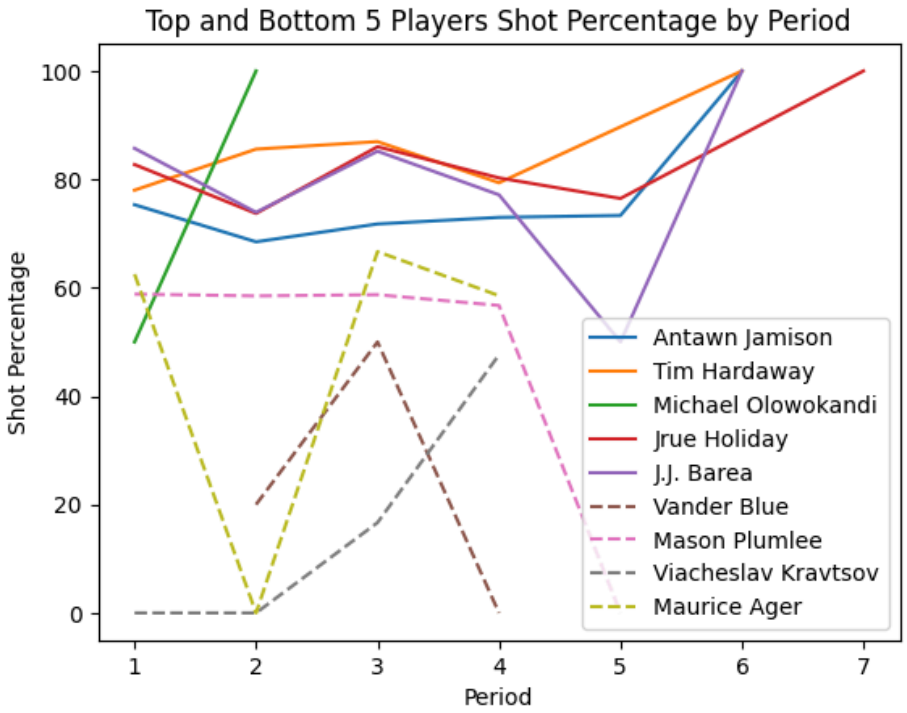
Similarly, when we compared playoff vs. non-playoff games, the rates of free throw success were unchanged.



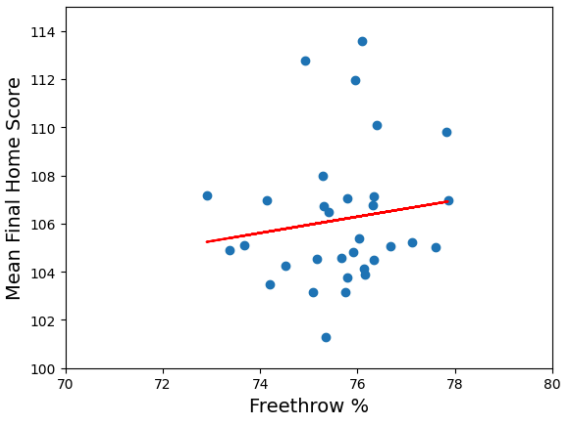
When we looked at how rates of success changed within the course of a game, we saw that there seems to be a tendency to improve slightly across the course of a game - about 3%. We had a couple of theories as to why this might be - perhaps players performed better under pressure, or maybe it took time for them to get warmed up. This seemed like a subject that might warrant further investigation.

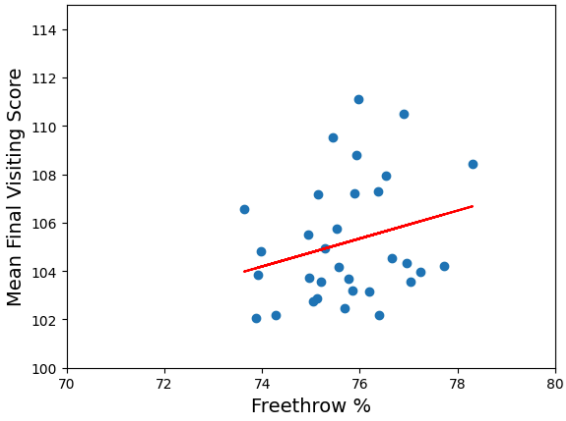


Further looking into the question of how shot performance changed over the course of a game, we also looked at how the free throw success rates of the top and bottom 5 players changed per period. The top 5 players seemed to mirror the same trend seen in the overall data where they improved over the course of a game. The bottom 5 players seemed to have missed all of their shots in a period relatively often. In future research, we might want to remove players from the data who only took a very small number of free throws overall, since the data points at 0% or 100% seem to be exceptions created by small sample sizes.



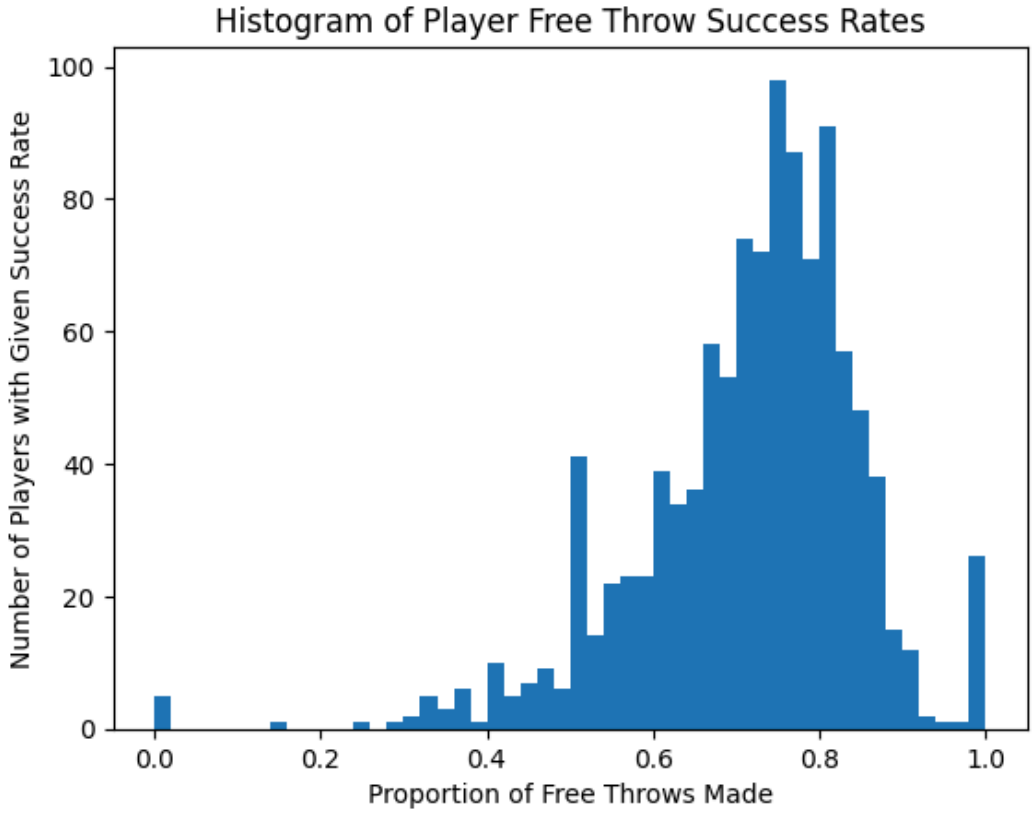
We also investigated whether free throws had a significant impact on winning or losing the game. In order to do this, we split the data into games where the home team won, vs. where the visiting team won. Within these sets, we looked at whether there was any correlation between free throw success rates and final score. The linear regression showed a positive slope, but had a correlation coefficient of less than 0.1 for both groups, so we concluded that free throw success does not have a large impact on winning or losing the game.



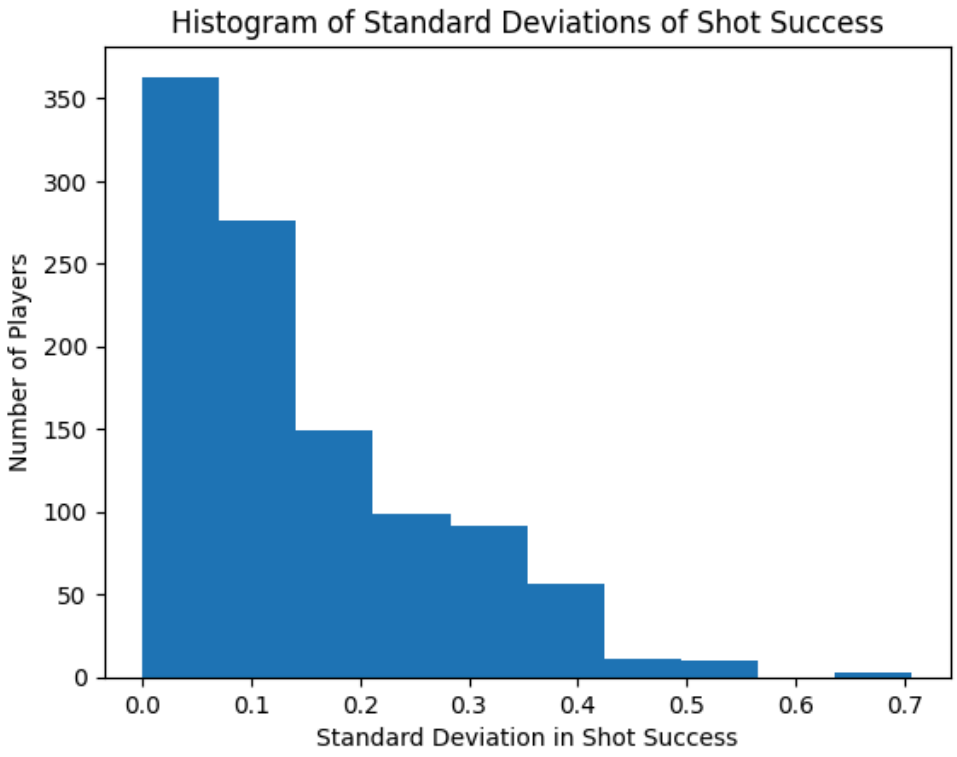


Finally, we wanted to research how consistent different players were in terms of making their shots regardless of the circumstances, whether in visiting games, home games, playoffs, and at any time during the match. To achieve this, we created a histogram of each player's success rate. We can see a major cluster around the 76% range, with a slight left-hand skew. This seems to suggest that making 7 or 8 free throws out of 10 is relatively normal for the league,

with a small number of players achieving a slightly higher overall rate, and a larger number of players having poorer performance overall.



Then to analyze which of the players was the most consistent, we took the data about success rates per player per period, and analyzed the standard deviation for each player. There are a large number of players that seem to have a zero standard deviation, or perfect consistency. However, many of the players in our data took very few free throws, and in a small enough sample making all or none of their shots would show up as this perfect consistency. So in future research, we would choose to filter out players who took less than some small number of free throws, maybe 20-50, in order to get a better assessment of consistency. Altogether, it seems like being relatively consistent is pretty common.



Our conclusions:

- Home games vs. away games are not significantly different in terms of free throw success rates
- Free throw success rates do not seem to decide the game being won or lost
- Game playoff status does not impact free throw success rates
- Player shot success clusters around 75-80% with a slight left-hand skew