THE MATH BEHIND BASKETBALL

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INTRODUCTION

- For my final project, I wanted to do a real world application that I'm interested in and pertains to my future job.

- I decided to research and figure out the perfect way to shoot a free throw.

- Free throws are supposed to be the easiest shot in the game of basketball. The main reason for that is they are set, uncontested shots. They are commonly called 'free points' in basketball slang.

- Free throws are vital factors in every basketball game ranging from the fourth grade level all the way up to professional games. It is not uncommon for free throws to be the deciding factor in winning or losing a game.

FUN FACTS

01

WIN

Teams that take more FTs are more likely to win the game.

02

WIN

On average, the best teams have the best FT shooting %. Coincidence?

03

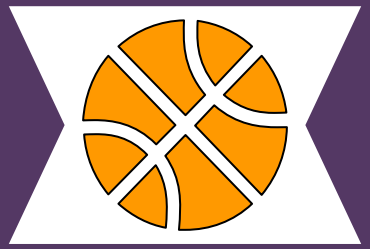
WIN

The best shooters have the best free throw percentage

04

WIN

During my junior year, I won the FT competition

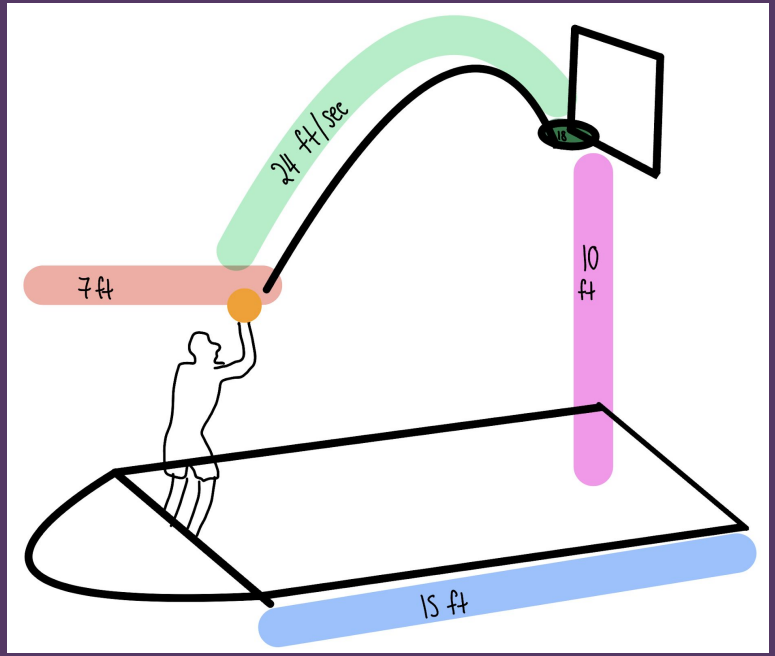


Now what?

Let’s figure out how to make some free throws

MATH!!!!!!

- Calculate the maximum height the ball reaches on its way to the basket
- Given information:
  - Height of hoop = 10 feet
  - Distance from FT line = 15 feet
  - Average initial velocity = 24 feet per second
  - Average release height = 7 feet
  - Rim = 18 inches in diameter



EQUATION

- Because we are finding the max height of ball, let us find what time the ball reaches 10 feet.
- Well, the ball reaches 10 feet twice. Once going up and once going down.
- In order to find this, we need 3 key factors
  1 - acceleration of gravity
  2 - initial vertical velocity x time = distance
  3 - release height of ball
  = $H(t) = -16t^2 + 24t + 7$

Plug it in!!!

We are going to plug in 10 for h(t)

10= -16t^2+24t+7

We need standard form! = ax^2 + bx + c

0 = -16t^2 + 24t = (-3)

Now solve for t by using the quadratic equation.

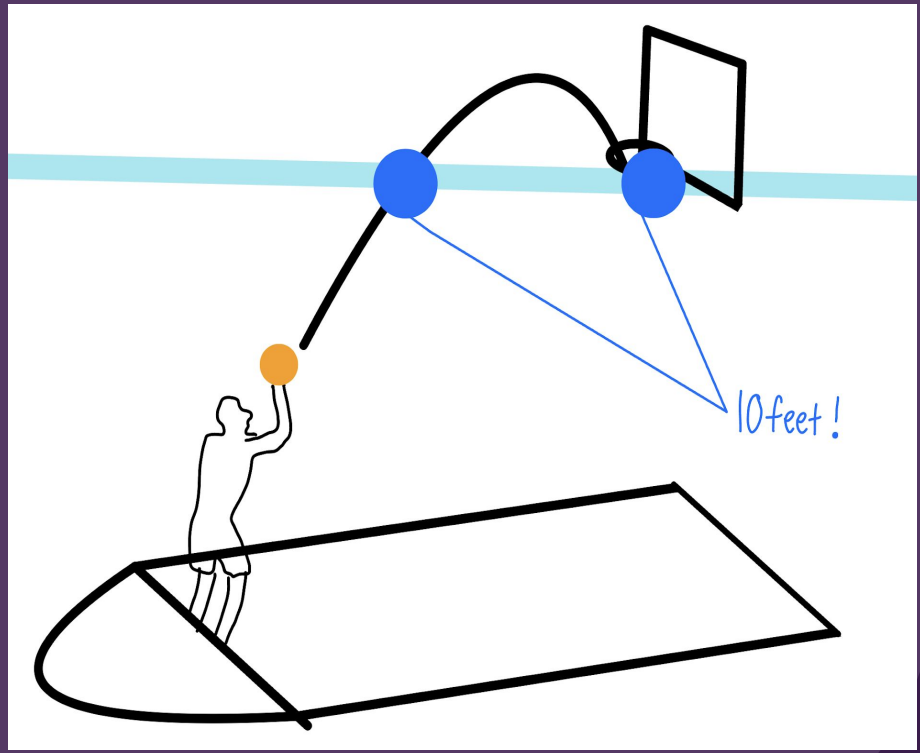
Quadratic

quad form = $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

where $a = -16$ $b = 24$ $c = -3$

$= \frac{-24 \pm \sqrt{24^2 - 4(-16)(-3)}}{32}$

$= 0.14$ or 1.36



OK BUT???

Now since we found the time where the ball reaches 10 feet, we can find the mean of where the ball hits in the middle of those two '10 foot' points.

Simple!

0.14+1.36= 1.5

1.5/2=.75 or ¾

We have now found the time when the ball is at the maximum height.

The hard part is over!

Let's plug the max time into our equation!

H(t)= when t = .75

h(t) = -16(.75) ^2 + 24(.75) + 7

= -16 (.5625) + 18 + 7

= -9 + 18 + 7

=16 !!!!!!!!! FEET

CONCLUSION

The maximum height of the ball when shooting the perfect free throw is 16 feet.

However, in order to calculate all of our maximum heights on our own individual free throws, we would change factors like

- height
- Velocity
- Release point
- Release angle

Although my hypothesis says that our release points and angles would be similar, in order to figure out how to shoot the perfect free throw, this is one of the many steps taken to get our final answer.

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Steph Curry.