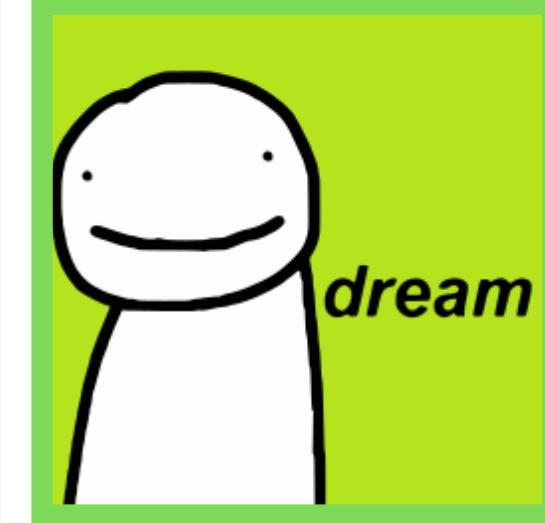
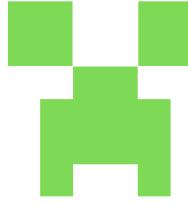


MINECRAFT & MATHS

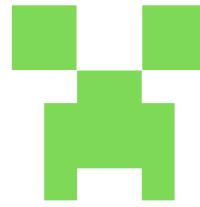
How Maths helped
discover a cheater



DREAM IS A MINECRAFT YOUTUBER WHO TRIED TO BEAT THE RECORD FOR COMPLETING MINECRAFT AS FAST AS POSSIBLE

IN HIS VIDEO HE GOT THE ITEMS HE NEEDED TO COMPLETE THE GAME (ENDER PEARLS AND BLAZE RODS) EXTREMELY QUICKLY. THIS ALLOWED HIM TO GET TO THE END OF THE GAME IN ALMOST RECORD TIME

BUT MANY BELIEVED HE WAS TOO LUCKY....

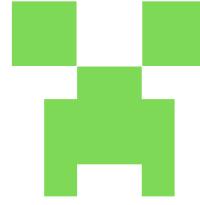


PROBABILITY

Probability is the chance of something happening

for example the chance of rolling a 6 on a die is 1 out of 6, or $1/6$. or 16.7%



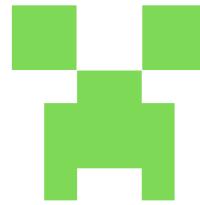


MINECRAFT

In Minecraft there are many random events

Can you name any?





MINECRAFT

In Minecraft there are many random events

**Animal types when you breed
locations of certain areas and biomes**

Mob Drops (what enemies or animals drop if you kill them)

Dispenser Blocks (drop a random item from their stored inventory)

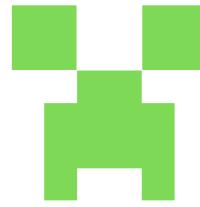
What you get from trading piglins

What you get when using an enchantment table

What you find in 'treasure' chests

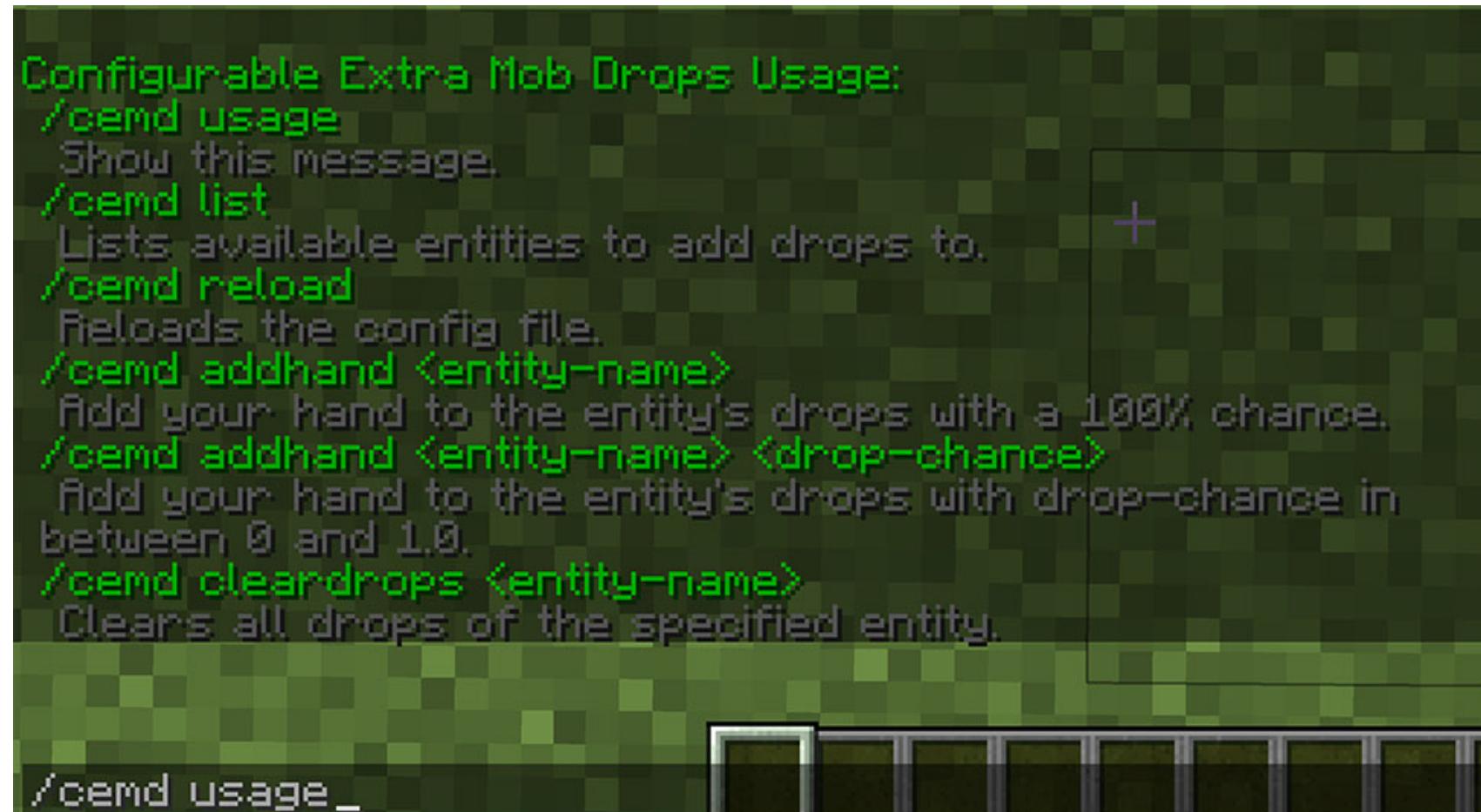
and many more....



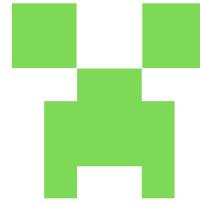


MINECRAFT

To ensure everyone gets the same experience when playing, in the minecraft code you can find the probability of something happening



```
Configurable Extra Mob Drops Usage:  
/cemd usage  
Show this message.  
/cemd list  
Lists available entities to add drops to.  
/cemd reload  
Reloads the config file.  
/cemd addhand <entity-name>  
Add your hand to the entity's drops with a 100% chance.  
/cemd addhand <entity-name> <drop-chance>  
Add your hand to the entity's drops with drop-chance in  
between 0 and 1.0.  
/cemd cleardrops <entity-name>  
Clears all drops of the specified entity.  
  
/cemd usage_
```



MINECRAFT

For example - when you chop down some leaves, the game could drop a tree sapling, some sticks, or even an apple

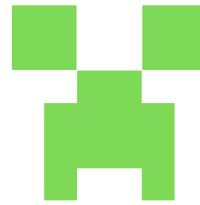
saplings $1/20$ chance

sticks $1/50$ chance

apple $1/200$ chance



This means **on average** you get one apple for every 200 leaves you chop down



MINECRAFT

We can work out how many apples we could get from chopping 1000 leaves

saplings 1/20 chance

sticks 1/50 chance

apple 1/200 chance

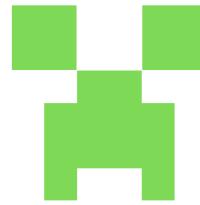


$1000 \times (\text{chance})$

$1000 \times 1/200 = 5$

5 apples roughly for 1000 leaves

How many sticks would be expected to drop?



MINECRAFT

Question 1:

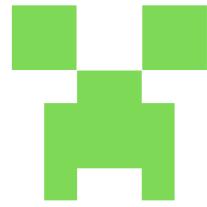
This dropper will drop a random item from its 9 full spots when activated



- a) What is the chance of you getting pink dye? (the middle one!)**

- b) what is the chance of getting two pinks in a row on the first two drops?**

hint: don't worry about the number 64 at all in this question.

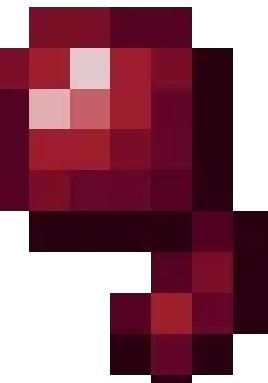


MINECRAFT

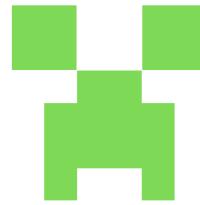
Question 2:

Spiders

chance of getting a spider eye
when you kill a spider is $1/3$



- a) how many spider eyes would you expect if you killed 12 spiders?**
- b) If you have 16 spider eyes - what is a good guess of how many spiders you could have killed?**



MINECRAFT

Question 3:

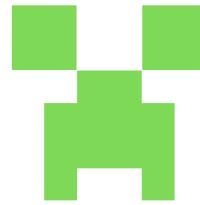
A "drowned" sometimes carries a trident -
but to get the trident is difficult

chance of drowned having a
trident - $1 / 16$

chance that he will drop his item
for you - $17/200$



- a) What is the chance of you getting a trident when you kill a "drowned"?**
- b) Convert your answer to a % (use a calculator if needed)**
- c) how many tridents would you get from 500 drowneds?**



MINECRAFT

Question 4:

Sheep can randomly spawn in four colours

chance of white = 78%

chance of black = 4.75%

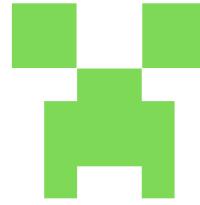
(also light grey and grey)

chance of brown = 2.85%

chance of pink(!) = 0.16%



- a) If you see 200 sheep, what colours of each would you have expected to see?**
- b) what chances are there of finding two white sheep together?**
- c) the chance of it being a baby (lamb) is 5% what are the chances of finding a pink lamb?**



MINECRAFT

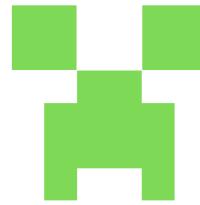
Question 5: Checking Dreams speedrun

Blazes

chance of dropping one
blaze rod = $1/2$



- a) What are the chances of three blaze rods dropped in a row?**
- b) If you killed 305 blazes - how many blaze rods would you expect**



MINECRAFT

Question 6: Checking Dreams speedrun

Piglins will trade with you if you have gold. They can give you over 15 different items. Here are some of the probabilities:

chance of enchanted book = $5/459$

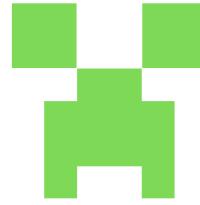
chance of ender pearls = $10/459$

chance of gravel = $40/459$

chance of string = $20/459$



- a) what is the chance of getting two ender pearls in a row?**
- b) if you traded 262 times, how many times would you trade ender pearls roughly?**
- c) if you get 2.5 (average) ender pearls each time it trades ender pearls - how many ender pearls would you expect from part (b)**



MINECRAFT

Recap

Blazes dropping rods is the same as flipping a coin and getting a heads or a tails

Now it is important to remember that probability is just a guide - if you flipped a coin 20 times, it is not guaranteed to get 10 heads and ten tails. In fact it is just as likely not to be 10H and 10T.



However - we know that it is EXTREMELY UNLIKELY to be more than 16H or more than 16T

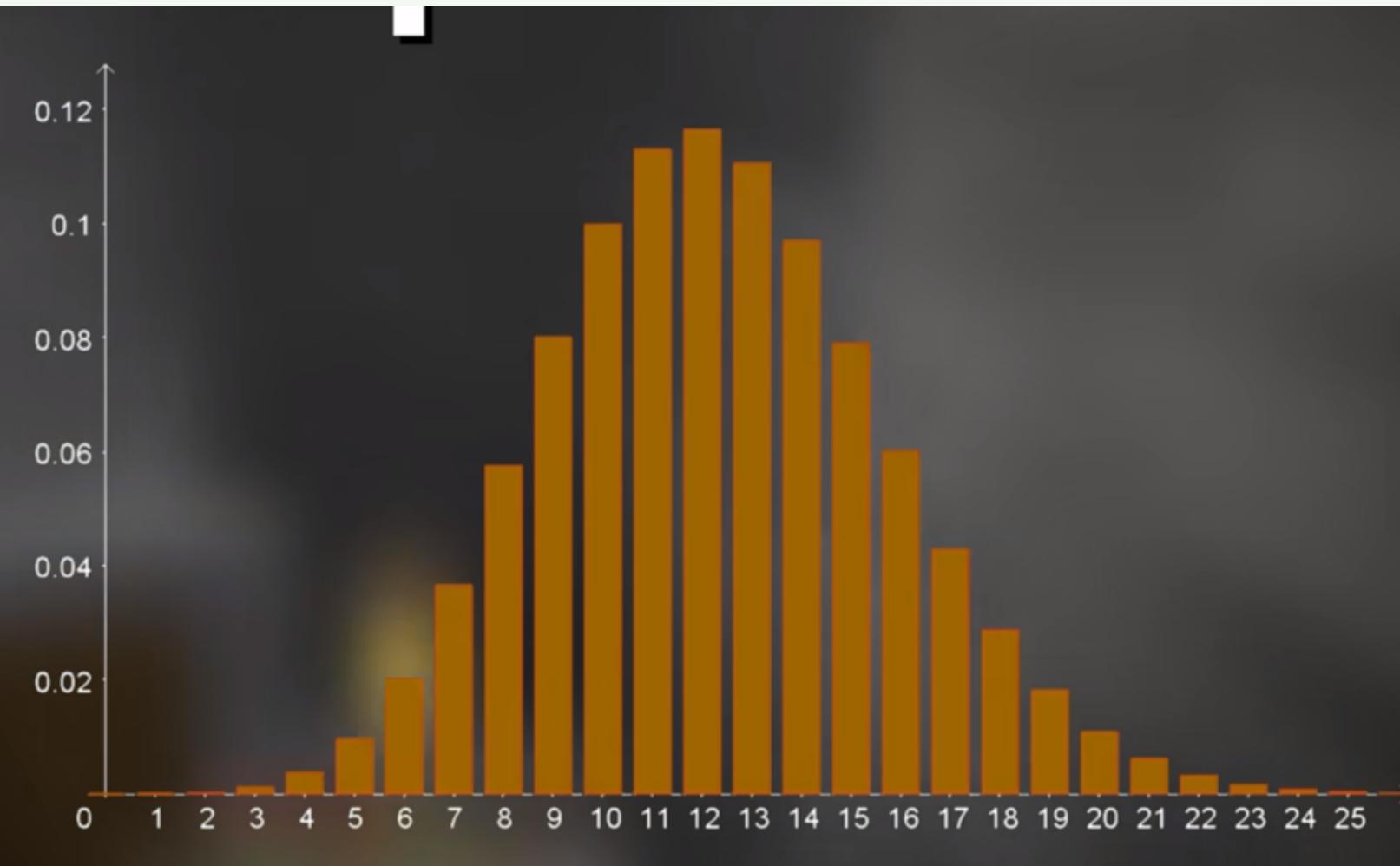
BINOMIAL DISTRIBUTION

We can use something called binomial distribution to predict the most likely amount of ender pearls to receive when trading 262 times (It's a little tricky to explain it all now)

What this shows is that you are over 99% likely to get between 1 and 25 ender pearls, and most likely to get 12 ender pearls

Dream got 42 ender pearls - the odds of this are 1/180000000000!!

Successes	% chance
0	0.0003
1	0.004
2	0.026
3	0.112
4	0.359
5	0.918
6	1.952
7	3.543
8	5.605
9	7.85
10	9.857
11	11.206
12	11.633
13	11.102
14	0.789



very lucky!

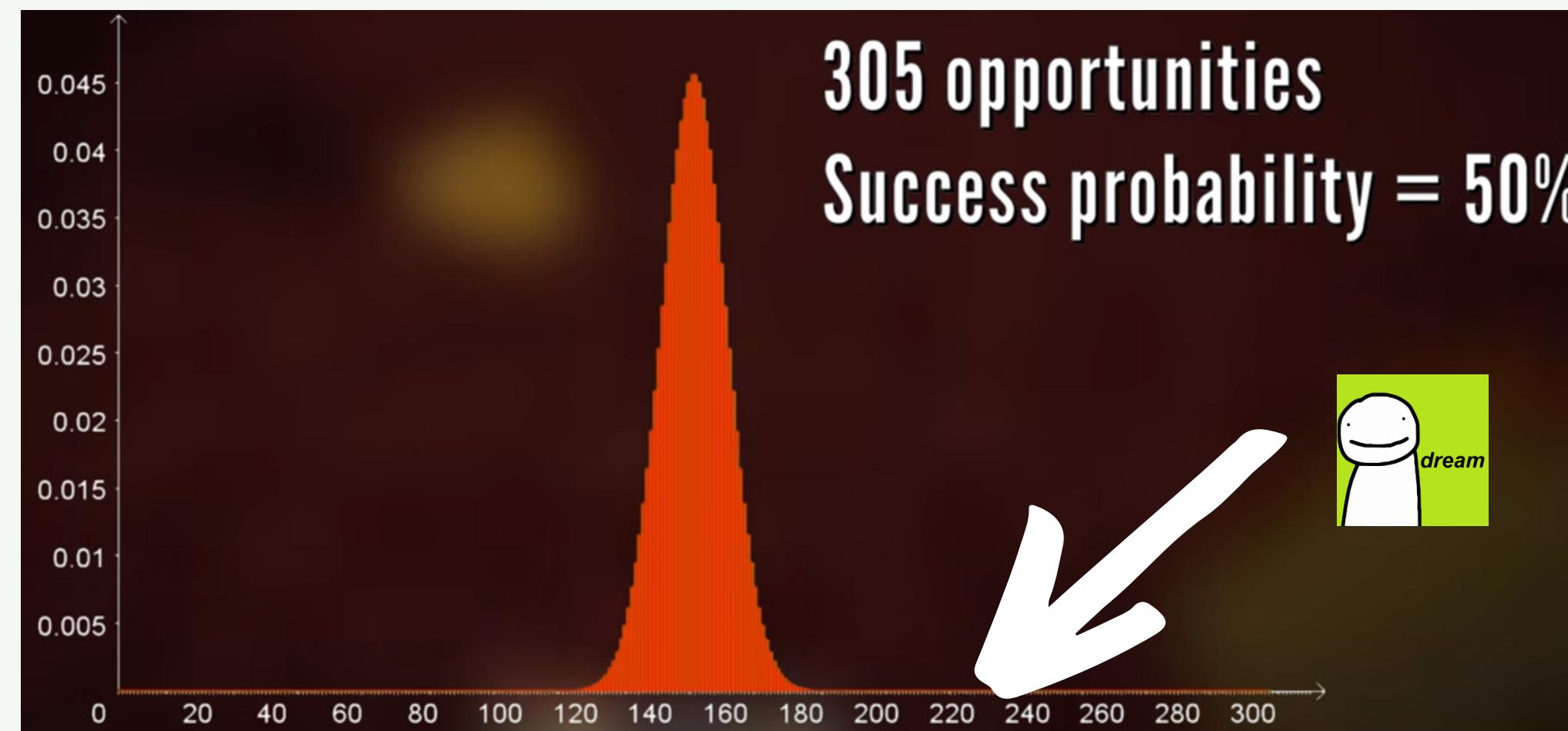


BINOMIAL DISTRIBUTION

Doing the same with blaze rods, Dream got 211 from 305 kills.

The chances of that happening are also very very small, you can see in this graph, you can mostly expect between 120 and 180.

The chances he gets 211 is $1/11000000000$



But finally...

Remember that both these happened in the same live stream - so to find the chances of both happening - we multiply them together:

$$1/180000000000 \times 1/110000000000$$

=1/200000000000000000000000000000 chance

An amazing maths teacher and vlogger Matt Parker - found that if every human played minecraft every second for the next 100 years this lucky set of events would still be unlikely to happen. No one has ever done anything remotely as lucky in any game in any history books

But finally...

Thanks to maths - Dream's record attempts were not allowed to be submitted.

Dream, who tried to prove his innocence at first by hiring an astrophysicist to explain how he got lucky, finally admitted that he didn't realise he was playing a *modded* version - one where the code had been changed in his favour.

For more watch this hilarious and engaging video by @standupMaths

