Binomial Distribution

Combinations, Probability and Distributions. Oh my!

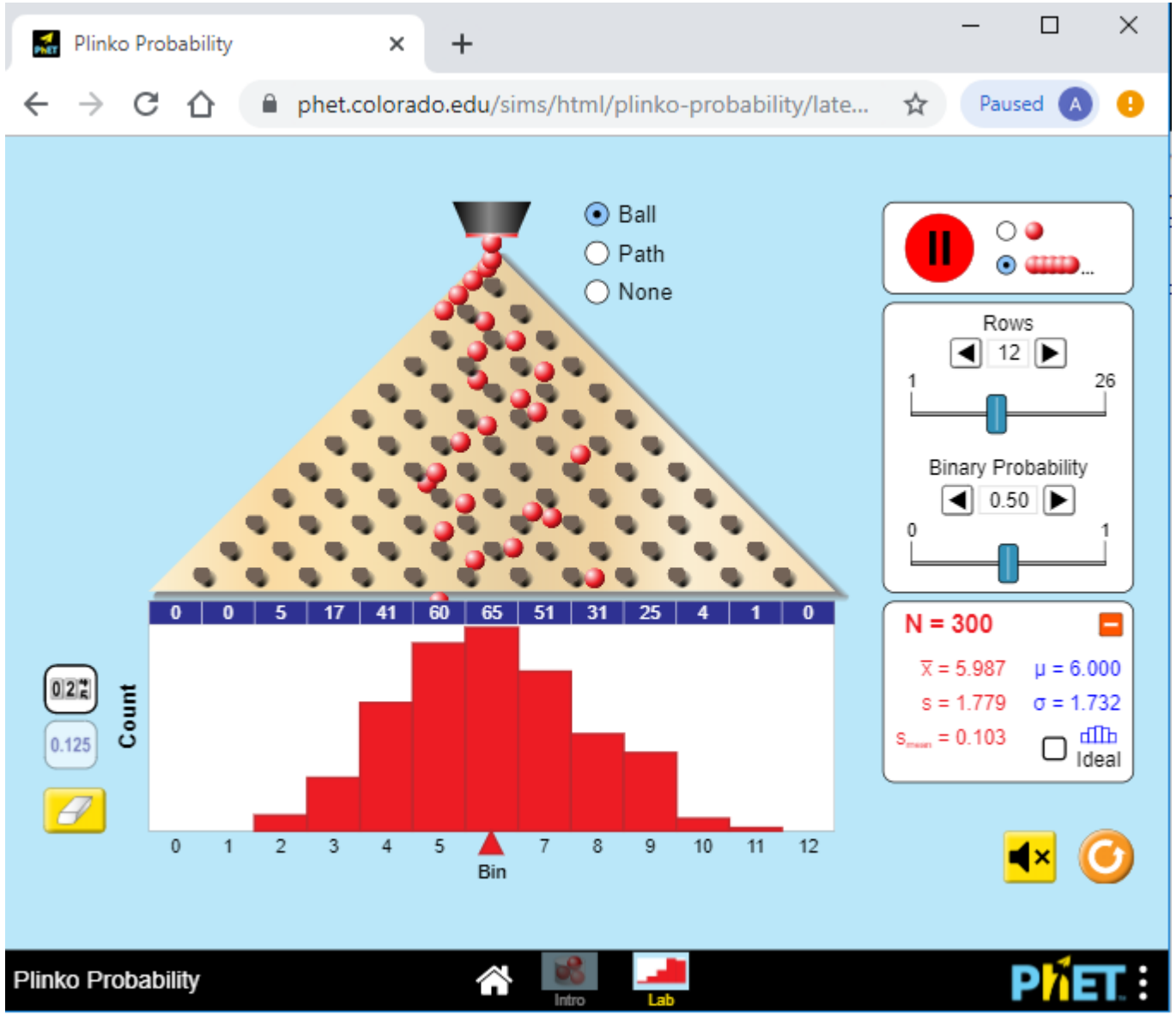
Pg 375, #8. A lottery has a $1,000,000 first prize, a $25,000 second prize and five $1,000 third prizes. A total of 2,000,000 tickets are sold. If a ticket costs $2.00 what is the expected profit per ticket?

	A	B	C	D	E	F
1	**Prize**	**First**	**Second**	**Third**	**No win**	**Sum**
2	**$**	$ 1,000,000.00	$ 25,000.00	$ 1,000.00	$ -	$ 1,026,000.00
3	**Freq**	1	1	5	1999993	2000000
4	**P(x)**	0.0000005	0.0000005	0.0000025	0.999997	1
5	**$ * P(x)**	$ 0.50	$ 0.01	$ 0.00	$ -	$ 0.52
6						
7	(b)	One Ticket	2		One Ticket	2
8		All Tickets	$ 4,000,000.00		E(x)	$ 0.52
9		Costs	$ 1,026,000.00		Profit	$ 1.49
10		Profit	$ 2,974,000.00			
11		Profit per ticket	$ 1.49			

Bernoulli Trial

- Two outcomes: success/failure; boy/girls; true/false
- Independent
- The probability of success is the same at every trial
- The trial happens a series of times

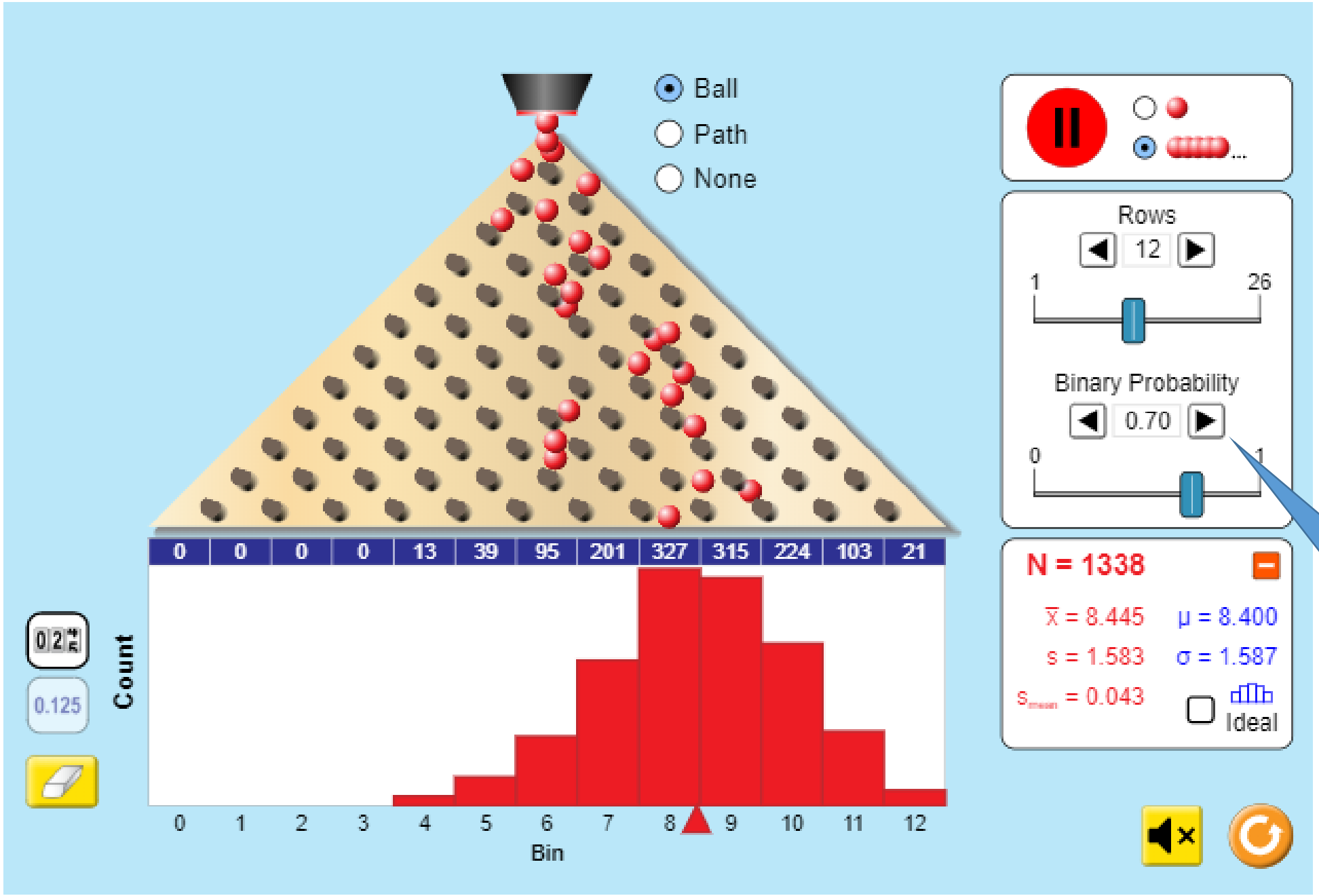
- Flipping a coin
- Rolling a six
- Opinion poll; voter that will vote “yes”
- Is the top card of a shuffled deck an ace
- Was the new born child a girl?



Bernoulli Trial

- Ball hits a peg.
- It can go right (success) or left, with a probability of 0.5 in this model.

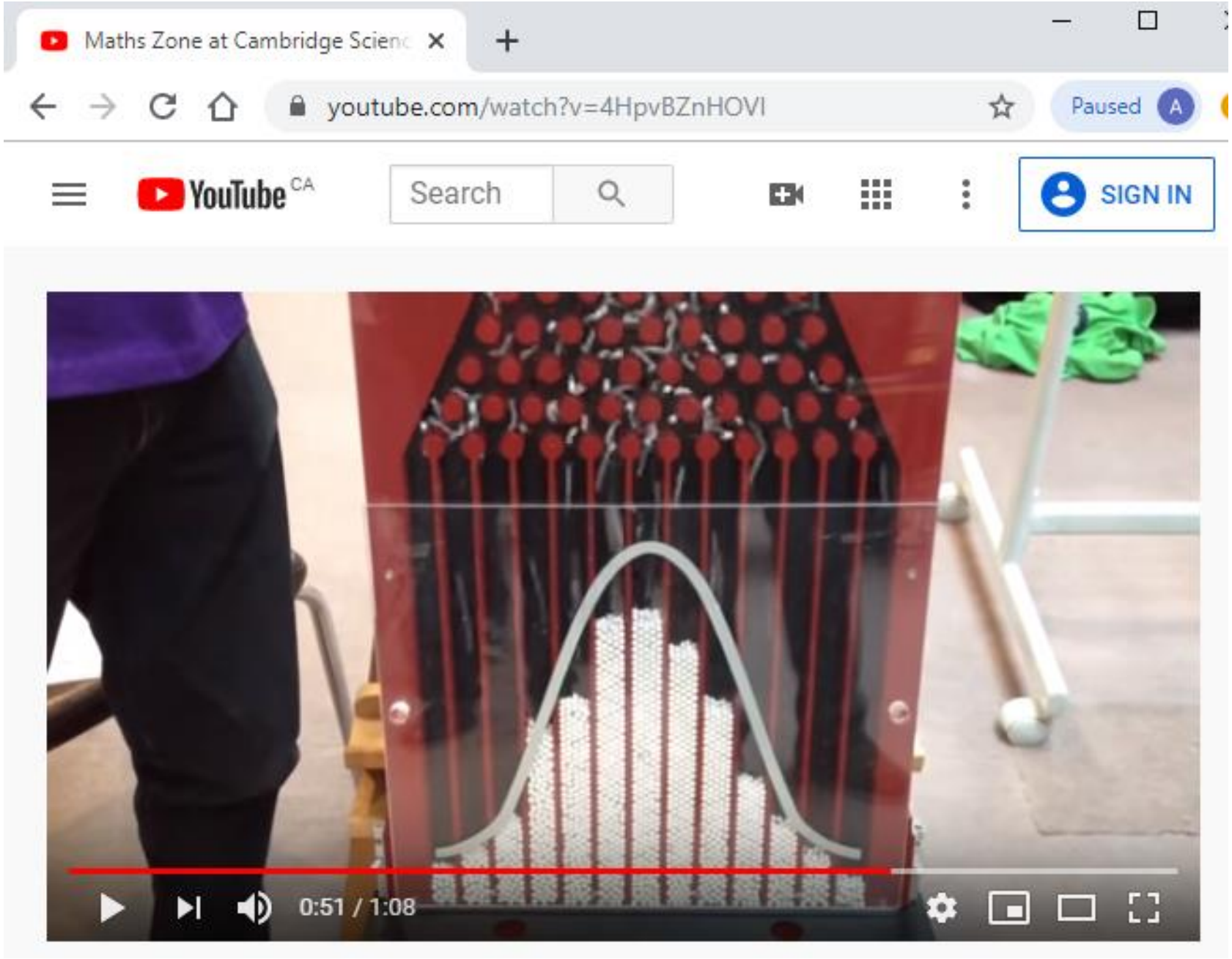
https://phet.colorado.edu/sims/html/plinko-probability/latest/plinko-probability_en.html



Experimental Probability Vs. Theoretical Probability

LLN

Also, notice the probability shift.



Genuine not simulated

https://www.youtube.com/watch?v=4HpvBZnHOVI

Probability of an Event in a Binomial Distribution

$$\mathrm{P(x)} = C(n,x)\, p^{x}\, q^{n-x}$$

n = number of trials
x = number of successes
p = prob of success
q = prob of failure

What is the Probability of flipping a coin 6 times and getting 5 heads and 1 tail?

success is flip heads
n = 6
x = 5
p = 0.5
q = 0.5

$$\mathrm{P(x=5)} = C(6,5)\, 0.5^{5}\, 0.5^{1}$$
$$= 6 \times 0.01563$$
$$= 0.094$$

Binomial Distributions

Name: . . . . . 5.6 K 

1. Write out the formula for the probability of a binomial event 9 times.

2. You are flipping a weighted coin twice. It lands on heads with a probability of 0.6.
What is the probability distribution for heads?

X~ Bin(n=2, p=0.6). Thus, q=_____

x	0 heads	1 head	2 heads
C(n,x)	C(__, __)=	C(__, __)=	C(__, __)=
p^x	___^___=	___^___=	___^___=
q^{n-x}	___^___=	___^___=	___^___=
P(x)			

6. For each question, identify the “success”, n, p and q.

	Success	n	p	q
a. You are writing a multiple choice test and have 0.9 probability of getting a question correct. There are 10 questions.				
b. The probability of getting a red light is 0.4. On your way to school there are 19 lights.				

7. Write the equation in the form: X~Bin(n=___, p=___).
Then write the formula for the probability of event x, with n, p and q filled in.

	Equation	Probability of X
a. You are writing a multiple choice test and have 0.9 probability of getting a question correct. There are 10 questions.		
b. The probability of getting a red light is 0.4. On your way to school there are 19 lights.		

$$P(x) = C(n,x) \times p^x q^{n-x}$$

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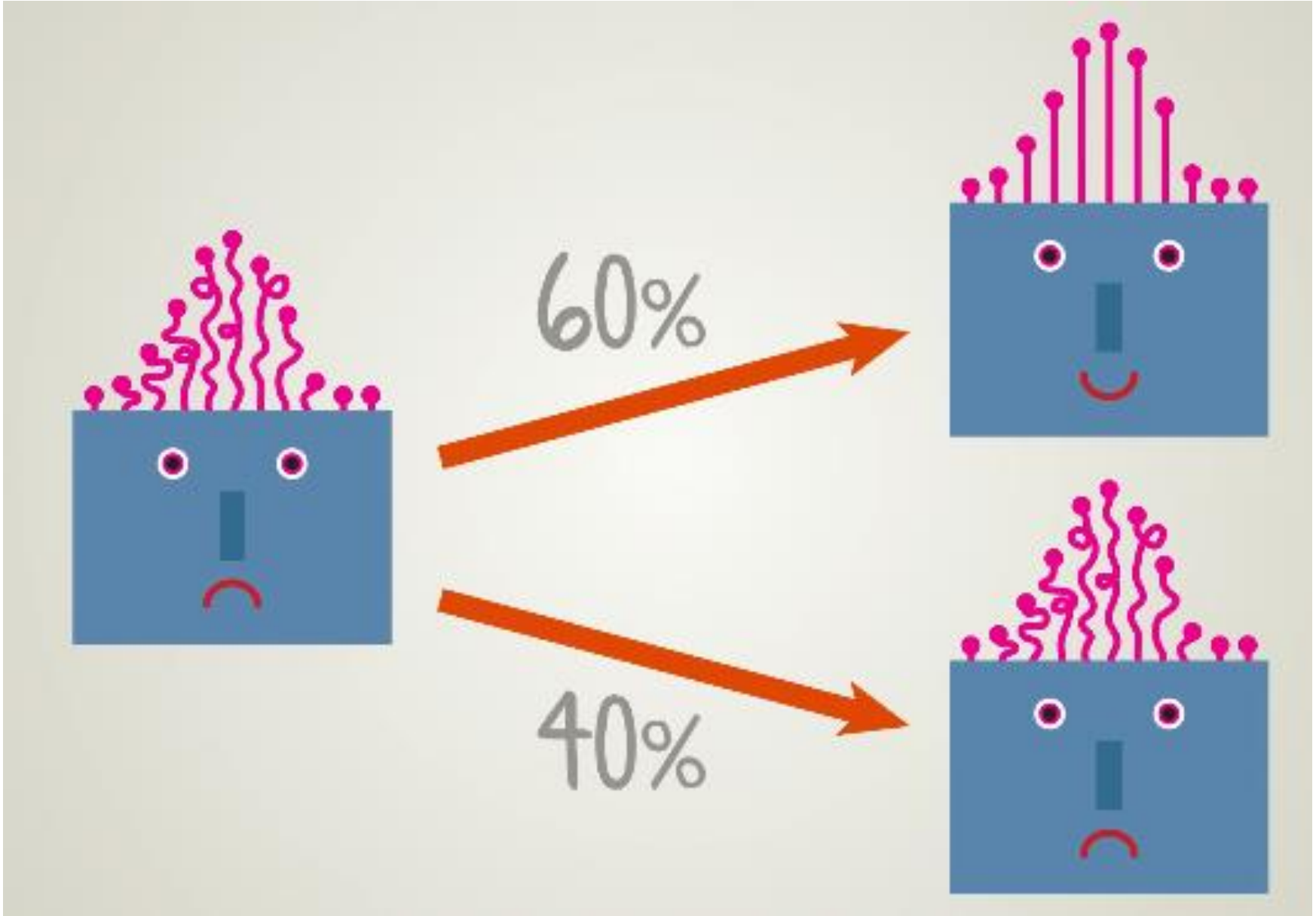
=COMBIN($F$3,B5)*($B$3^B5)*($D$3^($F$3-B5))
```

	A	B	C	D	E	F	G	H
1	Binomial Distribution							
2								
3	p	0.2	q	0.8	n	5		
4								
5	x	0	1	2	3	4	5	Sum
6	p(x)	=COMBIN	0.41	0.205	0.051	0.006	0.0003	1

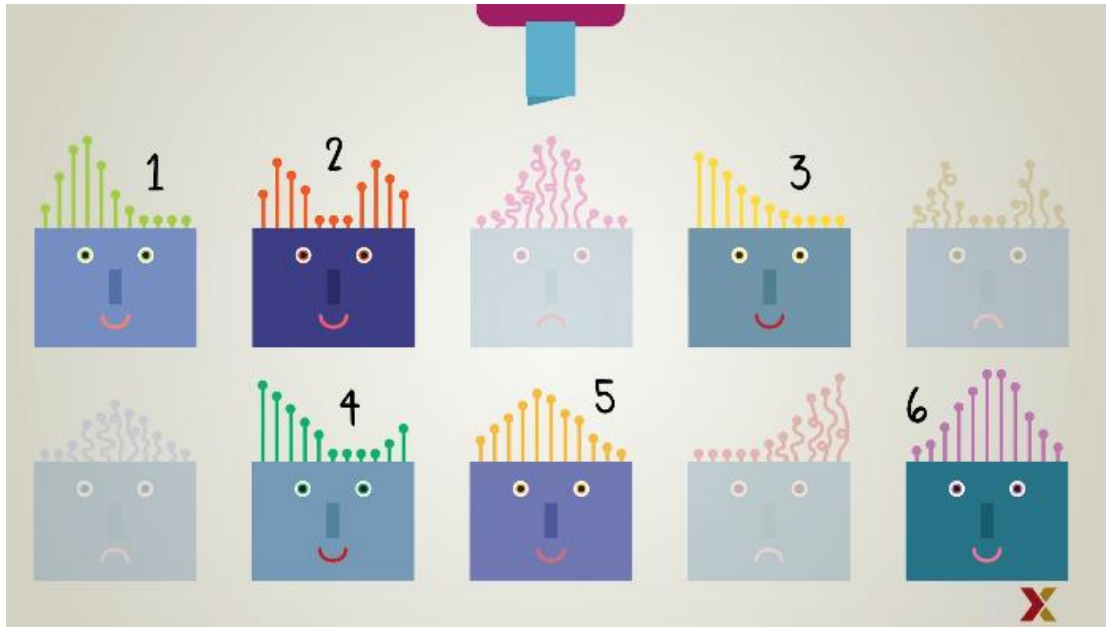
Discretetown


DISCRETOWN MEDICAL CLINIC
Breakout of hypertangliousis
4
DNN


Can only treat 10 patients per day. Limited capacity.
DNN

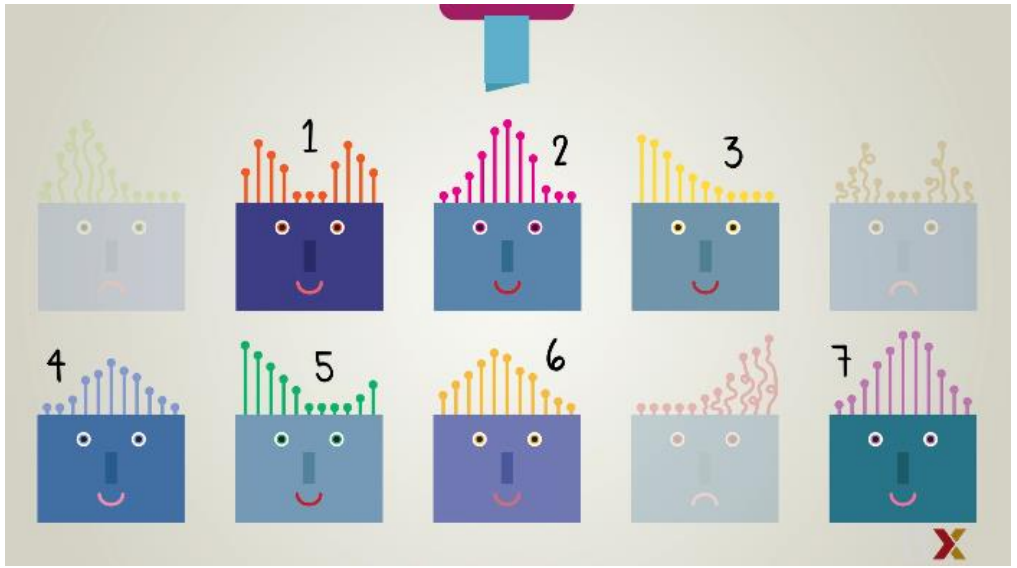


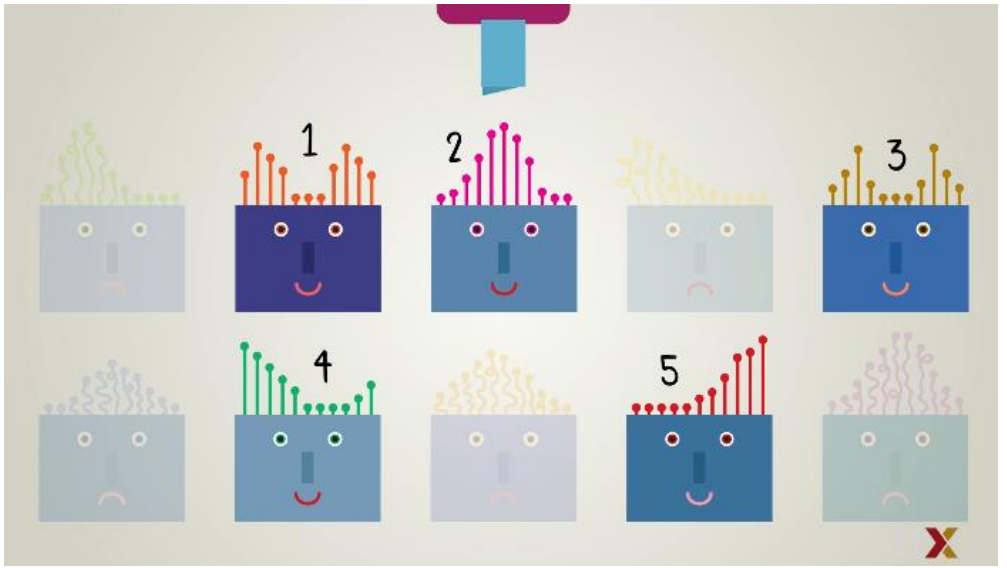
Treatment works 60% of the time

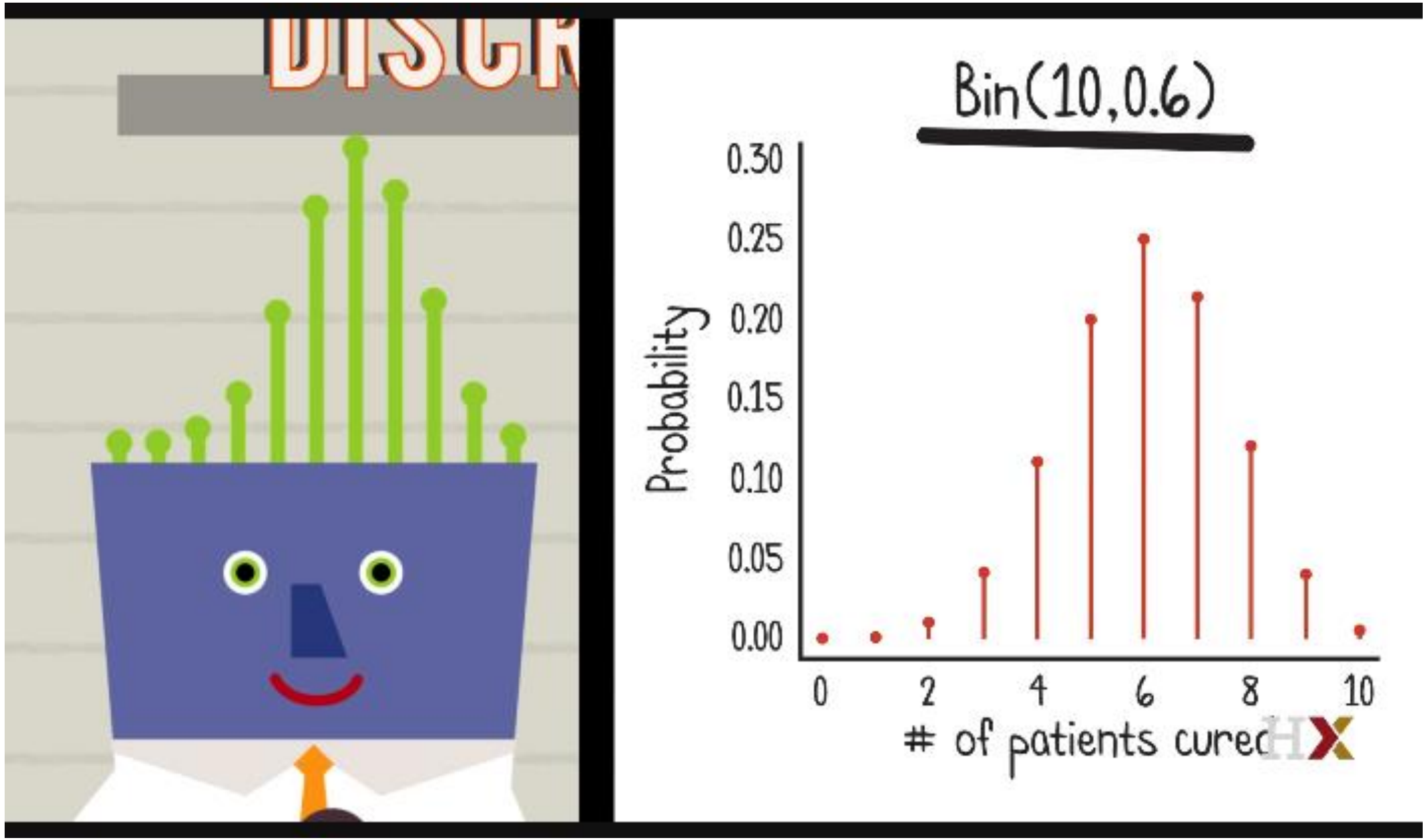


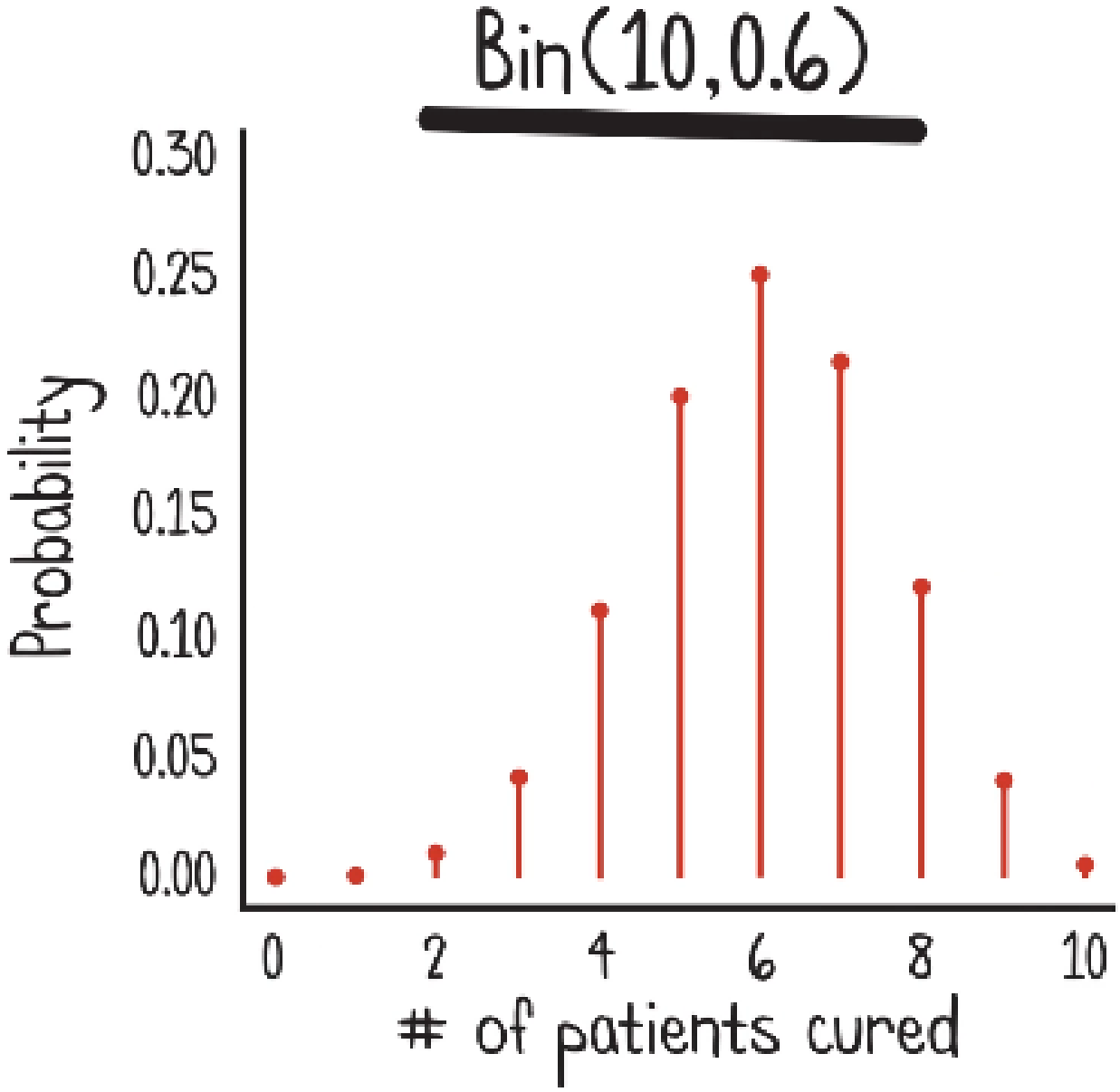
We expect to be able to cure 6 patients per day.

However, on a particular day, we could easily have more than 6 or fewer than 6.






DISCR
Bin(10,0.6)
Probability
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
2
4
6
8
10
# of patients cured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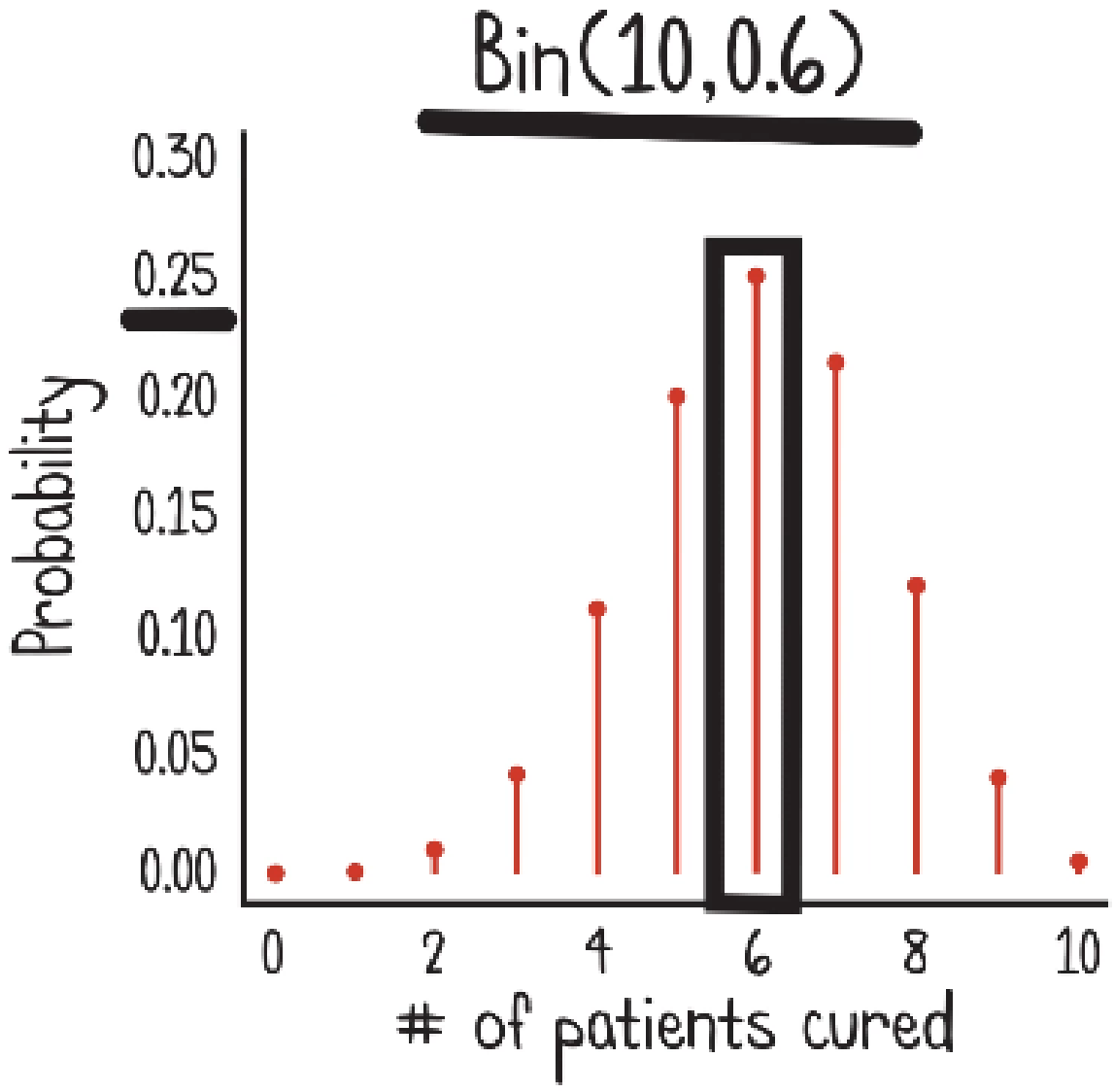
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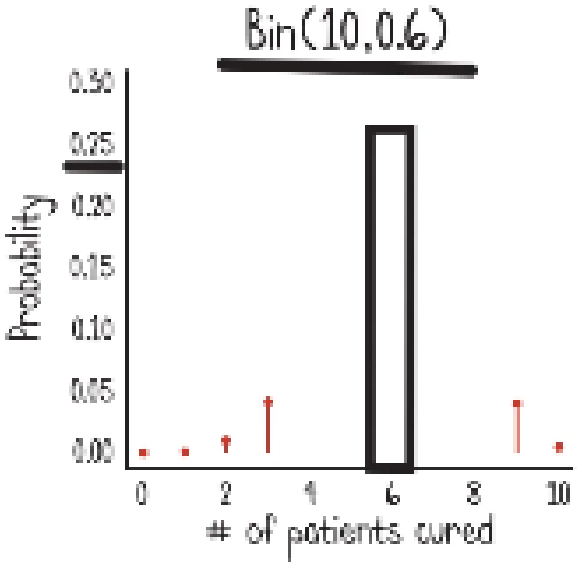
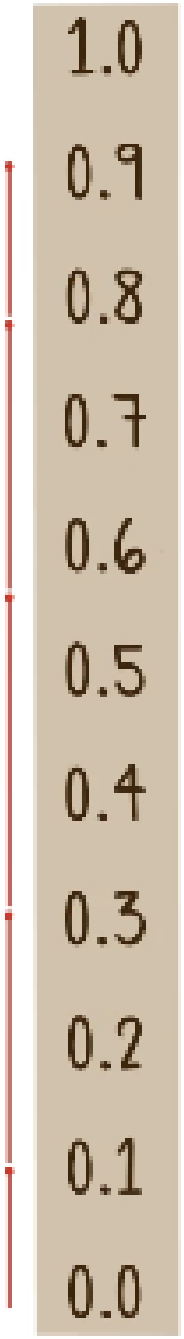
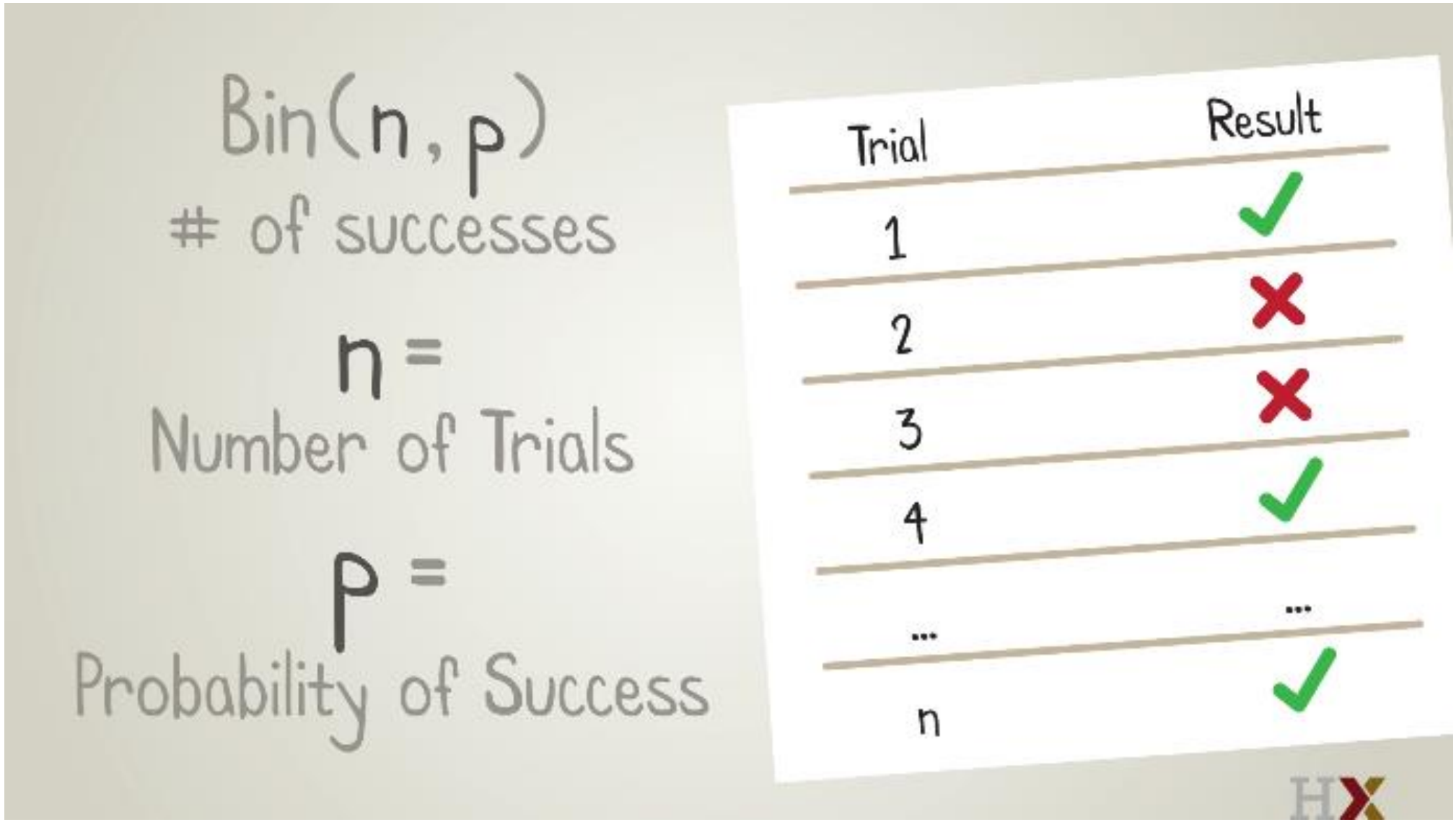




90% chance it is between 4 and 8.


Bin(n, p)
# of successes
n =
Number of Trials
p =
Probability of Success
Trial
Result
1
2
3
4
...
...
n