Turn in take home LCQ, now

1. Two presentations
2. Lesson on 6.3-Day 1B

CALCULATE and INTERPRET probabilities involving **binomial** distributions.

Lesson 6.3: Day 1B: Is it smart to foul at the end of the game?

In the 2005 Conference USA men's basketball tournament, Memphis trailed Louisville by two points. At the buzzer, Memphis's Darius Washington attempted a 3-pointer; he missed but was fouled, and went to the line for three free throws. Each made free throw is worth 1 point. Was it smart to foul?

1. What are all the possible ways the shots could fall (e.g. make-miss-miss, etc.)?

2. Darius Washington was a 72% free-throw shooter. Find the probability that Memphis will win, lose or go to overtime. When you have found the probabilities put them in the table in #3.

Win	Lose	Overtime

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Win	Lose	Overtime
3 makes (.72)(.72)(.72) = .373	0 makes and 3 misses (.28)(.28)(.28) = .022 1 make and 2 misses (.72)(.28)(.28) = .056	2 makes and 1 miss

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Win	Lose .022 + .169 = .191	Overtime
3 makes (.72)(.72)(.72) = .373	0 makes and 3 misses (.28)(.28)(.28) = .022 1 make and 2 misses (.72)(.28)(.28) × 3 ways = .056 × 3 ways = .169	2 makes and 1 miss $(.72)^2(.28)$ =

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3. Prior to watching each shot, calculate the probability that Memphis wins the game in regulation, loses the game in regulation, or sends the game into overtime.

Louisville	Memphis	Shots Remain.	Probability Memphis Win	Probability Memphis Lose	Probability Overtime
75	73	3			
75		2			
75		1			

4. Washington is a 40% 3-point shooter. Do you think Louisville was smart to foul? Why or why not?

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75		🏀			

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75	74	🏀🏀	make make $(.72)^2 = .5184$	miss miss $(.28)^2 = .0789$	make miss or miss make $2(.72)(.28) = .4032$
75	74	🏀	0	miss .28	make .72

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MEMPHIS, March 12 - LOUISVILLE 75, MEMPHIS 74

The Memphis freshman Darius Washington slumped to the court, covering his head in anguish over his two missed free throws.

Nobody -- his coach, his teammates, even the player who fouled him -- could console him.

Washington missed two of three free throws with no time left on the clock Saturday, allowing sixth-ranked Louisville to escape with a 75-74 victory and the Conference USA championship.

Blood Type

Each child of a particular set of parents has probability 0.25 of having type O blood. Suppose these parents have 5 children.

What's the probability that exactly one of the five children has type O blood?

$$P(X = 1) = P(\text{exactly 1 child with type O blood})$$

$$= \underbrace{5}_{\text{Number of ways to get 1 child out of 5 with type O blood}}\underbrace{(0.25)^1}_{\text{1 child with type O blood}}\underbrace{(0.75)^4}_{\text{4 children don't have type O blood}} = 0.3955$$

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$\binom{5}{1}$

$1+4$
$=5$

$n=3$

${}_5C_1$

$$P(X=k) = \begin{pmatrix}\text{\# ways to get} \\ k \text{ successes} \\ \text{in } n \text{ trials}\end{pmatrix}\begin{pmatrix}\text{success} \\ \text{probability}\end{pmatrix}^{k}\begin{pmatrix}\text{failure} \\ \text{probability}\end{pmatrix}^{n-k}$$

Binomial Probability Formula

Suppose that X is a binomial random variable with *n* trials and probability *p* of success on each trial. The probability of getting exactly *k* successes in *n* trials (k = 0, 1, 2, ..., *n*) is

$$P(x = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

where

$$\binom{n}{k} = \frac{n!}{k!\,(n-k)!}$$

If X has a binomial distribution with parameters n and p, then:

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

but formula for binomial coeffient is not shown.

$$_nC_k = \frac{n!}{k!(n-k)!}$$

Red Light
Green Light

Red Light-Green Light

Pedro drives the same route to work on Monday through Friday. His route includes one traffic light. According to the local traffic department, there is a 55% chance that the light will be red on a randomly selected work day. Suppose we choose 10 of Pedro's work days at random and let Y = the number of times that the light is red.

a. Explain why Y is a binomial random variable.

B I

N S

b. Find the probability that the light is red on exactly 7 days.

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$$P(Y=7) = {}_{10}C_7 \bullet (.55)^7 \bullet (.45)^3$$

$\binom{10}{7}$

total # trials ; # of Successes ; p Success ; p failure

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$$P(Y=7) = {}_{10}C_7 \bullet (.55)^7 \bullet (.45)^3 = .166$$

.17

total # trials ; # of Successes ; p Success ; p failure

Using technology

binompdf

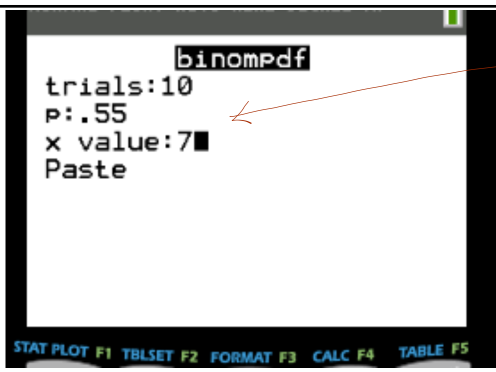
Probability

binompdf(n, p, k) computes $P(X = k)$

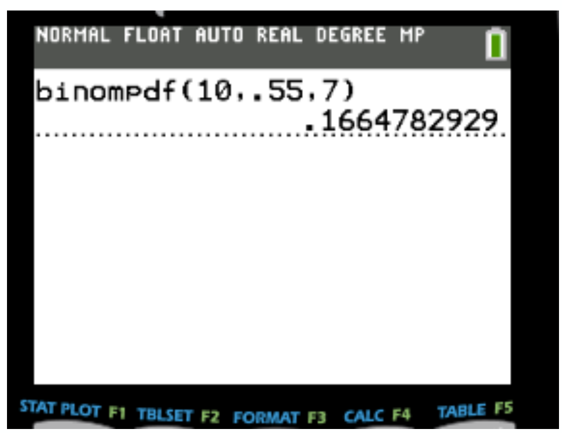
last example: $n = 10$

$p = .55$

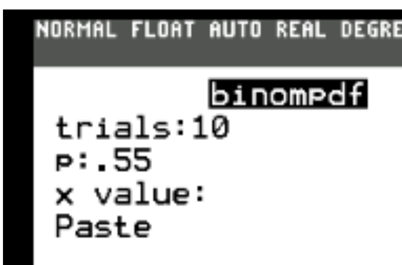
$k = 7$

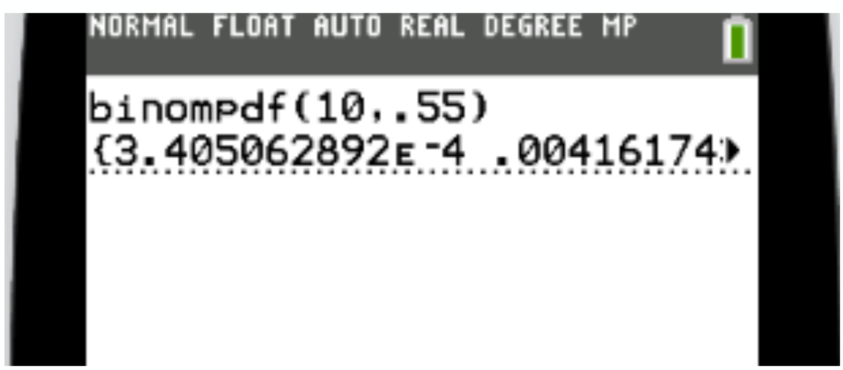


There is a way older 84's and 83's can display prompts.



Watch what happens if you leave out K
?





BLOOD TYPE
FOLLOW UP

Blood Type follow up

The preceding example tells us that each child of a particular set of parents has probability 0.25 of having type O blood. Suppose these parents have 5 children. Should the parents be surprised if more than 3 of their children have type O blood? Calculate an appropriate probability to support your answer.

$P(X > 3) = P(X=4) + P(X=5)$

0 1 2 3 4 5

$\cancel{0}$ $\cancel{1}$ $\cancel{2}$ $\cancel{3}$ 4 5

Let X = the number of children with type O blood.
X has a binomial distribution with n = 5 and p = 0.25.

show on free response

$$P(X > 3) = P(X = 4) + P(X = 5)$$
$$= \binom{5}{4}(0.25)^4(0.75)^1 + \binom{5}{4}(0.25)^4(0.75)^1$$
$$= 0.01465 + 0.00098$$
$$= 0.01563$$

Because there's only about a 1.5% probability of having more than 3 children with type O blood, the parents should definitely be surprised if this happens.

How to Find Binomial Probabilities

Step 1: state the distribution and the values of interest. Specify a binomial distribution with the number of trials *n*, success probability *p*, and the values of the variable clearly identified.

Step 2: Perform calculations—show your work! Do one of the following:
(i) Use the binomial probability formula to fi nd the desired probability; or
(ii) Use the binompdf or binomcdf command and label each of the inputs.

Be sure to answer the question that was asked.

Aussie Instant
Lottery

Aussie instant lottery

The Australian Official Lottery has scratch-off instant lottery tickets that can be purchased for $1. The probability of winning a prize is 1 in 4.

(a) Mr. Urban is feeling lucky one day and decides to purchase 100 of the scratch-off instant lottery tickets. Find the probability that fewer than 20 tickets are winners.

(b) In fact, Mr. Urban won a prize for only 19 of the tickets. Does this result give convincing evidence that the probability of winning is less than 1 in 4?

a) Let Y = the number of tickets that win a prize

Y has a binomial distribution with $n = 100$ and $p = \frac{1}{4}$

$P(Y < 20)$

$= P(Y \leq 19)$

$= P(0) + P(1) + P(2) + \ldots P(19)$

$=$ binomcdf (trials: 100 p: $\frac{1}{4}$ value: 19)

$= 0.09953$

b) If the prob. of winning is 1 in 4, there is a 0.09953 prob. that fewer than 20 of his 100 tickets win a prize. (this is Plausible)

Because it is plausible that Mr. Urban would win on 19 tickets purely by chance, we do not have convincing evidence that the prob of winning is less than 1 in 4.

See LCQ 6.1

X = Number of lawns

(b) Describe $P(X > 0)$ in words and find its value.

Is different than "interpret"

$P(X>0)$ is the probability that Dave mowed at least 1 lawn on a randomly selected day. ✓

$P(X>0) = .4 + .3 + .1 = 0.8$ ✓

(c) Express the event "mows at most one lawn" in terms of X and find its probability.

"mows at most one lawn" is the event $X \leq 1$

$P(X \leq 1) = 0.2 + .4 = 0.6$

6.3......77, 79, 80, 81, 83, 85, 89

Study pp. 402-412