

## SECTION 7.5B

## Exercises (Attach work)

In Exercises 69 to 72, explain whether the given random variable has a binomial distribution.

69. **Sowing seeds** Seed Depot advertises that 85% of its flower seeds will germinate (grow). Suppose that the company's claim is true. Judy buys a packet with 20 flower seeds from Seed Depot and plants them in her garden. Let  $X$  = the number of seeds that germinate.
70. **Long or short?** Put the names of all the students in your class in a hat. Mix them up, and draw four names without looking. Let  $Y$  = the number whose last names have more than six letters.
71. **Lefties** Exactly 10% of the students in a school are left-handed. Select students at random from the school, one at a time, until you find one who is left-handed. Let  $V$  = the number of students chosen.
72. **Lefties** Exactly 10% of the students in a school are left-handed. Select 15 students at random from the school and define  $W$  = the number who are left-handed.

75. **Blood types** In the United States, 44% of adults have type O blood. Suppose we choose 7 U.S. adults at random. Let  $X$  = the number who have type O blood. Use the binomial probability formula to find  $P(X = 4)$ . Interpret this result in context.

76. **Rhubarb** Suppose you purchase a bundle of 10 bare-root rhubarb plants. The sales clerk tells you that on average you can expect 5% of the plants to die before producing any rhubarb. Assume that the bundle is a random sample of plants. Let  $Y$  = the number of plants that die before producing any rhubarb. Use the binomial probability formula to find  $P(Y = 1)$ . Interpret this result in context.

78. **Rhubarb** Refer to Exercise 76. Would you be surprised if 3 or more of the plants in the bundle die before producing any rhubarb? Calculate an appropriate probability to support your answer.

80. **More lefties** Refer to Exercise 72.

(a) Find the probability that exactly 3 students in the sample are left-handed. Show your work.

INTERPRET RESULT IN CONTEXT.

→ FIND THE FOLLOWING PROBABILITIES. SHOW WORK. FIND %'S. NO CONTEXT.

(b)  $P(W=0)$

(c)  $P(W=1)$

(d)  $P(W=2)$

(e)  $P(W \geq 4)$

81. **Random digit dialing** When an opinion poll calls residential telephone numbers at random, only 20% of the calls reach a live person. You watch the random digit dialing machine make 15 calls. Let  $X$  = the number of calls that reach a live person.
- (a) Find and interpret  $\mu_X$ .
- (b) Find and interpret  $\sigma_X$ .

83. **Random digit dialing** Refer to Exercise 81. Let  $Y$  = the number of calls that *don't* reach a live person.
- (a) Find the mean of  $Y$ . How is it related to the mean of  $X$ ? Explain why this makes sense.
- (b) Find the standard deviation of  $Y$ . How is it related to the standard deviation of  $X$ ? Explain why this makes sense.

## BINOMIAL ACTIVITY

• There are 2 handouts

① BINOMIAL ACTIVITY (with the scenario of 10 light bulbs)

② GRAPH TEMPLATE -  
You will be assigned

1 of the scenarios. You are to make a presentation Quality Graph + be prepared to explain to class

7.5 B HW ANSWERS

(69) BINARY (Y) GERMINATE VS. NOT  
I INDEPENDENT - SEEMS REASONABLE EACH SEED IS INDEPENDENT  
N NUMBER FIXED (Y) 20 SEEDS  $N=20$   
S SUCCESS (Y) FIXED PROBABILITY SUCCESS  $p=.85$

Random Variable  $X = \#$  of seeds that germinate

ASSUMING INDEPENDENCE HOLDS, THIS IS  
A BINOMIAL SETTING AND  $X$  HAS A  
BINOMIAL DISTRIBUTION  $B(20, .85)$

(70) B  
I (NO) SINCE SAMPLING WITHOUT REPLACEMENT & A SMALL  
N  $\checkmark$   $N=4$  NUMBER  $N=4$  SAMPLE. WE CAN NOT  
S ASSUME INDEPENDENCE

THIS IS NOT A BINOMIAL DISTRIBUTION

(71) B (Y) - LEFT vs RIGHT  
I (Y) - Selected randomly  
N (NO) THERE IS NOT FIXED NUMBER OF TRIALS  
S

THIS IS NOT A BINOMIAL DISTRIBUTION

(72) B: yes - left vs right  
I: yes - randomly selected  
N: yes - fixed number of trials  $n=15$   
S: yes - the probability of lefty remains constant  
from one student to the next.  $p=.10$

RANDOM VARIABLE  $W =$  the number who are lefty's

This is a binomial setting and  $W$  has a  
binomial distribution  $B(15, .10)$

75

$X = \#$  who have type O blood

$p = .44$  (probability type O)

$q = .56$

$N = 7$

Define distribution  $B(7, .44)$

$$\begin{aligned}
 P(X=4) &= \binom{N}{K} p^K (1-p)^{N-K} \\
 &= \binom{7}{4} (.44)^4 (.56)^3 \\
 &= 35 (.44)^4 (.56)^3
 \end{aligned}$$

$$P(X=4) = .23037$$

# of combinations

$$\begin{aligned}
 \binom{7}{4} &= \binom{n}{k} = \frac{N!}{K!(N-K)!} \\
 &= \frac{7!}{4!3!} = \frac{7 \cdot 6 \cdot 5}{3 \cdot 2}
 \end{aligned}$$

$$\binom{7}{4} = 35$$

$$\text{CALC } 7 nCr 4 = 35$$

(math) (PRB) (3)

Yellow - make sure to write these assumptions

Know how to do these calculations

USING CALC

→ CAN NOW USE  
 CALC TO FIND Probability  
 $P(X=4) = \text{binom pdf}(7, .44, 4)$   
 $P(X=4) = .23037$

\*\*\* MUST WRITE ANSWER IN CONTEXT:

THERE is about a 23% chance that exactly 4 of the 7 chosen have blood type O

76

$Y = \#$  OF PLANTS THAT DIE BEFORE PRODUCING ANY RHUBARB

$$n = 10$$

$$B(10, .05)$$

$$p = .05$$

$$q = .95$$

$$P(Y=1) = \text{binompdf}(10, .05, 1) = .3151$$

THERE IS ABOUT A 32% CHANCE THAT EXACTLY 1 OF THE 10 RHUBARB PLANTS WILL DIE BEFORE PRODUCING RHUBARB.

78

$$P(Y \geq 3) = 1 - P(Y \leq 2) = 1 - \text{binomcdf}(10, .05, 2) = 1 - .9885 = .0115$$

THERE IS ABOUT A 1% CHANCE THAT 3 OR MORE OF THE PLANTS WILL DIE BEFORE PRODUCING RHUBARB. THIS WOULD BE SURPRISING IF IT OCCURRED

80

$W = \#$  OF LEFTY'S

$$B(15, .10)$$

$$(a) P(W=3) = \text{binompdf}(15, .1, 3) = .1285$$

THERE IS ABOUT A 13% CHANCE THAT EXACTLY 3 OF THE 15 STUDENTS WERE LEFT HANDED

$$(b) P(W=0) = \text{binompdf}(15, .1, 0) = .2059\%$$

$$(c) P(W=1) = \text{binompdf}(15, .1, 1) = .3432\%$$

$$(d) P(W=2) = \text{binompdf}(15, .1, 2) = .2669\%$$

$$(e) P(W \geq 4) = 1 - P(W \leq 3) = 1 - .9444 = .0555 \quad (5.56\%)$$

DOUBLE CHECKED:

$$P(W=0) + P(W=1) + P(W=2) + P(W=3) =$$

$$.2059 + .3432 + .2669 + .1285 = .9445$$

Checks 😊

81) Check assumptions for a binomial distribution

B = BINARY REACH OR DON'T REACH

I = INDEPENDENT YES, RANDOMLY SELECTED

N = FIXED # of trials ( $n=15$ )

S = Fixed probability for success ( $p=.2$ )

Assumptions - were met

$X$  = the number of calls that reach a live person

$$\boxed{B(15, .2)}$$

CONTEXT:

a)  $\mu_x = np = 15(.2) = 3$  You would expect to reach a live person in an average of 3 phone calls when making 15 calls

$$\begin{aligned} \text{b) } \sigma_x &= \sqrt{np(1-p)} = \\ &= \sqrt{15(.2)(.8)} \\ &= 1.549 \end{aligned}$$

CONTEXT:

IN ACTUAL PRACTICE, YOU WOULD EXPECT THE NUMBER OF LIVE PERSONS YOU REACH TO VARY FROM 3 per 15 calls by 1.55 calls, on average

83)  $Y$  = # OF CALLS THAT YOU DO NOT REACH A LIVE PERSON  $\boxed{B(15, .8)}$

$$\text{a) } \mu_y = np = 15(.8) = 12$$

Notice  $\mu_x = 3$  and  $12 + 3 = 15$ . In other words, if we reach an average of 3 LIVE PERSONS IN OUR 15 CALLS, Then we must not reach a LIVE PERSON IN AN AVERAGE OF 12 calls.

$$\text{b) } \sigma_y = \sqrt{np(1-p)} = \sqrt{npq} = \sqrt{15(.8)(.2)} = 1.549$$

$\sigma_x$  and  $\sigma_y$  are the same thing as we have just switch the definitions of  $p$  and  $1-p$ .