6.3 HW ANSWERS

(69) BINARY (Y) GERMINATE VS. NOT
INDEPENDENT – SEEMS REASONABLE EACH SEED IS INDEPENDENT
NUMBER FIXED (Y) 20 SEEDS $N=20$
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 Sample, WE CAN NOT ASSUME INDEPENDENCE
N ✓ $N=4$
S

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 $B(15,.10)$

6.3

75

X = # who have type O blood

$p = .44$ (probability type O)

$q = .56$

$N = 7$

Define distribution $B(\overset{n}{7}, \overset{p}{.44})$

$P(X=4) = \binom{N}{K} p^K (1-p)^{N-K}$

$= \binom{7}{4} (.44)^4 (.56)^3$

$= 35 \; (.44)^4 (.56)^3$

$\boxed{P(X=4) = .23037}$

Yellow – make sure to write these assumptions

Know how to do these calculations

\# of COMBINATIONS

$\binom{7}{4} = \binom{n}{k} = \frac{N!}{K!(N-K)!}$

$= \frac{7!}{\cancel{4!}\,3!} = \frac{7 \cdot 6 \cdot 5}{3 \cdot 2} =$

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

CALC $7 \; {}_nC_r \; 4 = 35$

(math) (PRB) (3)

CAN NOW USE CALC TO FIND Probability

$P(X=4) = \text{binompdf}(7, .44, 4)$

$\boxed{P(X=4) = .23037}$

USING CALC

**** MUST WRITE ANSWER IN CONTEXT:

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

$\boxed{6.3}$

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) $P(W=0) = \text{binompdf}(15, .1, 0) = 20.59\%$

(c) $P(W=1) = \text{binompdf}(15, .1, 1) = 34.32\%$

(d) $P(W=2) = \text{binompdf}(15, .1, 2) = 26.69\%$

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

DOUBLE CHECKED:
$P(W=0) + P(W=1) + P(W=2) + P(W=3) =$
$.2059 + .3432 + .2669 + .1285 = .9445$ Checks ☺

6.3

(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

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

(a) $\mu_X = np = 15(.2) = 3$

CONTEXT: You would expect to reach a live person in an average of 3 phone calls when making 15 calls

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

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 $\boxed{B(15, .8)}$

(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.

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

σ_X and σ_Y are the same thing as we have just switch the definitions of p and $1-p$.

6.3 (CONT)

(85) X = # that operate for an hour WITHOUT FAILURE

(a) ✓BINARY - Success - operates for an hour successfull
Failure - does NOT

✓INDEPENDENT - THE OPERATION OF ONE ENGINE DOES NOT AFFECT ANOTHER ENGINE

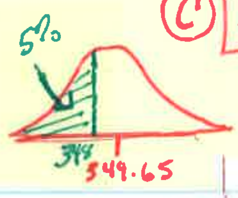
✓ Number - fixed number of trials $n = 350$

✓ Success - fixed probability of succes $p = .999$

(b) $B(350, .999)$ $\mu_x = np = (350)(.999) = \boxed{349.65}$

$\sigma_x = \sqrt{npq} = \sqrt{350(.999)(.001)} = .5913$

IF WE WERE TO TEST 350 ENGINES OVER AND OVER AGAIN, WE WOULD EXPECT THAT, ON AVERAGE, 349.65 of them would OPERATE FOR 1 HOUR WITHOUT FAILURE. IN INDIVIDUAL TESTS, WE WOULD EXPECT TO FIND THE NUMBER OF ENGINES THAT OPERATE FOR AN HOUR WITHOUT FAILURE TO VARY FROM 349.65 by an average of .591.



(c) $\boxed{B(350, .999)}$; $P(x \leq 348) = \text{binomcdf}(350, .999, 348) = .0485$

THERE IS ABOUT A 5% CHANCE THAT 348 machines will OPERATE CORRECTLY. YOU WOULD EXPECT MACHINES TO BE MORE RELIABLE THAN THIS.

(87) Population = N = 76 Rule: $n \leq \frac{1}{10} N$

Sample = n = 10 $10 \leq \frac{1}{10}(76) = 7.6$ X

We can not use the binomial distribution here because the sample size (10) is more than 10% of the population (76).

(88) Population = N = 100 Rule: $n \leq \frac{1}{10} N$

Sample = n = 7 $7 \leq \frac{1}{10}(100) = 10$ ✓

We can use the binomial distribution in this case because the sample size (7) is less than 10% of the population.

6.3 GEO HW

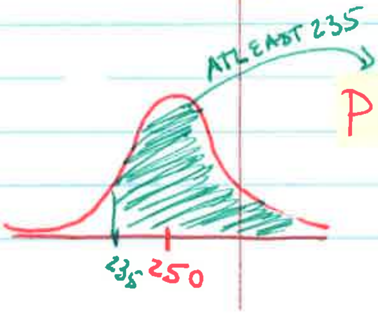
91 X = # IN SAMPLE WHO VISIT AN AUCTION SITE AT LEAST once a month

(a) X is a random binomial variable because there is a fixed number of trials ($N=500$); a fixed probability of success ($p=.5$) and participants are randomly selected (so independent)

(b) Normal conditions are met: $Np = 500(.5) = 250 > 10$ $Nq = 500(.5) = 250 > 10$

(c) $\boxed{N(250, 11.18)}$ $\mu_X = np = 500(.5) = 250$

$\sigma_X = \sqrt{npq} = \sqrt{500(1/2)(1/2)} = \sqrt{125} = 11.18$



$P(X \geq 235)$ = normalcdf(235, E99, 250, 11.18) = .9102

THERE IS ABOUT A 91% CHANCE THAT 235 surveyed males visit an auction site once a month

95 (a) This is NOT A GEOMETRIC SETTING (b/c NUMBER)

✓ BINARY – Success: GET A CARD YOU DO NOT HAVE
FAILURE: GET A CARD YOU DO HAVE

✓ INDEPENDENT – WE ASSUME CARDS ARE PUT IN BOXES RANDOMLY

NUMBER – WE ARE NOT COUNTING TO THE 1ST SUCCESS

(b) This is a Geometric Setting $\boxed{G(.259)}$

✓ BINARY – SUCCESS – WINS FAILURE – Does NOT WIN $

✓ INDEPENDENT – RANDOMLY SELECTED 20 NUMBERS

✓ NUMBER – COUNT THE NUMBER OF GAMES TILL SHE WINS

✓ SUCCESS – FIXED probability = .259

96 (a) This NO GEOMETRIC SETTING BECAUSE THE TRIALS ARE NOT INDEPENDENT, WE ARE NOT REPLACING THE PREVIOUS CARD BACK

(b) THIS A GEOMETRIC SETTING $\boxed{G(.1)}$

BINARY – SUCCESS – GET A BULLS EYE FAILURE – DOES NOT

INDEPENDENT – DIFFERENT SHOTS SHOULD BE INDEPENDENT OF EACH OTHER

NUMBER – REPEAT TRIALS UNTIL THE 1ST BULLS EYE

SUCCESS – FIXED Probability $p = .1$

97. (a) X = # OF PULLS TO GET MOWER STARTED

$\boxed{G(.2)}$

$P(X=3) = (.8)^2(.2) = .128$ or geometpdf(.2, 3)

There is about a 13% chance the mower starts on the 3RD TRY

(b) $P(X>10) = 1 - \text{geometcdf}(.2, 10) = .1074$

99. X = # of spins until Marti WINS $\boxed{G(1/38)}$

(a) $E(X) = \mu_X = 1/p = \frac{1}{1/38} = 38$

WE EXPECT MARTI TO SPIN 38 times, on average, to WIN.

(b) $P(X \le 3) = \text{geometcdf}(1/38, 3) = .0768$

ALTHOUGH THIS IS NOT AN UNUSUAL OCCURANCE, IT HAPPENS ABOUT 8% OF THE TIME, SO IT IS NOT COMPLETELY SURPRISING.