STA 247
Probability with Computer Applications

Professor K. H. Wong

Week 4

Tentative Schedule for This Week

This Week...

- Take up a couple binomial distribution problems
- Guided learning activity - JIGSAW
- Problem solving worksheet - Complete by Friday!
- Friday: Regroup, discuss worksheet problems
- Friday: Worksheet competition
- Participate as a group for a chance to win one of three exciting prizes!

Binomial Distⁿ Problems

→ n # of trials are fixed
→ each trial is indep. & identical
→ Prob. of success "p" is fixed.

4.50: Each day a large animal clinic schedules 10 horses to be tested for a common respiratory disease. The cost of each test is $80. The probability that a horse having the disease is 0.1. If the horse has the disease, treatment costs $500.

a) What is the probability that at least one horse will be diagnosed with the disease on a randomly selected day?

Let D = # of horses that are diseased
$n = 10$ horses
"success" = horse is diseased
$p = 0.10$

$D \sim Bin(10, 0.10)$

$P(D \geq 1) = P(D=1) + P(D=2) + \dots + P(D=10)$

$= 1 - P(D<1)$

$= 1 - P(D=0)$

$= 1 - \binom{10}{0} \times (0.1)^0 (0.9)^{10}$

$= 65.13\%$

Why isn't it just $(0.1)^0$?
B/C it's
P(No diseased horses AND 10 healthy horses)

b) What is the expected daily revenue that the clinic earns from testing horses for the disease and treating those that are sick?

① $E(D) = n \times p = 10 \times 0.1 = 1$ On average, 1 horse is diseased on any given day.

② Let R = revenue $= 10 \times \$80 + \$500 D$ ⇒ is another RV

$E(R) = E[800 + 500D]$ $E[a+bX] = a + bE(X)$

$= 800 + 500\, E(D)$

$= 800 + 500$

$= \$1{,}300$

JIGSAW Activity

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STA 247 Week 4 – Activity Sheet   Name: ________________________________ Topic letter: _______

geometric and negative binomial relies on a series of independent bernoulli distribution
while hypergeometric relies on dependent trials

	Page	Distribution Name	Example with Solution	PMF + explain	E(X)	V(X)
A	p. 137-138 p. 140-141 p. 144 *You do not need to go over the derivations of E(X) & V(X)*	Geometric	- 100 failures before first success - Prob of success $= p$. $P(X=100) = (1-p)^{100}\, p$ $X \to$ # of trials before 1st success, $X \sim Geo(p)$	$P(X=x) = (1-p)^x\, p$ $\downarrow$ first x trials are failures	$\frac{1-p}{p}$	$\frac{1-p}{p^2}$
B	p. 144-146 p. 150	Negative Binomial	# of trials it takes to reach r successes. $\rightarrow$ e.g. Make cars, see how likely it is to make 100 car parts before you get 5 defects.	r = # of successes X = # of failures $\Rightarrow$ RV $P(X=x) = \binom{x+r-1}{r-1} p^r (1-p)^x$ Ex Blue Jay's Game we win 3 games by the 5th game. _ _ _ _ W $r=3 \quad x=2$ $\binom{3+2-1}{3-1} p^3 (1-p)^2$ when r=1, its genometric distribution	$\frac{r(1-p)}{p}$ similar to E(x) = np for binomial	$\frac{r(1-p)}{p^2}$
C	p. 162 (first 2 paragraphs) p. 163 starting from P(X=x) p. 164 (example only) p. 165, 167	Hypergeometric	like a Binomial except trials are DEPENDENT $\rightarrow$ No replacement $\rightarrow$ sample size from a small pop^n. which is most likely the case in real world situations Ex 8 females, 5 males want a committee of 4 people. X = # of F $P(X=2) = \frac{\binom{8}{2}\binom{5}{2}}{\binom{13}{4}}$	1. $\nearrow$ N population K | N-K X = # of items of a particular characteristic Sample of n $P(X=x) = \frac{\binom{K}{x}\binom{N-K}{n-x}}{\binom{N}{n}}$	$\frac{n \cdot K}{N}$	$n \cdot \frac{K}{N}\left(\frac{N-K}{N}\right)\boxed{\left(\frac{N-n}{N-1}\right)}$

correction factor for dependent samples

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On geometric notes : $(0.98)^{\cdots}(0.02)$

↑ Typo, should be (0.02), not (0.2)

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7. For homework this week: Complete the problem set posted on Blackboard by Friday! It's your ticket into the game.

Suggested Practice Problems

DUE FRIDAY: Complete problem set on Blackboard to the best of your abilities

p. 150: 4.65, 4.67, 4.70,4.72, 4.74, 4.83
p. 167: 4.109, 4.112, 4.118, 4.119, 4.121