

AP Statistics – 6.3C	Name:
Goal: Understand Sampling without replacement	Date:

I. Example 1: (page 394) *Hiring Discrimination*

Work this problem out and then you should be able to do the next problem on your own.

- Check Conditions $X = \text{THE NUMBER OF FEMALE PILOTS SELECTED TO BE CAPTAIN.}$

Population: 15 MALES AND 10 FEMALES

Sample: 3 MALES AND 5 FEMALES

B - FEMALE, NOT FEMALE

I - Sampling without replacement, therefore NOT INDEPENDENT

N - Fixed Trials. $n = 8$

S - NOT FIXED PROBABILITY OF SELECTING A FEMALE CAPTAIN.

$$P(\text{1st pick}) = \frac{10}{25} = .4$$

$P(\text{2nd Pick FEMALE})$ will be less than .4

- What is the given Binomial probability? $P(X=5) \binom{8}{5} (.4)^5 (.6)^3 = \boxed{0.124}$
- What is the correct probability (this is based on the laws of probability)? $P(X=5) = \boxed{0.106}$
- What % of the population is being sampled? $\% \text{ POP} = \frac{8}{25} = 32\%$
 $n = 8 \quad N = 25$
- Are you surprised these 2 probabilities are off?

NO. We have a small sample (8) AND the sample is 32% of the population. Therefore we can not use a binomial distribution (FYI, we would need to use a hypergeometric distribution – which is beyond the scope of AP Stats)

II. **Example 2:** *Dead Batteries*

Almost everyone has one—a drawer that holds miscellaneous batteries of all sizes. Suppose that your drawer contains 8 AAA batteries but only 6 of them are good. You need to choose 4 for your graphing calculator. If you randomly select 4 batteries, what is the probability that all 4 of the batteries you choose will work?

Problem: Explain why the answer isn't $P(X=4) = \binom{4}{4}(0.75)^4(0.25)^0 = 0.3164$.

- Check Conditions $X = \text{THE NUMBER OF GOOD BATTERIES}$

B - Battery is Good or BAD

I - (No) Sampling without replacement

N - Fixed Trials $n=4$

S - (No) NOT A Fixed probability

$P(\text{1st pick is Good}) = \frac{6}{8}$

Prob 2ND Pick is Good is out of 7 batteries

THIS IS NOT A BINOMIAL DISTRIBUTION

- The actual probability is 0.2143. Using the laws of probability, how would calculate this probability?

$$P(X=4) = P(\text{all 4 Good}) = \frac{6}{8} \cdot \frac{5}{7} \cdot \frac{4}{6} \cdot \frac{3}{5} = 0.21428$$

$$P = \frac{6}{8}$$

- What % of the population is being sampled? $\% \text{ Pop} = \frac{4}{8} = 50\%$

$$n=4 \quad N=8$$

III. **When can you Sample WITHOUT Replacement?**

- Hint: See page 394. What is the "10% condition"?

We can ignore the lack of independence,

when sampling without replacement,

WHEN THE SAMPLE IS LESS THAN 10% OF

THE POPULATION. THIS WORKS BECAUSE THE

Probability for success will be very close

(AKA "P" will be ROUGHLY fixed)

"10% Condition" -

$$n \leq 0.1N$$

or

$$10 \cdot n \leq N$$

$n = \text{sample size}$

$N = \text{population size}$