Day #1: **10.1 Comparing Two Proportions**

Read 602-608

What is meant by "the sampling distribution of the difference between two proportions"?

It describes possible values of $\hat{p}_1 - \hat{p}_2$ + how often they occur, where $\hat{p}_1$ and $\hat{p}_2$ are proportions of successes from 2 independent random samples.

What are the shape, center, and spread of the sampling distribution of $\hat{p}_1 - \hat{p}_2$? Are there any conditions that need to be met?

Shape- when n_1p_1, $n_1(1-p_1)$, n_2p_2, $n_2(1-p_2)$ are all atleast 10 then sampling distributions of $\hat{p}_1 - \hat{p}_2$ is approx. normal

Center - mean of sampling distribution is $p_1 - p_2$ (difference in sample proportion is an unbiased estimator of difference of population proportions)

Spread- std. deviation of sampling distribution of $\hat{p}_1 - \hat{p}_2 =$

$$\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$ as long as 10% condition applies

Alternate Example: *Who does more homework? Part 2*

Suppose that two counselors at School 1, Michelle and Julie, independently take a random sample of 100 students from their school and record the proportion of students who did their homework last night. When they are finished, they find that the difference in their proportions, $\hat{p}_M - \hat{p}_J$, is 0.08. They are surprised to get a difference this big, considering that they were sampling from the same population.

(a) Describe the shape, center, and spread of the sampling distribution of $\hat{p}_M - \hat{p}_J$.

(b) Find the probability of getting two proportions that are at least 0.08 apart.

(c) Should the counselors have been surprised to get a difference this big? Explain.

Read 608-611

What is the standard error of $\hat{p}_1 - \hat{p}_2$? How is this different than the standard deviation of $\hat{p}_1 - \hat{p}_2$?

* when we use the estimated std. deviation ($\hat{p}_1$ and $\hat{p}_2$ instead of population parameters p_1 and p_2)

What is the formula for a two-sample z interval for $p_1 - p_2$? Is this on the formula sheet?

$$(\hat{p}_1 - \hat{p}_2) \pm z^* \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

What are the conditions for calculating a two-sample z interval for $p_1 - p_2$? How are these different than the conditions for a one-sample z interval for p?

Random - Both samples must be random OR n_1, n_2 in a randomized exper.

differences: must check both samples

Normal - $n_1\hat{p}_1$, $n_1(1-\hat{p}_1)$, $n_2\hat{p}_2$, $n_2(1-\hat{p}_2)$ all atleast 10

Independent - samples themselves indep. & groups indep of each other. & when sampling w/o replacement 10% condition must be met.

Is it OK to use your calculator for the Do step? Are there any drawbacks?

STAT

↓

Tests

↓

B: 2-PropZInt

Alternate Example: *Presidential approval*

Many news organizations conduct polls asking adults in the United States if they approve of the job the president is doing. How did President Obama's approval rating change from August 2009 to September 2010? According to a CNN poll of 1024 randomly selected U.S. adults on September 1–2, 2010, 50% approved of Obama's job performance. A CNN poll of 1010 randomly selected U.S. adults on August 28–30, 2009, showed that 53% approved of Obama's job performance.

(a) Explain why we should use a confidence interval to estimate the change in Obama's approval rating rather than just saying that his approval rating went down 3 percentage points.

(b) Use the results of these polls to construct and interpret a 90% confidence interval for the change in Obama's approval rating among all U.S. adults.

(c) Based on your interval, is there convincing evidence that Obama's job approval rating has changed?

HW #1: page 621 (1-13 odd)

<u>Day #2</u>: 10.1 Significance Tests for a Difference in Proportions

Read 611-615

What is the pooled (combined) sample proportion? Why do we pool the sample proportions?

Recalculate Sample proportion
Using Both Samples → more data / larger Sample Better

What is the test statistic for a two-sample *z* test for a difference in proportions? Is this on the formula sheet? What does the test statistic measure?

where
$\hat{p}_c$ = pooled prop. (combined Samples)

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - 0}{\sqrt{\hat{p}_c(1-\hat{p}_c)/n_1 + \hat{p}_c(1-\hat{p}_c)/n_2}}$$

p_0

What are the conditions for conducting a two-sample *z* test for a difference in proportions?

Same as 2 Prop Z int.
Plus check pooled

Calculator OR 2 Prop Z-test p. 619

Alternate Example: *Hearing loss*
Are teenagers going deaf? In a study of 3000 randomly selected teenagers in 1988–1994, 15% showed some hearing loss. In a similar study of 1800 teenagers in 2005–2006, 19.5% showed some hearing loss. (These data are reported in *Arizona Daily Star*, August 18, 2010.)
(a) Do these data give convincing evidence that the proportion of all teens with hearing loss has increased?

(b) Between the two studies, Apple introduced the iPod. If the results of the test are statistically significant, can we blame iPods for the increased hearing loss in teenagers?

HW #2: page 623 (15, 17, 19)

<u>Day #3</u>: 10.1 Inference for Experiments, 10.2 Comparing Two Means

Read 615-619

What mistake do students often make when defining parameters in experiments? How can you avoid it?

Can you use your calculator for the Do step? Are there any drawbacks?

Alternate Example: *Cash for quitters*
In an effort to reduce health care costs, General Motors sponsored a study to help employees stop smoking. In the study, half of the subjects were randomly assigned to receive up to $750 for quitting smoking for a year while the other half were simply encouraged to use traditional methods to stop smoking. None of the 878 volunteers knew that there was a financial incentive when they signed up. At the end of one year, 15% of those in the financial rewards group had quit smoking while only 5% in the traditional group had quit smoking. Do the results of this study give convincing evidence that a financial incentive helps people quit smoking? (These data are reported in *Arizona Daily Star,* February 11, 2009.)

Read 627-632

What are the shape, center, and spread of the sampling distribution of $\bar{x}_1 - \bar{x}_2$? Are there any conditions that need to be met?

Shape – if pop. distr ~ normal then so is sampling distr.
else check $\bar{x}_1 - \bar{x}_2$ is approx. normal → if $n_1 \geq 30$ and $n_2 \geq 30$

Center – $\mu_1 - \mu_2$ (diff. of sample means is an unbiased estimator)

Spread – std. dev. of $\bar{x}_1 - \bar{x}_2$ sampling distr. is $\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

Alternate Example: *Potato chips*

A potato chip manufacturer buys potatoes from two different suppliers, Riderwood Farms and Camberley, Inc. The weights of potatoes from Riderwood Farms are approximately Normally distributed with a mean of 175 grams and a standard deviation of 25 grams. The weights of potatoes from Camberley are approximately Normally distributed with a mean of 180 grams and a standard deviation of 30 grams. When shipments arrive at the factory, inspectors randomly select a sample of 20 potatoes from each shipment and weigh them. They are surprised when the average weight of the potatoes in the sample from Riderwood Farms $\bar{x}_r$ is higher than the average weight of the potatoes in the sample from Camberley $\bar{x}_c$.

(a) Describe the shape, center, and spread of the sampling distribution of $\bar{x}_c - \bar{x}_r$.

(b) Interpret the standard deviation of the sampling distribution of $\bar{x}_c - \bar{x}_r$.

(c) Find the probability that the mean weight of the Riderwood sample is larger than the mean weight of the Camberley sample. Should the inspectors have been surprised?

HW #3 page 624 (21, 23, 29-32), page 652 (35, 37), page 657 (57)

Day #4: **10.2 Inference for a Difference of Two Means**

std. error not on formula sheet

Read 633-634

What is the standard error of $\bar{x}_1 - \bar{x}_2$? Is this on the formula sheet?

when SD of population is not known we estimate using sample std. dev.

What is the formula for the two-sample t statistic? Is this on the formula sheet? What does it measure?

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

What distribution does the two sample t statistic have? Why is this a t statistic rather than a z statistic? How do you calculate the degrees of freedom?

approx t-distribution

* use technology
or
* use df = smaller of $n_1 - 1$ or $n_2 - 1$

estimating std. dev. using sample data

Read 634-637

What is the formula for the two-sample t interval for $\mu_1 - \mu_2$? What are the conditions for this interval to be valid? Is this formula on the formula sheet?

$$(\bar{x}_1 - \bar{x}_2) \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Random - (same - check Both samples)

Normal - Both populations are normal or Both samples/group sizes are large ($n_1 \geq 30$, $n_2 \geq 30$)

Indep - Both samples indiv. indep + of eachother + if sampling w/o replacement then 10% condition will apply!

Is it OK to use your calculator for the Do step? Are there any drawbacks?

* Always say "NO" to pooling when doing inference for means

Alternate Example: *Plastic grocery bags*

Do plastic bags from Target or plastic bags from Bashas hold more weight? A group of AP Statistics students decided to investigate by filling a random sample of 5 bags from each store with common grocery items until the bags ripped. Then they weighed the contents of items in each bag to determine its capacity. Here are their results, in grams:

Target:	12,572	13,999	11,215	15,447	10,896
Bashas:	9552	10,896	6983	8767	9972

(a) Construct and interpret a 99% confidence interval for the difference in mean capacity of plastic grocery bags from Target and Bashas.

(b) Does your interval provide convincing evidence that there is a difference in the mean capacity between the two stores?

Read 638-643

What are the conditions for conducting a two-sample t test for $\mu_1 - \mu_2$?

Alternate Example: *The stronger picker-upper?*

In commercials for Bounty paper towels, the manufacturer claims that they are the "quicker picker-upper." But are they also the stronger picker upper? Two AP Statistics students, Wesley and Maverick, decided to find out. They selected a random sample of 30 Bounty paper towels and a random sample of 30 generic paper towels and measured their strength when wet. To do this, they uniformly soaked each paper towel with 4 ounces of water, held two opposite edges of the paper towel, and counted how many quarters each paper towel could hold until ripping, alternating brands. Here are their results:

Bounty:	106, 111, 106, 120, 103, 112, 115, 125, 116, 120, 126, 125, 116, 117, 114
	118, 126, 120, 115, 116, 121, 113, 111, 128, 124, 125, 127, 123, 115, 114
Generic:	77, 103, 89, 79, 88, 86, 100, 90, 81, 84, 84, 96, 87, 79, 90
	86, 88, 81, 91, 94, 90, 89, 85, 83, 89, 84, 90, 100, 94, 87

(a) Display these distributions using parallel boxplots and briefly compare these distributions. Based only on the boxplots, discuss whether or not you think the mean for Bounty is significantly higher than the mean for generic.

(b) Use a significance test to determine if there is convincing evidence that wet Bounty paper towels can hold more weight, on average, than wet generic paper towels.

(c) Interpret the P-value from (b) in the context of this question.

HW #4 page 652 (39, 41, 43, 51, 53)

Day #5: **10.2 Using *t* Procedures Wisely**

Read 644-648

When doing two-sample *t* procedures, should we pool the data to estimate a common standard deviation? Is there any benefit? Are there any risks?

Should you use two-sample *t* procedures with paired data? Why not? How can you know which procedure to use?

Alternate Example: *Testing with distractions*
Suppose you are designing an experiment to determine if students perform better on tests when there are no distractions, such as a teacher talking on the phone. You have access to two classrooms and 30 volunteers who are willing to participate in your experiment.
(a) Design an experiment so that a two-sample *t* test would be the appropriate inference method.
(b) Design an experiment so that a paired *t* test would be the appropriate inference method.
(c) Which experimental design is better? Explain.

HW #5: page 658 (59-64, 65, 67-70)

Day #6: **Review Chapter 10**
HW #6: **Chapter 10 Review Exercises**