8-2 Inferences about Two Means: Independent and Large Samples

Two Samples: Independent

The sample values selected from one population are not related or somehow paired with the sample values selected from the other population.

If the values in one sample are related to the values in the other sample, the samples are dependent. Such samples are often referred to as matched pairs or paired samples.

Mar 9-3:22 PM

Hypothesis Tests

1. The two samples are *independent.*
2. The two sample sizes are *large*. That is, $n_1 > 30$ and $n_2 > 30$.
3. Both samples are *simple random samples.*

Test Statistic for Two Means:

*Group 1 is either assigned or the one mentioned first.

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

σ_1 and σ_2 : If σ_1 and σ_2 are not known, use s_1 and s_2 in their places. provided that both samples are large.

Critical values: Based on the significance level α, find critical values by using the procedures introduced in Section 7-2.

A-2

P-value: Use the computed value of the test statistic z, and find the *P*-value by following the same procedure summarized in Figure 7-8.

pvalue ≤ α

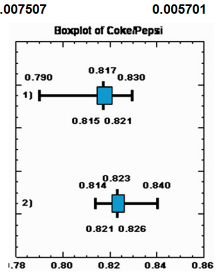
* For testing and trying to determine if they are the same: H_0: $\mu_1 = \mu_2$ H_1: $\mu_1 \neq \mu_2$
For testing and greater or less than: H_1: $\mu_1 - \mu_2 > 0$

Mar 9-3:24 PM

Coke Versus Pepsi

Data Set 1 in Appendix B includes the weights (in pounds) of samples of regular Coke and regular Pepsi. Sample statistics are shown. Use the 0.01 significance level to test the claim that the mean weight of regular Coke is different from the mean weight of regular Pepsi.

	Regular Coke	Regular Pepsi
n	36	36
$\bar{x}$	0.81682	0.82410
s	0.007507	0.005701



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Data Set 1 in Appendix B includes the weights (in pounds) of samples of regular Coke and regular Pepsi. Sample statistics are shown. Use the 0.01 significance level to test the claim that the mean weight of regular Coke is different from the mean weight of regular Pepsi.

1. $H_o : \mu_1 = \mu_2$
   $H_1 : \mu_1 \neq \mu_2$

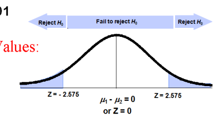
2. TS

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \qquad z = \frac{(0.81682 - 0.82410) - 0}{\sqrt{\frac{.007505^2}{36} + \frac{0.005701^2}{36}}}$$

$= -4.63$

$\alpha = 0.01$

3. Critical Values:



4. Conclusion: Reject the null. There is sufficient evidence to the support the claim that there is a difference between the mean weight of Coke and Pepsi.

Mar 9-3:29 PM

Ex1b) Students at a college randomly select 217 student cars and found that they had ages with a mean of 7.89 years and s = 3.67 years . They also randomly select 152 faculty cars and found they had ages of 5.99 years and s = 3.65 years. Use .05 for α and determine if there is sufficient evidence to support the claim that the students cars are older than faculty cars?

group 1: students group 2: teachers students > teachers
$\mu_1 > \mu_2$
$\mu_1 - \mu_2 > 0$

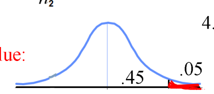
1. H_0: $\mu_1 - \mu_2 \leq 0$ H_1: $\mu_1 - \mu_2 > 0$

2. Test Statistic:

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \qquad \frac{(7.89 - 5.99) - 0}{\sqrt{\frac{3.67^2}{217} + \frac{3.65^2}{152}}}$$

4.910

3. Critical Value:



1.645

4. Conclusion:

Reject H_o: There is sufficient evidence to support the claim $\mu_1 - \mu_2 > 0$.

Mar 12-2:14 PM

Confidence Intervals

$$(\bar{x}_1 - \bar{x}_2) - E < (\mu_1 - \mu_2) < (\bar{x}_1 - \bar{x}_2) + E$$

where $E = z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

* treat as 2-tail test to find critical values and only use + critical value in test.

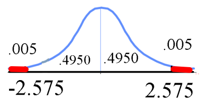
If the confidence interval does not include the value 0, then it indicates that there is significant difference between the 2 means.

Mar 12-3:21 PM

Ex2a) Using the Coke and Pepsi data make a 99% confidence interval estimating the difference between the mean weights of the cans.

Coke: n = 36, $\bar{x}$ = 0.81682, s = .007507 group #1
Pepsi: n = 36, $\bar{x}$ = .82410, s = .005701 group #2

$$E = z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$



$$2.575\sqrt{\frac{.007507^2}{36} + \frac{.005701^2}{36}} = .004045$$

$$(\bar{x}_1 - \bar{x}_2) - E < (\mu_1 - \mu_2) < (\bar{x}_1 - \bar{x}_2) + E$$

$$(.81682 - .82410) - .004045 < \mu_1 - \mu_2 < (.81682 - .82410) + .004045$$

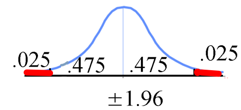
$$-0.01133 < \mu_1 - \mu_2 < -.00324$$

Mar 12-3:19 PM

Ex2b) Students at a college randomly select 217 student cars and found that they had ages with a mean of 7.89 years and s = 3.67 years . They also randomly select 152 faculty cars and found they had ages of 5.99 years and s = 3.65 years. Construct a 95% confidence interval, where μ_1 is the age of the students cars.

$$E = z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$1.96\sqrt{\frac{3.67^2}{217} + \frac{3.65^2}{152}}$$



E=.76

$$(\bar{x}_1 - \bar{x}_2) - E < (\mu_1 - \mu_2) < (\bar{x}_1 - \bar{x}_2) + E$$

$$(7.89 - 5.99) - .76 < \mu_1 - \mu_2 < (7.89 - 5.99) + .76$$

$$1.14 < \mu_1 - \mu_2 < 2.66$$

Mar 12-3:21 PM