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Find critical values.

1) a. Assume that normal distribution applies. Use  $\alpha = 0.05$  for a two-tailed test. Find the critical z value.

$\alpha = 0.05$

2 tailed test



$-1.96 \quad 1.96$

$\frac{z\alpha}{2} = \pm 1.96$

b. Assume that t-distribution applies. Use  $\alpha = 0.01$  for a right-tailed test and  $n = 15$ . Find the critical t value.

$\alpha = 0.01 \quad n = 15 \quad df = 14$



$t_{\frac{\alpha}{2}} = 2.624$

c. Assume that normal distribution applies. Use  $\alpha = 0.05$  for a left-tailed test. Find the critical z value.



$1.645$

$\alpha = 0.05$   
 $\frac{z\alpha}{2} = -1.645$

d. Assume that chi-square distribution applies. Use  $\alpha = 0.05$  and  $n = 12$ . It is a two-tailed test. Find the critical values.

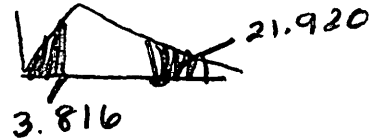
$\alpha = 0.05$

$n = 12$

$df = 11$

$\chi^2_R = 0.025 = 21.920$

$\chi^2_L = 1 - 0.025 = 3.816$



e. Assume that t-distribution applies. Use  $\alpha = 0.10$  and  $n = 10$  for a two-tailed test. Find the critical t values.

$\alpha = 0.10$

$n = 10$

$df = 9$

$t_{\frac{\alpha}{2}} = 1.833$



Construct a confidence interval for  $\mu_d$ , the mean of the differences  $d$  for the population of paired data. Assume that the population of paired differences is normally distributed.

2) Ten different families are tested for the number of gallons of water a day they use before and after viewing a conservation video. Construct a 90% confidence interval for the mean of the differences.

Before 33 33 38 33 35 35 40 40 40 31

After 34 28 25 28 35 33 31 28 35 33

$n = 10$

$\bar{d} = 4.8$

$Sd = 5.245$

$t_{\frac{\alpha}{2}} = 1.833$

$df = 9$

Error of Margin

$E = 1.833 \left( \frac{5.245}{\sqrt{10}} \right)$

$E = 3.0402$

$4.8 - 3.0402 < \mu_d < 4.8 + 3.0402$

$1.760 < \mu_d < 7.8402$

Conclusion: since the intervals contain  $\mu_1 > \mu_2$   
The families use more water before viewing the conservation video.

3) An article in a journal reports that 34% of American fathers take no responsibility for child care. A researcher claims that the figure is higher for fathers in the town of Littleton. A random sample of 234 fathers from Littleton yielded 96 who did not help with child care. Test the researcher's claim at the 0.05 significance level.

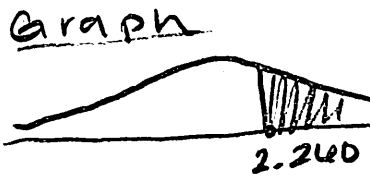
$n = 234$   
 $x = 96$   
 $p = .34 \quad q = .66$   
 $\hat{p} = .410$   
 $\hat{q} = .59$

Claim  
 $P > .34$  ✓  
 $H_0: P = .34$   
 $H_1: P > .34$  ✓  
 Test statistic

$$z = \frac{\hat{p} - p}{\sqrt{\frac{pq}{n}}}$$

$$z = 2.260$$

Pvalue =  
 normalcdf (2.260, E99)  
 $= 0.0119$  ✓  $\alpha > Pvalue$   
 $0.05 > 0.0119$



Reject  $H_0$ .

Conclusion: There is sufficient evidence to support the claim that the figure is higher for the fathers in the town of Littleton.

$\alpha = 0.05$   
 Requirement  
 $n p \geq 5 \quad n q \geq 5$

Assume that two dependent samples have been randomly selected from normally distributed populations. <sup>who take no responsibility for</sup> <sub>child care.</sub>

4) A coach uses a new technique in training middle distance runners. The times for 8 different athletes to run 800 meters before and after this training are shown below.

Athlete	A	B	C	D	E	F	G	H
Time before training (seconds)	118.7	111.1	115.1	109.4	117.9	111.3	116.2	109
Time after training (seconds)	119.3	109.8	112.7	110.2	116.1	111.4	112.6	105.1

p dis

5) Using a 0.05 level of significance, test the claim that the training helps to improve the athletes' times for the 800 meters.

$n = 8$   
 $df = 7$   
 $\bar{d} = 1.438$   
 $Sd = 1.824$   
 $\alpha = .05$

claim:  $> 0$   
 $H_0: \mu d = 0$  ✓  
 $H_1: \mu d > 0$   
 7

Test statistic  
 $= 1.438 - 0$   
 $\frac{1.824}{\sqrt{8}}$  ✓  
 $t = 2.227$

Critical value  
 $df = 7 \quad \alpha = 0.05$   
 Area in 1 tail  
 $= 1.895$



conclusion: There is not sufficient evidence to support the claim that the training helps to improve the athletes times for the 800 meters.

-5

Test the indicated claim about the means of two populations. Assume that the two samples are independent simple random samples selected from normally distributed populations. Do not assume that the population standard deviations are equal.

5) A researcher was interested in comparing the amount of time (in hours) spent watching television by women and by men. Independent simple random samples of 14 women and 17 men were selected, and each person was asked how many hours he or she had watched television during the previous week. The summary statistics are as follows.

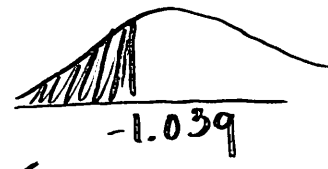
Women	Men
$\bar{x}_1 = 11.8$ hr	$\bar{x}_2 = 13.5$ hr
$s_1 = 3.9$ hr	$s_2 = 5.2$ hr
$n_1 = 14$	$n_2 = 17$

Use a 0.05 significance level to test the claim that the mean amount of time spent watching television by women is smaller than the mean amount of time spent watching television by men. Use the traditional method of hypothesis testing.

$\mu_1 < \mu_2$  ✓  
 $H_0: \mu_1 = \mu_2$   
 $H_1: \mu_1 < \mu_2$   
 graph

$P$ value:  $df = 13$  ✓  
 $t_{cdf}(-E99, -1.039, 13)$   
 $P$ value = .158 ✓

$P$ value  $> \alpha$   
 $.158 > .05$



Requirements  
 $n_1 > 30$   $n_2 > 30$   
 normally distributed ✓  
 use  $t$  distribution

Test statistic:  

$$t = \frac{11.8 - 13.5}{\sqrt{\frac{(3.9)^2}{14} + \frac{(5.2)^2}{17}}}$$

$$t = -1.039$$
 ✓

Conclusion:  
 There is not sufficient evidence to support the claim that the mean amount of time spent watching tv by women is smaller than the mean spent by men.

Assume that the population is normally distributed and that the sample has been randomly selected.

- 6) The standard deviation of math test scores at one high school is 16.1. A teacher claims that the standard deviation of the girls' test scores is smaller than 16.1. A random sample of 22 girls results in scores with a standard deviation of 13.2. Use a significance level of 0.01 to test the teacher's claim.

$$S = 13.2$$

$$n = 22$$

$$\alpha = 0.01$$

$$df = 21$$

Requirements:  
State normal  
population test  
is about  $\sigma$

Claim:

$$\sigma < 16.1 \checkmark$$

$$H_0: \sigma = 16.1$$

$$H_1: \sigma < 16.1 \checkmark$$

Test Statistic:

$$\chi^2 = \frac{(n-1)S^2}{\sigma^2}$$

$$\chi^2 = \frac{21(13.2)^2}{(16.1)^2}$$

$$\chi^2 = 13.942$$

Pvalue > .01  
Fail to reject  
 $H_0$

Pvalue:

$$(\chi^2_{cdf}(13.942, 21))$$

$$Pvalue = 0.128$$

Conclusion: There is not sufficient evidence at  $\alpha = 0.01$  to support the claim that the standard deviation of girls test score is smaller than 16.1

Assume that the samples are independent and that they have been randomly selected.

- 7) A marketing survey involves product recognition in New York and California. Of 558 New Yorkers surveyed, 193 knew the product while 196 out of 614 Californians knew the product. Construct a 99% confidence interval for the difference between the two population proportions.

New York

$$n_1 = 558$$

$$X_1 = 193$$

$$\hat{p}_1 = 0.346$$

$$\hat{q}_1 = 0.654$$

California

$$n_2 = 614$$

$$X_2 = 196$$

$$\hat{p}_2 = 0.319$$

$$\hat{q}_2 = 0.681 \checkmark$$

$$\hat{p}_1 - \hat{p}_2 = 0.346 - 0.319 = 0.027 \checkmark$$

$$0.027 - 0.0710 < p_1 - p_2 < 0.027 + 0.0710$$

$$-0.044 < p_1 - p_2 < 0.098$$

Conclusion:

Since interval contain 0.

The proportion of New Yorkers who knew the product and Californians who knew the product is the same (Equal to each other).

Requirement  
 $n_1 \hat{p}_1 \geq 5$   $n_2 \hat{p}_2 \geq 5$   
 $n_1 \hat{q}_1 \geq 5$   $n_2 \hat{q}_2 \geq 5$

use normal distribution  $\checkmark$

Error of Margin:  $z_{\frac{\alpha}{2}} = 2.575 \checkmark$

$$E = z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}_1 \hat{q}_1}{n_1} + \frac{\hat{p}_2 \hat{q}_2}{n_2}}$$

$$E = 2.575 \sqrt{\frac{0.346 \times 0.654}{558} + \frac{0.319 \times 0.681}{614}}$$

$$E = 0.0710$$

(-2)

Assume that the samples are independent and that they have been randomly selected

8) In a random sample of 360 women, 65% favored stricter gun control laws. In a random sample of 220 men, 60% favored stricter gun control laws. Test the claim that the proportion of women favoring stricter gun control is higher than the proportion of men favoring stricter gun control. Use a significance level of 0.05.

women	men
$n_1 = 360$	$n_2 = 220$
$X_1 = 234$	$X_2 = 132$
$\hat{p}_1 = .65$	$\hat{p}_2 = .60$
$\hat{q}_1 = .35$	$\hat{q}_2 = .40$

claim:  
 $P_1 > P_2$   
 $H_0: P_1 = P_2$   
 $H_1: P_1 > P_2$

Test statistic

$$z = \frac{.65 - .60}{\sqrt{\frac{.631 \times .369}{360} + \frac{.631 \times .369}{220}}}$$

$$z = 1.21 \checkmark$$

P value  
 $P \text{ value} = .113$

normalcdf(1.21, E99) ✓

$P \text{ value} > \alpha$   
 Fail to reject  
 $H_0$

graph



Requirements:  
 $n_1 \hat{p}_1 \geq 5$      $n_2 \hat{p}_2 \geq 5$   
 $n_1 \hat{q}_1 \geq 5$      $n_2 \hat{q}_2 \geq 5$

$$\bar{p} = \frac{234 + 132}{360 + 220} = .631$$

$$\bar{q} = 0.369 \checkmark$$

Conclusion: There is not sufficient evidence to support the claim that the proportion of women favoring stricter gun control is higher than the proportion of men favoring stricter gun control.

Construct the indicated confidence interval for the difference between the two population means. Assume that the two samples are independent simple random samples selected from normally distributed populations. Do not assume that the population standard deviations are equal.

- 9) A researcher was interested in comparing the amount of time spent watching television by women and by men. Independent simple random samples of 14 women and 17 men were selected, and each person was asked how many hours he or she had watched television during the previous week. The summary statistics are as follows.

Women	Men
$\bar{x}_1 = 12.5$ hrs	$\bar{x}_2 = 14.3$ hrs
$s_1 = 3.9$ hrs	$s_2 = 5.2$ hrs
$n_1 = 14$	$n_2 = 17$

Construct a 99% confidence interval for  $\mu_1 - \mu_2$ , the difference between the mean amount of time spent watching television for women and the mean amount of time spent watching television for men.

①  $t = \frac{\alpha}{2} = 3.012$  ✓

$df = 13$

②  $E = 3.012 \sqrt{\frac{(3.9)^2}{14} + \frac{(5.2)^2}{17}} = 4.928$

③  $\bar{x}_1 - \bar{x}_2 = 12.5 - 14.3 = -1.8$

④  $-1.8 - 4.928 < \mu_1 - \mu_2 < -1.8 + 4.928$

$-6.728 < \mu_1 - \mu_2 < 3.128$

conclusion:  
 Since interval contains 0  
 The mean amount of time spent watching television for women and the mean amount of time spent watching television for men is the same.

Assume that a simple random sample has been selected from a normally distributed population.

- 10) A cereal company claims that the mean weight of the cereal in its packets is 14 oz. The weights (in ounces) of the cereal in a random sample of 8 of its cereal packets are listed below.

14.6 13.8 14.1 13.7 14.0 14.4 13.6 14.2

Test the claim at the 0.01 significance level.

$n = 8$   
 $\bar{x} = 14.05$   
 $s = 0.346$   
 $\mu = 14$  ✓

claim:  
 $\mu = 14$   
 $H_0: \mu = 14$   
 $H_1: \mu \neq 14$  ✓

test statistic

$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$

$t = \frac{14.05 - 14}{\frac{0.346}{\sqrt{8}}}$

$t = -4.08$

P value:

$2(tcdf(-4.08, E99, 7))$

$P\text{value} = 0.005$   
 Graph ✓



$P\text{value} > \alpha$   
 Fail to reject  $H_0$  ✓

Requirement:

$n > 30$   
 and  $\sigma$  is not given use  $t$  distribution

conclusion:

There is not sufficient evidence to warrant rejection of claim that the mean weight of the cereal in its packets is 14 oz