

SOLUTIONS: TWO-SAMPLE HYPOTHESIS TESTING
TWO-SAMPLE T-TESTS

PROBLEM 1:

Who lives longer, married or unmarried men? Test at $\alpha = .01$

Single Men

$$\bar{X}_1 = 72.5 \text{ years}$$

$$S_1 = 7.0 \text{ years}$$

$$n_1 = 14$$

Married Men

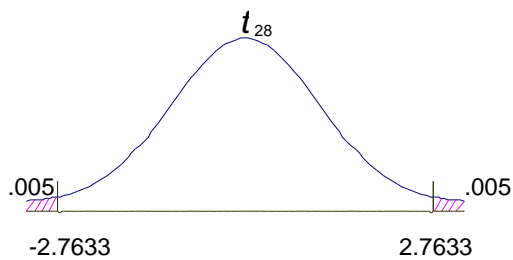
$$\bar{X}_2 = 74.5 \text{ years}$$

$$S_2 = 8.0 \text{ years}$$

$$n_2 = 16$$

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{13(49) + 15(64)}{28} = 57$$

$$t_{28} = \frac{-2}{\sqrt{57\left(\frac{1}{14} + \frac{1}{16}\right)}} = \frac{-2}{\sqrt{7.6}} = \frac{-2}{2.76} = -.72$$

Do not reject H_0 .

PROBLEM 2:

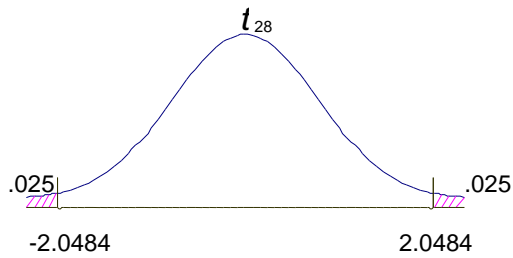
Who does better on the CPA EXAM? Test at .05 significance level

College A: Average score = 70.5; standard deviation = 15.0; n = 12

College B: Average score = 66.5; standard deviation = 10.0; n = 18

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{11(225) + 17(100)}{28} = 149.1$$

$$t_{28} = \frac{4}{\sqrt{149.1\left(\frac{1}{12} + \frac{1}{18}\right)}} = \frac{4}{\sqrt{20.71}} = \frac{4}{4.55} = 0.88$$

Do not reject H_0 . The 4-point difference is not statistically significant.

PROBLEM 3:

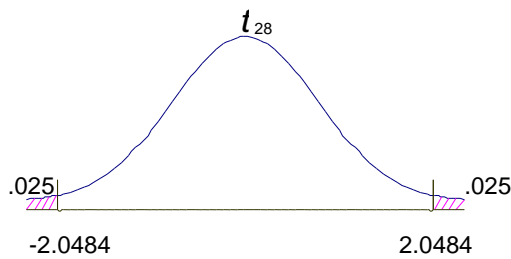
Who misses work more often: male managers or female managers? Test at .05 significance level

Female Managers: Average number of times absent from work = 10.9 days;
standard deviation = 2.4 days; $n = 10$

Male Managers: Average number of times absent from work = 9.9 days;
standard deviation = 1.8 days; $n = 20$

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{9(5.76) + 19(3.24)}{28} = 4.05$$

$$t_{28} = \frac{1}{\sqrt{4.05\left(\frac{1}{10} + \frac{1}{20}\right)}} = \frac{1}{\sqrt{.6075}} = \frac{1}{0.78} = 1.28$$

Do not reject H_0 . The 1 day difference is not statistically significant.

PROBLEM 4:

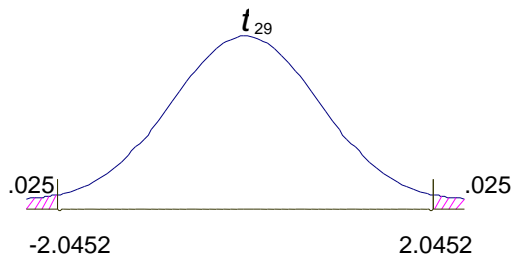
Which yogurt ice cream has less fat? Test at .05 significance level

Company A: Average amount of fat = 10.6 milligrams; standard deviation = 2.6 milligrams;
n = 13

Company B: Average amount of fat = 10.2 milligrams; standard deviation = 2.4 milligrams;
n = 18

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{12(6.76) + 17(5.76)}{29} = 6.17$$

$$t = \frac{.4}{\sqrt{6.17\left(\frac{1}{13} + \frac{1}{18}\right)}} = \frac{.4}{\sqrt{.817}} = \frac{.4}{0.90} = 0.44$$

Do not reject H_0 . The .4 milligram difference is not statistically significant.

PROBLEM 5:

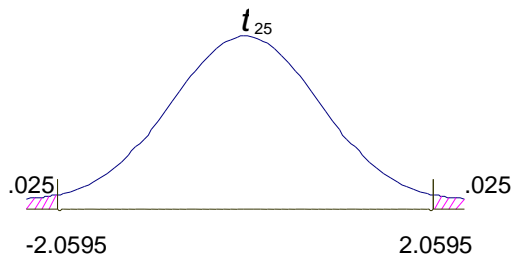
Which approach to treating brain cancer works best ? Test at .05 significance level

Approach A: lived on average and additional = 6.8 years; standard deviation = 1.6 years;
n = 14 patients

Approach B: lived on average and additional = 5.4 years; standard deviation = 2.4 years;
n = 12 patients

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{13(2.56) + 11(5.76)}{24} = 4.03$$

$$t_{25} = \frac{1.4}{\sqrt{4.03\left(\frac{1}{14} + \frac{1}{12}\right)}} = \frac{1.4}{\sqrt{.676}} = \frac{1.4}{0.82} = 1.77$$

Do not reject H_0 . The 1.4 year difference is not statistically significant.

PROBLEM 6:

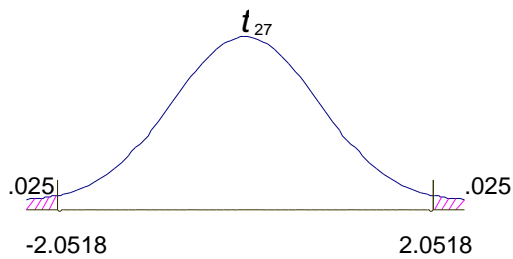
Who makes more money at Company X ? Test at .05 significance level

Men: Average gross income = \$48,500; standard deviation = \$1,000;
n = 18 employees

Women: Average gross income = \$43,600; standard deviation = \$2,000;
n = 11 employees

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{17(1000000) + 10(4000000)}{27} = 2,111,111$$

$$t_{27} = \frac{4900}{\sqrt{2,111,111\left(\frac{1}{18} + \frac{1}{11}\right)}} = \frac{4900}{\sqrt{309,203}} = \frac{4900}{556} = 8.81$$

Reject H_0 ; The difference of \$4,900 in salary is statistically significant. This firm is paying the men more than the women.

PROBLEM 7:

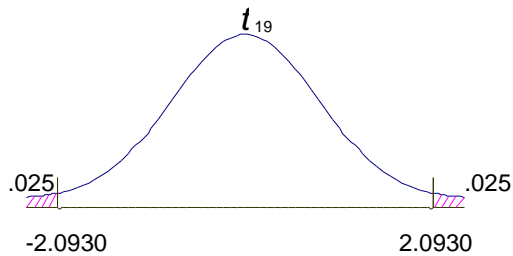
Who makes a better motor ? Test at .05 significance level

Company ABC: Average life= 14.50 years; standard deviation = 1.50 years;
n = 10

Company QQQ: Average life = 13.60 years; standard deviation = 2.10 years;
n = 11

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



$$S_{pooled}^2 = \frac{9(2.25) + 10(4.41)}{19} = 3.39$$

$$t_{27} = \frac{.90}{\sqrt{3.39\left(\frac{1}{10} + \frac{1}{11}\right)}} = \frac{.90}{\sqrt{.647}} = \frac{.90}{.80} = 1.125$$

Do not Reject H_0 ; The difference of .9 years in motor life is not statistically significant.

PROBLEM 8:

A company has two potential suppliers for a key part. The data below represents the life in hours of samples of the parts made by the two suppliers. Does it matter which supplier the company chooses? Test at a significance level (α) of .05. You may assume that the two variances are statistically equivalent.

Company

ABC 151 153 177 166 149 151 201 199 189 177 165 192 194 202

Company

XYZ 168 158 176 181 101 153 130 124 122 127 160 202 181 148 129

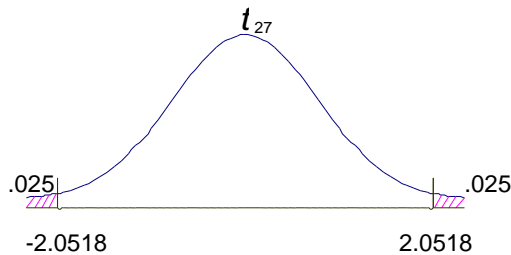
From MS Excel:

t-Test: Two-Sample Assuming Equal Variances

	Variable 1	Variable 2
Mean	176.14286	150.6667
Variance	408.43956	787.6667
Observations	14	15
Pooled Variance	605.07584	
Hypothesized Mean Difference	0	
df	27	
t Stat	2.7870209	
P(T<=t) one-tail	0.0048091	
t Critical one-tail	1.7032884	
P(T<=t) two-tail	0.0096183	
t Critical two-tail	2.0518305	

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



Reject H_0 . The two suppliers' parts do not have the same average life.

PROBLEM 9:

A company is interested in determining whether there is a difference in job satisfaction between white and non-white employees. Job satisfaction is measured on a 0 (not at all satisfied) to 100 (extremely satisfied) scale. Test at a significance level of .05 and assume equal variances. **Use MS Excel.**

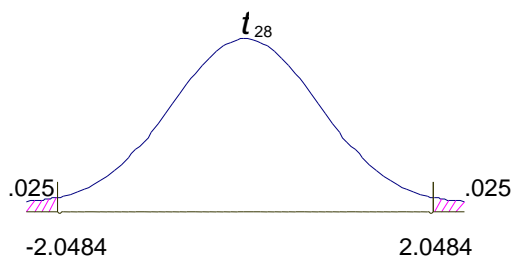
White	91	87	67	99	83	87	90	45	77	81	92	79	83	99	92	75
Non-White	74	66	81	39	49	55	67	71	62	50	58	60	73	70		

From MS Excel:

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	Variable 2
Mean	82.9375	62.5
Variance	175.9291667	132.2692
Observations	16	14
Pooled Variance	155.6584821	
Hypothesized Mean Difference	0	
df	28	
t Stat	4.476151283	
P(T<=t) one-tail	5.79724E-05	
t Critical one-tail	1.701130934	
P(T<=t) two-tail	0.000115945	
t Critical two-tail	2.048407142	

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$



Reject H_0 . There is a difference in job satisfaction of white and non-white employees.