10-2 a) 1) The parameter of interest is the difference in means $\mu_1 - \mu_2$. Note that $\Delta_0 = 0$.

2) $H_0: \mu_1 - \mu_2 = 0$ or $\mu_1 = \mu_2$

3) $H_1: \mu_1 - \mu_2 < 0$ or $\mu_1 < \mu_2$

4) $\alpha = 0.05$

5) The test statistic is

$$z_0 = \frac{(\overline{x}_1 - \overline{x}_2) - \Delta_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

6) Reject H_0 if $z_0 < -z_\alpha = -1.645$

7) $\overline{x}_1 = 14.2$ $\overline{x}_2 = 19.7$

$\sigma_1 = 10$ $\sigma_2 = 5$

$n_1 = 10$ $n_2 = 15$

$$z_0 = \frac{(14.2 - 19.7)}{\sqrt{\frac{(10)^2}{10} + \frac{(5)^2}{15}}} = -1.61$$

8) Because –1.61>-1.645, do not reject the null hypothesis. There is not sufficient evidence to conclude that the two means differ at $\alpha = 0.05$.

$P\text{-value} = \Phi(-1.61) = 0.0537$

b) $$\mu_1 - \mu_2 \le (\overline{x}_1 - \overline{x}_2) + z_\alpha \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$\mu_1 - \mu_2 \le (14.2 - 19.7) + 1.645\sqrt{\frac{(10)^2}{10} + \frac{(5)^2}{15}}$$

$$\mu_1 - \mu_2 \le 0.12$$

With 95% confidence, we believe the true difference in the means is less than 0.12. Because 0 is contained in this interval, we can conclude there is no significant difference between the means. We fail to reject the null hypothesis.

c)

$$\beta = 1 - \Phi\left(-z_\alpha - \frac{\delta}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}\right)$$

$$= 1 - \Phi\left(-1.65 - \frac{-4}{\sqrt{\frac{(10)^2}{10} + \frac{(5)^2}{15}}}\right)$$

$= 1 - \Phi(-0.4789)$ = 1-0.316 = 0.684

Power = 1 – 0.684 = 0.316

Section 10-3

10-10 a) 1) The parameter of interest is the difference in mean, $\mu_1 - \mu_2$

2) $H_0: \mu_1 - \mu_2 = 0$ or $\mu_1 = \mu_2$

3) $H_1: \mu_1 - \mu_2 \neq 0$ or $\mu_1 \neq \mu_2$

4) $\alpha = 0.05$

5) The test statistic is

$$t_0 = \frac{(\bar{x}_1 - \bar{x}_2) - \Delta_0}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

6) Reject the null hypothesis if $t_0 < -t_{\alpha/2, n_1+n_2-2}$ where $-t_{0.025,28} = -2.048$ or $t_0 > t_{\alpha/2, n_1+n_2-2}$ where $t_{0.025,28} = 2.048$

7) $\bar{x}_1 = 4.7$ $\quad \bar{x}_2 = 7.8$

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$

$s_1^2 = 4$ $\quad s_2^2 = 6.25$

$$= \sqrt{\frac{14(4) + 14(6.25)}{28}} = 2.26$$

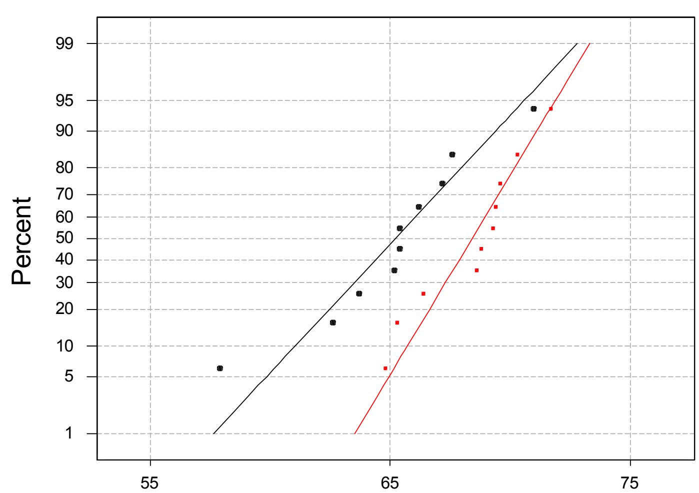
$n_1 = 15$ $\quad n_2 = 15$

$$t_0 = \frac{(4.7 - 7.8)}{2.26\sqrt{\frac{1}{15} + \frac{1}{15}}} = -3.75$$

8) Because $-3.75 < -2.048$, reject the null hypothesis at $\alpha = 0.05$.

P-value $= 2P(t > 3.75) < 2(0.0005)$, P-value $< .001$

b) 95% confidence interval: $t_{0.025,28} = 2.048$



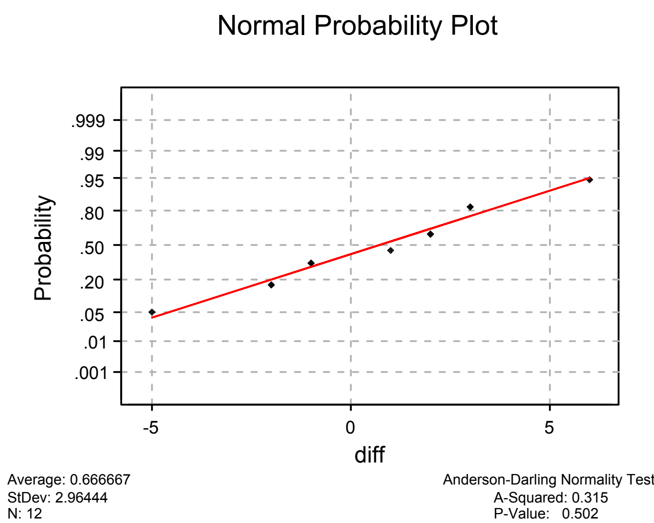
$$\left(\bar{x}_1 - \bar{x}_2\right) - t_{\alpha/2,n_1+n_2-2}(s_p)\sqrt{\frac{1}{n_1}+\frac{1}{n_2}} \le \mu_1 - \mu_2 \le \left(\bar{x}_1 - \bar{x}_2\right) + t_{\alpha/2,n_1+n_2-2}(s_p)\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}$$

$$(4.7-7.8) - 2.048(2.26)\sqrt{\frac{1}{15}+\frac{1}{15}} \le \mu_1 - \mu_2 \le (4.7-7.8) + 2.048(2.26)\sqrt{\frac{1}{15}+\frac{1}{15}}$$

$$-4.79 \le \mu_1 - \mu_2 \le -1.41$$

Because zero is not contained in this interval, we are 95% confident that the means are different.

10-32 a) According to the normal probability plots, the assumption of normality does not appear to be violated since the data fall approximately along a straight line.



b) $\bar{d} = 0.667$ $s_d = 2.964$, n = 12

95% confidence interval:

$$\bar{d} - t_{\alpha/2,n-1}\left(\frac{s_d}{\sqrt{n}}\right) \le \mu_d \le \bar{d} + t_{\alpha/2,n-1}\left(\frac{s_d}{\sqrt{n}}\right)$$

$$0.667 - 2.201\left(\frac{2.964}{\sqrt{12}}\right) \le \mu_d \le 0.667 + 2.201\left(\frac{2.964}{\sqrt{12}}\right)$$

$$-1.216 \le \mu_d \le 2.55$$

Because zero is contained within this interval, there is no significant indication that one design language is preferable at a 5% significance level

10-36 a) 1) The parameter of interest is the mean difference in impurity level, μ_d where d_i = Test 1 – Test 2.

2) $H_0: \mu_d = 0$

3) $H_1: \mu_d \ne 0$

4) $\alpha = 0.01$

5) The test statistic is

$$t_0 = \frac{\bar{d}}{s_d / \sqrt{n}}$$

6) Reject the null hypothesis if $t_0 < -t_{0.005,7}$ or $t_0 > t_{0.005,7}$ where $t_{0.005,7} = 3.499$

7) $\bar{d} = -0.2125$

$s_d = 0.1727$

$n = 8$

$$t_0 = \frac{-0.2125}{0.1727/\sqrt{8}} = -3.48$$

8) Because −3.499 < −3.48 < 3.499 cannot reject the null hypothesis. There is not sufficient evidence that the tests give different mean impurity levels at $\alpha = 0.01$.

b) 1) The parameter of interest is the mean difference in impurity level, μ_d where d_i = Test 1 – Test 2.

2) H_0 : $\mu_d + 0.1 = 0$

3) H_1 : $\mu_d + 0.10 < 0$

4) $\alpha = 0.05$

5) The test statistic is

$$t_0 = \frac{\bar{d} + 0.1}{s_d / \sqrt{n}}$$

6) Reject the null hypothesis if $t_0 < -t_{0.05,7}$ where $t_{0.05,7} = 1.895$

7) $\bar{d} = -0.2125$

$s_d = 0.1727$

$n = 8$

$$t_0 = \frac{-0.2125 + 0.1}{0.1727/\sqrt{8}} = -1.8424$$

8) Because -1.895<-1.8424 we fail to reject the null at the 0.05 level of significance.