STAT 3004

Assignment 3

## Question 1

a) $\hat{\beta}_1 = \frac{18387 - 17(9)(115.0588)}{1785 - 17(9)^2}$
$\approx 1.9191$

$\hat{\alpha} = 115.0588 - 1.9191(9)$
$\approx 97.7869$

$\hat{y}_i = 97.7869 + 1.9191 x_i$

b) $\hat{\sigma}^2 = \frac{1}{15}\left\{[22658 - 17(115.0588)^2] - \frac{[18397 - 17(9)(115.0588)^2]^2}{1785 - 17(9)^2}\right\}$
$\approx 1.49$

$\hat{Var}(\hat{\beta}_1) = 1.49 \frac{1}{1785 - 17(9)^2}$
$\approx 0.0037$

CI for $\beta_1 = 1.9191 \pm 2.1315\sqrt{0.0037}$
$\approx (1.7894, 2.0488)$

e) $\hat{y} = 97.7869 + 1.9191(13)$
$= 122.7352$

d) $SE = \sqrt{1.49\left[\frac{1}{17} + \frac{(13-9)^2}{1785 - 17(9)^2}\right]}$
$\approx 0.3822$

## Question 2

a) test for correlation coefficient

b) $H_0: \rho = 0$ vs $H_1: \rho \neq 0$
$t_0 = \frac{0.19\sqrt{77}}{\sqrt{1-(0.19)^2}}$
$\approx 1.6982$

p-value $\approx 0.0935$
Since p-value $> 0.05$, we do not reject $H_0$ at $\alpha = 0.05$. We cannot conclude that there is a relationship between reactivity as measured by the automated and manual monitors.

c) $z = \frac{1}{2}\ln\left(\frac{1+0.19}{1-0.19}\right)$
$\approx 0.1923$

$z_1 = 0.1923 - \frac{1.96}{\sqrt{76}}$
$\approx -0.0325$

$z_2 = 0.1923 + \frac{1.96}{\sqrt{76}}$
$\approx 0.4171$

CI for $\rho = \left(\frac{e^{2(-0.0325)}-1}{e^{2(-0.0325)}+1}, \frac{e^{2(0.4171)}-1}{e^{2(0.4171)}+1}\right)$
$\approx (-0.0325, 0.3945)$

## Question 3

a) $H_0: \alpha_i = \alpha_j$ vs $H_1:$ at least one $\alpha_i \neq \alpha_j$ $\forall\ i \neq j$
$F = \frac{[5(18.68)^2 + 12(8.575)^2 + 5(5.46)^2 - 22(10.1636)^2]/2}{[4(10.0656)^2 + 11(6.8373)^2 + 4(3.1342)^2]/19}$
$\approx 4.9895$
p-value $\approx 0.0181$
Since p-value $< 0.05$, we reject $H_0$ at $\alpha = 0.05$

b) $H_0: L = 0$ vs $H_1: L \neq 0$
$\{A, B\}$ $t_0 = \frac{18.68 - 8.575}{\sqrt{50.4628(\frac{1}{5} + \frac{1}{12})}}$
$\approx 2.6724$
$\{A, C\}$ $t_0 = \frac{18.68 - 5.46}{\sqrt{50.4628(\frac{1}{5} + \frac{1}{5})}}$
$\approx 2.9425$
$\{B, C\}$ $t_0 = \frac{8.575 - 5.46}{\sqrt{50.4628(\frac{1}{12} + \frac{1}{5})}}$
$\approx 0.8238$
critical value $= 2.093$
All the $t_0 > 2.093$, except pair $\{B, C\}$, we reject $H_0$ for pair $\{A, B\}$ and $\{A, C\}$ at $\alpha = 0.05$

c) $H_0: \alpha_i = \alpha_j$ vs $H_1:$ at least one $\alpha_i \neq \alpha_j$ $\forall\ i \neq j$
critical value $= 2.627$
All the $t_0 > 2.627$, except pair $\{B, C\}$, we reject $H_0$ for pair $\{A, B\}$ and $\{A, C\}$ at $\alpha = 0.05$

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Question 4
$H_0$: median of all groups are the same vs $H_1$: at least one pair of medians are different

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> kruskal.test(maxfwt ~ lead_grp, data = data)

       Kruskal-Wallis rank sum test

data:  maxfwt by lead_grp
Kruskal-Wallis chi-squared = 4.2895, df = 2, p-value = 0.1171
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Since the p-value $> 0.05$, we do not reject $H_0$ at $\alpha = 0.05$

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