STA 6167 – Exam 3 – Spring 2016   PRINT Name ___________________________________

Conduct all tests at $\alpha = 0.05$ significance level.

Q.1. A study in Edmonton, Canada modelled the relationship between the number of fresh food stores (including: supermarket, local grocery store, community garden, and farmers' market) in n = 247 shopping districts, with the following independent variables: (percent children, percent seniors, percent unemployed, percent minority, percent with private motor vehicle, percent using public transportation, percent walk, percent bike).

p.1.a. Complete the following table.

Variable	Coefficient	Std. Error	Chi-Square	P > 0.05 or < 0.05	Median
Constant	1.538	0.5			#N/A
Children	-3.787	0.979			23.43
Senior	0.699	0.672			10.91
Unemployment	16.08	2.931			2.13
Minority	0.694	0.428			23.52
Private Vehicle	-1.342	0.61			42
Public Transport	2.903	1.26			6.82
Bicycle	2.954	3.098			0
Walk	5.626	1.583			1.19

p.1.b. The authors used a log link function for the model. Give the predicted number of fresh food stores for a hypothetical shopping district that has the median percentage for each of the independent variables.

Q.2. A study sampled pillars in n = 29 coal mines. Pillars were classified as being either stable or unstable. Two variables were measured on each pillar: strength/stress ratio (s_s) and width/height ratio (w_h). The following models were fit for the probability (π) that a pillar is classified as stable:

Model 0: $\ln\left(\frac{\pi}{1-\pi}\right) = \alpha \qquad -2\ln L_0 = 40.168$

Model 1: $\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_{ss} s\_s \qquad -2\ln L_1 = 16.282$

Model 2: $\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_{ss} s\_s + \beta_{wh} w\_h \qquad -2\ln L_2 = 8.810$

Model 3: $\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_{ss} s\_s + \beta_{wh} w\_h + \beta_{ss\times wh} s\_sw\_h \qquad -2\ln L_3 = 8.072$

p.2.a. Based on the Likelihood Ratio Test, test whether the interaction between strength/stress ratio and width/height ratio is significant.

Null Hypothesis: Alternative Hypothesis:

Test Statistic: ______________________________ Rejection Region: ____________________

p.2.b. Based on models 1 and 2, test whether the width/height ratio is associated with pillar stability, controlling for strength/stress ratio:

Null Hypothesis: Alternative Hypothesis:

Test Statistic: ______________________________ Rejection Region: ____________________

p.2.c. The fit for Model 2 is given below. Compute the estimated probability that a pillar is stable for the following 2 mines: Bellampali: s_s = 2.40 w_h = 1.80 Kankanee: s_s = 0.86 w_h = 2.21

```
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -13.146      5.184  -2.536   0.0112 *
w_h            2.774      1.477   1.878   0.0604 .
s_s            5.668      2.642   2.145   0.0319 *
```

Bellampali: _________________________ Kankanee: _________________________

Q.3. An experiment was conducted as an Analysis of Covariance to measure the effect of an experimental treatment on creative performance. The experimental group received the Theory of Inventive Problem Solving (TRIZ) approach, and the control group received traditional problem solving approach. Baseline creativity scores of Novelty (X) were obtained, as well as post-treatment scores (Y). The authors report the following partial ANOVA table, there were 61 students in the experimental group, and 60 in the control group. The model is written as:

$E\{Y_i\} = \alpha + \beta X_i + \beta_1 Z_{1i}$ where $Z_{1i} = 1$ if Subject i is in the Experimental Group, 0 if in Control Group

p.3.a. Complete the following ANOVA table. For the P-value, state whether it is > 0.05 or < 0.05. Note that these are the partial sums of squares (Groups given Pre-Test and Pre-Test given groups).

Source	df	SS	MS	F	F(.05)	P-value
Pre-Test		2574.301		#N/A	#N/A	#N/A
Groups		58.36				
Error		340.98		#N/A	#N/A	#N/A

p.3.b. The fitted equation and overall mean for pre-test scores are: $\hat{Y} = -120 + 6.7X + 5.6Z$ $\overline{X} = 21.00$

Compute the Adjusted means for each group.

Experimental: ________________________ Control: ________________________________

p.3.c. The Pre-Test Means for each group are 20.76 for Experimental, and 21.24 for Control groups, respectively. Compute the Unadjusted means for each group.

Experimental: ________________________ Control: ________________________________

Q.4. A nonlinear regression model was fit, relating Cutter Life Index (Y) to the quartz content of rocks being cut (X, in %) in tunneling operations. The model fit is:

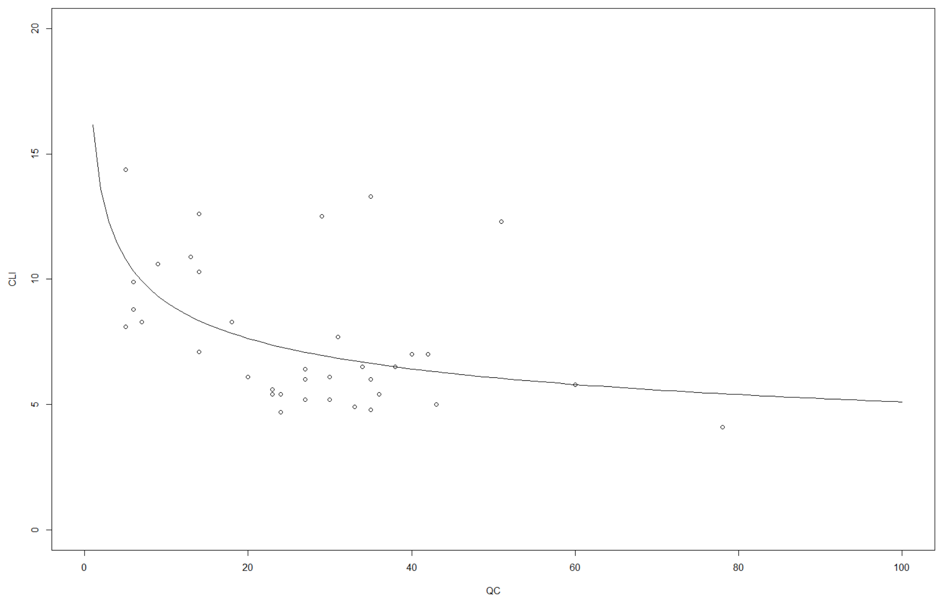
$Y = \beta_0 X^{\beta_1} + \varepsilon$ with $\beta_0 > 0$ and $\beta_1 < 0$ and $\varepsilon \sim N\left(0, \sigma^2\right)$

p.4.a. The model fit is given below. Obtain simultaneous 95% confidence Intervals for β_0 and β_1:

```
> rock.mod <- nls(CLI ~ b0*(QC^b1), start=c(b0=1, b1=-0.1))
> summary(rock.mod)

Formula: CLI ~ b0 * (QC^b1)

Parameters:
   Estimate Std. Error t value Pr(>|t|)
b0 16.16447    3.21159   5.033 1.36e-05 ***
b1 -0.25024    0.06667  -3.754 0.000615 ***
---

Residual standard error: 2.449 on 36 degrees of freedom
```

β_0 ________________________________ β_1 ________________________________

p.4.b. Give the fitted values for X=0%, 40%, and 80% Quartz and identify them on the graph.



$\hat{Y}_0 =$ ____________________ $\hat{Y}_{40} =$ ____________________ $\hat{Y}_{80} =$ ____________________

Q.5. A repeated measures design was used to compare the effects of Zylkene and Selgian Anipryl in dogs with anxiety disorders. There were 38 dogs, randomly assigned to the treatments (19 dogs per treatment). Each dog was measured at 5 time points, with a scale that has lower scores are better outcomes than higher scores).

p.5.a. Complete the following table.

Source	df	SS	MS	F	F(.05)	Significant?
Treatment		8.85				
Dog(Treatment)		2020.42		#N/A	#N/A	#N/A
Time		1573.45				
Time*Treatment		20.44				
Error2 (Time*Dog(Trt))		1212.11		#N/A	#N/A	#N/A
Total		4835.27	#N/A	#N/A	#N/A	#N/A

p.5.b. Assuming no significant interaction, obtain a 95% Confidence Interval for $\mu_Z - \mu_{SA}$. Note that the sample means are 19.99 and 19.56 for Zylkene and Selgian Anipryl, respectively.

p.5.c. Assuming no significant interaction, use Bonferroni's method to compare all pairs of Time Means. The sample means are: $Time_1$ = 24.58 $Time_2$ = 21.21 $Time_3$ = 19.00 $Time_4$ = 17.63 $Time_5$ = 16.45

$Time_5$ $Time_4$ $Time_3$ $Time_2$ $Time_1$

Have an Excellent Summer Break!