UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	CIVIL ENGINEERING STATISTICS
COURSE CODE	:	BFC 34303
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) A group of bearings have a mean weight of 5.02 grams and a standard deviation of 0.30 grams. A random samples of 100 balls bearings chosen from this group, find the probability that an average weight of ball bearings chosen from this group are:

(i) Between 4.96 and 5.00 grams,

(ii) More than 5.10 grams

(7 marks)

(b) The usefulness of two different design languages in improving programming task has been studied. 40 expert programmers, who are familiar in both languages, are asked to code a standard function in both languages, and the time (in seconds) is recorded. For the Design Language 1, the mean time is 255s with standard deviation of 26s and for the Design Language 2, the mean time is 319s with standard deviation of 17s.

(i) Construct a 96% confidence interval for the difference in mean coding times between Design Language 1 and Design Language 2?

(ii) Construct a 95% confidence interval for the difference in mean coding times between Design Language 1 and Design Language 2?

(10 marks)

(c) Given that 41 students and 44 professors took part in a study to find mean commuting distance. The mean number of miles traveled by students was 5.6 and the standard deviation was 2.8. The mean number of miles traveled by professors was 14.3 and the standard deviation was 9.1. Construct 99% confidence interval for the different between two mean numbers of miles traveled by professors and students. Interpret your result.

(8 marks)

Q2 (a) In a large university, the average score in a examination is 82%. Thirty eight students are to go through an hour meditation before the first examination. The mediator averaged is 84% in the examination with a standard deviation of 5%. Conclude the significant at 0.05 level.

(11 marks)

(b) There are 39 cats and 40 dogs was tested to determine if there are difference in the average number of days that animal can survive without food. The cats average are 11 days with a standard deviation of 2 days while the dogs averaged are 12 days with a standard deviation of 3 days. Conclude the significant at 0.01 level.

(14 marks)

Q3 The following **Table Q3** shows the relationship between thickness of material (millimeter) and the thermal conductivity of the material (watt per meter Kelvin) for eight materials where the pressure and temperature are at normal rate

Table Q3 : The thermal conductivity on different thickness

Thickness, x	2.78	1.41	2.74	0.92	2.44	3.50	3.68	1.97
Thermal Conductivity, y	2.16	0.88	1.04	1.10	0.96	2.18	1.54	1.39

(a) Sketch a scatter plot for the data above.

(4 marks)

(b) Use the method of least squares to estimate the regression line and interpret the result.

(11 marks)

(c) Estimate the thermal conductivity if given the thickness are 4.02.

(2 marks)

(d) Calculate the sample coefficient of correlation and interpret the result.

(3 marks)

(e) Calculate the coefficient of determination and interpret the result.

(5 marks)

Q4 The study "Less of Nitrogen Through Sweat by Preadolescent Girls Consuming Three Levels of Dietary Protein" (shown in **Table 4)** was conducted to determine perspiration nitrogen loss at various dietary protein levels. Twelve pre-adolescent girls ranging in age from 7 years and 9 years and judge to be clinically healthy, were used in the experiment. Each girl was subjected to one of the three controlled diets in which 30, 55 and 80 grams of protein per day were consumed. The following data represent the body perspiration nitrogen loss, in milligrams, collected during the last two days of the experimental period.

Table Q4: Level of dietary protein

Protein level		
30 grams	55 grams	80 grams
190	318	390
266	295	321
270	271	396
	438	399
	402	

(a) Estimate the parameter.

(7 marks)

(b) From the estimation in (a), is there a significant difference in the effect of protein levels on the body perspiration nitrogen loss? Use level of significance 0.01.

(18 marks)

- END OF QUESTION -

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Formula

Sampling Distributions :

$$\bar{X} \sim N\left(\mu, \sigma^2/n\right),\ Z = \frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim N(0,1),\ T = \frac{\bar{x}-\mu}{s/\sqrt{n}},\ \bar{X}_1 - \bar{X}_2 \sim N\left(\mu_1-\mu_2, \frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}\right).$$

Estimations :

$$n = \left(\frac{Z_{\alpha/2}\cdot\sigma}{E}\right)^2,\ \bar{x} \pm z_{\alpha/2}\left(\sigma/\sqrt{n}\right),\ \bar{x} \pm z_{\alpha/2}\left(s/\sqrt{n}\right),\ \bar{x} \pm t_{\alpha/2,v}\left(\frac{s}{\sqrt{n}}\right)$$

$$\left(\bar{x}_1-\bar{x}_2\right) - Z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}} < \mu_1-\mu_2 < \left(\bar{x}_1-\bar{x}_2\right) + Z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}},$$

$$\left(\bar{x}_1-\bar{x}_2\right) - Z_{\alpha/2}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}} < \mu_1-\mu_2 < \left(\bar{x}_1-\bar{x}_2\right) + Z_{\alpha/2}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}},$$

$$\left(\bar{x}_1-\bar{x}_2\right) - t_{\alpha/2,v}\cdot S_p\sqrt{\frac{2}{n}} < \mu_1-\mu_2 < \left(\bar{x}_1-\bar{x}_2\right) + t_{\alpha/2,v}\cdot S_p\sqrt{\frac{2}{n}};v=2n-2$$

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

where Pooled estimate of variance, $S_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$ with $v = n_1+n_2-2$,

$$\left(\bar{x}_1-\bar{x}_2\right) - t_{\alpha/2,v}\sqrt{\frac{1}{n}\left(s_1^2+s_2^2\right)} < \mu_1-\mu_2 < \left(\bar{x}_1-\bar{x}_2\right) + t_{\alpha/2,v}\sqrt{\frac{1}{n}\left(s_1^2+s_2^2\right)} \text{ with } v = 2(n-1),$$

$$\left(\bar{x}_1-\bar{x}_2\right) - t_{\alpha/2,v}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}} < \mu_1-\mu_2 < \left(\bar{x}_1-\bar{x}_2\right) + t_{\alpha/2,v}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}} \text{ with } v = \frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1}+\frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}},$$

$$\frac{(n-1)\cdot s^2}{\chi^2_{\alpha/2,v}} < \sigma^2 < \frac{(n-1)\cdot s^2}{\chi^2_{1-\alpha/2,v}} \text{ with } v = n-1,$$

$$\frac{s_1^2}{s_2^2}\cdot\frac{1}{f_{\alpha/2}(\nu_1,\nu_2)}<\frac{\sigma_1^2}{\sigma_2^2}<\frac{s_1^2}{s_2^2}\cdot f_{\alpha/2}(\nu_2,\nu_1) \text{ with } \nu_1=n_1-1 \text{ and } \nu_2=n_2-1.$$

Hypothesis Testing :

$$Z_{Test}=\frac{\bar{x}-\mu}{\sigma/\sqrt{n}},\quad Z_{Test}=\frac{\bar{x}-\mu}{s/\sqrt{n}},\quad T_{Test}=\frac{\bar{x}-\mu}{s/\sqrt{n}}$$

$$Z=\frac{(\bar{X}_1-\bar{X}_2)-(\mu_1-\mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}},\quad T=\frac{(\bar{X}_1-\bar{X}_2)-(\mu_1-\mu_2)}{S_p\cdot\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \text{ with } v=n_1+n_2-2,$$

$$Z=\frac{(\bar{X}_1-\bar{X}_2)-(\mu_1-\mu_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}},\quad T=\frac{(\bar{X}_1-\bar{X}_2)-(\mu_1-\mu_2)}{\sqrt{\frac{1}{n}\left(s_1^2+s_2^2\right)}},\quad T=\frac{(\bar{X}_1-\bar{X}_2)-(\mu_1-\mu_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}} \text{ with}$$

$$v=\frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1}+\frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}}.\ ;\ S_p^2=\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}\ ;\ \chi^2=\frac{(n-1)s^2}{\sigma^2}$$

$$F=\frac{s_1^2}{s_2^2},\quad \text{with } \frac{1}{f_{\alpha/2}(\nu_2,\nu_1)} \quad \text{and} \quad f_{\alpha/2}(\nu_1,\nu_2)$$

Simple Linear Regressions :

$$S_{xy}=\sum x_iy_i-\frac{\sum x_i\cdot\sum y_i}{n},\ S_{xx}=\sum x_i^2-\frac{\left(\sum x_i\right)^2}{n},\ S_{yy}=\sum y_i^2-\frac{\left(\sum y_i\right)^2}{n},\ \bar{x}=\frac{\sum x}{n},\ \bar{y}=\frac{\sum y}{n},$$

$$\hat{\beta}_1=\frac{S_{xy}}{S_{xx}},\ \hat{\beta}_0=\bar{y}-\hat{\beta}_1\bar{x},\ \hat{y}=\hat{\beta}_0+\hat{\beta}_1x,\ r=\frac{S_{xy}}{\sqrt{S_{xx}\cdot S_{yy}}},\ SSE=S_{yy}-\hat{\beta}_1S_{xy},\ MSE=\frac{SSE}{n-2},$$

$$T=\frac{\hat{\beta}_1-\beta_1^*}{\sqrt{\frac{MSE}{S_{xx}}}}\sim t_{n-2},\ T=\frac{\hat{\beta}_0-\beta_0^*}{\sqrt{MSE\left(\frac{1}{n}+\frac{\bar{x}^2}{S_{xx}}\right)}}\sim t_{n-2}.$$

Analysis of Variance

$$SST=\sum_{i=1}^{n}\sum_{j=1}^{k}y_{ij}^2-\frac{Y_{..}^2}{N},\ SSTrt=\sum_{i=1}\frac{Y_{i.}^2}{n_i}-\frac{Y_{..}^2}{N},\ SSE=SST-SSTrt,\quad MSTrt=\frac{SSTrt}{k-1}$$

$$MSE=\frac{SSE}{N-k},\quad f_{table}=f_{\alpha,k-1,N-k}$$