UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	STATISTICS
COURSE CODE	:	BIC 10603
PROGRAMME CODE	:	BIS / BIP / BIW / BIM
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 A network provider investigates the load of its network. The number of concurrent users is recorded at fifty locations (thousands of people) as in **Table 1**.

Table 1: The number of concurrent users

17.2	24.1	13.5	15.4	19.7
22.1	13.3	15.8	16.7	18.7
18.5	16.2	13.1	19.5	17.6
17.2	17.5	16.1	16.2	15.9
18.6	19.0	21.9	16.9	15.2
14.8	23.9	23.9	17.1	17.1
21.7	14.8	19.3	20.2	15.0
15.8	22.2	12.0	13.4	18.8
16.3	21.7	19.9	19.8	21.6
22.8	20.7	19.4	17.7	11.9

(a) Calculate the point estimate of the population mean (μ) and the margin of error (ME).

(6 marks)

(b) Construct a 90% and 95% confidence intervals about the population mean (μ).

(6 marks)

(c) Based on answer from **Q1(b)**, is the width of 95% confidence interval larger than the width of 90% confidence interval? Explain your answer.

(3marks)

(d) Construct a 90% confidence interval for $n = 85$.

(2 marks)

(e) Comparing your answers from **Q1(b)** and **Q1(d)**, how does the sample size, n, affect the confidence interval?

(3 marks)

Q2 (a) The realibility of a system is the probability that a system is consistently perfoms according to its specifications. The reliability of a series system consisting of n independent components is given by

$$R_S = \prod_{i=1}^{n} R_{i,}$$

and the realibility of a parallel system consisting of n independent components is given by

$$R_p = 1 - \prod_{i=1}^{n} (1 - R_i),$$

where R_i is the realibility of the i^{th} component and $\prod_{i=1}^{n} x_i = x_1 \times x_2 \times \cdots \times x_n$. Consider a system consists of series and parallel CPUs (A, B, C, D, E, F) with realibility as shown in **Figure Q2(a)**.

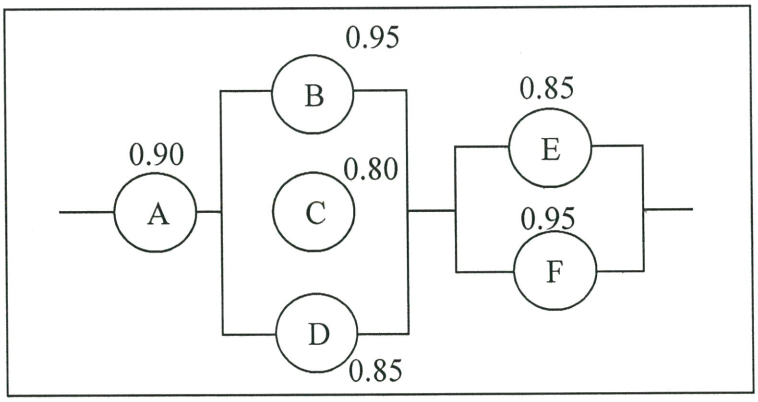

Figure Q2(a)

Find the realibility of the system.

(10 marks)

(b) Let Z be a continous random variable with the function below,

$$f(z) = \begin{cases} 12(z^2 - z^3), 0 < z < 1 \\ 0, \quad otherwise \end{cases}.$$

(i) Show that $f(z)$ satisfy with the probability density function.

(5 marks)

(ii) Find $E(Z)$ and $Std.dev\ (Z)$.

(5 marks)

Q3 (a) A system consists of seven databases that to be accessed by user's transaction. A transaction can successfully update databases when the transaction obtain majority locked from those databases. Assume that the probability of obtaining lock from each database is, p = 0.7. Find the probability of a transaction that unsuccessfully update databases from the system.

(10 marks)

(b) A server on average has to do five read-locks per hour. For any given hour, find the probability that will do the following:

(i) At most four read-locks.

(5 marks)

(ii) At least six read-locks.

(5 marks)

Q4 (a) Make the following test of hyphotesis.

(i) **Table 2** provides data on battery lives for laptops with a CD writer (sample *X*) and without a CD writer (sample *Y*). Does CD writer consume extra energy, and therefore, does it reduce the battery life on a laptop?

Table 2: Data of battery lives for laptops for sample *X* and *Y*

Sample X	Sample Y
$n_x = 12$	$n_y = 18$
$\bar{x} = 4.8$	$\bar{y} = 5.3$
$s_x = 1.6$	$s_y = 1.4$

(6 marks)

(ii) $H_0: \mu = 42$, $H_1: \mu < 42$, $n = 75$, $\bar{x} = 40.5$, $\sigma = 7.4$, $\alpha = 0.01$.

(4 marks)

(b) An experiment was conducted to compare three different computer keyboard designs with respect to their effect on repetitive stress injuries (rsi). 15 businesses of comparable size participated in a study to compare three keyboard designs. 5 of 15 businesses were randomly selected and their computers were equipped with design 1. 5 of the remaining 10 were selected and equipped with design 2, and the remaining 5 used design 3. After one year, the number of repetitive stress injuries (rsi) were recorded for each company. The results are shown in **Table 3**.

Table 3: The results of computer keyboard design and rsi

No. Exp.	Design 1	Design 2	Design 3
1	10	24	17
2	10	22	17
3	8	24	15
4	10	24	19
5	12	26	17

Test a claim that repetitive stress injuries (rsi) affects the keyboard design at $\alpha = 0.05$ significance level.

(10 marks)

Q5 In **Table 4**, the data represent investments (in thousands of Ringgit Malaysia), in the development of new software by some computer companies over 11-years period.

Table 4: The investment data in the development of new software

Year, X	Investment, Y	Year, X	Investment, Y
2003	17	2008	39
2004	23	2009	39
2005	31	2010	40
2006	29	2011	41
2007	33	2012	44

(a) Based on the data in **Table 4**, obtain the regression line of the year and investment in the development of new software.

(6 marks)

(b) If we randomly select a yearly investment is 2012, predict the investment in the new software development and calculate its error.

(4 marks)

(c) Test at 1% significance level whether the slope of the regression line for year investment is positive.

(6 marks)

(d) Calculate the coefficient of determination (R^2) and comment on your answer.

(4 marks)

- END OF QUESTION –

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Formula

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

$$r=\frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}},\quad \hat{\beta}_1=\frac{S_{xy}}{S_{xx}},\quad \hat{\beta}_0=\bar{y}-\hat{\beta}_1\bar{x}$$

$$Z=\frac{\bar{x}-\mu}{\sigma/\sqrt{n}},\quad Z=\frac{\bar{x}-\mu}{s/\sqrt{n}},\quad T=\frac{\bar{x}-\mu}{s/\sqrt{n}}$$

$$\bar{x}-z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)<\mu<\bar{x}+z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right)$$

$$\bar{x}-z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)<\mu<\bar{x}+z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

$$\bar{x}-t_{\alpha/2,\,v}\left(\frac{s}{\sqrt{n}}\right)<\mu<\bar{x}+t_{\alpha/2,\,v}\left(\frac{s}{\sqrt{n}}\right),\ v=n-1$$

$$S_p^2=\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}\ \text{and}\ v=n_1+n_2-2\quad v=2(n-1)$$

$$\chi^2=\sum_{i=1}^{k}\frac{(O_i-E_i)^2}{E_i},\ \chi^2=\sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij}-E_{ij})^2}{E_{ij}},\ MSTR=\frac{SSTR}{k-1},\ MSE=\frac{MSTR}{N-k}$$

$$SST=\sum X^2-(\sum X)^2/N,\ SSTR=\sum T_i^2/n_i-(\sum X)^2/N,\ SSE=SST-SSTR$$

$$T=\frac{\hat{\beta}_1-\beta_c}{\sqrt{MSE/S_{xx}}},\ SSE=S_{yy}-\hat{\beta}_1 S_{xy},\ MSE=\frac{SSE}{n-k}$$

$$\chi^2=\frac{(n-1).s^2}{\sigma^2{}_0},\ F=\frac{s_1^2}{s_2^2}$$

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$$v = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\frac{\left(s_1^2/n_1\right)^2}{n_1 - 1} + \frac{\left(s_2^2/n_2\right)^2}{n_2 - 1}}$$

$$\sum_{i=-\infty}^{\infty} p(x_i) = 1, \; E(X) = \sum_{\forall x} xp(x), \; Var(X) = E(X^2) - [E(X)]^2,$$

$$P(X = r) = {}^nC_r \cdot p^r \cdot (1-p)^{n-r} \quad r = 0, 1, \ldots, n \quad P(X = r) = \frac{e^{-\mu} \cdot \mu^r}{r!} \quad r = 0, 1, \ldots, \infty$$

$$X \sim N(\mu, \sigma^2), \; Z \sim N(0,1) \text{ and } Z = \frac{X - \mu}{\sigma},$$

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

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