UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ENGINEERING STATISTICS
COURSE CODE	:	BWM 20502 / BSM 2922
PROGRAMME	:	1 BDD 2 BDD/BED/BEH/ BFF 3 BDD/ BEE/BFF 4 BDD/ BEE/BFF
EXAMINATION DATE	:	JUNE 2012
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Assume that the number of network errors experienced in a day on a local area network (LAN) is distributed as a Poisson random variable. The average number of network errors experienced in a day is 2.4. Find the probability that;

(i) exactly one network error will occur in any given day.

(ii) at most three network errors will occur in any given day.

(iii) more than two network error will occur in two days.

(14 marks)

(b) A test consists of 50 multiple choice questions with five choices for each question. As an experiment, you guess on each and every answer without even reading the questions.

(i) State the distribution type (binomial/poisson/normal) for the above statement?

(ii) Obtain mean and variance for the number of correct answers.

(iii) Find the probability of getting more than 20 correct answers.

(11 marks)

Q2 (a) The television picture tubes of manufacturer ABC have a mean life time of 6.5 years and standard deviation of 0.9 year, while those of manufacturer XYZ have a mean lifetime of 6.0 years and a standard deviation of 0.8 year. What is the probability that a random sample of 36 tubes from manufacturer ABC will have a mean lifetime that is at least 1 year more than the mean lifetime of a sample of 49 tubes from manufacturer XYZ?

(10 marks)

(b) **Table Q2** shows percentage of investments in energy securities (x) and tax efficiency of a mutual fund portfolio.

Table Q2 : Percentage of Investments in Energy Securities and Tax Efficiency of a Mutual Fund Portfolio

x	3.1	3.2	3.7	4.3	4.0	5.5	6.7	7.4	7.4	10.6
y	98.1	94.7	92.0	89.9	87.5	85.0	82.0	77.8	72.1	53.5

(i) Fit a straight line to the relationship of investments in energy securities (x) and tax efficiency of a mutual fund portfolio (y) and interpret your result.

(ii) Predict the tax efficiency of a mutual fund portfolio with 5% of its investment in energy securities.

(iii) Compute the linear correlation coefficient, r and interpret the result.

(15 marks)

Q3 The data in **Table Q3** show the salaries (in RM) of professional doctors employed by private hospitals and by government-owned hospital.

Table Q3 : Salaries (in RM) of professional doctors employed by private hospitals and by government-owned hospital

	Private	**Government**
Mean Sample	72, 800	60, 400
Sample standard deviation	12, 800	11, 500
Sample size	21	21

(a) Find a 90% confidence interval for salary of professional doctors in private sector.

(7 marks)

(b) Find the 95% confidence interval for different salary of professional doctors employed by private hospitals and government-owned hospital. Assume that the populations are approximately normal distributed with equal variances.

(9 marks)

(c) Find a 95% confidence interval for the ratio of variance salary for professional doctors employed by private hospitals and by government-owned hospital.

(9 marks)

Q4 (a) Analyses of drinking water samples for 100 homes in each of two different sections of a city gave the following means and standard deviations of lead levels (in parts per million) as given in **Table Q4(a)**.

Table Q4(a) : Analyses of Drinking Water Samples for 100 Homes in Each of Two Different Sections of a City

	Section 1	Section 2
Sample size	100	100
Mean	34.1	36.0
Standard deviation	5.9	6.0

Use a 5% level of significance to test the difference in the mean lead levels for Section 1 and Section 2 of the city. Assume that the variances of population are unknown.

(12 marks)

(b) To investigate the effect of amphetamines on water consumption, 15 lab rats were injected with amphetamine and 10 with saline solution. The water consumed by each rat in ml/kg of body weight was recorded and the results are summarized in the **Table Q4(b)**.

Table Q4(b) : Data of 15 Lab Rats Were Injected with Amphetamine and 10 lab rats with Saline Solution

	Amphetamine	**Saline**
n	15	10
$\bar{x}$	115	135
s	40	15

To compare the two variances, test the hypothesis using $\alpha = 0.05$.

(13 marks)

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Formula

Random variables:

$\sum_{i=-\infty}^{\infty} P(x_i) = 1$, $E(X) = \sum_{\forall x} x \cdot P(x)$, $E(X^2) = \sum_{\forall x} x^2 \cdot P(x)$, $\int_{-\infty}^{\infty} f(x)\, dx = 1$,

$E(X) = \int_{-\infty}^{\infty} x \cdot P(x)\, dx$, $E(X^2) = \int_{-\infty}^{\infty} x^2 \cdot P(x)\, dx$, $Var(X) = E(X^2) - [E(X)]^2$.

Special Probability Distributions :

$P(x=r) = {}^nC_r \cdot p^r \cdot q^{n-r}, r = 0, 1, \ldots, n$, $X \sim B(n, p)$, $P(X=r) = \dfrac{e^{-\mu} \cdot \mu^r}{r!}$, $r = 0, 1, \ldots, \infty$,

$X \sim P_0(\mu)$, $Z = \dfrac{X-\mu}{\sigma}$, $Z \sim N(0,1)$, $X \sim N(\mu, \sigma^2)$.

Sampling Distributions :

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

Estimations :

$n = \left(\dfrac{Z_{\alpha/2} \cdot \sigma}{E}\right)^2$, $\bar{x} - Z_{\alpha/2}\sqrt{\dfrac{\sigma^2}{n}} < \mu < \bar{x} + Z_{\alpha/2}\sqrt{\dfrac{\sigma^2}{n}}$, $\bar{x} - t_{\alpha/2,v}\sqrt{\dfrac{s^2}{n}} < \mu < \bar{x} + t_{\alpha/2,v}\sqrt{\dfrac{s^2}{n}}$

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

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

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

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

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

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

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

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

$$\frac{s_1^2}{s_2^2}\cdot\frac{1}{f_{\alpha/2}(v_1,v_2)}<\frac{\sigma_1^2}{\sigma_2^2}<\frac{s_1^2}{s_2^2}\cdot f_{\alpha/2}(v_2,v_1) \text{ with } v_1=n_1-1 \text{ and } v_2=n_2-1.$$

Hypothesis Testing :

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

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

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

$$F=\frac{s_1^2}{s_2^2}, \quad \text{with } \frac{1}{f_{\alpha/2}(v_2,v_1)} \quad \text{and} \quad f_{\alpha/2}(v_1,v_2)$$

Simple Linear Regressions :

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

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

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