UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	MATHEMATICS III
COURSE CODE	:	BWM 21303
PROGRAMME	:	1 BBV 2 BBV 3 BBV
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Casual workers in a certain industry are paid on average RM5.00 per hour which is normally distributed with standard deviation of RM1.90. A sample of 40 casual workers from the industry was selected to be respondents for the underpaid issue questionnaires. Find the probability that the average payment for those casual workers is

(i) at least RM6 per hour

(ii) lower than RM 4.5 per hour

(11 marks)

(b) The average running times of films produced by Company M is 107.3 minutes and a standard deviation of 17.5 minutes, while those of Company N have a mean running times of 102.3 minutes and a standard deviation of 12.3 minutes. Assume the populations are approximately normal distributed, find the probability that a random sample of 42 films from company M will have mean running times more than men running times of a random sample of 52 films from company N.

(9 marks)

Q2 (a) A restaurant owner wishes to find the 95% confidence interval of the true mean cost of a sea bass fish. A previous study showed that the standard deviation of the price of a sea bass fish was RM 0.53. Given that the true mean to be accurate within RM 0.15.

(i) What is the value of standard error?

(ii) How large should the sample of a sea bass fish be taken?

(7 marks)

(b) A study was done to investigate the salaries per month (in RM) of secondary teacher employed by private schools and by government schools by choosing 150 private school teachers and 200 government schools teachers. The sample mean and standard deviation for salary employed by private schools was RM 4133 and RM 803, while for salary employed by government schools was RM 4210 and RM 935 respectively.

(i) Construct a 97% confidence interval for the salaries per month (in RM) of secondary teacher employed by private schools.

(ii) Construct a 99% confidence interval for the salaries per month (in RM) of secondary teacher employed by government schools.

(iii) Which confidence interval shows more deviation?

(13 marks)

Q3 A study to investigate the melting point of two type alloys is conducted where the data in **Table Q3** show the melting point (in °C) for alloy Type I and Type II.

Table Q3 : The Melting Point (in °C) for Alloy Type I and Type II

	Alloy Type I	**Alloy Type II**
Mean Sample	143°C	151°C
Sample standard deviation	13°C	11°C
Sample size	60	60

(a) Find a 90% confidence interval for variance melting point for alloy Type I.
(6 marks)

(b) Find the 95% confidence interval for different mean melting point for alloy Type I and Type II. Assume that the populations are approximately normal distributed with equal variances.
(7 marks)

(c) Find a 95% confidence interval for the ratio of variance melting point for alloy Type I and Type II.
(7 marks)

Q4 (a) Twenty years ago, entering first-year high school students could do an average of 24 push-ups in 60 seconds. To see whether this remain true today, a random sample of 36 first-year students was chosen. If their average was 22.5 with sample standard deviation of 3.1, can we conclude that the mean is no longer equal to 24? Use the 5% level of significance.
(10 marks)

(b) Data were collected to determine if there is a difference between the mean IQ scores of urban and rural students in upper Michigan. A random sample of 100 urban students yielded a sample mean score of 102.2 and a sample standard deviation of 11.8. A random sample of 60 rural students yielded a sample mean score of 105.3 with sample standard deviation of 10.6. Are the data significant enough, at the 5 percent level, for us to reject the null hypothesis that the mean scores of urban and rural students are the same? Assume that the variances of population are unknown.
(10 marks)

Q5 An electric utility wants to estimate the relationship between the daily summer temperature and the amount of electricity used by its customers. The following data were collected as in **Table Q5**.

Table Q5 : Data for Carbonation and Temperature

Temperature (X) (degrees Fahrenheit)	Electricity (Y) (millions of kilowatts)
85	22.5
90	23.7
76	20.3
91	23.4
84	24.2
94	23.5
88	22.9
85	22.4
97	26.1
86	23.1
82	22.5
78	20.9
77	21.0
83	22.6

(a) Find the estimated regression line. Interpret the result.

(10 marks)

(b) Predict the electricity that will be consumed tomorrow if the predicted temperature for tomorrow is 93.

(2 marks)

(c) Find the value of coefficient of determination and interpret the result.

(5 marks)

(d) Find the value of correlation coefficient and interpret the result.

(3 marks)

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Formula

Random variables:

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

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

Special Probability Distributions :

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

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

Sampling Distributions :

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

Estimations :

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

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

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

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

(Equal population variances)

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 $v=n_1+n_2-2$,

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

(Unequal population variances, $n_1=n_2$)

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

(Unequal population variances, $n_1 \neq n_2$)

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

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

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 :

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

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

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