UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	STATISTICS FOR MANAGEMENT
CODE	:	BSM 1823
COURSE	:	1 BPA/BPB/BPC
DATE	:	APRIL 2010
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS IN **PART A** AND TWO (2) QUESTIONS IN **PART B**

THIS EXAMINATION PAPER CONSISTS OF 7 PAGES

PART A

Q1 (a) Director of the human resource claims that the average starting salary for their executive managers is RM48000 per year. Is there enough evidence to reject the director's claim at $\alpha = 0.05$ if

(i) a sample of 10 executive managers has a mean of RM48450 and a standard deviation of RM400?

(ii) a sample of 40 executive managers has a mean of RM48900 and a variance of RM90000?

(12 marks)

(b) An experiment was conducted to assess the effect of using magnets at the filter point in the manufacture of coffee filter packs. The data in **Table Q1(b)** presents the weight of filter packs in gram.

Table Q1(b): Weight of filter packs.

20.1	20.1	19.5	19.4	19.8	20.4	19.9	20.5	19.7

At 0.05 level of significant, test whether the variance of the weight is less than 0.16 gram.

(8 marks)

Q2 In a study relating the degree of warping of a copper plate *y*, (in mm) to temperature *x*, (in °C), the following summary statistics were calculated:

$$n = 40,\ \sum_{i=1}^{n}(x-\bar{x})^2 = 98{,}775,\ \sum_{i=1}^{n}(y-\bar{y})^2 = 19.10,\ \bar{x} = 26.36,\ \bar{y} = 0.5188 \text{ and}$$

$$\sum_{i=1}^{n}(x-\bar{x})(y-\bar{y}) = 826.94$$

(a) Compute the least-squares equation for predicting warping from temperature and interpret your result.

(4 marks)

(b) Predict the warping when the temperature is 40^0C.

(2 marks)

(c) What is the temperature when the predicted warping is 0.55 mm?

(2 marks)

(d) Compute the coefficient of correlation *r*, between the degree of warping and the temperature.

(2 marks)

(e) Compute the coefficient of determination and interpret your result.

(2 marks)

(f) At significance level, α = 0.05, test if there is a significance relationship between warping and temperature. What is your conclusion?

(8 marks)

Q3 (a) Operation managers wanted to investigate whether there is difference of time in completing their finishing product from three production lines. The output of one way ANOVA is shown in **Table Q3(a)**. Assume that $\alpha = 0.05$.

Table Q3(a): ANOVA

	D.f.	Sum of Squares	Mean Square Variance	F
Between Groups	2	0.011	**B**	**D**
Within Groups	**A**	0.285	**C**	
Total	14	0.296		

(i) Find the value of **A**, **B**, **C** and **D**.

(ii) Test the hypothesis if there is any difference of time in completing their finishing product from the three production lines.

(10 marks)

(b) The experiment was carried out in a laboratory to investigate the amount of dirt (in mg) removed by the detergent. The detergent has three brands, and three samples are selected at random from each brand. The data are shown in **Table Q3(b)**. Test the hypothesis that there is no difference of the amount of dirt removed among the three brands at the 0.05 level of significance.

Table Q3(b): Amount of dirt removed from the detergent

Brand A	Brand B	Brand C
12	12	17
13	16	16
15	17	19

(10 marks)

PART B

Q4 The concentration of a reactant is a random variable with probability density function given as below:

$$f(x) = \begin{cases} 1.2(x + x^2), & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$$

Find the

(a) probability that the concentration is greater than 0.55,

(4 marks)

(b) mean of the concentration,

(3 marks)

(c) probability that the concentration is within $\pm$ 0.1 of the mean,

(5 marks)

(d) standard deviation, σ of the concentrations,

(3 marks)

(e) probability that the concentration is within $\pm 2\sigma$ of the mean.

(5 marks)

Q5 In Malaysia, only four percent of people have Type AB blood.

(a) How many donors must be checked to find on the average one donor with Type AB blood?

(2 marks)

(b) Among 50 donors, what is the probability that:

(i) at most five donors with Type AB blood?

(ii) exactly one donor with Type AB blood?

(11 marks)

(c) Among 300 donors, what is the probability that less than 10 donor with Type AB blood?

(7 marks)

Q6 (a) The waiting time of clients in a bank is normally distributed with a mean 3.2 minutes with a standard deviation of 1.6 minutes. If a random sample of 49 clients is selected, find the

(i) sampling distribution of the mean waiting time,

(ii) probability that the mean waiting time at a bank is less than 3.0 minutes,

(iii) probability that the mean waiting time at a bank is at least 2.8 minutes but less than 3.55 minutes.

(8 marks)

(b) Study on height of male and female students was conducted at certain university and assume that the students height is normally distributed. The mean height of male students is 175.5 cm and standard deviation of 1.25 cm, while female students have a mean height of 168.6 cm and standard deviation of 1.82 cm. Assume that 36 male students and 30 female students were selected randomly. Find the probability that the

(i) average height of male students is between 175 and 176 cm,

(ii) different average between height of male and female students less than 6.5 cm,

(iii) average height of male students at least 6 cm more than height of female students.

(12 marks)

Q7 The data in **Table Q7(a)** are number of accidents cases occur in Malaysia from January to December for the year 2006 and 2007. Assume that the variances of 2006 and 2007 are equal.

Table Q7(a): Number of accidents occur in Malaysia from January to December for the year 2006 and 2007

	Year	
Month	**2006**	**2007**
1	51441	62445
2	46793	49834
3	50476	56032
4	56806	52458
5	51318	54391
6	45168	49620
7	50303	60040
8	53663	57179
9	51721	54114
10	70792	61381
11	53737	54172
12	52867	56507

Source: Malaysia Road and Safety Department

(a) Construct a 95% confidence interval for the difference between two means for number of accidents cases for the year 2006 and 2007.

(13 marks)

(b) Construct a 95% confidence interval for the ratio of two variances for number of accidents cases for the year 2006 and 2007.

(7 marks)

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Formulae

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 :

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

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

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

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 Testings :

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

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

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

Simple Linear Regressions :

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

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

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

ANOVA

$$F = \frac{SS_{Between}}{SS_{Within}} \qquad N = n_1 + n_2 + \dots + n_k$$

The degrees of freedom are

d.f.N = $k - 1$ where k is the number of groups

d.f.D = $N - k$ where N is the sum of the sample sizes of the groups,

$$SS_{Total} = \left(\sum A^2 + \sum B^2 + \sum C^2\right) - \frac{(\sum A + \sum B + \sum C)^2}{n}$$

$$SS_{Between} = \frac{1}{k}[(\sum A)^2 + (\sum B)^2 + (\sum C)^2] - \frac{(\sum A + \sum B + \sum C)^2}{n}$$

$$SS_{Within} = SS_{within} = SS_{total} - SS_{between}$$