# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2010/2011

| | | |
|---|---|---|
| COURSE NAME | : | STATISTICS FOR MANAGEMENT |
| COURSE CODE | : | BWM 11003 / BSM 1823 |
| PROGRAMME | : | 1 BPA/ BPB/ BPC<br>2 BPA/ BPB/ BPC<br>3 BPA/ BPC |
| EXAMINATION DATE | : | APRIL / MAY 2011 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**. |

THIS EXAMINATION PAPER CONSISTS OF 7 PAGES

## PART A

**Q1** (a) Halimah is a new nurse in Hospital Batu Pahat. Her duty is to help doctors to measure the patients' systolic blood pressure. **Table Q1(a)** shows the data of the ages (in year) and the systolic blood pressures (in mm Hg), which is taken from 12 patients in this hospital.

**Table Q1(a)** : Data of Age and Systolic Blood Pressure

| Age | Blood pressure |
|---|---|
| 56 | 147 |
| 42 | 125 |
| 72 | 160 |
| 36 | 118 |
| 63 | 149 |
| 47 | 128 |
| 55 | 150 |
| 49 | 145 |
| 38 | 115 |
| 42 | 140 |
| 68 | 152 |
| 60 | 155 |

(i) Calculate and interpret the coefficient of Pearson correlation.
(3 marks)

(ii) Using the least square method, find the regression line that approximates the blood pressure of a patient.
(7 marks)

(iii) Estimate the blood pressure of a patient whose age is 44 years old.
(2 marks)

(b) **Table Q1(b)** shows the result of ANOVA.

**Table Q1(b)** : Result of ANOVA

| Source of Variation | *SS* | *df* | *MS* | *F* |
|---|---|---|---|---|
| Between Groups | 20.4 | 4 | *B* | *D* |
| Within Groups | 9.6 | *A* | *C* | |
| Total | 45.0 | 20 | | |

(i) State the null and alternative hypotheses from the table above.
(1 mark)

(ii) What is the value of $A$, $B$, $C$ and $D$?
(4 marks)

(iii) What is your conclusion at 5% level of significance?
(3 marks)

**Q2** (a) A sample of 30 students from FPTPK has an average expense of RM500 per month with a standard deviation of RM80. Another sample of 32 students from FSSW has an average expense of RM530 per month with a standard deviation of RM50. Test the hypothesis if there are significance differences in average of students' expenses between the two faculties. Use 0.05 of significance level.

(7 marks)

(b) The methods used for teaching reading were applied to two randomly selected groups of elementary school children. The results of these methods were compared as shown in Table **Q2(b)** after a reading comprehension test was being given at the end of the learning period.

**Table Q2(b):** Results from the Two Methods of Teaching Reading

| Item | Method $A$ | Method $B$ |
|---|---|---|
| Number of children in a group | 11 | 13 |
| Mean | 73 | 91 |
| Variance | 52 | 71 |

(i) Test the hypothesis to determine whether the variance for Method $A$ is higher than 53. Use 0.01 of significance level.

(6 marks)

(ii) Test the hypothesis to determine whether the variance for Method $A$ is difference than Method $B$. Use 0.05 of significance level.

(7 marks)

## PART B

**Q3** (a) The prior probabilities for event $A_1$ and $A_2$ are given below.

$$P(A_1) = 0.40 \text{ and } P(A_2) = 0.60.$$

It is also known that $P(A_1 \cap A_2) = 0$. Suppose that

$$P(B \mid A_1) = 0.20 \text{ and } P(B \mid A_2) = 0.05.$$

(i) Are $A_1$ and $A_2$ mutually exclusive? Give the reason.

(2 marks)

(ii) Compute $P(A_1 \cap B)$.

(2 marks)

(iii) Compute $P(B)$ and apply Bayes' theorem to find $P(A_1 \mid B)$.

(4 marks)

(b) The actual amount of coffee (in gram) in a 230-gram jar filled by a certain machine is a random variable and the probability density function is given by

$$f(x) = \begin{cases} 0, & x \leq 227.5 \\ \dfrac{1}{5}, & 227.5 \leq x \leq 232.5 \\ 0, & x \geq 232.5 \end{cases}$$

(i) Find the probability that a 230-gram jar filled by this machine will contain at most 228.65 grams of coffee.

(3 marks)

(ii) Find the probability that a 230-gram jar filled by this machine will contain anywhere from 229.85 grams to 231.66 grams of coffee.

(3 marks)

(iii) Find the standard deviation of $X$.

(6 marks)

**Q4** (a) Airline passengers arrive randomly and independently at the passenger-screening facility at an international airport. The mean arrival rate is 10 passengers per minute. Compute the probability that

(i) no arrivals in a one-minute period.

(2 marks)

(ii) three or fewer passengers arrive in a one-minute period.

(2 marks)

(iii) no arrivals in a 15-second period.

(4 marks)

(iv) at least one arrival in a 15-second period.

(2 marks)

(b) An electronic device contains 5000 electronic chips. With assumption that the chips fail independently, the probability that each chip operated without failure during the useful life of the device is 0.999. Let $X$ be the number of failure of the chips.

(i) Write down the appropriate probability distribution of $X$.

(1 mark)

(ii) Calculate the mean and the variance of $X$.

(4 marks)

(iii) Rewrite the probability distribution of $X$ in **part b(i)** if given that the normal approximation can be used.

(1 mark)

(iv) Compute the probability that 10 or more of the original 5000 electronic chips fail during the useful life of the electronic device. The continuity correction shall be considered.

(4 marks)

**Q5** A company manufactures two types of cars, which are $A$ and $B$. The mean weight of cars $A$ is 5500kg, while the weight of cars $B$ is 5000kg. The standard deviation for cars $A$ is 300kg and cars $B$ is 250kg. The company randomly selects 100 cars $A$ and 50 cars $B$.

(a) What is the probability that the mean weight of cars $A$ is more than 5550kg? (4 marks)

(b) What is the probability that the mean weight of cars $B$ is less than 5000kg? (5 marks)

(c) Write the distribution of the difference between the mean weight of cars $A$ and $B$. Then, find the probability that the mean weight of cars $A$ is less than the mean weight of cars $B$. (3 marks)

(d) Find the probability that the difference mean weight of cars $A$ and $B$ is more than 625kg. (4 marks)

(e) Find the probability that the mean weight of cars $A$ lies between 600kg and 700kg more than mean weight of cars $B$. (4 marks)

**Q6** Table **Q6** shows the random samples for the ages of lecturers in University $A$ and University $B$.

**Table Q6** : The Ages of Lecturers in University

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| University $A$ | 35 | 60 | 44 | 57 | 39 | 72 | 62 | 55 |
| University $B$ | 33 | 40 | 70 | 38 | 55 | 58 | | |

(a) Construct a 95% confidence interval of standard deviation for University $A$. (10 marks)

(b) Construct a 90% confidence interval for the ratio of two variances between the ages of lecturers in University $A$ and University $B$. (10 marks)

**FINAL EXAMINATION**

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COURSE: 1 BPA/BPB/BPC, 2 BPA/BPB/BPC & 3 BPA/BPC

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## Formulae

Random Variables :

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

$$\int_{-\infty}^{\infty} f(x)\,dx = 1, \quad E(X) = \int_{-\infty}^{\infty} x \cdot P(x)\,dx, \quad E(X^2) = \int_{-\infty}^{\infty} x^2 \cdot P(x)\,dx, \quad Var(X) = E(X^2) - [E(X)]^2.$$

Special Probability Distributions :

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

$$X \sim P_0(\mu),\ P(X = r) = \frac{e^{-\mu} \cdot \mu^r}{r!},\ r = 0, 1, \ldots, \infty, \quad X \sim N(\mu, \sigma^2),\ Z \sim N(0,1),\ Z = \frac{X-\mu}{\sigma}.$$

Sampling Distributions :

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

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

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

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

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

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

**Hypothesis Testing :**

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

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

$$v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}; \quad S_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}; \quad \chi^2 = \frac{(n-1)s^2}{\sigma^2}; \quad F = \frac{S_1^2}{S_2^2}.$$

**Simple Linear Regressions :**

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

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

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