UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2008/2009

SUBJECT	:	MANAGEMENT STATISTICS
CODE	:	BSM1823
COURSE	:	1 BPA/ BPB/ BPC
DATE	:	APRIL 2009
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE** (5) QUESTIONS.

THIS EXAMINATION PAPER CONSISTS OF 7 PAGES

Q1 Let h be a constant and consider the probability distribution function

$$f(x)=\begin{cases} hx^2-1, & 0\le x\le 3 \\ 0, & \text{otherwise.}\end{cases}$$

Find

(a) the value of h.

(3 marks)

(b) cumulative density function of X.

(3 marks)

(c) expectation of X, $E(X)$.

(3 marks)

(d) variance of X, $Var(X)$.

(5 marks)

(e) $E(2X-1)$.

(3 marks)

(f) $Var(2X-1)$.

(3 marks)

Q2 (a) Professor Irfan encourages his statistics students to 'act in a prudent manner' by consulting the tutor if they have any questions as they prepare for the final exam. It appears that students' arrival at the tutor's office fits a Poisson distribution, with an average of 5.2 students every 20 minutes. He is concerned that if too many students need the tutor's services, a crowding problem may develop.

(i) Find the probability that four students will arrive every 20 minutes interval, which could create the crowding problem Professor Irfan fears. If this probability exceeds 20 percent, a second tutor will be hired.

(ii) Find the probability that more than four students will arrive every 20 minutes period. If it is greater than 50 percent, the tutors' office hours will be extended, allowing students to spread out the times they come to see the tutor.

(iii) Interpret your result in Q2(a)(i) and Q2(a)(ii).

(10 marks)

(b) An article in the international journal evaluated the relationship between physical fitness and stress. The research revealed that white-collar workers in good physical condition have only 10% probability of developing a stress-related health problem. In random sample of 400 white-collar employees, what is the probability that (Use Normal approximation)

(i) more than 50 white-collar employees in good physical condition will develop stress-related illnesses?

(ii) at most 39 white-collar employees in good physical condition will develop stress-related illnesses?

(10 marks)

Q3 (a) A machine used to extract juice from mangoes obtains an amount from each mango that is approximately normally distributed with mean of 133.2 grams and standard deviation of 11.3 grams. Suppose that a sample of 30 mangoes is selected.

(i) Find the probability that the mean extract juice is at least 130.4 grams.

(ii) If the sample increase to 50 mangoes, find the probability that the mean extract juice is between 131.2 and 135.6 grams.

(11 marks)

(b) A process used in filling bottles with soft drink result in net weight (in liter) that are normally distributed. There are two production lines that fill the soft drink in the bottles. The distribution for Line 1 is $X_1 \sim N(2.2, 0.5^2)$ and for Line 2 is $X_2 \sim N(2.3, 0.4^2)$. A random sample of 100 bottles in Line 1 and 150 bottles in Line 2 is selected. What is the probability that average net weight filled in

(i) Line 2 is at most 2.32 liter?

(ii) Line 1 is 0.02 liter less than Line 2?

(9 marks)

Q4 (a) Permata Hotel wants to develop a 99% interval for the mean number of rooms occupied each night at its location around the nation. How many nights must be included in the sample if an error of 50 rooms can be tolerated and a pilot sample reveals $s = 165$ rooms?

(3 marks)

(b) The percentage of carbon in incoming shipments of steel from two different vendors is to be compared. The means and standard deviation of percent carbon computed from random samples taken from the shipments are shown in **Table Q4(b)** below. Assume that the variances are equal and all necessary assumptions are satisfied.

Table Q4(b): Summary statistics for carbon in steel.

Shipment	n	$\bar{x}$	s^2
1	10	3.62	0.086
2	8	3.18	0.082

(i) Find the 95% confidence interval for the mean different between percentage of carbon in Shipment 1 and Shipment 2.

(ii) Find the 95% confidence interval for $\frac{\sigma_1^2}{\sigma_2^2}$ when the number of ships is increase by 3 unit for each vendors.

(17 marks)

Q5 (a) Gemilang Goods Sdn. Bhd. has implemented a special trade promotion for its propane stove and feels that the promotion should result in a price change for the consumer. The company knows that before the promotion began, the average retail price of stove was RM44.95, with population standard deviation of RM5.75. The manager samples 25 of its retailer after the promotion begins and finds the mean price for the stove is now RM42.95. At a 2% significance level, does Gemilang have reason to believe that the average retail price to the consumer has decreased?

(7 marks)

(b) The data in **Table Q5(b)** are earnings per share for a random samples of nine firms chosen from the certain report in year 2008. Assume that the variances of 2007 and 2008 earnings are equal.

Table Q5(b): Earning per share

Firm	1	2	3	4	5	6	7	8	9
2007 earnings	1.38	1.26	3.64	3.50	2.47	3.21	1.05	1.98	2.72
2008 earnings	2.48	1.50	4.59	3.06	2.11	2.80	1.59	0.92	0.47

(i) Find the mean and standard deviation of earnings per share for year 2007 and 2008.

(ii) At 0.05 significance level test whether the average of earnings per share is different in year 2007 and year 2008.

(13 marks)

Q6 Medical researchers have noted that adolescent females are much more likely to deliver low birth weight babies than adult females. Because low birth weight babies have higher mortality rates, there have been a number of studies examining the relationship between birth weight and mother's age for babies born to young mother. The summary statistics are shown below.

$$n = 10 \quad \sum x = 170 \quad \sum x^2 = 2910$$

$$\sum y = 30{,}041 \quad \sum y^2 = 91{,}785{,}351 \quad \sum xy = 515{,}600$$

(a) Find the equation of the regression line.

(5 marks)

(b) Find the average birth weight of babies born to 18 year-old mothers.

(2 marks)

(c) Find the correlation coefficient, r and coefficient of determination, r^2. Interpret the results for each coefficient.

(8 marks)

(d) Test the null hypothesis $\beta_1 = 100$ against the alternative hypothesis $\beta_1 > 100$ at the 0.05 level of significance.

(5 marks)

Q7 (a) Manufactured gas plans are used to produce gas for lighting, heating and feedstock for the chemical industry. This process creates wastes that include toxic hydrogen sulfide. The amount of sulfide (in meg/g) from three independent runs produced by a gas plant is collected at random. The output of one way ANOVA is shown in **Table Q7(a)**. Assume that $\alpha = 0.05$.

Table Q7(a): ANOVA

	Df	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, is there any a difference amount of sulfide from three independent runs produce by a gas plant.

(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 four brands, and three samples are selected at random from each brand. The data are shown in **Table Q7(b).** Test the hypothesis that there is no difference of the amount of dirt removed among the four brands at the 0.05 level of significance.

Table Q7(b): Amount of dirt removed from the detergent

Brand			
A	B	C	D
11	12	18	11
13	14	16	12
17	17	20	16

(10 marks)

STATISTICAL FORMULAE

$$\sum_{i=-\infty}^{\infty} p(x_i) = 1 \qquad \int_{-\infty}^{\infty} f(x)\, dx = 1 \qquad \text{Var}(X) = E(X^2) - [E(X)]^2$$

$$E(X) = \sum_{\forall x} x p(x) \qquad E(X) = \int_{-\infty}^{\infty} x f(x)\, dx$$

$$E(X^2) = \sum_{\forall x} x^2 p(x) \qquad E(X^2) = \int_{-\infty}^{\infty} x^2 f(x)\, dx$$

$$p(x) = \binom{n}{x} p^x (1-p)^{n-x},\ x = 0, 1, 2, \ldots, n \qquad p(x) = \frac{e^{-\mu}\mu^x}{x!},\ x = 0, 1, 2, \ldots$$

$$X \sim N(\mu, \sigma^2) \qquad \bar{X} \sim N(\mu, \frac{\sigma^2}{n}) \qquad Z = \frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim N(0, 1)$$

$$Z \sim N(0, 1) \qquad Z = \frac{X-\mu}{\sigma}$$

$$\bar{X}_1 - \bar{X}_2 \sim N(\mu_1 - \mu_2, \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}) \qquad Z = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \sim N(0, 1)$$

$$T = \frac{\bar{X}-\mu}{S/\sqrt{n}} \sim t_{\alpha, n-1} \qquad F = \frac{S_1^2}{S_2^2} \sim f_{\alpha, n_1-1, n_2-1}$$

$$\chi^2 = \frac{(n-1)S^2}{\sigma^2} \sim \chi^2_{\alpha, n-1} \qquad s^2 = \frac{1}{n-1}\left(\sum x^2 - \frac{(\sum x)^2}{n}\right)$$

$$T = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{S_P\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \sim t_{\alpha,\ n_1+n_2-2} \qquad S_P^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}$$

$$T = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \sim t_{\alpha, v} \qquad v = \frac{\left(S_1^2/n_1 + S_2^2/n_2\right)^2}{\frac{\left(S_1^2/n_1\right)^2}{(n_1-1)} + \frac{\left(S_2^2/n_2\right)^2}{(n_2-1)}} \quad \text{or} \quad v = 2(n\text{-}1)$$

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x \qquad \hat{\beta}_0 = \bar{y} - \hat{\beta}_1\bar{x} \qquad \hat{\beta}_1 = \frac{S_{xy}}{S_{xx}} \qquad \text{SSE} = S_{yy} - \hat{\beta}_1 S_{xy} \qquad \text{MSE} = \frac{\text{SSE}}{n-2}$$

$$s_{xx} = \sum_{i=1}^{n} x_i^2 - \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n} \qquad s_{yy} = \sum_{i=1}^{n} y_i^2 - \frac{\left(\sum_{i=1}^{n} y_i\right)^2}{n} \qquad s_{xy} = \sum_{i=1}^{n} x_i y_i - \frac{\sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n}$$

$$\hat{\beta}_1 \sim N\left(\beta_1, \frac{\sigma^2}{S_{xx}}\right) \qquad T = \frac{\hat{\beta}_1 - \beta_1^*}{\sqrt{\text{MSE}/S_{xx}}} \sim t_{\alpha, n-2} \qquad r^2 = \frac{(S_{xy})^2}{S_{xx}S_{yy}}$$

$$\hat{\beta}_0 \sim N\left(\beta_0, \sigma^2\left(\frac{1}{n} + \frac{\bar{x}^2}{S_{xx}}\right)\right) \qquad T = \frac{\hat{\beta}_0 - \beta_0^*}{\sqrt{\text{MSE}\left(1/n + \bar{x}^2/S_{xx}\right)}} \sim t_{\alpha, n-2}$$

$$SSTR(\text{between group}) = \sum r_j(\bar{x}_j - \bar{\bar{x}})^2 \qquad SSE(\text{within group}) = \sum\sum(x_{jk} - \bar{x}_j)^2$$

$$SST(\text{total}) = \sum_{i=1}^{r}\sum_{j=1}^{c}(x_{ij} - \bar{\bar{x}})^2 \qquad F = \frac{MSTR}{MSE} \sim f_{\alpha, (df1, df2)}$$