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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2011/2012

COURSE NAME	:	STATISTICS FOR MANAGEMENT
COURSE CODE	:	BSM 1823
PROGRAMME	:	4BPA/ 4BPB
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS EXAMINATION PAPER CONSISTS OF SEVEN (7) PAGES

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Q1. **Table Q1** presents the probability distribution function of the number of drums X ordered by a randomly chosen customer.

Table Q1: Probability Distribution Function of X

x	1	2	3	4	5
$p(x)$	0.4	k	0.2	0.1	0.1

Find

(a) the value of k if $p(x)$ is probability distribution function.
(3 marks)

(b) $P(X < 3)$.
(3 marks)

(c) $P(X \geq 2)$.
(3 marks)

(d) the mean number of drums ordered.
(5 marks)

(e) the variance of the number of drums ordered.
(6 marks)

Q2 (a) A sample of five items is drawn from a large lot in which 10% of the items are defective. Find

(i) the probability that none of the sampled items are defective.
(ii) the probability that exactly one of the sampled items is defective.
(iii) the probability that one or more of the sampled items are defective.
(10 marks)

(b) Assume that the number of hits on a certain website during a fixed time interval follows a Poisson distribution. Assume that the mean rate of hits is 5 per minute. Find

(i) the probability that there will be exactly 5 hits in the next one minute.
(ii) the probability that there will be at least 2 hits in the next one minute.
(iii) the probability that there will be exactly 17 hits in the next three minutes.
(10 marks)

Q3. A computer system administrator notices that computers run in a particular operating system seem to freeze up more often as the installation of the operating system ages. He measure the time (in minutes) before freeze-up for five computers one month after installation and for six computers seven month after installation. The results are as in **Table Q3.**

Table Q3: Time (in minutes) before freeze-up the computers after installation

One month after installation	20.74	23.31	21.59	23.51	22.56	
Seven month after installation	18.43	25.32	22.73	20.13	23.74	24.62

(a) Find a 95% confidence interval for the mean of time before freeze-up for one month after installation.

(5 marks)

(b) Conclude that at the 5% level that the variance of time freeze-up for one month after installation and seven month after installation is different.

(8 marks)

(c) Find a 95% confidence interval for the difference between mean time one month after installation and seven month after installation.

(7 marks)

Q4 In a test that is designed to measure the effect of a certain additive (in %) on the drying time (in hour) of a paint, the data is given in **Table Q4.**

Table Q4: Data on concentration of additive (X) and drying time (Y)

Concentration of additive (X)	Drying time (Y)
10.000	8.0400
14.000	9.9600
5.000	5.6800
8.000	6.9500
9.000	8.8100
12.000	10.8400
4.000	4.2600
7.000	4.8200
11.000	8.3300
13.000	7.5800
6.000	7.2400

A summary of the data is given as below:
$\Sigma X = 99.0000$; $\Sigma Y = 82.5100$; $\Sigma X^2 = 1001.0000$;
$\Sigma Y^2 = 660.1727$; $\Sigma XY = 797.6000$

(a) Construct the scatter plot of drying time (Y) versus additive concentration (X). Verify there is a linear relationship between drying time (Y) and additive concentration (X).
(3 marks)

(b) Compute the least-squares line for predicting drying time from additive concentration. Interpret your result.
(6 marks)

(c) Predict the drying time for concentration of 4.4%.
(2 marks)

(d) For what concentration would you predict a drying time of 8.2 hours?
(2 marks)

(e) Calculate the coefficient of determinations (r square) and interpret your result.
(4 marks)

(f) Can least-squares line be used to predict the drying time for a concentration of 20%. If so, predict the drying time. If not, explain why not.
(3 marks)

Q5 (a) A study was done to investigate the tensile strength of parachutes produced by suppliers. The analysis of variance was performance using *SPSS* and the results is given in **Table Q5 (a)**.

Table Q5 (a): Table of analysis of variance

Source of variation	Sum of squares	Degree of freedom	Mean square	F value
Between groups	A	3	C	E
Within groups	45.648	B	D	
Total	47.418	19		

(i) Determine the values of A, B, C, D and F.
(2.5 marks)

(ii) At the 0.05 level of significance, is there evidence of a difference in the mean tensile strength?

(7 marks)

(b) You are conducting an experiment with one factor containing four groups, with four values in each group. For the ANOVA summary table as shown in **Table Q5 (b)**, fill in all the missing values.

Table Q5 (b): Table of analysis of variance

Source of variation	Sum of squares	Degree of freedom	Mean square	F value
Between groups	a	b	80	c
Within groups	560	d	e	
Total	f	g		

(i) Determine the values of a, b, c, d, e, f and g.

(3.5 marks)

(ii) At the 0.05 level of significance, is there evidence of a difference in the mean cost between four groups?

(7 marks)

FINAL EXAMINATION

SEMESTER / SESSION: SEM I / 2011/2012 COURSE: 4 BPA/ 4 BPB

SUBJECT : STATISTICS FOR MANAGEMENT CODE: BSM1823

Formulae

Random variables:

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

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

$$Var(X) = E(X^2) - [E(X)]^2.$$

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

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

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

$$v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}}, \quad \frac{(n-1)\cdot s^2}{\chi^2_{\alpha/2,v}} < \sigma^2 < \frac{(n-1)\cdot s^2}{\chi^2_{1-\alpha/2,v}} \text{ with } v = n-1,$$

FINAL EXAMINATION

SEMESTER / SESSION: SEM I / 2011/2012 COURSE: 4 BPA/ 4 BPB

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

Hypothesis Testing:

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

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

$$T = \frac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \text{ with } v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}. ; \quad \chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

Simple Linear Regressions :

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

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

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

$$w_1 + w_2 = \frac{(n_1 + n_2)(n_1 + n_2 + 1)}{2}; \quad u_1 = w_1 - \frac{n_1(n_1 + 1)}{2}; \quad u_2 = w_2 - \frac{n_1(n_1 + 1)}{2}$$

$$h = \frac{12}{n(n+1)}\sum_{i=1}^{k}\frac{r_i^2}{n_i} - 3(n+1); \quad r_s = 1 - 6\sum\frac{d_i^2}{n(n^2 - 1)}$$