KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

PEPERIKSAAN AKHIR
SEMESTER I
SESI 2006/2007

NAMA MATA PELAJARAN	:	STATISTIK KEJURUTERAAN
KOD MATA PELAJARAN	:	BSM 3013
KURSUS	:	3 BKC, 3 BKL
TARIKH PEPERIKSAAN	:	NOVEMBER 2006
JANGKA MASA	:	3 JAM
ARAHAN	:	JAWAB **ENAM (6) SOALAN** DARIPADA **TUJUH (7) SOALAN**

KERTAS SOALAN INI MENGANDUNGI 6 MUKA SURAT

Q1 Crickets make a chirping sound with their wing covers. Scientists have recognized that there is relationship between the frequency of chirps and the temperature. 15 data had been observe from the study, as shown in Table Q1.

Table Q1

Chirps, x	20	16	19.8	18.4	17.1	15.5	14.7	17.1
Temperature, y	88.6	71.6	93.3	84.3	80.6	75.2	69.7	82

Chirps, x	15.4	16.3	15	17.2	16	17	14.4
Temperature, y	69.4	83.3	79.6	82.6	80.6	83.5	76.3

(a) sketch a scatter plot for the data above.

(2 marks)

(b) use the method of least squares to estimate the regression line. Interpret the result.

(8 marks)

(c) predict the temperature when x = 15 chirps per second.

(2 marks)

(d) test the null hypothesis $\beta_1 = 3$ against the alternative hypothesis $\beta_1 > 3$ at the 0.01 level of significance.

(8 marks)

Q2 (a) The slant shear test is widely accepted for evaluating the bond of resinous repair materials to concrete; it utilizes cylinder specimens made of two identical halves bonded at 30^0. A research reported that for 12 specimens prepared using wire-brushing, the sample mean shear strength (N/mm^2) and sample standard deviation were 19.2 and 1.58 respectively. Whereas for 12 hand-chiseled specimens, the corresponding values were 23.13 and 4.01. Does the true average strength appear to be different for the two method of surface preparation? State and test the relevant hypotheses using a significance level of 0.05.

(10 marks)

(b) To find out whether the inhabitants of two state in Malaysia may be regarded as having the same racial ancestry, an anthropologist determines the cephalic indices of six adult males from each state, getting $\bar{x}_1 = 77.4$ and $\bar{x}_2 = 72.2$ and the corresponding standard deviations $s_1 = 3.3$ and $s_2 = 2.1$. Test at the 0.01 level of significance whether it is reasonable to assume that the two sample have equal variances.

(10 marks)

Q3 (a) Concrete specimens with varying height-to-diameter ratios cut from various positions on the original cylinder were obtained both from a normal-strength concrete mix and from a high-strength mix. The peak stress (MPa) was determined for each mix, as shown in Table Q3.

Table Q3

Normal condition	High condition
90.9	88.1
93.1	93.2
86.3	90.8
90.3	90.1
88.5	92.5

Assuming that the data constitute independent random samples from normal populations with equal variances, construct a 99% confidence interval for the difference between the normal-strength concrete mix and from a high-strength mix.

(10 marks)

(b) A study of body temperatures (at 12.00 am) obtained by a KUiTTHO researchers showed that 30 students selected at random have a mean of 98.20 ^{0}F and a standard deviation of 0.62 ^{0}F. Construct a 95% confidence interval estimate of σ, the standard deviation of the body temperatures of the whole population.

(5 marks)

(c) Two sample of size $n_1 = 10$ and $n_2 = 9$, are taken from two normal population that independent with $\bar{x}_1 = 91.5, \bar{x}_2 = 88.3, s_1 = 5.5$ and $s_2 = 7.8$. Construct a 98% confidence interval for $\dfrac{\sigma_1^2}{\sigma_2^2}$.

(5 marks)

Q4 (a) Five randomly selected 100 ohm resistors are connected in a series circuit. Suppose that it is known that the population of all resistors has a mean resistance of exactly 100 ohms with a standard deviation of 2.0 ohms. What is the probability that the average resistance in the circuit

(i) exceeds 102 ohm?
(ii) between 98 ohm and 102 ohm?
(ii) less than 101 ohm if the sample size is 10?

(10 marks)

(b) The firmness of a piece of fruit is an important indicator of fruit ripeness. The Mariam firmness (N) was determined for a sample of 100 pineapples with a shelf life of zero days, resulting in a sample mean of 7000 and a sample standard deviation of 1000. Another sample of 250 pineapple with a shelf life of 20 days, with a mean and sample standard deviation of 7500 and 1200, respectively. Find the probability that the sample for 20 days will have mean at most 670.5 than the sample for zero days.

(10 marks)

Q5 If X is a continuous random variable with probability density function,

$$f(x)=\begin{cases}\dfrac{kx}{5}, & \text{for } 0\le x<2\\ \dfrac{x^2}{7}, & \text{for } 2\le x\le 3\\ 0, & \text{otherwise}\end{cases}$$

(a) Find the value of k.

(4 marks)

(b) Find the cumulative distribution function of X.

(6 marks)

(c) Evaluate $P(1 \le X \le 4)$.

(3 marks)

(d) Calculate $E(X)$ and $Var(X)$

(7 marks)

Q6 (a) A set of final examination grades in an engineering statistics course is normally distributed with a mean of 73 and a standard deviation of 8.

(i) What is the probability of getting a grade of 90 or less on this exam?
(ii) What is the probability that a student scored more than 78?
(iii) What is the probability that a student scored between 65 and 89?

(10 marks)

(b) Based upon past experience at TT Tires Manufacturing, 8% of certain branded tires produced are defective during ongoing production process. If a random sample of 1600 tires s selected, what is the approximate probability that

(i) exactly 125 tires will be defective?
(ii) at least 150 tires will be defective??
(iii) not more than 110 tires will be defective?

(10 marks)

Q7 The discrete random variables A and B are independent and have the following probability distributions as shown in Table Q7.

Table Q7

A	1	2	3
$P(A=a)$	1/4	1/2	1/4

B	1	2
$P(B=b)$	1/3	2/3

The random variable Q is the product of one observation from A and one observation from B.

(a) Show that $P(Q = 2) = 1/3$

(4 marks)

(b) Find the probability distribution for Q.

(6 marks)

(c) Hence, or otherwise, show that $E(Q) = 10/3$.

(4 marks)

(d) Find Var(Q)

(6 marks)

Formulas

$X \sim B(n,p)$; $\quad P(X=r) = {}^nC_r p^r (1-p)^{n-r}$, $r = 0,1,2,\ldots,n$

$X \sim P_o(\mu)$; $\quad P(X=r) = \dfrac{e^{-\mu}\mu^r}{r!}$, $\quad r = 0, 1, 2, \ldots, \infty.$

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

$$\overline{X}_A - \overline{X}_B \sim N\left(\mu_A - \mu_B, \frac{\sigma_A^2}{n_A} + \frac{\sigma_B^2}{n_B}\right) \qquad Z = \frac{(\overline{X}_A - \overline{X}_B) - (\mu_A - \mu_B)}{\sqrt{\frac{\sigma_A^2}{n_A} + \frac{\sigma_B^2}{n_B}}} \sim N(0,1)$$

$$\bar{x} - z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right) < \mu < \bar{x} + z_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

$$\bar{x} - t_{\alpha/2,\,\nu}\left(\frac{s}{\sqrt{n}}\right) < \mu < \bar{x} + t_{\alpha/2,\,\nu}\left(\frac{s}{\sqrt{n}}\right), \text{ where } \nu = n-1.$$

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

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

where degree of freedom, $\nu = 2(n-1)$

$$Z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}; \qquad T = \frac{\bar{x}-\mu}{s/\sqrt{n}}$$

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

$$T = \frac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \text{ where } S_p^{\,2} = \frac{(n_1-1)s_1^{\,2} + (n_2-1)s_2^{\,2}}{n_1+n_2-2}$$

$$S_{xx} = \sum x^2 - \frac{\left(\sum x\right)^2}{n}; \quad S_{yy} = \sum y^2 - \frac{\left(\sum y\right)^2}{n}; \quad S_{xy} = \sum xy - \frac{\sum x \sum y}{n};$$

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x; \qquad \hat{\beta}_1 = \frac{S_{xy}}{S_{xx}}; \qquad \hat{\beta}_0 = \bar{y} - \hat{\beta}_1\bar{x};$$

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} \qquad t = \frac{\hat{\beta}_1 - \beta_1^{*}}{\sqrt{MSE/S_{xx}}}$$