PPS.

KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

PEPERIKSAAN AKHIR SEMESTER II SESI 2004/2005

NAMA MATA PELAJARAN : STATISTIK KEJURUTERAAN

KOD MATA PELAJARAN : BSM 3013

KURSUS : 5 BKJ, 5 BKM, 5 BKL, 5 BKA, 5 BKC, 4 BKC

TARIKH PEPERIKSAAN : MAC 2005

JANGKA MASA : 3 JAM

ARAHAN : JAWAB **SEMUA SOALAN** DARI BAHAGIAN A DAN PILIH **EMPAT** (4) SOALAN DARI BAHAGIAN B.

KERTAS SOALAN INI MENGANDUNGI 5 MUKA SURAT

PART A

Q1 Given data below:

x	1	2	3	4	5	6	7	8	9
y	5.2	4.8	3.4	5.0	3.2	2.9	4.4	4.0	3.1

(a) Assume that x and y can be related by a straight line. Find $\sum_{i=1}^{n} x_i, \sum_{i=1}^{n} y_i, \sum_{i=1}^{n} x_i^2, \sum_{i=1}^{n} x_i y_i$. Then obtain the linear regression line equation by using the least squares method.

(12 marks)

(b) Predict the value for y if given $x = 3$.

(2 marks)

(c) Calculate the correlation between x and y if both are values of random variables. Interpret your results.

(6 marks)

Q2 (a) The life of a battery in hours is known to be normally distributed, with standard deviation $\sigma = 1.25$ hours. A random sample of 10 batteries has a mean life of $\bar{x} = 40.5$ hours. Is there an evidence to support the claim that battery life exceeds 40 hours? Use $\alpha = 0.05$.

(10 marks)

(b) Machine 1 and machine 2 are used to fill plastic bottles with dishwashing detergent. The standard deviations of filled volume are known to be $\sigma_1 =$ 0.15 mg and $\sigma_2 =$ 0.18 mg for two machines, respectively. Two random samples of $n_1 = 12$ bottles and $n_2 = 10$ are selected. The sample mean filled volumes are $\bar{x}_1 = 30.87$ mg and $\bar{x}_2 = 30.68$ mg. Test the hypothesis whether both machines have the same mean filled volume. Use $\alpha = 0.05$.

(10 marks)

PART B

Q3 The following data shows the lifetime of 40 batteries.

Class	frequency
1.5-1.9	2
2.0-2.4	1
2.5-2.9	4
3.0-3.4	15
3.5-3.9	10
4.0-4.4	5
4.5-5.0	3

(a) Build a table to show its class boundary, cumulative frequency and class midpoint for data above.

(3 marks)

(b) Find the
(i) mean.
(ii) mode.
(iii) median class.
(iv) median.

(12 marks)

Q4 (a) A certain student goes to the college either by the college bus or a public bus. Usually 70% of the time, he takes the college bus. The probability that he will be early if he takes the college bus is 0.8.
(i) Draw the tree diagram of the above events.
(ii) What is the probability that he takes the public bus?
(iii) If on a certain day he is late, what is the probability that he uses the public bus?

(6 marks)

(b) Suppose that the probability distribution of a discrete random variable, X is defined as

$$P(X=x)=\begin{cases} cx, & x=1,2,3,4,5 \\ 0, & \text{otherwise} \end{cases}$$

(i) Show that the value of $c=\dfrac{1}{15}$

(ii) Find $P(\frac{1}{2}<X<\frac{5}{2})$.

(iii) Show that the variance, $\mathrm{Var}(X)=\dfrac{14}{9}$

(9 marks)

Q5 (a) In a study, the batches that consist of 50 coil springs from production process are checked for conformance to customer requirements. The mean number of nonconforming coil springs in a batch is $\mu = 5$. Assume that the number of nonconforming coil springs in a batch, denote as X, is a binomial random $X \sim B(n,p)$.
(i) State the value of n and p.
(ii) What is the probability that there are not more than 2 nonconforming coil springs have been checked?
(iii) What is the probability that there are more than 10 nonconforming coil springs have been checked?

(6 marks)

(b) A secretary is copying a list of 1000 numbers. For each number, the probability that she will type it wrongly is 0.002. Use the Poisson approximation to the binomial to find that there will be fewer than two mistakes in the whole list.

(4 marks)

(c) A college guard stated that the number of students arrive at the main gate before 7.30 a.m. is a Poisson distribution with mean 7 vehicles per minute. Find the probability, for a random

(i) one minute at that certain time the number of vehicles is exactly 5 vehicles.

(ii) three minutes at that certain time the number of vehicles is less than 20 vehicles.

(5 marks)

Q6 (a) The mean serum cholesterol of a large population of overweight adults is μ = 220 mg/dl and the standard deviation is σ = 16.3 mg/dl. If a sample of 49 adults is selected, find the probability that the mean will be between 220 and 222 mg/dl.

(7 marks)

(b) The distribution of height of a certain breed of terrier dogs has a mean height μ_A = 72 cm and standard deviation σ_A = 10 cm, whereas the distribution of heights of a certain breed of poodles has a mean height μ_B = 28 cm and standard deviation σ_B = 5 cm. Find the probability that the sample mean for a random sample of heights 64 terries is greater than the sample mean for a random sample of heights of 100 poodles by at most 44.2 cm.

(8 marks)

Q7 (a) The weight of the students' bags is distributed normal $N(\mu, 0.5^2)$. A sample of 25 was taken from the students and the mean of the sample is 3.0 kg. Obtain the

(i) point estimator for μ.

(ii) 95% confidence interval for μ

(7 marks)

(c) Two chemical companies can supply a raw material. The concentration of a particular element in this material is important. The mean concentration for both suppliers is the same, but we suspect that the variability in concentration may differ between the two companies. The standard deviation of concentration in a random sample of n_1 = 11 batches produced by company 1 is s_1 = 4.7 grams per liter, while for a company 2, a random sample of n_2 = 9 batches yields s_2 = 5.8 grams per liter. Obtain a 95% confidence interval on $\frac{\sigma_1^2}{\sigma_2^2}$.

(8 marks)

STATISTICAL FORMULAS

$$S_{xy} = \sum x_i y_i - \frac{\sum x_i \sum y_i}{n} \qquad S_{xx} = \sum (x_i)^2 - \frac{\left(\sum x_i\right)^2}{n} \qquad \hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x}$$

$$\hat{\beta}_1 = \frac{S_{XY}}{S_{XX}} \qquad E(X) = \sum_x xp(x)$$

$$E(X) = \int_{-\infty}^{\infty} xp(x)dx \qquad M = L_M + c\left[\frac{n/2 - F}{f_m}\right] \qquad M_0 = L + c\left[\frac{d_1}{d_1 + d_2}\right]$$

$$X \sim N(\mu, \sigma^2) \qquad Z = \frac{X - \mu}{\sigma}$$

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

$$p(x) = \frac{\binom{k}{x}\binom{N-k}{n-x}}{\binom{N}{n}}, \ x = 0,1,2,\ldots,k \qquad \bar{X}_1 - \bar{X}_2 \sim N(\mu_1 - \mu_2, \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2})$$

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

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

$$T = \frac{\bar{X} - \mu}{s / \sqrt{n}} \sim t_{\alpha, n-1} \qquad F = \frac{\sigma_2^2 S_1^2}{\sigma_1^2 S_2^2} \sim f_{\alpha, n_1 - 1, n_2 - 1} \qquad \chi^2 = \frac{(n-1)S^2}{\sigma^2} \sim \chi^2_{\alpha, n-1}$$

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

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

$$\hat{P} = N(p, \frac{pq}{n}) \qquad Z = \frac{\hat{P} - P}{\sqrt{pq / n}} \sim N(0,1)$$