UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	STATISTICS FOR ENGINEERING TECHNOLOGY
COURSE CODE	:	BWM 22502
PROGRAMME CODE	:	BNB / BNG / BNH / BNL / BNN / BNM
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) The continuous random variable X has probability density function such as below,

$$f(x) = \begin{cases} k(x+2)^2, & -2 \le x \le 0, \\ 4k, & 0 \le x \le \dfrac{4}{3}, \\ 0, & \text{otherwise.} \end{cases}$$

(i) Find the value of the constant k.

(5 marks)

(ii) Find $\Pr(-1 \le X \le 1)$.

(4 marks)

(iii) Compute the mean and variance of X.

(8 marks)

(b) Based upon past experience at TT Tires Manufacturing, 8% of certain branded tires produced were defective during ongoing production process. If a random sample of 1,600 tires was selected, find the probability that exactly 125 tires will be defective by using Normal approximation.

(8 marks)

Q2 (a) The chemical benzene is highly toxic to humans. However, it is used in the manufacture of any medicine dyes, leather and coverings. Government regulations dictate that for any production process involving benzene, the water in the output of the process must not exceed 7950 parts per million (ppm) of benzene. For a particular process of concern, the water sample was collected by a manufacturer 36 times randomly and the sample average was 7960 ppm. It is known from the historical data that the standard deviation is 100 ppm. Assume that the distribution of benzene concentration is normal.

(i) Find the probability that the sample average in this experiment would not exceed the government limit.

(5 marks)

(ii) Calculate the probability that the sample average in this experiment between 7945 and 7948 ppm.

(5 marks)

(b) The following **Table Q2 (b)** represents the length of time, in days, to recover the patients randomly treated with one of two medications to clear up severe bladder infections:

Table Q2 (b) : Recovery Time

Medication 1	Medication 2
$n_1 = 14$	$n_2 = 16$
$\bar{x}_1 = 17$	$\bar{x}_2 = 19$
$s_1 = 1.5$	$s_2 = 1.8$

If the variances of the populations are equal,

(i) determine an appropriate distribution for this problem. Give your reason.
(3 marks)

(ii) compute a 95% confidence interval for the difference $\mu_2 - \mu_1$ in the mean recovery times for the two medications.
(12 marks)

Q3 The manager of a fleet of automobiles is testing two brands of radial tires. He assigns one tire of each brand at random to the two rear wheels of eight cars until the tire wear out. The data of the mean life spend (in kilometers) are shown in **Table Q3**.

Table Q3 : Tires and Mean Life Spend

Car	1	2	3	4	5	6	7	8
Brand 1	36925	45300	36240	32100	37210	48360	38200	33500
Brand 2	34318	42280	35500	31950	38015	47800	37810	33215

(a) Conduct a hypothesis test whether the mean life spend for Brand 1 is equal to 36000 kilometers at 5% level of significant.
(12 marks)

(b) Conduct a hypothesis test whether the mean life spend for Brand 1 have more kilometers than the mean life spend for Brand 2 at 5% level of significant.
(13 marks)

Q4 The strength of paper used in manufacture of cardboard boxes (y) is related to the percentage of hardwood concentration in the original pulp (x). Under control conditions, a pilot plan to manufacture 10 samples, each from different batch of pulp, and measure the tensile strength. The data are shown in **Table Q4**.

Table Q4 : Tensile Strength of Cardboard Boxes

y	101.4	117.4	117.1	106.2	131.9	146.9	146.8	133.9	111.0	123.0
x	1.0	1.5	1.5	1.5	2.0	2.0	2.2	2.4	2.5	2.5

(a) Fit the simple linear regression model to the data. Interpret the result.
(15 marks)

(b) Estimate the paper strength when the hardwood concentration is equal to 2.3 percent.
(2 marks)

(c) Calculate the coefficient of correlation and the coefficient of determination. Give your interpretation.
(8 marks)

- END OF QUESTIONS -

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FORMULA

$$Var(X)=E[(x-\mu)^2]=E(x^2)-[E(x)]^2$$

$$\sum_{i=1}^{n}\Pr(X_i)=1 \qquad E(X)=\sum_{i=1}^{n}x_i\times\Pr(X=x_i)$$

$$\int_{-\infty}^{\infty}f(x)dx=1 \qquad E(X)=\int_{-\infty}^{\infty}xf(x)dx$$

$$\Pr(X=r)=\binom{n}{r}p^r(1-p)^{n-r}={}^nC_r p^r q^{n-r} \qquad \Pr(X=r)=\frac{e^{-\mu}\mu^r}{r!}$$

$$Z=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{\dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}}}\sim Z_\alpha \qquad Z=\frac{x-\mu}{\sigma}\sim Z_\alpha$$

$$Z=\frac{\bar{x}-\mu}{\sigma/\sqrt{n}}\sim Z_\alpha$$

$$Z=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{\dfrac{s_1^2}{n_1}+\dfrac{s_2^2}{n_2}}}\sim Z_\alpha \qquad T=\frac{\bar{x}-\mu}{s/\sqrt{n}}\sim T_\alpha(v=n-1)$$

$$\chi^2=\frac{(n-1)s^2}{\sigma^2}\sim\chi_\alpha^2(v=n-1)$$

$$T=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{\dfrac{1}{n}(s_1^2+s_2^2)}}\sim T_\alpha(v) \qquad F=\frac{s_1^2}{s_2^2}\sim F_\alpha(v_1=n_1-1,v_2=n_2-1)$$

$$T=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{S_p\sqrt{\dfrac{1}{n_1}+\dfrac{1}{n_2}}}\sim T_\alpha(v) \qquad S_p^2=\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$$

$$T=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{\dfrac{s_1^2}{n_1}+\dfrac{s_2^2}{n_2}}}\sim T_\alpha(v) \qquad v=\frac{(s_1^2/n_1+s_2^2/n_2)^2}{\dfrac{(s_1^2/n_1)^2}{n_1-1}+\dfrac{(s_2^2/n_2)^2}{n_2-1}}$$

$$v=n_1+n_2-2$$

$$S_{xx}=\sum_{i=1}^{n}x_i^2-\frac{1}{n}\left(\sum_{i=1}^{n}x_i\right)^2 \qquad \hat{\beta}_1=\frac{S_{xy}}{S_{xx}} \qquad \bar{y}=\frac{1}{n}\sum_{i=1}^{n}y_i$$

$$S_{yy}=\sum_{i=1}^{n}y_i^2-\frac{1}{n}\left(\sum_{i=1}^{n}y_i\right)^2 \qquad \hat{\beta}_0=\bar{y}-\hat{\beta}_1\bar{x} \qquad \bar{x}=\frac{1}{n}\sum_{i=1}^{n}x_i$$

$$S_{xy}=\sum_{i=1}^{n}x_iy_i-\frac{1}{n}\left(\sum_{i=1}^{n}x_i\right)\left(\sum_{i=1}^{n}y_i\right) \qquad s^2=\frac{1}{n-1}\left[\sum_{i=1}^{n}x_i^2-\frac{1}{n}\left(\sum_{i=1}^{n}x_i\right)^2\right]$$

$$r=\frac{n\Sigma xy-(\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2-(\Sigma x)^2]}\sqrt{[n\Sigma y^2-(\Sigma y)^2]}}=\frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} \qquad r^2=\frac{(S_{xy})^2}{S_{xx}S_{yy}}=R^2$$