UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	ENGINEERING STATISTICS
COURSE CODE	:	BWM 20502/BSM2922
PROGRAMME	:	3/4 BFF, 3/4 BEE, 1/2/3/4 BDD, 2/3 BEU, 2/3 BED, 2/3 BEB, 3 BEC
EXAMINATION DATE	:	JUNE 2013
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

THIS EXAMINATION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Marks obtained by students in a statistics tests are normally distributed with mean 64 and standard deviation 21. Calculate the probability that a randomly selected student obtained marks

(i) less than 78

(ii) between 60 and 76.

(8 marks)

(b) If the random variable X follows a normal distribution with mean, μ and variance, $\sigma^2 = 5$, and $P(X < 26.5) = 0.8186$. Find the value of μ.

(7 marks)

(c)

Of the members of a badminton team, 20% are males. If 200 badminton team members are selected at random, find the probability that 30 or more members are males.

(10 marks)

Q2 (a) Give one example for point estimate and point interval.

(2 marks)

(b) A problem with an internet line that prevents a customer from downloading or uploading is disconcerting to both the customer and the telecommunication company. The data in **Table Q2(a)** represent the time to clear these problems (in minutes) from the customers' lines reported to two different companies.

Table Q2(a) : Time to clear internet line problems (in minutes) from the customers' lines reported to two different companies

Company A	20	15	13	18	22	27	33
Company B	17	19	22	21	23	22	20

(a) State the point estimate for the time to clear internet line problems (in minutes) for company A

(1 mark)

(b) Find the 95% confidence interval for different the time to clear internet line problems (in minutes) from the customers' lines reported to two different companies. Assume that the populations are approximately normal distributed with unequal variances.

(8 marks)

(c) Find the 90% confidence interval for the variance for the time to clear internet line problems (in minutes) for company A.

(6 marks)

(d) Find a 95% confidence interval for the ratio of variance for the time to clear internet line problems (in minutes) for company A and company B.

(8 marks)

Q3 (a) A test was conducted in order to evaluate the marks among mechanical student. A random sample of 36 students was selected and assumes the variance is normally distributed. **Table Q3(a)** below shows their marks.

Table Q3(a): Marks of Mechanical students

66	77	75	95	80	65	52	45	88
54	65	97	85	85	45	45	62	93
66	77	75	95	80	65	52	45	88
54	65	97	85	85	45	45	62	93

(i) It was claims that the average mark for the students is less than 74. Test the hypothesis with **0.10 level** of significance.

(10 marks)

(ii) While in another class, with a random sample of 34 students, it was claims that the average marks is 73 and the standard deviation is 15.2314. Using alpha 0.1 perform the hypothesis testing whether any significant difference in average marks between the two classes.

(7 marks)

(b) Financial data for 3 years indicate that the amount of money flow contributed by the working residents of a large city of a volunteer rescue squad is a normal distribution with a variance of RM1.56. If the contributions of a random sample of 15 employees from the sanitation department have a standard deviation of RM1.35, can we conclude at the 0.2 level of significance that the variance of the contributions of all sanitation workers is greater than RM 3?

(8 marks)

Q4 (a) To reduce cost, a bakery has implemented a new leavening process for preparing bread loaves. Loaves of bread were randomly sampled and analyzed for calorie content both before and after implementation of the new process. A summary of results of the two samples is shown in the **Table Q4(a)**.

Table Q4: The result of the calorie content both before and after implementation of the new process.

Old Process	New Process
Average = 1255 calories Variance = 215 calories Sample Size = 11	Average = 1330 calories Variance = 238 calories Sample Size = 8

Do these samples provide sufficient evidence to conclude that the variance of calories per loaf has decreased since the new leavening process was implemented. Use the 0.05 level of significance to test the ratio of population variance.

(8 marks)

(b) A researcher wishes to determine if there is a relationship between the Energy Efficiency Rating (EER) of an air conditioner and its cost. The data is shown below in the following **Table Q4(b).**

Table Q4(b): Cost y against Energy Efficiency Rating (EER) x

EER, x	9.5	10	10	10	10.3	9.1	8.6
Cost, y	370	360	400	400	420	350	310

(i) Assuming a linear relationship, use the least squares method to find the simple linear regression model.

(11 marks)

(ii) What is the approximate number of cost if the EER is 12

(2 marks)

(iii) Determine the value of Pearson correlation. Interpret the result.

(4 marks)

- END OF QUESTION -

FINAL EXAMINATION

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Formula

Special Probability Distributions :

$P(x=r)={}^{n}C_r \cdot p^r \cdot q^{n-r}, r=0,1,\ldots,n,\ X \sim B(n,p),\ P(X=r)=\dfrac{e^{-\mu}\cdot \mu^r}{r!},\ r=0,1,\ldots,\infty,$

$X \sim P_0(\mu),\ Z=\dfrac{X-\mu}{\sigma},\ Z \sim N(0,1),\ X \sim N(\mu,\sigma^2).$

Sampling Distributions :

$\bar{X} \sim N(\mu,\sigma^2/n),\ Z=\dfrac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim N(0,1),\ T=\dfrac{\bar{x}-\mu}{s/\sqrt{n}},\ \bar{X}_1-\bar{X}_2 \sim N\left(\mu_1-\mu_2, \dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}\right).$

Estimations :

$n=\left(\dfrac{Z_{\alpha/2}\cdot\sigma}{E}\right)^2,\ \bar{x}\pm z_{\alpha/2}\left(\sigma/\sqrt{n}\right),\ \bar{x}\pm z_{\alpha/2}\left(s/\sqrt{n}\right),\ \bar{x}\pm t_{\alpha/2,v}\left(\dfrac{s}{\sqrt{n}}\right)$

$\left(\bar{x}_1-\bar{x}_2\right)-Z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}}<\mu_1-\mu_2<\left(\bar{x}_1-\bar{x}_2\right)+Z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{n_1}+\dfrac{\sigma_2^2}{n_2}},$

$\left(\bar{x}_1-\bar{x}_2\right)-Z_{\alpha/2}\sqrt{\dfrac{s_1^2}{n_1}+\dfrac{s_2^2}{n_2}}<\mu_1-\mu_2<\left(\bar{x}_1-\bar{x}_2\right)+Z_{\alpha/2}\sqrt{\dfrac{s_1^2}{n_1}+\dfrac{s_2^2}{n_2}},$

$\left(\bar{x}_1-\bar{x}_2\right)-t_{\alpha/2,v}\cdot S_p\sqrt{\dfrac{2}{n}}<\mu_1-\mu_2<\left(\bar{x}_1-\bar{x}_2\right)+t_{\alpha/2,v}\cdot S_p\sqrt{\dfrac{2}{n}};v=2n-2$

$\left(\bar{x}_1-\bar{x}_2\right)-t_{\alpha/2,v}\cdot S_p\sqrt{\dfrac{1}{n_1}+\dfrac{1}{n_2}}<\mu_1-\mu_2<\left(\bar{x}_1-\bar{x}_2\right)+t_{\alpha/2,v}\cdot S_p\sqrt{\dfrac{1}{n_1}+\dfrac{1}{n_2}}$

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 $v=n_1+n_2-2$,

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

$$\left(\bar{x}_1-\bar{x}_2\right)-t_{\alpha/2,v}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}<\mu_1-\mu_2<\left(\bar{x}_1-\bar{x}_2\right)+t_{\alpha/2,v}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}} \text{ with } v=\frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1}+\frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}},$$

$$\frac{(n-1)\cdot s^2}{\chi^2_{\alpha/2,v}}<\sigma^2<\frac{(n-1)\cdot s^2}{\chi^2_{1-\alpha/2,v}} \text{ with } v=n-1,$$

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

Hypothesis Testing :

$$Z_{Test}=\frac{\bar{x}-\mu}{\sigma/\sqrt{n}},\quad Z_{Test}=\frac{\bar{x}-\mu}{s/\sqrt{n}},\quad T_{Test}=\frac{\bar{x}-\mu}{s/\sqrt{n}}$$

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

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

$$v=\frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1}+\frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}};\quad S_p^2=\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2};\quad \chi^2=\frac{(n-1)s^2}{\sigma^2}$$

$$F=\frac{s_1^2}{s_2^2},\quad \text{with } \frac{1}{f_{\alpha/2}(v_2,v_1)} \quad \text{and} \quad f_{\alpha/2}(v_1,v_2)$$

Simple Linear Regressions :

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

$$\hat{\beta}_1=\frac{S_{xy}}{S_{xx}},\ \hat{\beta}_0=\bar{y}-\hat{\beta}_1\bar{x},\ \hat{y}=\hat{\beta}_0+\hat{\beta}_1 x,\ r=\frac{S_{xy}}{\sqrt{S_{xx}\cdot S_{yy}}},\ SSE=S_{yy}-\hat{\beta}_1 S_{xy},\ MSE=\frac{SSE}{n-2},$$

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