UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	ENGINEERING STATISTICS
COURSE CODE	:	BWM 20502/BSM2922
PROGRAMME	:	2/3/4 BFF, 3/4 BDD, 2/3 BEJ, 1/2 BEV
EXAMINATION DATE	:	DECEMBER/JANUARY 2014
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

THIS EXAMINATION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Suppose that during periods of meditation the reduction of a person's oxygen consumption is a random variable having a normal distribution with average of 37.6 cc per minute and a variance of 21.16 cc per minute. Find the probability that during a period of meditation a person's oxygen consumption will be reduced by

(i) At least 44.5 cc per minute
(ii) At most 35.0 cc per minute
(iii) Anywhere from 30.0 to 40.0 cc per minute

(9 marks)

(b) A multiple-choice quiz has 80 questions each with 4 possible answers of which only 1 is correct answer. Find the probability the student yields

(i) From 25 to 30 correct answers.
(ii) Less than 15 answers are correct

(16 marks)

Q2 (a) Pull-strength tests on 10 soldered leads for a semiconductor device yield the following results in kg-force required to rupture the bond:

15.8 12.7 13.2 16.9 10.6 18.8 11.1 14.3 17.0 12.5

Another set of eight (8) leads was tested after encapsulation to determine whether the pull strength has been increased by encapsulation of the device, with the following results:

24.9 23.6 19.8 22.1 20.4 21.6 21.8 22.5

Assume that the populations are approximately normal distributed with unequal variances.

(i) Find the 95% confidence interval of the difference between two samples.

(10 marks)

(ii) Find the 99% confidence interval of the difference between two samples.

(5 marks)

(b) Seven pilots in Fighter Flight Sdn. Bhd. were tested in a flight simulator. The time taken for each pilot to complete a certain corrective action was measured in seconds, with the following results.

7.5 7.3 3.6 4.6 6.3 8.6 9.3

(i) Give one example for point estimate and point interval for the case above.

(2 marks)

(ii) State the point estimate for the time taken for each pilot to complete a certain corrective action.

(1 mark)

(iii) Find the 98% confidence interval for variance of time taken for each pilot to complete a certain corrective action.

(7 marks)

Q3 (a) The Minions just had their examination on Engineering Statistics under the supervision of Dr Suliadi Macho. A random sample of 36 marks was selected and assumed to be normally distributed. **Table Q3(a)** below shows their marks.

Table Q3(a): Marks of Civil Engineering students

60	77	75	95	80	55	52	45	88
100	65	80	85	85	45	75	62	93
70	50	95	100	90	75	85	89	67
90	63	95	100	85	65	91	70	76

(i) Dr Suliadi Macho claims that the average mark for his students is less than 79. Test the hypothesis with 10% level of significance.

(10 marks)

(ii) While in another class, with a random sample of 35 students, Dr Loki Evil claims that the average mark for his students is 85 and the standard deviation is 15.2314. Using alpha 0.10, perform the hypothesis testing whether any significant difference in average marks between the two classes.

(7 marks)

(b) Financial data for 5 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 RM2.30. If the contributions of a random sample of 20 employees from the sanitation department have a standard deviation of RM2.15, can we conclude at the 0.2 level of significance that the variance of the contributions of all sanitation workers is greater than RM 3.50?

(8 marks)

Q4 (a) Two college instructors are interested in whether or not there is any variation in the way they grade math exams. They each grade the same set of 30 exams. The first instructor's grades have a variance of 52.3. The second instructor's grades have a variance of 89.9.

Test the claim that the first instructor's variance is smaller. (In most colleges, it is *desirable for the variances of exam grades to be nearly the same among instructors.*) The level of significance is 10%.

(8 marks)

(b) An experiment was held to investigate the relationship between the diameter of a nail and its ultimate withdrawal strength. Annularly threaded nails were driven into Douglas fir lumber, and then their withdrawal strengths were measured in N/mm. **Table Q4(b)** shows the following results for 10 different diameters (in mm) were obtained:

Table Q4(b)

Diameter	Strength
3.1	55
3.3	51
3.5	55
3.7	61
3.9	59
4.1	69
4.3	73
4.5	70
4.7	80
4.9	77

where $\sum X^2 = 163.3$, $\sum Y^2 = 43172$ and $\sum XY = 2652.2$.

(i) Based on the above results, find the estimated equation of the linear regression line, $\hat{Y} = \hat{\alpha} + \hat{\beta} X$.

(3 marks)

(ii) What can you interpret from the estimated value of the slope?

(1 mark)

(iii) Estimate the strength if the diameter is 5.0 mm.

(2 marks)

(iv) Do we have sufficient evidence to conclude that there exists a linear relationship between the diameter of a nail and its ultimate withdrawal strengths at a 0.01 level of significance?

(8 marks)

(v) Obtain the Pearson correlation coefficient for the sample data. Conclude your result.

(3 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER / SESSION: SEM II / 2012/2013

COURSE: 3/4 BFF, 3/4 BEE, 1/2/3/4 BDD, 2/3 BEU, 2/3 BED, 2/3 BEB, 3 BEC

SUBJECT : ENGINEERING STATISTICS

CODE: BWM 20502/ BSM2922

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 :

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

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

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

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

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

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 $v=n_1+n_2-2$,

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

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

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

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

Hypothesis Testing :

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

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

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

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

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

Simple Linear Regressions :

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

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

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