UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	STATISTICS FOR ENGINEERING TECHNOLOGY
COURSE CODE	:	BWM 22502
PROGRAMME	:	2 BNB/ BNL/ BNN
EXAMINATION DATE	:	DECEMBER 2013/ JANUARY 2014
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS EXAMINATION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Given that 6% of a population are left-handed, use the suitable distribution to estimate the probability that a random sample of 100 people contains;

(i) two or more left-handed people.

(5 marks)

(ii) not more than two left-handed people.

(4 marks)

(iii) exactly five left-handed people.

(4 marks)

(b) A test consists of 50 multiple choice questions with four choices for each question. As an experiment, you guess on each and every answer without even reading the questions.

(i) State the distribution type (binomial/poisson/normal) for the above statement? Should we use any approximation distribution?. If yes, state your reason.

(3 marks)

(ii) Obtain mean and variance for the number of correct answers.

(3 marks)

(iii) Find the percentage of getting more than 25 correct answers.

(6 marks)

Q2 (a) Assume there are two species of green beings on Earth. The mean height of Species 1 is 32 cm while the mean height of Species 2 is 22 cm. The variances of the two species are 60 and 70, respectively and the heights of both species are normally distributed. You randomly sample 10 members of Species 1 and 14 members of Species 2. What is the probability that the mean of the 10 members of Species 1 will exceed the mean of the 14 members of Species 2 by 5 or more?

(10 marks)

(b) **Table Q2** shows the scores for 9 students obtained on the midterm and final examinations in a course in statistics.

Table Q2 : Scores for 9 students obtained on the midterm and final examinations

x	73	93	85	58	82	64	32	87	80
y	77	89	74	48	78	76	51	73	89

(i) Fit a straight line to the relationship of final examination score and midterm score. Then, interpret your result.

(8 marks)

(ii) Predict the final examination score of a student who received 70 for midterm score.

(2 marks)

(iii) Compute the linear correlation coefficient, r and interpret the result.

(5 marks)

Q3 Given that a random sample of 40 light bulbs of the first kind lasted on the average 425 hours of continuous use and 50 light bulbs of the second kind lasted on the average 407 hours of continuous use. The population standard deviations for the first and second kind are known to be 26 and 22 respectively.

(a) State the 2 parameters of point estimate for life time of the first kind bulb.

(2 marks)

(b) Find a 98% confidence interval for mean life time of the first kind bulb.

(7 marks)

(c) Find the 95% confidence interval for different of mean life time of the first and second kind bulb. Assume that the populations are approximately normal distributed with equal variances.

(8 marks)

(d) Find a 98% confidence interval for the ratio of variance life time of the first and second kind of bulb.

(8 marks)

Q4 (a) The specifications for a certain kind of ribbon call for a mean breaking strength of 190 pounds. If five pieces randomly selected from different rolls have breaking strengths of 181.5, 197.8, 188.3, 194.9, and 189.1 pounds.

(i) What type of distribution should be used for the above case.

(1 mark)

(ii) Test the null hypothesis μ = 190 pounds against the alternative hypothesis μ<190 pounds at the 0.05 level of significance.

(11 marks)

(b) A study of the number of business lunches that executives in the insurance and banking industries claim as deductible expenses per month was based on random samples and yielded the following results:

$$n_1 = 50,\ \bar{x}_1 = 9.2,\ s_1 = 1.8$$
$$n_2 = 60,\ \bar{x}_2 = 8.3,\ s_2 = 2.2$$

Test the hypothesis using $\alpha = 0.05$ to compare the two variances.

(13 marks)

- END OF QUESTION -

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Formula

Random variables:

$$\sum_{i=-\infty}^{\infty} P(x_i) = 1, \quad E(X) = \sum_{\forall x} x \cdot P(x), \quad E(X^2) = \sum_{\forall x} x^2 \cdot P(x), \quad \int_{-\infty}^{\infty} f(x)\,dx = 1,$$

$$E(X) = \int_{-\infty}^{\infty} x \cdot P(x)\,dx, \quad E(X^2) = \int_{-\infty}^{\infty} x^2 \cdot P(x)\,dx, \quad Var(X) = E(X^2) - [E(X)]^2.$$

Special Probability Distributions :

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

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

Sampling Distributions :

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

Estimations :

$$n = \left(\frac{Z_{\alpha/2} \cdot \sigma}{E}\right)^2, \quad \bar{x} - Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}} < \mu < \bar{x} + Z_{\alpha/2}\sqrt{\frac{\sigma^2}{n}}, \quad \bar{x} - t_{\alpha/2,v}\sqrt{\frac{s^2}{n}} < \mu < \bar{x} + t_{\alpha/2,v}\sqrt{\frac{s^2}{n}}$$

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

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

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

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

where Pooled estimate of variance, $S_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$ 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 :

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

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

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

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

Simple Linear Regressions :

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

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

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