UNIVERSITI
TEKNOLOGI
PETRONAS

FINAL EXAMINATION
MAY 2022 SEMESTER

COURSE	:	**FDM2063/FEM1063 - PROBABILITY AND STATISTICS / STATISTICS AND APPLICATION**
DATE	:	**5 AUGUST 2022 (FRIDAY)**
TIME	:	**9:00 AM - 12:00 NOON (3 HOURS)**

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

Note :

i. There are **SEVEN (7)** pages in this Question Booklet including the cover page .

ii. **DOUBLE-SIDED** Question Booklet.

iii. UTP Statistical Formula Book will be provided.

1. a. Define the terms Population and Sample.

[2 marks]

b. In a statistics class of 30 students, the mean score on semester Jan 2021 was 72. In another class of 40 students, the mean score was 79. Calculate the mean for the two classes combined.

[3 marks]

c. Suppose that thirty UTP students live in Village 2. The ages of the students are as follows:

18, 20, 21, 26, 24, 19, 25, 20, 22, 21,
19, 24, 25, 28, 24, 20, 26, 20, 35, 17,
18, 24, 20, 21, 22, 27, 25, 28, 27, 24.

i. Construct stem and leaf plot.

[3 marks]

ii. From the stem and leaf plot in **part (c)(i)**, compute the mean, the first quartile, the median and the third quartile.

[6 marks]

iii. Construct the box plot of the data and comment.

[6 marks]

2. a. A hole is drilled in a sheet-metal component, and then a shaft is inserted through the hole. The shaft clearance is equal to the difference between the radius of the hole and radius of the shaft. Let the random variable X denote the clearance (mm). The probability density function of X is

$$f(x) = \begin{cases} 1.25(1-x^4) & 0 < x < 1 \\ 0 & otherwise \end{cases}$$

i. Components with clearance larger than 0.8mm must be scrapped. Determine the proportion of components that are scrapped.

[3 marks]

ii. Find the cumulative distribution function F(x).

[4 marks]

iii. Use the cumulative distribution to find the probability that the shaft clearance is less than 0.5mm.

[3 marks]

b. The number of student failures in probability and statistics course is a Poisson random variable with a mean failure rate of 0.05. The course is offered to the students in three semesters per year. Find the probability that

i. all will pass the course in one semester.

[2 marks]

ii. there is no failure in one year.

[3 marks]

iii. there are at least three failures in one year.

[5 marks]

3. a. A book seller has 50 books to sell. The number of books that he sells per day follows a Poisson distribution with mean of 10.

i. Calculate the probability that at most 15 books are sold in one day.

[5 marks]

ii. Calculate the probability that the number of books sold in one day is within the interval [5, 10].

[5 marks]

b. A fair coin is tossed 15 times. Find the probability of getting between 5 and 9 heads inclusive by using

i. the binomial distribution

[4 marks]

ii. the normal approximation to the binomial distribution.

[4 marks]

iii. Discuss the results in **parts (b)(i)** and **(b)(ii)**

[2 marks]

4. a. A semiconductor manufacturer produces controllers used in automobile engine applications. The customer requires that the process fallout or fraction defective at a critical manufacturing step does not exceed 0.05 and that the manufacturer demonstrate process capability at this level of quality using α = 0.05. The semiconductor manufacturer takes a random sample of 200 devices and finds 4 of them are defective.

i. Determine if the manufacturer is able to demonstrate process capability for the customer.

[7 marks]

ii. Find the p-value for the test and comment.

[3 marks]

b. Good website design can make Web navigation easier. A study on the comparison of item recognition between two designs is carried out. A sample of 10 users using a conventional Web design averaged 32.3 items identified, with a standard deviation of 8.56. Another sample of 10 users using a new structured Web design averaged 44.1 items identified, with a standard deviation of 10.09.

i. Is there any reason to believe that the mean number of items identified is greater with the new structured design?

[7 marks]

ii. Construct a two-sided 98% confidence interval for the above test.

[3 marks]

5. a. The partially completed output for a statistical analysis is presented in **TABLE Q5(a).**

TABLE Q5(a)

The regression output

Predictor	Coef	SE Coef	T
Constant	3.318	1.007	3.29
x_1	0.7417	0.5768	?
x_2	?	0.6571	13.87
S = ?	R - squared = ?		

Analysis of Variance

Source	Df	SS	MS	F
Regression	?	133.366	66.683	?
Residual	?	17.332	?	
Total	27	150.698		

i. Copy the output **TABLE Q5(a)** and fill all missing values.

[4 marks]

ii. If Y is the dependent variable, write the regression equation for the above analysis.

[2 marks]

iii. Test for significance of regression. Use $\alpha = 0.05$.

[4 marks]

b. One of the factors that determines the degree of risk a pesticide poses to human health is the rate at which the pesticide is absorbed into skin after contact. An important question is whether the amount in the skin continues to increase with the length of contact, or whether it increases for only a short time before levelling off. To investigate this, measured amounts of certain pesticide were applied to 20 samples of rat skin. Four skins were analyzed at each of the time intervals 1,2,4,10, and 24 hours. The amounts of the chemical (μg) that were in the skin are given in **TABLE Q5(b).**

TABLE Q5(b)

Duration	Amounts Absorbed			
1	1.7	1.5	1.2	1.5
2	1.8	1.6	1.8	1.9
4	1.9	1.7	2.1	2.0
10	2.3	1.9	1.7	1.5
24	2.1	2.2	2.5	2.3

i. Construct the analysis of variance table for the above data.

[8 marks]

ii. Based on the results in **part (b)(i)** determine if the amount in the skin varies with time.

[2 marks]

- END OF PAPER -