- SAMPLE -

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THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF BASIC SCIENCES
ACADEMIC YEAR 2018/2019 – SEMESTER II

BACHELOR OF PHARMACY HONOURS – LEVEL 5
BACHELOR OF MEDICAL LABORATORY SCIENCES HONOURS – LEVEL 5
BSU5230 – APPLIED STATISTICS
CONTINUOUS ASSESSMENT II (NBT II)

DATE: 27th AUGUST 2019

DURATION: ONE HOUR
TIME: 11.00 AM – 12.00 NOON

REGISTRATION NO: .....

This question paper consists of 10 pages with 10 Multiple Choice Questions, 10 True/False statements (Part A) and 02 Structured Essay Questions (Part B).

IMPORTANT INSTRUCTIONS TO CANDIDATES

- Write your Registration Number in the space provided.
- Answer **ALL questions.** (All answers must be in **INK:** Answers in pencil will **NOT** be marked))
- **Multiple Choice Questions and True / False Questions (Part A):** Indicate answers in the answer sheet provided by placing a cross (X) in **INK** in the relevant cage.
- **Structured Essay Questions (Part B):** Write answers within the space provided.
- Do not remove any page/part of this question paper and do not take the paper out of the examination hall.
- Mobile phones and any other electronic equipment are **NOT** allowed. Leave them outside.
- Scientific Calculators are allowed.
- Please fill the address sheet. (See last page)

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ANSWER SHEET FOR PART A: Question 01

Q. 1	(a)	(b)	(c)	(d)
1.1				
1.2				
1.3				
1.4				
1.5				
1.6				
1.7				
1.8				
1.9				
1.10				

ANSWER SHEET FOR PART A: Question 02

Q. 2	True	False
2.1		
2.2		
2.3		
2.4		
2.5		
2.6		
2.7		
2.8		
2.9		
2.10		

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Part A – Multiple Choice Questions and True/False Statements

(1 20 = 20 marks)*

1. Multiple Choice Questions: Choose the most suitable/ best answer and indicate with a 'X' in the answer sheet

1.1 A Pearson correlation coefficient value of zero ($r = 0$) indicates that,

a) there is a negative relationship between the two variables.
b) there is a positive relationship between the two variables.
c) there is no relationship between the two variables.
d) there is a weak negative relationship between the two variables.

1.2 The slope and the intercept of a linear regression line are calculated as 2.5 and 16 respectively. What is the value of the dependent variable (Y) when independent variable (X) is equal to 4?

a) 11.6
b) 26.0
c) 66.5
d) 116.0

1.3 What is the statistical technique that can be used to compare three or more population means?

a) Paired t test
b) Z test
c) ANOVA
d) Regression

1.4 A regression equation is used to:

a) measure the association between two variables.
b) estimate the value of a dependent variable based on an independent variable.
c) estimate the value of an independent variable based on a dependent variable.
d) none of the above.

1.5 In simple linear regression analysis, a change in the value of Y (dependent variable) for a unit change in X (independent variable) is given by,

a) slope of the regression line
b) intercept of the regression line
c) correlation coefficient
d) standard error

1.6 If the null hypothesis of an ANOVA test is accepted, then the ratio of $\frac{MST}{MSE}$ must have been,

a) close to 1
b) more than 1
c) close to 0.05
d) more than 0.05

1.7 Suppose you obtain a significant calculated test statistic value when comparing three treatments using a one-way ANOVA. How would you interpret the alternative hypothesis H_A in words?

a) At least one of the population means is significantly different from the others.
b) All the treatments are significantly different from each other.
c) All treatments are the same.
d) All treatments are not the same.

1.8 If two independent samples with ranked data are available, which of the following nonparametric statistical test can be used to test the difference between two populations?

a) Two sample t-test
b) Paired t-test
c) Wilcoxon signed-rank test
d) Wilcoxon rank-sum test

1.9 In which one of the following cases can we use a Wilcoxon signed rank test?

a) When comparing men and women's scores
b) When comparing the means of three or more groups
c) When comparing performance of participants before and after training
d) When assessing relationships between two groups

1.10 The *F*-ratio is typically used to test differences between

a) two dependent means.
b) a sample and a population mean.
c) two independent means.
d) three or more means.

2. True/False statement Questions

2.1 ANOVA is an extension of the t-test and is used to compare means among three or more independent populations. (TRUE/ FALSE)

2.2 Non-parametric tests do not require the variables to be normally distributed. (TRUE/FALSE)

2.3 Spearman's rank correlation coefficient is used for nominal data. (TRUE/ FALSE)

2.4 A negative correlation coefficient implies that there is no association between the relevant variables. (TRUE/ FALSE)

2.5 The range of possible values for the coefficient of correlation is [0, 1]. (TRUE/ FALSE)

2.6 The intercept of a simple linear regression line is equal to the value of Y when X is equal to zero. (TRUE/ FALSE)

2.7 Parametric tests usually require more assumptions about the underlying population distribution of the data than nonparametric tests. (TRUE/ FALSE)

2.8 A strong correlation confirms a causal relationship. (TRUE/ FALSE)

2.9 The ANOVA test assumes that all samples come from the same normal population with equal variances. (TRUE/ FALSE)

2.10 F-test statistic is the ratio between MSE and MST ($\frac{MSE}{MST}$). (TRUE/ FALSE)

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Part B –Structured Essay Questions

(80 marks)

Write answers in the space provided.

3.

a) A researcher conducted a small study involving 20 patients to investigate the association between cholesterol level in blood (in milligrams per deciliter, mg/dL) and the Body Mass Index (BMI, measured as the ratio of weight in kilograms to height in meters). The correlation coefficient was calculated as 0.78.

i. What would be the independent and dependent variables?

Independent Variable-

Dependent variable-

(2 marks)

ii. What is the strength of the relationship between two variables?

(2 marks)

iii. If the least squares linear regression line has been calculated as, $Y = 11.8X - 87.6$. What is the slope of the regression line? Interpret the answer.

(4 marks)

iv. What is the intercept of the regression line?

(2 marks)

v. Estimate the cholesterol levels of patients whose BMI values are;

a. 26
b. 28

using the given fitted regression equation.

(10 marks)

b) A medical researcher wishes to test the claim "number of ear infections of swimmers is significantly different when the swimmers use earplugs". To test the hypothesis, a random sample of 10 swimmers is selected. The average number of infections before using ear plugs and the average number of infections after using ear plugs are recorded respectively.

i. What is the suitable non-parametric test that can be used to test above claim? Give the reason.

(4 marks)

ii. State the null hypothesis and the alternative hypothesis.

(4 marks)

iii. Complete the table that corresponds to the test mentioned in part (ii).

Swimmer	Number of infections		Difference	Rank
	Before	After		
1	3	0		
2	0	1		
3	5	4		
4	4	0		
5	3	1		
6	3	3		
7	4	1		
8	0	0		
9	2	2		
10	1	3		

(6 marks)

i.Calculate $S+ and\ S-$ values.

(4 marks)

ii.If the table value at 5% of significance level is 8, interpret the results.

(2 marks)

4. A pharmaceutical company is interested in comparing the effectiveness of three treatments designed to relieve arthritis pain. Treatments differ according to the proportion of an active ingredient included. Percentages of the active ingredient in treatment A, B, and C are 15%, 40% and 50% respectively. A sample of 15 patients is selected for the study. (Each sample includes 5 patients). Each patient is randomly assigned to one of the three treatments (A, B, C) and the time (in minutes) until pain relief is recorded on each subject.

Treatment A	Treatment B	Treatment C
20	17	14
21	16	13
22	19	12
19	15	14
20	19	11

i. What is the inferential method that can be used to test the equality of means of three treatments?

(2 marks)

ii. State the null hypothesis and alternative hypothesis.

(4 marks)

iii. What are the assumptions that should be made before the analysis?

(4 marks)

iv. Calculate the MST and MSE using summarized data given in the table. **(20 marks)**

	Treatment A	Treatment B	Treatment C
Sample mean	20.4	17.2	12.8
Sample variance	1.3	3.2	1.7
Overall mean	**16.8**		

$$MST = \frac{n_1(\overline{x}_1 - \overline{x})^2 + n_2(\overline{x}_2 - \overline{x})^2 + \ldots\ldots\ldots + n_k(\overline{x}_k - \overline{x})^2}{k-1}$$

$$MSE = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2 + \ldots\ldots\ldots + (n_k - 1)S_k^2}{n-k}$$

v. Calculate the F-test statistic. $F = \frac{MST}{MSE}$

(5 marks)

vi. If the critical F value at 5% of significance is 3.88, interpret the results.

(5 marks)

Reg. No:.....

Name:.....

Address:.....

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