UNIVERSITY OF RUHUNA – FACULTY OF ALLIED HEALTH SCIENCES
DEPARTMENT OF PHARMACY
SECOND BPHARM PART I EXAMINATION – JANUARY/FEBRUARY 2022

PH 2143 BIOSTATISTICS II – SEQ

TIME: THREE HOURS

INSTRUCTIONS

- There are **six** questions in part **A** and **B** in this SEQ paper.
- Answer all questions.
- No paper should be removed from the examination hall.
- Do not use any correction fluid.
- Use illustrations where necessary.

PART A

1.

1.1. A new anesthetic was tested on ten patients who were underwent surgeries. These are their recovery times (in hours):

2.6   3.0   2.8   3.1   3.5   2.9   3.1   2.7   2.9   3.3

1.1.1. Construct a normal Q-Q plot. Can we assume that the recovery time is normally distributed? **(10 marks)**

1.1.2. Write down the point estimate of mean recovery time for the new drug. **(10 marks)**

1.1.3. Write down a 95% confidence interval for the mean recovery time for the new drug. **(20 marks)**

1.2. The following data for blood protein (g/100 ml) were observed for the comparison of two drugs on two groups of patients.

Drug A	8.1	9.4	7.2	6.3	6.6	9.3	7.6	8.1	8.6	8.3	7.0	7.7
Drug B	9.0	9.9	8.0	6.7	7.9	9.0	7.9	8.3	8.2	8.9	8.3	8.8

1.2.1. Construct the side-by-side boxplots. **(10 marks)**

1.2.2. Based on the side-by -side boxplots of the two samples, do the variances of the two samples appear to be homogeneous? **(10 marks)**

1.2.3. Construct normal Q-Q plots for two drug groups. **(10 marks)**

1.2.4. What do the boxplots and normal Q-Q plots tell about the underlying parent distributions? **(10 marks)**

1.2.5. Based on your results in part (1.2.4), complete the pooled t-test or the two-sample t-test or the Mann-Whitney U test to compare the Drug A and Drug B. Write down the null and alternative hypotheses and p-value and state your conclusion. **(20 marks)**

2. The data in the following table represent the number of hours of relief provided by three different brands of headache tablets administered to 18 subjects experiencing fevers of 38°C or more.

A	B	C
5.2	9.1	2.4
4.7	7.1	3.4
8.1	8.2	4.1
6.2	6.0	1.0
3.0	9.1	4.0
5.8	7.2	3.2

2.1. State the null and alternative hypotheses for a one-way analysis of variance test for comparing three brands of headache tablets. **(20 marks)**

2.2. Construct side by side boxplots. Does it appear that there is a difference among the three tablets? **(15 marks)**

2.3. Construct normal Q-Q plots for each tablet. Does the normality assumption seem to be satisfied? **(15 marks)**

2.4. Obtain the sample standard deviation for each brand of tablets. Do you think the population standard deviations are homogeneous? Explain. **(20 marks)**

2.5. If the assumptions for the one-way analysis of variance are satisfied, complete the analysis of variance output. **(10 marks)**

2.6. Test the hypothesis that there is no difference among the three tablets. Be sure to state your conclusions. **(20 marks)**

3.

3.1. Suppose a random sample of 170 patients having the skin disease are classified into the three age categories yielding the frequencies given in the following table:

	Age Category		
Severity	A	B	C
Moderate	15	32	18
Mildly Severe	8	29	23
Severe	1	20	24

3.1.1. Identify the variable classifications. **(10 marks)**

3.1.2. State the null and alternative hypotheses to test whether the severity of the disease is independent of the age of the patient. **(10 marks)**

3.1.3. What is the value of test statistic? **(10 marks)**

3.1.4. What is the p-value? Write your conclusion. **(20 marks)**

3.2. Two drugs, amantadine (A) and rimantadine (R), are being studied for use in combatting the influenza virus. A single 100-milligram dose is administered orally to healthy adults. The variable studied is T_{max}, the time in minutes required to reach maximum plasma concentration. The following data are obtained:

$T_{max}(A)$		$T_{max}(R)$	
105	205	230	236
126	340	253	246
120	200	256	340
119	123	227	271
133	180	244	280

3.2.1. Construct the side-by-side boxplots for the $T_{max}(A)$ group and the $T_{max}(R)$ group. Are the parent distributions symmetric or skewed? **(10 marks)**

3.2.2. Construct normal Q-Q plots for two groups. Does the normality assumption seem to be satisfied? **(10 marks)**

3.2.3. Based on your results in parts (3.2.1) & (3.2.2), use the most appropriate test to compare the center of the two distributions. Give the value of test statistic and p-value. State your conclusion. **(30 marks)**

4. The following table gives information on the amount of sugar (in grams) and the calorie count in one serving of a sample of 13 varieties of certain brand of cereal.

Sugar (x)(grams)	4	15	12	11	8	6	7	2	7	14	20	3	13
Calories (y)	120	180	140	110	120	90	140	100	120	170	190	110	120

4.1. Construct a scatter diagram for these data. Does the scatter diagram exhibit a linear relationship between the amount of sugar and the number of calories per serving?

(10 marks)

4.2. Obtain the least square estimates of β_0 and β_1 for the model $y = \beta_0 + \beta_1 x + \varepsilon$.

(20 marks)

4.3. Interpret the estimated value of β_1 in this equation. *(20 marks)*

4.4. Test the hypothesis that $\beta_1 = 0$. Write down the value of test statistic and p-value. Do the results of this test indicate that a linear trend is significant? *(20 marks)*

4.5. What percentage of the variation in calories (y) is explained by the linear regression model? *(15 marks)*

4.6. Calculate the predicted calorie count for a cereal with 16 grams of sugar per serving.

(15 marks)

5.
   5.1. Briefly explain the following designs:

   5.1.1. Completely randomized design, *(15 marks)*

   5.1.2. Randomized block design *(15 marks)*

   5.2. Write down the mathematical model and the relevant null hypotheses for the fixed effects two-factor model. *(25marks)*

   5.3. Three diets were compared on premature babies with two types of respiratory disease. The table below gives the increase in weight, in kilograms, for these babies.

		Diets		
		1	2	3
Respiratory disease	A	3.2	3.9	4.8
		3.5	3.7	4.7
	B	2.5	3.0	4.2
		2.8	3.3	4.5

Using a 0.05 level of significance, test the hypothesis that

    5.3.1. the types of diet and types of respiratory disease do not interact.   (*15 marks*)

    5.3.2. the diets have no effect on the increase of weight of premature babies.

                                                                    (*15 marks*)

    5.3.3. the types of respiratory disease have no effect on the increase of weight of premature babies.   (*15 marks*)

PART B

6.

6.1 A study is to be conducted to determine the risk factors for side effects following COVID 19 vaccination among the elders in the Southern province in Sri Lanka.

    6.1.1 What type of a study design would you recommend?   (*10 marks*)

    6.1.2 Give reasons for selecting the study design stated above in 6.1.1.   (*20 marks*)

    6.1.3 List two (02) advantages and two (02) disadvantages of the study design stated above in 6.1.1   (*20 marks*)

    6.1.4 State **the measure of association** that you would select for the above study to show the associations.   (*10 marks*)

6.2 Data related to dengue fever in two Medical Officer of Health areas were reviewed to plan future action for prevention and control of dengue fever. The number of new cases of dengue fever reported for the year 2021 in MOH area 'A' and 'MOH area B' were 120 and 150 respectively. The estimated population of these two MOH areas in the same year was 60,000 and 37,500 respectively.

    6.2.1 Calculate the measure of disease frequency that can be obtained using the above data for the two MOH areas separately.   (*20 marks*)

    6.2.2 Compare two measure of disease frequencies calculated in 6.2.1 using an appropriate risk estimate and interpret the results.   (*20 marks*)

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