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UNIVERSITY OF RUHUNA – FACULTY OF ALLIED HEALTH SCIENCES

DEPARTMENT OF PHARMACY

SECOND BPHARM PART I EXAMINATION – JULY 2018

PH 2143 BIOSTATISTICS II (SEQ)

TIME: THREE HOURS

INSTRUCTIONS

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

PART A

1.

1.1. Define the following terms: ***(50 marks)***

1.1.1. Crude birth rate,

1.1.2. Crude death rate,

1.1.3. Infant mortality rate,

1.1.4. Maternal mortality rate,

1.1.5. Neonatal mortality rate.

1.2. Briefly explain the following terms: ***(50 marks)***

1.2.1. Laboratory bias,

1.2.2. Double Blinded Procedure in Pharmacy Research.

PART B

2.

2.1. The paper "Effect of long-term blood pressure control on salt sensitivity" [Journal of Medicine (1997) 28:147–156] describes a study evaluating salt sensitivity (SENS) after a period of antihypertensive treatment. Ten hypertensive patients (diastolic blood pressure between 90 and 115 mmHg) were studied after at least 18 months on antihypertensive treatment. SENS readings, which were obtained before and after the patients were placed on an antihypertensive treatment, are given here:

Patient	1	2	3	4	5	6	7	8	9	10
Before Treatment	22.86	7.74	15.49	9.97	1.44	9.39	11.40	1.86	-2.71	6.42
After Treatment	6.11	-4.02	8.04	3.29	-0.77	6.99	10.19	2.09	4.40	10.70

Is there significant evidence that the mean SENS value decreased after the patient received antihypertensive treatment? Use $\alpha = 0.05$. ***(50 marks)***

2.2. In an effort to link cold environments with hypertension in humans, a preliminary experiment was conducted to investigate the effect of cold on hypertension in rats. Two random samples of 6 rats each were exposed to different environments. One sample of rats was held in a normal environment at 26 °C. The other sample was held in a cold 5 °C environment. Blood pressures and heart rates were measured in both groups of rats. The blood pressures of the 12 rats are shown in the tables below.

26 °C	
Rat	**Blood Pressure (mmHg)**
1	152
2	157
3	179
4	182
5	176
6	149

5 °C	
Rat	**Blood Pressure (mmHg)**
7	384
8	369
9	354
10	375
11	366
12	380

2.2.1. Do the data provide sufficient evidence that rats exposed to a 5 °C environment have a higher mean blood pressure than rats exposed to a 26 °C environment? Use $\alpha = 0.05$. ***(40 marks)***

2.2.2. Write down a 95% confidence interval on the difference in the two population means. ***(10 marks)***

3. A consumer agency wanted to find out if the mean time taken by each of three brands of medicines to provide relief from a headache is the same. The first drug was administered to six randomly selected patients, the second to four randomly selected patients, and the third to five randomly selected patients. The following table gives the time (in minutes) taken by each patient to get relief from a headache after taking the medicine.

Drug I	**Drug II**	**Drug III**
25	15	44
38	21	39
42	25	54
65	35	58
47		73
52		

3.1. State the null and alternative hypotheses to test the mean time taken to provide relief from a headache is the same for each of the three drugs. ***(10 marks)***

3.2. Construct side by side boxplots. Does it appear that there is a difference among the three drugs? ***(10 marks)***

3.3. Construct normal Q-Q plots for each Drug. Does the normality assumption seem to be satisfied? ***(10 marks)***

3.4. Obtain the sample standard deviation for each brand of drugs. Do you think the population standard deviations are homogeneous? Explain. ***(10 marks)***

3.5. Do you think that the three assumptions for the F test in one-way analysis of variance are satisfied? Explain. ***(10 marks)***

3.6. Obtain the analysis of variance output for the above data. ***(10 marks)***

3.7. Test the hypothesis that the mean time taken to provide relief from a headache is the same for each of the three drugs at 5% level of significance. State your conclusions. ***(20 marks)***

3.8. Determine whether a multiple comparison test is necessary to make a conclusion on effects. If it is, complete the test and indicate the differences among the three drugs.

(20 marks)

4.

4.1. Interviews with 185 persons engaged in a stressful occupation revealed the following classification.

	Alcoholic	Nonalcoholic	Total
Depressed	54	27	81
Not depressed	22	82	104
Total	76	109	185

Do these observations demonstrate an association between alcoholism and mental depression? Test at $\alpha = 0.01$. Answer the question by carrying out the following steps:

4.1.1. State the null and alternative hypotheses of the test. ***(10 marks)***

4.1.2. Obtain the output of the statistical test for the hypothesis in Part 4.1.1. ***(10 marks)***

4.1.3. Write down the value of the Pearson Chi-Square test statistic. ***(10 marks)***

4.1.4. Write down the p-value. ***(10 marks)***

4.1.5. Write down your conclusion. ***(10 marks)***

4.2. In a study of the cognitive capacities of nonhuman primates, 19 monkeys of the same age are randomly divided into two groups of 10 and 9. The groups are trained by two different teaching methods to recollect an acoustic stimulus. The monkeys' scores on a subsequent test are

Method I	167	149	137	178	179	155	164	104	151	150
Method II	105	127	140	120	125	122	55	117	131	

Do the data strongly indicate a difference in the recollection abilities of monkeys trained by the two methods? Answer the question by carrying out the following steps:

4.2.1. Construct the side-by-side boxplots for the Method I group and the Method II group. Are the parent distributions symmetric or skewed? ***(10 marks)***

4.2.2. Complete the tests of normality and state your conclusion. ***(10 marks)***

4.2.3. Based on your results in part (i) & (ii), 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. Use $\alpha = 0.01$. ***(30 marks)***

5. In one stage of the development of a new drug for an allergy, an experiment is conducted to study how different dosages of the drug affect the duration of relief from the allergy symptoms. Ten patients are included in the experiment. Each patient receives a specific dosage of the drug and is asked to report back as soon as the protection of the drug seems to wear off. The observations are recorded in the following table, which shows the dosage x and duration of relief y for the 10 patients.

Dosage (in Milligrams) x	**Duration of Relief (Number of days)** y
3	9
3	5
4	12
5	9
6	14
6	16
7	22
8	18
8	24
9	22

5.1. Construct a scatter diagram for these data. Does the scatter diagram exhibit a linear relationship between dosage and duration of relief? ***(10 marks)***

5.2. Calculate the sample correlation, r. ***(10 marks)***

5.3. Test the null hypothesis that $\rho = 0$ against the alternative that $\rho > 0$ at the 0.01 level of significance. ***(10 marks)***

5.4. Obtain the least square estimates of β_0 and β_1 for the model $y = \beta_0 + \beta_1 x + \varepsilon$. . ***(10 marks)***

5.5. Interpret the meaning of β_1 in this problem. ***(15 marks)***

5.6. 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? ***(15 marks)***

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

5.8. Predict the duration of relief when the dosage is 4.5 milligrams. ***(15 marks)***

6.

6.1. Briefly explain the following terms in the design of experiments: ***(40 marks)***

6.1.1. Extraneous variable

6.1.2. Random Assignment

6.1.3. Blocking

6.1.4. Replication

6.2. Write down the mathematical model and the relevant null and alternative hypotheses for the Latin Square design. ***(10 marks)***

6.3. The effect of five different ingredients (A, B, C, D, E) on the reaction time of a chemical process is being studied. Each batch of new material is only large enough to permit five runs to be made. Furthermore, each run requires several hours, so only five runs can be made in one day. The experimenter decides to run the experiment as a Latin square so that day and batch effects may be systematically controlled. She obtains the data that follow. Analyze the data from this experiment (use $\alpha = 0.05$) and draw conclusions.

(50 marks)

	Day				
Batch	1	2	3	4	5
1	$A = 8$	$B = 7$	$D = 1$	$C = 7$	$E = 3$
2	$C = 11$	$E = 2$	$A = 7$	$D = 3$	$B = 8$
3	$B = 4$	$A = 9$	$C = 10$	$E = 1$	$D = 5$
4	$D = 6$	$C = 8$	$E = 6$	$B = 6$	$A = 10$
5	$E = 4$	$D = 2$	$B = 3$	$A = 8$	$C = 8$

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