



UNIVERSITY OF RUHUNA – FACULTY OF MEDICINE

ALLIED HEALTH SCIENCES DEGREE PROGRAMME

SECOND BPHARM PART I EXAMINATION - 2015

PH 2143 - BIOSTATISTICS II

TIME: THREE HOURS

INSTRUCTIONS

- questions all Answer.
- paper should be removed from the examination hall No.
- Do not use any correction fluid.
- Use illustrations where necessary.

1.

(a)

- i. Briefly explain what the experimental design is. (10 marks)
- ii. List the three fundamental principles that need to be considered in the design of an experiment. (10 marks)

(b) Briefly explain the following topics in Statistical Quality Control:

- i. Statistical Process Control, (10 marks)
- ii. The process is under control, (10 marks)
- iii. The process is out of control. (20 marks)

(c) Two batches of a certain chemical were delivered to a factory. For each batch ten determinations were made of the percentage of manganese in the chemical. The results were as follows:

Batch 1	3.3	3.7	3.5	4.1	3.4	3.5	4.0	3.8	3.2	3.7
Batch 2	3.2	3.6	3.1	3.4	3.0	3.4	2.8	3.1	3.3	3.6

Is there a significant difference between the two sample means?

(40 marks)

2.

- (a) Suppose we wish to compare the length of stay in the hospital for patients with the same diagnosis at two different hospitals. The following results were found:

First hospital	21, 10, 32, 60, 8, 44, 29, 5, 13, 26, 33
Second hospital	86, 27, 10, 68, 87, 76, 125, 60, 35, 73, 96, 44, 238

- i. Why might a t test not be very useful in this case? Verify your answer. (20 marks)

- ii. Carry out a nonparametric procedure for testing the hypothesis that the lengths of stay are comparable in the two hospitals. (20 marks)

- (b) The effects of two drugs on reaction time to a certain stimulus were studied in three samples of experimental animals. Sample III served a control while the animals in sample I were treated with drug A and those in sample II were treated with drug B, prior to the application of the stimulus. The following table shows the reaction times in seconds of the 13 animals.

Sample		
I	II	III
17	8	2
20	7	5
40	9	4
31	8	3
35		

- i. Construct the normal probability plots of the three samples. Is normality a reasonable assumption in each case? (10 marks)
- ii. Construct boxplots of three samples. Does the variability in the three distributions appear the same? (10 marks)
- iii. Should the ordinary F-test or Kruskal-Wallis test be used to compare the three distributions? (20 marks)
- iv. Complete the test recommended in part (iii) to determine whether there is a significant difference in the reaction time and state your conclusion. (20 marks)

3.

Rats were given one of four different diets at random, and the response measure was liver weight as a percentage of body weight. The responses were

Treatment			
1	2	3	4
3.52	3.47	3.54	3.74
3.36	3.73	3.75	3.83
3.57	3.38	3.61	3.87
3.68	3.87	3.76	4.08
3.88	3.69	3.65	4.31
3.76	3.51	3.51	3.98
3.94	3.35		3.86
	3.64		3.71

- (a) State the null and alternative hypotheses for a one-way analysis of variance test. (10 marks)
- (b) Construct side by side boxplots.
Does it appear that there is a difference among the four treatments? (10 marks)
- (c) Construct normal probability plots for each treatment. Does the normality assumption seem to be satisfied? (10 marks)
- (d) Obtain descriptive statistics of the data for each treatment. Do you think the population standard deviations are homogeneous? Explain. (10 marks)
- (e) Do you think that the assumptions for the F test are satisfied? Explain. (10 marks)
- (f) Complete an analysis of variance output. (10 marks)
- (g) Test the hypothesis that there is no difference among the four diets. Be sure to state your conclusions. (20 marks)
- (h) Determine whether a multiple comparison test is necessary. If it is, complete the test and indicate what differences exist among the four diets. (20 marks)

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4.

(a) A researcher found that the mean serum cholesterol level for males aged 20-74 years was 211. The standard deviation was approximately 90. Consider the sampling distribution of the sample mean based on samples of size 50 drawn from this population of males.

Write down the mean and the standard deviation of the sampling distribution of sample mean.

(30 marks)

(b) A survey of children under 15 years of age residing in the city area were classified according to ethnic group and hemoglobin level. The results were as follows:

Ethnic group	Hemoglobin level (g/100 ml)			Total
	10.0 or greater	9.0-9.9	<9.0	
A	80	100	20	200
B	99	190	96	385
C	70	30	10	110
Total	249	320	126	695

Display these data in a 3-D bar plot.

(20 marks)

Do these data provide sufficient evidence to indicate, at the 0.05 level of significance, that the two variables are related? Assume the null hypothesis is $H_0: \text{The two variables are not related.}$

5.

The following are the weights (kg) and blood glucose levels (mg/100 ml) of 16 apparently healthy adult males;

Weight (X)	64.0	75.3	73.0	82.1	76.2	95.7	59.4	93.4	82.1
Glucose (Y)	90	109	104	102	105	121	79	107	101

Weight (X)	78.9	76.7	82.1	83.9	73.0	64.4	77.6
Glucose (Y)	85	99	100	108	104	102	87

- (a) Construct a scatterplot of weight versus glucose. (10 marks)
- (b) Does there appear to be a linear trend in the data? (10 marks)
- (c) Obtain the least square estimates of α and β for the linear model $y = \alpha + \beta x + \epsilon$. (10 marks)
- (d) Test the hypothesis that $\beta = 0$ using both ANOVA and the t test. Write down the value of test statistic, p-value and interpretation for each test. Do the results of these tests indicate that the linear model is a reasonable model? (20 marks)
- (e) Write down the 95% confidence interval for β . (10 marks)
- (f) How much does glucose level increase for each additional 5kg of weight? (20 marks)
- (g) Write down the value of the coefficient of determination and interpret it. (10 marks)
- (h) What is the predicted glucose level for a man who weight 95 kg? (10 marks)

6.

6.1

Define the following terms,

- 6.1.1 Crude Death Rate (10 marks)
- 6.1.2 Infant Mortality Rate (10 marks)
- 6.1.3 Incidence Rate (10 marks)
- 6.1.4 Attack Rate (10 marks)

6.2

- 6.2.1 Briefly describe the term "case control study" (20 marks)
- 6.2.2 List **three** advantages of the case-control study (15 marks)
- 6.2.3 Why randomization is important in clinical trials? (25 marks)