

THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. /B.Ed. Degree Programme, Continuing Education Programme

APPLIED MATHEMATICS-LEVEL 05

PCU3142/PSU2182/ PCU2142/PCE5142/PCE4142- DESIGN AND ANALYSIS OF EXPERIMENTS

FINAL EXAMINATION 2015/2016

Duration: Two Hours.

Date: 09.01.2017

Time: 1. 30p.m- 3. 30p.m

Answer FOUR questions only.

Instructions:

- This question paper consists of 06 questions and 05 pages.
- Statistical Tables are provided.
- Non-programmable calculators are permitted.
- Consider the level of significance as 0.05 for all the tests.

01. A physician wants to determine whether diabetes can be controlled through diet. He is interested in studying the effect of three different types of diets, say *Type I*, *Type II*, *Type III*. He selected 15 volunteers for the study and they were divided into three groups of five randomly. Each person in first, second and third groups were given *Type I*, *Type II*, *Type III* diets respectively. Same quantity was given from each diet. After a specified period of diet use, the fasting blood sugar levels were measured for all 15 patients. The data obtained are given below.

Diet Types	Observations					Total
<i>Type I</i>	200	195	195	200	190	590
<i>Type II</i>	175	180	185	175	170	540
<i>Type III</i>	160	155	165	165	160	480

Total sum of squares = 3340

- (a) Are there any weaknesses in planning the experiment? Suggest possible remedial measures for each of those weaknesses. (if any)

(b) In relation to this experiment, identify

- (i) Response variable
- (ii) Experimental unit
- (iii) Treatments

(c) Estimate the mean blood sugar level for *Type I* diet along with its standard error.

(d) Construct a 95% confidence interval for the difference between the mean blood sugar level of *Type I* and *Type II* diets.

(e). Interpret the confidence interval that you obtained in part(d).

02. An industrial engineer wanted to conduct an experiment on eye focus time. He is interested in the effect of the distance of the object from the eye on the focus time. Four different distances are of interest. He has five subjects available for the experiment because there may be differences among individuals. The focus time data is given below.

Distance (ft)	Subject				
	1	2	3	4	5
4	10	6	6	6	6
6	7	6	6	1	6
8	5	3	3	2	5
10	6	4	4	2	3

(a) Identify the design structure used in this experiment. Justify your answer.

(b) Write down the hypotheses to be used.

(c) Construct the analysis of variance table.

(d) Test your hypotheses in part (b) at 5% level of significance and write down your conclusions.

03. A researcher wishes to examine the qualities of five different home-made wines. Each of five tasters tries each wine once and rates it in scale 0-100. It is suspected that the order, in which the wines are tasted, can affect the results. Hence, it is decided that the tasting order should be varied systematically. The researcher decides to run the experiment using a suitable design and perform the analysis.

Assume that you were consulted by the researcher to select a proper experimental model and perform the analysis of collected data.

- (a) What experimental design you would select to perform the study? Justify your answer.
- (b) Write the corresponding effect model for the selected design.
- (c) Clearly describe how you would design this study.

04. A researcher wishes to determine whether four pharmaceutical drugs have the same effect to decrease the rate of the growth of a certain type of tumor. He selected 16 homogeneous mice and randomly divided into four groups, with each group receiving one of the drugs in its diet. At the end of the experiment, the following data on tumor size were recorded.

Drugs	Observations				Total
Drug 1	4.5	6.0	4.6	5.3	20.4
Drug 2	6.2	5.8	5.0	5.3	22.3
Drug 3	9.1	8.1	9.2	8.4	34.8
Drug 4	9.7	8.4	8.8	9.9	36.8

Total sum of squares = 57.86

- (a) Identify the design used in this study. Justify your answer.
 - (b) Construct an ANOVA table and test whether the mean tumor sizes are same for four drugs.
 - (c) Suppose that drugs 1 and 2 are from a group of related chemical compound, while drugs 3 and 4 are from another group. Write down two meaningful contrasts and test whether they are orthogonal.
 - (d) Test whether one of the contrasts that you mentioned in part (c) is significant. Interpret the results.
05. A researcher wants to study the effect of four diets (*A*, *B*, *C*, *D*) on weight gain (in kilograms) of cattle in a certain farm. It was believed that weight gain is affected by age of the animal and genetic factors. Animals were grouped by age and genetic factors. They were weighted at the beginning of the study period. The different diets were given to the animals for a period of three months, and then they were re-weighted. The study plan and the weight gain over the three months' period are given below:

Genetic Group	Age Group				Total
	1	2	3	4	
1	5 (A)	7 (B)	4 (C)	3 (D)	19
2	10 (B)	8 (A)	5 (D)	5 (C)	28
3	7 (C)	5 (D)	6 (A)	12 (B)	30
4	10 (D)	11 (C)	15 (B)	12 (A)	48
Total	32	31	30	32	125

Total sum of squares = 180.44

Diet	A	B	C	D
total	31	44	27	23

- Identify the design used in this experiment. Justify your answer.
- Construct the ANOVA table and test appropriate hypotheses. Interpret your results.
- Test the hypothesis that effects of diets (A) and (B) are equal.
- The estimated error variance in an RCBD with the age as blocks was 13.06. Which design do you prefer? Justify your answer.

06. A television production company is interested in studying the effects of the type of glass and the type of phosphor on the brightness of a television tube. They selected 2 levels of each factor and performed three replicates with each combination of glass type and phosphor type. The response variable is the current necessary (in micro amps) to obtain a specified brightness level. The data are presented in the following table.

Glass Type	Phosphor Type					
	1			2		
1	280	290	285	300	310	295
2	230	235	240	260	240	235

- Identify the treatment structure of the experiment. Justify your answer.
- How many treatments/ treatment combinations are there in this experiment? What are they?

- (c) Write down the model for the response measured on a randomly chosen television tube. Clearly explain all the terms you use.
- (d) Construct the complete Analysis of Variance table.
- (e) Test whether the effects of type of glass and type of phosphor on the brightness of a television tube are significant or not. Clearly explain your answer.
