THE OPEN UNIVERSITY OF SRI LANKA
B.Sc/B.Ed Degree Programme, Continuing Education Programme
APPLIED MATHEMATICS - LEVEL 04
PSU2182 – DESIGN AND ANALYSIS OF EXPERIMENTS
CLOSED BOOK TEST 2007/2008

DURATION: ONE AND HALF-HOURS

| DATE: 19 – 04 – 2008 | TIME: 4.00pm -5.30pm |
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ANSWER **ALL** QUESTIONS.

**Statistical Tables are provided. Non-programmable calculators are permitted.**

1. In an experiment to study the effect of a fertilizer on the yield of paddy, three amounts of fertilizers (1lb, 5lbs and 10lbs) along with the control (that is with no fertilizer) were applied to 20 experimental plots three months prior to harvesting. A completely randomized design with an equal number of replicates was used to assign the treatments to the experimental plots. The observed yield per plot (in kg) are presented in the accompanying table, where $F_1$, $F_5$ and $F_{10}$ denote the treatments corresponding to 1 lb, 5 lb and 10 lb of fertilizer respectively.

| | Treatments | | | |
|---|---|---|---|---|
| | Control | F1 | F5 | F10 |
| | 18.3 | 28.1 | 40.3 | 50.2 |
| | 22.6 | 28.6 | 35.3 | 49.7 |
| | 15.1 | 31.7 | 36.5 | 51.2 |
| | 11.4 | 30.3 | 43.3 | 48.4 |
| | 23.4 | 27.6 | 37.1 | 52.2 |
| Treatment Total | 90.8 | 146.3 | 192.5 | 251.7 |

i) Construct an analysis of variance table (ANOVA) and test whether there is a significant difference between treatment means. Use a 5% significance level. Clearly state your findings.

ii) Estimate the least significant difference for comparing any two treatment means. Use a 5% significance level.

iii) Using part (ii) or otherwise determine whether there is a significant difference between the yields obtained when 1llb and 10 lbs of fertilizer are applied. Use a 5% significance level. Clearly state your findings.

2. A researcher is interested in comparing the effects of four fertilizers on the yield of beans. Two of the fertilizers (say $P_1$ and $P_2$) are rich in phosphate while the rest of the two are rich in potassium (say $K_1$ and $K_2$). The researcher selected 200 plots for this study which are similar in size. Hundred of the plots are from the dry zone while the rest of the 100 plots are from the wet zone. Plots in each zone are quite similar with respect to the conditions that may possibly have an effect on the growth of beans. The researcher randomly allocated the four treatments to an equal number of plots from each zone.

   i) Using the random number table, clearly explain how you would randomly allocate the four treatments to the experimental plots in this study.

   ii) Write down a comparison between treatment means of phosphate rich fertilizers and potassium rich fertilizers. Clearly explain the notation you use.

   iii) How many linearly independent treatment mean comparisons are possible?

   iv) Write down a list of linearly independent treatment mean comparisons. The number of treatment comparisons in your list should be equal to that stated in part (iii).

3. The following data were collected in a randomized complete block design where the sites indicate blocks and $T_1$, $T_2$ and $T_3$ indicate the treatments. The response measured is the yield measured (kg) in a plot.

| | | Site | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Treatment | $T_1$ | 7.1 | 6.1 | 6.9 | 5.6 | 6.4 |
| | $T_2$ | 6.7 | 5.1 | 5.9 | 5.1 | 5.8 |
| | $T_3$ | 7.1 | 5.8 | 6.2 | 5.0 | 6.2 |

   i) Write down a model for the response measured on a randomly chosen plot.

   ii) Estimate the difference between the means of treatment $T_1$ and treatment $T_2$.

   iii) Give an estimate for the standard error of the estimate given in part (ii).