

BOWEN UNIVERSITY, IWO, NIGERIA
FACULTY OF SCIENCE AND SCIENCE EDUCATION
DEPARTMENT OF MATHEMATICS AND STATISTICS
BSc. DEGREE 2014/2015 FIRST SEMESTER EXAMINATION

COURSE CODE: STA 312 COURSE TITLE: DESIGN AND ANALYSIS OF EXPERIMENTS I

DATE: 26/01/2015 TIME ALLOWED: $2\frac{1}{2}$ hours CREDITS: 3

INSTRUCTION: Answer FOUR questions only

- 1(a) State the basic assumptions underlying the analysis of an experiment. What are the effects of departures from these assumptions .
- (b) Consider the following:

| Treatments | | | | |
|------------|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 |
| 83 | 84 | 86 | 89 | 90 |
| 85 | 85 | 87 | 90 | 92 |
| | 85 | 87 | 90 | |
| | 86 | 87 | 91 | |
| | 86 | 88 | | |
| | 87 | 88 | | |
| | | 88 | | |
| | | 88 | | |
| | | 88 | | |
| | | 89 | | |
| | | 90 | | |

- (i) Assuming a completely randomized design, carry out an ANOVA test and state your conclusions concerning the treatment effects.
- (ii) Compute the co-efficient of variation of your result and interpret it.
- 2(a) Give two examples each of complete block design and incomplete block design..
- (b) Four treatments A, B, C, D were involved in an experiment using blocks of size 3. The observation taken after the experiments are as follows:

| Blocks | Treatments | | | |
|--------|------------|----|----|----|
| | A | B | C | D |
| 1 | 2 | - | 20 | 7 |
| 2 | - | 32 | 14 | 3 |
| 3 | 4 | 13 | 31 | - |
| 4 | 0 | 23 | - | 11 |

- (i) Is the design balanced?
- (ii) What is the value of λ , the number of times each pair of treatments appear together.
- (iii) Carry out the analysis of variance to test for treatments effects.

3(a) Construct orthogonalized squares for a 4×4 Latin squares with letters $PQRS$ and $\alpha, \beta, \lambda, \gamma$ respectively.

(b) The following is an incomplete ANOVA table of a Latin square experiment involving 4 treatments.

| Source | df | SS | MS |
|-----------|----|---------|---------|
| Row | - | - | 163.17 |
| Column | - | 328.8 | - |
| Treatment | - | - | 1513.00 |
| Error | - | - | - |
| Total | - | 7444.00 | |

- (a) Complete the ANOVA table and test for differences between treatments.
- (b) Obtain the efficiency of the design relative to RCBD with rows as blocks.

4(a) What are the merits and demerits of factorial design.

(b) A 2^3 factorial experiment was run in three replicates and the resulting data are as shown below:

| Treatment Combination | Replicates | | |
|-----------------------|------------|----|----|
| | 1 | 2 | 3 |
| (1) | 22 | 31 | 25 |
| n | 32 | 43 | 29 |
| p | 35 | 34 | 50 |
| np | 55 | 47 | 46 |
| q | 44 | 45 | 38 |
| nq | 40 | 37 | 36 |
| pq | 60 | 50 | 54 |
| npq | 39 | 41 | 47 |

Analyse the data and indicate the significant effects at $\alpha = 5\%$

5(a) Consider the following data:

| Treatments | | | | |
|------------|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 |
| 7 | 12 | 14 | 19 | 7 |
| 7 | 17 | 18 | 25 | 10 |
| 15 | 12 | 18 | 22 | 11 |
| 11 | 18 | 19 | 19 | 15 |
| 9 | 18 | 19 | 23 | 11 |

Test for the significance of the following contrasts

C_1 = Comparing treatments 5 with 4

C_2 = Comparing treatments 1 and 3 with 4 and 5

C_3 = Comparing treatments 1 with 3

$C_4 =$ Comparing treatments 2 with treatments 1, 3, 4 and 5.

- 6(a) Draw the layout of Randomized complete block design with letters A, B, C, D, E .
- (b) Design a 2^5 factorial experiment in 2^3 blocks by confounding ADE and BCE factorial effects with blocks in one run. Which other factorial effect is confounded in this design?
- (c) Explain "Principal" block with an Illustration.