



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE

ACTUARIAL

SPECIAL RESIT 2015/2016 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: SAS 405

COURSE TITLE: ANALYSIS OF EXPERIMENTAL DESIGNS 11

EXAM VENUE: LAB 1

STREAM: (BSc. Actuarial)

DATE: 05/05/2016

EXAM SESSION: 2.00 – 4.00 PM

TIME: 2.00 HOURS

Instructions:

- 1. Answer question 1 (Compulsory) and ANY other 2 questions**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE (20 MARKS)

- a) Explain the following as used in experimental designs
- i. Confounding
 - ii. Nested design
 - iii. Split plot design
 - iv. Run
 - v. Three factor interaction
- (10 marks)

b) A 2^3 factorial design is presented with three replicates as shown below.

	REPLICATES		
	1	2	3
1	22	34	32
a	34	45	27
b	25	34	38
ab	32	22	45
c	34	36	55
ac	45	43	36
bc	40	48	44
abc	39	54	35

Estimate the factorial effects and state which single factor or combination of factors is dominant.

(8 marks)

- c) Confound 2^4 design in 8 blocks based on the effects ***ad, bc*** and ***abc***. (7 marks)
- d) You are provided with the following information on a 3^2 design where the two factors involved A and B correspond to the rows and columns of a latin square.

	Factor B		
	12	-5	3
Factor A	-6	5	11
	6	-4	-3

Obtain the sum of squares due to interaction AB. (5 marks)

QUESTION TWO (20 MARKS)

- a) In a 2^3 design, a researcher is interested in knowing the effect of three factors A,B and C on the response Y. He sets both A and B at High level with C at Low and compares this to setting A at low with both B and C at high levels. Based on the data below, check which of his choices favor a better response.

RUN	REPLICATES		
	1	2	3
1	52	54	52
a	64	75	67
b	55	64	38
ab	62	42	45
c	64	56	65
ac	75	43	56
bc	70	48	44
abc	69	54	65

- b) Confound 2^5 design in 2^p blocks where $p=3$ (12 marks)
(8 marks)

QUESTION THREE (20 MARKS)

- a. Confound 2^4 design with blocks using the effects **ab,acd** and **bc**. Clearly indicate which other effects are confounded with blocks.
(10marks)
- b. Compute the sum of squares due to interaction factor for the following three level factorial design three replicates by use of orthogonal Latin squares and a coding factor 30.

Treatments effects	totals
00	32
01	38
02	20
10	40
11	28
12	24
20	35
21	27
22	23

(10 marks)

QUESTION FOUR (20 MARKS)

- a) A company buys raw materials in batches from two different suppliers. It is believed that mineral content of raw materials affect the final manufactured product. Four batches of raw material are selected at random from each supplier and three determinants of mineral content made on each. A consultant uses the nested design for this scenario. The data collected is recorded below and may be coded by using a constant of 100.

	Supplier 1				Supplier 2			
batches	1	2	3	4	1	2	3	4
	110	109	102	104	112	107	105	100
	98	90	88	95	99	97	96	99
	100	102	101	99	105	107	102	106

The company is interested in knowing whether or not mineral content is attributed to difference in batches or to difference in suppliers. Give your opinion at 5% level of significance. (20 marks)

QUESTION FIVE (20 MARKS)

- a) An engineer is interested in the effect of cutting speed(A), metal hardness (B) and cutting angle (C) on the life of a cutting tool. The tool life data in hours is shown below.

Treatment combination	replicate	
	I	II
1	221	311
a	325	435
b	354	348
ab	552	472
c	440	453
ac	406	377
bc	605	500
abc	392	419

- i. Obtain the sum of squares for all the single factors, two factor interaction and three factor interaction. (12 marks)
- ii. Confound ABC with blocks and compute the sum of squares due the non-principal block. (8 marks)