UNIVERSITY OF EMBU

2016/2017 ACADEMIC YEAR

FIRST SEMESTER EXAMINATION

EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE IN LAND AND WATER RESOURCE MANAGEMENT

ACP 607: BIOMETRICS FOR AGRICULTURAL SCIENCES

DATE: NOVEMBER 29, 2016 **TIME: 2:00-4:00PM**

INSTRUCTIONS:

Answer Question ANY FOUR Questions

QUESTION ONE (25 MARKS)

a) Discuss the importance of statistical analysis in agricultural research. (10 marks)

b) In a preliminary analysis of the baseline soil organic carbon, a graduate student recorded the data shown below from experimental plots. (i) Calculate the measures of central tendency. (ii) Compute measures of dispersion. (15 marks).

Plot No	P1	P2	P3	P4	P5	P6	P7	P8
SOC (%)	1.8	1.9	2.1	2.0	2.3	2.3	3.3	2.1
Plot No	P9	P10	P11	P12	P13	P14	P15	P16
SOC	3.1	1.5	1.9	2.6	1.9	2.0	1.5	3.0

(%)								

QUESTION TWO (25 MARKS)

a) Describe the THREE basic principles of experimental design. (9 marks)

b) A study was conducted to assess the performance of a new hybrid maize variety (MHv) against the conventional variety (MCv) under farmers' conditions. The yield from the two varieties is as shown in the table below. The summary statistics have also been computed for you. (i) State the null and alternate hypothesis for study, (ii) Conduct a two-tailed Student's t-test to determine if the yields from the two varieties are significantly different and (iii) Draw a conclusion regarding the null hypothesis. (16 marks)

	Maize Yield (Tons/Ha)									
MCv	1.8	2.1	1.7	1.8	2.2	2.7	2.3	2.0	2.5	1.5
	2.3	2.4	2.8	1.9	2.1	2.6	2.0	2.2	1.7	1.5
	1.9	1.4	1.8	2.3	2.0	2.4	1.4	2.3	2.2	2.3
MHv	2.9	3.3	2.0	2.0	2.8	2.1	2.8	3.2	2.2	2.7
	2.7	3.2	1.8	2.1	2.2	1.9	2.5	1.7	1.9	2.1
	3.0	2.5	2.6	1.7	1.7	1.9	2.3	2.0	1.8	2.0

T-test

The TTEST Procedure

Variable: Yield

Variety	N	Mean	Std Dev	Std Err	Minimum	Maximum
MCv	30	2.0700	0.3734	0.0682	1.4000	2.8000
MHv	30	2.3200	0.4916	0.0898	1.7000	3.3000
Diff (1-2)		-0.2500	0.4365	0.1127		

Variety	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
MCv		2.0700	1.9306	2.2094	0.3734	0.2974	0.5019
MHv		2.3200	2.1364	2.5036	0.4916	0.3915	0.6608
Diff (1-2)	**Pooled**	-0.2500	-0.4756	-0.0244	0.4365	0.3695	0.5334
Diff (1-2)	**Satterthwaite**	-0.2500	-0.4759	-0.0241			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	58	-2.22	0.0305
Satterthwaite	Unequal	54.105	-2.22	0.0308

QUESTION THREE (25 MARKS)

a) Describe the procedure of hypothesis testing. (10 marks)

b) Differentiate between a one-tailed test and a two-tailed test of significance. (4 marks)

c) Using a diagram show the 95% confidence level of a normal distribution. (5 marks)

d) Explain how the test for normality is achieved. (6 marks)

QUESTION FOUR (25 MARKS)

A fertilizer trial was conducted to determine the optimal fertilizer application rate for maize. Four fertilizer application rates (0N; 30N; 60N; 90N) were used in a randomized complete block design (RCBD) with four replicates. At the end of the season maize yield from all the plots were harvested using standard procedures and the data is as shown in the table below:

	Maize Yield (Kg/Ha)				
Treatment	**Block 1**	**Block 2**	**Block 3**	**Block 4**	
0N	1501	2638	2191	1755	
30N	3340	2772	2788	2414	
60N	4072	2380	2921	3720	
90N	3917	4537	3181	3873	

a) State the null and alternate hypothesis for the study. 2 marks)

b) Subject the data to a one-way analysis of variance (ANOVA) and show all the major components. (18 marks)

c) Using the F-distribution table provided, determine the critical values of F for one-tailed test at 95% confidence for Treatment and Block effects. (2 marks)

d) Draw a conclusion about your hypothesis. (3 marks)

QUESTION FIVE (25 MARKS)

A field experiment was carried out to investigate the effect of planting density (Plant –no. of stems/m^2) and amount of water used during irrigation in terms of percentage field capacity (Irrig - % of field capacity) on the girth of trees (Girth –in cm). The data and analysis results are shown in the tables below:

		Girth (cm)			
Block	**Plant**	**0FC**	**33FC**	**66FC**	**100FC**
1	1	15	16	21	21
2	1	13	20	19	19
3	1	17	19	23	14
4	1	11	15	22	17
5	1	12	21	26	18
1	2	16	18	22	24
2	2	19	20	26	18
3	2	12	21	20	18
4	2	14	21	21	22
5	2	14	21	18	17
1	3	10	13	16	15
2	3	9	10	19	15
3	3	13	14	20	15
4	3	10	11	23	22
5	3	9	15	16	16

The SAS System

The GLM Procedure

Dependent Variable: Girth

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	754.800000	50.320000	7.17	<.0001
Error	44	308.800000	7.018182		
Corrected Total	59	1063.600000			

R-Square	Coeff Var	Root MSE	Girth Mean
0.709665	15.40224	2.649185	17.20000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Block	4	1.6000000	0.4000000	0.06	0.9937
Plant	2	223.9000000	111.9500000	15.95	<.0001
Irrig	3	479.3333333	159.7777778	22.77	<.0001
Plant*Irrig	6	49.9666667	8.3277778	1.19	0.3311

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Block	4	1.6000000	0.4000000	0.06	0.9937
Plant	2	223.9000000	111.9500000	15.95	<.0001
Irrig	3	479.3333333	159.7777778	22.77	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Plant*Irrig	6	49.9666667	8.3277778	1.19	0.3311

a) Identify an ideal experimental design for the study and an appropriate model for analyzing the data. (2 marks)

b) State null and alternate hypotheses for the study. (6 marks)

c) Discuss the assumptions made for the ANOVA statistic to be used. (6 marks)

d) Identify the following terms from the model (6 marks)

i) Planting density degrees of freedom:
ii) Planting density* Irrigation percentage degrees of freedom:
iii) Error degrees of freedom:
iv) Planting density sum of squares:
v) Irrigation percentage sum of squares:
vi) Planting density* Irrigation percentage sum of squares:
vii) Planting density mean square:
viii) Irrigation percentage mean square:
ix) Planting density* Irrigation percentage mean square:
x) Error mean square:
xi) Determine the model F value:
xii) Determine planting density F value:
xiii) Determine planting density* Irrigation F value:

e) Explain your conclusions in relation to your hypotheses (5 marks)

ANOVA Computational Formula

Sum of squares total $(SS_T) = \sum_{i=1}^{n} Y_{ij}^2 - CF$

Where, **CF** is the correction factor, $= \frac{(\sum_{i=1}^{n} Y_{ij})^2}{n}$

Sum of squares treatment $(SS_{Trt}) = \sum_{i=1}^{b} \frac{Y_{i.}^2}{b} - CF$

Sum of squares block $(SS_{Blk}) = \sum_{i=1}^{t} \frac{Y_{.j}^2}{t} - CF$

Sum of squares error $(SS_E) = SS_T - SS_{Trt} - SS_{Blk}$

ANOVA TAble

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F_{calc}	F_{table}
Treatment	t-1	SS_{Trt}	MS_{Trt}	$\frac{MS_{Trt}}{MS_E}$	
Block	b-1	SS_{Blk}	MS_{Blk}	$\frac{MS_{Blk}}{MS_E}$	
Error	(t-1)(b-1)	SS_E	MS_E		
Total	n - 1	SS_T			

Statistical tables to be included in this exam

- *Critical t-values(p=0.05)*
- *Critical values of F-(one-tailed- p=0.05)*

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