UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME: B.SC. IN AGRICULTURAL EDUCATION IV
B.SC. IN AGRICULTURE IV (AEM, APH, CP, HORT, LWM)
B.SC. IN HOME ECONOMICS IV (HE, TADM)
B.SC. IN HOME ECONOMICS EDUCATION IV

COURSE CODE: AEM 403

TITLE OF PAPER: STATISTICS

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS:

1. ANSWER ALL QUESTIONS IN ALL SECTIONS.
2. ANSWER ALL QUESTIONS ON THE QUESTION PAPER. YOU DO NOT NEED AN EXAMINATION ANSWER FOLDER. SUBMIT THIS QUESTION PAPER. DO NOT REMOVE IT FROM THE EXAMINATION ROOM.
3. QUESTIONS CARRY MARKS AS INDICATED IN THIS PAPER.

Candidate's Examination Number :______________________________.

Time of Examination :______________________________.

Date of Examination :______________________________.

Venue of Examination :______________________________.

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SECTION I: Multiple Choice: For each item. circle the one letter corresponding to the choice that best completes/answers that item. Read all choices before you circle one.

(2 marks each) [50 marks total]

1. If two means are being compared by the t-test. and each mean is calculated from 13 observations. the degrees of freedom for finding the table t is/are:

a. 12	d. 1	g. 22
b. 2	e. 20	h. 23
c. 23	f. 11	i. 24

2. With reference to proper plot technique. experimental error will be reduced if:
   a. random mechanical errors are introduced.
   b. non-treatment operations are done differently to different plots in block.
   c. each treatment is applied to its respective plot as uniformly as possible.
   d. a. and b. f. b. and c.
   e. a. and c. g. a.. b.. and c.

3 and 4. Use the following information to answer questions A.3 and A.4. Assume that two fat types are used for cooking of dougnuts. Six doughnuts are prepared using each type of fat and the amount of fat (in grams) absorbed by each is measured. The mean amount of fat absorbed is 76 grams for Fat 1 and 62 grams for Fat 2. The t-test is used to test the difference in mean amount of fat absorbed between the two types of fat and the result is t = 2.67. The relevant table t values are 2.23 (5%) and 3.17 (1%).

3. The probability associated with the calculated t is:
   a. $p<0.01$ b. $p>0.05$ c. $p<0.05$

4. The conclusion for this experiment is:
   a. Fat 1 gave a significantly lower amount of fat absorbed than Fat 2.
   b. There was no significant difference in amount of fat absorbed between the two types of fat.
   c. Fat 1 gave a significantly higher amount of fat absorbed than Fat 2.

5. Dr. Anderson gets a cv of 8.5% in his experiments and others doing similar experiments usually get a cv of about 12%. This indicates that the experimental precision in Dr. Anderson's experiments is:
   a. less than the precision of the other experimenters.
   b. the same as the precision of the other experimenters.
   c. greater than the precision of the other experimenters.
   d. none of the above.

6. In the ANOVA of a two-factor experiment carried out in a randomized complete block design. the F value for factor A (Nitrogen) is significant. the F value for factor B (Cultivar) is not significant. and the F value for the Nitrogen x Cultivar interaction is significant. The final conclusions should be based on a mean seperation test based on the:
   a. overall Nitrogen means. e. a. and c.
   b. overall Cultivar means. f. b. and c.
   c. Nitrogen x Cultivar interaction means. g. a.. b. and c.
   d. a. and b. h. none of the above.

7. After an experiment is carried out in the Latin Square (LS) design. the relative efficiency compared with the Completely Random (CR) design is calculated as 1.46. Thus. the experimental precision of the LS design is:
   a. 0.46% greater than that of the CR design. e. 46% greater than that of the CR design.
   b. 0.46% less than that of the CR design. f. 46% less than that of the CR design.
   c. 1.46% greater than that of the CR design. g. 146% greater than that of the CR design.
   d. 1.46% less than that of the CR design. h. 146% less than that of the CR design.

8. In preparing a plot layout for a split-plot design. randomization will be done:
   a. less times than a design that does not have split-plots.
   b. more times than a design that does not have split-plots.
   c. the same number of times as a design that does not have split-plots.

9. Which of the following normally result(s) from increasing the number of factors considered in a single experiment?
   a. The number of treatments decreases.
   b. It is easier to have homogeneous blocks.
   c. More interactions can be evaluated.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

10. In a statistical model. an effect that might have the same levels if the experiment were repeated is referred to as:
   a. fixed.
   b. informal.
   c. formal.
   d. random.
   e. redundant.

11. To reach conclusions about the treatment means for multi-observation data. which of the following could be used as the data that is entered into the ANOVA?
   a. All observations from each plot.
   b. The variance of the observations in each plot.
   c. The mean of the observations in each plot.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

12. Which of the following is/are true about fractional factorial experiments?
   a. They are useful for experiments with five or more factors.
   b. They have more treatments than the corresponding complete factorials.
   c. They have smaller block size than the corresponding complete factorials.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

13. In an experiment designed to test the effect of applied N fertilizer on the yield of beans. yield is referred to as a/an:
   a. non-crop response variable.
   b. treatment variable.
   c. environmental variable.
   d. crop response variable.

14. Which of the following is/are discussed by Gomez and Gomez as a common cause of missing data?
   a. improper treatment.
   b. illogical data.
   c. loss of sample.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

15. The covariate must be unaffected by the treatments if the analysis of covariance is being used to:
   a. control experimental error and adjust treatment means.
   b. aid in interpretation of experimental.
   c. estimate missing data.
   d. none of the above.

16. The competition effects due to varietal competition can be corrected for by:
   a. removal of border plants.
   b. stand correction.
   c. grouping of homogeneous treatments.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

17. If you are testing 64 cultivars of beans and the field is quite heterogeneous. such that uniform blocks of that size are not likely. which of the following experimental designs would be most appropriate?

a. Completely Random.
b. Randomized Complete Block.
c. Latin Square.
d. Split-plot.
e. Lattice.
f. Group Balanced Block.

18. Optimum plot size is the plot size which:

a. gives the greatest precision.
b. gives the lowest cost.
c. balances precision and cost.

19. The Mann-Whitney U test is the non-parametric equivalent of:

a. one-way ANOVA.
b. paired t-test.
c. unpaired t-test.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.
h. none of the above.

20. When an area to be used for an experiment has a distinct fertility gradient in one direction. the plot shape should be:

a. As square as possible.
b. Long and narrow. with the length perpendicular to the gradient.
c. Long and narrow. with the length parallel to the gradient.

21. In analyzing data involving measurements over time. before the pooled ANOVA is computed the error mean squares of the individual time ANOVAs must be shown to be:

a. heterozygous.
b. heterogeneous.
c. homogeneous.
d. homozygous.

22. Removal of border plants helps to avoid competition effects arising from:

a. missing hills.
b. varietal competition.
c. non-planted borders.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.
h. none of the above.

23. To get the least soil heterogeneity in an experimental site. a researcher should:

a. avoid areas fertilized at different rates in previous experiments.
b. avoid sloping areas and choose flat areas instead.
c. avoid areas near trees.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.
h. none of the above.

24. Which of the following is/are assumption(s) of regression:

a. The variables have a bi-(multi-) variate normal distribution.
b. The Y's are a random sample at each level of X.
c. The X's are measured without error.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

25. When considering conducting experiments in farmers' fields in a developing country. one must realize that the farmers' fields are different from research stations because farmers' fields often:

a. have more variation between farms.
b. lack experimental facilities.
c. have good accessibility.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.
h. none of the above.

93

SECTION II. **Matching:** Assume that an experiment is designed to test the effectiveness of different types of insecticides in controlling a leaf hopper on beans. In the blank next to each variable on the left. place the letter of the one type of variable given on the right that best fits that variable in the context of this experiment. You may need to use some letters for more than one variable. but do not use more than one letter for one variable. (2 marks each) [10 marks total]

Variable Type:
a. non-crop response variable.
b. treatment variable.
c. environmental variable.
d. crop response variable.

_____1. Bean seed yield.

_____2. Soil fertility.

_____3. Leaf hopper incidence.

_____4. Insecticide type.

_____5. Incidence of other insects.

SECTION III.

1. Assume you test the yield of three different species of beans at two (2) levels of added nitrogen fertilizer in an RCB design with 5 replications and get the following results.

a. Complete the ANOVA table. [8 marks]

Effect of species and applied N on bean yield

ANOVA Table

Source	df	SS	MS	Calc.F	Table F 0.05	Table F 0.01
Blocks	4	2.40			2.87	4.43
Species	2	2.40			3.49	5.85
Nitrogen	1	2.70			4.35	8.10
Spec. X N		0.60			3.49	5.85
Error	—	___				
		10.10				

b. The main effects and blocks hypotheses are stated below. Write the interaction hypotheses in the space provided. [4 marks]

Main effects and blocks:

H_0: There are no differences between the mean yields for the relevant effect (blocks. species. nitrogen).

H_A: There is at least one difference between the mean yields for the relevant effect (blocks. species. nitrogen).

94

SECTION III Question 1. (continued)

Interaction:

H_0:

H_A:

c. Accept/reject the relevant hypotheses. and state what can be concluded for each effect based on the ANOVA table. [8 marks]

ANOVA Conclusions:

Blocks:

Species:

Nitrogen:

Species X N:

2. Assume that the simple correlation coefficient for 100 seed weight (g) and yield (metric tons/ha) is calculated as -0.707. Further assume that it is significantly different from zero ($P<0.01$). Interpret the meaning of the correlation coefficient. [Do not state or accept/reject the relevant hypotheses.] [10 marks]

3. In 1951. J.S. Hart. a biologist. determined the cooling constants of ninenteen (19) freshly killed mice and those of the same mice reheated to body temperature. Given below are the differences between corresponding cooling constants (freshly killed minus reheated).

+2. -4. -6. +8. +10. -11. -12. +13. +22. -25. -33. +33. +41. -45. +45. +45. +81. +92. +139

(Source: Steel and Torrie. Second Edition. 1980. McGraw-Hill. Page 539.)

Use the **Sign test** to test the hypothesis that the cooling constant for reheated mice is the same as the constant for freshly killed mice. Write a conclusion for this test. (Do not state the relevant hypotheses or accept/reject them.) [10 marks]

96

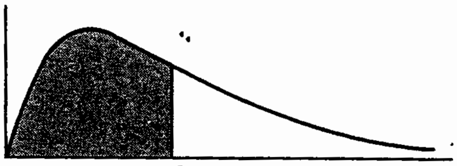
Formulas and Half-formulas you may need.

$$\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}, \quad \Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{n}, \quad \frac{\Sigma xy}{\Sigma x^2}, \quad \frac{\Sigma xy}{\sqrt{(\Sigma x^2)(\Sigma y^2)}}$$

$$s^2_{y.x} = \frac{\Sigma y^2 - \frac{(\Sigma xy)^2}{\Sigma x^2}}{n - 2}, \quad t_c = \frac{b}{\sqrt{\frac{s^2_{y.x}}{\Sigma x^2}}}, \quad t_c = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

$$\Sigma \frac{(O-E)^2}{E}, \quad \Sigma \frac{(|O-E|-0.5)^2}{E}, \quad \text{Adjusted } SS_y = SS_y - \frac{(SCP)^2}{SS_x}$$

Percentile Values (χ^2_p)
for
the Chi-Square Distribution
with ν Degrees of Freedom
(shaded area = p)



χ^2_p

ν	$\chi^2_{.995}$	$\chi^2_{.99}$	$\chi^2_{.975}$	$\chi^2_{.95}$	$\chi^2_{.90}$	$\chi^2_{.75}$	$\chi^2_{.50}$	$\chi^2_{.25}$	$\chi^2_{.10}$	$\chi^2_{.05}$	$\chi^2_{.025}$	$\chi^2_{.01}$	$\chi^2_{.005}$
1	7.88	6.63	5.02	3.84	2.71	1.32	.455	.102	.0158	.0039	.0010	.0002	.0000
2	10.6	9.21	7.38	5.99	4.61	2.77	1.39	.575	.211	.103	.0506	.0201	.0100
3	12.8	11.3	9.35	7.81	6.25	4.11	2.37	1.21	.584	.352	.216	.115	.072
4	14.9	13.3	11.1	9.49	7.78	5.39	3.36	1.92	1.06	.711	.484	.297	.207
5	16.7	15.1	12.8	11.1	9.24	6.63	4.35	2.67	1.61	1.15	.831	.554	.412
6	18.5	16.8	14.4	12.6	10.6	7.84	5.35	3.45	2.20	1.64	1.24	.872	.676
7	20.3	18.5	16.0	14.1	12.0	9.04	6.35	4.25	2.83	2.17	1.69	1.24	.989
8	22.0	20.1	17.5	15.5	13.4	10.2	7.34	5.07	3.49	2.73	2.18	1.65	1.34
9	23.6	21.7	19.0	16.9	14.7	11.4	8.34	5.90	4.17	3.33	2.70	2.09	1.73
10	25.2	23.2	20.5	18.3	16.0	12.5	9.34	6.74	4.87	3.94	3.25	2.56	2.16
11	26.8	24.7	21.9	19.7	17.3	13.7	10.3	7.58	5.58	4.57	3.82	3.05	2.60
12	28.3	26.2	23.3	21.0	18.5	14.8	11.3	8.44	6.30	5.23	4.40	3.57	3.07
13	29.8	27.7	24.7	22.4	19.8	16.0	12.3	9.30	7.04	5.89	5.01	4.11	3.57
14	31.3	29.1	26.1	23.7	21.1	17.1	13.3	10.2	7.79	6.57	5.63	4.66	4.07
15	32.8	30.6	27.5	25.0	22.3	18.2	14.3	11.0	8.55	7.26	6.26	5.23	4.60
16	34.3	32.0	28.8	26.3	23.5	19.4	15.3	11.9	9.31	7.96	6.91	5.81	5.14
17	35.7	33.4	30.2	27.6	24.8	20.5	16.3	12.8	10.1	8.67	7.56	6.41	5.70
18	37.2	34.8	31.5	28.9	26.0	21.6	17.3	13.7	10.9	9.39	8.23	7.01	6.26
19	38.6	36.2	32.9	30.1	27.2	22.7	18.3	14.6	11.7	10.1	8.91	7.63	6.84
20	40.0	37.6	34.2	31.4	28.4	23.8	19.3	15.5	12.4	10.9	9.59	8.26	7.43
21	41.4	38.9	35.5	32.7	29.6	24.9	20.3	16.3	13.2	11.6	10.3	8.90	8.03
22	42.8	40.3	36.8	33.9	30.8	26.0	21.3	17.2	14.0	12.3	11.0	9.54	8.64
23	44.2	41.6	38.1	35.2	32.0	27.1	22.3	18.1	14.8	13.1	11.7	10.2	9.26
24	45.6	43.0	39.4	36.4	33.2	28.2	23.3	19.0	15.7	13.8	12.4	10.9	9.89
25	46.9	44.3	40.6	37.7	34.4	29.3	24.3	19.9	16.5	14.6	13.1	11.5	10.5
26	48.3	45.6	41.9	38.9	35.6	30.4	25.3	20.8	17.3	15.4	13.8	12.2	11.2
27	49.6	47.0	43.2	40.1	36.7	31.5	26.3	21.7	18.1	16.2	14.6	12.9	11.8
28	51.0	48.3	44.5	41.3	37.9	32.6	27.3	22.7	18.9	16.9	15.3	13.6	12.5
29	52.3	49.6	45.7	42.6	39.1	33.7	28.3	23.6	19.8	17.7	16.0	14.3	13.1
30	53.7	50.9	47.0	43.8	40.3	34.8	29.3	24.5	20.6	18.5	16.8	15.0	13.8
40	66.8	63.7	59.3	55.8	51.8	45.6	39.3	33.7	29.1	26.5	24.4	22.2	20.7
50	79.5	76.2	71.4	67.5	63.2	56.3	49.3	42.9	37.7	34.8	32.4	29.7	28.0
60	92.0	88.4	83.3	79.1	74.4	67.0	59.3	52.3	46.5	43.2	40.5	37.5	35.5
70	104.2	100.4	95.0	90.5	85.5	77.6	69.3	61.7	55.3	51.7	48.8	45.4	43.3
80	116.3	112.3	106.6	101.9	96.6	88.1	79.3	71.1	64.3	60.4	57.2	53.5	51.2
90	128.3	124.1	118.1	113.1	107.6	98.6	89.3	80.6	73.3	69.1	65.6	61.8	59.2
100	140.2	135.8	129.6	124.3	118.5	109.1	99.3	90.1	82.4	77.9	74.2	70.1	67.3

Source: Catherine M. Thompson, *Table of percentage points of the χ^2 distribution*, Biometrika, Vol. 32 (1941), by permission of the author and publisher.

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Section	Internal Examiner		External Examiner	
	Mark	Signature	Mark	Signature
I.				
II.				
III.1				
III.2				
III.3				
TOTAL				