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, FST, 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.Repetition of treatments for the purpose of estimating variation is referred to as:

a. replication.
b. blocking.
c. randomization.
d. transcription.

2. In reference to blocks being used to control experimental error:

a. The order treatments is the same in all blocks.
b. Variation among blocks can be estimated.
c. Variation among blocks can not be removed from experimental error.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

3. In the analysis of variance of a two factor experiment carried out in a split-plot design, the F value for the whole-plot factor (Factor A) is significant, the F value for the sub-plot factor (Factor B) is significant and the F value for the A X B interaction is not significant. The final conclusions should be based on a mean separation test based on the:

a. overall means for Factor A.
b. overall means for Factor B.
c. A X B interaction means.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b. and c.
h. none of the above.

4. In the analysis of variance of a two factor experiment carried out in a split-plot design, the whole-plots are arranged in an RCB design. If Factor A is the whole plot factor and Factor B is the sub-plot factor, the Error (a) sum of squares is calculated as the otherwise unexplained variation in a:

a. Blocks X Factor A totals table.
b. Blocks X Factor B totals table.
c. Blocks X Factor A X Factor B totals table.
d. All of the above.
e. None of the above.

5. In the ANOVA described in the previous question (Question A.4.), which error term is used to calculate the F test for Factor B?

a. Error(a).
b. Error(b).
c. Error(a) and Error(b).
d. None of the above.

6. Dr. Wilson gets a cv of 4% in her experiments and others doing similar experiments usually get a cv of about 8%. This indicates that the reliability of Dr. Wilson's experiments is:

a. less than the reliability of the other experimenters.
b. greater than the reliability of the other experimenters.
c. the same as the reliability of the other experimenters.
d. none of the above.

7. After an experiment is carried out in the Randomized Complete Block (RCB) design, the relative efficiency compared with the Completely Randomized (CR) design is calculated as 1.35. Thus, the experimental precision of the RCB design is:

a. 135% less than that of the CR design.
b. 135% greater than that of the CR design.
c. 35% less than that of the CR design.
d. 35% greater than that of the CR design.
e. 1.35% less than that of the CR design.
f. 1.35% greater than that of the CR design.
g. 0.35% less than that of the CR design.
h. 0.35% greater than that of the CR design.

8. 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. The experiment becomes more expensive.
   c. More interactions can be evaluated.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

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

10. Single degree of freedom contrasts can be used to make:
   a. trend comparisons.
   b. factorial comparisons.
   c. comparisons between groups of treatments.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

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

12. Which of the following techniques is/are used for estimating missing data to be used in an ANOVA:
   a. analysis of covariance.
   b. correlation.
   c. missing data formula.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

13. Assume P is a random effect in the statistical model of an experiment. This implies that if the experiment were repeated the levels of P used in the first experiment:
   a. would be used without change in the second experiment.
   b. would be doubled in the second experiment.
   c. would be tripled in the second experiment.
   d. might be replaced by other P levels in the second experiment.

14. A common violation/Common violations of the underlying assumptions of the ANOVA is/are:
   a. variance homogeneity.
   b. non-normal distribution of errors.
   c. independence of errors.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b. and c.
   h. none of the above.

15. Mann-Whitney U test is the non-parametric equivalent of:
   a. the paired t-test.
   b. the unpaired t-test
   c. the one-way ANOVA
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.
   h. none of the above.

16. Grouping of homogeneous treatments helps to avoid competition effects due to:
    a. missing hills.
    b. non-planted borders.
    c. varietal competition.
    d. a. and b.
    e. a. and c.
    f. b. and c.
    g. a., b., and c.
    h. none of the above.

17. The covariate must be unaffected by the treatments if the analysis of covariance is being used to:
    a. aid in interpretation of experimental results.
    b. control experimental error and adjust treatment means.
    c. estimate missing data.
    d. estimate chi-square.

18. Assume that the root dry weight of two cultivars is measured using 20 plants of each cultivar, and the existence or not of a difference between the cultivars in root weight is tested using the sign test. If the resulting chi-square is 7.5, then:
    a. $P>0.10$
    b. $P>0.05$
    c. $P<0.05$
    d. $P<0.01$

19. The unit on which the treatment is applied is referred to as the:
    a. experimental unit.
    b. environmental unit.
    c. sampling unit.
    d. sub-sampling unit.

20. To get the least soil heterogeneity in an experimental site, a researcher should:
    a. choose flat areas instead of sloping areas.
    b. choose areas fertilized at different rates in previous experiments instead of areas previously fertilized uniformly.
    c. choose areas in the shade of trees.
    d. a. and b.
    e. a. and c.
    f. b. and c.
    g. a., b., and c.

21. The underlying assumptions of correlation include the assumption(s):
    a. One variable is dependent.
    b. The observations are drawn at random.
    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.

22. In analysing data involving measurements over time, the pooled ANOVA should not be computed if the error variances of the individual time ANOVAs are:
    a. homozygous.
    b. heterozygous.
    c. homogeneous.
    d. heterogeneous.

23. 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 parallel to the gradient.
    a. Long and narrow, with the length perpendicular to the gradient.

24. In a field experiment, when off-type plants are noticed, the researcher should:
    a. remove the off-type plants early in the growing season, and correct yield mathematically after harvest.
    b. remove the off-type plants just before harvest, and correct yield mathematically after harvest.
    c. treat the off-type plants as normal plants.

25. In developing countries of humid tropics, technology performance may be different in farmers' fields than in research stations, because:

a. crop yield is usually high in farmers' fields.
b. variability among farm conditions is low.
c. response to improved crop management is less favourable in farmers' fields than in research stations.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

SECTION II. Matching: In the blank next to each description, place the letter of the one experimental design given below that best fits that description. You may need to use the same design more than once. (2 marks each) [10 marks total]

Experimental Designs:

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

Descriptions:

___ 1. In a two factor experiment, you want greater precision for one factor than for the other factor.

___ 2. You are planting a single factor experiment in a field that has a fertility gradient in one direction.

___ 3. In a two factor experiment, one factor requires a larger area than the other factor.

___ 4. The experimental site is fairly uniform, with no expected gradients.

___ 5. There are two equal fertility gradients in a field and they are perpendicular to each other.

SECTION III. Show all your work!

1. Assume you wanted to compare the effect of three (3) herbicides and two (2) row spacings on the yield of jugo beans. Further assume that you use a split-plot design with spacing being the whole (main) plot factor, herbicide being the sub-plot factor, and the whole plots are arranged in a Randomized Complete Block design with three (3) blocks, and that you obtain the following results:

SECTION III Question 1. (continued)

a. Complete the ANOVA table [8 marks]

Effect of herbicide and spacing on jugo bean yield

ANOVA Table

Source	df	SS	MS	Calc.F	Table F 0.05	Table F 0.01
Blocks	2	0.03			19.00	99.00
Spacing	1	1.62			18.51	98.49
Error (a)	2	0.01				
Herbicide	2	0.93			4.46	8.65
Spac. X Herb.	2	0.09			4.46	8.65
Error (b)	17	2.76				

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, spacing, herbicide).

H_A: There is at least one difference between the mean yields for the relevant effect (blocks, spacing, herbicide).

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:

SECTION III Question 1. (continued)

Spacing:

Nitrogen:

Species X N:

2. Assume that in a test of six bean cultivars in a single factor experiment in an RCB design with 4 replications, the cultivar effect was significant ($P<0.05$) and an appropriate Duncan's New Multiple Range Test gave results as shown in the table below. In the space next to the table, write a brief conclusion for this mean separation test. (10 marks)

Variety	Mean Yield(t/ha)	
SR 100	2.2	ab
SR 200	1.5	cd
TT 80	1.7	bc
TT 120	0.8	e
XK 150	2.4	a
XK 40	1.0	de

3. For the multiple linear regression of number of seeds/cob on applied N and Mn fertilizer, given the information in the table below, state whether or not the partial regression coefficients are significantly different from zero. Interpret the specific meaning of each partial regression coefficient, if appropriate. (Do not state or accept/reject the hypotheses.) [10 marks]

Variable	**Partial Regression Coefficient**	**calculated t**	**Prob.**
N (kg/ha)	1.62	1.303	0.200
Mn (kg/ha)	3.45	3.551	0.001

Formulas and Half-formulas you may need.

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

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

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

FOR EXAMINERS' USE ONLY :

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