UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME: B.SC. AG. ECON. & AGBMNGT. YEAR 3 (NEW PROG.)
B.SC. AN. SCI. YEAR 3 (NEW PROG.)
B.SC. AGRON. YEAR 3 (NEW PROG.)
B.SC. HORT. YEAR 3 (NEW PROG.)
B.SC. LWM YEAR 3 (NEW PROG.)

COURSE CODE: AEM 303

TITLE OF PAPER: AGRICULTURAL 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. In reference to complete blocks being used to control experimental error:
   a. Variation among blocks can be estimated.
   b. Variation among blocks can be removed from experimental error.
   c. All treatments are applied to each block.
   d. a. and b. f. b. and c.
   e. a. and c. g. a., b., and c.

2. Repetition of treatments for the purpose of estimating variation is referred to as:
   a. blocking. b. randomization.
   c. transcription. c. replication.

3. If two means are being compared by using the t-test. and each mean is the mean of 9 observations, the degrees of freedom for finding the table t is/are:
   a. 8 d. 7 g. 14
   b. 18 e. 16 h. 1
   c. 17 f. 2 i. 9

4. to 5. Use the following information to answer questions A.3 to A. 4. Assume that a t-test has been conducted on the means below to determine whether or not there is a real difference between the cultivars, with results as indicated.

Bean Cultivar	Cooking Time (min.)	Calculated t	Table t 5%	Table t 1%
Groovy	130			
Doovy	110	-2.78	2.228	3.169

4. The conclusion for this experiment is:
   a. There was no significant difference in cooking time between the two cultivars.
   b. Groovy cooked over a significantly longer period than Doovy.
   c. Doovy cooked over a significantly longer period than Groovy.

5. The probability associated with the calculated t is:
   a. $P<0.05$) b. $P>0.05$ c. $P<0.01$

6. Which of the following normally result(s) from increasing the number of factors considered in a single experiment:
   a. It is difficult to have homogeneous blocks. e. a. and c.
   b. The number of treatments increases. f. b. and c.
   c. Less interactions can be evaluated. g. a., b., and c.
   d. a. and b. h. none of the above.

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

8. Which of the following is/are discussed by Gomez and Gomez as a common cause of missing data:
   a. proper treatment. e. a. and c.
   b. logical data. f. b. and c.
   c. loss of sample. g. a., b., and c.
   d. a. and b.

d. a. and b.

9. Among the following, choose the assumption(s) of the analysis of covariance (ANCOVA):
   a. The functional relationship between X and Y is known before the experiment is done.
   b. The Y's are a random sample at each level of X.
   c. The experimental errors are random, independetly and identically distributed as the normal distribution with mean zero and a common variance.
   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. comparisons within groups of treatments.
   b. all possible comparisons.
   c. factorial comparisons.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

11. The underlying assumptions of regression include the assumption(s):
   a. the variables have a bi-(multivariate)-variate normal distribution.
   b. the X's are measured without error.
   c. the Y's are a random sample at each level of X.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.

12. 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.

13. Which of the following measures is appropriate before the ANOVA for percentage data that range from 75% to 100%
   a. square-root transformation.
   b. arc-sine transformation.
   c. no corrective measure.
   c. partitioning of the error term.
   d. logarithmic transformation.

14. In the analysis of variance, treatment and environmental effects are assumed to be:
   a. exponential.
   b. multiplicative.
   c. additive.
   d. a. and b.
   e. a. and c.
   f. b. and c.
   g. a., b., and c.
   h. none of the above.

15. 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 doubled in the second experiment.
   b. would be tripled in the second experiment.
   c. would be used without change in the second experiment.
   d. might be replaced by other P levels in the second experiment.
   e. would definitely be replaced by other P levels in the second experiment.

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.
   d. Split-plot.
   e. Lattice.

c. Latin Square.
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. 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:** To the right of each description of data, circle the letter of the one measure given below that is most appropriate for that data before an ANOVA is done. (2 marks each) [10 marks total]

Measure:
a. square-root transformation.
b. arc sine transformation.
c. partitioning of the error term.
d. logarithmic transformation.
e. no corrective measure.

1. Data where effects are multiplicative. a. b. c. d. e.
2. Percentage data where the range is between 20% and 80%. a. b. c. d. e.
3. Data in which the variance tends to be proportional to the mean a. b. c. d. e.
4. Data with normally distributed, independent errors, additive effects and homogeneous variances. a. b. c. d. e.
5. Data with heterogeneous variance and no functional relationship between the variance and the mean. a. b. c. d. e.

SECTION III.

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:

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:

Spacing:

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 **Wilcoxon's Signed Rank 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. [The appropriate table values are 46 (approx. 5%) and 32 (approx. 1%).] (Do not state the relevant hypotheses or accept/reject them.) [10 marks]

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				