UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER DECEMBER 2009

BSC YEAR 3 (NEW PROG.) : ABE, AGRIC. ECON & AGRIBMNGT., AN. SCI, AGRON & HORT

PAPER : AEM 303

TITLE OF PAPER : APPLIED 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.

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

Candidate's Examination Number :_____

Time of Examination :_____

Date of Examination :_____

Venue of Examination :_____

FOR EXAMINERS' USE ONLY :

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

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. blocking. b. randomization.
   c. transcription. c. replication.
2. 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.
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. If you are testing 2 varieties of rice, one tall and one short, in a field with a fertility gradient in one direction, which of thye following experimental designs would be most appropriate?
   a. Completely Random. c. Lattice e. Split-plot.
   b. Randomized Complete Block. d. Split-plot. f. Group Balanced Block.
5. Prof. Smith gets a cv of 6.5% in his experiments and others doing similar experiments usually get a cv of about 8%. This indicates that the experimental precision in Prof. Smith's experiments is:
   a. greater than the precision of the other experimenters.
   b. less than the precision of the other experimenters.
   c. the same as the precision of the other experimenters.
   d. none of the above.
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. If an experiment is to be carried out to compare 12 varieties, with 6 being tall and the other 6 being short, the best experimental design would be:
   a. Completely Random d. Randomized Complete Block.
   b. Latin Square. e. Split-plot.
   c. Lattice. f. Group Balanced Block.
8. Which of the following is/are not discussed by Gomez and Gomez as a common cause of missing data:
   a. improper treatment. d. a. and c.
   b. experimenter neglect. e. a. and c.
   c. illogical data. f. a. and c.
   g. a., b., and c.
9. After an experiment is carried out in Latin Square design, the relative efficiency compared with the Randomized Complete Block design is calculated as 2.46. Thus, the experimental precistion of the Latin Square design is:
   a. 2.46% greater than that of the Randomized Complete Block design.
   b. 2.46% less than that of the Randomized Complete Block design.

c. 246% greater than that of the Randomized Complete Block design.
d. 246% less than that of the Randomized Complete Block design.
e. 146% greater than that of the Randomized Complete Block design.
f. 146% less than that of the Randomized Complete Block design.
g. 46% greater than that of the Randomized Complete Block design.
h. 46% less than that of the Randomized Complete Block design.

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 analysing data involving measurements over time, if it is established that the error variances of the individual time ANOVAs are homogeneous, the pooled ANOVA should be computed with time as a:

a. whole-plot factor.
b. sub-plot factor.
c. covariate.
d. none of the above.

14. For reaching a conclusion concerning Spearman's rank correlation coefficient, the table for significance of r can be used only if the degrees of freedom is greater than or equal to:

a. three.
b. nine.
c. six.
d. twelve.
e. fifteen.
f. eighteen.

15. Which of the following is/are true about missing value estimation?

a. We loose one degree of freedom from the total and error for each missing value.
b. It gives the true value we would have obtained from the experiment.
c. It does not add new information.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

16. Which of the following is/are true about missing value estimation?

a. It adds new information.
b. The value estimated allows us to complete the ANOVA.
c. We discover the true value of the missing observation.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

17. For data with heterogeneous variance and no functional relationship between the variance and the mean, which of the following is appropriate?

a. square-root transformation.
d. Logarithmic transformation.

b. Partitioning of the error term.
c. No corrective measure.
e. Arc-sine transformation.

18. To get the least soil heterogeneity in an experimental site, a researcher should:
a. avoid areas fertilized at different rates in previous experiments.
b. use areas near trees.
c. avoid sloping areas and choose flat areas instead.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

19. The Mann-Whitney U test is the non-parametric equivalent of:
a. unpaired t-test.
b. paired t-test.
c. 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.

20. Among the following, choose the use(s) of Chi-Square:
a. Testing existence of a linear relationship between two variables.
b. Testing goodness of fit to an expected ratio.
c. Testing independence in a contingency table.
d. a. and b.
e. a. and c.
f. b. and c.
g. a., b., and c.

21. Assume the yield of two maize cultivars is measured using 10 plants of each cultivar, and the existence or not of a difference between the cultivars in yield is tested using the sign test. If the resulting Chi-square is 2.10, then
a. $P<0.05$
b. $P>0.01$
c. $P>0.05$
d. $P<0.01$

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.

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. Leaf hopper incidence.

_____3. Soil fertility.

_____4. Incidence of other insects.

_____5. Insecticide type.

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:

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).

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:

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.

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

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

$$t_r = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}, \quad \sum \frac{(O-E)^2}{E}, \quad \sum \frac{(|O-E|-0.5)^2}{E}, \quad Adj.SS_Y = SS_Y - \frac{(SCP)^2}{SS_X}$$