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SUPP. 2005/2006

UNIVERSITY OF SWAZILAND

SUPPLEMENTARY 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 QUESTION ONE AND ANY TWO (2) OF THE OTHER QUESTIONS.
2. QUESTION ONE (1) CARRIES 40 MARKS AND THE OTHER QUESTIONS CARRY 30 MARKS EACH.

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QUESTION 1

Assume you tested the yield of six cultivars of maize in a Randomized Complete Block design with four replications and got the following results:

Mean Yield (tonnes/ha) of 6 maize cultivars.

Cultivar	**Block**				
	I	**II**	**III**	**IV**	**Total**
A	6.2	5.8	6.1	5.9	24.0
B	5.4	5.6	5.3	5.3	21.6
C	4.8	5.1	5.2	4.9	20.0
D	5.2	4.9	4.9	5.0	20.0
E	4.4	4.0	3.9	3.7	16.0
F	7.0	6.9	7.3	6.8	28.0
Total	33.0	32.3	32.7	31.6	129.6

i. Write the statistical model for this experiment. [4 marks]

ii. Write appropriate hypotheses for the F tests. [3 marks]

iii. Copy the following ANOVA table into your answer booklet and complete it, including the cv. Round the MS's, F's and cv to three decimal places. [15 marks]

Effect of cultivar on maize yield.

ANOVA Table

Source	df	SS	MS	Calc.F	Table F 0.05	Table F 0.01
Blocks						
Cultivars						
Error						
Total		21.520				

iv. Do any appropriate mean separation test(s). [10 marks]

v. Interpret the results. [8 marks]

QUESTION 2

a. Assume that in a test of 6 bean cultivars in a single factor experiment in an RCB design with 3 replications, the cultivar effect was significant ($P<0.05$), the EMS= 0.12, and the means and r_p values are as given below. Calculate an appropriate Duncan's New Multiple Range Test, including a brief conclusion. [10 marks]

Variety	Yield(t/ha)
SD1	1.5
SD2	0.8
SD3	1.0
SD4	0.5
SD5	1.2
SD6	1.6

p=number of means for range being tested	2	3	4	5	6
r_p (5% level)	3.15	3.30	3.37	3.43	3.46

b. Given the following data:

Response of maize to P fertilizer

Source:Hypothetical

P applied (kg/ha):	0	20	40	60	80	100
Yield of maize (metric tons/ha):	0.8	1.9	2.7	4.4	5.5	5.7

i. Find the equation of the linear regression of yield on P applied. [10 marks]

ii. Test whether or not the regression coefficient is significantly different from zero (do not state the hypotheses); and, if appropriate, interpret its specific meaning in this problem. [10 marks]

QUESTION 3

a. 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 **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%).] [18 marks]

b. Explain briefly how blocking, proper plot technique, and data analysis can be used to control experimental error. [12 marks]

QUESTION 4

a. Assume the yield of four cultivars of beans was studied in a completely randomized design with four replications, and that an insect damages the plots in an irregular pattern unrelated to the cultivars. Further assume that to take this damage into account an analysis of covariance is performed with yield as the variable of interest (Y), and insect damage as the covariate (X). Part of the analysis of covariance table is given below.

Analysis of Covariance Table:

Source of Variation	df				Y Adjusted for X				Table F	
		SS_X	SCP	SS_Y	df	SS	MS	F	5%	1%
Treatment	3	2	7	50						
Error	12	6	9	20						
Total	15	8	16	70						
Treatment adjusted									3.59	6.22

i. Complete the analysis of covariance table. Show the calculations for the adjusted SS in the following space. You do not need to show the other calculations.
[13 marks]

ii. State the conclusion. (Do not state hypotheses or accept/reject them.)
[7 marks]

b. Assume that the following data is from a survey of farmers in two districts of the imaginary country of Paradise. Assume that a sample of farmers in each district were asked:

Which do you prefer to raise, cattle or goats?

Test the internal consistency of the data. Interpret the results. [10 marks]

Animal Preference in Paradise
Source: Hypothetical
Number of farmers prefering:

District	Cattle	Goats
1	50	80
2	40	30

Formulas and Half-formulas you may need.

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

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

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

******Insert F-table here******

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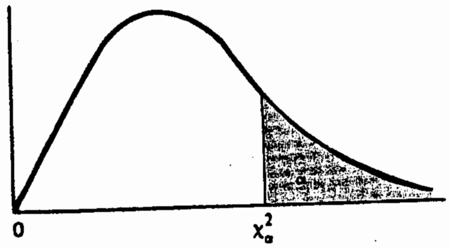
TABLE A.6*
Critical Values of the Chi-Square Distribution

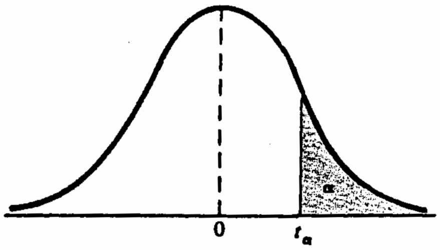


ν	α = 0.995	0.99	0.975	0.95	0.05	0.025	0.01	0.005
1	0.0^4393	0.0^3157	0.0^3982	0.0^2393	3.841	5.024	6.635	7.879
2	0.0100	0.0201	0.0506	0.103	5.991	7.378	9.210	10.597
3	0.0717	0.115	0.216	0.352	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	11.070	12.832	15.086	16.750
6	0.676	0.872	1.237	1.635	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	36.415	39.364	42.980	45.558
25	10.520	11.524	13.120	14.611	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	40.113	43.194	46.963	49.645
28	12.461	13.565	15.308	16.928	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	43.773	46.979	50.892	53.672

*Abridged from Table 8 of *Biometrika Tables for Statisticians*, Vol. I, by permission of E. S. Pearson and the Biometrika Trustees.

TABLE A.5*

Critical Values of the t Distribution



ν	α 0.10	0.05	0.025	0.01	0.005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
inf.	1.282	1.645	1.960	2.326	2.576

*Table A.5 is taken from Table IV of R. A. Fisher, *Statistical Methods for Research Workers*, Oliver & Boyd Ltd., Edinburgh, by permission of the author and publishers.