University of Fort Hare
Together in Excellence

Department of Agronomy/Livestock and Pasture Sciences

AGR 322: Supplementary Exam

January 2019

Time: 3 hours

Subject: Agricultural Research

Marks: 100

Paper: Research Method in Agricultur

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Instructions:

1. **Answer any FIVE (5) questions.**
2. **This document contains five (5) pages including the cover page.**

Question 1 (20 Marks)

Differentiate between the following pair of terms.

a. Basic research vs applied research
b. Descriptive statistics vs inferential statistics
c. Quantitative data vs quantitative data
d. Empirical vs conceptual research

Question 2 (20 Marks)

e. Suppose that mean yield of standard barley cultivar in South Africa is 10.2 t/ha. You have been doing research to get a better performing wheat cultivar(s). From 40 samples of a new cultivar, you obtained a mean yield of 11.4 t/ha with 2.0 t/ha standard deviation. Confirm whether these results provide sufficient evidence to conclude that the new cultivar gives higher yield than the conventional cultivar or not,
   i. State the hypothesis. [2]
   ii. Use the appropriate test statistic and give your conclusion, at 5% significant level. [6]

$$z = \frac{\bar{x} - \mu}{S_{\bar{x}}} \; ; \; t = \frac{\bar{x} - \mu}{S_{\bar{x}}}$$

f. Under what circumstances do we use the following basic experimental designs? State the advantages and disadvantage of using each of the experimental designs.

i. Completely randomized design	[3]	v.	Split-plot design	[3]
ii. Randomized complete block design	[3]	vi.	Latin square design	[3]

Question 3 (20 Marks)

a. Provide the complete trial layout (sketch the plan) for the following experiments:
   i. Completely randomised design: Factor A at 3 levels; Factor B at 2 levels; Replicates = 3. [6]
   ii. Split-plot design: Factor A at 5 levels in the main plot (in randomised complete block design); Factor B at 3 levels in the subplot;
   Blocks (replications) = 3. [6]
b. Discuss/explain effect of number of replication on MSE, F-value, LSD-value, CV, and SE. [8]

Question 4 (20 Marks)

a. Draw-up ANOVA-table skeletons and indicate degrees of freedom associated with the different sources of variations for the following experiments:
   i. Completely randomised design: Factor A at 5 levels; Factor B at 3 levels; Replicates = 4. [5]
   ii. Randomized complete block design: Factor A at 5 levels; Factor B at 3 levels; Blocks = 4. [5]
c. Compare and contrast correlation and regression analysis [6]
d. Interpret (i) R =-0.98; and (ii) R^2= 0.89. [4]

Question 5 (20 Marks)

An experiment was carried out to investigate response of banana fruit yield to four nitrogen levels (N_1, N_2, N_3 and N_4). A randomized complete block design (RCBD) was used with three replications (blocks). You are provided with the following statistics, accompanied by F- and t-distribution tables:

Sum of squares: $\mathbf{SS_{Block} = 1256}$; $\mathbf{SS_{Trt} = 1260}$; and $\mathbf{SS_{Total} = 2922}$.
Mean yields for N_1, N_2, N_3 and N_4 are **60**, **77**, **84** and **62** t/ha, respectively.

$$\text{LSD} = S_{\bar{d}} \times t_{(\alpha,df)};\ S_{\bar{d}} = \sqrt{\frac{2MSE}{r}}$$

a. State the null hypothesis of the experiment. [2]
b. Identify the independent and the dependent variables in the experiment. [2]
c. Draw-up a skeleton ANOVA table and determine whether: (i) blocking was effective in this experiment and, (ii) there were any significant differences between fertilizer application rates. [8]
d. Calculate CV (Coefficient of variance). [2]
e. (i) Compare the banana mean yields recorded for the four nitrogen levels using LSD at the significance level of 5%, and (ii) make your recommendation(s). [6]

Question 6 (20 Marks)

Describe the basic components of a research process.

Question 7 (20 Marks)

Discuss the main issues that you would expect to be raised by your supervisor when marking/reviewing your research proposal. Please use appropriate examples related to your field of study.

F-table at 5%

Numerator degree of freedom (df) → ν_1

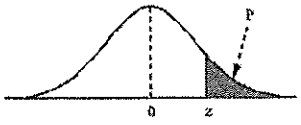
Denominator degree of freedom (df) ↓ ν_2

ν_2	1	2	3	4	5	6	7	8	9
2	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4
3	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3
4	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7
5	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2
6	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98
7	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
8	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
9	10.6	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
10	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89
50	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89	2.78

F-table at 1%

ν_2	1	2	3	4	5	6	7	8	9
2	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4
3	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3
4	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7
5	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2
6	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98
7	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
8	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
9	10.6	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
10	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89
50	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89	2.78

Percentage Points of the Normal Distribution



P = percentage of total area under curve to right of z

P	z	P	z	P	z
50	0.0000	2.9	1.8957	0.9	2.3656
45	0.1257	2.8	1.9110	0.8	2.4089
40	0.2533	2.7	1.9268	0.7	2.4573
35	0.3853	2.6	1.9431	0.6	2.5121
30	0.5244	2.5	1.9600	0.5	2.5758
25	0.6745	2.4	1.9774	0.4	2.6521
20	0.8416	2.3	1.9954	0.3	2.7478
15	1.0364	2.2	2.0141	0.2	2.8782
10	1.2816	2.1	2.0335	0.1	3.0902
5	1.6449	2.0	2.0537	0.09	3.1214
4.8	1.6645	1.9	2.0749	0.08	3.1559
4.6	1.6849	1.8	2.0969	0.07	3.1947
4.4	1.7060	1.7	2.1201	0.06	3.2389
4.2	1.7279	1.6	2.1444	0.05	3.2905
4.0	1.7507	1.5	2.1701	0.01	3.7190
3.8	1.7744	1.4	2.1973	0.005	3.8906
3.6	1.7991	1.3	2.2262	0.001	4.2649
3.4	1.8250	1.2	2.2571	0.0005	4.4172
3.2	1.8522	1.1	2.2904		
3.0	1.8808	1.0	2.3263		

Percentage Points of the *t*-distribution

	Percentage in top tail						
df	10	5	2.5	1	0.5	0.1	0.05
1	3.078	6.314	12.71	31.82	63.66	318.3	636.6
2	1.886	2.920	4.303	6.965	9.925	22.33	31.60
3	1.638	2.353	3.182	4.541	5.841	10.21	12.92
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.894	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.689
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.660
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
35	1.306	1.690	2.030	2.438	2.724	3.340	3.591
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
50	1.299	1.676	2.009	2.403	2.678	3.261	3.496
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	1.290	1.660	1.984	2.364	2.626	3.174	3.390
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Example: $t_{(9,2.5\%)} = 2.262$ means that the probability of a *t*-value greater than 2.262 is 2.5% for 9 *df* and the probability of a *t*-value outside the range −2.262 to +2.262 is 5% for 9 *df*.