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QUALIFICATION : BACHELOR OF AGRICULTURAL MANAGEMENT, BACHELOR OF HORTICULTURE	
QUALIFICATION CODE: **07BAGR, 07BHOR**	LEVEL: **5**
COURSE: **AGRICULTURAL STATISTICS**	COURSE CODE: **AGS520S**
DATE: **NOVEMBER 2024**	SESSION: **1**
DURATION: **3 HOURS**	MARKS: **100**

FIRST OPPORTUNITY: QUESTION PAPER

EXAMINER:	Mr. Jonas Amunyela, Mr. Polykarp Amukuhu
MODERATOR:	Mr. Andrew Roux

INSTRUCTIONS:

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

PERMISSIBLE MATERIALS:

1. Non-Programmable Calculator

ATTACHEMENTS

1. Z Table
2. T- distribution table
3. Chi-square table

This paper consists of 8 pages including this front page

SECTION A

QUESTION 1 **[24 marks]**

Write down the letter corresponding to your choice next to the question number.

1.1. A sample of a population is

A. An experiment in the population

B. A subset of the population

C A variable in the population

D An outcome of the population [2]

E. A sample point in the population

1.2. Which of the following is true about the normal distribution?

A. Mean is greater than the mode

B. Median is zero

C. Mode is below the mean

D. all measures of the central tendency are equal

E. all measures of dispersions are equal [2]

1.3. If X is a random variable that represent the number of animals dying due to Food and Mouth disease per month in Ohangwena region, then X is said to be a _______

A. Frequency

B. Binomial random variable

C. Mean deviation

D. Normal distribution [2]

E. Poisson random variable

1.4. Fill in the missing words to the quote "Statistical methods may be described as methods for drawing conclusions about ____________based on_______ computed from the ______________."

A. Statistics, samples, populations

B. Populations, parameters, samples

C. Statistics, parameters, samples

D. Parameters, statistics, populations

E. Populations, statistics, samples [2]

1.5 Which of the following is not an example of qualitative data [2]

A. Soil type

B. Seed categories

C. Types of seasons

D. Crop variety

E. The weight of Mahangu grains

1.6 ___________consists of methods for drawing and measuring the reliability of conclusions about population based on information obtained from a sample of the population. [2]

A. Probability statistics

B. Descriptive statistics

C. Inferential statistics

D. Sample statistics

E. none

1.7 Qualitative variables can be classified as: [2]

A. Discrete or continuous

B. Nominal or interval scale

C. Normal distribution or nominal

D. Ordinal or ratio scale

E. Ordinal or Nominal scale

1.8 If the $P(A) = 0$, this means [2]

A. The event A is certainly going to occur

B. The event is unlikely to occur

C. Second quartile

D. ranked data

E. none

1.9 If $P(A) = 0.6,\ P(B/A) = 0.42$, then $P(A \cap B) = ?$ [2]

A. impossible

B. 0.580

C. 0.400

D. 0.252

E. 0.360

1.10 The following are all properties of the Chi-squared distribution except: [2]

A. It is a positively skewed distribution

B. the values are always positive

C. can be used under the conditions with relatively small sample size

D. non-symmetric distribution

E. It is a negatively skewed distribution

1.11 A random sample of nine observations from a population containing 79 elements was taken, and the following values were obtained. The point estimate for the mean is: 14, 23,10,20,24,25,17,18, 11 [2]

A. 19.25

B. 3.77

C. 18

D. 24

E. None

1.12 If $H_0: \mu = 12\ and\ H_1: \mu \neq 12\ , n = 29, s = 6$ the decision rule for this hypothesis testing is: [2]

A. reject H_0 if $t_{\frac{\alpha}{2}}, n-1 \geq Z_{cal}$ or if $t_{cal} \leq -t_{\frac{\alpha}{2}}, n-1$

B. reject H_0 if $t_{cal} \geq t_{\frac{\alpha}{2}}, n-1$ or if $t_{cal} \leq -t_{\frac{\alpha}{2}}, n-1$

C. reject H_0 if $Z_{\frac{\alpha}{2}} \geq Z_{crit}$ or $Z_{\frac{\alpha}{2}} \leq -Z_{crit}$

D. reject H_0 if $\chi^2_{crit} \leq \chi^2_{stat}$

E. all the above

SECTION B (Clearly show all your work)

Question 2 **(32 marks)**

2.1 The body length of 20 pigs were recorded (in cm) in Omaheke region. Below is the dataset for data:

140	133	135	127	147	154	173	155	131	174
151	136	129	120	128	162	143	133	137	129

2.1.1 Determine the range for the rainfall data. [2]

2.1.2 Group the data into a grouped frequency distribution with a lowest class lower limit of 120 mm and a class width of 10 mm. (NB include class, frequency and relative frequency) [5]

2.1.3 What percentage of the rain fall was received between 120 mm to less than 130 ? [1]

2.2 Juice is among the highest vitamin C containing beverage available in terms of quantity. The following table presents the distribution of vitamin C per 100 ml that was measured from 27 Apple juice.

Nitrates contents (in grams)	Frequency
0-<5	2
5-<10	3
10-<15	9
15-<20	7
20-<25	6

2.2.1 Estimate the average vitamin C in the Apple juice [3]

2.2.2 Estimate the median for vitamin C in the Apple juice [3]

2.2.3 Estimate the mode for vitamin C in the Apple juice [3]

2.2.4 Estimate the variance and the standard deviation of vitamin C in the Apple juice [4]

2.2.5 Sketch the Less than Ogive of vitamin C in the Apple juice [4]

2.3 Let X be a random variable with the following probability distribution.

X	1	3	4	5
P(X)	0.4	0.3	0.2	0.1

2.3.1 Determine the expected value and variance of the random variable. [5]

2.3.2 Determine the $P(X < 3)$ [2]

Question 3 **(32 marks)**

3.1 It is assumed that a sampling error of no more than ±5 is desired along with 95% confidence to determine a sample size appropriate to estimate the mean weights of Ostrich eggs. Past data indicated that the standard deviations of the weight have been approximately 20Kg for substantial period.

Calculate the sample size needed [3]

3.2 You sample 34 carrots from your farm's harvest of over 500 000 carrots. The mean weight of the sample is 100 grams. The population standard deviation and mean are 30 grams and 115 grams respectively. What is the probability that the mean weight of carrots is less than 100 grams? [3]

3.3 During July 2024, tomatoes yield figures (in tons) were recorded over 11 farms around Tsumeb.

Farm	A	B	C	D	E	F	G	H	I	J	K
Tomato yield (ton)	35	21	33	24	30	36	27	39	25	26	28

3.3.1. Is this a T-statistic or a Z statistic, and why? [2]

3.3.2 Construct a 99% confidence interval to estimate the true mean tomato yield in Tsumeb. [6]

3.3.3 At the 5% level of significance test the hypothesis that the mean tomato yield around Tsumeb is below 30 tons. [6]

3.4 The variance protein content (in mg) of a random sample of 10 bags of beans was found to be 0.67 mg.

3.4.1 Estimate the variance for protein content of the entire population of beans with a 95% degree of confidence. [6]

3.4.2 Can we conclude that the population protein variance for the beans is less than 1.05 mg? $use\ \alpha = 0.05$ [6]

Question 4 **(12 marks)**

4.1 The specific activity of two fractions (S and D) of succinic dehydrogenase is measured. The following readings are obtained (units: $mg^{-1}\ protein$)

S	16	12	13	15	9
D	10	3	7	8	5

Do the means of the two populations from which the samples were taken differ significantly?

4.1.1 State the null and alternative hypotheses you would use to test the hypothesis [2]

4.1.2 Is this a two tail or single tail hypothesis [1]

4.1.3 State the decision rule and find the critical value at $\alpha = 0.05$ [4]

4.1.4 Write down the appropriate formula for the test statistics and calculate the value of the test statistic? [3]

4.1.5 What is your decision and conclusion? [2]

****************************END OF QUESTION PAPER**************************

FORMULA SHEET

$M_e = L + \frac{c[0.5n - CF]}{f_{me}}$	$M_0 = L + \frac{c[f_m - f_{m-1}]}{2f_m - f_{m-1} - f_{m+1}}$
$\bar{x} = \frac{\sum fx}{n}$	$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$
$\bar{x} \pm Z_{\frac{\alpha}{2}}(\frac{\sigma}{\sqrt{n}})$	$(p_1 - p_2) \pm Z_{\frac{\alpha}{2}}(\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}})$
$t_{stat} = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$	$\frac{(n-1)S^2}{\chi^2_{\frac{\alpha}{2}, n-1}} < \sigma^2 < \frac{(n-1)S^2}{\chi^2_{1-\frac{\alpha}{2}, n-1}}$
$\chi^2_{stat} = \frac{(n-1)S^2}{\sigma^2}$	$\chi^2_{stat} = \sum \frac{(f_0 - f_e)^2}{f_e}$
$E(X) = \sum x_i p_i$	$V(X) = \sum (x_i - \mu)^2 p(x_i)$
$P(X = x) = \binom{n}{x} p^x q^{n-x}$	$n = \frac{Z^2(\sigma^2)}{E^2}$
$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$	$a = \bar{y} - b\bar{x}$
$\hat{\pi} = \frac{x_1 + x_2}{n_1 + n_2}$	$Z_{cal} = \frac{(p_1 - p_2) - (\pi_1 - \pi_2)}{\sqrt{\hat{\pi}(1 - \hat{\pi})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$
$\bar{x} = \frac{\sum x}{n}$	$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$
$n = \frac{z^2 p(1-p)}{E^2}$	$s^2 = \frac{\sum (x_i - \bar{x})^2 f_i}{n-1}$
$p \pm z\sqrt{\frac{pq}{n}}$	$\bar{x} \pm t_{\frac{\alpha}{2}, n-1}(\frac{s}{\sqrt{n}})$
$Z = \frac{x - \mu}{\sigma}$	$(\bar{x}_A - \bar{x}_B) \pm t\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}$
$P(X = k) = \frac{e^{-\theta}\theta^x}{x!}$	$n = \frac{z^2 p(1-p)}{E^2}$

TABLE of CRITICAL VALUES for STUDENT'S *t* DISTRIBUTIONS

Column headings denote probabilities (α) ***above*** tabulated values.

d.f.	0.40	0.25	0.10	0.05	0.04	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	7.916	12.706	15.894	31.821	63.656	127.321	318.289	636.578
2	0.289	0.816	1.886	2.920	3.320	4.303	4.849	6.965	9.925	14.089	22.328	31.600
3	0.277	0.765	1.638	2.353	2.605	3.182	3.482	4.541	5.841	7.453	10.214	12.924
4	0.271	0.741	1.533	2.132	2.333	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.191	2.571	2.757	3.365	4.032	4.773	5.894	6.869
6	0.265	0.718	1.440	1.943	2.104	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.046	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.262	0.706	1.397	1.860	2.004	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	1.973	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	1.948	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.796	1.928	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	1.912	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.259	0.694	1.350	1.771	1.899	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	1.887	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	1.878	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	1.869	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	1.862	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	1.855	2.101	2.214	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	1.850	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	1.844	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	1.840	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	1.835	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.256	0.685	1.319	1.714	1.832	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.256	0.685	1.318	1.711	1.828	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	1.825	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	1.822	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	1.819	2.052	2.158	2.473	2.771	3.057	3.421	3.689
28	0.256	0.683	1.313	1.701	1.817	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	1.814	2.045	2.150	2.462	2.756	3.038	3.396	3.660
30	0.256	0.683	1.310	1.697	1.812	2.042	2.147	2.457	2.750	3.030	3.385	3.646
31	0.256	0.682	1.309	1.696	1.810	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.255	0.682	1.309	1.694	1.808	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.255	0.682	1.308	1.692	1.806	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.255	0.682	1.307	1.691	1.805	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.255	0.682	1.306	1.690	1.803	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.255	0.681	1.306	1.688	1.802	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.255	0.681	1.305	1.687	1.800	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.255	0.681	1.304	1.686	1.799	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.255	0.681	1.304	1.685	1.798	2.023	2.125	2.426	2.708	2.976	3.313	3.558
40	0.255	0.681	1.303	1.684	1.796	2.021	2.123	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	1.781	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.254	0.678	1.292	1.664	1.773	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.254	0.677	1.290	1.660	1.769	1.984	2.081	2.364	2.626	2.871	3.174	3.390
120	0.254	0.677	1.289	1.658	1.766	1.980	2.076	2.358	2.617	2.860	3.160	3.373
140	0.254	0.676	1.288	1.656	1.763	1.977	2.073	2.353	2.611	2.852	3.149	3.361
160	0.254	0.676	1.287	1.654	1.762	1.975	2.071	2.350	2.607	2.847	3.142	3.352
180	0.254	0.676	1.286	1.653	1.761	1.973	2.069	2.347	2.603	2.842	3.136	3.345
200	0.254	0.676	1.286	1.653	1.760	1.972	2.067	2.345	2.601	2.838	3.131	3.340
250	0.254	0.675	1.285	1.651	1.758	1.969	2.065	2.341	2.596	2.832	3.123	3.330
inf	0.253	0.674	1.282	1.645	1.751	1.960	2.054	2.326	2.576	2.807	3.090	3.290

Cumulative probabilities for POSITIVE z-values are shown below.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998