

2405/303
STATISTICAL METHODS
Oct./Nov. 2018
Time: 3 hours

-Exam



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN APPLIED STATISTICS

STATISTICAL METHODS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Non-programmable scientific calculator/Mathematical tables.

This paper consists of EIGHT questions.

Answer FIVE questions.

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

Tables of standard, normal and t-distributions are attached.

Candidates should answer the questions in English.

This paper consists of 8 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) Explain each of the following sampling methods:

- (i) quota;
- (ii) simple random;
- (iii) cluster.

(6 marks)

(b) With the aid of diagrams, differentiate between the following terms as used in statistics:

- (i) positive skewness and negative skewness;
- (ii) positive correlation and negative correlation.

(8 marks)

(c) A random sample of 600 customers of product x was taken and 48% were in support of the new upward price adjustment. Determine the 95% confidence interval for the population proportion of the customers who support the upward price adjustment.

(6 marks)

2. (a) Explain each of the following terms as used in probability theory:

- (i) dependent events;
- (ii) non-mutually exclusive events.

(4 marks)

(b) Table 1 shows the distribution of weights of 100 students in a college.

Table 1

Weights (kgs)	Number of students
30 - 34	4
35 - 39	10
40 - 44	12
45 - 49	20
50 - 54	26
55 - 59	16
60 - 64	10
65 - 69	2

Calculate the coefficient of variation.

(10 marks)

$$\frac{\text{mean}}{s} \times 100$$

- (c) The average number of customers arriving at a certain market is 20 per hour. Assuming a Poisson distribution, calculate the probability that in any particular minute:
- (i) no customer arrives;
 - (ii) exactly one customer arrives;
 - (iii) at least two customers arrive.



(6 marks)

3. (a) Explain three uses of regression analysis in decision making. (6 marks)

- (b) Table 2 shows the costs incurred in maintaining a production plant for a period of 8 years.

Table 2

Age of the plant X	1	2	3	4	5	6	7	8
Costs Ksh. '000 Y	3	5	9	12	14	15	20	28

0.1732×21
 0.1732×0.01
 0.001732

- (i) Calculate the Pearson's product moment correlation coefficient.
- (ii) Interpret the results in b (i). (10 marks)

- (c) Outline four advantages of median as a measure of central tendency. (4 marks)

4. (a) Explain each of the following terms as used in statistics:

- (i) point estimate;
- (ii) chi-square test;
- (iii) interval estimate. (6 marks)

- (b) In a certain college, 30% of the students use credit cards. If 12 students are selected at random, determine the probability that:

- (i) exactly two students use credit cards;
- (ii) at least ten students use credit cards;
- (iii) at most two students use credit cards. (7 marks)

$X > 10$
 $X > 9.5$

- (c) Table 3 shows the wages of 80 employees of a certain company.

Table 3

Wages Ksh. '000'	Number of employees
10 - 15	5
15 - 20	x
20 - 25	17
25 - 30	20
30 - 35	y
35 - 40	16
40 - 45	4



Given that the median wage is Ksh. 27,000, calculate the:

- (i) values of x and y ;
 (ii) upper quartile wage.

(7 marks)

5. (a) State four characteristics of a Poisson's distribution.

(4 marks)

- (b) Table 4 shows the sales revenue and advertisement expenditure of Udoto Enterprises.

Table 4

Advertisement Ksh. '000 x	4.0	4.4	4.8	4.2	5.0	5.4	5.2	5.6	5.8	6.2
Sales Ksh. '000 y	50	64	66	70	76	82	86	90	94	96

- (i) Using the least squares method, determine the equation of regression line of sales revenue on advertisement expenditure.
 (ii) Using the equation obtained in c (i), estimate the sales revenue when Ksh. 9,600 is spent on advertisement.

(11 marks)

- (c) A firm has tendered for two contracts, A and B. The probability of winning contract A is $\frac{4}{7}$ and that of winning contract B is $\frac{2}{5}$. Determine the probability of winning:

- (i) contract A or B;
 (ii) at least one contract.

(5 marks)

6. (a) Outline **four** merits of mean deviation. (4 marks)
- (b) Table 5 shows the distribution of lengths of a random sample of 19 rods taken from a large batch.

Table 5

Lengths (in cm)	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29
Frequency	4	3	2	5	2	3

Assuming the lengths are normally distributed, determine the 95% confidence interval for the mean length of the population. (12 marks)

- (c) State **four** limitations of the census method of data collection. (4 marks)

7. (a) The diameters of test tubes manufactured in a factory are normally distributed with a mean of 70 mm and a standard deviation of 8 mm. Determine the:

- (i) probability that a test tube chosen at random will have a diameter between 74 mm and 80 mm;
 $74 \leq x \leq 80$
 $73.5 \leq x \leq 80.5$
- (ii) proportion of test tubes which have more than 88 mm as their diameters;
- (iii) number of test tubes which are likely to have less than 82 mm out of the 800 test tubes which were supplied to a certain store.

(12 marks)

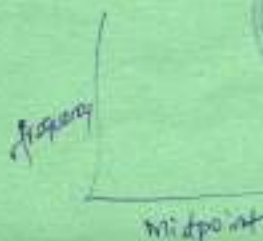
- (b) Table 6 shows the age distribution of 600 students studying in a city commercial college.

Table 6

Age in years	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54
No. of students	30	36	105	160	124	113	32

- (i) Construct a histogram to represent the data.
- (ii) Using the histogram in b (i) determine the modal age.

(8 marks)



$$5 = \frac{516}{70.5} = 70.5$$

8. (a) List five advantages of geometric mean as a measure of central tendency. (5 marks)

(b) A large buyer of light bulbs claims that brand 1 is the same as brand 2 of the light bulbs. To test this claim a random sample of 100 bulbs of each brand was taken. The means and standard deviations are as shown in table 7.

Table 7

	Brand 1	Brand 2
Mean (\bar{X}) hours	980	1010
Standard deviation(s) hrs	80	120

Test the buyer's claim at 5% significance level. (11 marks)

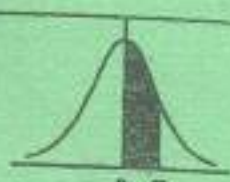
(c) Calculate the harmonic mean of the following data:

1, 3, 4, 5, 6, 7, 10, 12 (4 marks)



$$\bar{X}_H = 1.96 \frac{8}{5}$$

$$H.M = \frac{6}{\frac{1}{3} + \frac{1}{4}}$$



Areas under the Standard Normal curve from 0 to Z

z	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0754
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2258	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2996	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

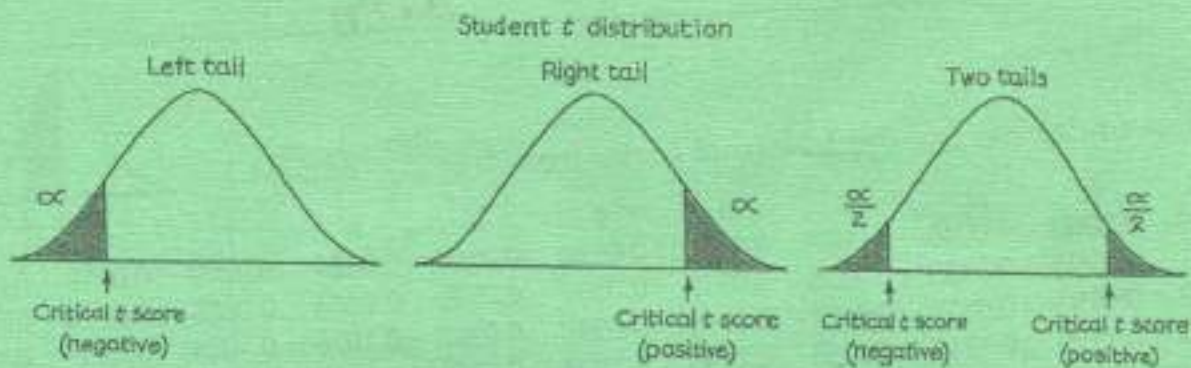


TABLE A-3

 t Distribution

Degrees of freedom	α					
	.005 (one tail) .01 (two tails)	.01 (one tail) .02 (two tails)	.025 (one tail) .05 (two tails)	.05 (one tail) .10 (two tails)	.10 (one tail) .20 (two tails)	.25 (one tail) .50 (two tails)
1	63.657	31.821	12.706	6.314	3.078	1.000
2	9.925	6.965	4.303	2.920	1.886	.816
3	5.841	4.541	3.182	2.353	1.638	.765
4	4.604	3.747	2.776	2.132	1.533	.741
5	4.032	3.365	2.571	2.015	1.476	.727
6	3.707	3.143	2.447	1.943	1.440	.718
7	3.500	2.998	2.365	1.895	1.415	.711
8	3.355	2.896	2.306	1.860	1.397	.706
9	3.250	2.821	2.262	1.833	1.383	.703
10	3.169	2.764	2.228	1.812	1.372	.700
11	3.106	2.718	2.201	1.796	1.363	.697
12	3.054	2.681	2.179	1.782	1.356	.696
13	3.012	2.650	2.160	1.771	1.350	.694
14	2.977	2.625	2.145	1.761	1.345	.692
15	2.947	2.602	2.132	1.753	1.341	.691
16	2.921	2.584	2.120	1.746	1.337	.690
17	2.898	2.567	2.110	1.740	1.333	.689
18	2.878	2.552	2.101	1.734	1.330	.688
19	2.861	2.540	2.093	1.729	1.328	.688
20	2.845	2.528	2.086	1.725	1.325	.687
21	2.831	2.518	2.080	1.721	1.323	.686
22	2.819	2.508	2.074	1.717	1.321	.686
23	2.807	2.500	2.069	1.714	1.320	.685
24	2.797	2.492	2.064	1.711	1.318	.685
25	2.787	2.485	2.060	1.708	1.316	.684
26	2.779	2.479	2.056	1.706	1.315	.684
27	2.771	2.473	2.052	1.703	1.314	.684
28	2.763	2.467	2.048	1.701	1.313	.683
29	2.756	2.462	2.045	1.699	1.311	.683
Large (∞)	2.575	2.327	1.960	1.645	1.282	.675

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