2209/301
QUANTITATIVE METHODS
July 2008
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION TECHNOLOGY

MODULE III

QUANTITATIVE METHODS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet.
Scientific calculator /Mathematical tables.

*Answer any **FIVE** of the following **EIGHT** questions.*
Statistical tables have been provided for use where necessary.

This paper consists of 10 printed pages.

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

1. (a) State **three** factors to consider when selecting a data collection method. (3 marks)

(b) Table 1 shows the sales of different sizes of trousers at Kwame Supermarket. Represent the information using a relative frequency curve.

Size of trouser	Frequency
10 - 14	4
15 - 19	6
20 - 24	8
25 - 29	4
30 - 34	3

Table 1

(4 marks)

(c) Differentiate between the following as used in network diagrams:

(i) earliest start time and latest start time;

(ii) total slack and free slack. (4 marks)

(d) Table 2 shows the activities in a project with their corresponding duration. Use it to answer the questions that follow.

Activity Code	Optimistic time	Most likely time	Pessimistic time
A 0 - 1	0.5	1.0	1.5
B 1 - 2	2.5	4.0	5.5
C 1 - 3	3.0	4.5	9.0
D 2 - 4	4.5	2.0	5.5
E 2 - 5	2.5	1.0	2.5
F 3 - 4	0.5	1.5	2.5
G 3 - 6	2.5	3.0	6.5
H 4 - 7	2.5	2.0	4.5
I 5 - 6	0.5	1.0	1.5
J 6 - 7	3.0	3.5	7.0

Table 2

(i) Draw a network diagram to represent the information clearly showing the critical path.

(ii) Evaluate the standard deviation of the time required to complete the project. (9 marks)

2. (a) The following data shows the service time at the registration counter of a local post office.

Service time (in minutes)	2.0	2.5	3.0	3.5	4.0	4.5
Frequency	5	30	40	15	5	5

(i) Compute the second, third and fourth moments about the mean for the distribution. (Use $\bar{x} = 3$).

(ii) Determine the type of kurtosis represented by the distribution based on the moments obtained in a (i). (8 marks)

(b) Describe the following terms as used in probability:

(i) Mutually exclusive events;

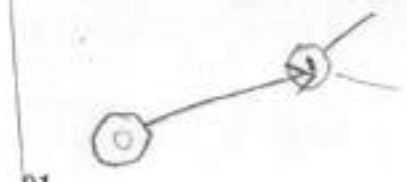
(ii) trial. (2 marks)

(c) (i) An electronic system has three components R, S and T. The probability that each component will work for a year is 0.95, 0.9 and 0.93 respectively. The system is operational as long as any two of the components are working. Find the probability that the system will work for the whole year. (2 marks)

(ii) During the Safaricom IPO, 80% of the stockbroking firms were positively advising their clients about the issue. Suppose John, a prospective investor, contacted six stockbroking firms, find the probability that at least five of them advised him positively. (3 marks)

(d) (i) Outline **two** characteristics of a normal distribution.

(ii) The performance of a particular type of UPS is normally distributed with a mean of 80 minutes and a standard deviation of 30 minutes. If the manufacturer replaces all the UPSs which fail before the guaranteed minimum performance of 45 minutes, determine the percentage of UPSs that will be replaced. (5 marks)



$t_e = \frac{t_o + 4(t_m) + t_p}{6}$

3. (a) Distinguish between geometric and harmonic means. (4 marks)

(b) Calculate the mode and median for the production data in table 3.

Output (in tonnes)	Number of days
25 - 30	6
30 - 35	5
35 - 40	10
40 - 45	20
45 - 50	10
50 - 55	5

Table 3

(4 marks)

(c) (i) Describe **two** types of errors associated with hypothesis testing.
(4 marks)

(ii) The family size in Kenya has continued to reduce because of economic hardships. According to the Kenya Bureau of Statistics, the mean family size was 3.17 in 1999. A researcher wants to check whether the current mean size is less than 3.17. He decides to use 900 different families which produced a mean family size of 3.13 with a standard deviation of 0.7. Using 0.025 significance level, determine whether the family size has reduced since 1999.
(5 marks)

(d) A company manager wants production estimate to be within 0.02 of the population proportion with a 95% confidence level. Determine the most conservative estimate for the sample size that will limit the maximum error to within 0.02 of the population proportion. (3 marks)

4. (a) (i) State **four** uses of index numbers. (2 marks)

(ii) Differentiate between construction of index numbers using relatives and using aggregates. (4 marks)

(b) Table 4 shows the price indices of a particular commodity for three consecutive years calculated using the chain based method.

Year 1990	1991	1992	1993
Price index 40	137.2	118.2	115.4

Table 4

If the commodity was Sh 40 in 1990, calculate the cost of the commodity for the years 1991, 1992 and 1993. (3 marks)

(c) (i) Describe the following decision rules:

I Maximax;

II Maximin. (4 marks)

(ii) Table 5 shows the possible net returns (discounted to present) and associated probabilities of two investments to be undertaken by a particular company.

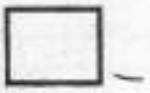
Net returns (Sh 000)	-3	-2	-1	0	1	2	3	4
Probability: Investment 1	0	0	0.1	0.2	0.3	0.2	0.2	0
Probabiliy: Investment 2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2

Table 5

Determine the best investment option for the company. (4 marks)

(d) State the significance of each of the following symbols in a decision tree:

(i) 

(ii) 

(iii) 

(3 marks)

5. (a) Describe the following methods of estimating the trend of a time series:

(i) Inspection;

(ii) Three point. (4 marks)

(b) Table 6 shows the total expenditure for Kenya for the year 1980 through 1989. Use the data to answer the questions that follow.

Year	Total expenditure (Billions of shillings
1980	467.6
1981	558.0
1982	503.4
1983	546.7
1984	718.9
1985	714.5
1986	717.6
1987	749.3
1988	793.6
1989	832.3

Table 6

(i) Given that the time series of the expenditure has no seasonal variations and its trend is given by $y = 523.9250 + 26.6907t$, calculate the cyclical-irregular relative for each year using the multiplicative model.

(ii) Draw a graph to represent the cyclical-irregular relatives obtained in b (i) against time. (10 marks)

(c) KK Bus Service Ltd. operates a minibus service to ferry commuters from Muthurwa market to the city centre. The following data was collected at the market bus terminus.

Time between successive arrivals	0	1	2	3	4	5	6
Probability	0.04	0.16	0.24	0.28	0.16	0.10	0.02

Table 7

The minibuses are scheduled to run every 10 minutes but because of traffic jam the arrival of the buses results in the following distribution.

1 - 64

Time between successive buses	8	10	12	14	16
Probability	0.10	0.38	0.28	0.15	0.09

Table 8

When the commuters board the buses, the number of empty seats in the bus is found to follow the distribution below:

Number of empty seats	0	1	2	3	4	5	6
Probability	0.06	0.18	0.27	0.34	0.11	0.03	0.01

Table 9

Generate random numbers for the data in tables 7, 8 and 9. (6 marks)

6. (a) Differentiate between determistic and probabilistic types of simulation. (4 marks)

(b) (i) Outline **four** assumptions of linear programming. (2 marks)

(ii) Identify **four** constraints that may limit the achievement of the objective in a linear programming model. (4 marks)

(c) Tupex Electronics Company Ltd manufactures floppy disks and CD-Roms using three machines **X**, **Y** and **Z**. The unit cost of a floppy disk and CD-Rom is Sh 40 and Sh 32 respectively. During production, the machines **X**, **Y** and **Z** can be used for utmost 400, 800 and 300 hours respectively. The production of a floppy disk requires 40 hours on machine **Y** and 10 hours on machine **Z**. The production of CD-Rom requires 16 hours on **X**, 20 hours on **Y** and 10 hours on **Z**.
Use the simplex method to determine the number of floppy disks and CD-Roms to be produced in order to maximize profits. (10 marks)

7. (a) (i) During a Quantitative methods lesson, Jane modelled a linear regression relationship as $y = A + Bx + \varepsilon$. Identify two components represented by ε in the model.

(ii) Distinguish between rank and product moment correlation coefficients. (6 marks)

(b) Table 10 shows the relationship between age (in years) and price (in thousands of shillings) of a BMW motorbike sold by a company dealing with secondhand motorbikes.

Age	8	3	6	9	2	5	6	4
Price	16	74	38	19	102	36	33	69

Table 10

(i) Draw a scatter diagram to represent the data.

(ii) Determine the regression line for the data. (8 marks)

(c) (i) Explain the following concepts as used in sampling:

I Sampling error;

II Unbiased estimator. (2 marks)

(ii) The time taken to learn the standing orders by members of parliament is normally distributed with a mean of 80 hours and a standard deviation of 6 hours. If a random sample of 16 members is selected, find the probability that the mean time to learn the standing orders will be more than 90 hours. (4 marks)

8. (a) (i) Explain the term 'simulation'.

(ii) State **two** disadvantages of simulation. (4 marks)

(b) (i) Differentiate between annuity and perpetuity.

(ii) Peter, a retired teacher, is entitled to Sh 2000 p.m. as pension for a period of 10 years. Determine the present value of his pension at a discounted rate of 10% p.a.

(iii) Assuming that Peter is meant to receive the pension for the rest of his life, calculate the present value of the pension at a discounted rate of 10% p.a. (9 marks)

(c) The demand for sugar at a college is constant over time and is equal to 600 kgs per year. The cost per kg is Sh 100 while the cost of placing an order is Sh 20. The cost of shortage is Sh 1 per kg per month and the inventory carrying cost is 20% of unit cost per annum.

(i) Find the optimal order quantity when stockouts are permitted.

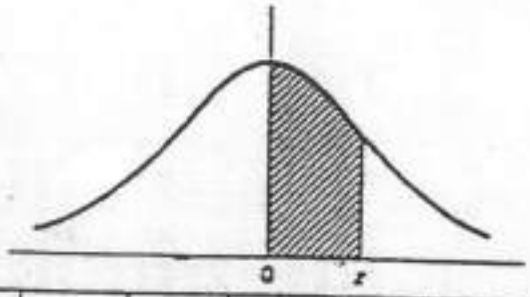
(ii) Determine the loss to be incurred by the company if the stockouts are not allowed. (7 marks)

Table B: Present Value of an Annuity of Sh. 1 Per Period for *n* Periods:

$$PVIFA_{r,t} = \sum_{t=1}^{n} \frac{1}{(1+r)^t} = \frac{1 - \frac{1}{(1+r)^n}}{r}$$

Number of payments	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8929	0.8772	0.8696	0.8621	0.8475	0.8333	0.8065	0.7813	0.7576
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.6901	1.6467	1.6257	1.6052	1.5656	1.5278	1.4568	1.3916	1.3315
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4018	2.3216	2.2832	2.2459	2.1743	2.1065	1.9813	1.8684	1.7663
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.0373	2.9137	2.8550	2.7982	2.6901	2.5887	2.4043	2.2410	2.0957
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6048	3.4331	3.3522	3.2743	3.1272	2.9906	2.7454	2.5320	2.3452
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.1114	3.8887	3.7845	3.6847	3.4976	3.3255	3.0205	2.7594	2.5342
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.5638	4.2883	4.1604	4.0386	3.8115	3.6046	3.2423	2.9370	2.6775
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	4.9676	4.6389	4.4873	4.3436	4.0776	3.8372	3.4212	3.0758	2.7860
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.3282	4.9464	4.7716	4.6065	4.3030	4.0310	3.5655	3.1842	2.8681
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.6502	5.2161	5.0188	4.8332	4.4941	4.1925	3.6819	3.2689	2.9304
11	10.3676	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	5.9377	5.4527	5.2337	5.0286	4.6560	4.3271	3.7757	3.3351	2.9776
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.1944	5.6603	5.4206	5.1971	4.7932	4.4392	3.8514	3.3868	3.0133
13	12.1337	11.3484	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.4235	5.8424	5.5831	5.3423	4.9095	4.5327	3.9124	3.4272	3.0404
14	13.0037	12.1062	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.6282	6.0021	5.7245	5.4675	5.0081	4.6106	3.9616	3.4587	3.0609
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	6.8109	6.1422	5.8474	5.5755	5.0916	4.6755	4.0013	3.4834	3.0764
16	14.7179	13.5777	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	6.9740	6.2651	5.9542	5.6685	5.1624	4.7296	4.0333	3.5026	3.0882
17	15.5623	14.2919	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.1196	6.3729	6.0472	5.7487	5.2223	4.7746	4.0591	3.5177	3.0971
18	16.3983	14.9920	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.2497	6.4674	6.1280	5.8178	5.2732	4.8122	4.0799	3.5294	3.1039
19	17.2260	15.6785	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.3658	6.5504	6.1982	5.8775	5.3162	4.8435	4.0967	3.5386	3.1090
20	18.0456	16.3514	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.4694	6.6231	6.2593	5.9288	5.3527	4.8696	4.1103	3.5458	3.1129
25	22.0232	19.5235	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	7.8431	6.8729	6.4641	6.0971	5.4669	4.9476	4.1474	3.5640	3.1220
30	25.8077	22.3965	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.0552	7.0027	6.5660	6.1772	5.5168	4.9789	4.1601	3.5693	3.1242
40	32.8347	27.3555	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574	9.7791	8.2438	7.1050	6.6418	6.2335	5.5482	4.9966	4.1659	3.5712	3.1250
50	39.1961	31.4236	25.7298	21.4822	18.2559	15.7619	13.8007	12.2335	10.9617	9.9148	8.3045	7.1327	6.6805	6.2463	5.5541	4.9995	4.1660	3.5714	3.1250
60	44.9550	34.7609	27.6756	22.6235	18.9293	16.1614	14.0392	12.3766	11.0480	9.9672	8.3240	7.1401	6.6851	6.2492	5.5553	4.9999	4.1667	3.5714	3.1250

Partial areas under the standardised normal curve



$z = \frac{x-\bar{x}}{\sigma}$	0	1	2	3	4	5	6	7	8	9
0.0	0.0000	0.0040	0.0080	0.0120	0.0159	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	0.0678	0.0714	0.0753
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	0.1388	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1891	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	0.2086	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2760	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3215	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3451	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	0.4430	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	0.4762	0.4767
2.0	0.4772	0.4778	0.4783	0.4785	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	0.4882	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	0.4980	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