

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

ZETECH COLLEGE  
PERSONAL STUDENT PAYMENTS

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20/Sep/2011

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- (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; (2 marks)
- (ii) <sup>(iii)</sup> 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)



$$t_r = t_p + \frac{4(w) + t_q}{6}$$



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

- (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.

5.105 +

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.

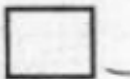
Net returns (Sh 000)	-3	-2	-1	0	1	2	3	4
Probability:								
Investment 1	0	0	0.1	0.2	0.3	0.2	0.2	0
Probability:								
Investment 2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2


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 - 6 =



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 deterministic 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  $y = A + Bx + \epsilon$ . Identify two components represented by  $\epsilon$  in the model.
- (ii) Distinguish between rank and product moment correlation coefficients. (6 marks)

X Y Z      X Y Z      floppy  
 40 32      16 20 10

- (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'. (4 marks)
- (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)

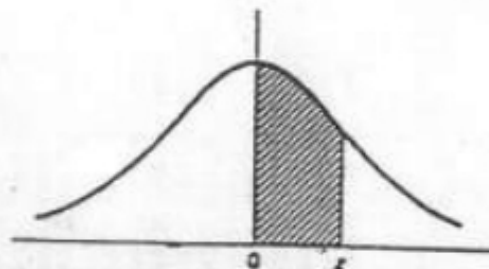


Table B: Present Value of an Annuity of Sh. 1 Per Period for n Periods:

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

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	0.9616	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8929	0.8772	0.8698	0.8627	0.8475	0.8333	0.8093	0.7813	0.7516
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7353	1.6991	1.6647	1.6327	1.6027	1.5642	1.5278	1.4598	1.3916	1.3215
3	2.9410	2.8928	2.8456	2.7993	2.7539	2.7093	2.6654	2.6223	2.5799	2.5382	2.4768	2.4168	2.3572	2.2982	2.2305	2.1642	1.9843	1.8694	1.7663
4	3.9029	3.8077	3.7131	3.6190	3.5254	3.4323	3.3397	3.2476	3.1560	3.0649	2.9532	2.8418	2.7307	2.6198	2.5005	2.3827	2.1403	1.9894	1.8683
5	4.8554	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7900	3.6648	3.5431	3.4252	3.3112	3.1925	3.0696	2.7454	2.5320	2.3402
6	5.7995	5.6014	5.4122	5.2421	5.0797	4.9133	4.7595	4.6079	4.4598	4.3153	4.1114	3.9467	3.7895	3.6397	3.4876	3.3325	3.0205	2.7564	2.5642
7	6.7282	6.4720	6.2202	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.5638	4.2882	4.1204	3.9596	3.7915	3.6166	3.2423	2.9310	2.6775
8	7.6517	7.3225	7.0127	6.7327	6.4632	6.2096	5.9712	5.7480	5.5389	5.3429	4.9676	4.6208	4.4873	4.3536	4.2076	4.0585	3.6230	3.2758	2.9850
9	8.5690	8.1822	7.7881	7.4333	7.1078	6.8017	6.5152	6.2469	5.9952	5.7592	5.3282	4.9464	4.7116	4.5005	4.3030	4.1010	3.5655	3.1842	2.8500
10	9.4713	8.9626	8.5302	8.1109	7.7217	7.3501	7.0226	6.7101	6.4127	6.1405	5.6502	5.2191	5.0186	4.8332	4.6541	4.4819	3.8919	3.4604	3.0764
11	10.3676	9.7988	9.2526	8.7605	8.3064	7.8869	7.4982	7.1390	6.8002	6.4911	5.9517	5.4727	5.2961	5.1307	4.9677	4.8157	4.1660	3.6814	3.2476
12	11.2551	10.6153	10.0940	9.5951	9.1233	8.6833	8.2719	7.8853	7.5239	7.1961	6.6172	6.1008	5.9514	5.8074	5.6557	5.5061	4.8063	4.2668	3.8013
13	12.1337	11.3464	10.8350	10.3585	9.9098	9.4928	9.1017	8.7308	8.3842	8.0619	7.4422	6.8912	6.7551	6.6214	6.4717	6.3250	5.5819	5.0014	4.5004
14	13.0037	12.1662	11.7061	11.2561	10.8298	10.4298	10.0507	9.6979	9.3662	9.0519	8.3922	7.8112	7.6811	7.5534	7.4095	7.2695	6.4916	5.8716	5.3409
15	13.8651	12.9452	12.5179	12.0884	11.6811	11.2907	10.9219	10.5695	10.2382	9.9279	9.2282	8.6172	8.4921	8.3674	8.2075	8.0516	7.2356	6.5756	6.0164
16	14.7179	13.7377	13.3401	12.9011	12.4823	12.0878	11.7129	11.3538	11.0059	10.6734	9.9347	9.2937	9.1726	9.0439	8.8799	8.7208	7.8658	7.1658	6.5764
17	15.5672	14.2919	13.9261	13.4961	13.0873	12.6954	12.3242	11.9689	11.6249	11.2964	10.5207	9.8417	9.7246	9.5919	9.4238	9.2607	8.3757	7.6357	7.0162
18	16.3983	14.9920	14.6520	14.2326	13.8355	13.4534	13.0896	12.7383	12.3949	12.0624	11.2507	10.6337	10.5206	10.3839	10.2168	10.0587	9.1437	8.3637	7.7142
19	17.2260	15.6705	15.3528	14.9338	14.5493	14.1798	13.8298	13.4923	13.1624	12.8441	12.0004	11.3454	11.2363	11.0946	10.9225	10.7554	9.8004	9.0004	8.3204
20	18.0456	16.3514	16.0475	15.6281	15.2583	14.8993	14.5543	14.2244	13.9027	13.5884	12.7107	12.0157	11.9106	11.7649	11.5928	11.4207	10.4357	9.6157	8.9104
25	22.0222	19.5235	19.4131	18.9221	18.4939	18.0734	17.6556	17.2448	16.8409	16.4439	15.5302	14.7932	14.6926	14.5539	14.3758	14.2027	13.1927	12.3427	11.6127
30	26.0077	22.2865	22.0004	21.5020	21.0728	20.6563	20.2473	19.8487	19.4546	19.0660	18.1103	17.3432	17.2477	17.1140	16.9319	16.7558	15.7008	14.8308	14.1608
40	32.0347	27.2555	27.1148	26.7526	26.3922	26.0353	25.6859	25.3440	25.0046	24.6687	23.6800	23.0732	22.9826	22.8479	22.6698	22.4927	21.4027	20.5027	19.8727
50	38.1961	31.4236	31.2798	31.0022	30.7289	30.4603	30.1964	29.9372	29.6827	29.4329	28.4002	27.7632	27.6776	27.5479	27.3732	27.2021	26.0921	25.1621	24.5721
60	44.9550	34.2109	34.0756	33.7756	33.4823	33.1948	32.9122	32.6345	32.3617	32.0938	31.0201	30.3632	30.2826	30.1579	29.9782	29.8021	28.6721	27.7121	27.1621

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	0.4152	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	0.4888	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

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