2209/301
QUANTITATIVE METHODS
June/July 2017
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;
Mathematical tables;
Non-programmable Scientific calculator.
*Answer any **FIVE** of the following **EIGHT** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 11 printed pages.

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

Turn over

(a) State **three** problems encountered in the construction of consumer price index. (3 marks)

(b) Explain the "composite index number" as used in index numbers. (2 marks)

(c) A certain computer firm manufactures eight models of computers. A panel of experts tested the computers for quality and ranked them beginning with the computer model having the highest quality. The ranking of the computer models and their retail prices are shown in table 1.

Table 1

Computer model	A	B	C	D	E	F	G	H
Quality rank	3	4	6	2	8	5	7	1
Retail price Ksh. "000"	45	40	35	50	30	42	32	44

Determine and comment on each of the following:

(i) Spearman's rank correlation coefficient;

(ii) Coefficient of determination. (15 marks)

(a) State **four** principal components of a time series. (4 marks)

(b) (i) Explain the difference between multiplicative and additive models used in time series.

(ii) State the condition under which each model in b (i) is used. (6 marks)

(c) The sales data for Formoco Computer Services (in millions of shillings) for years 2011 to 2014 are indicated in Table 2.

Table 2

YEAR	Quarter			
	1	2	3	4
2011	38	60	120	56
2012	40	88	144	62
2013	42	80	156	98
2014	56	82	180	100

1632 - 1296

103, 952

(i) Use the least square method to determine the trend equation.

(ii) Forecast the sales for each quarter of the year 2015.

(10 marks)

3. (a) Industrial Printers' Solutions Limited has produced a new model of printing machine. The management of the company has to make a decision whether to test market the printing machine or abandon it.

The cost of test marketing could either be positive or negative with probabilities of 0.6 and 0.4 respectively. If the response from test marketing is positive, the company could either abandon the printing machine or launch it into the market. If the company launches the printing machine into the market, the outcome might be low, medium or high demand with net pay-offs of Ksh. 200 million loss, Ksh. 200 gain and Ksh. 1,000 million gain respectively. Low, medium and high demands have probabilities of 0.2, 0.5 and 0.3 respectively.

If the result of test marketing is negative, the company could either abandon the printing machine or launch it into the market at an estimated loss of 500 million.

If the company abandons the printing machine at any point, the company would realize a net gain of Ksh. 50 million from the sale of the printing machine as a scrap.

(i) Construct a decision tree to represent the above information.

(ii) Advice the management of the Industrial Printers Solutions Limited on the best cause of action.

(8 marks)

8/64 - 7

512 - 8 = 504

(b) A certain institution recently acquired a certain photocopier with a useful life of 15 years. Over the useful life the photocopier is likely to have periodic failures and breakdowns. Past data for similar photocopier indicate a probability distribution of failures as shown in table 3.

Table 3

Number of failures	0	1	2	3
Probability	0.80	0.15	0.04	0.01

(i) Use the random numbers, 70, 88, 37, 12, 45, 99, 54, 71, 64, 93, 67, 80, 55, 34 and 32 to simulate the number of failures that will occur over the useful life of the photocopier.

(ii) Determine the average annual failure rate. (5 marks)

(c) A trade union claims that the average income for its members in Kisumu is different from that of employees of the same company in Nairobi. A survey of 60 employees in Kisumu showed an average income of Ksh. 39,500 per week with a standard deviation of Ksh. 12,000. A survey of 100 workers in Nairobi after making adjustments for various differences between the two towns, gave an average income of Ksh. 91,400 per week with a standard deviation of Ksh. 9,000. Test the union's claim at 5% significance level. (7 marks)

4. (a) Explain **three** limitations of linear programming. (6 marks)

(b) A certain cycle mart company operates two assembly lines, A and B. Each line is used to assemble components of three types of bicycles; Economy, Super and Racer. The expected daily production on each line is as follows:

Model	**Line A**	**Line B**
Economy	3	1
Super	1	1
Racer	2	6

The daily average running costs for line A is Ksh. 6,000 and that of line B is Ksh. 4,000. The company must manufacture at least 24 Economy, 16 Super and 48 Racer cycles for which the order is pending.

(i) Formulate a linear programming model for the minimization of running costs.

(ii) Use the graphical method to solve the linear programming model so as to determine the number of days the two assembly lines should operate with least running cost.

(14 marks)

(a) Table 4 shows the annual salary data collected from a group of skilled workers in a certain company.

Table 4

Annual salary in Ksh. '00000'	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20
Number of skilled workers	5	17	21	3	1	1

Determine the:

(i) mean annual salary;
(ii) standard deviation;
(iii) median annual salary;
(iv) coefficient of variation;
(v) coefficient of skewness.

(11 marks)

(b) The average prices of four commodities manufactured by a certain factory are shown in table 5.

Table 5

Commodity	**Average Price per unit in Ksh. (00)**		
	2013	**2014**	**2015**
A	101	105	109
B	103	106	107
C	79	93	108
D	83	89	86

The number of units used annually by a certain company is approximately 400, 200, 600 and 100 of commodities A, B, C and D respectively.
Calculate a weighted price index for the years 2014 and 2015 using the year 2013 as the base year. (9 marks)

6. (a) Explain any **two** limitations of Project Evaluation and Review Technique (PERT) in project management. (4 marks)

(b) A project comprises of activities whose durations in weeks are indicated in table 6.

Table 6

Activities	Optimistic time	Most likely time	Pessimistic time
1 - 2	2	4	12
1 - 3	10	12	26
2 - 4	8	9	10
2 - 5	10	15	20
3 - 4	7	7.5	11
4 - 5	9	9	9
4 - 6	2	3.5	8
5 - 6	2	4	6
6 - 7	4	6	14

(i) Determine the expected time and variance of each activity.

(ii) Construct the project network and indicate the critical path.

(iii) If the project manager sets a 44 weeks deadline for the project completion, calculate the probability that the project will be completed within the set-up limit. (16 marks)

7. (a) State **four** components of stockholding costs. (4 marks)

(b) A company has an annual demand for material Q of 30,00 units per annum. The cost price per unit is Ksh. 1,800 and the stock holding is 24% per annum of the stock value. Delivery cost per batch is Ksh. 600. Determine the:

(i) Economic Order Quantity;
(ii) number of annual orders.

(5 marks)

(c) A firm wishes to decide between two projects which have cashflows shown in table 7. The cash inflows are in Ksh. "000". The initial investment for each project is Ksh. 1.5 million.

If project I is discounted at 15% and project II at 20%, use the Net Present Value method to determine the most viable project. (11 marks)

Table 7

Project	Year			
	1	2	3	4
I	1000	500	600	400
II	1200	400	400	400

8. (a) The lifetime in tens of hours, of a certain delicate computer component is modelled by a continuous random variable x with probability density function

$$f(x) = \begin{cases} k(9-x), & 0 \leq x \leq 9 \\ 0, & \text{Otherwise} \end{cases}$$

Where k is a positive constant.
Determine the:

(i) value of constant k;
(ii) mean lifetime of the component;
(iii) probability that a component lasts at most 50 hours.

(10 marks)

(b) The number of telephone calls received in half-minute interval in a certain switchboard can be modelled by a Poisson distribution with mean of 3.5 calls per half minute. Determine the probability that:

(i) at least 2 calls will be received by the switchboard in a randomly chosen half-interval.

(ii) 5 or fewer calls will be received in a randomly chosen one-minute interval.

(7 marks)

(c) State **three** characteristics of a binomial probability distribution. (3 marks)

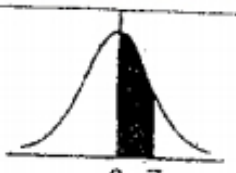
PRESENT VALUE FACTORS

Years	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174	.9091
2	.9803	.9612	.9426	.9426	.9070	.8900	.8734	.8573	.8417	.8264
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722	.7513
4	.9610	.9238	.8885	.8548	.8227	.7921	.7629	.7350	.7084	.6830
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499	.6209
6	.9420	.8880	.8375	.7903	.7462	.7050	.6663	.6302	.5963	.5645
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470	.5132
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019	.4665
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604	.4241
10	.9053	.8203	.7441	.6756	.6139	.5584	.5083	.4632	.4224	.3855
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875	.3505
12	.8874	.7885	.7014	.6246	.5568	.4970	.4440	.3971	.3555	.3186
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262	.2897
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992	.2633
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745	.2394
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519	.2176
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311	.1978
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120	.1799
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945	.1635
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784	.1486
21	.8114	.6598	.5375	.4388	.3589	.2942	.2415	.1987	.1637	.1351
22	.8034	.6468	.5219	.4220	.3418	.2775	.2257	.1839	.1502	.1228
23	.7954	.6342	.5067	.4057	.3256	.2618	.2109	.1703	.1378	.1117
24	.7876	.6217	.4919	.3901	.3101	.2470	.1971	.1577	.1264	.1015
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160	.0923

(Continued)

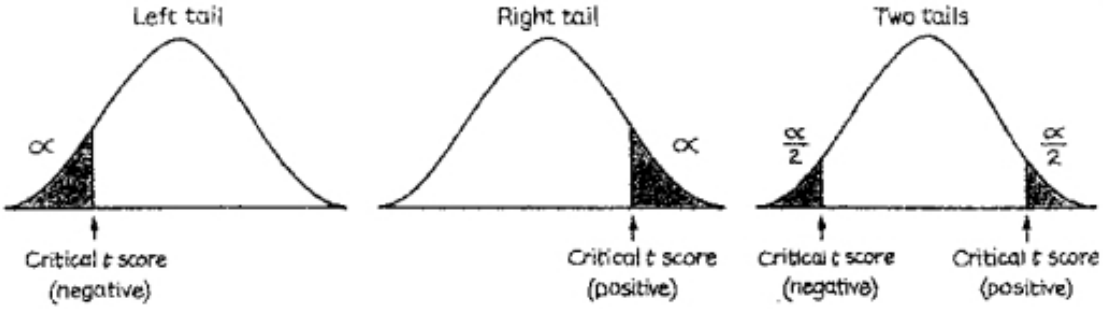
Years	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	9009	.8929	.8850	.8772	.8696	.8621	.8547	.8475	.8403	.8333
2	.8116	.7972	.7831	.7695	.7561	.7432	.7305	.7182	.7062	.6944
3	.7312	.7118	.6931	.6750	.6575	.6407	.6244	.6086	.5934	.5787
4	.6587	.6355	.6133	.5921	.5718	.5523	.5337	.5158	.4987	.4823
5	.5935	.5674	.5428	.5194	.4972	.4761	.4561	.4371	.4190	.4019
6	.5346	.5066	.4803	.4556	.4323	.4104	.3898	.3704	.3521	.3349
7	.4817	.4523	.4251	.3996	.3759	.3538	.3332	.3139	.2959	.2791
8	.4339	.4039	.3762	.3506	.3269	.3050	.2848	.2660	.2487	.2326
9	.3909	.3606	.3329	.3075	.2843	.2630	.2434	.2255	.2090	.1938
10	.3522	.3220	.2946	.2697	.2472	.2267	.2080	.1911	.1756	.1615
11	.3173	.2875	.2607	.2366	.2149	.1954	.1778	.1619	.1476	.1346
12	.2858	.2567	.2307	.2076	.1869	.1685	.1520	.1372	.1240	.1122
13	.2575	.2292	.2042	.1821	.1625	.1452	.1299	.1163	.1042	.0935
14	.2320	.2046	.1807	.1597	.1413	.1252	.1110	.0985	.0876	.0779
15	.2090	.1827	.1599	.1401	.1229	.1079	.0949	.0835	.0736	.0649
16	.1883	.1631	.1415	.1229	.1069	.0930	.0811	.0708	.0618	.0541
17	.1696	.1456	.1252	.1078	.0929	.0802	.0693	.0600	.0520	.0451
18	.1528	.1300	.1108	.0946	.0808	.0691	.0592	.0508	.0437	.0376
19	.1377	.1161	.0981	.0826	.0703	.0596	.0506	.0431	.0367	.0313
20	.1240	.1037	.0868	.0728	.0611	.0514	.0433	.0365	.0308	.0261
21	.1117	.0926	.0768	.0638	.0531	.0443	.0370	.0309	.0259	.0217
22	.1007	.0826	.0680	.0560	.0462	.0382	.0316	.0262	.0218	.0181
23	.0907	.0738	.0601	.0491	.0402	.0329	.0270	.0222	.0183	.0151
24	.0817	.0659	.0532	.0431	.0349	.0284	.0231	.0188	.0154	.0126
25	.0736	.0588	.0471	.0378	.0304	.0245	.0197	.0160	.0129	.0105

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

Student t distribution



t Distribution

	α					
Degrees of freedom	.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 (z)	2.575	2.327	1.960	1.645	1.282	.675

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