

1. (a) The demand and average cost functions for a firm are given by:

$$P = 1,300 - \frac{1}{4}Q$$

$$AC = Q - 200 + \frac{400}{Q}$$

Where P is the price in Kshs.
Q is the quantity in units.

R = Q x P
P = R - C

Determine the:

- (i) quantity that maximises the profits of the firm;
- (ii) maximum profits that would be made by the firm;
- (iii) price that maximises the profit of the firm.

R = P x Q
1,300 - \frac{1}{4}Q x

(12 marks)

- (b) Differentiate between the following components of a time series;

- (i) secular trend and seasonal trend;
- (ii) cyclical variation and irregular variation.

(8 marks)

2. (a) A company uses 12,000 units of an item per annum, each of which costs Ksh. 18. The ordering cost is Ksh. 250 per order, while the carrying cost is 25% of the cost price per annum. Calculate:

- (i) economic order quantity;
- (ii) optimum number of orders;
- (iii) cost of economic order quantity.

(8 marks)

- (b) Highlight six uses of network analysis.

(12 marks)

3. (a) The following table shows the units of fertilizers used and the corresponding productivity in a given firm.

Fertilizer ('000 kgs)	23	27	28	28	28	30	30	33	35	38
Productivity ('000 kgs)	18	20	22	27	21	29	27	29	28	29

Calculate Pearson's coefficient of correlation between fertilizer use and productivity.

(8 marks)

- (b) The brands of paint, x and y , were applied to eight test plaster boards to determine their average drying times in seconds. The drying times were recorded as shown in the table below:

Paint	Time (sec)							
	x	79.10	64.80	79.60	74.40	79.80	63.80	72.40	65.70
y	89.30	73.60	68.00	82.50	81.60	87.00	85.40	88.20

$y = a + bx$

Test at 0.01 level of significance the hypothesis that paint x dries faster than paint y .
(12 marks)

4. (a) The manager of an oil refinery firm must decide on the optimal mix of two possible blending processes of which the inputs and outputs per production run are given as shown in the table below.

Process	INPUT		OUTPUT	
	Crude A	Crude B	Gasoline X	Gasoline Y
1	2	3	5	8
2	2	5	4	4

The maximum amounts available of crudes A and B are 80 units and 150 units respectively. The market requirements show that at least 100 units of gasoline X and at least 80 units of gasoline Y must be produced. The profits per production run from Process 1 and Process 2 are Ksh. 3 and Ksh. 4 respectively.

- (i) Formulate a standard linear programming problem from the above information.
- (ii) Using the graphical method, determine the number of production runs of each process that would enable the firm to maximize profit.
- (iii) Determine the maximum profit.

(12 marks)

(b) The prices of three commodities between the year 2000 and 2009 is given as follows:

Commodity	2000		2009	
	Price (Ksh) p_0	Quantity (Kg.) q_0	Price (Ksh.) p_1	Quantity (Kg.) q_1
X	50	150	45	100
Y	55	100	60	50
Z	10	200	15	150

Using the 2000 as the base year, calculate:

$$45 \times 50 + 60 \times 55 + 15 \times 10$$

(i) Laspeyre's price index;

(ii) Paasche's price index.

(8 marks)

5. (a) In a year, a school bought 36 desktops and 32 laptops at a total cost of Ksh. 2,272,800. In the following year, the school bought 28 desktops and 24 laptops for a total cost of Ksh. 1,749,600. Using matrix method, determine the price of:

(i) one desktop;

(ii) one laptop.

(12 marks)

(b) A supplies management class is made up of 15 boys and 10 girls. The club has 3 officials. Determine the probability that:

(i) the club officials are all boys;

(ii) two of the officials are girls;

(iii) none of the officials is a boy.

(8 marks)

36d 32l

$$\frac{36 \times 2,272,800 + 32 \times 1,749,600}{28 \times 2,272,800 + 24 \times 1,749,600}$$

6

- (a) Discuss **four** uses of quantitative techniques in business. (8 marks) ✓
- (b) The table below shows details of activities involved in building an office block.

Activity	Preceding Activity	Duration (Days)
A	-	9
B	-	3
C	A	8
D	A	2
E	A	3
F	C	2
G	C	6
H	C	1
J	B,D	4
K	F,J	1
L	E,H,G,K	2
M	E,H	3
N	L,M	4

Handwritten notes on the left side of the page:

- 216 192 L
- 224 192 J
- 32L / 24L
- 24L / 8
- 34
- 140
- 196

- (i) Draw a network diagram for the project;
- (ii) Determine the:
- (I) critical path;
 - (II) expected project duration.

(12 marks) ✓

Handwritten calculation:

$$\frac{27}{32}$$

- Q. (a) B.N. Limited is considering the purchase of a new machine. Two alternative machines, A and B, have been identified. Each machine requires an initial cash outlay of Ksh. 500,000. The estimated life of each machine is 5 years.

Year	A	B
1	50,000	80,000
2	60,000	100,000
3	70,000	70,000
4	80,000	60,000
5	40,000	50,000

Using the Net Present Value (NPV) approach, select the better machine. (10 marks)

- (b) Highlight **five** benefits that accrue to an organization that uses inventory control system. (10 marks)

$$\frac{10}{104} \quad (1+r)^2$$

Table A
Present Value of Sh 1 Received at the End of n Periods:
 $PVIF_{r,n} = 1/(1 + r)^n = (1 + r)^{-n}$

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174	.9091	.8929	.8772	.8696	.8621	.8475	.8333	.8065	.7813	.7576	.7353
2	.9803	.9612	.9426	.9246	.9070	.8900	.8734	.8573	.8417	.8264	.7972	.7695	.7561	.7432	.7182	.6944	.6504	.6104	.5739	.5407
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722	.7513	.7118	.6750	.6575	.6407	.6086	.5787	.5245	.4768	.4348	.3975
4	.9610	.9238	.8885	.8548	.8227	.7921	.7629	.7350	.7084	.6830	.6355	.5921	.5718	.5523	.5158	.4823	.4230	.3725	.3294	.2923
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499	.6209	.5674	.5194	.4972	.4761	.4371	.4019	.3411	.2910	.2495	.2149
6	.9420	.8880	.8375	.7903	.7462	.7050	.6663	.6302	.5963	.5645	.5066	.4556	.4323	.4104	.3704	.3349	.2751	.2274	.1890	.1580
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470	.5132	.4523	.3996	.3759	.3538	.3139	.2791	.2218	.1776	.1432	.1162
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019	.4665	.4039	.3506	.3269	.3050	.2660	.2326	.1789	.1388	.1085	.0854
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604	.4241	.3606	.3075	.2843	.2630	.2255	.1938	.1443	.1084	.0822	.0628
10	.9053	.8203	.7441	.6756	.6139	.5584	.5083	.4632	.4224	.3855	.3220	.2697	.2472	.2267	.1911	.1615	.1164	.0847	.0623	.0462
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875	.3505	.2875	.2366	.2149	.1954	.1619	.1346	.0938	.0662	.0472	.0340
12	.8874	.7885	.7014	.6246	.5568	.4970	.4440	.3971	.3555	.3186	.2567	.2076	.1869	.1685	.1372	.1122	.0757	.0517	.0357	.0250
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262	.2897	.2292	.1821	.1625	.1452	.1163	.0935	.0610	.0404	.0271	.0184
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992	.2633	.2046	.1597	.1413	.1252	.0985	.0779	.0492	.0316	.0205	.0135
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745	.2394	.1827	.1401	.1229	.1079	.0835	.0649	.0397	.0247	.0155	.0099
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519	.2176	.1631	.1229	.1069	.0930	.0708	.0541	.0320	.0193	.0118	.0073
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311	.1978	.1456	.1078	.0929	.0802	.0600	.0451	.0258	.0150	.0089	.0054
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120	.1799	.1300	.0946	.0808	.0691	.0508	.0376	.0208	.0118	.0068	.0039
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945	.1635	.1161	.0829	.0703	.0596	.0431	.0313	.0168	.0092	.0051	.0029
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784	.1486	.1037	.0728	.0611	.0514	.0365	.0261	.0135	.0072	.0039	.0021
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160	.0923	.0588	.0378	.0304	.0245	.0160	.0105	.0046	.0021	.0010	.0005
30	.7419	.5521	.4120	.3083	.2314	.1741	.1314	.0994	.0754	.0573	.0334	.0196	.0151	.0116	.0070	.0042	.0016	.0006	.0002	.0001
40	.6717	.4529	.3066	.2083	.1420	.0972	.0668	.0460	.0318	.0221	.0107	.0053	.0037	.0026	.0013	.0007	.0002	.0001	.	.
50	.6080	.3715	.2281	.1407	.0872	.0543	.0339	.0213	.0134	.0085	.0035	.0014	.0009	.0006	.0003	.0001	.	.	.	.
60	.5504	.3048	.1937	.0951	.0535	.0303	.0173	.0099	.0057	.0033	.0011	.0004	.0002	.0001	.	.	.	.	.	.

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	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8829	0.8772	0.8696	0.8621	0.8475	0.8333	0.8065	0.7813	0.7576
2	1.9704	1.9418	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	1.3918	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	2.1066	1.9813	1.8664	1.7653
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	4.8694	4.5638	4.2882	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	2.7850
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.3282	4.9484	4.7716	4.6065	4.3030	4.0310	3.5655	3.1842	2.8661
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	3.2839	2.9304
11	10.3676	9.7868	9.2528	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	2.9276
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.1944	5.6803	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	11.2981	10.5631	9.8966	9.2950	8.7455	8.2442	7.7862	7.3667	6.6282	6.0021	5.7245	5.4685	5.0081	4.6106	3.9816	3.4667	3.0609
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1078	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	14.7178	13.5777	12.5611	11.5523	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	13.1861	12.1857	11.2741	10.4473	9.7632	9.1216	8.5436	8.0216	7.1196	6.3739	6.0472	5.7487	5.2223	4.7746	4.0591	3.5177	3.0971
18	16.3983	14.9920	13.7835	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	17.2280	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	18.0458	16.3514	14.8775	13.5903	12.4622	11.4699	10.5840	9.8181	9.1285	8.5138	7.4694	6.6231	6.2593	5.9288	5.3527	4.8696	4.1103	3.5468	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	5.4688	4.9476	4.1474	3.5640	3.1220
30	25.8077	22.3965	19.8004	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	4.1801	3.5993	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	4.9965	4.1859	3.5712	3.1250
50	39.1961	31.4236	25.7288	21.4822	18.2559	15.7619	13.8007	12.2335	10.9617	9.9148	8.3045	7.1327	6.6805	6.2483	5.5541	4.9995	4.1866	3.5714	3.1250
60	44.8550	34.7609	27.6766	22.6235	18.9293	16.1614	14.0392	12.3788	11.0480	9.9872	8.3240	7.1401	6.6651	6.2482	5.5653	4.9999	4.1667	3.5714	3.1250

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