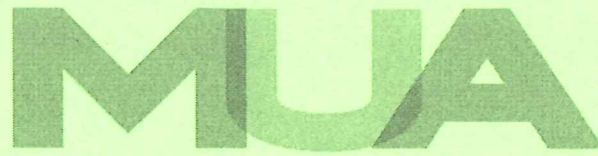


The
Management
University
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UNDERGRADUATE UNIVERSITY EXAMINATIONS

SCHOOL OF MANAGEMENT AND LEADERSHIP

DEGREE OF BACHELOR OF COMMERCE

BCM 222: BUSINESS STATISTICS

DATE: 2ND AUGUST 2024

DURATION: 2 HOURS

MAXIMUM MARKS: 70

INSTRUCTIONS:

1. Write your registration number on the answer booklet.
2. **DO NOT** write on this question paper.
3. This paper contains **SIX (6)** questions.
4. Question **ONE** is compulsory.
5. Answer any other **THREE** questions.
6. Question **ONE** carries **25 MARKS** and the rest carry **15 MARKS** each.
7. **Write all your answers in the Examination answer booklet provided.**

QUESTION ONE

- a) Consider the two-person zero sum game between players X and Y given the following pay-off table:

Player X	Player Y		
	Strategies		
Strategies	y ₁	y ₂	y ₃
x ₁	2	2	3
x ₂	4	3	2

Required: To determine optimal strategies for each player and the value of the game? Give reasons. (5 Marks)

- b) Given the formulated linear programming problem as follows:

$$\text{Objective Function, } Z = 20x_1 + 35x_2 \text{ (Minimization)}$$

$$\text{Subject to: } 4x_1 + 6x_2 \geq 10$$

$$3x_1 + 10x_2 \geq 20$$

$$5x_1 + 3x_2 \geq 15$$

$$\text{And } x_1, x_2 \geq 0 \text{ (Non-Negativity Condition)}$$

Required:

Obtain the dual programme (3 Marks)

- c) Define the following terms used in game theory:

i) Dominance. (1 Marks)

ii) Saddle point. (1 Marks)

iii) Mixed strategy. (1 Marks)

iv) Value of the game (1 Marks)

- d) Given the Input-output table below: -

OUTPUT	INPUT		
	P	Q	Consumer Demand
P	60	140	300
Q	110	90	150

- i. Find the Technical Coefficient Matrix. (2 Marks)
- ii. Determine the Total Output hence distribute the result among the users, given that the final demand for output from industry P increased by 10% while that from Q went down by 5%. (5 Marks)
- e) Differentiate between event and the activity in project network (2 Marks)

- f) In a particular population, arrivals are considered to be poisson distribution and it takes an average time of 8 minutes between the arrivals. The length of the services is exponentially distributed, with a mean of 4 minutes. Determine the expected number of units in the queue and expected time in the system (4 Marks)

QUESTION TWO

- a) The school Canteen operates with only one window. They have one staff who performs all the service required and the window remains continuously open from 7 am to 1 pm. From the records of the clients, an average of 62 clients visit the shop during the day and the average service time is 5 minutes per client. Find:
- i. Average waiting time (2 Marks)
 - ii. Average number of clients in the shop (3 Marks)
 - iii. The probability that a client would have to wait for services (2 Marks)
- b) The market for car insurance in a particular county is dominated by two companies: A and B. Currently, A insures 50% of the cars, B insures 20% and the remainder are insured by a collection of smaller companies. B decides to offer rebates to increase its market share. This has the following effects on the insurance purchases for the next several years; each of 30% of A's customers switch to B and 10% switch to other companies, 20% of B's customers switch to A and 5% switch to other companies, 30% of the customers of other companies switch to A and 40% switch to B. Determine the market share of the companies after two years and also in the long run. (8 Marks)

QUESTION THREE

- a) Explain three assumptions for transportation problems (3 Marks)
- b) Otieno Engineering Works Ltd. Has a network of branches all over Kenya. The branches are used to service, repair and install equipment for their clients. Currently, the Nairobi branch has four clients who require installation of equipment. Each client requires the services of one engineer. There are four engineers who are not engaged at the moment and can be assigned any one of the tasks. However, these engineers have to travel from different locations and the

Nairobi branch has to meet their travel and subsistence allowances. The allowances vary from one engineer to another and according to the client the engineer has been assigned to work for. The table below shows the costs (in thousands of shillings) associated with each engineer.

ENGINEER	CLIENT			
	W	X	Y	Z
A	37	27	34	21
B	57	22	79	34
C	22	25	61	45
D	39	42	54	43

Required:

The assignments to be made in order to minimize the total cost of the engineers and hence find the total cost. (12 Marks)

QUESTION FOUR

A construction company has documented various activities they plan to undertake, their predecessors and the estimated duration (in days) each activity would take. The table below summarizes the information:

Activity	Preceding Activity	Duration (Days)		
		Optimistic Time	Most likely Time	Pessimistic Time
A	-	4	5	6
B	A	7	9	11
C	A	5	5	5
D	A	6	6	8
E	B	2	3	4
F	C	3	5	7
G	E	5	6	7
H	B,F	11	12	13
I	G,H	7	9	10
J	C	4	5	7
K	D	3	4	6
L	I,J,K	4	4	4

Required:

- a) Draw the network diagram (3 Marks)
- b) Determine the critical path and project completion time (6 Marks)
- c) Calculate the probability of completing the project in 38 Days (6 Marks)

QUESTION FIVE

- a) A firm is engaged in producing two products, P_1 and P_2 . Each unit of product P_1 requires 2 kg of raw material and 4 labour hours for processing, whereas each unit of product P_2 requires 3 kg of raw material and 3 hours of labour, of the same type. Every week, the firm has an availability of 60 kg of raw material and 96 labour hours. One unit of product P_1 sold yields Sh. 40 and one unit of product P_2 sold gives Sh. 35 as profit. Determine how many units of each of the products should be produced per week so that the firm can earn the maximum profit. Assume that there is no marketing constraint so that all that is produced can be sold. Use Simplex Method (8 Marks)
- b) Find the initial feasible solution on the following transportation problem using:

SOURCE	DESTINATION				Total Supply
	A	B	C	D	
X	3	1	7	4	250
Y	2	6	5	9	400
Z	8	3	3	2	600
Total Demand	250	300	260	350	

- i. Northwest Corner Method (2 Marks)
- ii. Least Cost Method (2 Marks)
- iii. Vogel's Approximation Method (3 Marks)

QUESTION SIX

Otieno has some money to invest in one of the four options: Fiat Money, Commodity Money, Fiduciary Money or Commercial Bank Money. The money is to be used to run a factory in the long run which produces products of different quality measured in grades. Otieno would realise the return on investment depending on the quality of items produced. The possible returns under each strategy and produce state of nature in terms of grades are given in the table below.

Course of Action (Strategy)	Quality of Produce		
	Grade 1	Grade 2	Grade 3
Fiat Money	600	700	750
Commodity Money	500	650	550
Fiduciary Money	450	290	420
Commercial Bank Money	300	420	620

Determine the optimal decision which Otieno should take using the following criterion

- a) Pessimism (3 Marks)
- b) Optimism (3 Marks)
- c) Hurwicz method, $\alpha = 0.6$ (5 Marks)
- d) Minimax Regret (4 Marks)

FORMULAS

$$P = \frac{\lambda}{\mu}$$

$$N_q = \frac{\lambda^2}{\mu(\mu-\lambda)}$$

$$N_s = \frac{\lambda}{(\mu-\lambda)}$$

$$T_q = \frac{\lambda}{\mu(\mu-\lambda)}$$

$$T_s = \frac{1}{(\mu-\lambda)}$$

$$\text{Activity variance} = \left[\frac{p-o}{6} \right]^2$$

$$\text{Expected Time} = \frac{O+4M+P}{6}$$

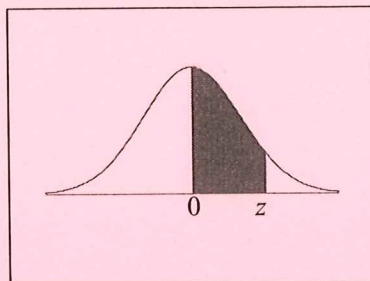
$$\text{Activity Standard Deviation} = \frac{P-O}{6}$$

$$Z = \frac{(x - \text{Mean})}{\text{project standard deviation}}$$

$$\text{Input-Output Model, } X = (I_n - M)^{-1} \times d$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Standard Normal Distribution Table



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998

