MONASH University

FIT3158 - Mock Exam 1

Started on	Sunday, 30 October 2022, 10:37 AM
State	Finished
Completed on	Sunday, 30 October 2022, 12:47 PM
Time taken	2 hours 10 mins

Information

Answer all questions in this exam.

This exam contributes to 60% of the unit assessment

This exam consists of TWO (2) sections:

Section A: 10 multiple choice questions worth 1 mark each. Subtotal 10 marks

Section B: 6 major topics worth 10 marks each. Subtotal 60 marks

Total 70 marks

Note: The Normal Distribution Table is on Page 17.

Unsure

Information

Section A

Multiple Choice (10 marks in total)
Answer all questions.
Select the best answer for each question. There is no penalty for incorrect answers.

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Mark

A company uses 4 pounds of resource 1 to make each unit of X1 and 3 pounds of resource 1 to make each unit of X2. There are only 150 pounds of resource 1 available. Which of the following constraints reflects the relationship between X1, X2 and resource 1?

Select one:

- a. 4 X1 + 3 X2 ≥ 150
- b. 4 X1 + 3 X2 ≤ 150
- c. 4 X1 + 3 X2 = 150
- d. 4 X1 ≤ 150

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1 Mark

What is the goal in optimization?

Select one:

- a. Find the best decision variable values that satisfy all constraints.
- b. Find the values of the decision variables that use all available resources.
- c. Find the values of the decision variables that satisfy all constraints.
- d. None of the above.

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3 of 20

1 Mark

How many constraints are there in a transportation problem which has 5 supply points and 4 demand points? (ignore the non-negativity constraints)

Select one:

- a. 4
- b. 5
- c. 9
- d. 20

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4 of 20

Mark

A production company wants to ensure that if Product 1 is produced, production of Product 1 not exceed production of Product 2. Which of the following constraints enforce this condition?

Select one:

- a. X1>M2Y2
- b. X1<M2X2
- c. X1<M1Y1, X1<Y1X2
- d. X1<X2

Report question issue Notes

Unsure

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1 Mark

The decision rule which determines the maximum payoff for each alternative and then selects the alternative associated with the largest payoff is the

Select one:

- a. maximax decision rule.
- b. maximin decision rule.
- c. minimax regret decision rule.
- d. minimin decision rule.

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Unsure

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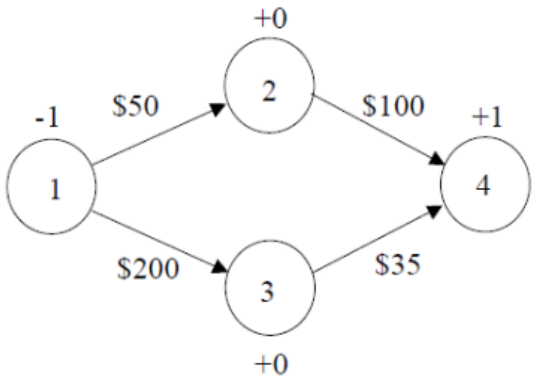
Mark

What is the constraint for node 2 in the following shortest path problem?



Select one:

- a. -X12--X13= 0
- b. -X12-X24= 1
- c. X12+ X13= 0
- d. -X12+ X24= 0

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Information

Questions 7 to 9 use the following information.

You are considering 4 investments, A, B, C and D. The payoff from each investment is a dependent on the economic condition over the next 2 years. The economy can expand or decline. The following payoff matrix has been developed for the decision problem.

Payoff Matrix		
Probability	0.7	0.3
	Economy	
Investment	Decline	Expand
A	-10	90
B	20	50
C	40	45
D	15	20

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Unsure

What decision should be made according to the expected regret decision rule?

Mark

Select one:

- a. A
- b. B
- c. C
- d. D

Report question issue Notes

Question 7 Notes

Or C, both are 0

8 of 20

Unsure

What decision should be made according to the expected monetary value decision rule?

1 Mark

Select one:

- a. A
- b. B
- c. C
- d. D

Report question issue Notes

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Unsure

What is the expected monetary value of Investment A?

1 Mark

Select one:

- a. 15
- b. 20
- c. 30
- d. 34

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10 of 20

Mark

A time-series which has no significant upward or downward trend is referred to as:

Select one:

- a. static
- b. stationary
- c. non-moving
- d. non-stationary

Report question issue Notes

Unsure

Information

Section B:

This section consists of 6 major topics with sub-parts.

Answer all questions (60 marks in total)

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Marks

A farmer is planning his spring planting. He has 20 acres on which he can plant a combination of Corn, Pumpkins and Beans. He wants to maximize his profit but there is a limited demand for each crop. Each crop also requires fertilizer and irrigation water which are in short supply. There are only 50 acre ft of irrigation available and only 8,000 pounds/acre of fertilizer available. The following table summarizes the data for the problem.

Crop	Profit per Acre ($)	Yield per Acre (lb)	Maximum Demand (lb)	Irrigation (acre ft)	Fertilizer (pounds/acre)
Corn	2,100	21,000	200,000	2	500
Pumpkin	900	10,000	180,000	3	400
Beans	1,050	3,500	80,000	1	300

Formulate the LP model for this linear programming problem. (4 marks)

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Let A, B, C be numbers of Corn, Pumpkins and Beans, respectively

DV

# of crops (Corn, Pumpkins and Beans) to be produced

OF

Max Profit : 2100A + 900B + C 1050

Constraints

Unsure YPA!!

21000A<=200000

10000B<=180000

3500C<= 80000

A+B+C <= 20

2A+3B+1A <= 50

500A + 400B + 300C <= 8000

Report question issue Notes

Unsure

Question 11 Notes

Marks

The problem in Question 11 is modeled in an Excel Spreadsheet and the Sensitivity Report is generated as shown below.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B4	Acres of Corn	9.52	0	2100	1E+30	350
C4	Acres of Pumpkin	0	-500.01	899.99	500.01	1E+30
D4	Acres of Beans	10.79	0	1050	210	375.00

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
E8	Corn demand Used	200000	0.017	200000	136000	152000
E9	Pumpkin demand Used	0	0	180000	1E+30	180000
E10	Bean demand Used	37777.78	0	80000	1E+30	42222.22
E11	Water Used	29.84	0	50	1E+30	20.15
E12	Fertilizer Used	8000	3.5	8000	3619.04	3238.09

Answer the following question based on the above report.

12a)

1 Marks

What is the optimal solution to this problem? (1 mark)

Let A, B, C be numbers of Corn, Pumpkins and Beans, respectively

9.52 units of A

0 units of B

10.79 units of C

Report question issue

12b)

2 Marks

Suppose the farmer can purchase more fertilizer for $2.50 per pound, should he purchase it and how much can he buy and still be sure of the value of the additional fertilizer? (2 marks)

2.5 < Shadow price (3.5)

With less cost, he should purchase more, in which he can buy 3619.04 more of the fertilizer

12c)

1
Marks

What does the reduced cost for pumpkin indicate? (1 mark)

It means that there is a non-binding constraint and there is no more slack.

Report question issue

12d)

1
Marks

Identify the binding resource and state how much would you pay to acquire an additional unit of that resource? (1 mark)

Identify the binding resource and state how much would you pay to acquire an additional unit of that resource? (1 mark)

Let A, B, C be numbers of Corn, Pumpkins and Beans, respectively
You can buy 500 more A, and buy 210 more C

Report question issue

12e)

1
Marks

What can you infer from the shadow price of corn in this report? (1 mark)

What can you infer from the shadow price of corn in this report? (1 mark)

If you increase one unit of corn, the profit of corn will increase .017

Report question issue

Report question issue Notes

Question 12 Notes

Unsure

Marks

Consider the following distribution problem for Ace Widgets:

	Shipping Costs to Warehouses				Capacity
Depot	W1	W2	W3	W4	
P1	2	6	4	12	100
P2	7	3	10	11	250
P3	5	8	9	13	300
Demand	50	150	200	250	

13a)

3 Marks

Formulate an LP formulation for Ace Widgets including an objective function and constraints. (3 marks)

DC

OF

C

Report question issue

13b)

2 Marks

Solve the problem using the North-West Corner method.

Update the given response template with costs, demand/supply values for any dummy variables if added and present the resulting allocations from the North West Corner method in appropriate cells. You do not need to show any working in the response template. (2 marks)

Source	Destination W1	W2	W3	W4	W5	SUPPLY

P2	7	3	10	11	25
P3	5	8	9	13	30
P4					
DEMAND	50	150	200	250	

Extra template (in case you need it)

1

Source	Destination W1	W2	W3	W4	W5	SUPPLY
P1	2 **50**	6	4	12		5
P2	7	3	10	11		25
P3	5	8	9	13		30
P4						
DEMAND	500	150	200	250		

2

Source	Destination W1	W2	W3	W4	W5	SUPPLY
P1	2 **50**	6 **50**	4	12		
P2	7	3	10	11		25
P3	5	8	9	13		30
P4						
DEMAND	500	150 100	200	250		

3

Source	Destination W1	W2	W3	W4	W5	SUPPLY
P1	2 **50**	6 **50**	4	12		
P2	7	3 **100**	10	11		15
P3	5	8	9	13		30
P4						
DEMAND	500	150 0	200	250		

Source	W1	W2	W3	W4	W5	SUPPLY
P1	2 **50**	6 **50**	4	12		
P2	7	3 **100**	10 **150**	11		
P3	5	8	9 **50**	13		25
P4						
DEMAND	500	150 0	200 0	250		

Source	Destination W1	W2	W3	W4	W5	SUPPLY
P1	2 **50**	6 **50**	4	12		
P2	7	3 **100**	10 **150**	11		
P3	5	8	9 **50**	13 250		
P4						
DEMAND	500	150 0	200 0	0		

Report question issue

13c)

3 Marks

Using the allocation solution generated in (b) apply the MODI method (closed-loop path) to determine the optimized allocation for one iteration only (i.e. stop after forming the first closed loop to find the updated allocations).

Update the given response template with relevant values as appropriate. You do not need to draw the loop. Include (+) and (-) signs in relevant cells to form the loop. (3 marks)

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	K1=	K2=	K3=	K4=	K5=
Source	Destination W1	W2	W3	W4	W5

R2=	P2	7	3	10	11
R3=	P3	5	8	9	13
R4=	P4				
	DEMAND	50	150	200	250

Extra template (in case you need it)

Let P1 = 0

Source	Destination W1 = 2	W2 = 6	W3 = 13	W4 = 17	W5 =	SUPPLY
P1 = 0	2 **50**	6 **50**	4	12		
P2 = -3	7	3 **100**	10 **150**	11		
P3 = -4	5	8	9 **50**	13 **250**		
P4 =						
DEMAND	500	150 0	200 0	0		

It1

Penalty = P

P of P1W3 = 13+0 - 4 = 9

P of P1W4 = 17 + 0 -12 = 5
P of P2W1 = -3 + 2 -7 = -8
P of P1W4 = -3 + 17 - 11 = 3
P of P3W1 = -4+2 -5 = -7
P of P3W3 = -6

Form loop around P1W3 and Let P1 = 0

Source	Destination W1 = 2	W2 = -3	W3 = 4	W4 = 8	W5 =	SUPPLY
P1 = 0	2 **50**	6	4 50	12		
P2 = 6	7	3 **50**	10 **100**	11		
P3 = 5	5	8	9 **50**	13 **250**		
P4 =						
DEMAND	500	150 0	200 0	0		

P of P1W4 = 0+8 -12 = -4

P of P2W1 = 8 - 7 = 1

P of P2W4 = 6+8 -11 = 3

P of P3W1 = 5+2 -5 = 2

P of P3W2 = 5-3 -8 = -6

It3
Form loop around P2W4 and Let P1 = 0

Source	Destination W1 =	W2 =	W3 =	W4 =	W5 =	SUPPLY
P1 = 0	2 **50**	6	4 **50**	12		
P2 =	7	3 **50**	10	11 **100**		
P3 =	5	8	9 **150**	13 1**50**		
P4 =						
DEMAND	500	150 0	200 0	0		

Penalty = P

P of P1W2 = 0-6 = -6

P of P2W1 = 5-7 = -2

P of P2W3 = 7-10 =-3

P of P3W1 = 5+2 -5 = 2

P of P3W2 = 5 -8 = -3

Form loop around P3W1 and Let P1 = 0

Source	Destination W1 = 2	W2 = 0	W3 = 4	W4 = 8	W5 =	SUPPLY
P1 = 0	2	6	4 **100**	12		
P2 = 3	7	3 **50**	10	11 **100**		
P3 = 5	5 **50**	8	9 **100**	13 1**50**		
P4 =						
DEMAND	500	150 0	200 0	0		

P of P1W4 = 8-12 =-4

P of P2W1 = 5 -7= -2

P of P2W3 = 7 -10= -3

P of P3W2 = 5 -8= -3

Optimal is reached

Report question issue

13d)

2 Marks

Is the solution from c) degenerate? How much has the solution from b) improved? (2 marks)

No, because M +N -1 = 6 which is # of allocated cells.

Report question issue

Report question issue Notes

Question 13 Notes

13a

Unsure

Inventory Modelling Formula Sheet

Inventory Models: Deterministic Demand

Economic Order Quantity

Note:
Annual holding cost per item = h
Ordering cost (per order) = k
Item cost = c
Backorder cost (per item) = p
Annual demand = A
Production rate = B

$$\text{Optimal order quantity}: Q^* = \sqrt{\frac{2Ak}{ch}}$$

$$\text{Number of orders per year} = \frac{A}{Q^*}$$

$$\text{Time between orders (cycle time)} = \frac{Q^*}{A} \text{ years}$$

$$\text{Total annual cost} = \text{ordering cost} + \text{holding cost} = \frac{Ak}{Q} + \frac{Qch}{2}$$

Economic Production Quantity

$$\text{Optimal production lot size}: Q^* = \sqrt{\frac{2Ak}{ch}}\sqrt{\frac{B}{B-A}}$$

$$\text{Number of production runs per year} = \frac{A}{Q^*}$$

$$\text{Time between setups (cycle time)} = \frac{Q^*}{A} \text{ years}$$

$$\text{Total annual cost} = \text{setup cost} + \text{holding cost} = \frac{Ak}{Q} + \frac{chQ}{2}\left(\frac{B-A}{B}\right)$$

EOQ with back orders

$$\text{Optimal order quantity, } Q^* = \sqrt{\frac{2Ak}{ch}\left(\frac{p+ch}{p}\right)}$$

$$\text{Quantity at the beginning of each cycle, } S^* = \sqrt{\frac{2Ak}{ch}\left(\frac{p}{p+ch}\right)}$$

$$\text{Maximum number of backorders} = Q^* - S^*$$

$$\text{Number of orders per year} = \frac{A}{Q^*}$$

$$\text{Time between orders (cycle time)} = \frac{Q^*}{A} \text{ years}$$

$$\text{Total annual cost} = \text{setup} + \text{holding} + \text{backorder}$$

$$= \frac{Ak}{Q} + \frac{chS^2}{2Q} + \frac{p(Q-S)^2}{2Q}$$

Formula for total cost using Quantity discounts.

$$\text{Total annual cost} = \text{purchase cost} + \text{holding cost} + \text{item cost}$$

$$= \frac{Ak}{Q} + \frac{chQ}{2} + Ac$$

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Marks

A baseball card dealer must determine how many 1955 reproduced Willie Mays cards to stock. He experiences an annual demand of 100 cards. Each card is acquired from a big dealer for $2. Each shipment must be sent by registered mail at a cost of $4 regardless of quantity. Inventory is financed through a 16% bank loan.Suppose a shortage penalty applies in the amount of $0.04 per card short (on an annual basis).

14a)

3 Marks

What is the economic order quantity? (3 marks)

A = 100

k = 4

C = 2

h = .16

backorder cost = .04

Q* = SQRT(2500 * (P + CH / P))

= SQRT(2500 * (P + .32 / P))

= SQRT(800)

Report question issue

14b)

2 Marks

What is the optimal order level? (2 marks)

S = SQRT(2500 * P / (P + CH))

= SQRT(2500 * 1/9)

= SQRT(2500/9)

Report question issue

14c)

1 Marks

If the optimal policy is used, determine the number of cards on backorder when a shipment arrives. (1 mark)

Q * - S

=SQRT(800) -SQRT(2500/9)

Report question issue

Report question issue Notes

Question 14 Notes

Unsure

Information

Inventory Models: Stochastic Demand

Inventory models under random demand, assumed to be normally distributed with mean μ and standard deviation σ.

Single Period Order Quantity	Reorder Point Model
$P(demand < Q^*) = \frac{C_u}{C_u + C_v}$, $Q^* = \mu + z\sigma$ Cost of overestimating demand: $C_v = h_E + c$ Cost of underestimating demand: $C_u = P_S + P_R - c$ Where: Unit cost = c Penalty for item held at end of inventory cycle = h_E Penalty for each item short (goodwill, etc.) = P_S Selling Price = P_R	Reorder Point : $r = \mu + z\sigma$ Average Inventory : $\frac{Q}{2} + z\sigma$ Total Annual Cost : $\left(\frac{Q}{2} + z\sigma\right)ch + \frac{Ak}{Q}$

Unsure

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Marks

The demand for Halloween pumpkins at the Black Cat's Patch is normally distributed with a mean of 1,000 and a standard deviation of 200. Each pumpkin costs $0.50 and sells for $0.90. Unsold pumpkins are disposed of at a cost of $0.10 each.

15a)

3 Marks

How many pumpkins should be ordered? (3 marks)

C = .5

P_r = .9

h_e = .1

P_s = 0 (assumed there is no good will)

Let D = C_u and C = C_v

P(demand < Q) = .4

Z = 1.28

m = 1000, sd = 200

1000+200(1.28) = 1256.3

Report question issue

15b)

1 Marks

For the quantity in a), determine the probability that there will be a shortage? (1 mark)

P(demand > Q) = 1 - .4 = 0.6

Report question issue

Report question issue Notes

Question 15 Notes

Unsure

Decision Analysis Formula Sheet

Expected Value of a Project

If a decision has a number of outcomes, i, each having a payoff x_i, with probability $p(x_i)$ then the expected value of the decision is given by $\sum_i x_i p(x_i)$

Bayes' Theorem

To find the posterior probability that event A_i will occur given that event B has occurred

$$P(A_i|B) = \frac{P(A_i \cap B)}{P(B)} = \frac{P(A_i)P(B|A_i)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2) + \ldots + P(A_n)P(B|A_n)}$$

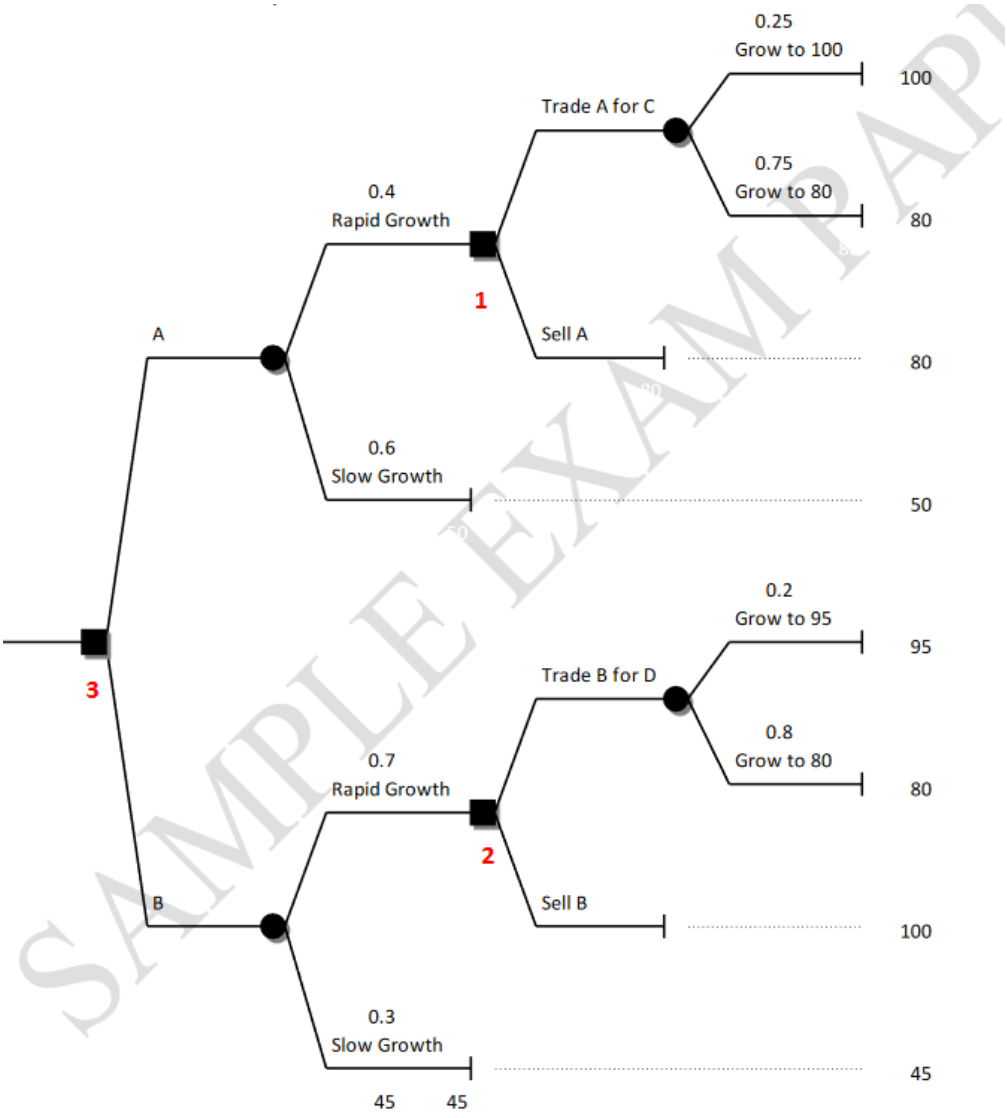
Tabular form for calculations

States of Nature	Prior Probabilities	Conditional Probabilities	Joint Probabilities	Posterior Probabilities
A1	$P(A_1)$	$P(B \mid A_1)$	$P(B \cap A_1)$	$P(A_1 \mid B)$
A2	$P(A_2)$	$P(B \mid A_2)$	$P(B \cap A_2)$	$P(A_2 \mid B)$
			$P(B)$	

Unsure

Marks

An investor is considering 2 investments, A, B, which can be purchased now for $10. There is a 40%chance that investment A will grow rapidly in value and a 60% chance that it will grow slowly. If A grows rapidly, the investor can cash it in for $80 or trade it for investment C, which has a 25% chance of growing to $100 and a 75% chance of reaching $80. If A grows slowly, it is sold for $50. There is a 70%chance that investment B will grow rapidly in value and a 30% chance that it will grow slowly. If B grows rapidly, the investor can cash it in for $100 or trade it for investment D, which has a 20% chance of growing to $95 and an 80% chance of reaching $80. If B grows slowly, it is sold for $45. A decision tree for the problem can be constructed as below.



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16a)

2 Marks

Using backward induction and the expected monetary value (EMV) approach, what is the EMV at decision nodes 1 and 2 (indicated in red in the given diagram). (2 marks)

EMV for node 1 = 85

EMV for node 1 = 100

Report question issue

16b)

3 Marks

Evaluate the complete decision tree using the Expected Monetary Value (EMV) criteria and advice on the course of action. What is the EMV at decision node 3 as indicated in red in the diagram? (3 marks)

EMV for node A = 85 *.4 + 50 *.6 = 64

EMV for node B = 70 + 45*.3 = 83.5

Since EMV for node B (83.5) is higher, so one should choose node B.

So, EMV at decision node 3 is 83.5

Report question issue

Report question issue Notes

Question 16 Notes

Unsure

Marks

Eagle Credit Union (ECU) has experienced a 10% default rate with its commercial loan customers (i.e.90% of commercial loan customers pay back their loans). ECU has developed a statistical test to assist in predicting which commercial loan customers will default. The test assigns either a rating of 'Approve' or 'Reject' to each loan applicant. When applied to recent loan commercial customers who paid their loans,the test gave an 'Approve' rating in 80% of the cases examined. When applied to recent loan commercial customers who defaulted, it gave a 'Reject' rating in 70% of the cases examined.

17a)

1 Marks

Fill in the joint probability table below (1 mark)

P(approved |Paid back) = .8

P(approved | default) = .2

P(Rj|Paid back) = .3

P(Rj|default) = .7

P(default) = 10%

P(Paid back) = 90%

	Joint Probabilities		
	Pay	Default	Total
Approve	.8*.9 = .72	.2*.1=.02	.74
Reject	.3*.9 =.27	.7*.1=.07	.34
Total	.99	.09	

Report question issue

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17b)

1 Marks

What is the conditional probability of a 'Reject' rating given that the customer defaulted? (1 mark)

Report question issue

17c)

1 Marks

What is the conditional probability of an 'Approve' rating given that the customer defaulted? (1 mark)

.2

Report question issue

17d)

2 Marks

Suppose a new customer receives a 'Reject' rating. If that customer gets the loan anyway, what is the probability of default? (2 marks)

posterior

Report question issue

Report question issue Notes

Question 17 Notes

Unsure

Queuing Theory and Simulation Formula Sheet

Queuing, Probability and Simulation

Service and waiting times for a single server queue, Poisson arrivals, Exponential service:

λ = the average number of arrivals per time period (arrival rate)

$\frac{1}{\lambda}$ = the average time between arrivals

μ = the average number of services per time period (service rate)

$\frac{1}{\mu}$ = the average time taken for each service

$P_0 = 1 - \frac{\lambda}{\mu}$ the probability that no units are in the system

$L_q = \frac{\lambda^2}{\mu(\mu - \lambda)}$ the average number of units in the waiting line

$L = L_q + \frac{\lambda}{\mu}$ the average number of units in the system

$W_q = \frac{L_q}{\lambda}$ the average time a unit spends in the waiting line

$W = W_q + \frac{1}{\mu}$ the average time a unit spends in the system

$P_w = \frac{\lambda}{\mu}$ the probability that an arriving unit has to wait for service

$P_n = \left(\frac{\lambda}{\mu}\right)^n P_0$ the probability of n units in the system

Probability distributions:

The Poisson distribution

$f(x) = \frac{\theta^x e^{-\theta}}{x!}$ for a distribution having mean $\theta, (e = 2.71828...)$

The exponential distribution

$f(x) = \frac{1}{\theta} e^{-x/\theta}$ for a distribution having mean $\theta, (e = 2.71828...)$

$P(x \le x_0) = 1 - e^{-x_0/\theta}$

$P(x \ge x_0) = e^{-x_0/\theta}$ for a given value of x_0

Generation of Exponentially distributed random variables

Exponential variates with mean b are generated from uniform [0,1] random numbers, r_n, by the transformation $t_n = -b \log_e(r_n)$.

Marks

The customer service desk at Joe's Discount Electronics store receives 5 customers per hour on average. On average, each customer requires 10 minutes for service. The customer service desk is staffed by a single clerk.

18a)

1 Marks

Determine the Arrival rate and the Service rate. (1 mark)

The customer service desk at Joe's Discount Electronics store receives 5 customers per hour on average. On average, each customer requires 10 minutes for service. The customer service desk is staffed by a single clerk.

lambda = 5

mu = 10

Report question issue

18b)

1 Marks

What is the average time a customer spends in the customer service area? (1 mark)

Lq = .5

L = 1

Wq = .1

W = .2

So, the average time a customer spends in the customer service area is W which is .2*60 = 12 mins

Report question issue

18c)

1 Marks

What is the probability that the customer service clerk takes more than 10minutes? (1 mark)

P(service > 10mins) = .5

Report question issue

18d)

1 Marks

What is the average number of customers in the queue? (1 mark)

Lq = .5

L = 1

Wq = .1

W = .2

So, the average number of customers in the queue is Lq , which is .5

Report question issue

18e)

2 Marks

What is the probability that there are less than 5 customers arriving in an hour? (2 marks)

P (less than 5 customers arriving in an hour) = 0.5

Report question issue

Report question issue Notes

Question 18 Notes

18e

Unsure

Marks

Simulate the arrival of patients at a clinic using the uniform random number given in the table. The mean inter-arrival time is two minutes. Using the formula $t_n = -b \log_e(r_n)$, calculate the arrival time for 5 customers in answering the questions below. *b* is the mean inter-arrival time.

19a)

3 Marks

If service time is a constant at five minutes, complete the table below:

Customer	Random Number	Interarrival Time	Arrival Time	Service Starts	Service Ends	Number of patient in the clinic
1	0.42					
2	0.96					
3	0.37					
4	0.52					
5	0.23					

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Customer	Random Number	Inter-arrival Time	Arrival Time	Service Starts	Service Ends	Number of Patients in the Clinic
1	0.42					
2	0.96					
3	0.37					
4	0.52					
5	0.23					

Report question issue

19b)

1 Marks

Calculate the average number of patients in the clinic. (1 mark)

Report question issue

Report question issue Notes

Question 19 Notes

Information

Forecasting Formula Sheet

Least Squares Regression

For bivariate data consisting of n pairs of observations (x, y), the Least Squares Line of Best Fit is $y = mx + c$,
where $m = \dfrac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$ and $c = \bar{y} - m\bar{x}$.

Simple exponential smoothing

$\hat{y}_{t+1} = \hat{y}_t + \alpha(y_t - \hat{y}_t)$,
where : $\hat{y}_t$: forecast value, y_t : observed value, α : smoothing factor, t : period (time) index

Mean Squared Error

$$MSE = \frac{\sum_{i=1}^{n}(Y_i - F_i)^2}{n}$$

Mean Absolute Percent Error

$$MAPE = \frac{\sum_{i=1}^{n}\frac{|F_i - Y_i|}{Y_i}}{n}$$

Y_i are the actual (observed) values
F_i are the fitted (forecast) values
n is the number of forecast values

Unsure

Marks

The following is a set of quarterly sales data recorded over a period of 3 years.The deseasonalised sales data has also been worked out for you:

Period	Actual Sales	Seasonally adjusted
1	5	6.16
2	6	6.53
3	8	6.36
4	7	6.92
5	6.2	7.63
6	6.5	7.07
7	11	8.75
8	9	8.90
9	7.4	9.11
10	10	10.88
11	12	9.54
12	10.3	10.19

20a)

4 Marks

Fit a least square regression line for the above data. (4 marks)

sigma xy= 834.562

sigma x= 98.4

sigma y= 98.04

sigma x^2 = 861.54

r = 0.7813

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20b)

2 Marks

20 of 20

Assume the following seasonal indexes. (2 marks)

Quarter	Index
1	81.22%
2	91.89%
3	125.76%
4	101.13%

P1 = 9.11/81.22%=11.216

P2 = 10.88/91.89%=11.840

P3 = 9.54/125.76%=7.859

P4 = 10.19/101.13%=10.076

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20c)

2 Marks

Considering the following coefficients generated from regression summary statistics, forecast the sales for the next 4 quarters in the next year (Period 13, 14, 15 and 16) using the additive model. (2 marks)

Coefficients:

Intercept	Period	1	2	3	4
5.34	0.43	-1.28	-0.41	1.99	0

y = .43 x + 5.34

P1 = .43 (-1.28) + 5.34= 4.7896

P2 = .43 (-.41) + 5.34= 5.1637

P3 = .43 (1.99) + 5.34= 6.1957

P4 = .43 (0) + 5.34= 5.34

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20d)

2 Marks

If sales in 2018 the next year turn out to be Quarter 1: 8.5, Quarter 2: 10, Quarter 3: 15 and Quarter 4: 12, calculate the MAPE of the forecast in b) and c) and comment which model should be used. (2 marks)

Find APE of Forecast in b)

All values are absolute:

APE of P1 = 9.11-11.216 = 2.106

APE of P4 = 10.19-10.076 = 0.114

So, MAPE in forecast b is 1.21525

Find APE of Forecast in c)

All values are absolute:

APE of P1 = 9.11-4.7896 = 4.3204
APE of P2 = 10.88-5.1637 = 5.7163

APE of P3 = 9.54-6.1957 = 3.3443

APE of P4 = 10.19-5.34 = 4.85

So, MAPE in forecast c is 4.55775

Since value (MAPE in forecast c) > value (MAPE in forecast b)

that means MAPE in forecast c has higer error

we prefer MAPE in forecast b

Report question issue

Report question issue Notes

Question 20 Notes

Unsure

Normal Distribution Table

Cumulative Probabilities for the Standard Normal Distribution

Table gives P(Z<z) for Z = N(0,1)

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

☐ Unsure