B. TECH.

(SEM. VIII) EXAMINATION, 2006-07

OPERATIONS RESEARCH

Time : 3 Hours] [Total Marks : 100

Note : Answer the followings five questions, choices are within. Marks are indicate therein.

1 Answer any two :

(a) A factory produces two products A and B in three factories 1, 2 and 3. In plant 1 a maximum of 4 hrs. is used for producing 1 batch of A where each batch is produced in 1 hour. In plant 2, only B is produced and each batch takes 2 hours. A maximum of 12 hours is available. Plant 3 produces both A and B and each batch requires 3 and 2 hours respectively. A maximum of 18 hours can be used there.

The profit generated by A and B in the market is 3 and 5 (in thousand rupees) respectively.

Use simplex method to find out how much the factory should produce of each A and B to maximize profit.
(b) Minimise $z = 4x_1 + 12x_2 + 13y_3$
Subject to
\[x_1 + 3x_3 \geq 3\]
\[2x_2 + 2x_3 \geq 5\]
\[x_1, x_2, x_3 \geq 0.\]

Write down the primal of this problem.

What is the benefit of using a dual of a primal? What can you say about the optimum feasible solution given by the dual problem with respect to the primal?

(c) In the optimum solution if the co-efficient of any of the slack variable is 0, what does that signify?
A problem has the following constraints:
\[2x_1 + 3x_2 + \leq 24\]
\[3x_1 + 5x_2 + \leq 32\]

Later it is found out that, the right-hand side values are actually 28 and 26. Is it necessary to solve the problem from scratch? Explain how the problem can be addressed?

2 Answer any one of the following:

(a) What is the difference between a transportation and assignment problem? What are the methods used for finding the initial feasible solutions for a transportation problem? Explain each method. Use Vegel’s approximation to find the initial feasible solution of the following problem.
(b) Solve the following dynamic programming problem:
A research institute finds out that having experts in factories increase the life of three components in the following manner:

<table>
<thead>
<tr>
<th>Experts</th>
<th>Increase in life in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Products</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>105</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
</tr>
</tbody>
</table>

Total no. of available experts = 5

Use dynamic programming to find out which allocation maximizes the increase in life of the products.
3 Answer any two:

(a) In the following two-person zero sum game the payoff table for player 1 is given:

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Player 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Player 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Is any of the strategies dominated by any other? If so, reduce the table. Does the game have a stable solution? Show with help of minimax and maximin values. Use mixed strategies and formulate the problem as a linear programming problem.

(b) Construct a decision tree and decide the correct course of action for the following problem:

A company has acquired some land and is trying to decide whether to drill or not. It has found out the payoff table.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oil</td>
</tr>
<tr>
<td>Drill for oil</td>
<td>Rs.7 crore</td>
</tr>
<tr>
<td>Sell the land</td>
<td>0.9 crore</td>
</tr>
<tr>
<td>Chance</td>
<td>0.25</td>
</tr>
</tbody>
</table>

[Contd...]
The cost of drilling is Rs. 1 crore.

It is thinking of further experimentation to have a better idea of the estimates of probability. The cost of such a seismic survey is 0.3 crore.

It can give only 2 outcomes viz. oil is unlikely, or unfavourable survey (us) and oil is likely or favourable survey (fs). Experience shows that:

- \( P(US/state=oil) = 0.4 \) and \( P(fs/state=oil) = 0.6 \)
- \( P(US/state=dry) = 0.8 \) and \( P(fs/state=dry) = 0.2 \)

(c) Write brief notes: (any five) \( 2 \times 5 = 10 \)

(i) Maximax for decision making under uncertainty
(ii) Maximin for decision making under uncertainty
(iii) Equal likelihood criterion
(iv) Criterion of Realism
(v) Minimax Regret
(vi) Maximum likelihood criterion
(vii) Expected value of perfect information
(viii) Opportunity loss

4 Answer any two:
(a) Write short notes on: \( 1 \times 4 + 6 = 10 \)

(i) Ordering cost
(ii) Holding cost
(iii) Inventory carrying cost
(iv) Order quantity

[Contd...]
Use the above to derive the Economic Order Quantity for a demand ‘D’

(b) Define and explain:

(i) Reorder point
(ii) Order quantity
(iii) Safety stock
(iv) Stochastic single period model
(v) Stochastic multi-period model with setup cost.

(c) Justify whether the following are true or false:

(counter examples would be co-efficient)

(i) A company has the following demand:

<table>
<thead>
<tr>
<th>Period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>25</td>
<td>15</td>
<td>25</td>
<td>6</td>
<td>25</td>
<td>14</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

The inventory carrying cost is Re.1/unit/period
The setup cost is Rs.100
The cost of production = Rs.4/unit
The capacity of production = 40/period

The company has come up with the following production plan because it is optimal:

<table>
<thead>
<tr>
<th>Period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>40</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>39</td>
<td>0</td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>

(ii) The total yearly demand for a particular component in a machine is 1000. The set up cost is Rs.100. The ordering cost is Rs.20/order. The cost per unit is Rs.2 and the inventory holding cost is Re.1/unit/month. The company thinks it should place two orders (at the beginning of the
year and at the beginning of the seventh
month) of 500 each. That they think
would be the optimal scheme.

5 Answer any two:
(a) In a bank there is only one counter. \[ 2 \times 5 = 10 \]
The arrival of customers follow a poisson
process and service times follow an exponential
process. The mean of the poisson process is 2
and that of the exponential process is 3. Find
(i) the probability of exactly 5 customers in
the system
(ii) Expected number of customers in the
system
(iii) The expected queue length
(iv) The expected waiting time in the system.
(v) The expected waiting time in the queue.

(b) What is meant by a M/M/S model? \[ 2 + 2 + 1 + 5 = 10 \]
What happens in a M/M/1 model when the
mean arrival rate exceeds the mean service rate?
What happens when they are equal? Derive
the expression for the expected no. of customers
in the system for the M/M/1 model (Assume
the expression for the probability of ‘n’
customers in the system for n=0,1,2…..)

(c) Explain the Monte Carlo simulation \[ 4 + 4 + 2 = 10 \]
technique with respect to random sampling and
stratified sampling approaches. Define random
number generator.

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