TOTAL PAGES: 4
22CBA208N/ 22CBA208

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BCom DEGREE EXAMINATION MAY 2024
(Second Semester)

Branch – **COMMERCE (BUSINESS ANALYTICS)**

OPTIMIZATION TECHNIQUES FOR BUSINESS ANALYTICS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	A constraint in an LPP restricts __________. a) value of an objective function b) value of an decision variable c) use of available resource d) uncertainty of optimum value	K1	CO1
	2	Graphical method can be applied to solve LPPs with _______ decision variables. a) One b) two c) three d) any number of	K2	CO1
2	3	The solution to a transportation problem with m-sources and n-destinations is feasible, if the number of allocations are _____. a)$m+n-1$ b) $m+m+1$ c)$m+n$ d)$m \times n$	K1	CO2
	4	An assignment problem can be a) designed and solved as a transportation problem b) of maximization type c) solved only if number of rows equals the number of columns d) all of the above	K2	CO2
3	5	The pay-off value for which each player in a game always selects the same strategy is called _______. a) equilibrium point b) saddle point c) both (a) and (b) d) none of the above	K1	CO3
	6	The size of the pay-off matrix of a game can be reduced by using the principle of a) dominance b) rotation reduction c) game inversion d) game transpose	K2	CO3
4	7	In critical path analysis, CPM is a) event oriented b) probabilistic in nature c) deterministic in nature d) dynamic in nature	K1	CO4
	8	$L_i - E_i$ is _________ float. a) event b) free c) total d) independent	K2	CO4
5	9	A sequencing problem involving six jobs and three machines requires evaluation of ______ sequences. a) $(6!+6!+6!)$ b) $(6!)^3$ c)$(6 \times 6 \times 6)$ d) $(6+6+6)$	K1	CO5
	10	The time for which a machine does not have a job to process is _________ time. a) processing b) elapsed c) total elapsed d) idle	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

<table>
<tr><th>Module No.</th><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td rowspan="3">1</td><td>11.a.</td><td>The manager of an oil refinery has to decide upon the optimal mix of two possible blending processes, of which the input and output per production runs are as follows
<table>
<tr><th rowspan="2">Process</th><th colspan="2">Input</th><th colspan="2">Output</th></tr>
<tr><th>Crude A</th><th>Crude B</th><th>Gasoline X</th><th>Gasoline Y</th></tr>
<tr><td>1</td><td>6</td><td>4</td><td>6</td><td>9</td></tr>
<tr><td>2</td><td>5</td><td>6</td><td>5</td><td>5</td></tr>
</table>
The maximum amount available of crude A and B are 200 units and 150 units respectively. Market requirements show that at least 100 units of gasoline X and 80 units of gasoline Y must be produced. The profits per production run from process 1 and process 2 are Rs.3 and Rs.4 respectively. Formulate the problem as a linear programming problem.</td><td rowspan="3">K3</td><td rowspan="3">CO1</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>11.b.</td><td>Rewrite the following LPP in standard form
Minimize $z = 2x_1 + x_2 + 4x_3$
Subject to constraints
$-2x_1 + 4x_2 \leq 4$
$x_1 + 2x_2 + x_3 \geq 5$
$2x_1 + 3x_3 \leq 2$
$x_1, x_2 \geq 0$ and x_3 unrestricted in sign.</td></tr>
<tr><td rowspan="3">2</td><td>12.a.</td><td>Apply matrix minima method to obtain an initial basic feasible solution for the following T.P.
<table>
<tr><th></th><th>D_1</th><th>D_2</th><th>D_3</th><th>D_4</th><th>Capacity</th></tr>
<tr><td>O_1</td><td>1</td><td>2</td><td>3</td><td>4</td><td>6</td></tr>
<tr><td>O_2</td><td>4</td><td>3</td><td>2</td><td>0</td><td>8</td></tr>
<tr><td>O_3</td><td>0</td><td>2</td><td>2</td><td>1</td><td>10</td></tr>
<tr><td>Demand</td><td>4</td><td>6</td><td>8</td><td>6</td><td></td></tr>
</table></td><td rowspan="3">K5</td><td rowspan="3">CO2</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>12.b.</td><td>A departmental head has four subordinates and four tasks to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulty. His estimate of the time each man would take to perform each task is given in the matrix below
<table>
<tr><th rowspan="2">Task</th><th colspan="4">Men</th></tr>
<tr><th>E</th><th>F</th><th>G</th><th>H</th></tr>
<tr><td>A</td><td>18</td><td>26</td><td>17</td><td>11</td></tr>
<tr><td>B</td><td>13</td><td>28</td><td>14</td><td>26</td></tr>
<tr><td>C</td><td>38</td><td>19</td><td>18</td><td>15</td></tr>
<tr><td>D</td><td>19</td><td>26</td><td>24</td><td>10</td></tr>
</table>
How the tasks should be allocated one to a man, so as to minimize the total man-hour.</td></tr>
<tr><td rowspan="3"></td><td>13.a.</td><td>Determine the range of value of p and q that will make the payoff element a_{22}, a saddle point for the game whose payoff matrix is
$$\begin{array}{cc} & \textit{Player B} \\ \textit{Player A} & \begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{array}$$</td><td rowspan="3">K4</td><td rowspan="3">CO3</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>13.b.</td><td>Consider a modified form of matching biased coins game problem. The matching player is paid Rs.8 if the two coins turn both heads and Rs.1 if the coin turns both tails. The non-matching player is paid Rs.3 when the two coins do not match. Given the choice of being the matching or non-matching player, which one would you choose and what would be your strategy?</td></tr>
</table>

<table>
<tr><td rowspan="3">4</td><td>14.a.</td><td>Construct the network diagram comprising activities B,C,….Q and N such that the following constraints are satisfied
B < E; C< G, L; E,G < H; H < I; L < M;
H < N; H < J; I,J< P; P < Q.</td><td rowspan="3">K5</td><td rowspan="3">CO4</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>14.b.</td><td>A project consist of a series of tasks labeled A,B,   H,I with the following relationships (W < X,Y means X and Y cannot start until W is completed; X,Y < W means W cannot start until both X and Y are completed). Construct the network diagram having the following constraints.
$A < D,E; B,D < F; C < G; B,G < H; F,G < I$
Find the minimum time of completion of the project, when the time of completion of each task is as follows
<table>
<tr><td>Task</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td></tr>
<tr><td>Time</td><td>23</td><td>8</td><td>20</td><td>16</td><td>24</td><td>18</td><td>19</td><td>4</td><td>10</td></tr>
</table></td></tr>
<tr><td rowspan="3">5</td><td>15.a.</td><td>Describe optimum sequence algorithm for processing n jobs through two machines.</td><td rowspan="3">K4</td><td rowspan="3">CO5</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>15.b.</td><td>Solve the following sequencing problem when passing out is not allowed
<table>
<tr><td rowspan="2">Item</td><td colspan="4">Machine processing time</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><td>I</td><td>15</td><td>5</td><td>4</td><td>15</td></tr>
<tr><td>II</td><td>12</td><td>2</td><td>10</td><td>12</td></tr>
<tr><td>III</td><td>16</td><td>3</td><td>5</td><td>16</td></tr>
<tr><td>IV</td><td>17</td><td>3</td><td>4</td><td>17</td></tr>
</table></td></tr>
</table>

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

<table>
<tr><th>Module No.</th><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td>1</td><td>16</td><td>Apply graphical method to solve LPP
maximize
$z = 2x_1 + 3x_2$
Subject to constraints
$x_1 + x_2 \leq 30$
$x_1 - x_2 \geq 0$
$x_2 \geq 3$
$0 \leq x_1 \leq 20$ and $0 \leq x_2 \leq 12$</td><td>K5</td><td>CO1</td></tr>
<tr><td>2</td><td>17</td><td>Apply Vogel's approximation method to obtain an initial basic feasible solution of the Transportation problem
<table>
<tr><td></td><td>D</td><td>E</td><td>F</td><td>G</td><td>Available</td></tr>
<tr><td>A</td><td>11</td><td>13</td><td>17</td><td>14</td><td>250</td></tr>
<tr><td>B</td><td>16</td><td>18</td><td>14</td><td>10</td><td>300</td></tr>
<tr><td>C</td><td>21</td><td>24</td><td>13</td><td>10</td><td>400</td></tr>
<tr><td>Demand</td><td>200</td><td>225</td><td>275</td><td>250</td><td></td></tr>
</table></td><td>K5</td><td>CO2</td></tr>
<tr><td>3</td><td>18</td><td>Solve the game graphically
$$\begin{array}{cc|cccc} & & & \text{Player } B & & \\ & & B_1 & B_2 & B_3 & B_4 \\ \text{Player } A & A_1 & 2 & 1 & 0 & -2 \\ & A_2 & 1 & 0 & 3 & 2 \end{array}$$</td><td>K5</td><td>CO3</td></tr>
</table>

<table>
<tr>
<td>4</td>
<td>19</td>
<td>
A small project is composed of seven activities whose time estimates are listed in the table as follows
<table>
<tr><th colspan="2">Activity</th><th colspan="3">Estimated duration</th></tr>
<tr><th>i</th><th>j</th><th>Optimistic</th><th>Most likely</th><th>Pessimistic</th></tr>
<tr><td>1</td><td>2</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td>1</td><td>3</td><td>1</td><td>4</td><td>7</td></tr>
<tr><td>1</td><td>4</td><td>2</td><td>2</td><td>8</td></tr>
<tr><td>2</td><td>5</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>3</td><td>5</td><td>2</td><td>5</td><td>14</td></tr>
<tr><td>4</td><td>6</td><td>2</td><td>5</td><td>8</td></tr>
<tr><td>5</td><td>6</td><td>3</td><td>6</td><td>15</td></tr>
</table>
a) Draw the project network
b) Find the expected duration and variance of each activity. What is the expected project length?
c) Calculate the variance and standard deviation of project length. What is the probability that the project will be completed
i) At least 4 weeks earlier than expected
ii) No more than 4 weeks later than expected
d) If the project due date is 19 weeks, identify the probability of finding the due date.
Given
<table>
<tr><td>Z</td><td>0.5</td><td>0.67</td><td>1.00</td><td>1.33</td><td>2.00</td></tr>
<tr><td>p</td><td>0.3085</td><td>0.2514</td><td>0.1587</td><td>0.0918</td><td>0.0228</td></tr>
</table>
</td>
<td>K6</td>
<td>CO4</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>
A book binder has a printing press, one binding machine and the manuscripts of a number of different books. The time required to perform the printing and binding operations for each book is shown below. Determine the order in which books should be processed in order to minimize the total time required to turn out all the books
<table>
<tr><td>Book</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Printing time (hrs)</td><td>30</td><td>120</td><td>50</td><td>20</td><td>90</td><td>100</td></tr>
<tr><td>Binding time (hrs)</td><td>80</td><td>100</td><td>90</td><td>60</td><td>30</td><td>10</td></tr>
</table>
</td>
<td>K5</td>
<td>CO5</td>
</tr>
</table>

Z-Z-Z END