64

RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.SC (General) Degree

Third Year – Semester I Examination – October / November 2014

MAT 3301 - Advanced Linear Programming

Time allowed: **Three** hours.   Number of pages: 05

Answer **ALL** Questions.   Calculators will be provided.

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1. (a) State the methods for finding an Initial Basic Feasible Solution of a transportation problem.

[15 Marks]

(b) Consider the following transportation table for a minimization problem:

	Warehouse				Supply
Factory	3	4	3	3	60
	6	5	9	4	70
	3	2	1	2	90
Demand	100	60	40	20	

(i) An Initial Basic Feasible Solution for the above transportation problem is given as $\{x_{11}, x_{13}, x_{21}, x_{24}, x_{32}, x_{33}\}$. Find the values of the basic variables. **[25 Marks]**

(ii) Prove that this solution is not optimal. **[10 Marks]**

(iii) Find the optimal solution using the MODI method, starting from the basic feasible solution given in part (i). **[50 Marks]**

2. (a) How do you deal with the unbalanced assignment problems where the objective function is of maximization type? **[10 Marks]**

(b) **The Bride-Groom Problem:** A marriage broker has four female clients and five male clients who desire to be married. She ranks possible matching between bride and groom from among her clients on a scale of zero to ten- Zero for the poorest match and ten for the best match. Her rankings are given in the following table:

Groom

		Adithya	Vinod	Sachi	Santhush	Suraj
	Vihara	7	4	7	3	10
Bride	Kawmini	5	9	3	8	7
	Swapna	3	5	6	2	9
	Waruni	6	5	0	4	8

How should she match her clients in order to maximize the sum of the rankings of the matches?

[90 marks]

3. (a) Define the following terms:

(i). Deviational Variable, **[05 Marks]**

(ii). Pre-emptive Goal Programming . **[05 Marks]**

(b) The Dewright Company is one of the largest producers of power tools in the United States. The company intends to replace its current production line with the next generation of products with three new power tools. Management of the company needs to determine the mix of the three new products of the company to best meet the following three goals:

Goal 1: Achieve a total profit (net present value) of at least $125 million.

Goal 2: Maintain the current employment level of 4,000 employees.

Goal 3: Hold the capital investment down to no more than $55 million.

The penalties for missing each goal and the data for contributions to the goals are given in

Table.01 and Table 02 respectively:

Goal	Factor	Penalty weight for missing goal
1	Total profit	5 (per $1 million under the goal)
2	Employment level	4(per 100 employees under the goal) 2 (per 100 employees over the goal)
3	Capital Investment	3 (per $1 million over the goal)

Table 01: Penalty for missing each goal

Factor	Unit contribution of product		
	Type 1	Type 2	Type 3
profit (millions of Dollars)	12	9	15
Employment level (hundreds of employees)	5	3	4
Capital investment (millions of Dollars)	5	7	8

Table 02: Data for contribution to the goals

(i). Define the decision variables to reach the above objectives. **[10 Marks]**

(ii). Write each goal using the decision variables. **[15 Marks]**

(iii). Add deviational variables to the goal constraints. [15 Marks]

(iv). Formulate the linear goal programming model to solve the above problem.

[15 Marks]

(v). Solve the model using Goal Programming Simplex Method. [35 Marks]

04. State the steps of Dantzig-Wolfe Decomposition Algorithm . [30 Marks]

Consider the following Linear Programming Problem:

Minimize $Z = -x_1 - 2x_2 - 4x_3 - 3x_4$
Subject to
$x_1 + x_2 + 2x_3 \leq 4$
$x_2 + x_3 + x_4 \leq 3$
$2x_1 + x_2 \leq 4$
$x_1 + x_2 \leq 2$
$x_3 + x_4 \leq 2$
$3x_3 + 2x_4 \leq 5$
$x_i \geq 0$ for $i = 1, 2, 3, 4$.

Solve the above problem using Dantzig- Wolfe Decomposition Algorithm. [70 Marks]

5. The following table shows all the necessary information on the available supply to each warehouse, the requirement of each market and the unit transportation cost in thousands of rupees from each warehouse to each market:

Market

		1	2	3	4	supply
Warehouse	A	5	2	4	3	22
	B	4	8	1	6	15
	C	4	6	7	5	8
	Requirement	7	12	17	9	

The shipping clerk has worked out the following scheduled from past experience:

12 units from A to 2 , 1 unit from A to 3, 9 units from A to 4, 15 units from B to 3 , 7 units from C to 1 and from C to 3.

(i). Check whether the clerk has made the optimal schedule.   **[20 Marks]**

(ii). Find the optimal schedule and the minimum total shipping cost.   **[60 Marks]**

(iii). If the clerk is approached, by how much the rate should be reduced before the clerk should consider giving him an order?   **[20 Marks]**