RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES, MIHINTALE

B.Sc. (General) Degree

Third Year – Semester I Examination – March/ April 2014

MAT 3301 Advanced Linear Programming

Time allowed: Three hours. **Calculators will be provided.**

Answer ALL Questions.

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1. (a) State three methods of finding initial basic feasible solution for transportation problem . **[15 Marks]**

(b) Consider the following linear transportation model:

Minimize $z = 17x_{11} + 10x_{12} + 15x_{13} + 11x_{21} + 14x_{22} + 10x_{23} + 9x_{31} + 13x_{32} + 11x_{33} + 19x_{41} + 8x_{42} + 12x_{43}$

subject to

$$x_{11} + x_{12} + x_{13} = 120$$
$$x_{21} + x_{22} + x_{23} = 70$$
$$x_{31} + x_{32} + x_{33} = 180$$
$$x_{41} + x_{42} + x_{43} = 30$$
$$x_{11} + x_{21} + x_{31} + x_{41} = 200$$
$$x_{12} + x_{22} + x_{32} + x_{42} = 120$$
$$x_{13} + x_{23} + x_{33} + x_{43} = 80$$
$$x_{ij} \geq 0 \text{ for all } i \text{ and } j,$$

where x_{ij} = number of units shipped from i th factory to j th warehouse.

(i). Define the ranges of values for i and j. **[05 Marks]**

(ii). Using the above model, formulate the transportation matrix. **[10 Marks]**

(iii). Find the initial basic feasible solution using Vogel's approximation method. **[20 Marks]**

(iv). Test for optimality and find the optimal solution. **[50 Marks]**

Turn Over

2. (a) What is an unbalanced assignment problem? **[05 Marks]**

(b) How would you deal with the assignment problems, where

(i) the objective function is to be maximized? **[05 Marks]**

(ii) some assignments are prohibited? **[05 Marks]**

(c) A captain of a cricket team wants to arrange the batting order of his team, according to the average score each batsman received in the past, in five different batting positions, as given in the following table:

Batting position

Batsman	1	2	3	4	5
P	40	40	35	25	50
Q	42	30	16	25	27
R	50	48	40	60	50
S	20	19	20	18	25
T	58	60	59	55	53

Using the above data,

(i) Check whether the problem is balanced. **[05 Marks]**

(ii) Determine the batting position for each batsman in order to maximize the total average score. **[50 Marks]**

(iii)The average scores of a new batsman U in the same five positions are as follows:

Position	1	2	3	4	5
Score of U	45	52	38	50	49

Should the new batsman U be allowed to play in the cricket team, replacing one of the five mentioned above? If so, which batsman should he replace?

[30 Marks]

3. (a) What is goal programming? Why are all goal programming problems minimization problems? **[10 Marks]**

(b) Explain the term " **deviational variables**". **[05 Marks]**

A small paint company manufactures two types of paint, Latex and Enamel. In production, the company uses 10 man-hours of labour to produce 100 gallons of Latex and 15 man-hours of labour to produce 100 gallons of Enamel. The company has 40 man-hours of labour and 30 man-hours of overtime labour in each week. Furthermore, if Enamel paint is produced, Latex paint must be produced. Each type of paint generates a profit at the rate of $1.00 per gallon. The company has the following goals listed in decreasing priority order:

Goal 1: Avoid the use of overtime.

Goal 2: Achieve a weekly profit of $1000

Goal 3: Produce at least 700 gallons of Enamel paint each week .

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

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

(iii). Add deviational variables to the goal constraints. **[05 Marks]**

(iv). Formulate the linear goal programming model to solve the above problem. **[15 Marks]**

(v). Solve the model using Goal Programming Simplex Method. **[30 Marks]**

(vi). Using the solution model, determine the deviation from the goal. **[10 Marks]**

4. State the steps of Dantzig-Wolfe Decomposition Algorithm . **[25 Marks]**

Consider the following Linear Programming Problem:

Minimize $Z = -90x_1 - 80x_2 - 70x_3 - 60x_4$

Subject to

$8x_1 + 6x_2 + 7x_3 + 5x_4 \leq 80$

$3x_1 + x_2 \leq 12$

$2x_1 + x_2 \leq 10$

$3x_3 + 2x_4 \leq 15$

$x_3 + x_4 \leq 4$

$x_i \geq 0$ for $i = 1, 2, 3, 4$.

Solve the above problem using Dantzig- Wolfe Decomposition Algorithm.

[75 Marks]

5. SBRSP is concerned with finding a set of routes that optimizes certain objectives (including total cost) for operating a fleet of school buses. The buses pick up students from bus stops near their homes, transport them to their schools in the morning, and transport them back in the afternoon, while observing certain pre-specified physical and time limitations.

You are requested to deal with a number of complaints received daily on students' transportation, from parents, school principals, drivers, and even government officials.

(i) Determine issues that are related to students' transportation by buses. **[20 marks]**

(ii) What are the issues related to bus stops? **[20 marks]**

(iii) Outline methods of gathering related data.(ex. Time estimation, distance estimation) **[20 marks]**

(iv) Formulate your objectives. **[20 marks]**

(v) Identify the methods used to solve the model. **[20 marks]**