RAJARATA UNIVERSITY OF SRI LANKA, MIHINTALE

B.Sc. (Four Year Degree) in Industrial Mathematics

Fourth Year - Semester II Examination – October/November 2014

MAT 4306 – Optimization Modeling

Answer any five questions ***Time: 3 hours***

Note: You have to use MS Excel to model and solve the problem

01. Echo-Air company produces home dehumidifiers at two different plants in Colombo and Kandy. The per unit cost of production in Colombo and Kandy is Rs. 400 and Rs. 360, respectively. Each plant can produce a maximum of 300 units per month. Each month inventory holding costs are assessed at Rs. 30 per unit in the inventory opening. Echo-Air estimates the demand for its product to be 300, 400 and 500 units, respectively, over the next three months. Echo-Air wants to be able to meet this demand at minimum cost.

Note: *A **dehumidifier** is generally a household appliance which reduces the level of humidity in the air, usually for health or comfort reasons, or to eliminate musty odour .*

a. Formulate the problem as an LP model. ***04***

b. Implement your model in a spreadsheet and solve it. ***04***

c. What is the optimal solution? ***04***

d. How does the solution change if each plant is required to produce at least 50 units per month? ***04***

e. How does the solution change if each plant is required to produce at least 100 units per month? ***04***

02. A company is trying to determine how to allocate its Rs. 145,000 advertising budget for a new product. The company is considering newspaper ads and television commercials as its primary means of advertising. The following table summarizes the cost of advertising in these different media and the number of new customers reached by increasing amount of advertising.

Media & Number of Ads	Number of New Customers Reached	Cost per Ads
Newspaper : 1-10	900	Rs. 1,000
Newspaper : 11-20	700	Rs. 900
Newspaper : 21-30	400	Rs. 800
Television : 1-5	10,000	Rs. 12,000
Television : 6 - 10	7,500	Rs. 10,000
Television : 11 - 15	5,000	Rs. 8,000

For instance, each of the first ten ads the company places in newspapers will cost Rs. 1,000 and is expected to reach 900 new customers. Each of the next 10 newspaper ads will cost Rs.900 and is expected to reach 700 new customers. Note that the number of new customers reached by increasing amounts of advertising decreases as the advertising saturates the market. Assume the company will purchase no more than 30 newspaper ads and 15 television ads.

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02. Continued.

a. Formulate the problem as an LP model to determine the maximum number of new customers reached by advertising. *04*

b. Implement your model in a spreadsheet and solve it. *04*

c. Find the optimal solution. *04*

d. Suppose the number of new customers reached by 11 – 20 newspaper ads is 400 and the number of new customers reached by 21 – 30 newspaper ads is 700. Make these changes in your spreadsheet and re-optimize the problem. What is the new optimal solution? If anything is wrong with this solution explain it. *08*

03. Sri-Net is a leading internet service provider in Sri Lanka. Presently, the company operates one centralized facility that all of its clients call into for Internet access. To improve service, the company is planning to open three satellite offices in the cities of Colombo, Kandy and Jaffna. The company has identified five different regions to be serviced by these three offices. The following table summarizes the number of customers in each region, the service capacity at each office, and the average monthly per customer cost of providing service to each region from each office. Table entries of "NA" indicate infeasible region to service center combinations. Sri-Net wants to determine how many customers from each region to assign to each service center in order to minimize cost.

Region	Colombo	Kandy	Jaffna	Customers
1	Rs. 6.50	Rs. 7.50	NA	30,000
2	Rs. 7.00	Rs. 8.00	NA	40,000
3	Rs. 8.25	Rs. 7.25	Rs. 6.75	25,000
4	NA	Rs. 7.75	Rs. 7.00	35,000
5	NA	Rs. 7.50	Rs. 6.75	33,000
Capacity	60,000	70,000	40,000	

a. Create the network flow model to represent the problem. *04*

b. Implement your network model in a spreadsheet and solve it. *12*

c. Discuss the optimal solution obtained above. *04*

04. The Fish Food company needs to distribute 100 cases of fresh ***Tilapia*** from its warehouse in Anuradhapura to island wide distributors at minimum cost. The costs associated with distributing 100 cases between various cities are :

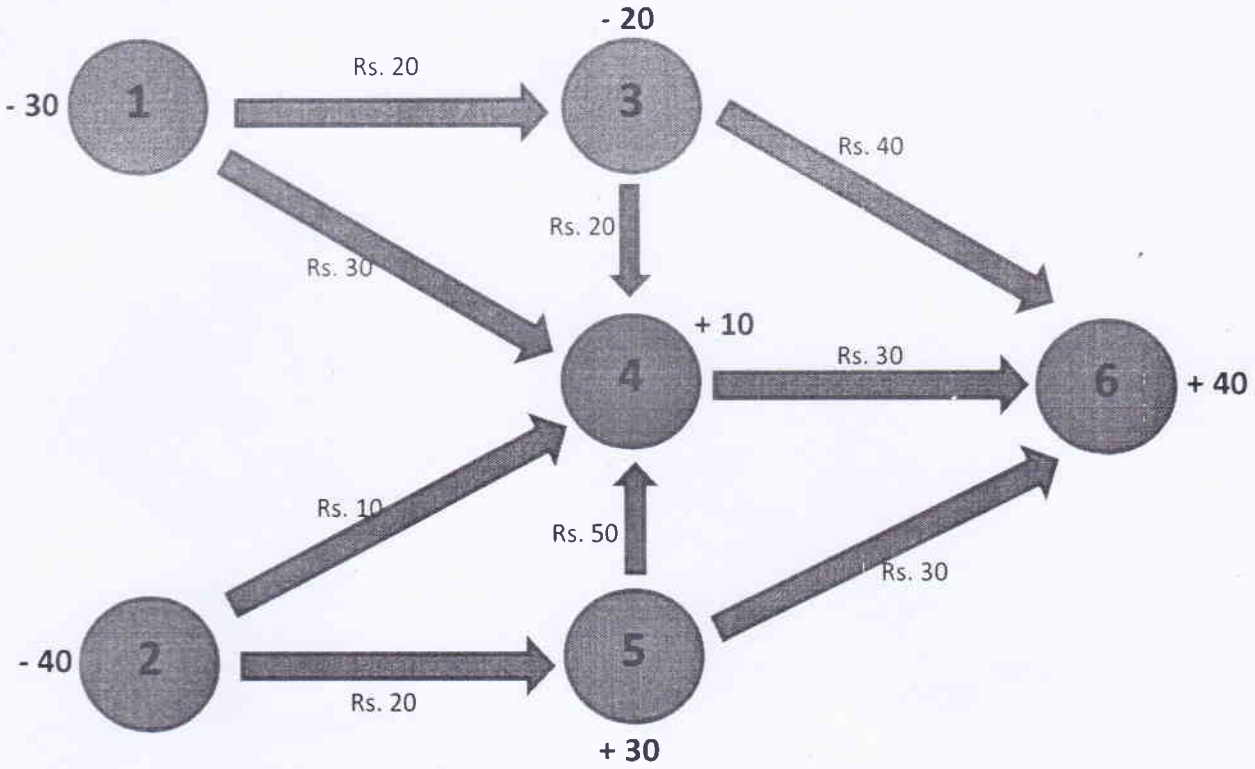
	To					
From	Colombo	Nuwara eliya	Ampara	Kurunegala	Kilinochchi	Kandy
Anuradhapura	5	13	-	45	-	105
Colombo	-	27	19	50	-	95
Nuwara eliya	-	-	14	30	32	-
Ampara	-	14	-	35	24	-
Kurunegala	-	-	35	-	18	25
Kilinochchi	-	-	24	18	-	17

a. Draw the network representation of this problem. *04*

b. Write out the LP formulation of this problem. *04*

c. Solve the problem using solver. Interpret your solution. *12*

05. A furniture manufacturer has warehouse in cities represented by nodes 1, 2 and 3 in figure given below. The values on the arcs indicate the per unit shipping costs required to transport living room suits between the various cities. The supply of living room suites at each warehouse is indicated by the negative number next to nodes 1, 2, and 3. The demand for living room suites is indicated by the positive number next to the remaining nodes.



a. Note down the balance of flow rule used in optimization
Hence identify the supply, demand and transshipment nodes in this problem. *08*

b. Use Solver to determine the least costly shipping plan for this problem. **12**

06. A company has three warehouses that supply four stores with a given product. Each warehouse has 30 units of the product. Stores 1, 2, 3 and 4 require 20, 25, 30 and 35 units of the product, respectively. Per unit shipping costs from each warehouse to each store are :

	Stores			
Warehouse	1	2	3	4
1	5	4	6	5
2	3	6	4	4
3	4	3	3	2

a. Draw the network representation of this problem. What kind of problem is this? *04*

b. Formulate the problem as an LP model to determine the least expensive shipping plan to fill the demand at the stores. *04*

c. Solve the problem using solver *04*

d. Suppose that shipments are not allowed between warehouse 1 and store 2 or between warehouse 2 and store 3. What is the easiest way to modify the spreadsheet so that you can solve this modified problem?
What is the optimal solution to the modified problem? *08*