

MAT540

Week 9 Homework

Chapter 5

1. Rowntown Cab Company has 70 drivers that it must schedule in three 8-hour shifts. However, the demand for cabs in the metropolitan area varies dramatically according to time of the day. The slowest period is between midnight and 4:00 A.M. the dispatcher receives few calls, and the calls that are received have the smallest fares of the day. Very few people are going to the airport at that time of the night or taking other long distance trips. It is estimated that a driver will average \$80 in fares during that period. The largest fares result from the airport runs in the morning. Thus, the drivers who start their shift during the period from 4:00 A.M. to 8:00 A.M. average \$500 in total fares, and drivers who start at 8:00 A.M. average \$420. Drivers who start at noon average \$300, and drivers who start at 4:00 P.M. average \$270. Drivers who start at the beginning of the 8:00 P.M. to midnight period earn an average of \$210 in fares during their 8-hour shift.

To retain customers and acquire new ones, Rowntown must maintain a high customer service level. To do so, it has determined the minimum number of drivers it needs working during every 4-hour time segment- 10 from midnight to 4:00 A.M. 12 from 4:00 to 8:00 A.M. 20 from 8:00 A.M. to noon, 25 from noon to 4:00 P.M., 32 from 4:00 to 8:00 P.M., and 18 from 8:00 P.M. to midnight.

- a. Formulate and solve an integer programming model to help Rowntown Cab schedule its drivers.
 - b. If Rowntown has a maximum of only 15 drivers who will work the late shift from midnight to 8:00 A.M., reformulate the model to reflect this complication and solve it
 - c. All the drivers like to work the day shift from 8:00 A.M. to 4:00 P.M., so the company has decided to limit the number of drivers who work this 8-hour shift to 20. Reformulate the model in (b) to reflect this restriction and solve it.
2. Juan Hernandez, a Cuban athlete who visits the United States and Europe frequently, is allowed to return with a limited number of consumer items not generally available in Cuba. The items, which are carried in a duffel bag, cannot exceed a weight of 5 pounds. Once Juan is in Cuba, he sells the items at highly inflated prices. The weight and profit (in U.S. dollars) of each item are as follows:

Item	Weight (lb.)	Profit
Denim jeans	2	\$90
CD players	3	150
Compact discs	1	30

Juan wants to determine the combination of items he should pack in his duffel bag to maximize his profit. This problem is an example of a type of integer programming problem known as a “knapsack” problem. Formulate and solve the problem.

3. The Texas Consolidated Electronics Company is contemplating a research and development program encompassing eight research projects. The company is constrained from embarking on all projects by the number of available management scientists (40) and the budget available for R&D projects (\$300,000). Further, if project 2 is selected, project 5 must also be selected (but not vice versa). Following are the resources requirement and the estimated profit for each project.

Project	Expense (\$1,000s)	Management Scientists required	Estimated Profit (1,000,000s)
1	50	6	0.30
2	105	8	0.85
3	56	9	0.20
4	45	3	0.15
5	90	7	0.50
6	80	5	0.45
7	78	8	0.55
8	60	5	0.40

Formulate the integer programming model for this problem and solve it using the computer.

4. Corsouth Mortgage Associates is a large home mortgage firm in the southeast. It has a pool of permanent and temporary computer operators who process mortgage accounts, including posting payments and updating escrow accounts for insurance and taxes. A permanent operator can process 220 accounts per day, and a temporary operator can process 140 accounts per day. On average, the firm must process and update at least 6,300 accounts daily. The company has 32 computer

workstations available. Permanent and temporary operators work 8 hours per day. A permanent operator averages about 0.4 error per day, whereas a temporary operator averages 0.9 error per day. The company wants to limit errors to 15 per day. A permanent operator is paid \$120 per day whereas a temporary operator is paid \$75 per day. Corsouth wants to determine the number of permanent and temporary operators it needs to minimize cost. Formulate, and solve an integer programming model for this problem and compare this solution to the non-integer solution.

5. Globex Investment Capital Corporation owns six companies that have the following estimated returns (in millions of dollars) if sold in one of the next 3 years:

Company	Year Sold		
	(estimated returns, \$1,000,000s)		
	1	2	3
1	\$14	\$18	\$23
2	9	11	15
3	18	23	27
4	16	21	25
5	12	16	22
6	21	23	28

To generate operating funds, the company must sell at least \$20 million worth of assets in year 1, \$25 million in year 2, and \$35 million in year 3. Globex wants to develop a plan for selling these companies during the next 3 years to maximize return.

Formulate an integer programming model for this problem and solve it by using the computer.