I.E. 2001 OPERATIONS RESEARCH

(*Homework Assignment 9: Due April 9, 2020*)

Question 1

Question 1, at the end of Section 9.2 on page 502 of the text (Coach Night). In HW 8 you already modeled the restrictions in parts 1, 2 and 5. Here I would like you to model the remaining restrictions.

Question 2

Question 14 (State University…), at the end of Section 9.2 on pages 503-504 of the text. Try and solve the IPs formulated for each part using LINDO or Excel Solver (in LINDO use the **INT** ***x*** command at the end to make *x* a 0-1 variable. In Solver you can specify the variable as "bin" in the constraint section). Just write out the optimum solution and objective value for each part; no need to submit the entire output.

14† The manager of State University's DED computer wants to be able to access five different files. These files are scattered on 10 disks as shown in Table 13. The amount of storage required by each disk is as follows: disk 1, 3K; disk 2, 5K; disk 3, 1K; disk 4, 2K; disk 5, 1K; disk 6, 4K; disk 7, 3K; disk 8, 1K; disk 9, 2K; disk 10, 2K.

a Formulate an IP that determines a set of disks requiring the minimum amount of storage such that each file is on at least one of the disks. For a given disk, we must either store the entire disk or store none of the disk; we cannot store part of a disk.

b Modify your formulation so that if disk 3 or disk 5 is used, then disk 2 must also be used.

TABLE 13

	Disk									
File	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	x	x		x	x			x	x	
2	x		x							
3		x			x		x			x
4			x			x		x		
5	x	x		x		x	x		x	x

Question 3
Question 43, at the end of Section 9.2 on page 511 of the text (Ford). Solve the formulated IP using LINDO or Excel Solver; just write out the optimum solution and objective value.

43 Ford has four automobile plants. Each is capable of producing the Taurus, Lincoln, or Escort, but it can only produce one of these cars. The fixed cost of operating each plant for a year and the variable cost of producing a car of each type at each plant are given in Table 51.

Ford faces the following restrictions:

a Each plant can produce only one type of car.

b The total production of each type of car must be at a single plant; that is, for example, if any Tauruses are made at plant 1, then all Tauruses must be made there.

c If plants 3 and 4 are used, then plant 1 must also be used.

TABLE 51

Plant	Fixed Cost ($)	Variable Cost ($)		
		Taurus	Lincoln	Escort
1	7 billion	12,000	16,000	9,000
2	6 billion	15,000	18,000	11,000
3	4 billion	17,000	19,000	12,000
4	2 billion	19,000	22,000	14,000

Each year, Ford must produce 500,000 of each type of car. Formulate an IP whose solution will tell Ford how to minimize the annual cost of producing cars.

Question 4
Consider an urban planning project to locate firehouses for serving the population of a metropolitan area. The area is divided into a total of N districts and each district has a population of p_i people. Preliminary analysis has limited the potential location of firehouses to a total of M different locations. The distance from the center of district i to location j is given by d_{ij}. Every district must be assigned to exactly one location, and obviously, if a location is not used, then no district should be assigned to this site. The size and hence the cost of building a firehouse at location j depends on the number of people it is designed to serve (say s_j) and is given by a function of the form $f(s_j)$. A total budget of B is available for building the firehouses. Finally, due to political reasons, either *both* locations **1 and 2** must be selected, or *both* locations **3 and 4** must be selected (all four locations could be selected as well). The objective is to choose locations for the firehouses and assign districts to the selected locations, in such a way that the *average* distance (across all districts) to a district center from its assigned firehouse location is minimized. Formulate an appropriate integer program. How would you modify the formulation if the objective is to minimize the *maximum* distance to a district center from its assigned firehouse location?