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Mathematical Tools for Engineering and Management
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Exercise sheet 4

Exercise 1

The *Belmont Bank* is considering placing ATM machines in the town centers of some of the following six communities: Arlington, Belmont, Cambridge, Lexington, Concord, and Winchester. The bank would like to purchase the minimum number of ATM machines needed to ensure that at least one ATM machine is within a ten-minute-drive from the center of each of these six communities. The times required to drive between the communities are shown in the following table.

Town	Arlington	Belmont	Cambridge	Lexington	Concord	Winchester
Arlington	0	5	10	15	20	15
Belmont	5	0	8	10	15	12
Cambridge	10	8	0	15	20	10
Lexington	15	10	15	0	10	12
Concord	20	15	20	10	0	12
Winchester	15	12	10	12	12	0

Table 1: Driving distances between the centers of six communities in minutes.

1. Write up an integer linear program for the problem faced by Belmont Bank.
2. Solve your model using AIMMS. What is the optimal number of ATM machines that Belmont Bank needs to purchase? What is the optimal placement of these ATM machines?

Exercise 2

In a Sudoku, a 9x9-matrix has to be filled with entries from 1 to 9. In each row, in each column and in each of the highlighted 3x3-blocks, every number from 1 to 9 has to appear exactly once.

Formulate Sudoku as an integer program, and solve the following Sudoku using AIMMS:

1								2
	9		4				5	
		6				7		
	5		9		3			
				7				
			8	5			4	
7						6		
	3				9		8	
		2						1

Figure 1: Sudoku Instance