1. There are six cities (cities 1–6) in Kilroy County. The county must determine where to build fire stations. The county wants to build the minimum number of fire stations needed to ensure that at least one fire station is within 15 minutes (driving time) of each city. The times (in minutes) required to drive between the cities in Kilroy County are shown in following table. Formulate an IP that will tell Kilroy how many fire stations should be built and where they should be located.

Time required to travel between cities in Kilroy country						
From	T0					
	City 1	City 2	City 3	City 4	City 5	City 6
City 1	0	10	20	30	30	20
City 2	10	0	25	35	20	10
City 3	20	25	0	15	30	20
City 4	30	35	15	0	15	25
City 5	30	20	30	15	0	14
City 6	20	10	20	25	14	0

2. SOUTHWESTERN AIRWAYS need to assign its crews to cover all its upcoming flights. We will focus on the problem of assigning three crews based in San Francisco to the flights listed in the first column of following Table. The other 12 columns show the 12 feasible sequences of flights for a crew. (The numbers in each column indicate the order of the flights.) Exactly three of the sequences need to be chosen (one per crew) in such a way that every flight is covered. (It is permissible to have more than one crew on a flight, where the extra crews would fly as passengers, but union contracts require that the extra crews would still need to be paid for their time as if they were working.) The cost of assigning a crew to a particular sequence of flights is given (in thousands of dollars) in the bottom row of the table. The objective is to minimize the total cost of the three crew assignments that cover all the flights.

	Feasible sequence of flights											
Flight	1	2	3	4	5	6	7	8	9	10	11	12
1.San Francisco to Los Angeles	1			1			1			1		
2.San Francisco to Denver		1			1			1			1	
3.San Francisco to Seattle			1			1			1			1
4. Los Angeles to Chicago				2			2		3	2		3
5.Los Angeles to San Francisco	2					3				5	5	
6. Chicago to Denver				3	3				4			
7. Chicago to Seattle							3	3		3	3	4
8. Denver to San Francisco		2		4	4				5			
9. Denver to Chicago					2			2			2	
10. Seattle to San Francisco			2				4	4				5
11.Seattle to Los Angeles						2			2	4	4	2
Cost, $1,000 ‘s	2	3	4	6	7	5	7	8	9	9	8	9

3. A university is acquiring mathematical programming software for use in operations research classes. The four codes available and the types of optimization algorithms they provide are indicated by *'s in the following table.

Algorithm Type	Code,j			
	1	2	3	4
LP	*	*	*	*
IP	-	*	-	*
NLP	-	-	*	*
Objective	3	4	61	4

(a) Taking objective function coefficients as code costs, formulate a set covering model to acquire a minimum cost collection of codes providing LP, IP, and NLP capability.
(b) Taking objective function coefficients as code costs, formulate a set partitioning model to acquire a minimum cost collection of codes with exactly one providing LP, one providing IP, and one providing NLP.
(c) Taking objective function coefficients as indications of code quality, formulate a set packing model to acquire a maximum quality collection of codes with at most one providing LP, at most one providing IP, and at most one providing NLP.

4. The Presidents of the United States are elected indirectly by accumulating a majority of electoral votes awarded in-block to the candidate in each state who gets the most popular votes there, regardless of how narrow the margin might be. Following table shows numbers of electoral votes vj for n = 7 target states in which our consultant believes the election race is very close going into its final 2 weeks. The table also shows amounts aj (in $ million) the consultant believes would be required to be spent on advertising and activities like get-out-the-vote in each of the targets over the next 2 weeks to insure her candidate wins there. With a total budget of b = $10 million, she wishes to choose the expenditure that will maximize the total resulting electoral vote for her candidate.

Target j	1	2	3	4	5	6	7
Electoral votes vj	9	29	6	10	4	18	13
$ million cost to win aj	2	5	1	2	1	4	3