

Location Problems (Exercises)

Warehouses

A company is considering opening warehouses in four cities: Sydney, Perth, Brisbane, and Melbourne. Each warehouse can ship 100 units per week. The weekly fixed cost of keeping each warehouse open is AU\$400 for Sydney, AU\$500 for Perth, AU\$300 for Brisbane, and AU\$150 for Melbourne. Region 1 of the country requires 80 units per week, region 2 requires 70 units per week, and region 3 requires 40 units per week.

From	To (AU\$)		
	Region 1	Region 2	Region 3
Sydney	20	40	50
Perth	48	15	26
Brisbane	26	35	18
Melbourne	24	50	35

The costs (including production and shipping costs) of sending one unit from a plant to a region are shown in the table. It is desired to meet weekly demands at minimum cost, subject to the preceding information and the following restrictions:

- If the Sydney warehouse is opened, then the Perth warehouse must be opened.
- At most two warehouses can be opened.

Either the Melbourne or the Perth warehouse must be opened.

1. Formulate an Integer Programming Model that will solve the requirements of the Warehouses.
2. Solve the formulated Integer Programming Model using Solver.
3. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
4. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.

Disk Access

The IT Facilities Manager of Uppington University wants to be able to access five different computer files. These files are scattered on ten CD-ROM disks as shown in the table. The amount of storage required by each disk is as follows: disk 1, 3M; disk 2, 5M; disk 3, 1M; disk 4, 2M; disk 5, 1M; disk 6, 4M; disk 7, 3M; disk 8, 1M; disk 9, 2M; disk 10, 2M.

File	Disk									
	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

1. Formulate an Integer Programming Model 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,

it is necessary to either store the entire disk or store none of the disk; it is not possible to store part of a disk.

2. Modify the formulation so that if disk 3 or disk 5 is used, then disk 2 must also be used.
3. Solve the formulated Integer Programming Model using Solver.
4. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
5. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.

Eastinghouse Air Conditioners

Eastinghouse sells air conditioners. The annual demand for air conditioners in each region of the country is as follows: East, 100 000; South, 150 000; Midwest, 110 000; West, 90 000. Eastinghouse is considering building the air conditioners in four different cities: New York, Atlanta, Chicago, and Los Angeles. The cost of producing an air conditioner in a city and shipping it to a region of the country is given in the table.

City	Price by Region R			
	East	South	Midwest	West
New York	206	225	230	290
Atlanta	225	206	221	270
Chicago	230	221	208	262
Los Angeles	290	270	262	215

A factory can produce as many as 150 000 air conditioners per year. The annual fixed cost of operating a factory in each city is given in the table.

City	Annual Fixed Cost (R Million)
New York	206
Atlanta	225
Chicago	230
Los Angeles	290

At least 50 000 units if the Midwest demand for air conditioner must come from New York or at least 50 000 units of the Midwest demand must come from Atlanta.

1. Formulate an Integer Programming Model whose solution will tell Eastinghouse how to minimise the annual cost of meeting demand for air conditioners.
2. Solve the formulated Integer Programming Model using Solver.
3. Solve the formulated Integer Programming Model using the Branch & Bound Simplex Algorithm.
4. Solve the formulated Integer Programming Model using the Cutting Plane Algorithm.