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## Set Covering – Fire station problem

There are six cities (cities 1 – 6) in the Ekurhuleni metropolitan area. The metro must determine where to build fire stations. The metro 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 time (in minutes) required to drive between the cities in Ekurhuleni are shown in the table.

# Set Covering – Fire station problem

Time required to travel between cities in Ekurhuleni						
	City 1	City 2	City 3	City 4	City 5	City 6
City 1	-	10	20	30	30	20
City 2		-	25	35	20	10
City 3			-	15	30	20
City 4				-	15	25
City 5					-	14
City 6						-

Formulate an IP that will tell Ekurhuleni how many fire stations should be built and where they should be located.

# Set Covering – formulating the IP

- Decision variables:

$x_i =$  If fire station is placed in city  $i$  (1) or not (0) where  
 $i = \text{Cities } 1 - 6$

- Objective function:

$$\min z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6$$

- Constraints are based on the times required to travel:

$$x_1 + x_2 \geq 1$$

$$x_1 + x_2 + x_6 \geq 1$$

$$x_3 + x_4 \geq 1$$

$$x_3 + x_4 + x_5 \geq 1$$

Cities within 15 minutes of Given city	
City	Within 15 minutes
1	1, 2
2	1, 2, 6
3	3, 4
4	3, 4, 5
5	4, 5, 6
6	2, 5, 6

# Set Covering – formulating the IP

$$x_4 + x_5 + x_6 \geq 1$$

$$x_2 + x_5 + x_6 \geq 1$$

- Sign restrictions:

$$x_i \ (i = \text{Cities } 1 - 6) = 0 \text{ or } 1$$

Solver									
	x1	x2	x3	x4	x5	x6	ref	sign	b
var	0	1	0	1	0	0			
obj	1	1	1	1	1	1	2		
1	1	1	0	0	0	0	1	≥	1
2	1	1	0	0	0	1	1	≥	1
3	0	0	1	1	0	0	1	≥	1
4	0	0	1	1	1	0	1	≥	1
5	0	0	0	1	1	1	1	≥	1
6	0	1	0	0	1	1	1	≥	1

Cities within 15 minutes of Given city	
City	Within 15 minutes
1	1, 2
2	1, 2, 6
3	3, 4
4	3, 4, 5
5	4, 5, 6
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# Exercises


In the document 'Set-Covering Problems (Exercises)'

# END



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