

# HIMCM 2013

## Problem A: Emergency Medical Response

The Emergency Service Coordinator (ESC) for a county is interested in locating the county's three ambulances to best maximize the number of residents that can be reached within 8 minutes of an emergency call. The county is divided into 6 zones and the average time required to travel from one zone to the next under semi-perfect conditions is summarized in the following Table 1.

Zones	Average Travel Times (min.)					
	1	2	3	4	5	6
1	1	8	12	14	10	16
2	8	1	6	18	16	16
3	12	18	1.5	12	6	4
4	16	14	4	1	16	12
5	18	16	10	4	2	2
6	16	18	4	12	2	2

**Table 1:** Average travel times from Zone  $i$  to Zone  $j$  in semi-perfect conditions.

The population in zones 1, 2, 3, 4, 5 and 6 are given in Table 2 below:

Zones	Population
1	50,000
2	80,000
3	30,000
4	55,000
5	35,000
6	20,000
Total	270,000

**Table 2:** Population in each Zone

### Goals of your model

1. Determine the locations for the three ambulances which would maximize the number of people who can be reached within 8 minutes of a 911 call. Can we cover everyone? If not, then how many people are left without coverage?
2. We now have only two ambulances since one has been set aside for an emergency call; where should we put them to maximize the number of people who can be reached within the 8 minute window? Can we cover everyone? If not, then how many people are left without coverage?
3. Two ambulances are now no longer available; where should the remaining ambulance be posted? Can we cover everyone? If not, then how many people are left without coverage?
4. If a catastrophic event occurs in one location with many people from all zones involved, could the ESC cover the situation? How do counties or cities design for those rare but catastrophic events?
5. In addition to the contest's format, prepare a short 1-2 page non-technical memo outlining your recommendations from your model and analysis finding for the ESC.

## Problem B: Bank Service Problem

The bank manager is trying to improve customer satisfaction by offering better service. Management wants the average customer to wait less than 2 minutes for service and the average length of the queue (length of the waiting line) to be 2 persons or fewer. The bank estimates it serves about 150 customers per day. The existing arrival and service times are given in the tables below.

Time between arrival (min.)	Probability
0	0.10
1	0.15
2	0.10
3	0.35
4	0.25
5	0.05

**Table 1:** Arrival times

Service Time (min.)	Probability
1	0.25
2	0.20
3	0.40
4	0.15

**Table 2:** Service times

- (1) Build a mathematical model of the system.
- (2) Determine if the current customer service is satisfactory according to the manager guidelines. If not, determine, through modeling, the minimal changes for servers required to accomplish the manager's goal.
- (3) In addition to the contest's format, prepare a short 1-2 page non-technical letter to the bank's management with your final recommendations.