IE453 Facilities Planning

Ch10 QUANTITATIVE FACIUTIES PLANNING MODELS

10.1 Let four existing facilities be located at P1 = (0, 10), P2 = (5, 10), P3 = (5, 15), and P4 = (10, 5) with w1= 15, w2 = 20, w3= 5, and w4 = 30. Determine the optimum location for a single new facility when cost is proportional to rectilinear distance. Construct a contour line passing through the point having coordinates (10, 10).

10.2 The XYZ Company has six retail sales stores in the city of Raleigh. The company needs a new warehouse facility to service its retail stores. The location of the stores and the expected deliveries per week from the warehouse to each store are

Store	Location (miles)	Expected Deliveries
1	(1, 0)	4
2	(2, 5)	7
3	(3, 8)	5
4	(1, 6)	3
5	(−5, −1)	8
6	(−3, −3)	3

Assume that travel distance within the city of Raleigh is rectilinear and that after each delivery, the delivery truck must return to the warehouse. If there are no restrictions on the warehouse location, where should it be located?

10.3 Four hospitals are located within a city at coordinate points P1 = (10, 20), P2 = (14,12), P3 = (8, 4), and P4 = (32, 6). The hospitals are served by a centralized blood bank facility that is to be located in the city. The number of deliveries to be made each year between the blood bank facility and each hospital is estimated to be 450, 1200, 300, and 1500, respectively.

If it is desired to locate the blood bank at a point that minimizes the weighted distance traveled per year, where should it be located if travel is rectilinear in the city?

10.4 Solve Problem 10.1 as a minisum planar location problem using Euclidean distances. Do not construct contour lines.

10.5 Solve Problem 10.1 as aminisum planar location problem using squared Euclidean distances. Do not construct contour lines.

10.6 A new back-up power generator is to be located to serve a total of six precision machines in a manufacturing facility. Separate electrical cables are to be run from the generator to each machine. The locations of the six machines are P1=(0, 0), P2 = (30,90), P3= (60, 20), P4 = (20, 80), P5 = (70, 70), and P6=(90,40). Determine the location for the generator that will minimize the total required length of the electrical cable. Assume rectilinear distance.

10.8 Six housing subdivisions within a city area are targeted for emergency service by a centralized fire station. Where should the new fire station be located such that the maximum rectilinear travel distance is minimized? The centroid locations (in miles) and total value of the houses in the subdivisions are as follows:

Subdivision	*x*-Coordinate	*y*-Coordinate	Total Value (in millions)
A	20	15	50
B	25	25	120
C	13	32	100
D	25	14	250
E	4	21	300
F	18	8	75

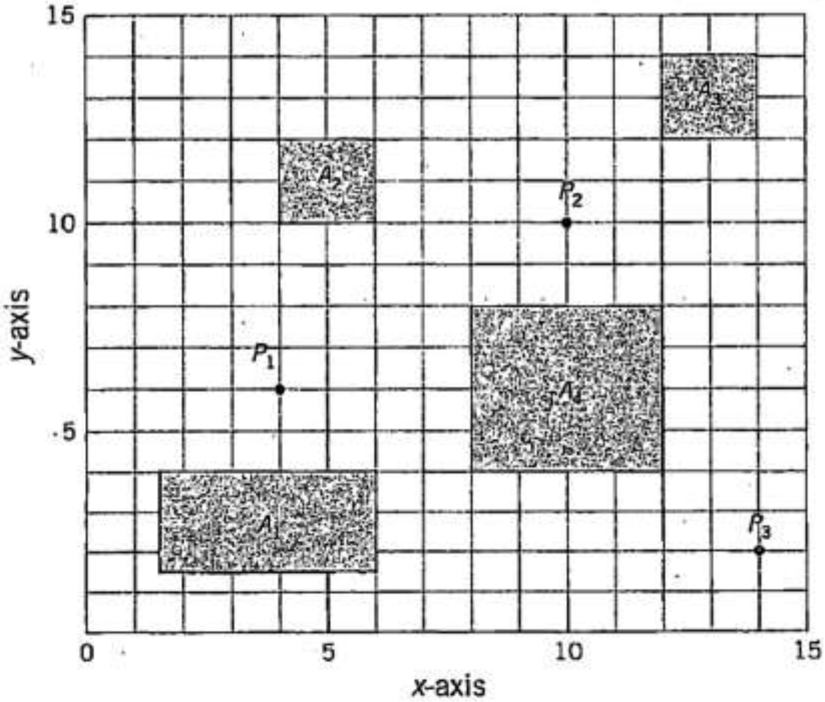
10.9 The city council of Fayetteville has decided to locate an emergency response unit within the city. This unit is responsible for four housing sectors (A) and three major street intersections (P) as shown in the figure below. Assume that the weights are uniformly distributed over the housing sectors.

a. Determine the minisum location based on the weights given in the table below, assuming no restrictions apply to the location of the emergency response unit.

b. Determine the minisum location assuming the new facility cannot be located within a housing sector.

c. Determine the minimax location by measuring distances to the centroids of areas and using the weights given in the table below.

Housing Sector	Weight	Intersection	Weight
A_1	10	P_1	30
A_2	15	P_2	15
A_3	20	P_3	5
A_4	30		



10.10 A new elementary school is needed in a suburban area of Detroit, Michigan. After extensive research, the school board has narrowed down its choice to three possible sites. The locations for the current residential areas, expected students from each residential area, and possible locations for the school are shown in the tables below.

a. Determine the optimal location for the new elementary school such that the total distance the students have to travel is minimized. It is fair to assume that the construction cost for all three sites is similar and distance is measured rectilinearly.

b. Determine the minimax distance (considering weights, and then ignoring weights).

Residences	x-Coordinate	y-Coordinate	Weight
A	20	25	600
B	36	18	400
C	62	37	500
D	50	56	300
E	25	0	200

Possible sites for the new elementary school:

Possible Sites	x-Coordinate	y-Coordinate
1	50	50
2	30	45
3	65	28

10.11 The Ashley County News Observer plans to rent building space for a new print shop within the city limits. The locations for current distribution centers, expected deliveries, and possible locations for the facility are shown in the tables and figures below.

a. Determine the optimal location for the new print shop.

b. Rank the alternative locations in order of preference using contour lines.

c. Solve part (a) using a minimax criterion (weighted and unweighted).

d. Solve part (a) using squared Euclidean distances.

e. Use the Excel® SOLVER tool to solve part (a) using Euclidean distances.

Current distribution centers:

Center	x-Coordinate	y-Coordinate	Weight
A	5	10	200
B	50	15	400
C	25	25	500
D	35	5	300
E	15	20	400
F	30	30	600

Possible locations for the new print shop:

Building	x-Coordinate	y-Coordinate
1	20	20
2	40	25
3	25	35