

Problem 1. (20 Points)

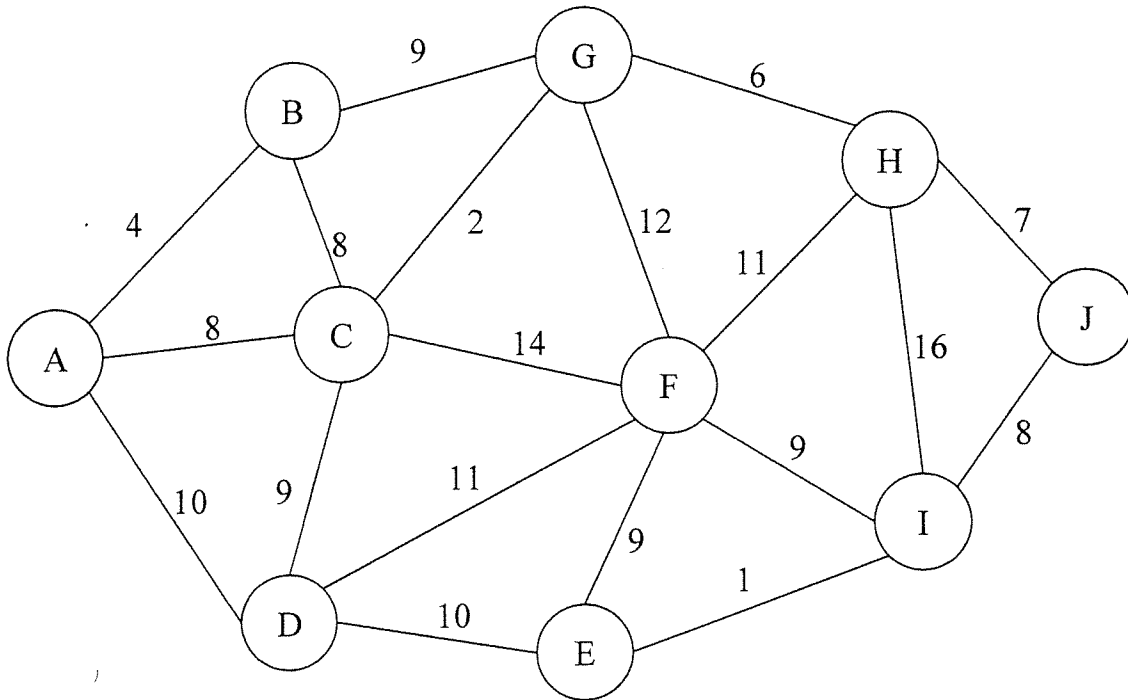
A manufacturing company has five jobs that must be completed as soon as possible. Six machine are available for doing the work, however the processing times for the various jobs varies depending on the machine doing the processing. The company wants to use an assignment method to determine which machine processes each job. Estimates of editing times (in hours) for each job by each machine is:

Job	Machine					
	A	B	C	D	E	F
1	9	14	11	13	17	20
2	11	14	10	11	10	9
3	7	9	9	8	10	6
4	11	10	12	14	15	13
5	15	18	21	17	23	20
6	12	17	15	16	19	14

- Formulate the problem as an assignment model, show all decision variables and constraints.
- What is the total minimum editing time? What editors will be assigned to each manuscript?

Problem 2. (10 Points)

Draw the Minimum Spanning Tree and **provide (draw)** the required distance to span the network.



Distance = _____

Problem 3. (20 Points)

Consider a national firm that receives checks from all over the United States. Due to the vagaries of the U.S. Postal Service, as well as the banking system, there is a variable delay from when the check is postmarked (and hence the customer has met her obligation) and when the check clears (and when the firm can use the money). For instance, a check mailed in Norfolk sent to a Norfolk address might clear in just two days. A similar check sent to San Francisco might take eight days to clear. It is in the firm's interest to have the check clear as quickly as possible since then the firm can use the money. In order to speed up this clearing, firms open offices (called lockboxes) in different cities to handle the checks.

Suppose we receive payment from four regions (West, Midwest, East, and South). The average daily value from each region is found in table 1: The average days from mailing to clearing is given in table 2. Also a region can only be assigned to an open lockbox. Assuming an annual investment rate of 15% and operational costs of \$60,000 per year per lockbox, which lockboxes should we open (Las Vegas, St. Louis, Washington D.C., or Charlotte)?

Daily Values	
West	\$ 110,000.00
Midwest	\$ 80,000.00
East	\$ 100,000.00
South	\$ 90,000.00

Table 1

From	Las Vegas	St. Louis	Washington, D.C.	Charlotte
West	2	5	7	6
Midwest	5	3	6	5
East	7	5	3	4
South	6	5	4	3

Table 2

- Formulate the problem as an integer programming problem. Specify the complete model including all decision variables and constraints.
- Specify which lockboxes should be open and what is the minimum annual loss?
- Assume the decision variable do not have to be binary but still have to range between 0 – 1. What are the value of the decision variables and what is the minimum annual cost, are these values useful?

Problem 4. (20 Points)

A city is reviewing the location of its fire stations. The city is made up of a number of neighborhoods, as illustrated in Figure 1. A fire station can be placed in any neighborhood. It is able to handle the fires for both its neighborhood and any adjacent neighborhood. The objective is to minimize the number of fire stations used.

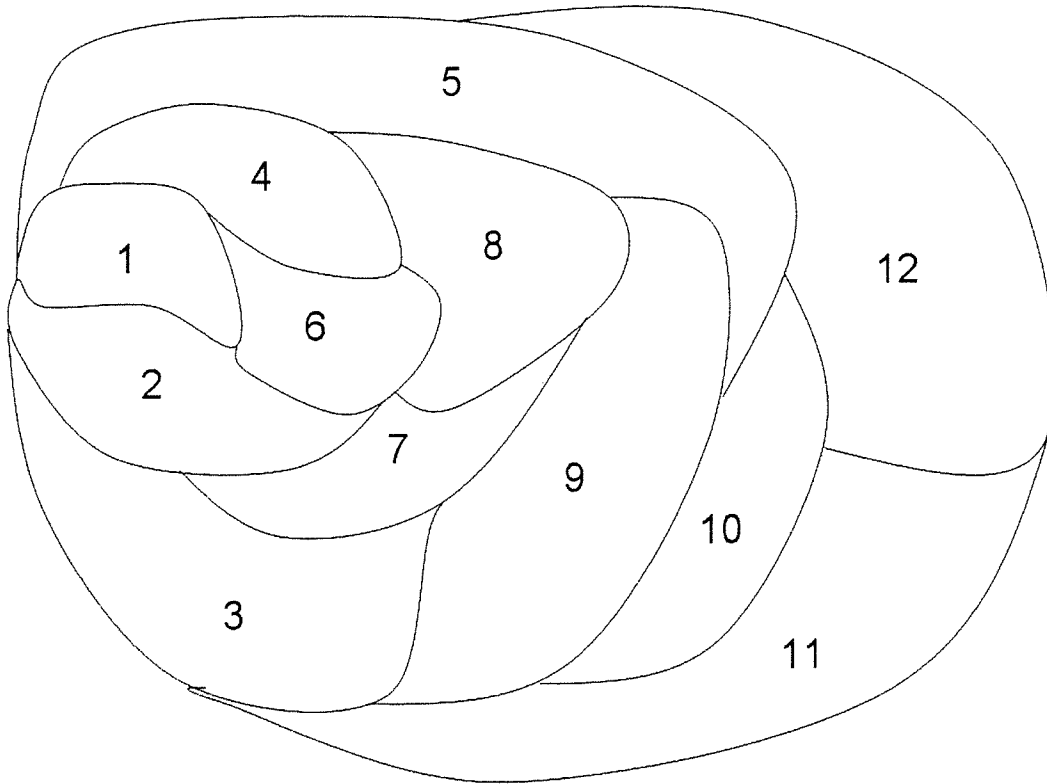


Figure 1

- D. Formulate the problem as a binary-integer programming problem. Specify the complete model including all decision variables and constraints.
- E. Specify what neighborhoods should contain a fire station.
- F. In addition to part B, give two more feasible solutions to this problem. Which solution is best, justify.

Problem 5. (30 Points) For the project schedule, answer the following questions.

The ODU bookstore has decided to promote its new opening by having a shopping spree. The winner of the shopping spree will have to abide by the following rules. They will have 10 minutes to grab as many items as possible from the store. They must place a shopping cart in one spot and leave it there for the entire duration of the spree. Also they can only pick up one item at a time from the shelves and bring it to the cart. The following table provides a list of all of the items in the store (22), the X,Y coordinates of each item, the cost of each item, and the quantity available. It is estimated that a person can travel 20 feet in one second, therefore if an item is 100 feet away it will take a person 5 seconds to retrieve the item and 5 seconds to return it to a cart for a total of 10 seconds. The shopping cart must be placed inside of the store.

Product	X Coordinate	Y-Coordinate	# Available	\$Cost
A	78	75	14	33
B	97	1	97	22
C	56	96	21	49
D	62	10	56	52
E	22	31	58	34
F	66	98	42	56
G	93	45	29	57
H	88	98	50	46
I	25	44	50	23
J	34	90	62	48
K	10	4	77	43
L	52	31	3	58
M	44	35	36	40
N	66	16	14	37
O	3	50	23	22
P	99	61	75	35
Q	79	16	16	48
R	13	62	13	37
S	5	84	4	28
T	9	80	23	118
U	20	67	82	24
V	95	84	8	56

- A. Assuming the shopping cart must be placed at X,Y coordinates (0,0) and assuming Euclidean distances, what is the maximum profit a contestant can achieve from the shopping spree? (Remember, maximum profit for the contestant is maximum loss for the book store.) **7 Points**

- B. Assuming the shopping cart must be placed at X,Y coordinates (0,0) and assuming Rectilinear distances, what is the maximum profit a contestant can achieve from the shopping spree? (Remember, maximum profit for the contestant is maximum loss for the book store.) **7 Points**
- C. Assuming you can place the shopping cart anywhere and assuming Euclidean distances, what is the maximum profit a contestant can achieve from the shopping spree? Also, where should the contestant place the shopping cart in order to maximize their profit? Provide the solution that Excel solver gives and provide a model or logic of your formulation. (Remember, maximum profit for the contestant is maximum loss for the book store.) **7 Points**
- D. Assuming you can place the shopping cart anywhere and assuming Rectilinear distances, what is the maximum profit a contestant can achieve from the shopping spree? Also, where should the contestant place the shopping cart in order to maximize their profit? Provide the solution that Excel solver gives and provide a model or logic of your formulation. (Remember, maximum profit for the contestant is maximum loss for the book store.) **7 Points**