Assignment 3

1. Three electric power plants with capacities of 25, 40 and 30 million kWh supply electricity to three cities. The maximum demands at the three cities are estimated at 30, 35 and 25 million kWh. The price per million kWh at the three cities is given in table.

Price/Million kWh

		City 1	2	3
	1	$600	$700	$400
Plant	2	$320	$300	$350
	3	$500	$480	$450

During the month of august, there is a 20% increase in demand at each of the three cities, which can be met by purchasing electricity from another network at a premium rate of $1000 per million kWh. The network is not linked to city 3, however. The utility company wishes to determine the most economical plan for the distribution and purchase of additional energy.

(a) Formulate the problem as a transportation modal.
(b) Determine an optimal distribution plan for the utility company.
(c) Determine the cost of the additional power purchased by each of the three cities.
(d) Solve the problem, assuming that there is a 10% power transmission loss through the network.

2. Three orchards supply crates of oranges to four retailers. The daily demand amounts at the four retailers are 150, 150, 400 and 100 crates, respectively. Supplies at the three orchards are dictated by available regular labor and are estimated at 150, 200 and 250 crates daily. However, both orchards 1 and 2 have indicated that they could supply more crates, if necessary, by using overtime labor. Orchard 3 does not offer option. The crates if necessary, by using overtime labor. Orchard 3 does not offer this option. The transportation costs per crate from the orchards to the retailer are given by

Transportation cost/ crates

		Retailer 1	2	3	4
	1	$1	$2	$3	$2
Orchard	2	$2	$4	$1	$2
	3	$1	$3	$5	$3

3. Cars are shipped from three distribution centers to five dealers. The shipping cost is based on the mileage between the sources and the destination, and is independent of whether the truck makes the trip with partial or full load. Table summarizes the mileage between the distribution centers and the dealers together with the monthly supply and demand figures given in number of cars. A full truckload includes 18 cars. The transportation cost per truck mile is $25.

		Dealer 1	2	3	4	5	Supply
	1	100	150	200	140	35	400
Center	2	50	70	60	65	80	200
	3	40	90	100	150	130	150
	Demand	100	200	150	160	140	

(a) Formulate the associated transportation model.

(b) Determine the optimal shipping schedule.

4. The demand for a perishable item over the next four month is 400, 300, 420 and 380 tons, respectively. The supply capacities for the same months are 500, 600, 200 and 300 tons. The purchase price per ton varies from month to month and is estimated at $100, $140, $120, and $150 respectively. Because the item is perishable, a current month's supply must be consumed within 3 months (stating with current month). The storage cost per ton per month is $3. The nature of the item does not allow back-ordering. Solve the problem as a transportation problem and determine the optimum delivery schedule for the item over the next 4 months.

5. Solve the following using the Cutting Plane Algorithm.

$$\begin{aligned} & \text{Maximize}(x_1 + 3x_2) \\ \text{subject to} \quad & -x_1 + 3x_2 \leq 6 \\ & 2x_1 + x_2 \leq 12 \\ & x_1, x_2 \geq 0 \text{ and integral} \end{aligned}$$

6. A firm with two plants must supply three outlets over the next three time periods. The supplies and demands over the three periods and the shipping costs for any period are given in the following tables

	Plant Supplies		***Outlet Demands***		
Period	*1*	*2*	*1*	*2*	*3*
1	15	25	10	5	20
2	15	25	10	10	10
3	10	20	10	15	10

Shipping Costs	*To Outlet*		
	1	*2*	*3*
From Plant 1	7	9	12
From Plant 2	10	11	16

The period demands at each outlet must be met exactly. Any units produced but undelivered at a plant may be stored at the plant for later delivery with a storage cost of 3/unit/period at Plant 1 and 2/unit/period at Plant 2, or such units may be sold at a profit of 5/unit at Plant 1 and 8/unit at Plant 2. How should the units be distributed so that net expenses are minimized?

7. Two plants supply four outlets weekly, with supplies, demands, and production and transportation costs as follows:

53	50	43	44	200
50	47	42	44	400
250	200	150	75	

The total supply of 600, which must be distributed, represents output using regular time. Plant 1 can produce up to another 40 units weekly using overtime at a cost of 5/unit over the costs given in the above table; Plant 2 can produce up to another 80 units weekly using overtime, at an increase in cost of 7/unit. Determine a minimal-cost production and delivery schedule.