THE AIRCO MANUFACTURING COMPANY

The AIRCO Manufacturing Company is one of the country's largest producers of home air conditioners. Its major product, a 3.000 portable BTU model, is distributed from four main plants (P1, P2, P3, P4) to six distribution centers DC's (A, B, C, D, E, F) scattered around the country. Weekly production capacities of the four plants for the next planning period, direct production costs (in $ / unit), and estimated rail shipping rates (in $ / unit) are summarized in the table that follows:

Plants	Prod. Capacity/ period	Prod. Cost ($/unit)	Distribution Centers					
			A	B	C	D	E	F
P1	8,900	10.80	6	15	25	21	24	33
P2	2,700	12.00	13	14	8	6	8	12
P3	1,250	10.50	19	21	19	10	19	26
P4	4,750	11.20	5	12	9	8	10	19

Table 1

From this table we can see that plant P1 has a production capacity of 8,900 units of air conditioners for the next planning period, incurs a direct production cost of $10.8 per unit, and its transportation costs per unit to the 6 DC's are 6, 15, 25, 21, 24, and 33 dollars respectively. Similar readings we can do for the other plants.

Overtime production is possible at plants P1 and P4, where labor agreements permit up to a 20% increase in weekly production capacity at an incremental cost of $1.00 per unit. Weekly inventory carrying costs at the plants are roughly $0.10 per unit. However, only up to 20% of production can be stored from one week to the next.

The expected minimum and maximum sales from the DC's and respective gross revenues per unit are as follows:

DC	Sales per planning period (units)		Gross Revenues ($ / unit)
	Min sales	Max sales	
A	2,305	3,216	20
B	1,278	2,878	30
C	2,915	4,065	25
D	84	117	40
E	3,699	5,160	38
F	3,708	5,172	42

Table 2

In addition to the normal shipping rates shown in table 1, the rail facilities serving certain routes from P2 additionally impose the following limitations:

From Plant	To DC	Maximum Weekly Flow (units)	Premium Cost for Truck Shipment ($/unit)
P2	A, B, C	1,400	Not available
P2	D	1,000	33.00
P2	E	500	14.50

Table 3

According to this table, for P2 to DC's A, B, C only up to 1,400 units can be shipped. For DC's D and E there is no actual limit in the quantity that can be transported, since quantities can be shipped above the maximum weekly flow at a premium. For example, if more than 1,000 units are shipped from P2 to D, then the premium cost of $33.00/unit incurs for the entire shipment. In the same way, if more than 500 units are shipped from P2 to E, then $14,50/unit need to be paid.

Management has made it clear that shipping and inventory policies should receive particular attention, but that temporary plant closings would not be feasible in view of company personnel policies. It has also supported that, mostly for reasons of brand image, demand of all distribution centers should be aimed at being satisfied. For this reason, you are asked to develop a model of the company's purchasing, manufacturing, and transportation activities for the next planning horizon. More specifically, AIRCO's CEO is concerned that the total delivered cost could be significantly reduced, and, hence, net revenues significantly increased, if the company would pursue an integrated planning approach. He is also interested in evaluating options for next year relating to future expansions.

You are asked to answer the following questions in a clear and concise manner:

(a) Develop a model, and explain all variable, constraints and objective function
(b) Optimize the model using Excel and prepare a brief report on AIRCO's optimal strategy for the next planning horizon.
(c) The CEO believes that the maximal sales forecasts developed by the Marketing Department may be overly optimistic. He asks you to return the model with an across the board 15% decrease in maximal sales. Explain he changes you do in the previous model, optimize the model with this new data and briefly compare the strategy with the one obtained in part (a).
(d) AIRCO is currently considering starting to negotiate with local trade unions in the areas of plants P2 and P3 for the possibility of overtime work. If overtime work was also possible at these plants, this would mean up to a 20% increase of weekly production capacity, for an incremental cost of $1.00 / unit. How would the company's optimal strategy change and what would the new gross revenues become?