(Kellwood) Kellwood, a company that produces a single product, has three plants and four customers. The three plants will produce 6000, 4000, and 5000 units, respectively, during the next time period. Kellwood has made a commitment to sell 3000 units to customer 1, 5000 units to customer 2, and at least 2000 units to customer 3. Both customers 3 and 4 also want to buy as many of the remaining units as possible. The profit associated with shipping a unit from each plant to each customer is given in the file **P05_80.xlsx**. Determine how to maximize Kellwood's profit

Kellwood data				
Unit profits	Cust 1	Cust 2	Cust 3	Cust 4
Plant 1	$69	$62	$69	$73
Plant 2	$66	$62	$56	$66
Plant 3	$60	$78	$66	$79

WinstonAlbright_6e_ P05_80.xlsx

Discussion: -

Our objective is to increase profit for Kellwood. We must plan the distribution system between plants and customers. Total profit is sum-product of the unit profit and number of units distributed from a plant to customer. So, we can go for Number of units distributed from each plant to each customer as our decision variable.

Mathematical Model: -

Parameters (Inputs):

$i \in 1,2,3$ $\quad (i: Index\ for\ plants)$
$j \in 1,2,3,4$ $\quad (j: Index\ for\ customers)$
A_{ij} : $Profit\ associated\ with\ plant\ i\ and\ customer\ j$
P_i : $Production\ capacity\ of\ plant\ i$
D_j : $Demand\ from\ customer\ j$ $\{D_1: 3000, D_2: 5000, D_3: 2000, D_4: 0\}$

Decision Variables:
x_{ij} : $Units\ shipped\ from\ plant\ i\ to\ customer\ j$

Objective:

$$Maximize\ total\ \ profit = \sum_{j=1}^{4}\sum_{i=1}^{3}(x_{ij} * A_{ij})$$

Constraints:

$$\sum_{j=1}^{6} x_{ij} \le P_i \ ; \quad for\ i \in \{1,2,3\} \qquad (1)\ Production\ capacity\ constraint$$

$$\sum_{i=1}^{3} x_{ij} \geq D_j \; ; \quad for\ j\ \epsilon\{1,2,3,4\} \qquad (2)\ Demand\ constraint\ from\ each\ customer$$

Our model will not go for any negative decision values as it is maximization problem, so no need to define non-negative constraint in the model.

Excel Implementation: Please find the attached spreadsheet for solution.

35[RA].xlsx

Kellwood data										Inputs
Unit profits	Cust 1	Cust 2	Cust 3	Cust 4						Decision variables
Plant 1	$69	$62	$69	$73				Profit		Calculated Variables
Plant 2	$66	$62	$56	$66				1084000		Constraints
Plant 3	$60	$78	$66	$79						Objective
	Cust 1	Cust 2	Cust 3	Cust 4						
Plant 1	0	0	2000	4000	6000	<=	6000			
Plant 2	3000	0	0	1000	4000	<=	4000			
Plant 3	0	5000	0	0	5000	<=	5000			
	3000	5000	2000	5000						
	>=	>=	>=	>=						
	3000	5000	2000	0						