

Optimization Model

1. Aire-Co's dehumidifiers

Decision Variable x_{ij} : The number of dehumidifiers produce at plant i $\begin{cases} 1: \text{Atlanta} \\ 2: \text{Phoenix} \end{cases}$ <units> in month $j \rightarrow \{1, 2, 3\}$
 y_i : The number of dehumidifiers held in inventory after month $i \rightarrow \{1, 2, 3\}$ <units>

Objective Function MIN: $400x_{11} + 400x_{12} + 400x_{13} + 360x_{21} + 360x_{22} + 360x_{23} + 30y_1 + 30y_2 + 30y_3$

Subject to $x_{ij} \leq 300 \quad \forall i, j \rightarrow$ จำนวนผลิตต่อเดือน $\sum_{i,j=1}^3 (400x_{ij} + 360x_{2j} + 30y_i)$

$$\begin{aligned} y_1 &= x_{11} + x_{21} - 300 \\ y_2 &= y_1 + x_{12} + x_{22} - 400 \\ y_3 &= y_2 + x_{13} + x_{23} - 500 \end{aligned} \quad \left. \vphantom{\begin{aligned} y_1 &= x_{11} + x_{21} - 300 \\ y_2 &= y_1 + x_{12} + x_{22} - 400 \\ y_3 &= y_2 + x_{13} + x_{23} - 500 \end{aligned}} \right\} \text{Inventory}$$

$$\begin{aligned} x_{11} + x_{21} &\geq 300 \\ x_{12} + x_{22} &\geq 400 \\ x_{13} + x_{23} &\geq 500 \end{aligned} \quad \left. \vphantom{\begin{aligned} x_{11} + x_{21} &\geq 300 \\ x_{12} + x_{22} &\geq 400 \\ x_{13} + x_{23} &\geq 500 \end{aligned}} \right\} \text{Demand}$$

$$x_{ij} \geq 0 \quad \forall i, j$$

$$y_i \geq 0 \quad \forall i$$

	Plant	
	Atlanta	Phoenix
Production Cost (\$/unit)	400	360

Each plant's limit: 300 units/month

Inventory cost: \$30 per unit each month

Demand: 300, 400, 500 units (3 month)

Goal: Minimize cost

Optimal Solution คือ $x_{11} = 0, x_{12} = 100, x_{13} = 200, x_{21} = 300, x_{22} = 300, x_{23} = 300, y_1 = 0, y_2 = 0, y_3 = 0$

Objective Function Value คือ $F(x) = \$444000$

Decision Variable:	1st Month	2nd Month	3rd Month		
Atlanta Produce (units)	0	100	200		
Phoenix Produce (units)	300	300	300		
Inventory (units)	0	0	0		
Objective Function:					
Minimize cost:	444000				
Subject to:	1st Month	2nd Month	3rd Month		
Maximum Atlanta production	0	100	200	<=	300
Maximum Phoenix production	300	300	300	<=	300
y_1	0	=	0		
y_2	0	=	0		
y_3	0	=	0		
$x_{11} + x_{21}$	300	>=	300		
$x_{12} + x_{22}$	400	>=	400		
$x_{13} + x_{23}$	500	>=	500		
	1st Month	2nd Month	3rd Month		
x_{ij}	0	100	200	>=	0
	300	300	300	>=	0
y_i	0	0	0	>=	0

2. Investment Plan

Decision Variable x_i : The number of money to allocate to investment i $\{1: \text{bonds}, 2: \text{mortgages}, 3: \text{car loans}, 4: \text{personal loans}\}$ <\$>

Objective Function MAX: $0.1x_1 + 0.085x_2 + 0.095x_3 + 0.125x_4$

Subject to $x_4 \leq 0.25(650000) \rightarrow$ restrict personal loans

$$x_2 - x_4 \geq 0 \rightarrow \text{more invest in mortgages}$$

$$x_1 - x_4 \geq 0 \rightarrow \text{more invest in bonds}$$

$$x_1 + x_2 + x_3 + x_4 \leq 650000 \rightarrow \text{assets available}$$

$$x_i \geq 0 \quad \forall i$$

Optimal Solution คือ $x_1 = 325000, x_2 = 162500, x_3 = 0, x_4 = 162500$

Objective Function Value คือ $F(x) = \$66625$

Decision Variable:	Investment		
Bonds (\$)	325000		
Home Mortgages (\$)	162500		
Car Loans (\$)	0		
Personal Loans (\$)	162500		
Objective Function:			
Maximize return:	66625		
Subject to:			
x_4	162500	<=	162500
$x_2 - x_4$	0	>=	0
$x_1 - x_4$	162500	>=	0
$x_1 + x_2 + x_3 + x_4$	650000	<=	650000
x_1	325000	>=	0
x_2	162500	>=	0
x_3	0	>=	0
x_4	162500	>=	0

3. Weedwacker Company's lawn trimmers

Decision Variable X_i : The number of lawn trimmers produce type i {1: electric, 2: gas} <units>

Y_i : The number of lawn trimmers bought type i {1: electric, 2: gas} <units>

Objective Function MIN: $55X_1 + 82X_2 + 67Y_1 + 95Y_2$

Subject to $X_1 + Y_1 \geq 30000$
 $X_2 + Y_2 \geq 15000$ } Contract

$0.2X_1 + 0.4X_2 \leq 10000$
 $0.3X_1 + 0.5X_2 \leq 15000$
 $0.1X_1 + 0.1X_2 \leq 5000$ } Hours Available

$X_i \geq 0 \quad \forall i$

$Y_i \geq 0 \quad \forall i$

Optimal Solution is $X_1 = 30000, X_2 = 10000, Y_1 = 0, Y_2 = 5000$

Objective Function Value is $F(x) = \$2945000$

Decision Variable:	Electric	Gas	
Produce (units)	30000	10000	
Bought (units)	0	5000	
Objective Function:			
Minimize cost:	2945000		
Subject to:			
$X_1 + Y_1$	30000	\geq	30000
$X_2 + Y_2$	15000	\geq	15000
$0.2X_1 + 0.4X_2$	10000	\leq	10000
$0.3X_1 + 0.5X_2$	14000	\leq	15000
$0.1X_1 + 0.1X_2$	4000	\leq	5000
X_1	30000	\geq	0
X_2	10000	\geq	0
Y_1	0	\geq	0
Y_2	5000	\geq	0

4. Electrotech Corporation's profit

Decision Variable X_i : The number of electrical devices produce type i {1: generators, 2: alternators} <units>

Objective Function MAX: $250X_1 + 150X_2$

Subject to $2X_1 + 3X_2 \leq 260$ (wiring time)

$X_1 + 2X_2 \leq 140$ (testing time)

$X_1 \geq 0$

$X_2 \geq 0$

Optimal Solution is $X_1 = 130, X_2 = 0$

Objective Function Value is $F(x) = \$32500$

Decision Variable:	Produce		
Generator (units)	130		
Alternator (units)	0		
Objective Function:			
Maximize profit:	32500		
Subject to:			
Wiring time	260	\leq	260
Testing time	130	\leq	140
X_1	130	\geq	0
X_2	0	\geq	0