Model Formulation

(1) Min-Cost Model

Index:

i = Customers { Marietta, Reno, Charleston, St Augustine, Boise, Phoenix, Tulsa }

j = Warehouses { Las Vegas, Atlanta, Memphis, Dallas, Philadelphia, Chicago }

Data:

S = Cost per mile per pallet = $0.06

P_i = Daily Demand (pallets)

F_j = Fixed cost of operating warehouse for 4 years

C_{ij} = Distances in miles from each warehouse(j) to each customers (i)

Decision Variables:

x_{ij} = 1 if Warehouse j serves Customer i, 0 otherwise

Auxiliary Variables:

y_j = 1 if Warehouse j is used, 0 otherwise

Objective:

$$TC = Transportation\ Cost = S * C_{ij} * P_i * 365 * 4$$

$$\min \sum_j F_j y_j + \sum_i \sum_j x_{ij} * TC$$

Constraints:

$\sum_j x_{ij} = 1 \ \forall i$ "Each customer is served by one warehouse"

$y_j \geq x_{ij} \ \forall i \ \forall j$ "If warehouse is not open you can not use the route associated"

$x_{ij} \in \{0, 1\}$

$y_j \in \{0, 1\}$

(2) Two Warehouses Model

Index:

i = Customers { Marietta, Reno, Charleston, St Augustine, Boise, Phoenix, Tulsa }

j = Warehouses { Las Vegas, Atlanta, Memphis, Dallas, Philadelphia, Chicago }

Data:

S = Cost per mile per pallet = $0.06

P_i = Daily Demand (pallets)

F_j = Fixed cost of operating warehouse for 4 years

C_{ij} = Distances in miles from each warehouse(j) to each customers (i)

Decision Variables:

x_{ij} = 1 if Warehouse j serves Customer i, 0 otherwise

Auxiliary Variables:

y_j = 1 if Warehouse j is used, 0 otherwise

Objective:

$$TC = Transportation\ Cost = S * C_{ij} * P_i * 365 * 4$$

$$\min \sum_j F_j y_j + \sum_i \sum_j x_{ij} * TC$$

Constraints:

$\sum_j x_{ij} = 1 \ \forall i$ "Each customer is served by one warehouse"

$y_j \geq x_{ij} \ \forall i \ \forall j$ "If warehouse is not open you can not use the route associated"

$\sum_j y_j = 2$ "Open two warehouses"

$x_{ij} \in \{0, 1\}$

$y_j \in \{0, 1\}$

(3) Three Warehouses Model

Index:

i = Customers { Marietta, Reno, Charleston, St Augustine, Boise, Phoenix, Tulsa }

j = Warehouses { Las Vegas, Atlanta, Memphis, Dallas, Philadelphia, Chicago }

Data:

S = Cost per mile per pallet = $0.06

P_i = Daily Demand (pallets)

F_j = Fixed cost of operating warehouse for 4 years

C_{ij} = Distances in miles from each warehouse(j) to each customers (i)

Decision Variables:

x_{ij} = 1 if Warehouse j serves Customer i, 0 otherwise

Auxiliary Variables:

y_j = 1 if Warehouse j is used, 0 otherwise

Objective:

$$TC = Transportation\ Cost = S * C_{ij} * P_i * 365 * 4$$

$$\min \sum_j F_j y_j + \sum_i \sum_j x_{ij} * TC$$

Constraints:

$\sum_j x_{ij} = 1 \ \forall i$ "Each customer is served by one warehouse"

$y_j \geq x_{ij} \ \forall i \ \forall j$ "If warehouse is not open you can not use the route associated"

$\sum_j y_j = 3$ "Open three warehouses"

(4) Min-Distance Model

Index:

i = Customers { Marietta, Reno, Charleston, St Augustine, Boise, Phoenix, Tulsa }

j = Warehouses { Las Vegas, Atlanta, Memphis, Dallas, Philadelphia, Chicago }

Data:

C_{ij} = Distances in miles from each warehouse(j) to each customers (i)

Decision Variables:

x_{ij} = 1 if Warehouse j serves Customer i, 0 otherwise

Objective:

$\min \sum_i \sum_j x_{ij} * C_{ij}$

Constraints:

$\sum_j x_{ij} = 1 \; \forall i$ "Each customer is served by one warehouse"

$y_j \geq x_{ij} \; \forall i \; \forall j$ "If warehouse is not open you can not use the route associated"

$x_{ij} \in \{0, 1\}$

$y_j \in \{0, 1\}$