Decision Variable

We have 8 locations that are considered to be potential warehouse locations

1. Atlanta
2. Buffalo
3. Chicago
4. Cincinnati
5. Detroit
6. Pittsburgh
7. Richmond
8. St. Louis

We have 22 cities that need the distribution centers to send products

1. Atlanta
2. Birmingham
3. Buffalo
4. Charteston
5. Charlotte
6. Chattanooga
7. Chicago
8. Cincinnati
9. Cleveland
10. Columbus
11. Detroit
12. Evansville
13. Ft Wayne
14. Indianapolis
15. Knoxville
16. Louisville
17. Memphis
18. Nashville
19. Peoria
20. Pittsburgh
21. Richmond
22. St. Louis

We assign Xij (i=1,⋯,8, j=1,⋯,22) to represent how much cwt of product should each of the 8 potential warehouse locations send to the 22 cities

We assign Zi(i=1,⋯,8) to represent how much cwt of product should each of the 8 potential warehouse locations hold

Zi=Sum (Xij), i=1,⋯,8

We assign binary decision variable Yi (1=1,⋯,8) to represent if the potential warehouse location should have a ware house

Yi=0 if Zi=0

Yi=1 if Zi >0

Objective Function

We would like to minimize the leasing cost

Let FCi (i=1,⋯,8) represent the fixed cost of each of the 8 potential warehouse locations

Let VCi (i=1,⋯,8) represent the variable cost of each of the 8 potential warehouse locations

Let Li (i=1,⋯,8) represent the minimum capacity of each of the 8 potential warehouse locations

Let Ui (i=1,⋯,8) represent the maximum capacity of each of the 8 potential warehouse locations

Let Nj (j=1,⋯,22) represent the need of each 22 cities

Let Dij (i=1,⋯,8, j=1,⋯,22) represent the distribution cost of each of the 8 potential warehouse locations sending products to the 22 cities

Total cost=Leasing cost + Distribution cost

Leasing cost=fixed cost + variable cost=Sum (FCi*Yi)+Sum [(Zi-Li)*VCi*Yi]

Distribution cost=Sum(Xij*Dij)

Total cost= Sum (FCi*Yi)+Sum [(Zi-Li)*VCi*Yi]+Sum (Xij*Dij)

Constraints

1. The total volume of a single warehouse is equal to the sum of all the amount of product should the potential warehouse send to the 22 cities
   Zi=Sum (Xij), i=1,⋯,8
2. The binary decision variable Yi (1=1,⋯,8) should be 0 if the total volume of a single warehouse is 0
   Yi=0 if Zi=0
   Yi=1 if Zi >0
3. The total volume of a single warehouse should be less or equal to the maximum capacity of each of the potential warehouse location
   Zi<=Ui
4. Meet the demand
   Sum(Xij)>=Nj (j=1,⋯,22)
5. Non-negativity

Optimal Solution

According to the output, the optimal solution in chart is shown below:

Open or not	**Yes**	**Yes**	**No**	**Yes**	**No**	**No**	**Yes**	**Yes**
	Atlanta	Buffalo	Chicago	Cincinnati	Detroit	Pittsburgh	Richmond	St. Louis
Atlanta	275	0	0	0	0	0	0	0
Birmingham	160	0	0	0	0	0	0	0
Buffalo	0	240	0	0	0	0	0	0
Charteston	135	0	0	0	0	0	260	0
Charlotte	0	0	0	0	0	0	0	0
Chattanooga	160	0	0	0	0	0	0	0
Chicago	0	0	0	0	0	0	0	400
Cincinnati	0	0	0	200	0	0	0	0
Cleveland	0	320	0	0	0	0	0	0
Columbus	0	0	0	220	0	0	0	0
Detroit	0	190	0	0	0	0	0	0
Evansville	0	0	0	0	0	0	0	100
Ft Wayne	0	0	0	100	0	0	0	40
Indianapolis	0	0	0	0	0	0	0	310
Knoxville	125	0	0	0	0	0	0	0
Louisville	0	0	0	340	0	0	0	0
Memphis	0	0	0	0	0	0	0	240
Nashville	210	0	0	0	0	0	0	0
Peoria	0	0	0	0	0	0	0	150
Pittsburgh	0	340	0	0	0	0	0	0
Richmond	0	0	0	0	0	0	300	0
St. Louis	0	0	0	0	0	0	0	260
Total product held	**1065**	**1090**	**0**	**860**	**0**	**0**	**560**	**1500**

Hornby can lease warehouses in Atlanta, Buffalo, Cincinnati, Richmond, and St.Louis

The chart shows how to distribution the products from the ware houses to the 22 cities as well as the total capacity each warehouse should have

Optimal Cost

The optimal cost for is 56075.0