Maxwell Ojerholm Assignment 2

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* 1. The optimal solution by maximizing profits is $4,364.80. This optimization is achieved by producing 1000 lbs of Whole, 500 lbs of Cluster, 80 lbs of Crunch, and 200 lbs of Roaster.
  2. Yes, the solution is unique as the allowable increase and decrease do not include a value of zero.
  3. No, the solution is not degenerated as all the decision variables are not zero.
  4. Decrease the production of Crunch as it has the lowest profit margin of each of the products at $1.56 per lbs.
  5. Increase the production of Whole as it has the highest profit margin of each of the products at $2.77.
  6. The Packaging Used Machine is a resource that is limiting MNC from making more money as it is using all 3,600 minutes. The shadow price for additional machine time is 1.248. The marginal value of adding more time is $1.248.
  7. MNC would be willing to pay for 36 more pounds of chocolate as they have 800 pounds of chocolate available to use yet only 764 pounds were used.
  8. A decrease in $0.25 for Whole would change Unit Profit Margin from $2.77 to $2.52. This would change the objective function to

Maximize Profits: 2.52x1 + 2.10x2 + 1.56x3 + 2.10x4

2.52(1000) + 2.10(500) + 1.56(80) + 2.10(200)= 4,4114.8

The optimal solution to maximize profits is $4,114.80

* 1. As an increase of $0.50 to Whole is outside of the allowable increase it would alter the optimal solution. The marketing department is allowed to increase the price by $0.35. $2.77 + $0.50= $3.27.

Objective function: Maximize Profits= 3.27x1 + 2.10x2 + 1.56x3 + 2.10x4

1000\*0.35= $350

1000\*0.50= $500

The impact on the objective function is at least $350, and at most $500.

* 1. Network Flow Model



* 1. (See Attached Excel Spreadsheet)
  2. The optimal solution is found when costs are minimized at $397,000. The amount of units shipped to the specified location is seen by looking at the spreadsheet.
  3. Network Representation:



* 1. LP Formulation:

Decision Variables: Xft= shipping cases from city “f” to city “t”

1= San Diego, 2= Los Aneles, 3= Denver, 4= St. Louis, 5= Memphis, 6= Chicago, 7= New York

Cost Minimization= 5x12 + 13x13 + 45x15 +105x17 + 27x23 + 19x24 + 50x25 + 95x27 + 14x34 + 30x35 + 32x36 + 14x43 + 35x45 + 24x46 + 35x54 + 18x56 + 25x57 + 24x64 + 18x65 + 17x67

Subject To:

Restrictions

x12 + x13 + x15 + x17 = 100 (San Diego supplies 100 cases)

x12 - x23 - x24 - x25 - x27 = 0 (LA gets supply, ships it off to other cities, left with 0 cases)

x13 + x23 + x43 - x34 - x35 - x36 = 0 (Denver gets supply, ships it off, left with 0 cases)

x24 + x34 + x54 + x64 - x43 - x45 - x46 = 0 (St. Louis gets supply, ships it off, left with 0 cases)

x15 + x25 + x35 + x45 + x65 - x54 - x56 - x57 = 0 (Memphis gets supply, ships it off, left with 0 cases)

x36 + x46 + x56 - x64 - x65 - x67 = 0 (Chicago gets supply, ships it off, left with 0 cases)

x17 + x27 + x57 + x67 = 100 (New York gets 100 cases as demanded)

x12, x13, x15, x17, x23, x24, x25, x27, x34, x35, x36, x43, x45, x46, x54, x56, x57, x64, x65, x67 > 0 (non negative)

* 1. (See Attached Excel Spreadsheet)

The optimal solution to minimize total cost is found at $6,200. Using the path from San Diego to Denver, then from Denver to Chicago, then Chicago to New York minimizes the costs at $6,200.