Optimizing Product Transportation at Frito Lay

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Agenda

- Company Overview
- Current Situation
- Objective
- Model
- Results
- Recommendations
Company Overview: Frito Lay

- Division of PepsiCo that manufactures corn chips, potato chips and other snack foods.
- Brands: Doritos, Tostitos, Cheetos, Ruffles, Munchies, Grandma’s
- Headquarters: Plano, TX
- Revenue: $15 billion
Company Overview: Gamesa

- Largest cookie company in Mexico
  - Division of PepsiCo.
- Brands: Emperador, Marias, Mamut, Chokis….
- Revenue: $2 billion
- Headquarters: Monterrey, MX
Current Situation

- In order to satisfy the large Hispanic market in the US, Frito Lay imports Gamesa brands from Mexico.
- Several Frito Lay brands are also produced in Mexico and imported into the US as well.
Plants in Monterrey, Vallejo, Celaya and Obregon.

All pass through Obregon to be consolidated. Then, exported all across the U.S.
Current Situation - Products

- Our project was narrowed down to focus specifically on two products.
  - Munchies Mini Sandwich Crackers
  - Grandma’s Mini Fudge Chocolate Chips
Current Situation

- All products are produced in Vallejo.
- Demand in 5 cities for each of the 4 products.
  - Cucamonga CA
  - Modesto CA
  - Dallas TX
  - Frankfort IN
  - Pulaski TN
- Only plants with consolidation capabilities are Dallas and Obregon.
Current Situation - Transportation
Objective

- Help Frito Lay reduce transportation costs by finding the optimal routes to export/import from Mexico into the different cities in the United States

- Things to consider:
  - Geography
  - Production Capabilities
  - Space to consolidate
Model – Multi-Commodity Fixed Charge Network Flow Problem
Model - Inputs

- **Sources:** All products manufactured in Vallejo
  - Infinite production capacity for current demands.

- **Demands:** All 5 cities
  - Couldn’t create accurate forecast
    - Have only 8 months of past data.
    - Insufficient for seasonality analysis.
  - Used Average of the 8 months as the future demand.
Model - Inputs

- **Arcs (Cost):**
  - Got current quotes from Swift, Magellan, Schneider. (International transportation includes border fees).
  - Crossing fees:
    - Mty-Laredo: $600, Obregon-Nogales: $1200
Model - Algorithm

Code

```plaintext
param Demand {Destinations, Commodities}, default 0.0;
param Cost {Arcs};

data e:FL_Data.txt;

var x {Arcs, Commodities} := 0;
var b {Arcs} binary;

display Nodes;
display Sources;
display Destinations;
display Commodities;
display Arcs;
display Demand;
display Cost;

minimize OBJ: sum{{i,j} in Arcs} Cost[i,j] * b[i,j];

subject to C1{k in Sources, c in Commodities}:
    sum{{k,j} in Arcs} x[k,j,c] - sum{{i,k} in Arcs} x[i,k,c] = 999999;

subject to C2{k in Destinations, c in Commodities}:
    sum{{k,j} in Arcs} x[k,j,c] - sum{{i,k} in Arcs} x[i,k,c] = Demand[k,c];

subject to C3{{i,j} in Arcs}: sum{{c in Commodities} x[i,j,c] <= 1000000000*b[i,j];

solve;
# expand;
display x, b;
```

Data

```plaintext
set Nodes := 1 2 3 4 5 6 7;
sset Sources := 1 2 3;
sset Destinations := 2 3 4 5 6 7;
sset Commodities := q w e r t;
sset Arcs := (1,2) (1,3) (2,4) (2,5) (2,6) (2,7) (3,4) (3,5) (3,6) (3,7);

param Cost :=
    1 2 2208
    1 3 1838.59
    2 4 2074.66
    2 5 2728.75
    2 6 1953.68
    2 7 1262.06
    3 4 2461
    3 5 3212
    3 6 4738
    3 7 4511;

param Demand :=
    # q is product 62700 (Chokis 85g)
    # w is product 62000 (Chokis 35g)
    # e is product 63200 (Munchies 35g)
    # r is product 63000 (Munchies 85g)
    2 q -25117.38
    2 w -6957.49
    2 e -10294.53
    2 r -26633.75
    4 q -10343.83
    4 w -5142.49
    4 e -5434.41
    4 r -10973.75
```
Results

AMPL/CPLEX

Results

AMPL/CPLEX 10.0.0: optimal integer solution; objective 9319.97
0 MIP simplex iterations
0 branch-and-bound nodes

\[ x \begin{bmatrix} e & q & r & w \end{bmatrix} \begin{bmatrix} 2 & 60742.3 & 89082.9 & 99600.5 & 48130.3 \\ 3 & 0 & 0 & 0 & 0 \end{bmatrix} \]

\[ \begin{bmatrix} e & q & r & w \end{bmatrix} \begin{bmatrix} 4 & 5434.41 & 10343.8 & 10973.8 & 5142.49 \\ 5 & 0 & 3685.82 & 5083.73 & 0 \\ 6 & 30438.6 & 22828.2 & 24906.1 & 2384.1 \\ 7 & 14584.8 & 27828.5 & 32003.2 & 12152.2 \end{bmatrix} \]

\[ \begin{bmatrix} e & q & r & w \end{bmatrix} \begin{bmatrix} 4 & 0 & 0 & 0 \\ 5 & 0 & 0 & 0 \\ 6 & 0 & 0 & 0 \\ 7 & 0 & 0 & 0 \end{bmatrix} \]

\[ \begin{bmatrix} b \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 0 \\ 2 & 1 \\ 2 & 1 \\ 2 & 1 \\ 2 & 1 \\ 3 & 0 \\ 3 & 0 \\ 3 & 0 \end{bmatrix} \]
Results - Map
## Results - Costs

<table>
<thead>
<tr>
<th>Presentation</th>
<th>85g</th>
<th>35g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36 bags</td>
<td>64 bags</td>
</tr>
<tr>
<td></td>
<td>36 bales</td>
<td>48 bales</td>
</tr>
<tr>
<td></td>
<td>60 platforms</td>
<td>60 platforms</td>
</tr>
<tr>
<td>Total bags per truck</td>
<td>77,760.00</td>
<td>184,320.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>521,233.57</td>
</tr>
<tr>
<td>Total Trucks per Month</td>
<td>6.70</td>
<td>2.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transportation Cost (9319.97 per truck)</th>
<th>$62,472.75</th>
<th>$26,355.69</th>
</tr>
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<tbody>
<tr>
<td>Total Cost</td>
<td>$88,828.44</td>
<td></td>
</tr>
<tr>
<td>TOTAL Real Cost (10 Trucks)</td>
<td>$93,199.70</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Cost</th>
<th>$167,125.90</th>
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</thead>
<tbody>
<tr>
<td>Savings per Month</td>
<td>$73,926.20</td>
</tr>
<tr>
<td>Savings per Year</td>
<td>$887,114.40</td>
</tr>
</tbody>
</table>
Recommendations

- Consolidate products in Dallas
  - Driving distance: 22 hours in total
    - Vallejo - Laredo: 14
    - Laredo - Dallas: 8

- Train employees in Vallejo to export (fill out paperwork).
- Teach new route to drivers.
CONTACTS

- Alberto Galvan– Frito Lay Marketing Director
- Greta Medina– Gamesa/Quaker International Supply Chain Manager
- Heather Diamond– Frito Lay National Supply Chain Integration Manager
QUESTIONS?