Assignment: The LP Model

Gaurav Kudeshia

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Summary

• The maximum achievable revenue is $1780, which can be obtained by producing 40 artisanal truffles, 12 handcrafted chocolate nuggets, and 4 Premium Gourmet Chocolate Bars.

• Constraints are imposed by the availability of cacao butter, dairy cream, and honey.

• Regarding the cacao butter constraint, the shadow price is $2, and the feasible range for cacao butter availability is between 475 and 600 pounds.

• Concerning the dairy cream constraint, the shadow price is $30, and the feasible range for dairy cream availability is between 300 and 520 pounds.

• For the honey constraint, the shadow price is $6, and the feasible range for honey availability is between 250 and 500 pounds.

• The range of optimality for the product prices is as follows: Artisanal truffles can be priced between $20.00 and $38.00, handcrafted chocolate nuggets between $22.50 and $26.67, and premium gourmet chocolate bars between $18.75 and $35.00.

Loaded lpsolveAPI

```
library(lpSolveAPI)
```

**Problem Statement:

A renowned chocolatier, Francesco Schröeder, makes three kinds of chocolate confectionery: artisanal truffles, handcrafted chocolate nuggets, and premium gourmet chocolate bars. He uses the highest quality of cacao butter, dairy cream, and honey as the main ingredients. Francesco makes his chocolates each morning, and they are usually sold out by the early afternoon. For a pound of artisanal truffles, Francesco uses 1 cup of cacao butter, 1 cup of honey, and 1/2 cup of cream. The handcrafted nuggets are milk chocolate and take 1/2 cup of cacao, 2/3 cup of honey, and 2/3 cup of cream for each pound. Each pound of the chocolate bars uses 1 cup of cacao butter, 1/2 cup of honey, and 1/2 cup of cream. One pound of truffles, nuggets, and chocolate bars can be purchased for $35, $25, and $20, respectively. A local store places a daily order of 10 pounds of chocolate nuggets, which means that Francesco needs to make at least 10 pounds of the chocolate nuggets each day. Before sunrise each day, Francesco receives a delivery of 50 cups of cacao butter, 50 cups of honey, and 30 cups of dairy cream.

1, Formulate and solve the LP model that maximizes revenue given the constraints. How much of each chocolate product should Francesco make each morning? What is the maximum daily revenue that he can make?

2, Report the shadow price and the range of feasibility of each binding constraint.

3, If the local store increases the daily order to 25 pounds of chocolate nuggets, how much of each product should Francesco make?

Let's define the following:

Decision Variables: We have three variables:

x: Represents the number of artisanal truffles.

y: Represents the number of handcrafted chocolate nuggets.

z: Represents the number of premium gourmet chocolate bars.

- Our goal is to maximize the objective function Max 35x + 25y + 20z.
- To achieve this, we must adhere to the following constraints:

1, Butter Constraint: The total cups of cacao butter used must not exceed the available supply of 50 cups, expressed as 1x + 0.5y + 1z <= 50.

2, Honey Constraint: The total cups of honey used should stay within the available supply of 50 cups, represented as 1x + 0.66y + 0.5z <= 50.

3, Cream Constraint: We must manage the total cups of dairy cream used to stay within the available supply of 30 cups, indicated by 0.5x + 0.66y + 0.5z <= 30.

- Chocolate Nuggets Minimum Order: To meet the local store's daily order requirement for chocolate nuggets, we ensure that z (representing the daily quantity of chocolate nuggets) is greater than or equal to 10.
- These constraints ensure that our solution respects the available resources, and we meet the minimum order requirement for chocolate nuggets.
- Output cannot be negative it will be >= 0.

Output is Zero that means our model is working perfectly

```
solve(A)
```

```
## [1] 0
```

Got maximized value

```
get.objective(A)
```

```
## [1] 1780
```

```
D <- get.variables(A)
```

Solved the model

```
solve(A)
```

```
## [1] 0
```

```
get.objective(A)
```

```
## [1] 1780
```

```
get.variables(A)
```

```
## [1] 40 12  4
```

```
get.constraints(A)
```

```
## [1] 50 50 30
```

Post optimal solution

Below is the code for the next part of the question- where while keeping the same optimal solution I have changed rhs & objective for the first code defines shadow prices & second one defines reduced cost.

```
get.sensitivity.rhs(A)
```

```
## $duals
## [1]  2 30  6  0  0  0
##
## $dualsfrom
## [1]  4.75e+01  3.00e+01  2.50e+01 -1.00e+30 -1.00e+30 -1.00e+30
##
## $dualstill
## [1] 6.0e+01 5.2e+01 5.0e+01 1.0e+30 1.0e+30 1.0e+30
```

```
get.sensitivity.obj(A)
```

```
## $objfrom
## [1] 20.00 22.50 18.75
##
## $objtill
## [1] 38.00000 26.66667 35.00000
```