# Assigment -1(qmm)

2023-09-19

This notebook contains the code for Assignment 1

# Summary

1. Maximum revenue = $1816.667 by making 40.00000 of truffels, 16.66667 by nuggets, 0.00000 by bars.
2. *Cacao Butter: 0.00000 is it shadow price. where range of feasibility is No change in revenue if the availability of cacao butter increases or decreases within the given constraints.* Honey: 16.67 shadow price. range of feasibility is 16. $*DairyCream : 66.7shdowprice.rangeoffeasibilityis66.$ *Chocolate Nuggets Order: 000000 shadow price. range os feasibility is An increase or decrease no change.
3. Range of optimality:Artisanal Truffles (x1):$83.33,Chocolate Nuggets (x2):$60, Premium Chocolate Bars(x3):$41.66

```
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? ***

we define the following

- Decision variables: Let *x1* price of one pound of truffel, *x2* price of one pound of nuggets and *x3* price of one pound of bars.
- The objective is to *35x1 + 25x2 + 20x3*. The constrain are
- *coco butter: 1, 0.5, 1 <=50; Honey : 1, 0.6, 0.5 <=50; Cream : 0.5, 0.6, 0.5 <=30;* Non-negativity Constraint: *x1,x2,x3 >= 10;* Nuggets order constrain: *x2 >= 10;*(Francesco must make at least 10 pounds of chocolate nuggets each day.)

we now solve the lp problem

```
solve(lprec)
```

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

The output above doesn't indicate that the answer is 0, but that there was a successful solution We now output the value of the objective function, and the variables

```
max_revenue = get.objective(lprec)
max_revenue
```

```
## [1] 1816.667
```

```
varV = get.variables(lprec)
varV
```

```
## [1] 40.00000 16.66667  0.00000
```

---

We now read the lp formulation using an lp file. To read about about the lp format for files, you can read the documentation at ("C:/Users/khush/Downloads/Qm.lp")

```
x = read.lp("C:/Users/khush/Downloads/Qm.lp")# create an lp object x
print(x)                          #to display x
```

```
## Model name:
##            Truffel  Nuggets     Bars
## Maximize        50        50       30
## Butter           1       0.5        1  <=  50
## Honey            1       0.6      0.5  <=  50
## Cream          0.5       0.6      0.5  <=  30
## Kind           Std       Std      Std
## Type          Real      Real     Real
## Upper          Inf       Inf      Inf
## Lower            0         0        0
```

solve the lp model

```
solve(x)
```

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

```
get.objective(x)# get objective value
```

```
## [1] 2833.333
```

```
get.variables(x)# get values of decision variables
```

```
## [1] 40.00000 16.66667  0.00000
```

```
get.constraints(x)# get constraint RHS values
```

```
## [1] 48.33333 50.00000 30.00000
```

---

let us solve last two part of question. 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?

This is called post-optimality analysis

```
get.sensitivity.rhs(x) # get shadow prices
```

```
## $duals
## [1]   0.00000  16.66667  66.66667   0.00000   0.00000 -11.66667
##
## $dualsfrom
## [1] -1.0e+30  3.0e+01  2.5e+01 -1.0e+30 -1.0e+30 -1.0e+30
##
## $dualstill
## [1] 1.000000e+30 5.142857e+01 5.000000e+01 1.000000e+30 1.000000e+30
## [6] 2.857143e+00
```

```
get.sensitivity.obj(x)# get reduced cost
```

```
## $objfrom
## [1]  4.166667e+01  3.600000e+01 -1.000000e+30
##
## $objtill
## [1] 83.33333 60.00000 41.66667
```

- If the local store increases the daily order to 25 pounds of chocolate nuggets, how much of each product should Francesco than sol also change

1. maxi revenue change to $1675 and the varaibles change
2. truffels :$30, nuggets:$25,bars:$0.