Group Assignment- WQD7011: Numerical Optimization

Simplex Optimization

in the Production of Homemade Snacks

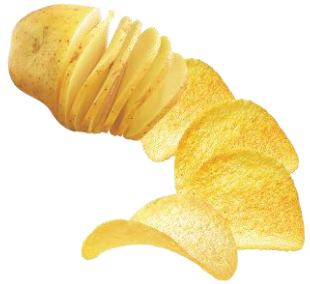
Name	Matric. No.
Kristian Surya Dinata	S2043845
Tey Yi Jie	17081752
Ani Yeap	17218658
Chan Jie Min	S2141167

Problem Statement

A business currently produces and sells three types of homemade snacks:

Cheese Puffs

RM5



Potato Chips

RM7

Pretzels

RM6

Given their existing resources, they wonder what quantity they should produce of each product to **maximize profits**.

Existing Resources

	Input Factor	Resource Availability	Unit
0	Flour	350	kg
1	Sugar	250	kg
2	Vegetable Oil	50	kg
3	Salt	15	kg
4	Cheese	100	kg
5	Spices	50	kg
6	Baking Powder	30	kg
7	Yeast	2	kg
8	Butter	100	kg
9	Flour	300	kg
10	Mixer	10	Hour
11	Oven	5	Hour
12	Packaging Machine	15	Hour
13	Labor Hours	60	Hour

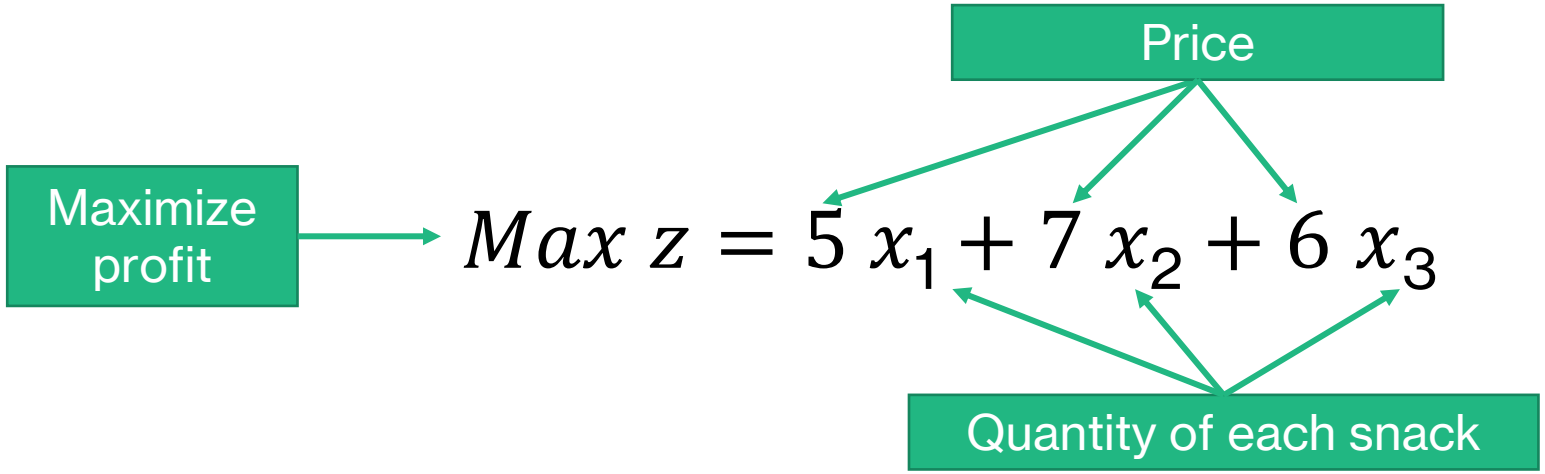
These are all the available resources that the business has. `

Additionally, the business has also found that to be profitable, they must produce a minimum quantity for each of their products:

Products	Minimum Qty (packs)
Cheese Puffs	800
Potato Chips	350
Pretzels	250

Objective Function

- Using the Simplex method of optimization, the following objective function to maximize profit is formed:



Constraint Equations

These are the resources needed to produce each snack. These represent the constraint equations.

	Input Factor	Cheese Puffs	Potato Chips	Pretzels	Equation
0	Flour (grams)	150	200	250	150x1 + 200x2 + 250x3 ≤ 350000
1	Cheese (grams)	50	5	7	50x1 + 5x2 + 7x3 ≤ 250000
2	Potatoes (grams)	-	50	-	50x2 ≤ 60000
3	Salt (grams)	5	7	8	5x1 + 7x2 + 8x3 ≤ 10000
4	Vegetable Oil (grams)	15	25	20	15x1 + 25x2 + 20x3 ≤ 100000
5	Baking Powder (grams)	5	-	-	5x1 ≤ 50000
6	Sugar (grams)	12	8	15	12x1 + 8x2 + 15x3 ≤ 30000
7	Egg (grams)	200	300	250	200x1 + 300x2 + 250x3 ≤ 500000
8	Yeast (grams)	-	-	5	5x3 ≤ 2000
9	Spices (grams)	5	10	5	5x1 + 10x2 + 5x3 ≤ 10000
10	Butter (grams)	4	6	8	4x1 + 6x2 + 8x3 ≤ 30000
11	Machine Working Hours (s)	60	90	75	60x1 + 90x2 + 75x3 ≤ 108000
12	Labor Hours (s)	45	75	60	45x1 + 75x2 + 60x3 ≤ 216000

Also, here are the constraints for minimum production quantity of the snacks.

x1 ≥ 800
x2 ≥ 350
x3 ≥ 250

Total = 16 c

Simplex Optimization

- Octave
- MATLAB
- Python

```
Status:
0
Optimal solution:
   962.50
   350.00
   250.00
Maximum profit:
8762.5
>>
```

x_1	x_2	x_3	s_1	s_2	s_3	s_4	s_5	s_6	s_7	s_8	s_9	s_10	s_11	s_12	s_13	s_14	s_15	s_16	Sol
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.083333	0	0	0.5	0.25	8762.5
0	0	0	1	0	0	0	0	0	0	0	0	0	0	-2.5	0	0	-25	62.5	73125
0	0	0	0	1	0	0	0	0	0	0	0	0	0	-0.83333	0	0	-70	-55.5	1.9838e+05
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	50	4.4409e-15	42500
0	0	0	0	0	0	1	0	0	0	0	5.5511e-17	0	0	-0.083333	0	0	-0.5	1.75	737.5
0	0	0	0	0	0	0	1	0	0	0	0	0	0	-0.25	0	0	2.5	1.25	71812
0	0	0	0	0	0	0	0	1	0	0	0	0	0	-0.083333	0	0	-7.5	-6.25	45188
0	0	0	0	0	0	0	0	0	1	0	0	0	0	-0.2	0	0	-10	0	11900
0	0	0	0	0	0	0	0	0	0	1	0	0	0	-3.3333	0	0	8.8818e-15	1.3323e-14	1.4e+05
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	250
0	1	0	0	0	0	0	0	0	0	0	0	0	0	4.6259e-18	0	0	-1	0	350
0	0	0	0	0	0	0	0	0	0	0	0	0	1	-0.066667	0	0	0	3	22050
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.016667	0	0	1.5	1.25	962.5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.75	1	0	7.5	3.75	1.3144e+05
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.016667	0	1	1.5	1.25	162.5
0	0	0	0	0	0	0	0	0	0	0	0	1	0	-0.083333	0	0	2.5	-1.25	437.5
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	750

x_1	x_2	x_3	s_1	s_2	s_3	s_4	s_5	s_6	s_7	s_8	s_9	s_10	s_11	s_12	s_13	s_14
962.5	350	250	73125	1.9838e+05	42500	737.5	71812	45188	11900	1.4e+05	750	437.5	22050	0	1.3144e+05	162.5

Results

- Python

Results:

	Snack	Selling Price (RM)	Initial Value	Optimized Value	Initial Profit (RM)	Optimized Profit (RM)
0	x1	5	800	962.5	4000	4812.5
1	x2	7	350	350	2450	2450
2	x3	6	250	250	1500	1500
3	Total		1400	1562.5	7950	8762.5

```
Total Initial Profit (RM) = 7950
Total Optimized Profit (RM) = 8762.5
```