

(Maggie Stewart) Maggie Stewart loves desserts, but due to weight and cholesterol concerns, she has decided that she must plan her desserts carefully. There are two possible desserts she is considering: snack bars and ice cream. After reading the nutrition labels on the snack bar and ice cream packages, she learns that each serving of snack bar weighs 37 grams and contains 120 calories and 5 grams of fat. Each serving of ice cream weighs 65 grams and contains 160 calories and 10 grams of fat. Maggie will allow herself no more than 450 calories and 25 grams of fat in her daily desserts, but because she loves desserts so much, she requires at least 120 grams of dessert per day. Also, she assigns a “taste index” to each gram of each dessert, where 0 is the lowest and 100 is the highest. She assigns a taste index of 95 to ice cream and 85 to snack bars (because she prefers ice cream to snack bars). Use Solver to find the daily dessert plan that stays within her constraints and maximizes the total taste index of her dessert.

Discussion: -

In this problem, Maggie has two options (Snack bars and ice creams) to take daily. Each serving item has specific parameters (weights, calories, fat, taste index) which are our inputs. Let’s discuss about one parameter ‘weights’, which will help us in finding our decision variable. As per Maggie’s plan, she wants to take 120 grams of dessert in a day. Snack bar and ice cream contains 37 and 65 grams respectively. If we can decide the number of serving items we can calculate the total intake of desserts, which will help us in calculating the taste index. With the available inputs we can calculate only the taste index of only one serving. If we have the number of servings that Maggie is getting in a day, we can calculate the total taste index. So, our decision variable should be the number of servings. Our objective is to maximize the taste index value by deciding the number of serving items. Maggie will allow herself to take the serving in such a way that her intake calories, grams and fat are in control, which will be constraints in this problem.

Mathematical Model: -

Parameters (Inputs):

$i \in 1, 2, (\text{Index for items snack bars, ice creams})$

W_i : Weights of item i

C_i : Calories in item i

F_i : Fat in item i

T_i : Taste index to each gram of item i

W : Per day limitations of weight

C : Per day limitations of Calories

F : Per day limitations of fat

Decision Variables:

x_i : Number of servings of item i

Objective:

$$\text{Minimize Total Taste Index} = \sum_{i=1}^2 (x_i * W_i * T_i)$$

Constraints:

$$x_i \geq 0 \quad (1) \text{Non Negative constraint}$$

$$\sum_{i=1}^2 (x_i * W_i) \geq W \quad (2) \text{Per day limitations of weight constraint}$$

$$\sum_{i=1}^2 (x_i * C_i) \leq C \quad (3) \text{Per day limitations of Calories constraint}$$

$$\sum_{i=1}^2 (x_i * F_i) \leq F \quad (4) \text{Per day limitations of fat constraint}$$

Excel Implementation:

Please find the attached spreadsheet for solution.



6[RA].xlsx

							Inputs
Items	Snack Bars	Ice creams					Decision variables
Each serving of item Weighs	37	65					Calculated Variables
Each serving of item contains Calories	120	160					Constraints
Each serving of item contains Fat	5	10					Objective
Taste index to each gram	95	85					
	Snack Bars	Ice creams					
# of servings	1.25	1.875					
					Per Day Limitations		
Weighs	46.25	121.875	168.125	>=	120		
Calories	150	300	450	<=	450		
Fat	6.25	18.75	25	<=	25		
Taste Index	4393.75	10359.375					
Total Taste Index	14753.125						

As per the optimization model Maggie can take 1.25 serving of snack bar and 1.875 servings of ice creams. As our objective is to maximize the Total taste index, solver suggests ice cream over snack bar as it has higher per gram taste index.

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Items	Snack Bars	Ice creams					Decision variables
Each serving of item Weighs	37	65					Calculated Variables
Each serving of item contains Calories	120	160					Constraints
Each serving of item contains Fat	5	10					Objective
Taste index to each gram	95	85					
	Snack Bars	Ice creams					
# of servings	1	2					
					Per Day Limitations		
Weighs	37	130	167	>=	120		
Calories	120	320	440	<=	450		
Fat	5	20	25	<=	25		
Taste Index	3515	11050					
Total Taste Index	14565						

If we put integer constraint for our decision variables, solution would be as given in screenshot 2. As per the optimization model Maggie can take 1 serving of snack bar and 2 servings of ice creams. To meet the Calories and Fat constraints, solver didn't pick the 3rd unit of ice cream.