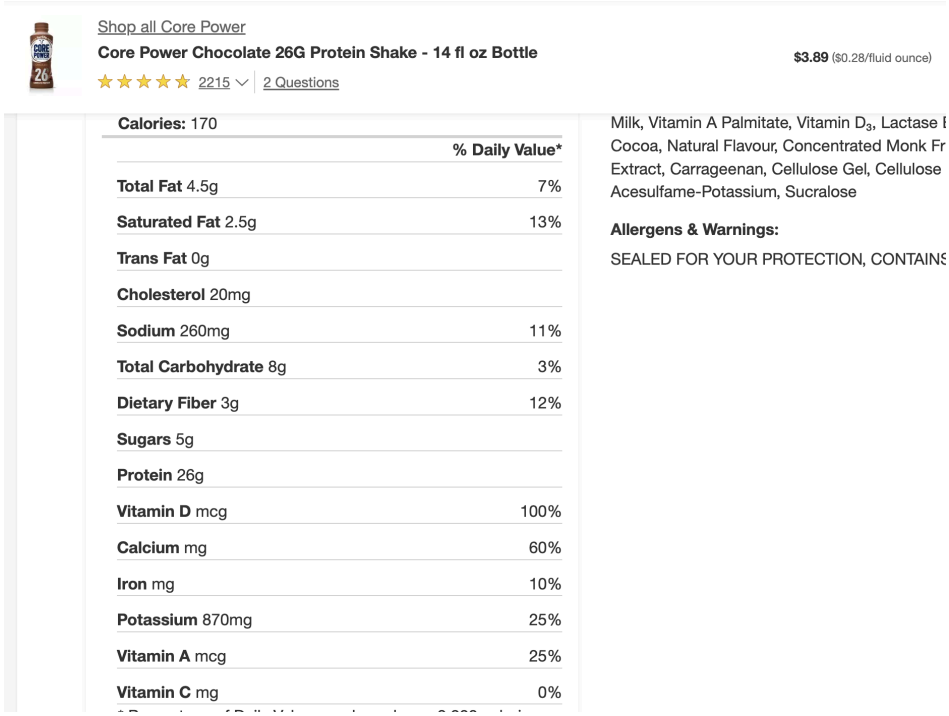
Timmy Li
MSDS460 Assignment 1

Part 1: Below are images of my selected food item's nutritional facts



Shop all Core Power

Core Power Chocolate 26G Protein Shake - 14 fl oz Bottle

★★★★★ 2215 | 2 Questions

$3.89 ($0.28/fluid ounce)

Calories: 170

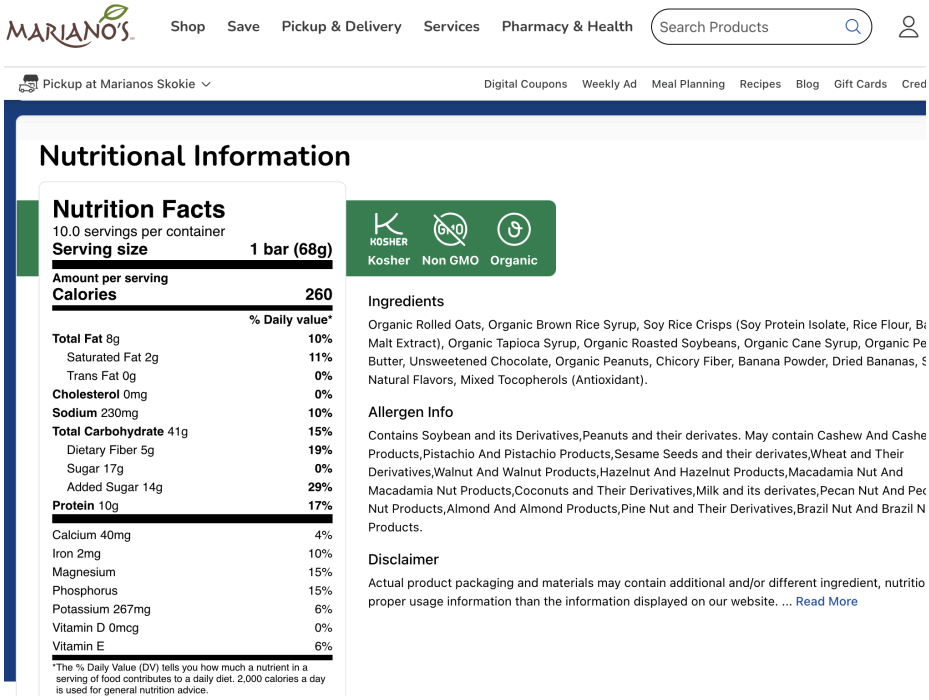
	% Daily Value*
Total Fat 4.5g	7%
Saturated Fat 2.5g	13%
Trans Fat 0g	
Cholesterol 20mg	
Sodium 260mg	11%
Total Carbohydrate 8g	3%
Dietary Fiber 3g	12%
Sugars 5g	
Protein 26g	
Vitamin D mcg	100%
Calcium mg	60%
Iron mg	10%
Potassium 870mg	25%
Vitamin A mcg	25%
Vitamin C mg	0%

Milk, Vitamin A Palmitate, Vitamin D_3, Lactase E
Cocoa, Natural Flavour, Concentrated Monk Fr
Extract, Carrageenan, Cellulose Gel, Cellulose
Acesulfame-Potassium, Sucralose

Allergens & Warnings:

SEALED FOR YOUR PROTECTION, CONTAINS

Protein shake, $3.89



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Nutritional Information

Nutrition Facts

10.0 servings per container

Serving size **1 bar (68g)**

Amount per serving

Calories **260**

	% Daily value*
Total Fat 8g	**10%**
Saturated Fat 2g	**11%**
Trans Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 230mg	**10%**
Total Carbohydrate 41g	**15%**
Dietary Fiber 5g	**19%**
Sugar 17g	**0%**
Added Sugar 14g	**29%**
Protein 10g	**17%**
Calcium 40mg	4%
Iron 2mg	10%
Magnesium	15%
Phosphorus	15%
Potassium 267mg	6%
Vitamin D 0mcg	0%
Vitamin E	6%

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

KOSHER Kosher | Non GMO | Organic

Ingredients

Organic Rolled Oats, Organic Brown Rice Syrup, Soy Rice Crisps (Soy Protein Isolate, Rice Flour, Ba Malt Extract), Organic Tapioca Syrup, Organic Roasted Soybeans, Organic Cane Syrup, Organic Pe Butter, Unsweetened Chocolate, Organic Peanuts, Chicory Fiber, Banana Powder, Dried Bananas, S Natural Flavors, Mixed Tocopherols (Antioxidant).

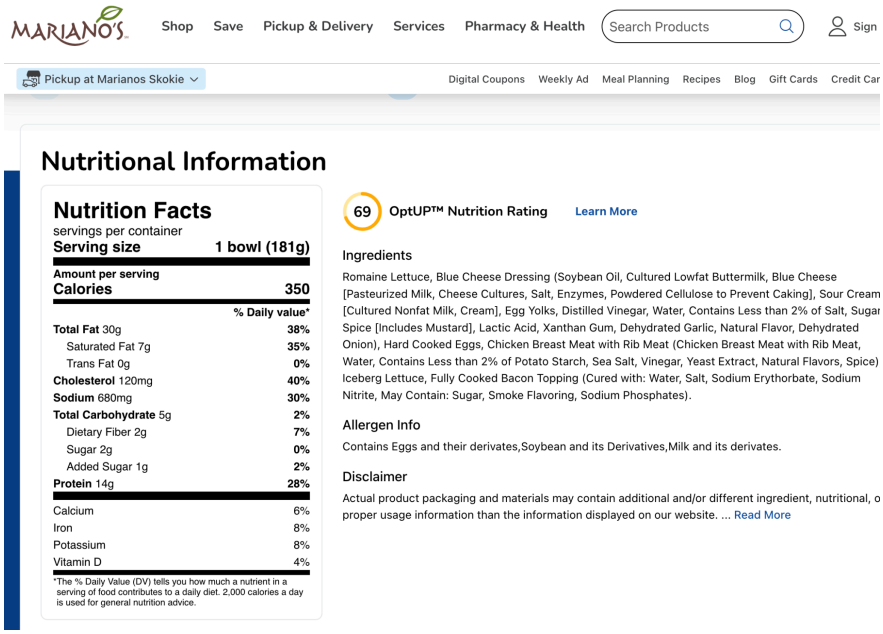
Allergen Info

Contains Soybean and its Derivatives,Peanuts and their derivates. May contain Cashew And Cashe Products,Pistachio And Pistachio Products,Sesame Seeds and their derivates,Wheat and Their Derivatives,Walnut And Walnut Products,Hazelnut And Hazelnut Products,Macadamia Nut And Macadamia Nut Products,Coconuts and Their Derivatives,Milk and its derivates,Pecan Nut And Pec Nut Products,Almond And Almond Products,Pine Nut and Their Derivatives,Brazil Nut And Brazil N Products.

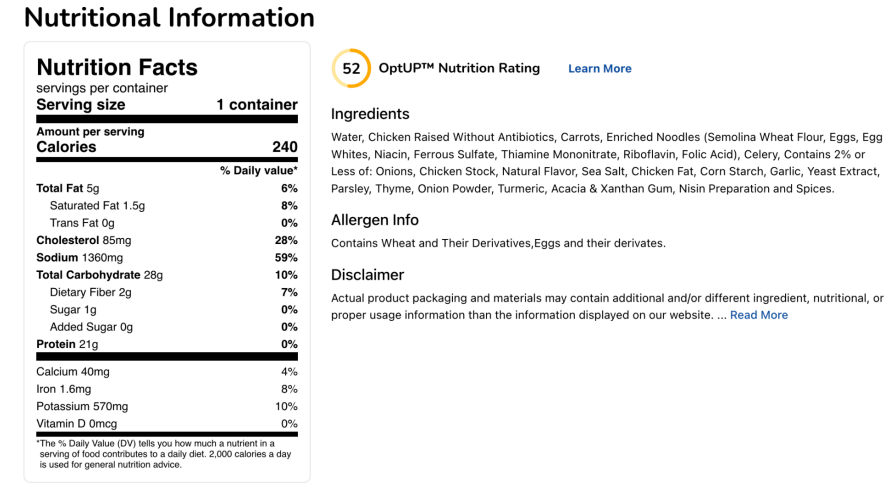
Disclaimer

Actual product packaging and materials may contain additional and/or different ingredient, nutritio proper usage information than the information displayed on our website. ... Read More

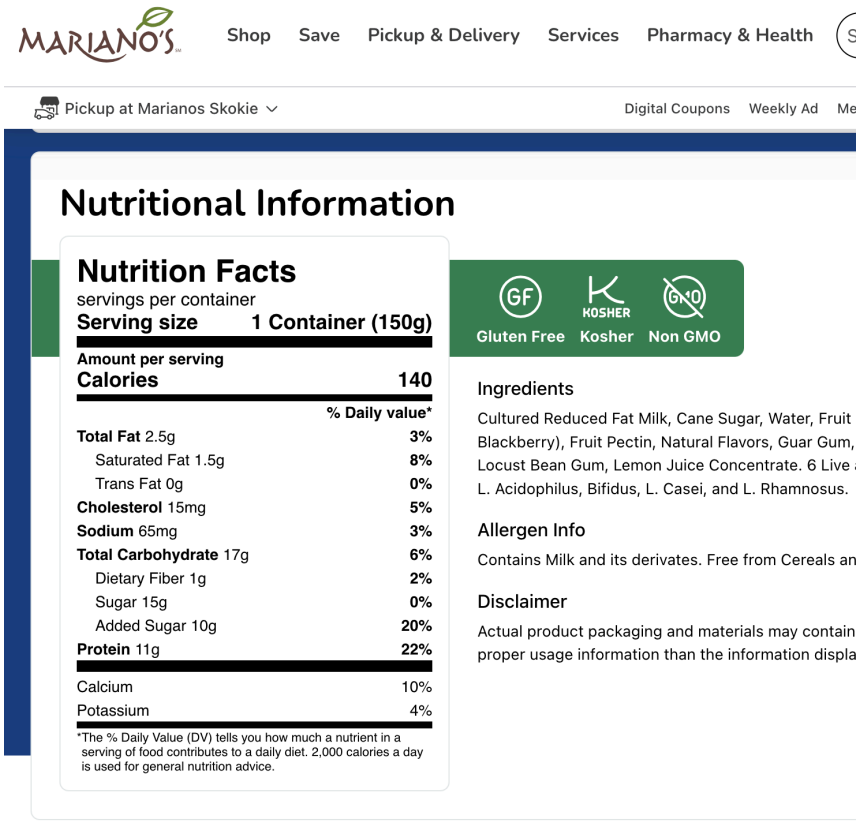
Clif bars, a box of 10 costs 15.99



Cobb Salad, $3.67



Chicken Noodle Soup, $6.49



Mixed Fruit Yogurt, $1.69

Part 2

We want to set up a linear programming solution for the diet problem. The problem is essentially we want to spend the least amount of money on food and still meet all the requirements that we have for nutrition. Our decision variables are the food items: Mixed fruit yogurt, chicken noodle soup, cobb salad, protein shake, Clif protein bar. The objective function is based on the costs of each food item, we will be minimizing this function because we want the least cost while satisfying the eighth nutritional constraints.

Nutritional requirements below

Component	Max/Min	Daily Amount and measure	Weekly Amount and measure
Sodium	Maximum	5,000 milligrams (mg)	35,000 milligrams (mg)
Energy	Minimum	2,000 Calories (kilocalories, kcal)	14,000 Calories (kilocalories, kcal)
Protein	Minimum	50 grams (g)	350 grams (g)

Vitamin D	Minimum	20 micrograms (mcg)	140 micrograms (mcg)
Calcium	Minimum	1,300 milligrams (mg)	9,100 milligrams (mg)
Iron	Minimum	18 milligrams (mg)	126 milligrams (mg)
Potassium	Minimum	4,700 milligrams (mg)	32,900 milligrams (mg)

Min Z = 1.69 * x1 + 3.89 * x2 + 3.67 * x3 +6.49 *x4 +1.599*x5
Sodium Constraint
65 * x1 + 260 * x2 + 680*x3 + 1360*x4 + 230*x5 <= 5000*7
Calorie Constraint
140*x1 + 170*x2 + 350*x3 + 240*x4 + 260*x5 >= 2000*7
Protein Constraint
11*x1 + 26*x2 + 14*x3 + 21*x4+ 10*x5 >=50*7
Vitamin D Constraint
0*x1 + 20*x2 + .04*20*x3 + 0*x4 + 0*x5 >=20*7
Calcium Constraint
.10 * 1300*x1 + .6*1300*x2 + .06*1300*x3 + 40*x4 + 40*x5 >=1300*7
Iron Constraint
0*x1 +.1*18*x2 + .08*18*x3 + 1.6*x4 + 2*x5 >=18*7
Potassium Constraint
.04*4700*x1 + 870*x2 + .08*4700*x3 + 570*x4 + 267*x5 >=4700*7

- Where x1 is yogurt, x2 protein shake, x3 cobb salad, x4 chicken noodle soup, x5 clif bar

Standard form
Max v = -1.69 * x1 - 3.89 * x2 -3.67 * x3 -6.49 *x4 -1.599*x5
ST
65 * x1 + 260 * x2 + 680*x3 + 1360*x4 + 230*x5 +s1= 5000*7
140*x1 + 170*x2 + 350*x3 + 240*x4 + 260*x5 -s2= 2000*7
11*x1 + 26*x2 + 14*x3 + 21*x4+ 10*x5 -s3=50*7
0*x1 + 20*x2 + .04*20*x3 + 0*x4 + 0*x5 -s4=20*7
.10 * 1300*x1 + .6*1300*x2 + .06*1300*x3 + 40*x4 + 40*x5 -s5=1300*7
0*x1 +.1*18*x2 + .08*18*x3 + 1.6*x4 + 2*x5 -s6=18*7
.04*4700*x1 + 870*x2 + .08*4700*x3 + 570*x4 + 267*x5 -s7=4700*7

- Where s1 is a slack variable, s2-s7 are surplus variables.

We want to spend the least amount of money that we need to while still following each of these constraints. Note that sodium is a maximum of 35,000mg weekly while the rest of the constraints are minimum.

Chicken_Noodle_Soup = 0.0
Chobani_Yogurt = 0.0
Clif_Bar = 40.019057
Cobb_Salad = 0.0
Protein_Shake = 25.534381

OPT = 163.319214233
The optimal solution seems to be buying only two of the food items out of the five. Only purchasing clif bars and protein shakes seems to meet all of the requirements.

Part 4
If we need to have at least one serving of each food item that I looked into. The solution is as follows
Chicken_Noodle_Soup = 1.0
Chobani_Yogurt = 1.0
Clif_Bar = 39.539781
Cobb_Salad = 1.0
Protein_Shake = 24.378021
OPT = 169.904611509

I would not be spending much more, it looks like about 6 dollars more. The solution itself hasn't changed much either, only buying one of each of the items that weren't bought before a slightly less clif bars. This does feel like it still lacks variety. If I had to try and change a few things about my diet without changing the food items I selected, there may be a few things that could be changed with nutrition requirements. These requirements are based on a 2000 calorie diet and is a default for most people. Not everyone is the same so it is possible to change a few of the nutritional requirements which would in turn change the requirements for the diet. Such as changing the calorie requirement or protein requirement. We can also be looking at possibly changing from maximum to minimum and vice versa for the constraints, this may affect the output a bit as well.

Part 5
I'm using Google's Gemini for this part. https://gemini.google.com/app?hl=en
It pretty much did the job perfectly. The code that it outputs should work. The first solution that it suggested used a dictionary for the food items which I think should work (I did not use a dictionary). I also had it go about the solution without using a dictionary and it essentially was the same code that I had written. I would say yes if you were to use this to do this assignment you could get pretty far. The only thing it couldn't really do was actually have real food items, it made up food items for placeholders. The only two prompts were the ones below, the initial and then a follow up request.
"You are trying to solve a linear programming problem called the diet problem. The goal or objective of this problem is to find the minimum-cost diet (servings of food items) that satisfies the eight nutritional requirements. Use Python PuLP or AMPL (perhaps with its Python API). In this problem you have various nutritional requirements. You are to select 5 packaged food items and use their nutritional facts to create the constraints. You may select whichever food items you can. "
"instead of creating a dictionary for the different foods , can you define each food with a different variable and then continue the solution from there"
I would say it went very well, I was able to tailor the solution to what I was looking for, especially to compare it to my own solution.