


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 D₃, Lactase I
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.



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

Allergen Info
Contains Soybean and its Derivatives,Peanuts and their derivatives. May contain Cashew And Cashe Products,Pistachio And Pistachio Products,Sesame Seeds and their derivatives,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 derivatives,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

Nutritional Information

Nutrition Facts

servings per container

Serving size1 bowl (181g)

Amount per serving

Calories350

% Daily value*

Total Fat30g38%

Saturated Fat7g35%

Trans Fat0g0%

Cholesterol120mg40%

Sodium680mg30%

Total Carbohydrate5g2%

Dietary Fiber2g7%

Sugar2g0%

Added Sugar1g2%

Protein14g28%

Calcium6%

Iron8%

Potassium8%

Vitamin D4%

*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.

69

OptUP™ Nutrition Rating

[Learn More](#)

Ingredients

Romaine Lettuce, Blue Cheese Dressing (Soybean Oil, Cultured Lowfat Buttermilk, Blue Cheese [Pasteurized Milk, Cheese Cultures, Salt, Enzymes, Powdered Cellulose to Prevent Caking], Sour Cream [Cultured Nonfat Milk, Cream], Egg Yolks, Distilled Vinegar, Water, Contains Less than 2% of Salt, Sugar Spice [Includes Mustard], Lactic Acid, Xanthan Gum, Dehydrated Garlic, Natural Flavor, Dehydrated Onion), Hard Cooked Eggs, Chicken Breast Meat with Rib Meat (Chicken Breast Meat with Rib Meat, Water, Contains Less than 2% of Potato Starch, Sea Salt, Vinegar, Yeast Extract, Natural Flavors, Spice) Iceberg Lettuce, Fully Cooked Bacon Topping (Cured with: Water, Salt, Sodium Erythorbate, Sodium Nitrite, May Contain: Sugar, Smoke Flavoring, Sodium Phosphates).

Allergen Info

Contains Eggs and their derivatives,Soybean and its Derivatives,Milk and its derivatives.

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Cobb Salad, \$3.67

Nutritional Information

Nutrition Facts

servings per container

Serving size1 container

Amount per serving

Calories240

% Daily value*

Total Fat5g6%

Saturated Fat1.5g8%

Trans Fat0g0%

Cholesterol85mg28%

Sodium1360mg59%

Total Carbohydrate28g10%

Dietary Fiber2g7%

Sugar1g0%

Added Sugar0g0%

Protein21g0%

Calcium40mg4%

Iron1.6mg8%

Potassium570mg10%

Vitamin D0mcg0%

*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.

52

OptUP™ Nutrition Rating

[Learn More](#)

Ingredients

Water, Chicken Raised Without Antibiotics, Carrots, Enriched Noodles (Semolina Wheat Flour, Eggs, Egg Whites, Niacin, Ferrous Sulfate, Thiamine Mononitrate, Riboflavin, Folic Acid), Celery, Contains 2% or Less of: Onions, Chicken Stock, Natural Flavor, Sea Salt, Chicken Fat, Corn Starch, Garlic, Yeast Extract, Parsley, Thyme, Onion Powder, Turmeric, Acacia & Xanthan Gum, Nisin Preparation and Spices.

Allergen Info

Contains Wheat and Their Derivatives,Eggs and their derivatives.

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Chicken Noodle Soup, \$6.49

Nutritional Information

Nutrition Facts

servings per container

Serving size 1 Container (150g)

Amount per serving

Calories 140

% Daily value*

Total Fat 2.5g 3%

Saturated Fat 1.5g 8%

Trans Fat 0g 0%

Cholesterol 15mg 5%

Sodium 65mg 3%

Total Carbohydrate 17g 6%

Dietary Fiber 1g 2%

Sugar 15g 0%

Added Sugar 10g 20%

Protein 11g 22%

Calcium 10%

Potassium 4%

*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.



Gluten Free



Kosher



Non GMO

Ingredients

Cultured Reduced Fat Milk, Cane Sugar, Water, Fruit (Blackberry), Fruit Pectin, Natural Flavors, Guar Gum, Locust Bean Gum, Lemon Juice Concentrate, 6 Live L. Acidophilus, Bifidus, L. Casei, and L. Rhamnosus.

Allergen Info

Contains Milk and its derivatives. Free from Cereals and

Disclaimer

Actual product packaging and materials may contain proper usage information than the information displayed.

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)

$$\text{Min } Z = 1.69 * x_1 + 3.89 * x_2 + 3.67 * x_3 + 6.49 * x_4 + 1.599 * x_5$$

Sodium Constraint

$$65 * x_1 + 260 * x_2 + 680 * x_3 + 1360 * x_4 + 230 * x_5 \leq 5000 * 7$$

Calorie Constraint

$$140 * x_1 + 170 * x_2 + 350 * x_3 + 240 * x_4 + 260 * x_5 \geq 2000 * 7$$

Protein Constraint

$$11 * x_1 + 26 * x_2 + 14 * x_3 + 21 * x_4 + 10 * x_5 \geq 50 * 7$$

Vitamin D Constraint

$$0 * x_1 + 20 * x_2 + .04 * 20 * x_3 + 0 * x_4 + 0 * x_5 \geq 20 * 7$$

Calcium Constraint

$$.10 * 1300 * x_1 + .6 * 1300 * x_2 + .06 * 1300 * x_3 + 40 * x_4 + 40 * x_5 \geq 1300 * 7$$

Iron Constraint

$$0 * x_1 + .1 * 18 * x_2 + .08 * 18 * x_3 + 1.6 * x_4 + 2 * x_5 \geq 18 * 7$$

Potassium Constraint

$$.04 * 4700 * x_1 + 870 * x_2 + .08 * 4700 * x_3 + 570 * x_4 + 267 * x_5 \geq 4700 * 7$$

- Where x_1 is yogurt, x_2 protein shake, x_3 cobb salad, x_4 chicken noodle soup, x_5 cliff bar

Standard form

$$\text{Max } v = -1.69 * x_1 - 3.89 * x_2 - 3.67 * x_3 - 6.49 * x_4 - 1.599 * x_5$$

ST

$$65 * x_1 + 260 * x_2 + 680 * x_3 + 1360 * x_4 + 230 * x_5 + s_1 = 5000 * 7$$

$$140 * x_1 + 170 * x_2 + 350 * x_3 + 240 * x_4 + 260 * x_5 - s_2 = 2000 * 7$$

$$11 * x_1 + 26 * x_2 + 14 * x_3 + 21 * x_4 + 10 * x_5 - s_3 = 50 * 7$$

$$0 * x_1 + 20 * x_2 + .04 * 20 * x_3 + 0 * x_4 + 0 * x_5 - s_4 = 20 * 7$$

$$.10 * 1300 * x_1 + .6 * 1300 * x_2 + .06 * 1300 * x_3 + 40 * x_4 + 40 * x_5 - s_5 = 1300 * 7$$

$$0 * x_1 + .1 * 18 * x_2 + .08 * 18 * x_3 + 1.6 * x_4 + 2 * x_5 - s_6 = 18 * 7$$

$$.04 * 4700 * x_1 + 870 * x_2 + .08 * 4700 * x_3 + 570 * x_4 + 267 * x_5 - s_7 = 4700 * 7$$

- Where s_1 is a slack variable, s_2 - s_7 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.

$$\text{Chicken_Noodle_Soup} = 0.0$$

$$\text{Chobani_Yogurt} = 0.0$$

$$\text{Clif_Bar} = 40.019057$$

$$\text{Cobb_Salad} = 0.0$$

$$\text{Protein_Shake} = 25.534381$$

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.