

MSDS 460 Assignment 1 - Garo Bazarbachian

Part 1.

Having recently succumbed to the allure of Trader Joe's, I found myself drawn to utilizing their diverse array of food items for my initial assignment. What captivates me about Trader Joe's is their expansive selection, offering everything from humble rice dishes to indulgent Portuguese custard tarts. For this assignment, I selected five distinct food items: Japanese-Style Fried Rice, Chicken Burrito Bowl, and Blackened Salmon, along with additional grocery essentials such as Pasture-raised Large Brown Eggs and Greek Nonfat Yogurt. In Appendix A, comprehensive documentation including nutritional facts and pricing for these items is provided.

The pricing methodology employed to determine the cost per serving is outlined in Appendix B. This process involves multiplying the serving size in grams by the number of servings per item to ascertain the total weight in grams. Subsequently, dividing the serving size in grams by the total weight yields a decimal value, which is then multiplied by the price of the entire item to derive the cost per serving.

Part 2.

1. **Decision Variables:** $x_1, x_2, x_3, x_4, \text{ and } x_5$ represent quantities of each of the five selected food items that will be purchased weekly.

$x_1 = \text{Japanese - Style Fried Rice}$

$x_2 = \text{Pasture Raised Large Brown Eggs}$

$x_3 = \text{Blackened Salmon}$

$x_4 = \text{Chicken Burrito Bowl}$

$x_5 = \text{Greek Nonfat Yogurt Plain}$

2. **Objective Function:** My objective is to minimize the total cost of purchasing the selected food items. $C_1, C_2, C_3, C_4, \text{ and } C_5$ denote the costs per serving of their respective food items. From there we create our objective function which is formulated below:

$$\text{Minimize: } Z = C_1x_1 + C_2x_2 + C_3x_3 + C_4x_4 + C_5x_5$$

3. **Nutritional Constraints:** Now I can break down each of the recommended daily nutritional allowances multiplied by seven to represent weekly values.

Sodium: $7(x_1s_1 + x_2s_2 + x_3s_3 + x_4s_4 + x_5s_5) \leq 35000$

Energy: $7(x_1e_1 + x_2e_2 + x_3e_3 + x_4e_4 + x_5e_5) \geq 14000$

Protein: $7(x_1p_1 + x_2p_2 + x_3p_3 + x_4p_4 + x_5p_5) \geq 350$

Vitamin D: $7(x_1d_1 + x_2d_2 + x_3d_3 + x_4d_4 + x_5d_5) \geq 140$

Calcium: $7(x_1c_1 + x_2c_2 + x_3c_3 + x_4c_4 + x_5c_5) \geq 9100$

Iron: $7(x_1i_1 + x_2i_2 + x_3i_3 + x_4i_4 + x_5i_5) \geq 126$

Potassium: $7(x_1k_1 + x_2k_2 + x_3k_3 + x_4k_4 + x_5k_5) \geq 32900$

Here, $s_i, e_i, p_i, d_i, c_i, i_i$, and k_i represent the respective nutritional values per serving of food item i .

In Appendix C, I have my program code and the output of my code showing my solution.

Part 3.

To meet the nutritional requirements while minimizing the total cost, I should consume approximately (Rounded two decimal points):

- Japanese-Style Fried Rice: **0 servings or 0 grams**
- Pasture Raised Large Brown Eggs: **3.80 servings or 190 grams**
- Blackened Salmon: **1.28 servings or 145 grams**
- Chicken Burrito Bowl: **5.17 servings or 1706 grams**
- Greek Nonfat Yogurt Plain: **2.65 servings or 451 grams**

At a total, minimized cost of **\$29.83**

This means I would need to spend, at a minimum, \$29.83 on food a week.

It is important to note that the Japanese-Style Fried Rice is not included in the optimal solution, meaning it does not contribute to meeting the nutritional requirements most cost-effectively.

Part 4.

The revised linear programming problem, enforcing at least one serving of each food item per week, yielded a slightly altered solution compared to the original. Before the constraint, servings ranged from 0.00 to 5.17, totaling \$29.83. With the constraint, servings varied from 1.00 to 5.17, totaling \$30.01. This adjustment increased weekly expenses by \$0.18. To further diversify my diet, I can introduce new food items, set maximum serving constraints per item, and consider taste preferences and dietary restrictions, enhancing the variety of the diet solution.

Part 5.

LLM Implementation: ChatGPT

ChatGPT URL: <https://chat.openai.com/>

Step-by-step review of implementation:

1. Opened up ChatGPT via the URL provided and started to prompt.
2. The first prompt I provided was "You are a data science master's student in a decision analytics class. You are tasked with the problem below. Please specify a model for The Diet Problem and create a linear programming model that finds the optimal solution, that is to find the optimal servings of five food items at the minimal cost. Where there is a variable I must fill in, please indicate it so I can update it with the correct information."
3. After the prompt, I provided the assignment details.
4. Next, ChatGPT was able to construct a response for Part 1 but did not continue with Parts 2, 3, and 4 so I asked to continue with those parts.
5. ChatGPT then provided me with the code for my linear programming model and was also able to add the additional constraint from Part 4.

ChatGPT was able to develop the Python code needed to solve this problem. It was successful in understanding my problem and was able to provide not only the code but the write-ups, for example in Part 2 explaining the problem and creating a sort of template that I would need to just go into and fill in my appropriate information. Some successes was that ChatGPT caught that we were supposed to satisfy a weekly diet so it knew to multiply the daily required values by 7. The only failure which was not really a failure was that I had to continue to prompt ChatGPT to finish answering all the parts of the assignment. Overall, the conversation was seamless and did not require too much tailoring. I was impressed that ChatGPT was able to understand information very quickly and efficiently to produce a backbone or jumping-off point for this assignment. I also used PuLP for my problem so it was easy for me to understand the code it produced. I believe I could have continued to prompt ChatGPT to complete the full assignment if I provided the information about my five food items. ChatGPT is very capable of doing this assignment and assignments like this as it can effectively understand the situation and understand more information to construct the solution

Appendix A

TRADE JOE'S


Products


Discover


Recipes


Listen

We Love This For...

- Alfresco Dining
- Dinner Hack
- Fry It Up
- In Lieu of Pizza
- Put An Egg On It!

Ingredients

RICE, WATER, EDAMAME SOYBEANS, SOY SAUCE (WATER, SOYBEANS, WHEAT, SALT), SWEET COOKING RICE WINE (WATER, MIRIN [WATER, RICE, ALCOHOL, SALT, KOJI (ASPERGILLUS ORYZAE)], SUGAR, LACTIC ACID), CARROT, DEEP FRIED TOFU (WATER, SOYBEANS, CANOLA OIL AND/OR SOYBEAN OIL, CALCIUM CHLORIDE), CANOLA OIL, CONTAINS 1% OR LESS OF SAKE (WATER, RICE, KOJI [ASPERGILLUS ORYZAE], SALT), SUGAR, HIJIKI SEAWEED, SESAME OIL.

CONTAINS SOY, SESAME, WHEAT.

Nutrition Facts

Per serving	Per container	
SERVING SIZE		
1 1/2 cups frozen (180g), makes 1 cup cooked		
CALORIES PER SERVING		
340		
SERVES ABOUT 2.5	AMOUNT	% DV
Total Fat	7 g	9%
Saturated Fat	1.0 g	5%
Trans Fat	0 g	
Cholesterol	0 mg	0%
Sodium	680 mg	30%
Total Carbohydrate	58 g	21%
Dietary Fiber	3 g	11%
Total Sugars	5 g	
Includes	3 g Added Sugars	6%
Protein	9 g	
Vitamin D	0.0 mcg	0%
Calcium	70 mg	6%
Iron	1.4 mg	8%
Potassium	260 mg	6%

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TRADE JOE'S


Products


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Recipes


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Home > Products > Food > From The Freezer > Entrées & Sides > Japanese Style Fried Rice

Japanese Style Fried Rice

\$3.79/16 Oz

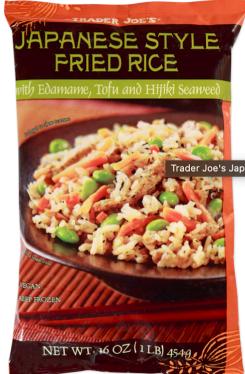
Vegan

What exactly is Trader Joe's Japanese Style Fried Rice? It's a big favorite among our Crew Members, and a mainstay in our freezer case. More specifically, it's our take on takikomi gohan, a traditional Japanese style of rice flavored with soy sauce and mirin (a tangy rice wine). Our version

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[!\[\]\(cc85a30f63baef1deb136fedc7f69231_img.jpg\)](#)
[!\[\]\(e8d9a93ec20b03a87f87656d82b1d87f_img.jpg\)](#)
[!\[\]\(26f705032f9bfc35af8f50827c41fe0d_img.jpg\)](#)

TRADE JOE'S

Home > Products > Food > From The Freezer > Entrées & Sides > Chicken Burrito Bowl

Chicken Burrito Bowl

\$3.49/11.6 Oz

Where do you go to get the best Burrito Bowl around? As of now, you head to Trader Joe's freezers. And where did Trader Joe's go to get that Burrito Bowl? Well, Canada, of course! We travel the world to find the best food and beverages, and sometimes we find them in the most unlikely

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TRADE JOE'S

We Love This For... [Time-pressed](#)

Ingredients

PAR BOILED BROWN RICE (WATER, BROWN RICE), WATER, WHITE MEAT CHICKEN (CHICKEN BREAST, WATER, POTATO STARCH, SEA SALT), BLACK BEANS (WATER, BLACK BEANS), RED QUINOA (WATER, RED QUINOA), RED PEPPER, GREEN PEPPER, CORN, CHEDDAR CHEESE (MILK, BACTERIAL CULTURE, SALT, CALCIUM CHLORIDE, ANNATTO [COLOR], MICROBIAL RENNET, CELLULOSE), CRUSHED TOMATOES, SOUR CREAM (MILK SOLIDS, CREAM, BACTERIAL CULTURE), DICED TOMATOES (TOMATOES, TOMATO JUICE), POBLANO PEPPERS, ONIONS, CREAM, CORNSTARCH, EXPELLER PRESSED CANOLA OIL, GARLIC PUREE (GARLIC, WATER), SPICES, SEA SALT, CHILI POWDER, CHIPOTLE PEPPER PASTE (RED BELL PEPPERS, SEA SALT, CHIPOTLE PEPPERS), CILANTRO, LIME JUICE (WATER, LIME JUICE CONCENTRATE, LIME OIL).

CONTAINS MILK.

Nutrition Facts

SERVING SIZE
1 bowl (330g)

CALORIES PER SERVING
370

SERVES 1	AMOUNT	%DV
Total Fat	10 g	13%
Saturated Fat	4.5 g	23%
Trans Fat	0 g	
Cholesterol	55 mg	18%
Sodium	630 mg	27%
Total Carbohydrate	51 g	19%
Dietary Fiber	9 g	32%
Total Sugars	2 g	
Added Sugars	0 g Added Sugars	0%
Protein	22 g	
Vitamin D	0.0 mcg	0%
Calcium	130 mg	10%
Iron	2.6 mg	15%
Potassium	690 mg	15%

TRADE JOE'S

Home > Products > Food > Meat, Seafood & Plant-based > Fish & Seafood > Blackened Salmon Seasoned Boneless Fillet

Blackened Salmon Seasoned Boneless Fillet

\$10.99/1 Lb

Salmon is far and away the most popular fresh seafood that we carry at Trader Joe's, and it's easy to see why. Nutritious, versatile, and remarkably easy to work with, salmon typically only needs a bit of seasoning before it's ready to be cooked. Over the years, we've received many requests from our

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We Love This For...

- Fry It Up
- In Lieu of Pizza
- Pair With Wine
- The "X" Factor

Ingredients

- ATLANTIC SALMON (COLOR ADDED)
- DEHYDRATED GARLIC
- DEHYDRATED ONION
- SEASONING BLEND (BLACK PEPPER, CUMIN, CHIPOTLE CHILI PEPPER, THYME, JALAPENO, OREGANO, CHILI PEPPER)
- SEA SALT
- PAPRIKA (COLOR)
- SUGAR
- GARLIC OIL.

CONTAINS SALMON.

Nutrition Facts

SERVING SIZE

4 oz (113g)

CALORIES PER SERVING

230

SERVES VARIED	AMOUNT	%DV
Total Fat	15 g	19%
Saturated Fat	3.5 g	18%
Trans Fat	0 g	
Cholesterol	60 mg	20%
Sodium	240 mg	10%
Total Carbohydrate	1 g	0%
Dietary Fiber	0 g	0%
Total Sugars	0 g	
Includes	0 g Added Sugars	0%
Protein	23 g	
Vitamin D	12.1 mcg	60%
Calcium	20 mg	2%
Iron	0.6 mg	4%
Potassium	390 mg	8%



Home > Products > Food > Dairy & Eggs > Yogurt, etc. > Greek Nonfat Yogurt Plain

Greek Nonfat Yogurt Plain

\$2.99/16 Oz

Kosher

Ever wonder how Greek yogurt is crafted? Do we culture the milk by reading each batch of yogurt epic Hellenic poetry? It couldn't hurt, however Trader Joe's Nonfat Plain Greek Yogurt uses a traditional Greek yogurt process to yield a deliciously creamy nonfat Greek yogurt.

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We Love This For...

- Alfresco Dining
- Brunch All Day
- Rain or Shine
- Rise & Shine

Ingredients

- GRADE A PASTEURIZED SKIM MILK
- LIVE ACTIVE CULTURES (BIFIDOBACTERIUM, LACTOBACILLUS ACIDOPHILUS, L. BULGARICUS, L. PARACASEI, STREPTOCOCCUS THERMOPHILUS)

CONTAINS MILK.

Nutrition Facts

Per Serving

Per Container

SERVING SIZE

3/4 Cup (170g)

CALORIES PER SERVING

110

SERVES ABOUT 2.5	AMOUNT	%DV
Total Fat	0 g	0%
Saturated Fat	0 g	1%
Trans Fat	0 g	
Cholesterol	10 mg	3%
Sodium	75 mg	3%
Total Carbohydrate	7 g	3%
Dietary Fiber	0 g	0%
Total Sugars	5 g	
Includes	0 g Added Sugars	0%
Protein	17 g	34%
Vitamin D	0.0 mcg	0%
Calcium	190 mg	15%
Iron	0.0 mg	0%
Potassium	240 mg	6%

TRADE JOE'S

Home > Products > Food > Dairy & Eggs > Eggs > Pasture Raised Large Brown Eggs

Pasture Raised Large Brown Eggs

\$4.99/1 Doz

Antibiotic Free

When it comes to the work we do to offer products that fit our customers' needs, we're continually evaluating our offerings and adjusting them as warranted by sales and direct customer feedback.

With regard to eggs, we offer a range of choices

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TRADE JOE'S

We Love This For...

- Brunch All Day
- Family Style
- Put An Egg On It!
- Rise & Shine

Ingredients

- OUTDOOR FORAGE & VEGETARIAN FEED FRESH EGGS

CONTAINS EGG.

Nutrition Facts

SERVING SIZE
1 egg (50g)

CALORIES PER SERVING
70

SERVES 12	AMOUNT	%DV
Total Fat	5g	6%
Saturated Fat	1.5g	8%
Trans Fat	0 g	
Cholesterol	185mg	62%
Sodium	70mg	3%
Total Carbohydrate	0g	0%
Fiber	0g	0%
Total Sugars	0g	
Includes	0g Added Sugars	0%
Protein	6g	12%
Vitamin D		6%
Calcium		2%
Iron		4%
Potassium		0%

Appendix B

	A	B	C	D	H	I	J	K	L
1	Recommended				Japanese-Style Fried Rice	Pasture Raised Large Brown Eggs	Blackened Salmon	Chicken Burrito Bowl	Greek Nonfat Yogurt Plain
2	Component	Daily Amount	Weekly Amount	Measure					
3	Sodium	5000 =B3*7		milligrams (mg)	680	70	240	630	75
4	Energy(Calories)	2000 =B4*7		Calories (kcal)	340	70	230	370	110
5	Protein	50 =B5*7		grams (g)	9	6	23	22	17
6	Vitamin D	20 =B6*7		micrograms (mcg)	0	1.2	12.1	0	0
7	Calcium	1300 =B7*7		milligrams (mg)	70	26	20	130	190
8	Iron	18 =B8*7		milligrams (mg)	1.4	1	0.6	2.6	0
9	Potassium	4700 =B9*7		milligrams (mg)	260	0	390	690	240
10	Price				\$3.79	\$4.99	\$10.99	\$3.49	\$2.99
11	Serving (in grams)				180	50	113	330	170
12	Serves				2.5	12	2	1	2.5
13	Total Amount (in grams)			=H11*H12	=I11*I12	=J11*J12	=K11*K12	=L11*L12	
14	Serving/Total			=H11/H13	=I11/I13	=J11/J13	=K11/K13	=L11/L13	
15	Adjusted Price Per Serving			=H10*H14	=I10*I14	=J10*J14	=K10*K14	=L10*L14	
16					\$1.52	\$0.42	\$5.50	\$3.49	\$1.20

Appendix C

```
Assignment 1 Part 2.py X Assignment 1 Part 2.txt ● README.md

Assignment 1 Part 2.py > ...
1 import pulp as lp
2
3 prob = lp.LpProblem("Minimize Total Cost", lp.LpMinimize)
4
5 x1 = lp.LpVariable("Japanese-Style Fried Rice", lowBound=0, cat='Continuous')
6 x2 = lp.LpVariable("Pasture Raised Large Brown Eggs", lowBound=0, cat='Continuous')
7 x3 = lp.LpVariable("Blackened Salmon", lowBound=0, cat='Continuous')
8 x4 = lp.LpVariable("Chicken Burrito Bowl", lowBound=0, cat='Continuous')
9 x5 = lp.LpVariable("Greek Nonfat Yogurt Plain", lowBound=0, cat='Continuous')
10
11 C1 = 1.52 # Adjusted price per serving of Japanese-Style Fried Rice
12 C2 = 0.42 # Adjusted price per serving of Pasture Raised Large Brown Eggs
13 C3 = 5.50 # Adjusted price per serving of Blackened Salmon
14 C4 = 3.49 # Adjusted price per serving of Chicken Burrito Bowl
15 C5 = 1.20 # Adjusted price per serving of Greek Nonfat Yogurt Plain
16 prob += C1 * x1 + C2 * x2 + C3 * x3 + C4 * x4 + C5 * x5
17
18 # Sodium
19 prob += 7 * (680 * x1 + 70 * x2 + 240 * x3 + 630 * x4 + 75 * x5) <= 35000
20
21 # Energy
22 prob += 7 * (340 * x1 + 70 * x2 + 230 * x3 + 370 * x4 + 110 * x5) >= 14000
23
24 # Protein
25 prob += 7 * (9 * x1 + 6 * x2 + 23 * x3 + 22 * x4 + 17 * x5) >= 350
26
27 # Vitamin D
28 prob += 7 * (0 * x1 + 1.2 * x2 + 12.1 * x3 + 0 * x4 + 0 * x5) >= 140
29
30 # Calcium
31 prob += 7 * (70 * x1 + 26 * x2 + 20 * x3 + 130 * x4 + 190 * x5) >= 9100
32
33 # Iron
34 prob += 7 * (1.4 * x1 + 1 * x2 + 0.6 * x3 + 2.6 * x4 + 0 * x5) >= 126
35
36 # Potassium
37 prob += 7 * (260 * x1 + 0 * x2 + 390 * x3 + 690 * x4 + 240 * x5) >= 32900
38
39 prob.solve()
40
41 print("Optimal Solution:")
42 for var in prob.variables():
43     print(f"{var.name}: {var.varValue}")
44
45 print(f"Total Cost: {lp.value(prob.objective)}")
46
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
Optimal Solution:  
Blackened_Salmon: 1.2762197  
Chicken_Burrito_Bowl: 5.1677501  
Greek_Nonfat_Yogurt_Plain: 2.6521949  
Japanese_Style_Fried_Rice: 0.0  
Pasture_Raised_Large_Brown_Eggs: 3.798118  
Total Cost: 29.832499639  
o (base) garobazarbachian@Garos-MacBook-Air MSDS-460-Assignment-1-The-Diet-Problem %
```