

# **Diet Problem Solver: Methods and Results**

This paper outlines the process of solving the Diet Problem using linear programming. The goal was to determine the optimal number of servings of selected food items per week that would meet minimum nutritional requirements while minimizing cost. The food items used in this problem reflect my personal eating habits, including Eggs, Hash Browns, Yogurt, Cobb Salad, and Canned Tuna. I have provided additional more detail in the provided Jupyter Notebook.

The problem is framed as an optimization task in part 1. The decision variables are the number of servings per week for each of the five food items and the constraints are the minimum and maximum values of their nutrients. The objective minimizes the total cost while ensuring consumption of the appropriate amounts of nutrients to meet weekly dietary recommendations.

In part 2 of the assignment, the linear programming problem was expressed in standard form, where the objective function represents the total cost of the weekly servings of food items, and the constraints represent the required nutritional intake.

Below are the methods used and results for each of the coded segments of the assignment.

## **Part 3: Solving the Linear Programming Problem**

### **Methods**

I implemented the model using Python's pulp library to solve the linear programming problem. A function was written to calculate the optimal number of servings of each food item and determine the minimum cost. It also contained the nutrient amounts per the nutritional facts for an individual serving of each item.

### **Results**

The optimal solution suggested consuming:

- **140 servings of Eggs,**
- **78.31 servings of Hash Browns,**
- **19.99 servings of Yogurt.**

This resulted in a total weekly cost of \$121.91, while meeting all nutritional requirements.

## Part 4: Adding Variety to the Diet Problem

### **Methods**

To add variety to the diet, I introduced a constraint requiring that each food item must be consumed at least once per week. This modification ensured that no food item was completely excluded from the diet. The solver was rerun with the new constraints in place.

### **Results**

The results showed a slight increase in the total weekly cost, which rose to \$126.26. The optimal servings included:

- **136.90 servings of Eggs,**
- **76.81 servings of Hash Browns,**
- **20.21 servings of Yogurt,**
- **1 serving each of Cobb Salad and Canned Tuna.**

The variety constraint was satisfied but only showed a slight increase in variety. I then provided some examples of how I could further increase variety in future iterations.

## Part 5: Using Large Language Models for Assistance

### **Methods**

For this part, I used Anthropic's Claude 3.5 Sonnet to generate a parameterized Python function for solving the diet problem. The LLM provided a well-structured code template, which I then adapted to fit my specific needs. I also relied on JetBrains' Copilot to assist with code writing.

### **Results**

The use of LLMs significantly accelerated the process of building the model. I made sure to use a prompt that had clear asks of the LLM and Claude's first response included code that effectively solved the problem, and the explanation provided was accurate. This reinforced the utility of LLMs in solving optimization problems like this.

## **Conclusion**

This assignment helped me explore how linear programming can optimize dietary decisions based on cost and nutrition. Adding constraints, such as a lower bound on the serving sizes, demonstrated the potential of creating more complex linear programming problems to tailor results to specific use cases. LLMs provided valuable assistance throughout the process, streamlining the model-building process and yielding accurate results.

# Appendices

## Part 1: Documentation / Nutritional Facts

The following are the nutritional labels for the five foods I chose:

### Trader Joe's Pasture Raised Large Brown Eggs

Source:

<https://www.traderjoes.com/home/products/pdp/pasture-raised-large-brown-eggs-062124>

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%

## Trader Joe's Hash Browns

Source: <https://www.traderjoes.com/home/products/pdp/hashbrowns-094769>

SERVING SIZE

**1 potato patty** (64g)

CALORIES PER SERVING

**120**

SERVES 10	AMOUNT	%DV
Total Fat	6 g	8%
Saturated Fat	1 g	5%
Trans Fat	0 g	
Cholesterol	0 mg	0%
Sodium	250 mg	11%
Total Carbohydrate	15 g	5%
Dietary Fiber	1 g	4%
Total Sugars	0 g	
Includes	0 g Added Sugars	0%
Protein	1 g	
Vitamin D	0 mcg	0%
Calcium	10 mg	0%
Iron	0.4 mg	2%
Potassium	210 mg	4%

## Chobani Yogurt Strawberry Banana Low Fat Greek Yogurt Drink

Source:

<https://www.q.kroger.com/p/chobani-strawberry-banana-low-fat-greek-yogurt-drink/0081829001179>

Nutrition Facts	
Serving size 1 Bottle (207mL)	
Amount per serving	
<b>Calories</b>	<b>140</b>
% Daily Value*	
<b>Total Fat</b> 4g	<b>5%</b>
Saturated Fat 2.5g	<b>13%</b>
Trans Fat 0g	
<b>Cholesterol</b> 20mg	<b>7%</b>
<b>Sodium</b> 90mg	<b>4%</b>
<b>Total Carbohydrate</b> 18g	<b>7%</b>
Dietary Fiber <1g	<b>3%</b>
Total Sugars 15g	
Incl. 7g Added Sugars	<b>14%</b>
<b>Protein</b> 10g	<b>20%</b>
Vit. D 0mcg 0% • Calcium 220mg 15%	
Iron 0mg 0% • Potas. 340mg 8%	
*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.	

## Safeway Cobb Salad

Source: <https://www.safeway.com/shop/product-details.960056940.html>

Nutrition Facts		Amount/serving	% DV	Amount/serving	% DV
<b>Serving size</b> <b>1 bowl (206g)</b>		<b>Total Fat</b> 16g	<b>21%</b>	<b>Total Carb.</b> 8g	<b>3%</b>
		Sat. Fat 4g	<b>20%</b>	Fiber 1g	<b>4%</b>
		Trans Fat 0g		Total Sugars 5g	
<b>Calories</b> per serving <b>210</b>		<b>Cholest.</b> 110mg	<b>37%</b>	Incl. 2g Added Sugars	<b>4%</b>
		<b>Sodium</b> 760mg	<b>33%</b>	<b>Protein</b> 11g	
Vit. D 4% • Calcium 4% • Iron 6% • Potas. 6%					

Note that on this one, the specific values for Vitamin D, Calcium, Iron and Potassium were not listed so I took the daily recommended values and multiplied them by the stated percentages. I was unsure what guidelines they were following but chose to use the chart provided by the FDA here:

<https://www.fda.gov/food/nutrition-facts-label/daily-value-nutrition-and-supplement-facts-labels>

## Canned Tuna (Starkist Chunk Light in Oil)

Sources:

<https://starkist.com/product/chunk-light-tuna-in-oil-can/>

Amount Per Serving		DV%*
<b>Calories</b>	<b>100</b>	
Total Fat	3.5g	4%
Saturated Fat	0.5g	3%
Trans Fat	0g	
Polyunsaturated Fat	2g	
Monounsaturated Fat	1g	
Cholesterol	35mg	12%
Sodium	320mg	14%
Total Carbohydrate	0g	0%
Dietary Fiber	0g	0%
Total Sugars	0g	
Includes Added Sugars	0g	0%
Protein	16g	28%
<b>Vitamin D</b>	2.3mcg	10%
<b>Calcium</b>	0mg	0%
<b>Iron</b>	0.9mg	6%
<b>Potassium</b>	170mg	4%
<b>Niacin</b>		60%

## Part 2/3/4/5

These have been solved in the provided Jupyter notebook.