

Part 1. (see Appendix for labels)

1. Organic Rolled Quick Oats

Package Cost: \$3.29

Number of Servings per Container: about 13 servings

Serving Size: 40g (1/2 cup)

Price per Serving Calculation: $\$3.29 / 13 \text{ servings} = \0.25 per serving

2. Original Oatmilk, 32 Fl Oz

Package Cost: \$2.79

Number of Servings per Container: 4 servings

Serving Size: 240mL (1 cup)

Price per Serving Calculation: $\$2.79 / 4 \text{ servings} = \0.70 per serving

3. Creamy Peanut Butter With Salt, 16 Ounce

Package Cost: \$2.49

Number of Servings per Container: about 14 servings

Serving Size: 32g (2 tbsp)

Price per Serving Calculation: $\$2.49 / 14 \text{ servings} = \0.18 per serving

4. 365 by Whole Foods Market, Spinach Chopped Organic, 16 Ounce

Package Cost: \$2.79

Number of Servings per Container: about 5 servings

Serving Size: 85g (3/4 cup)

Price per Serving Calculation: $\$2.79 / 5 \text{ servings} = \0.56 per serving

5. 365 By Whole Foods Market, Salmon Pink Alaskan Wild, 14.75 Ounce; \$5.79

Package Cost: \$5.79

Number of Servings per Container: about 5 servings

Serving Size: 85g (3 oz)

Price per Serving Calculation: $\$5.79 / 5 \text{ servings} = \1.16 per serving

Part 2.

Decision Variables:

Let:

- x_1 = servings of Organic Rolled Quick Oats per week
- x_2 = servings of Original Oatmilk per week
- x_3 = servings of Creamy Peanut Butter per week
- x_4 = servings of Spinach Chopped Organic per week
- x_5 = servings of Salmon Pink Alaskan Wild per week

Objective Function:

Minimize the total weekly cost:

Minimize $Z = 0.25 x_1 + 0.70 x_2 + 0.18 x_3 + 0.56 x_4 + 1.16 x_5$

Constraints, ensure nutritional needs are met over the week, (based on FDA daily recommendations multiplied by 7 for weekly requirements):

1. **Energy:** At least 14,000 kcal per week:
 $150 x_1 + 120 x_2 + 190 x_3 + 30 x_4 + 100 x_5 \geq 14000$
2. **Protein:** At least 350 grams per week:
 $5 x_1 + 3 x_2 + 8 x_3 + 3 x_4 + 17 x_5 \geq 350$
3. **Sodium:** Max 35,000 mg per week:
 $0 x_1 + 140 x_2 + 120 x_3 + 80 x_4 + 260 x_5 \leq 35000$
4. **Vitamin D:** At least 140 mcg per week:
 $0 x_1 + 3.6 x_2 + 0 x_3 + 0 x_4 + 15.9 x_5 \geq 140$
5. **Calcium:** At least 9,100 mg per week
 $0 x_1 + 350 x_2 + 0 x_3 + 130 x_4 + 200 x_5 \geq 9100$
6. **Iron:** At least 126 mg per week
 $1.7 x_1 + 0 x_2 + 0.5 x_3 + 1.7 x_4 + 0.4 x_5 \geq 126$
7. **Potassium:** At least 32,900 mg per week:
 $140 x_1 + 390 x_2 + 200 x_3 + 260 x_4 + 280 x_5 \geq 32900$

Summary of the Problem

The task is to design a cost-effective and nutritionally complete weekly diet plan using five chosen food items. We aim to minimize the total cost while ensuring the diet meets FDA-recommended weekly intakes of key nutrients including energy, protein, sodium, Vitamin D, calcium, iron, and potassium. At a high level, the process involves:

1. Selecting Food Items
2. Calculating Costs and Nutrients
3. Formulating a Linear Programming Model

Implementation

The linear programming model and associated files/outputs can be found at this public GitHub repository: <https://github.com/ryano0ceros/projectrefuge-dietproblemrev11>

Part 3.

Status: Optimal

Minimum Cost: \$47.33

Servings_Oatmilk: 24.08 servings

Servings_Oats: 50.55 servings

Servings_PeanutButter: 77.46 servings

Servings_Salmon: 3.35 servings

Servings_Spinach: 0.00 servings

Part 4.

Total cost difference is \$0.13 All requirements met in diet_problem_p4.py and output_p4.txt (in repo)

Status: Optimal

Minimum Cost: \$47.46

Servings_Oatmilk: 23.66 servings
Servings_Oats: 49.48 servings
Servings_PeanutButter: 77.60 servings
Servings_Salmon: 3.45 servings
Servings_Spinach: 1.00 servings

To add further variety to the diet beyond ensuring at least one serving of each food item, you can introduce new constraints that limit the maximum number of servings for any single item. This prevents any single food from dominating the diet, promoting a wider range of nutrients from different sources. Additionally, incorporating new food items periodically or seasonally can enhance dietary diversity. You might also consider adding constraints that require specific combinations of foods (i.e. fruits, vegetables, proteins) each week. These modifications should increase the overall cost but lead to a more balanced and varied diet.

Part 5.

Overall, this process was a failure. After a few prompts, ChatGPT was able to deliver code leveraging pulp that looked reasonable. I fed the whole assignment as prompt input, then had to prompt it to choose 5 foods and solve the linear model before receiving code. When I prompted ChatGPT to run the code and perform a writeup for parts 1-5 it failed to run pulp code in its current environment. If I chose to go down this route, I think that the ChatGPT could eventually get pulp code working if I continually fed it errors and re-prompted it. However in its current state there would be a lot of back and forth from a prompt engineering standpoint.

Appendix

1. Organic Rolled Quick Oats

Nutrition Facts	
about 13 servings per container	
Serving size 1/2 cup (40g) dry	
Amount per serving	
Calories	150
	% Daily Value*
Total Fat 2.5g	3%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 27g	10%
Dietary Fiber 4g	14%
Soluble Fiber 2g	
Insoluble Fiber 2g	
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 5g	
Vitamin D 0mcg	0%
Calcium 0mg	0%
Iron 1.7mg	10%
Potassium 140mg	2%
*The % Daily Value 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.	

Package Cost: \$3.29

Number of Servings per Container: about 13 servings

Serving Size: 40g (1/2 cup)

Price per Serving Calculation: $\$3.29 / 13 \text{ servings} = \0.25 per serving

2. Original Oatmilk, 32 Fl Oz

Nutrition Facts

4 servings per container

Serving size 1 cup (8 fl oz/240mL)

Amount per serving

Calories **120**

% Daily Value*

Total Fat 5g **6%**

Saturated Fat 0.5g **3%**

Trans Fat 0g

Cholesterol 0mg **0%**

Sodium 140mg **6%**

Total Carbohydrate 16g **6%**

Dietary Fiber 2g **7%**

Total Sugars 7g

Includes 7g Added Sugars **14%**

Protein 3g

Vitamin D 3.6mcg **20%**

Calcium 350mg **25%**

Iron 0mg **0%**

Potassium 390mg **8%**

Vitamin A 160mcg **20%**

Riboflavin 0.6mg **45%**

Vitamin B₁₂ 1.2mcg **50%**

*The % Daily Value 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.

Package Cost: \$2.79

Number of Servings per Container: 4 servings

Serving Size: 240mL (1 cup)

Price per Serving Calculation: \$2.79 / 4 servings = \$0.70 per serving

3. Creamy Peanut Butter With Salt, 16 Ounce

Nutrition Facts

about 14 servings per container

Serving size
2 Tbsp (32g)

Calories
per serving **190**

Amount/serving	% DV	Amount/serving	% DV
Total Fat 16g	21%	Total Carb. 7g	3%
Sat. Fat 2.5g	13%	Dietary Fiber 3g	11%
Trans Fat 0g		Total Sugars 2g	
Cholest. 0mg	0%	Incl. 0g Added Sugars	0%
Sodium 120mg	5%	Protein 8g	
Vit. D 0mcg 0% • Calcium 0mg 0% • Iron 0.5mg 2%			
Potas. 200mg 4%			

Package Cost: \$2.49

Number of Servings per Container: about 14 servings

Serving Size: 32g (2 tbsp)

Price per Serving Calculation: \$2.49 / 14 servings = \$0.18 per serving

4. 365 by Whole Foods Market, Spinach Chopped Organic, 16 Ounce

Nutrition Facts

servings per container about 5

Serving size
3/4 cup (85g)

Calories
per serving **30**

INGREDIENTS: ORGANIC SPINACH.

Amount/serving	% Daily Value*	Amount/serving	% Daily Value*
Total Fat 0.5g	1%	Total Carbohydrate 4g	1%
Saturated Fat 0g	0%	Dietary Fiber 3g	11%
Trans Fat 0g		Total Sugars 0g	
Cholesterol 0mg	0%	Includes 0g Added Sugars	0%
Sodium 80mg	3%	Protein 3g	
Vitamin D 0mcg 0% • Calcium 130mg 10% • Iron 1.7mg 10%, Potassium 260mg 6% • Vitamin A 510mcg 60%			

*The % Daily Value 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.

Package Cost: \$2.79

Number of Servings per Container: about 5 servings

Serving Size: 85g (3/4 cup)

Price per Serving Calculation: \$2.79 / 5 servings = \$0.56 per serving

5. 365 By Whole Foods Market, Salmon Pink Alaskan Wild, 14.75 Ounce; \$5.79

Nutrition Facts

about 5 servings per container
Serving size 3oz (85g/1/3 cup)

Amount per serving

Calories 100

% Daily Value*

Total Fat 3.5g 4%

Saturated Fat 1g 5%

Trans Fat 0g

Cholesterol 55mg 18%

Sodium 260mg 11%

Total Carbohydrate 0g 0%

Dietary Fiber 0g 0%

Total Sugars 0g

Includes 0g Added Sugars 0%

Protein 17g

Vit. D 15.9mcg 80% • Calcium 200mg 15%

Iron 0.4mg 2% • Potas. 280mg 6%

*The % Daily Value 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.

Package Cost: \$5.79

Number of Servings per Container: about 5 servings

Serving Size: 85g (3 oz)

Price per Serving Calculation: $\$5.79 / 5 \text{ servings} = \1.16 per serving