Part 1:

Food items used for this problem:

Nutrition Facts

About 15 servings per container
Serving size 1/4 cup (44g)

Amount per serving	
Calories	**170**
	% Daily Value*
Total Fat 2.5g	3%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 31g	11%
Dietary Fiber 5g	18%
Total Sugars 1g	
Includes 0g Added Sugars	0%
Protein 5g	
Vitamin D 0mcg	0%
Calcium 15mg	2%
Iron 2mg	10%
Potassium 162mg	4%

*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.

INGREDIENT: Whole Grain Oats.

Nutrition Facts

about 14 servings
Serv. size
2 Tbsp (32g)

Amount/serving	% DV*	Amount/serving	% DV*
Total Fat 17g	22%	**Sodium** 0mg	0%
Sat. Fat 1.5g	8%	**Total Carb.** 7g	3%
Trans Fat 0g		Dietary Fiber 3g	11%
Polyunsat. Fat 4g		Total Sugars 2g	
Monounsat. Fat 11g		Incl. 0g Added Sugars	0%
Cholest. 0mg	0%	**Protein** 7g	

Calories per serving 190

Vit. D 0mcg 0% • Calcium 90mg 6% • Iron 1.2mg 6% Potas. 230mg 4%

Nutrition Facts

About 9 servings per container
Serving size 4 oz (112g)

Amount per serving	
Calories	**110**
	% Daily Value*
Total Fat 1g	1%
Saturated Fat 0g	1%
Trans Fat 0g	
Cholesterol 70mg	24%
Sodium 75mg	3%
Total Carbohydrate 0g	0%
Protein 24g	48%

Iron 0.4mg 2% • Potas 410mg 9%

Not a significant source of dietary fiber, total sugars, added sugars, vitamin D, and calcium.

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Nutrition Facts

about 20 servings per container
Serving size
1/4 cup dry (45g)

Amount/serving	% Daily Value*	Amount/serving	% Daily Value*
Total Fat 1g	1%	**Total Carbohydrate** 34g	12%
Saturated Fat 0g	0%	Dietary Fiber 1g	4%
Trans Fat 0g		Total Sugars 0g	
Cholesterol 0mg	0%	Includes 0g Added Sugars	0%
Sodium 5mg	0%	**Protein** 3g	

Calories per serving 160

Vitamin D 0mcg 0% • Calcium 0mg 0% • Iron 0.5mg 2% • Potassium 0mg 0%

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Nutrition Facts

about 8 servings per container
Serving size 1 cup (56g) dry

Amount per serving	
Calories	**200**
	% Daily Value*
Total Fat 1g	1%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 43g	16%
Dietary Fiber 2g	7%
Total Sugars 2g	
Includes 0g Added Sugars	0%
Protein 6g	
Vitamin D 0mcg	0%
Calcium 0mg	0%
Iron 0.5mg	2%
Potassium 120mg	2%

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Nutrition Facts

about 6 servings per container
Serving size 1/2 cup (118g)

Amount per serving	
Calories	**60**
	% Daily Value*
Total Fat 0.5g	1%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 400mg	17%
Total Carbohydrate 10g	3%
Dietary Fiber 2g	7%
Total Sugars 5g	
Includes 0g Added Sugars	0%
Protein 2g	

Vit. D 0mcg 0% • Calcium 50mg 2%

Iron 0.8mg 4% • Potas. 460mg 10%

Nutrition Facts	
about 8 servings per container	
Serving size	4 oz (113g)
Amount per serving	
Calories	**150**
	% Daily Value*
Total Fat 5g	6%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 60mg	20%
Sodium 90mg	4%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 25g	
Vitamin D 15.9mcg	80%
Calcium 0mg	0%
Iron 0.5mg	2%
Potassium 410mg	8%

*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.

Nutrition Facts			
1 serving per container			
Serving size	1 tray (258g)		
Amount per serving			
Calories	**450**		
	% Daily Value*		
Total Fat 25g	32%		
Saturated Fat 9g	45%		
Trans Fat 0g			
Cholesterol 45mg	15%		
Sodium 880mg	39%		
Total Carbohydrate 36g	13%		
Dietary Fiber 4g	14%		
Total Sugars 7g			
Includes 0g Added Sugars	0%		
Protein 20g	26%		
Vitamin D 0.8mcg	4%	Calcium 390mg	30%
Iron 2.3mg	15%	Potassium 430mg	10%

*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.

Price Calculations:
Oatmeal - $4.99 pkg/15 servings = $0.34
Almond Butter - $11.49/14 servings = $0.82
Chicken - $13.79 pkg/9 servings = $1.53
Rice - $4.99 pkg/20 servings = $0.25
Pasta - $1.99 pkg/8 servings = $0.25
Pasta Sauce - $3.39 pkg/6 servings = $0.57
Salmon - $27.99 pkg/8 servings = $3.50
Quinoa - $6.29 pkg/10 servings = $0.63
Enchilada - Frozen packaged meal is a single serving = $5.49

Nutritional Information:

Item	Sodium	Energy	Protein	Vitamin D	Calcium	Iron	Potassium
Oatmeal	0mg	170 kcal	5g	0mcg	15mg	2mg	162mg
Almond Butter	0mg	190 kcal	7g	0mcg	90mg	1.2mg	230mg
Chicken	75mg	110 kcal	24g	0mcg	0mg	0.4mg	410mg
Rice	5mg	160 kcal	3g	0mcg	0mg	0.5mg	0mg
Pasta	0mg	200 kcal	6g	0mcg	0mg	0.5mg	120mg
Pasta Sauce	400mg	60 kcal	2g	0mcg	50mg	0.8mg	460mg
Salmon	90mg	150 kcal	25g	15.9mcg	0mg	0.5mg	410mg

Quinoa	0mg	160 kcal	6g	0mcg	0mg	1.7mg	290mg
Enchilada	890mg	450 kcal	20g	0.8mcg	390mg	2.3mg	430mg

Part 2:
The goal of this problem is to minimize cost for purchasing meals while sticking to recommended nutritional constraints. In part 1, I documented the cost and nutritional information for each meal item. Here, I use those values to define the linear programming problem.

Decision Variables:
o: oatmeal and almond butter serving
c: chicken and rice serving
p: pasta serving
s: salmon and quinoa serving
e: enchilada

Objective:
Minimize Cost = (0.34+0.82)o + (1.53+0.25)c + (0.25+0.57)p + (3.5+0.63)s + 5.79e
= 1.16o + 1.78c + 0.82p + 4.13s + 5.49e

Constraints:
**Setting to weekly diet, so multiplied daily requirements by 7*

80c + 400p + 90s + 890e <= 35000	[sodium intake constraint]
360o + 270c + 260p + 310s + 450e >= 14000	[energy/calorie intake]
12o + 27c + 8p + 31s + 20e >= 350	[protein intake]
15.9s + 0.8e >= 140	[vitamin D intake]
105o + 50p + 390e >= 9100	[calcium intake]
3.2o + 0.9c + 1.3p + 2.2s + 2.3e >= 126	[iron intake]
392o + 410c + 580p + 700s + 430e >= 32900	[potassium intake]

Part 3:
Linear programming problem was implemented using the AMPL API for Python.
Code files can be found at https://github.com/mamaOcoder/msds460_diet.
Text files containing the results for each run can be found at https://github.com/mamaOcoder/msds460_diet/results.

Part 4:
The minimal cost solution is $136.90/week for the following meal servings:

Meal	Servings
Oatmeal & Almond Butter	86.7
Chicken & Rice	0
Pasta	0
Salmon & Quinoa	8.8
Enchilada	0

The breakdown of meals is not very realistic for someone to follow- noone wants to eat that much oatmeal! But looking at the problem, it makes sense. Oatmeal is one of the cheapest meal options and it does not contain any sodium which is the only constraint that needs to be minimized. The cheapest meal is actually pasta, however, it contains a high level of sodium. Although the salmon meal is on the expensive side, it contains the most vitamin D, so is needed to ensure that constraint is met.

Part 5:
Changing the minimum serving for each food item did little to change the results, other than increasing the cost ($139.92). The results still show an overwhelming amount of oatmeal meals, which makes sense looking at the low cost of the meal combined with the 0 sodium count. To make the weekly menu more interesting, we could add additional constraints such as capping the number of oatmeal servings we would be willing to eat.