Hannah Graham Assignment 1: Linear Programming – The Diet Problem MSDS460, Fall 2024

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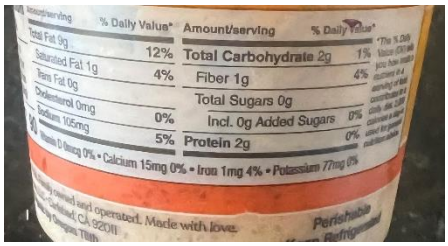
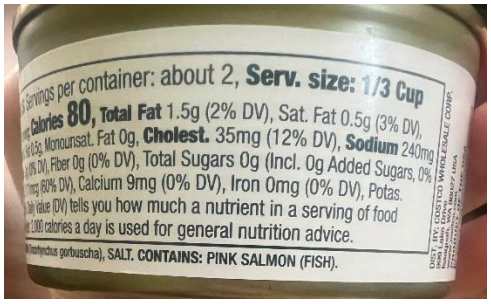
Part 1: Chosen Foods and Their Nutrition Facts

Food	Nutrition label	Price per serving:
Juanitas Tortilla Chips		$5.99 (whole cost) / 24 servings = $0.25 per serving

		
Bitchin' Sauce	 	$11.69 (whole cost) / 24 servings = $0.487 per serving
Kirkland Plain Greek Yogurt		$7.36 (whole cost) / 8 servings = $0.92 per serving
Kirkland canned		$17.42 (whole cost) / 6 cans = $2.90 per can / 2 servings per

pink Salmon	 	can = $1.4516 per serving
Kirkland Organic Black Beans		$10.28 (whole cost) / 6 cans = $1.71325 per can / 3.5 servings per can = $0.4895 per serving

Part 2: Linear Programming Problem Parameters

Goal: Given specific dietary constraints for sodium, energy, protein, vitamin D, Calcium, Iron, and Potassium, calculate the amounts needed for each of the 5 foods (tortilla chips, Bitchin' sauce, Greek Yogurt, canned salmon, and Black Beans) over the course of the week to satisfy the constraints, while minimizing costs.

GitHub Repo Link: https://github.com/hannah-r-graham/MSDS460_BusinessAnalytics_Assignment1_TheDietProblem.git

Decision Variables:

Food	Price per serving	Sodium (mg)	Energy (cal)	Protein (g)	Vitamin D (mcg)	Calcium (mg)	Iron (mg)	Potassium (mg)
Juanitas Tortilla Chips	0.25	160	150	1	0	0	0.5	0
Bitchin' Sauce	0.487	105	90	2	0	15	1	77
Kirkland Plain Greek Yogurt	0.92	60	100	18	0	190	0	190
Kirkland canned pink Salmon	1.45	240	80	17	11	9	0	320
Kirkland Organic Black Beans	0.4895	85	110	7	0	40	1.7	410

Functions for each nutritional element:

#sodium

prob += 160*Chips + 105*Sauce + 60*Yogurt + 240*Salmon + 85*Beans <= 35000

#Energy

prob += 150*Chips + 90*Sauce + 100*Yogurt + 80*Salmon + 110*Beans >= 14000

Protein

prob += 1*Chips + 2*Sauce + 18*Yogurt + 17*Salmon + 7*Beans >= 350

Vitamin D

prob += 0*Chips + 0*Sauce + 0*Yogurt + 11*Salmon + 0*Beans >= 140

Calcium

prob += 0*Chips + 15*Sauce + 190*Yogurt + 9*Salmon + 40*Beans >= 9100

Iron

prob += 0.5*Chips + 1*Sauce + 0*Yogurt + 0*Salmon + 1.7*Beans >= 126

Potassium

prob += 0*Chips + 77*Sauce + 190*Yogurt + 320*Salmon + 410*Beans >= 32900

Objective Function with Cost Coefficients:

Units = servings

Cost = 0.25*Chips + 0.487*Sauce + 0.92*Yogurt +1.45*Salmon + 0.4895*Beans

Weekly Nutritional Constraints:

Component	**Max/Min**	**Daily Amount and Measure**	**Weekly Conversion**
Sodium	Maximum	5,000 milligrams (mg)	35,0000 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)

Part 3: Solution and Results

Results (number of servings in the week):

status=Optimal

Beans = 70.175

Chips = 13.405

Salmon = 12.727273

Sauce = 0.0

Yogurt = 32.518182

Objective = 86.07318579 (dollars)

Results Review:

Seems very boring but very cheap. Being able to have the sauce would be nice. That is an excessive amount of beans - 10 servings a day!

Part 4: Revised Problem: Diversity – At Least One Serving Of Food Item In The Week

Results (servings per week):

status=Optimal

Beans = 69.6575

Chips = 13.1645

Salmon = 12.727273

Sauce = 1.0

Yogurt = 32.548182

Objective = 86.27434454 (dollars)

Results Review:

At least this has a bit more diversity. Program really doesn't like the sauce as it gave it the bare minimum. Still quite a bit of beans

Part 5: LLM Exploration: Microsoft Copilot

Link to chat (doesn't work I don't think): Microsoft Copilot: Your AI companion

Conversation link: https://github.com/hannah-r-graham/MSDS460_BusinessAnalytics_Assignment1_TheDietProblem/blob/main/GPTConvo_dietProblem.txt

Results Review

Results are close but slightly different than what I got in my part 3.

Optimal servings:

beans: 70.175

chips: 13.405

salmon: 12.727273

sauce: 0.0

yogurt: 32.518182

Total cost: 86.07318579

Results Review:

GPT first wanted to use the daily allotment and not week, so had to redo those. It also defaulted to maximize function when we are trying to minimize costs so I had to manually modify that. Otherwise, for part 3 the results were identical when using GPT code, however, they were not correct right out of the gate. The AI generated code still needed human intervention.