

Linear Programming Diet Problem Revisited

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Part 1: Food selection and recipes

Recipe	Serv.	Energy kcal	Protein g	Calcium mg	Sodium mg	Potassium mg	Iron mg	Vitamin D	Cost
Greek Omelet	1	456	30	463	1338	1648.2	9.2	3.1	\$4.45
Veg Biryani	1	855.17	45.93	1457.54	2962.98	1142.24	10.47	0.36	\$9.53
Tandoori Fish	1	395.33	22.8	209.47	2426.25	1031.92	2	12.5	\$14.79
Salmon Steak	1	345.01	35.32	32.04	718.74	665.84	1.09	18.5	\$6.74
Swiss Muesli	1	261	11	166.4	97.3	350.8	1.62	1.5	\$1.37

Refer to my_recipies.xlsx for details on ingredients and cost calculations.

Part 2: LP Setup

- **Decision variables**

The primary goal is to identify the optimal number of servings of each of the meals identified above such that it meets the recommended allowances for the nutrients while also minimizing costs.

- Greek Omelet per week = a
- Veg Biryani per week = b
- Tandoori Fish servings per week = c
- Salmon Steak servings per week = d
- Swiss Muesli servings per week = e

- **Objective Function**

- Minimize weekly cost of the diet plan.
- $z = 4.45a + 9.53b + 14.79c + 6.74d + 1.37e$

- **Constraints**

- Sodium: $1338a + 2962.98b + 2426.25c + 718.74d + 97.3e \leq 35000$
- Energy: $456a + 855.17b + 395.33c + 345.01d + 261e \geq 14000$
- Protein: $30a + 45.93b + 22.8c + 35.32d + 11e \geq 350$
- Vitamin D: $3.1a + 0.36b + 12.5c + 18.5d + 1.5e \geq 140$
- Calcium: $463a + 1457.54b + 209.47c + 32.04d + 166.4e \geq 9100$
- Iron: $9.2a + 10.47b + 2c + 1.09d + 1.09e \geq 126$
- Potassium: $1648.2a + 1142.24b + 1031.92c + 665.84d + 305.8e \geq 32900$
- $a \geq 0$
- $b \geq 0$
- $c \geq 0$
- $d \geq 0$
- $e \geq 0$

Part 3: Solution

Based on the constraints and our goal to minimize cost, the optimal solution seems to be to focus on the lowest costing foods that provide all the required nutrients. This unfortunately results in a

solution that recommends eating omelets 12 times and muesli 26 times to minimize cost while meeting the required nutrition!

- Status: Optimal
- Greek Omelet = 12.972585
- Salmon Steak = 3.2282946
- Swiss Muesli = 26.707691
- Tandoori Fish = 0.0
- Veg Biryani = 0.0
- Total cost of the plan per week: \$ 116.08

Part 4: LP Enhancement

To address the issues of an extremely boring meal plan, the decision variables were updated to ensure at each meal is eaten at least once per week. This change increases the total cost of the meal by \$15.27 but does introduce some variety in the meal. The problem of repeating meals is not completely solved as muesli is still recommended 23 times. Other options to explore could be to set ranges for each meal, add new meal varieties and then specify meal rotation by day and time and perhaps even include other variables to optimize not just cost.

- Status: Optimal
- Greek Omelet = 12.560724
- Salmon Steak = 2.8967726
- Swiss Muesli = 23.074307
- Tandoori Fish = 1.0
- Veg Biryani = 1.0
- Total cost of the plan per week: \$ 131.35

Part 5: LLM

I used ChatGPT for the LLM examination and provided the following prompt. “Hello. I would like to develop a Linear Program for a weekly Diet Plan. The core requirements are that I want to minimize my weekly food cost while making sure that I meet the following daily nutritional recommendations.”

The LLM was able to setup the decision variables and objective functions. It did however miss account for the week summation and therefore was slightly incorrect in the constraint definition. This can however be correct through follow up prompts. The LLM then setup the python code which included a sample plan which was not real food items but placeholders. Upon prompting for using real food, the LLM was able to generate a plan with actual food items.

While the LLM was very quickly able to setup the code and generate data, I would be hesitant to use the nutritional content without verification. The LLM did make mistakes in the initial setup which would require a detail review before being implemented. I think it would be a good assistant to help work through the problem, but not rely on it entirely.

Appendix

See my_recipes.xlsx files for details on recipes, nutrients and costing.