CMSC 150 Numerical and Symbolic Computation

1st Sem 2023-2024

FINAL PROJECT

A. GENERIC SOLVERS

CSV Input

Quadratic Spline Interpolation (QSI)

EXPECTED OUTPUTS

f(x) per interval and Correct f(x) for the estimate

Polynomial Regression (PR)

EXPECTED OUTPUTS

f(x) and estimate

B. SIMPLEX IMPLEMENTATION

Diet Problem Solver

The specific objective for this feature is to find the cheapest and most nutritious combination of foods that will satisfy all the daily nutritional requirements of an individual. The problem is formulated as a linear program where the objective is to minimize cost and meet constraints but will still satisfy the nutritional needs. We include constraints that regulate the number of **calories** and amounts of **vitamins**, **minerals**, **fats**, **sodium** and **cholesterol** in the diet. A certain food option may only have 0-10 servings.

MATHEMATICAL FORMULATION FOR DIET PROBLEM SOLVER

GIVEN:

A set $F = \{f_1, f_2, \dots, f_n\}$ containing n food items

A set $N = \{n_1, n_2, \dots, n_m\}$ containing m nutritional value

A set of parameters:

$cost_i$	cost of food item i, $1 < i, n$
x_i	unknown number of servings $food_i$ must be consumed, $1 < i < n$
$nutrient_{ij}$	value of nutrient j in food i, $1 < i < n$ and $1 < j < m$
$minNutrient_j$	minimum value of nutrient j
$maxNutrient_j$	Maximum value of nutrient j
$minFoodServing_i$	Minimum serving of food item i
$maxFoodServing_i$	Maximum serving of food item i a food item may only be served at most 10 times

REQUIRED:

Minimize

$$totalCost = (cost_1 * x_1) + (cost_2 * x_2) + \dots (cost_n * x_n)$$

Subject to

$$minNutrient < \sum_{i=1}^{n} (nutient_{ji} * x_i) < maxNutrient_j$$

Where

$$1 < j < m \ AND \ minFoodServing_i < x_i < maxFoodServing_i, \ 1 < i < n$$

SPECIFICATIONS:

The link to this feature must be made available in the main page of your project. For this feature, provide an interface where the user can select any or all (Check all option & Reset Option) of the food items. Make sure that changing the input is an easy task for the user. After specifying all the necessary information, the user will instruct the system to start solving (by pressing a button, etc.). The final output of your program must be a table wherein each row has the food item, number of times a food item is to be served, and total cost of the optimal combination. The tableau and basic solution for each iteration **must be displayed**. The final solution and resulting value of the objective function must be identified. You may use **ANY programming language**.

ASSUMPTIONS:

- Any food item may be selected. (For the Diet Problem Solver)
- Some solutions may be infeasible because of the non-satisfaction of constraints.

The project must be done INDIVIDUALLY. Students who will not submit/present their projects will automatically incur a grade of 0 for the project component of their Laboratory grade. The final presentation date is within the LAST WEEK OF CLASSES. Schedule will be based on the sign-up sheet to be posted at least a week before presentation.

SUBMISSION: Store all your well-documented program files and softcopy of User's Manual for your project in a *.zip* file. Save it as **<LASTNAME>_150PROJECT.zip**. Mode of submission for your respective sections will be according to your lab instructor.

NOTE: Be CREATIVE in designing user interface for your project.

Nutritional Requirements for Diet Problem *(Limits on the Nutritional Value Constraints)*

MINIMUM	NUTRIENT	MAXIMUM
2000	Calories	2250
0	Cholesterol	300
0	Total Fat	65
0	Sodium	2400
0	Carbohydrates	300
25	Dietary Fiber	100
50	Protein	100
5000	Vitamin A	50000
50	Vitamin C	20000
800	Calcium	1600
10	Iron	30

Sample Output:

Sample (FEASIBLE):

Your Input
You selected 20 foods to consider for your diet.

Frozen Broccoli	Carrots,Raw	Celery, Raw	Frozen Corn
Lettuce,Iceberg,Raw	Roasted Chicken	Potatoes, Baked	Tofu
Peppers, Sweet, Raw	Spaghetti W/ Sauce	Tomato,Red,Ripe,Raw	
Apple,Raw,W/Skin	Banana	Grapes	
Kiwifruit,Raw,Fresh	Oranges	Bagels	Wheat Bread
White Bread	Oatmeal Cookies		

The Optimized Menu
The cost of this **optimal** diet is $2.71 per day.

The Solution and Cost Breakdown by Food

Food	**Servings**	**Cost($)**
Wheat Bread	1.56	0.08
White Bread	10.00	0.60
Frozen Broccoli	1.50	0.24
Roasted Chicken	0.44	0.37
Oatmeal Cookies	10.00	0.90
Potatoes, Baked	0.37	0.02
Tofu	1.63	0.50

Sample (INFEASIBLE):

Your Input
You selected 6 foods to consider for your diet.
Frozen Broccoli
Carrots,Raw
Celery, Raw
Frozen Corn
Lettuce,Iceberg,Raw
Peppers, Sweet, Raw

The problem is infeasible.
It is not possible to meet the nutritional constraints with the foods that you have selected. *The possible reason is that the pivot element is 0.*

Attachments

Complete Nutritional Values For Food

Foods	Price/Serving	Serving Size	Calories	Cholesterol mg	Total_Fat g	Sodium mg	Carbohydrates g	Dietary_Fiber g	Protein g	Vit_A IU	Vit_C IU	Calcium mg	Iron mg
Frozen Broccoli	$0.16	10 Oz Pkg	73.8	0	0.8	68.2	13.6	8.5	8	5867.4	160.2	159	2.3
Carrots,Raw	$0.07	1/2 Cup Shredded	23.7	0	0.1	19.2	5.6	1.6	0.6	15471	5.1	14.9	0.3
Celery, Raw	$0.04	1 Stalk	6.4	0	0.1	34.8	1.5	0.7	0.3	53.6	2.8	16	0.2
Frozen Corn	$0.18	1/2 Cup	72.2	0	0.6	2.5	17.1	2	2.5	106.6	5.2	3.3	0.3
Lettuce,Iceberg,Raw	$0.02	1 Leaf	2.6	0	0	1.8	0.4	0.3	0.2	66	0.8	3.8	0.1
Peppers, Sweet, Raw	$0.53	1 Pepper	20	0	0.1	1.5	4.8	1.3	0.7	467.7	66.1	6.7	0.3
Potatoes, Baked	$0.06	1/2 Cup	171.5	0	0.2	15.2	39.9	3.2	3.7	0	15.6	22.7	4.3
Tofu	$0.31	1/4 block	88.2	0	5.5	8.1	2.2	1.4	9.4	98.6	0.1	121.8	6.2
Roasted Chicken	$0.84	1 lb chicken	277.4	129.9	10.8	125.6	0	0	42.2	77.4	0	21.9	1.8
Spaghetti W/ Sauce	$0.78	1 1/2 Cup	358.2	0	12.3	1237.1	58.3	11.6	8.2	3055.2	27.9	80.2	2.3
Tomato,Red,Ripe,Raw	$0.27	1 Tomato, 2-3/5 In	25.8	0	0.4	11.1	5.7	1.4	1	766.3	23.5	6.2	0.6
Apple,Raw,W/ Skin	$0.24	1 Fruit,3/Lb,Wo/ Rf	81.4	0	0.5	0	21	3.7	0.3	73.1	7.9	9.7	0.2
Banana	$0.15	1 Fruit,Wo/Skn &Seeds	104.9	0	0.5	1.1	26.7	2.7	1.2	92.3	10.4	6.8	0.4
Grapes	$0.32	10 Fruits,Wo/Rf	15.1	0	0.1	0.5	4.1	0.2	0.2	24	1	3.4	0.1
Kiwifruit,Raw, Fresh	$0.49	1 Med Frt,Wo/Skin	46.4	0	0.3	3.8	11.3	2.6	0.8	133	74.5	19.8	0.3

Complete Nutritional Values For Food

Foods	Price/Serving	Serving Size	Calories	Cholesterol mg	Total_Fat g	Sodium mg	Carbohydrates g	Dietary_Fiber g	Protein g	Vit_A IU	Vit_C IU	Calcium mg	Iron mg
Oranges	$0.15	1 Frt,2-5/8 Diam	61.6	0	0.2	0	15.4	3.1	1.2	268.6	69.7	52.4	0.1
Bagels	$0.16	1 Oz	78	0	0.5	151.4	15.1	0.6	3	0	0	21	1
Wheat Bread	$0.05	1 Sl	65	0	1	134.5	12.4	1.3	2.2	0	0	10.8	0.7
White Bread	$0.06	1 Sl	65	0	1	132.5	11.8	1.1	2.3	0	0	26.2	0.8
Oatmeal Cookies	$0.09	1 Cookie	81	0	3.3	68.9	12.4	0.6	1.1	2.9	0.1	6.7	0.5
Apple Pie	$0.16	1 Oz	67.2	0	3.1	75.4	9.6	0.5	0.5	35.2	0.9	3.1	0.1
Chocolate Chip Cookies	$0.03	1 Cookie	78.1	5.1	4.5	57.8	9.3	0	0.9	101.8	0	6.2	0.4
Butter,Regular	$0.05	1 Pat	35.8	10.9	4.1	41.3	0	0	0	152.9	0	1.2	0
Cheddar Cheese	$0.25	1 Oz	112.7	29.4	9.3	173.7	0.4	0	7	296.5	0	202	0.2
3.3% Fat,Whole Milk	$0.16	1 C	149.9	33.2	8.1	119.6	11.4	0	8	307.4	2.3	291.3	0.1
2% Lowfat Milk	$0.23	1 C	121.2	18.3	4.7	121.8	11.7	0	8.1	500.2	2.3	296.7	0.1
Skim Milk	$0.13	1 C	85.5	4.4	0.4	126.2	11.9	0	8.4	499.8	2.4	302.3	0.1
Poached Eggs	$0.08	Lrg Egg	74.5	211.5	5	140	0.6	0	6.2	316	0	24.5	0.7
Scrambled Eggs	$0.11	1 Egg	99.6	211.2	7.3	168	1.3	0	6.7	409.2	0.1	42.6	0.7
Bologna,Turkey	$0.15	1 Oz	56.4	28.1	4.3	248.9	0.3	0	3.9	0	0	23.8	0.4
Frankfurter, Beef	$0.27	1 Frankfurter	141.8	27.4	12.8	461.7	0.8	0	5.4	0	10.8	9	0.6
Ham,Sliced,Extralean	$0.33	1 Sl,6-1/4x4x1/16 In	37.1	13.3	1.4	405.1	0.3	0	5.5	0	7.4	2	0.2
Kielbasa,Prk	$0.15	1 Sl,6x3-3/4x1/16 In	80.6	17.4	7.1	279.8	0.6	0	3.4	0	5.5	11.4	0.4
Cap'N Crunch	$0.31	1 Oz	119.6	0	2.6	213.3	23	0.5	1.4	40.6	0	4.8	7.5

Complete Nutritional Values For Food

Foods	Price/Serving	Serving Size	Calories	Cholesterol mg	Total_Fat g	Sodium mg	Carbohydrates g	Dietary_Fiber g	Protein g	Vit_A IU	Vit_C IU	Calcium mg	Iron mg
Cheerios	$0.28	1 Oz	111	0	1.8	307.6	19.6	2	4.3	1252.2	15.1	48.6	4.5
Corn Flks, Kellogg'S	$0.28	1 Oz	110.5	0	0.1	290.5	24.5	0.7	2.3	1252.2	15.1	0.9	1.8
Raisin Brn, Kellg'S	$0.34	1.3 Oz	115.1	0	0.7	204.4	27.9	4	4	1250.2	0	12.9	16.8
Rice Krispies	$0.32	1 Oz	112.2	0	0.2	340.8	24.8	0.4	1.9	1252.2	15.1	4	1.8
Special K	$0.38	1 Oz	110.8	0	0.1	265.5	21.3	0.7	5.6	1252.2	15.1	8.2	4.5
Oatmeal	$0.82	1 C	145.1	0	2.3	2.3	25.3	4	6.1	37.4	0	18.7	1.6
Malt-O-Meal,Choc	$0.52	1 C	607.2	0	1.5	16.5	128.2	0	17.3	0	0	23.1	47.2
Pizza W/Pepperoni	$0.44	1 Slice	181	14.2	7	267	19.9	0	10.1	281.9	1.6	64.6	0.9
Taco	$0.59	1 Small Taco	369.4	56.4	20.6	802	26.7	0	20.7	855	2.2	220.6	2.4
Hamburger W/Toppings	$0.83	1 Burger	275	42.8	10.2	563.9	32.7	0	13.6	126.3	2.6	51.4	2.5
Hotdog, Plain	$0.31	1 Hotdog	242.1	44.1	14.5	670.3	18	0	10.4	0	0.1	23.5	2.3
Couscous	$0.39	1/2 Cup	100.8	0	0.1	4.5	20.9	1.3	3.4	0	0	7.2	0.3
White Rice	$0.08	1/2 Cup	102.7	0	0.2	0.8	22.3	0.3	2.1	0	0	7.9	0.9

Complete Nutritional Values For Food

Foods	Price/Serving	Serving Size	Calories	Cholesterol mg	Total_Fat g	Sodium mg	Carbohydrates g	Dietary_Fiber g	Protein g	Vit_A IU	Vit_C IU	Calcium mg	Iron mg
Macaroni,Ckd	$0.17	1/2 Cup	98.7	0	0.5	0.7	19.8	0.9	3.3	0	0	4.9	1
Peanut Butter	$0.07	2 Tbsp	188.5	0	16	155.5	6.9	2.1	7.7	0	0	13.1	0.6
Pork	$0.81	4 Oz	710.8	105.1	72.2	38.4	0	0	13.8	14.7	0	59.9	0.4
Sardines in Oil	$0.45	2 Sardines	49.9	34.1	2.7	121.2	0	0	5.9	53.8	0	91.7	0.7
White Tuna in Water	$0.69	3 Oz	115.6	35.7	2.1	333.2	0	0	22.7	68	0	3.4	0.5
Popcorn,Air-Popped	$0.04	1 Oz	108.3	0	1.2	1.1	22.1	4.3	3.4	55.6	0	2.8	0.8
Potato Chips,Bbqflvr	$0.22	1 Oz	139.2	0	9.2	212.6	15	1.2	2.2	61.5	9.6	14.2	0.5
Pretzels	$0.12	1 Oz	108	0	1	486.2	22.5	0.9	2.6	0	0	10.2	1.2
Tortilla Chip	$0.19	1 Oz	142	0	7.4	149.7	17.8	1.8	2	55.6	0	43.7	0.4
Chicknoodl Soup	$0.39	1 C (8 Fl Oz)	150.1	12.3	4.6	1862.2	18.7	1.5	7.9	1308.7	0	27.1	1.5
Splt Pea&Hamsoup	$0.67	1 C (8 Fl Oz)	184.8	7.2	4	964.8	26.8	4.1	11.1	4872	7	33.6	2.1
Vegetbeef Soup	$0.71	1 C (8 Fl Oz)	158.1	10	3.8	1915.1	20.4	4	11.2	3785.1	4.8	32.6	2.2
Neweng Clamchwd	$0.75	1 C (8 Fl Oz)	175.7	10	5	1864.9	21.8	1.5	10.9	20.1	4.8	82.8	2.8
Tomato Soup	$0.39	1 C (8 Fl Oz)	170.7	0	3.8	1744.4	33.2	1	4.1	1393	133	27.6	3.5
New E Clamchwd,W/ Mlk	$0.99	1 C (8 Fl Oz)	163.7	22.3	6.6	992	16.6	1.5	9.5	163.7	3.5	186	1.5
Crm Mshrm Soup,W/Mlk	$0.65	1 C (8 Fl Oz)	203.4	19.8	13.6	1076.3	15	0.5	6.1	153.8	2.2	178.6	0.6
Beanbacn Soup,W/Watr	$0.67	1 C (8 Fl Oz)	172	2.5	5.9	951.3	22.8	8.6	7.9	888	1.5	81	2