Linear program to design a diet

Over the past century, deficiencies of essential nutrients have dramatically decreased, many infectious diseases have been conquered, and the majority of the United States population can now anticipate a long and productive life. At the same time, rates of chronic diseases, many of which are related to poor quality diet and physical inactivity, have increased. About half of all American adults have one or more preventable, diet-related chronic diseases. However, a large body of evidence now shows that healthy eating patterns and regular physical activity can help people achieve and maintain good health and reduce the risk of chronic disease throughout all stages of their lifespan.

In 1990, The United States National Nutrition Monitoring and Related Research Act, which states that every 5 years, the U.S. Departments of Health and Human Services (HHS) and Agriculture (USDA) must jointly publish a report containing nutritional and dietary information and guidelines for the general public, put in the Dietary Guidelines for Americans; that, to Follow a healthy eating pattern across the lifespan, Focus on variety, nutrient density, and amount, Limit calories from added sugars and saturated fats and reduce sodium intake, Shift to healthier food and beverage choices, Support healthy eating patterns for all. Due to this, we are going to design a diet that meets the minimum recommended daily nutrition goals according to the U.S. Department of Health and Human Services Office of Disease Prevention and Health Promotion.

Let’s look at McDonald’s nutritional information, for demonstration,

	Cheeseburger	
	Avg Qty / Serve	Avg Qty / 100g
Energy (kJ)	1260	1050
Energy (Cal)	300	252
Protein (g)	16.1	13.5
Fat, total (g)	13.1	11.0
Saturated Fat (g)	6.6	5.5
Carbohydrate (g)	28.5	23.9
Sugars (g)	5.6	4.7
Sodium (mg)	680	571

Caesar Chicken Salad - Crispy

	Avg Qty / Serve	Avg Qty / 100g
Energy (kJ)	2500	828
Energy (Cal)	599	198
Protein (g)	34.5	11.5
Fat, total (g)	36.8	12.2
Saturated Fat (g)	6.3	2
Carbohydrate (g)	30.9	10.1
Sugars (g)	8.0	2.6
Sodium (mg)	1860	646

From the Nutritional goals for each age/sex group used in assessing the adequacy of USDA Food Patterns at various calories, let us determine the restrictions on the numbers and choices of dishes selected for the diet of females aged 19-30.

	Dishes		minimum recommendation
Nutrients	chicken salad	cheeseburger	
Macronutrients:			
Protein (g)	34.5	16.1	46
Carbohydrate (g)	30.9	28.5	130
Added Sugars (% kcal);	8.0	5.6	28
Total Fat (% kcal)	36.8	13.1	20-35
Saturated Fat (% kcal)	6.3%	6.6%	10%
– Minerals:			
Calcium (mg);	0	0	1000
Iron (mg);	0	0	18
Sodium (mg);	0	0	2300
– Vitamins:			
Vitamin A (mcg RAE);	0	0	700
Vitamin C (mg);	0	0	75
Vitamin D (IU).	0	0	600

	Cost
Cheeseburger	$2.00
Chicken salad	$5.39

Now, the linear program which will be used to determine a meal plan that satisfies the daily guidelines at a minimal cost;

By taking x to represent chicken salad and y to represent cheeseburger

Objective is to minimize cost = Min 2.00x+5.39y

34.5x+16.1y<=46 (Total proteins)

30.9x+28.5y<=130 (Total carbohydrates)

8.0x+5.6y<=28 (Added sugars)

36.8<=29.4x+13.1y<=35 (Total fat)

6.3x+6.6y<=10 (Saturated fat)

x>=0, y>=0 For (non-neg)