McDonald’s Diet Problem

“Balanced Fast Food”

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Summary

The optimization problem presented here is for a “balanced” diet at a McDonald’s fast food outlet. In this paper, we consider a diet problem which comes from a real-life situation where an average adult may need to choose a meal plan from McDonald’s that provides daily nutrients as well is optimal. An Integer Linear Programming model is used to find an optimal meal plan for a day with a range of constraints, so that the daily recommended intake is taken care of and consumption of harmful nutrients is minimized. The main objective of the problem is to minimize the cost of meals of a day while we fulfil all the nutrient requirements.

Our team considered a small dataset of 11 menu items which includes 9 food items and 2 beverages from the McDonald’s menu. It includes 7 major nutrients consisting of Protein, Carbohydrates, Fats, Iron, Calcium, Vitamin A, Vitamin C and Calories. The goal is to determine a balanced diet to cover a day’s meal with minimum cost. Upper and Lower Bounds on nutrient intake such as Protein, Carbohydrates, Fats, Iron, Calcium Vitamin A, Vitamin C and Sodium are included in the constraints of our model.

The team used McDonald’s price information from the official McDonald’s site and nutrients information from the pdf released by McDonald’s. The team used extensive research to match % DV values of Calcium, Iron, Vitamin A and Vitamin C from the official resources while building the model. We then used Microsoft Excel to get the optimal solution for our model which gives us an objective function of $21.31. A Sensitivity Analysis is done by using Solver Table to learn more about the relationship between the Constraints and Decision Variables. Improvements to the current model to cater different food choices is also explained in the Conclusion where one can customize the choice of menu items.

Introduction

Diet Problem

Diet Problem is considered a classic problem of Optimization. Linear Programming has been used to solve diet problems since it was used by a US economist George Stigler in 1945. The Stigler's original problem has opened the path to many minimum-cost problems such as animal feed, chemical and fertilizer bending. Now linear programming can solve problems relatively easier with the help of faster computers than 70 years ago. Most of the diet problems involve minimizing the cost as it is the main factor in choosing a meal. The cost is minimized while following the required nutrient intake.

In today's time people are trying to eat as healthy food as possible as a part of a healthier lifestyle. To be more related to the audience we narrowed down the target group of the project moderately active average adults in the age group 19-30 years. The dataset of this project takes into nutrients such as Protein, Fats, Carbohydrates, Calories, Iron, Calcium, Vitamin A and Vitamin C, Sodium and the boundary of the constraints are from the official site of McDonald's and official websites about recommended daily nutrition needs and limits respectively. By recognizing various assumptions for the model such as limiting the number of beverages and the number of food items to a limit.

Proposed Solution

The menu items included in our project from McDonald's menu include Hamburger, Fillet O Fish, McChicken, Premium Grilled Chicken Club Sandwich, Premium South West Salad with Grilled Chicken, Premium Bacon Salad with Grilled Chicken, Premium Caesar Salad with Grilled Chicken, Premium Caesar Salad with Crispy Chicken, Fruit and Maple Oatmeal, Orange juice (Medium) and Low-Fat Cappuccino(Medium).

The objective function of $21.31 is obtained by restricting the daily lower limit of Calories to 2000, daily Protein intake to 55gms, daily Carbohydrate intake to 300 grams and daily Fat intake to less than 65 grams. % DV values of Iron, Calcium, Vitamin A and Vitamin C are restricted to the limits provided by the official sites. An upper limit of 170 grams is put on Protein and 325 grams is put on Carbohydrates. An upper limit of 2400 is also put on Calories. An upper limit of 2 is put on the beverages and Fruit and Maple Oatmeal which is a snack, respectively.

Excel Solver is utilized to solve this Integer Linear Programming problem after all the data is inputted into excel. After inputting the values in the Excel Solver, an optimal plan is reached with the nutrition intakes of each nutrients on the model as well as minimum total intake of excess calories, fats, carbohydrates and protein. The model also shows the minimum cost that it will take to have a balanced meal for the day.

The solution proposed in this project shows an approach to diet meal plans for people with busy and fast paced lifestyles. It can be expanded to focus on different types of target groups to add breakfasts and dinners into consideration and to change the number of food items or names of fast food restaurants by altering the input datasets of the corresponding information. We believe this model provides a great feasible solution to the diet problem.

Main Chapter

Data Collection

The data for the nutrient information in each food item and beverages, shown in table 1 below, is collected from the official nutrient pdf released by McDonald's restaurant itself. This document clearly specifies the amount of Calories, Fats, Proteins, Carbohydrates, and other Vitamins present in the food items on the McDonald's menu. This pdf has been attached with our project report. The price for each menu item has been taken from the Official McDonald's site.

McDonald's Menu	Calories	Total fats	Sodium	Carbs	Calcium	Protein	Vit C	Vit A	Iron	Calories (fat)
Hamburger	250	9	520	31	110	12	1.8	0	2.7	80
Fish O Fillet	380	18	640	38	165	15	0	18	1.8	170
McChicken	360	16	830	40	110	14	1.8	0	2.7	150
Premium Grilled Chicken Club Sandwich	460	17	1040	43	330	35	7.2	72	3.6	150
Premium Southwest Salad with grilled chicken	320	9	960	30	165	30	31.5	14.4	2.7	80
Premium Bacon Salad with grilled chicken	260	9	1010	12	165	33	31.5	1440	1.8	90
Premium Caesar Salad with grilled chicken	220	6	890	12	220	33	31.5	1440	1.8	60
Premium Caesar Salad with crispy chicken	330	17	840	20	220	29	31.5	1440	1.8	150
Fruit and Maple oatmeal	290	4.5	160	48	110	6	117	18	1.8	40
Orange juice (medium)	190	0	0	39	44	3	162	0	0	0
Nonfat cappuccino (medium)	80	0	110	12	330	8	0	90	0.36	0

Table 1

The unit used for calculating Total Fats, Carbohydrate and Proteins is in grams. The units used for Sodium, Calcium, Iron and Vitamin C are calculated in milligrams. Vitamin A is calculated in micrograms.

Below is the table 2 for price per serving for each menu item.

McDonald's Menu	Cost per servings (in $)
Hamburger	2.49
Fillet O Fish	3.79
McChicken	2.59
Premium Grilled Chicken Club Sandwich	3.99
Premium Southwest Salad with Grilled Chicken	4.79
Premium Bacon Salad with Grilled Chicken	4.59
Premium Caesar Salad with Grilled Chicken	5.39
Premium Caesar Salad with Crispy Chicken	5.39
Fruit and Maple Oatmeal	1.99
Orange juice (medium)	1.89
Nonfat cappuccino (medium)	2.89

Table 2

The data for daily suggested requirement of nutrients per day has been taken from the sites U.S. Food & Drug Administration (FDA), Dietary Guidelines 2015-2020, US and Government of Canada Website for understanding food labels.

Data Analysis

The 2015-2020 Dietary Guidelines for Americans and the US Department of Agriculture choose my plate each sets out guidelines for what constitutes a well-balanced diet. For good health, you need to consume the appropriate amounts of each of the macronutrients, including Fat, Protein and Carbohydrates. The 2015-2020 Dietary Guidelines for Americans recommends consuming 45 to 65 percent of your calories as carbohydrates, 20 to 35 percent as fats and 10 to 35 percent of your calories as protein. For someone who eats 2,000 calories a day, this translates into 225 to 325 grams of carbohydrates, 50 to 175 grams of protein and 44 to 77 grams of fat each day. The figure 1 below shows the same.

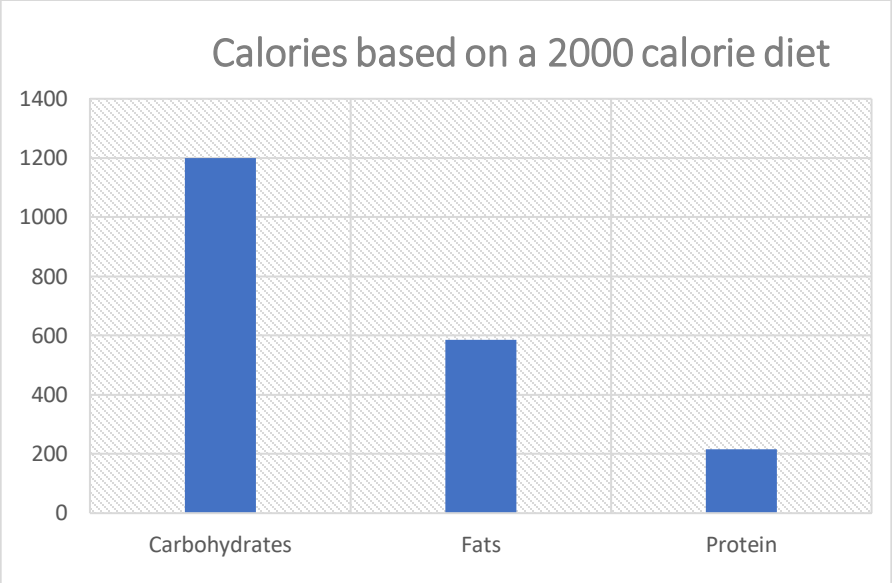


Figure 1

On analyzing our menu items below in figure 2, we find the contents of Protein, Carbohydrates and Fat in them. The food items rich in Protein here are Premium Grilled Chicken Club Sandwich, Premium Caesar Salad with Grilled Chicken and Premium Bacon Salad with Grilled Chicken.

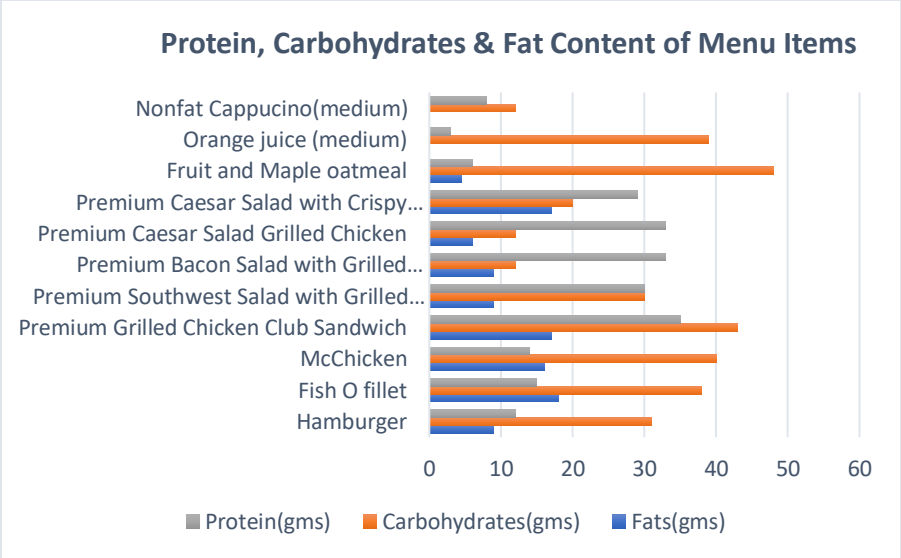


Figure 2

We also analyzed the total Calories and Calories from the Fat content of our menu items in figure 3 and found out that Premium Grilled Chicken Club Sandwich has maximum Calories reaching above 450 Calories per serving out of which 150 calories are from Fat. The next highest calorie food item is Fillet O Fish with Calories reaching 400 per serving out of which Calories from Fat are 170, highest in the menu. The third highest Calorie food in the menu is McChicken with 350 calories out of which Calories from Fat are 150.

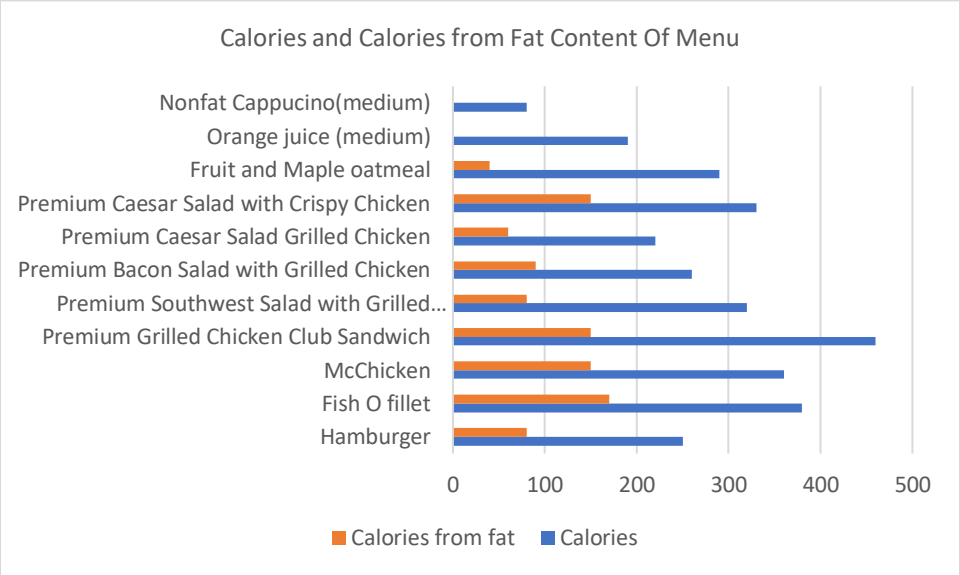


Figure 3

If we compare food items with the price per serving, in below figure 4, we find that the highest priced menu items are Premium Caesar Salad with Grilled Chicken and Premium Caesar Salad with Crispy Chicken at $5.39 per serving. The next highest menu item is Premium Southwest Salad with Grilled Chicken at $4.79. Salads being considered the healthiest are the most expensive items

on the menu. The Cheapest item available in the McDonald's menu is Orange juice (medium) at $1.89 and Fruit and Maple oatmeal at $1.99.

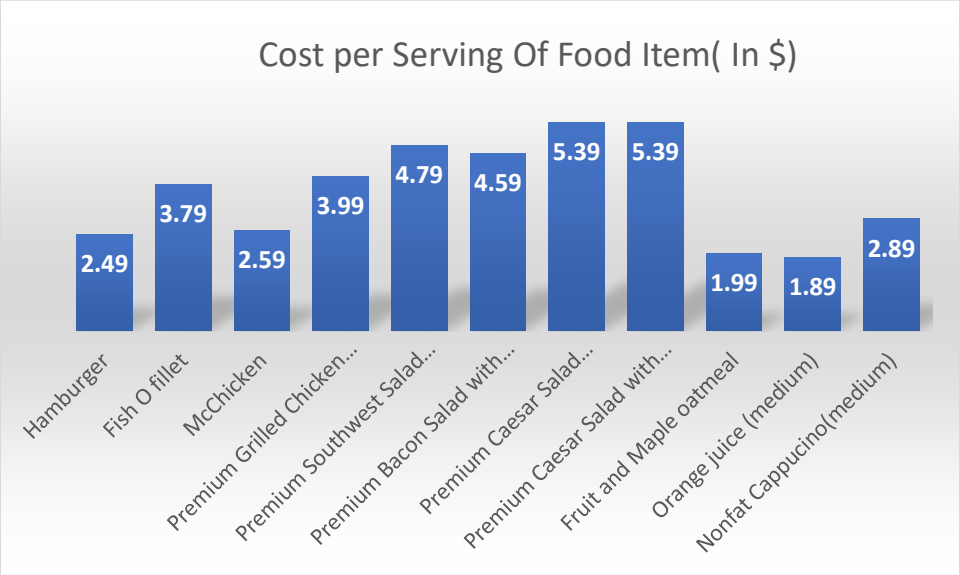


Figure 4

Requirement Gathering

The team did extensive research gathering for the project. Values for the daily acceptable values of nutrients were verified from various government health websites. As the daily recommended values of nutrients vary for different age groups and gender, we restricted our age group to average adults of 19-30 years of age. Our model concentrates on the average adult between 19-30 years of age consuming 2000-2400 calories per day. The WHO suggests consuming 2,000 mg (2 grams) of sodium per day, and the American Heart Association advises a much lower intake of 1,500 mg (1.5 grams) per day. Today, Americans consume much more sodium than health authorities

recommend - averaging about 3,400 mg (3.4 grams) daily. However, these recommendations have been controversial, as people with normal blood pressure levels may not benefit from restricting their sodium intake. In fact, evidence to suggest that consuming less salt decreases heart disease risk in healthy people is limited. It may even be harmful. Our study includes healthy people with normal blood pressure.

Optimization Model

Having completed our data retrieval, we were ready to build our model. Below you will see our model's decision variables, objective function, and constraints.

To complete this model, we had the following decision variables:

Decision Variables	Definition
X_1	Number of Hamburgers to be consumed
X_2	Number of Fillet O fish to be consumed
X_3	Number of McChicken to be consumed
X_4	Number of Premium Grilled Chicken Club Sandwich to be consumed
X_5	Number of Premium Southwest Salad with Grilled Chicken to be consumed

X_6	Number of Premium Bacon Salad with Grilled Chicken to be consumed
X_7	Number of Premium Caesar Salad with Grilled Chicken to be consumed
X_8	Number of Premium Caesar salad with crispy chicken to be consumed
X_9	Number of Fruit and maple oatmeal to be consumed
X_{10}	Number of Orange Juice (Medium) to be consumed
X_{11}	Number of Nonfat Cappuccino (Medium) to be consumed

For the inputs we had the following:

Inputs	C_i	K_i	F_i	S_i	Ca_i	Cm_i	P_i	Vc_i	Va_i	I_i
i=1 (Hamburger)	2.49	250	9	520	31	110	12	1.8	0	2.7
i=2 (Fillet O Fish)	3.79	380	18	640	38	165	15	0	18	1.8
i=3 (McChicken)	2.59	360	16	830	40	110	14	1.8	0	2.7

i=4 (Premium Grilled Chicken Club Sandwich)	3.99	460	17	1040	43	330	35	7.2	72	3.6
i=5 (Premium Southwest Salad with Grilled Chicken)	4.79	320	9	960	30	165	30	31.5	1440	2.7
i=6 (Premium Bacon Salad with Grilled Chicken)	4.59	260	9	1010	12	165	33	31.5	1440	1.8
i=7 (Premium Caesar Salad Grilled Chicken)	5.39	220	6	890	12	220	33	31.5	1440	1.8
i=8 (Premium Caesar Salad with Crispy Chicken)	5.39	330	17	840	20	220	29	31.5	1440	1.8

i=9 (Fruit and Maple oatmeal)	1.99	290	4.5	160	48	110	6	117	18	1.8
i=10 (Orange juice (medium))	1.89	190	0	0	39	44	3	162	0	0
i=11 (Nonfat Cappuccino(medium))	2.89	80	0	110	12	330	8	0	90	0.36
i=req Required	-	2000	-	-	300	1100	55	60	1000	14
i=ul Upper Limit	-	2400	65	3400	325	-	-	-	-	-

Table 3

Table 3 includes input to the model where,

i - Index for each food item

C_i - Cost per serving in $ at i

K_i - Calories at i

F_i -Fats in grams at i

S_i - Sodium in milligrams at i

Ca_i - Carbohydrates in grams at i

Cm_i - Calcium in milligrams at i

P_i - Proteins in grams at i

Vc_i – Vitamin C at in milligrams at i

Va_i – Vitamin A at in micrograms at i

I_i - Iron in milligrams at i

Our objective study, as stated earlier, is to minimize the total cost to fulfill essential nutrition requirements of a day at McDonald's. Here is the objective function:

Objective Function	Definition
Minimize Cost: $C_1X_1 + C_2X_2 + C_3X_3 + C_4X_4 + C_5X_5 + C_6X_6 + C_7X_7 + C_8X_8 + C_9X_9 + C_{10}X_{10} + C_{11}X_{11}$	We minimize the total cost to fulfill the essential nutrition requirement of a day at McDonald's.

For this model, we will have the following constraints:

Constraints	Equations	Explanation
Calories consumed should be greater than 2000 Cal	$K_1X_1 + K_2X_2 + K_3X_3 + K_4X_4 + K_5X_5 + K_6X_6 + K_7X_7 + K_8X_8 + K_9X_9 + K_{10}X_{10} + K_{11}X_{11} >= 2000$	We target that the total calorie intake of a day to be greater than equal to 2000 Cal
Minimum Protein intake should be greater than daily required value of protein	$P_1X_1 + P_2X_2 + P_3X_3 + P_4X_4 + P_5X_5 + P_6X_6 + P_7X_7 + P_8X_8 + P_9X_9 + P_{10}X_{10} + P_{11}X_{11} >= 55$	We target that the total protein intake of a day to be greater than equal to 55 grams

Minimum Carbohydrates intake should be greater than daily required value of carbohydrates	$Ca_1X_1 + Ca_2X_2 + Ca_3X_3 + Ca_4X_4 + Ca_5X_5 + Ca_6X_6 + Ca_7X_7 + Ca_8X_8 + Ca_9X_9 + Ca_{10}X_{10} + Ca_{11}X_{11} >= 300$	We target that the total carbohydrates intake of a day to be greater than equal to 300 grams
Maximum limit of Fat intake should be lesser than daily required value of Fat	$F_1X_1 + F_2X_2 + F_3X_3 + F_4X_4 + F_5X_5 + F_6X_6 + F_7X_7 + F_8X_8 + F_9X_9 + F_{10}X_{10} + F_{11}X_{11} <= 65$	We target that the total fat intake of a day to be not greater than equal to 65 grams
Calories should be lesser than 2400Cal	$K_1X_1 + K_2X_2 + K_3X_3 + K_4X_4 + K_5X_5 + K_6X_6 + K_7X_7 + K_8X_8 + K_9X_9 + K_{10}X_{10} + K_{11}X_{11} <= 2400$	We target that the total calorie intake of a day to be not be greater than or equal to 2400 Cal

Maximum Protein intake should be no greater than daily required value of protein	$P_1X_1 + P_2X_2 + P_3X_3 + P_4X_4 + P_5X_5 + P_6X_6 + P_7X_7 + P_8X_8 + P_9X_9 + P_{10}X_{10} + P_{11}X_{11} <= 170$	We target that the total protein intake of a day to be not greater than or equal to 170 grams
Maximum Carbohydrates intake should be no greater than daily required value of carbohydrates	$Ca_1X_1 + Ca_2X_2 + Ca_3X_3 + Ca_4X_4 + Ca_5X_5 + Ca_6X_6 + Ca_7X_7 + Ca_8X_8 + Ca_9X_9 + Ca_{10}X_{10} + Ca_{11}X_{11} <= 325$	We target that the total carbohydrates intake of a day to be not greater than or equal to 325 grams
Minimum Iron intake should be greater than daily required value of Iron	$I_1X_1 + I_2X_2 + I_3X_3 + I_4X_4 + I_5X_5 + I_6X_6 + I_7X_7 + I_8X_8 + I_9X_9 + I_{10}X_{10} + I_{11}X_{11} >= 14$	We target that the total iron intake of a day to be greater than or equal to 14 grams

Minimum calcium intake should be greater than daily required value of calcium	$Cm_1X_1 + Cm_2X_2 + Cm_3X_3 + Cm_4X_4 + Cm_5X_5 + Cm_6X_6 + Cm_7X_7 + Cm_8X_8 + Cm_9X_9 + Cm_{10}X_{10} + Cm_{11}X_{11} >= 1000$	We target that the total calcium intake of a day to be greater than equal to 1100 milligrams
Minimum Vitamin A intake should be greater than daily required value of Vitamin A	$Va_1X_1 + Va_2X_2 + Va_3X_3 + Va_4X_4 + Va_5X_5 + Va_6X_6 + Va_7X_7 + Va_8X_8 + Va_9X_9 + Va_{10}X_{10} + Va_{11}X_{11} >= 1000$	We target that the total Vitamin A intake of a day to be greater than equal to 1000 micrograms.
Minimum Vitamin C intake should be greater than daily required value of Vitamin C	$Vc_1X_1 + Vc_2X_2 + Vc_3X_3 + Vc_4X_4 + Vc_5X_5 + Vc_6X_6 + Vc_7X_7 + Vc_8X_8 + Vc_9X_9 + Vc_{10}X_{10} + Va_{11}X_{11} >= 60$	We target that the total Vitamin C intake of a day to be greater than equal to 60 milligrams

Maximum Sodium intake should be no more than daily required value of Sodium	$S_1X_1 + S_2X_2 + S_3X_3 + S_4X_4 + S_5X_5 + S_6X_6 + S_7X_7 + S_8X_8 + S_9X_9 + S_{10}X_{10} + S_{11}X_{11} <= 3400$	We target that the total Sodium intake of a day to be no more than 3400 milligrams
Maximum limit on Fruit and Maple Oats	$X_9 <= 2$	We target that the total Fruit and Maple Oats purchased from McDonald's should be less than equal to 2
Maximum limit on Beverages	$X_{10} + X_{11} <= 2$	We target that the total beverages purchased from McDonald's should be less than equal to 2
Non-Negativity	$X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11} >= 0$	To keep the values non-negative.

With our model constructed, we set out to solve the model with Excel's Solver. We used the Simplex Linear function with integer and non-integer solutions to get our optimized solution. See output below:

Solution Results and Analysis:

We started with the model using Simplex Linear, where we defined linear objective function, set given linear constraints and non-negativity constraints as stated above and got an optimal solution of $18.503.

Decisions and Inputs	Number of Serving	Cost Per Serving(in $)	Calories(Cal)	Total Fats(g)	Sodium (g)	Carbohydrates(g)	Calcium (mg)	Protein(mg)	Vitamin C(mg)	VitaminA(µg)	Iron(mg)
Hamburger	0.0	2.5	250.0	9.0	520.0	31.0	110.0	12.0	1.8	0.0	2.7
Fillet O Fish	0.0	3.8	380.0	18.0	640.0	38.0	165.0	15.0	0.0	18.0	1.8
Mcchicken	1.1	2.6	360.0	16.0	830.0	40.0	110.0	14.0	1.8	0.0	2.7
Premium Grilled Chicken Club Sandwich	2.1	4.0	460.0	17.0	1040.0	43.0	330.0	35.0	7.2	72.0	3.6
Premium Southwest Salad with Grilled Chicken	0.0	4.8	320.0	9.0	960.0	30.0	165.0	30.0	31.5	1440.0	2.7
Premium Bacon Salad with Grilled Chicken	0.0	4.6	260.0	9.0	1010.0	12.0	165.0	33.0	31.5	1440.0	1.8
Premium Caesar Salad Grilled Chicken	0.0	5.4	220.0	6.0	890.0	12.0	220.0	33.0	31.5	1440.0	1.8
Premium Caesar Salad with Crispy Chicken	0.0	5.4	330.0	17.0	840.0	20.0	220.0	29.0	31.5	1440.0	1.8
Fruit and Maple oatmeal	2.0	2.0	290.0	4.5	160.0	48.0	110.0	6.0	117.0	18.0	1.8
Orange juice (medium)	1.8	1.9	190.0	0.0	0.0	39.0	44.0	3.0	162.0	0.0	0.0
Nonfat Cappucino(med)	0.0	2.9	80.0	0.0	110.0	12.0	330.0	8.0	0.0	90.0	0.4

Objective Function	18.50378871

Constraints	LHS		RHS
Calories>=2000	2272.1	>=	2000.0
Protein>=46	104.9	>=	46.0
carbs>=300	300.0	>=	300.0
Fat<=65	61.7	<=	65.0
Calories<=2400	2272.1	<=	2400.0
Protein <=170	104.9	<=	170.0
Carbohydrates <=325	300.0	<=	325.0
Iron>=14	14.0	>=	14.0
Calcium>=1100	1100.0	>=	1100.0
Vitamin A>=1000	1100.0	>=	1000.0
Vitamin C>=60	546.2	>=	60.0
Sodium <=3400	3380.3	<=	3400.0
Fruit & Maple oatmeal <=2	2.0	<=	2.0
Bevrages<=2	1.8	<=	2.0

Figure 5

Figure 5 shows us the optimal solution for non-integer that meets all constraints with a minimum cost $18.503

The optimal solution is to consume 1.1 McChicken, 2.1 Premium Grilled Chicken Club Sandwich 2 Fruit and Maple Oatmeal, 1.8 Orange Juice(Medium) and 0 Fillet O fish, Premium Grilled Chicken Club Sandwich, Premium Southwest Salad with grilled chicken, Premium bacon salad with grilled chicken, Premium Caesar salad with grilled chicken, Premium Caesar salad with crispy chicken and Nonfat Cappuccino (Medium). The minimum cost to fulfill the essential nutrition requirement of a day at McDonald's is $18.503.

Since it is not possible to buy 1.1 McChicken, 2.1 Premium Grilled Chicken Club Sandwich and 1.8 Orange Juice (Medium) from McDonald's, team decided to follow Integer Linear Programming Model to overcome this scenario.

Running the model using Simplex Linear for integer solution was smooth, where we already defined linear objective function, set given linear constraints and non-negativity constraints as stated above and fixing decision variables to integer as number servings purchased by McDonald's should be in integer. Running the model using Simplex Linear for integer solution in Solver had quite a smooth and welcome result.

Table 3 shows the optimized values of the decision variables

Table 3

Decision Variables	Values
X_1	4
X_2	0
X_3	1
X_4	0
X_5	0
X_6	0

X_7	0
X_8	0
X_9	2
X_{10}	1
X_{11}	1

Decisions and Inputs	Number of Serving	Cost Per Serving(in $)	Calories(Cal)	Total Fats(g)	Sodium (g)	Carbohydrates(g)	Calcium (mg)	Protein(mg)	Vitamin C(mg)	VitaminA(µg)	Iron(mg)
Hamburger	4.0	2.5	250.0	9.0	520.0	31.0	110.0	12.0	1.8	0.0	2.7
Fillet O Fish	0.0	3.8	380.0	18.0	640.0	38.0	165.0	15.0	0.0	18.0	1.8
Mcchicken	1.0	2.6	360.0	16.0	830.0	40.0	110.0	14.0	1.8	0.0	2.7
Premium Grilled Chicken Club Sandwich	0.0	4.0	460.0	17.0	1040.0	43.0	330.0	35.0	7.2	72.0	3.6
Premium Southwest Salad with Grilled Chicken	0.0	4.8	320.0	9.0	960.0	30.0	165.0	30.0	31.5	1440.0	2.7
Premium Bacon Salad with Grilled Chicken	0.0	4.6	260.0	9.0	1010.0	12.0	165.0	33.0	31.5	1440.0	1.8
Premium Caesar Salad Grilled Chicken	0.0	5.4	220.0	6.0	890.0	12.0	220.0	33.0	31.5	1440.0	1.8
Premium Caesar Salad with Crispy Chicken	0.0	5.4	330.0	17.0	840.0	20.0	220.0	29.0	31.5	1440.0	1.8
Fruit and Maple oatmeal	2.0	2.0	290.0	4.5	160.0	48.0	110.0	6.0	117.0	18.0	1.8
Orange juice (medium)	1.0	1.9	190.0	0.0	0.0	39.0	44.0	3.0	162.0	0.0	0.0
Nonfat Cappucino(med)	1.0	2.9	80.0	0.0	110.0	12.0	330.0	8.0	0.0	90.0	0.4

Objective Function	21.31

Constraints	LHS		RHS
Calories>=2000	2210.0	>=	2000.0
Protein>=46	85.0	>=	46.0
carbs>=300	311.0	>=	300.0
Fat<=65	61.0	<=	65.0
Calories<=2400	2210.0	<=	2400.0
Protein <=170	85.0	<=	170.0
Carbohydrates <=325	311.0	<=	325.0
Iron>=14	17.5	>=	14.0
Calcium>=1100	1144.0	>=	1100.0
Vitamin A>=1000	1144.0	>=	1000.0
Vitamin C>=60	405.0	>=	60.0
Sodium <=3400	3340.0	<=	3400.0
Fruit & Maple oatmeal <=2	2.0	<=	2.0
Bevrages<=2	2.0	<=	2.0

Figure 6

Figure 6 show us the optimal solution that meets all constraints with a minimum cost $21.31.

The optimal solution is to consume 4 Hamburger, 1 McChicken, 2 Fruit and Maple Oatmeal, 1 Orange Juice(Medium), 1 Nonfat Cappuccino (Medium) and no Fish O fillet, Premium grilled chicken club sandwich, Premium Southwest salad with grilled chicken, Premium bacon salad with

grilled chicken, Premium Caesar salad grilled chicken, Premium Caesar salad with crispy chicken to be consumed. The minimum cost to fulfill the essential nutrition requirement of a day at McDonald's is $21.31.

Sensitivity Analysis

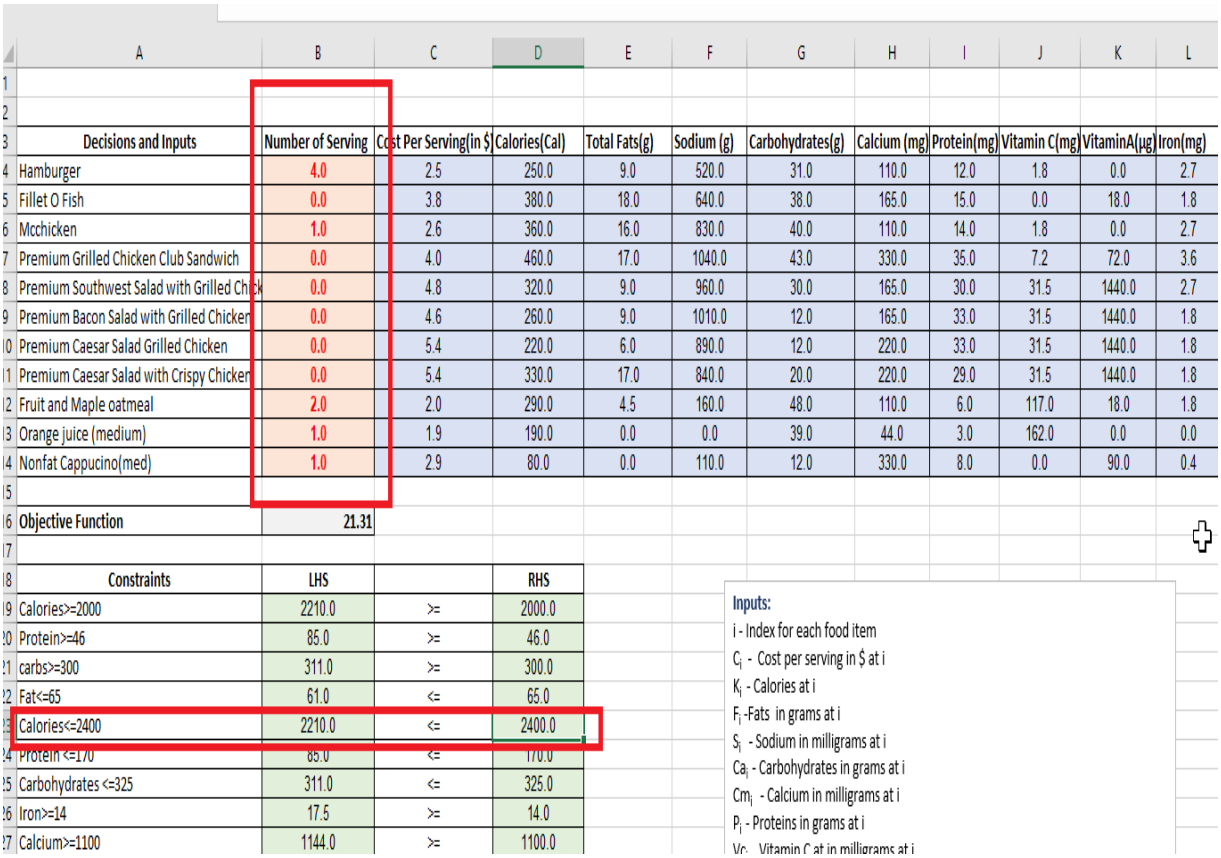
A major assumption in linear programs is that all of the model's parameters are known with certainty. Frequently, however, we find that we have to work with uncertain estimates of model parameters. It is always important to examine the sensitivity of the model's results to alternative assumptions about the values of the parameters.

In the following section we have analyzed both One way and Two-way sensitivity by changing the lower and upper boundary of nutrients to see how the variation is going to impact the optimal cost as well as the serving size of different food.

One Way Analysis

Using a solver table for the linear programming model, we study how the optimal cost function and food serving size varies, with changes in the upper bound of total calories consumption per day.

Specifically , as seen in below Figure 7 , first we ran one-way sensitivity analysis for upper bound of total calorie consumption (Cell D23) from 2100 to 3000 unit with an increment of 100 units to see its effect on the optimal cost(B16), and on the serving size of all the food considered in this case study (cell B4 to Cell B14).



Decisions and Inputs	Number of Serving	Cost Per Serving(in $)	Calories(Cal)	Total Fats(g)	Sodium (g)	Carbohydrates(g)	Calcium (mg)	Protein(mg)	Vitamin C(mg)	VitaminA(µg)	Iron(mg)
Hamburger	4.0	2.5	250.0	9.0	520.0	31.0	110.0	12.0	1.8	0.0	2.7
Fillet O Fish	0.0	3.8	380.0	18.0	640.0	38.0	165.0	15.0	0.0	18.0	1.8
Mcchicken	1.0	2.6	360.0	16.0	830.0	40.0	110.0	14.0	1.8	0.0	2.7
Premium Grilled Chicken Club Sandwich	0.0	4.0	460.0	17.0	1040.0	43.0	330.0	35.0	7.2	72.0	3.6
Premium Southwest Salad with Grilled Chick	0.0	4.8	320.0	9.0	960.0	30.0	165.0	30.0	31.5	1440.0	2.7
Premium Bacon Salad with Grilled Chicken	0.0	4.6	260.0	9.0	1010.0	12.0	165.0	33.0	31.5	1440.0	1.8
Premium Caesar Salad Grilled Chicken	0.0	5.4	220.0	6.0	890.0	12.0	220.0	33.0	31.5	1440.0	1.8
Premium Caesar Salad with Crispy Chicken	0.0	5.4	330.0	17.0	840.0	20.0	220.0	29.0	31.5	1440.0	1.8
Fruit and Maple oatmeal	2.0	2.0	290.0	4.5	160.0	48.0	110.0	6.0	117.0	18.0	1.8
Orange juice (medium)	1.0	1.9	190.0	0.0	0.0	39.0	44.0	3.0	162.0	0.0	0.0
Nonfat Cappucino(med)	1.0	2.9	80.0	0.0	110.0	12.0	330.0	8.0	0.0	90.0	0.4
Objective Function	21.31										

Constraints	LHS		RHS
Calories>=2000	2210.0	>=	2000.0
Protein>=46	85.0	>=	46.0
carbs>=300	311.0	>=	300.0
Fat<=65	61.0	<=	65.0
Calories<=2400	2210.0	<=	2400.0
Protein <=170	85.0	<=	170.0
Carbohydrates <=325	311.0	<=	325.0
Iron>=14	17.5	>=	14.0
Calcium>=1100	1144.0	>=	1100.0

Inputs:

i - Index for each food item

C_i - Cost per serving in $ at i

K_i - Calories at i

F_i -Fats in grams at i

S_i - Sodium in milligrams at i

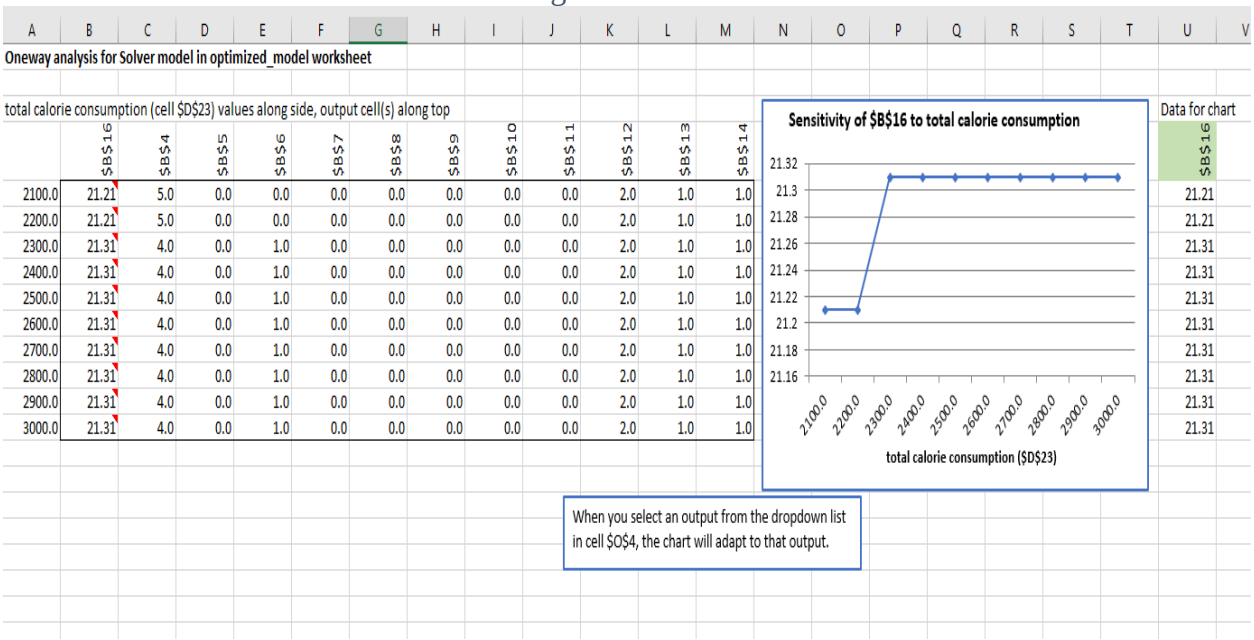
Ca_i - Carbohydrates in grams at i

Cm_i - Calcium in milligrams at i

P_i - Proteins in grams at i

Vc_i - Vitamin C at in milligrams at i

Figure 7



Oneway analysis for Solver model in optimized_model worksheet

total calorie consumption (cell D23) values along side, output cell(s) along top

	B16	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14
2100.0	21.21	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2200.0	21.21	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2300.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2400.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2500.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2600.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2700.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2800.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
2900.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0
3000.0	21.31	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0

Data for chart

B16
21.21
21.21
21.31
21.31
21.31
21.31
21.31
21.31
21.31
21.31

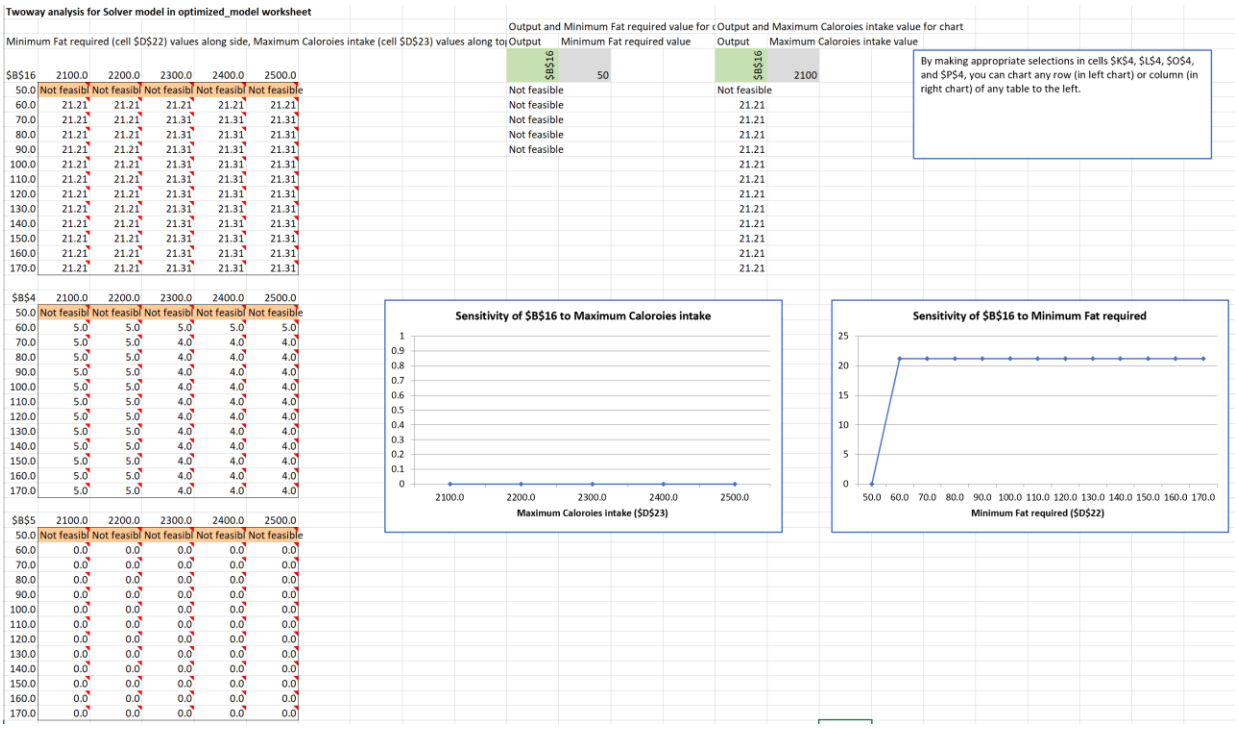
When you select an output from the dropdown list in cell O4, the chart will adapt to that output.

Figure 8

After running the one-way solver table to see the effect of a change in upper bound of total calorie consumption (Cell D23) from 2100 to 3000 on optimal cost function and serving size of food , we can observe in figure 8 that as calories vary between 2100 to 2200 the optimal cost remains at $21.21. From 2200 to 2300 calories the optimal cost increases by $0.10 to $21.31 and remains insensitive to further variation of calories till 3000 Calories.

When the calorie varies from 2100 to 2200 the serving size of Hamburger (B4) is 5 and McChicken (B6) is 0. For variation of calories from 2200 to 2300 the serving size of Hamburger (B4) is reduced by 1 to 4 and the serving size of McChicken (B6) has increased from 0 to 1. Fillet O fish, Premium Grilled Chicken Club sandwich, Premium Southwest salad with grilled chicken, Premium Bacon Salad with Grilled Chicken, Premium Caesar Salad Grilled Chicken, Premium Caesar Salad with Crispy Chicken, Fruit and Maple Oatmeal (B12), Orange juice (medium) (B13) and non-fat Cappuccino (B14) considered as decision variables are insensitive to the variation of upper bound of total calorie consumption from 2100 to 3000.

Two Way Analysis



Twoway analysis for Solver model in optimized_model worksheet

Minimum Fat required (cell D22) values along side, Maximum Caloroies intake (cell D23) values along to

B16	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	21.21	21.21	21.21	21.21	21.21
70.0	21.21	21.21	21.31	21.31	21.31
80.0	21.21	21.21	21.31	21.31	21.31
90.0	21.21	21.21	21.31	21.31	21.31
100.0	21.21	21.21	21.31	21.31	21.31
110.0	21.21	21.21	21.31	21.31	21.31
120.0	21.21	21.21	21.31	21.31	21.31
130.0	21.21	21.21	21.31	21.31	21.31
140.0	21.21	21.21	21.31	21.31	21.31
150.0	21.21	21.21	21.31	21.31	21.31
160.0	21.21	21.21	21.31	21.31	21.31
170.0	21.21	21.21	21.31	21.31	21.31

B4	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	5.0	5.0	5.0	5.0	5.0
70.0	5.0	5.0	4.0	4.0	4.0
80.0	5.0	5.0	4.0	4.0	4.0
90.0	5.0	5.0	4.0	4.0	4.0
100.0	5.0	5.0	4.0	4.0	4.0
110.0	5.0	5.0	4.0	4.0	4.0
120.0	5.0	5.0	4.0	4.0	4.0
130.0	5.0	5.0	4.0	4.0	4.0
140.0	5.0	5.0	4.0	4.0	4.0
150.0	5.0	5.0	4.0	4.0	4.0
160.0	5.0	5.0	4.0	4.0	4.0
170.0	5.0	5.0	4.0	4.0	4.0

B5	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	0.0	0.0	0.0
80.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.0
100.0	0.0	0.0	0.0	0.0	0.0
110.0	0.0	0.0	0.0	0.0	0.0
120.0	0.0	0.0	0.0	0.0	0.0
130.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0

Output and Minimum Fat required value for c

Output	B16
	50
Not feasible	
Not feasible	
Not feasible	
Not feasible	
Not feasible	

Output and Maximum Caloroies intake value for chart

Output	B16
	2100
Not feasible	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	
21.21	

By making appropriate selections in cells K4, L4, O4, and P4, you can chart any row (in left chart) or column (in right chart) of any table to the left.

B6	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	1.0	1.0	1.0
80.0	0.0	0.0	1.0	1.0	1.0
90.0	0.0	0.0	1.0	1.0	1.0
100.0	0.0	0.0	1.0	1.0	1.0
110.0	0.0	0.0	1.0	1.0	1.0
120.0	0.0	0.0	1.0	1.0	1.0
130.0	0.0	0.0	1.0	1.0	1.0
140.0	0.0	0.0	1.0	1.0	1.0
150.0	0.0	0.0	1.0	1.0	1.0
160.0	0.0	0.0	1.0	1.0	1.0
170.0	0.0	0.0	1.0	1.0	1.0

B7	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	0.0	0.0	0.0
80.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.0
100.0	0.0	0.0	0.0	0.0	0.0
110.0	0.0	0.0	0.0	0.0	0.0
120.0	0.0	0.0	0.0	0.0	0.0
130.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0

B8	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	0.0	0.0	0.0
80.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.0
100.0	0.0	0.0	0.0	0.0	0.0
110.0	0.0	0.0	0.0	0.0	0.0
120.0	0.0	0.0	0.0	0.0	0.0
130.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0

B9	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	0.0	0.0	0.0
80.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.0
100.0	0.0	0.0	0.0	0.0	0.0
110.0	0.0	0.0	0.0	0.0	0.0
120.0	0.0	0.0	0.0	0.0	0.0
130.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0

B10	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	0.0	0.0	0.0
80.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.0
100.0	0.0	0.0	0.0	0.0	0.0
110.0	0.0	0.0	0.0	0.0	0.0
120.0	0.0	0.0	0.0	0.0	0.0
130.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0

B11	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	0.0	0.0	0.0	0.0	0.0
70.0	0.0	0.0	0.0	0.0	0.0
80.0	0.0	0.0	0.0	0.0	0.0
90.0	0.0	0.0	0.0	0.0	0.0
100.0	0.0	0.0	0.0	0.0	0.0
110.0	0.0	0.0	0.0	0.0	0.0
120.0	0.0	0.0	0.0	0.0	0.0
130.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0

B12	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	2.0	2.0	2.0	2.0	2.0
70.0	2.0	2.0	2.0	2.0	2.0
80.0	2.0	2.0	2.0	2.0	2.0
90.0	2.0	2.0	2.0	2.0	2.0
100.0	2.0	2.0	2.0	2.0	2.0
110.0	2.0	2.0	2.0	2.0	2.0
120.0	2.0	2.0	2.0	2.0	2.0
130.0	2.0	2.0	2.0	2.0	2.0
140.0	2.0	2.0	2.0	2.0	2.0
150.0	2.0	2.0	2.0	2.0	2.0
160.0	2.0	2.0	2.0	2.0	2.0
170.0	2.0	2.0	2.0	2.0	2.0

B13	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	1.0	1.0	1.0	1.0	1.0
70.0	1.0	1.0	1.0	1.0	1.0
80.0	1.0	1.0	1.0	1.0	1.0
90.0	1.0	1.0	1.0	1.0	1.0
100.0	1.0	1.0	1.0	1.0	1.0
110.0	1.0	1.0	1.0	1.0	1.0
120.0	1.0	1.0	1.0	1.0	1.0
130.0	1.0	1.0	1.0	1.0	1.0
140.0	1.0	1.0	1.0	1.0	1.0
150.0	1.0	1.0	1.0	1.0	1.0
160.0	1.0	1.0	1.0	1.0	1.0
170.0	1.0	1.0	1.0	1.0	1.0

B14	2100.0	2200.0	2300.0	2400.0	2500.0
50.0	Not feasibl	Not feasibl	Not feasibl	Not feasibl	Not feasible
60.0	1.0	1.0	1.0	1.0	1.0
70.0	1.0	1.0	1.0	1.0	1.0
80.0	1.0	1.0	1.0	1.0	1.0
90.0	1.0	1.0	1.0	1.0	1.0
100.0	1.0	1.0	1.0	1.0	1.0
110.0	1.0	1.0	1.0	1.0	1.0
120.0	1.0	1.0	1.0	1.0	1.0
130.0	1.0	1.0	1.0	1.0	1.0
140.0	1.0	1.0	1.0	1.0	1.0
150.0	1.0	1.0	1.0	1.0	1.0
160.0	1.0	1.0	1.0	1.0	1.0
170.0	1.0	1.0	1.0	1.0	1.0

Figure 9

Using two-way sensitivity analysis, we have analyzed the effect of variation in the upper bound of calorie consumption(D23) between 2100 to 2500 in combination with variation of fat(D22) between 50 to 170 to Optimal Cost.

For variation in Calories from 2100 to 2500 and variation in fat value between 60 to 170 the model is giving an optimal solution. It can be observed that for fat value at 50 when the calorie varies between 2100 to 2500 the model is not giving feasible solution. When calorie value varies from 2100 and 2200 and fat varies between 60 to 170 the Optimal Cost remains constant at $21.21. For calorie value between 2300 to 2500 and when fat varies between 70 to 170 the optimal cost is increased by $.10 to $21.31.

For variation in Calories from 2100 to 2500 and fat at 50 the model is giving an infeasible solution. For variation in Calories from 2100 to 2200 and variation of fat from 60 to 170, number of Hamburger (B4) is 5. Further for variation in calories from 2300 to 2500 and fat at 60, we have to consume 5 Hamburgers. Further for variation of upper limit of calories from 2300 to 2500 and variation of fat from 70 to 170, it says 4 Hamburger to be consumed.

For variation in Calories from 2100 to 2500 and fat at 50 the model is giving an infeasible solution for McChicken. For variation in Calories from 2100 to 2500 and fat at 60 the model is suggesting to consume 0 McChicken. For variation in Calories from 2100 to 2200 and variation of fat from 70 to 170 the model is insensitive at 0 McChicken. For variation in Calories from 2300 to 2500 and variation of fat from 70 to 170 the model is insensitive at 1 McChicken.

For variation in Calories from 2100 to 2500 and fat at 50 the model is giving an infeasible solution for Fruit and Maple Oatmeal ($B12). For variation in Calories from 2100 to 2500 and variation in fat from 60 to 170 the model is insensitive to variation at 2 for Fruit and Maple Oatmeal (B12).

For variation in Calories from 2100 to 2500 and fat at 50 the model is giving an infeasible solution for Orange Juice (Medium) (B13). For variation in Calories from 2100 to 2500 and variation in fat from 60 to 170 the model is insensitive to variation at 1 for Orange Juice (B13).

For variation in Calories from 2100 to 2500 and fat at 50 the model is giving an infeasible solution for Non-Fat Cappuccino (B14). For variation in Calories from 2100 to 2500 and variation in fat from 60 to 170 the model is insensitive to variation at 1 for Non-Fat Cappuccino (B14).

For other decision variables for variation in Calories from 2100 to 2500 in combination of fat at 50 model is infeasible. Further for variation in Calories from 2100 to 2500 in combination with variation of fat from 60 to 170 it insensitive at 0.

Conclusion

Using Excel Solver and Excel Solver Table add-in, we, as a team analyzed the optimal cost for the most optimal McDonald's menu while meeting the nutritional constraints. We developed the linear integer programming models and solved the model using Excel Solver. The menu produced is ideal for those who want to eat at McDonald's but at the same time are also conscious about their health and cost.

Our Optimization result includes 4 servings of Hamburger,1 serving of McChicken, 2 Servings of Fruit and Maple oatmeal,1 serving of Orange juice (medium) and 1 serving of non-fat Cappuccino (medium) with a total cost of $21.31.

Furthermore, we also learnt about additional results by running One-way sensitivity analysis using Excel Solver Table tool. The prime objective of this study was to see how the optimal cost function varies with changes to total calories consumption. The total cost function went up only by $0.10 when the total calorie value goes up from 2200 to 2300.

From our demonstration, our application does meet our initial goal of providing a lowest-cost Mc Donald's menu combination for customers, that provides a day's requirement for nutrients. However, it is also apparent that the menu exhausts options that are cheap and high in nutrient contents, and it also repeats items quite often to save money. The reason why we end up getting a menu that people might not enjoy is that we disregard many important non-monetary factors in our modeling assumptions. The most salient of all disregarded factors is the satisfaction we get from eating. Some menu items, while having high nutritional contents, may not have a correspondingly savory level. For example, Fruit and maple oatmeal are healthy, but they might not be as attractive as Fillet O Fish, another menu considered in the model creation. This fact may impact the utilization rate of our application: users who receive their personally generated menus may not get options that are suited to their palates and thus do not follow the menu.

One possible solution is that when asking for user input, we can let them describe what types of food they like. Then we can consider calculating a satisfaction score for each item, based on how many ingredients in the food agree with the user's preference. While minimizing costs, we make sure the satisfaction level is acceptable by adding one more constraint.

Another problem is the serving size of food. The optimal solution provides “Hamburger” serving count as 4 and Fruit and Maple oatmeal as 2. The other food items present in the model are not considered in solution as their price is higher than the above menu items. Given that people generally do not enjoy eating the same food in a row, this may also deter people from using the model. Since this model considers some of the food items from McDonald’s menu list, a simple solution to this problem can be to consider all the options available in Mc Donald’s list. Then we can add some more constraints to limit the serving size of food items to have more options in the optimal solution.

Although we can make significant improvement in solving these two major problems and fine-tune our models in many other ways, the program currently is a functional tool that can be put into practical use for anyone whose primary aim is to tighten their budget for McDonald’s food which can serve daily targets of nutrient value.

Acknowledgement

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Citation

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APPENDIX

McDonald ‘s nutrition fact for popular menu items

McDonald's USA Nutrition Facts for Popular Menu Items

We provide a nutrition analysis of our menu items to help you balance your McDonald's meal with other foods you eat. Our goal is to provide you with the information you need to make sensible decisions about balance, variety and moderation in your diet.

Nutrition Facts	Serving Size	Calories	Calories from Fat	Total Fat (g)	% Daily Value**	Saturated Fat (g)	% Daily Value**	*Trans* Fat (g)	Cholesterol (mg)	% Daily Value**	Sodium (mg)	% Daily Value**	Carbohydrates (g)	% Daily Value**	Dietary Fiber (g)	% Daily Value**	Sugars (g)	Protein (g)	% DAILY VALUE			
																			Vitamin A	Vitamin C	Calcium	Iron
Sandwiches																						
Hamburger	3.5 oz (100 g)	250	80	9	13	3.5	16	0.5	25	9	520	22	31	10	2	6	6	12	0	2	10	15
Cheeseburger	4 oz (114 g)	300	110	12	19	6	28	0.5	40	13	750	31	33	11	2	7	6	15	6	2	20	15
Double Cheeseburger	5.8 oz (165 g)	440	210	23	35	11	54	1.5	80	26	1150	48	34	11	2	8	7	25	10	2	25	20
McDouble	5.3 oz (151 g)	390	170	19	29	8	42	1	65	22	920	38	33	11	2	7	7	22	6	2	20	20
Quarter Pounder® with Cheese+	7 oz (198 g)	510	230	26	40	12	61	1.5	90	31	1190	50	40	13	3	11	9	29	10	4	30	25

Premium Bacon Ranch Salad with Crispy Chicken	11.4 oz (324 g)	370	180	20	31	6	28	0	75	24	970	40	20	7	3	13	6	29	160	35	15	10
Premium Bacon Ranch Salad (without chicken)	7.8 oz (223 g)	140	70	7	11	3.5	18	0	25	9	300	12	10	3	3	13	4	9	160	30	15	8
Premium Caesar Salad with Grilled Chicken	11 oz (311 g)	220	60	6	10	3	15	0	75	25	890	37	12	4	3	13	5	30	160	35	20	10
Premium Caesar Salad with Crispy Chicken	11.1 oz (314 g)	330	150	17	26	4.5	22	0	60	19	840	35	20	7	3	13	6	26	160	35	20	10
Premium Caesar Salad (without chicken)	7.5 oz (213 g)	90	35	4	6	2.5	12	0	10	4	180	7	9	3	3	13	4	7	160	30	20	8
Side Salad	3.1 oz (87 g)	20	0	0	0	0	0	0	0	0	10	0	4	1	1	6	2	1	45	25	2	4
Butter Garlic Croutons	0.5 oz (14 g)	60	15	1.5	3	0	0	0	0	0	140	6	10	3	1	2	0	2	0	0	2	4
Snack Size Fruit & Walnut Salad	1 pkg (163 g)	210	70	8	13	1.5	7	0	5	2	60	2	31	10	2	9	25	4	0	170	8	2
Nutrition Facts	Serving Size	Calories	Calories from Fat	Total Fat (g)	% Daily Value**	Saturated Fat (g)	% Daily Value**	*Trans* Fat (g)	Cholesterol (mg)	% Daily Value**	Sodium (mg)	% Daily Value**	Carbohydrates (g)	% Daily Value**	Dietary Fiber (g)	% Daily Value**	Sugars (g)	Protein (g)	% DAILY VALUE			
																			Vitamin A	Vitamin C	Calcium	Iron

Nutrition Facts	Serving Size	Calories	Calories from Fat	Total Fat (g)	% Daily Value**	Saturated Fat (g)	% Daily Value**	*Trans* Fat (g)	Cholesterol (mg)	% Daily Value**	Sodium (mg)	% Daily Value**	Carbohydrates (g)	% Daily Value**	Dietary Fiber (g)	% Daily Value**	Sugars (g)	Protein (g)	% DAILY VALUE			
																			Vitamin A	Vitamin C	Calcium	Iron
Salads																						
Premium Southwest Salad with Grilled Chicken	12.3 oz (350 g)	320	80	9	14	3	14	0	70	24	960	40	30	10	6	25	11	30	160	35	15	15
Premium Southwest Salad with Crispy Chicken	12.5 oz (353 g)	430	180	20	30	4	20	0	55	18	920	38	38	13	6	25	12	26	160	30	15	15
Premium Southwest Salad (without chicken)	8.1 oz (231 g)	140	40	4.5	7	2	9	0	10	3	150	6	20	7	6	24	6	6	160	25	15	10

Premium Bacon Ranch Salad with Grilled Chicken	11.3 oz (321 g)	260	90	9	15	4	21	0	90	30	1010	42	12	4	3	13	5	33	160	35	15	10
Premium Bacon Ranch Salad with	11.4 oz (324 g)	370	180	20	31	6	28	0	75	24	970	40	20	7	3	13	6	29	160	35	15	10

Nutrition Facts	Serving Size	Calories	Calories from Fat	Total Fat (g)	% Daily Value**	Saturated Fat (g)	% Daily Value**	*Trans* Fat (g)	Cholesterol (mg)	% Daily Value**	Sodium (mg)	% Daily Value**	Carbohydrates (g)	% Daily Value**	Dietary Fiber (g)	% Daily Value**	Sugars (g)	Protein (g)	% DAILY VALUE			
																			Vitamin A	Vitamin C	Calcium	Iron
McCafe Coffees - Nonfat Milk																						
Nonfat Cappuccino (Small)§	12 fl oz cup	60	0	0	0	0	0	0	5	1	85	4	9	3	0	0	9	6	8	0	25	0
Nonfat Cappuccino (Medium)§	16 fl oz cup	80	0	0	0	0	0	0	5	2	110	5	12	4	0	0	12	8	10	0	30	2
Nonfat Cappuccino (Large)§	20 fl oz cup	90	0	0	0	0	0	0	5	2	130	5	13	4	0	0	13	9	10	0	35	2
Nonfat Latte (Small)§	12 fl oz cup	90	0	0	0	0	0	0	5	2	115	5	13	4	0	0	13	9	10	0	30	0
Nonfat Latte (Medium)§	16 fl oz cup	110	0	0	0	0	0	0	5	2	140	6	15	5	0	0	15	10	10	0	40	2
Nonfat Latte (Large)§	20 fl oz cup	120	0	0	0	0	0	0	5	2	160	7	18	6	0	0	18	12	15	0	45	2
Angus Mushroom & Swiss	10 oz (283 g)	770	360	40	61	17	85	2	135	46	1170	49	59	20	4	16	8	44	8	0	40	35
Filet-O-Fish®	5 oz (142 g)	380	170	18	28	3.5	18	0	40	14	640	27	38	13	2	7	5	15	2	0	15	10
McChicken ®	5 oz (143 g)	360	150	16	25	3	15	0	35	11	830	34	40	13	2	7	5	14	0	2	10	15
McRib ®†	7.4 oz (209 g)	500	240	26	40	10	48	0	70	23	980	41	44	15	3	10	11	22	2	2	15	20
Premium Grilled Chicken Classic Sandwich	7.1 oz (201 g)	360	80	9	14	2	10	0	65	21	820	34	41	14	4	14	8	27	6	8	15	20
Premium Crispy Chicken Classic Sandwich	7.5 oz (213 g)	510	200	22	33	3.5	18	0	45	16	990	41	56	19	3	13	10	24	4	6	15	20
Premium Grilled Chicken Club Sandwich	7.9 oz (224 g)	460	150	17	26	6	29	0	90	30	1040	43	43	14	4	15	9	35	8	8	30	20
Premium Crispy Chicken Club Sandwich	8.4 oz (237 g)	620	260	29	45	7	37	0	70	24	1200	50	57	19	3	14	11	31	8	6	30	20
Premium Grilled Chicken Ranch BLT Sandwich	7.1 oz (203 g)	380	90	10	16	3	14	0	75	25	1000	42	41	14	4	14	9	31	4	8	15	20

Nutrition Facts	Serving Size	Calories	Calories from Fat	Total Fat (g)	% Daily Value**	Saturated Fat (g)	% Daily Value**	*Trans* Fat (g)	Cholesterol (mg)	% Daily Value**	Sodium (mg)	% Daily Value**	Carbohydrates (g)	% Daily Value**	Dietary Fiber (g)	% Daily Value**	Sugars (g)	Protein (g)	% DAILY VALUE			
																			Vitamin A	Vitamin C	Calcium	Iron
Beverages																						
1% Low Fat Milk Jug	1 carton (236 ml)	100	20	2.5	4	1.5	8	0	10	3	125	5	12	4	0	0	12	8	10	4	30	0
1% Low Fat Chocolate Milk Jug	1 carton (236 ml)	170	25	3	4	1.5	9	0	5	2	150	6	26	9	1	3	25	9	10	6	30	0
Minute Maid® 100% Apple Juice Box	6.8 fl oz (200 ml)	100	0	0	0	0	0	0	0	0	15	1	23	8	0	0	22	0	0	100	10	0
Dasani® Water	16.9 fl oz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minute Maid® Orange Juice (Small)§	12 fl oz cup	150	0	0	0	0	0	0	0	0	0	0	30	10	0	0	30	2	0	140	2	0
Minute Maid® Orange Juice (Medium)§	16 fl oz cup	190	0	0	0	0	0	0	0	0	0	0	39	13	0	0	39	3	0	180	4	0
Minute Maid® Orange Juice	22 fl oz	280	0	0	0	0	0	0	0	0	5	0	58	19	0	0	58	4	0	260	4	0

Hotcake Syrup	1 pkg (60 g)	180	0	0	0	0	0	0	0	0	20	1	45	15	0	0	32	0	0	0	0	0
Whipped Margarine (1 pat)	6 g	40	40	4.5	7	1.5	8	0	0	0	55	2	0	0	0	0	0	0	4	0	0	0
Hash Brown	2 oz (56 g)	150	80	9	14	1.5	6	0	0	0	310	13	15	5	2	6	0	1	0	2	0	2
Grape Jam	0.5 oz (14 g)	35	0	0	0	0	0	0	0	0	0	0	9	3	0	0	9	0	0	2	0	0
Strawberry Preserves	0.5 oz (14 g)	35	0	0	0	0	0	0	0	0	0	0	9	3	0	0	9	0	0	4	0	0
Bacon, Egg & Cheese Bagel†	6.5 oz (185 g)	560	240	27	42	9	46	0.5	260	86	1300	54	56	19	3	10	7	24	20	2	20	20
Fruit & Maple Oatmeal†	9.2 oz (253 g)	290	40	4.5	7	2	10	0	10	3	160	7	57	19	5	20	32	5	2	130	10	10
Fruit & Maple Oatmeal without Brown Sugar†	9.2 oz (251 g)	260	40	4.5	7	2	10	0	10	3	115	5	48	16	5	20	18	5	2	130	6	10
Nutrition Facts	**Serving Size**	**Calories**	**Calories from Fat**	**Total Fat (g)**	**% Daily Value****	**Saturated Fat (g)**	**% Daily Value****	***Trans* Fat (g)**	**Cholesterol (mg)**	**% Daily Value****	**Sodium (mg)**	**% Daily Value****	**Carbohydrates (g)**	**% Daily Value****	**Dietary Fiber (g)**	**% Daily Value****	**Sugars (g)**	**Protein (g)**	**% DAILY VALUE**			
																			Vitamin A	**Vitamin C**	**Calcium**	**Iron**