Name(s) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(15 points) BA 353: Take Home Exam 2**

Is it possible to eat healthy for a day on the cheap at McDonald’s? To answer this question, you will set up a large LP with several items from the McDonald’s menu versus the regulatory information from the FDA.

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| --- | --- | --- |
|  | **Item** | **Price** |
| 1 | Big Mac | $3.99 |
| 2 | Double Quarter Pounder with Cheese | $4.79 |
| 3 | Cheeseburger | $1 |
| 4 | McChicken | $3.49 |
| 5 | Filet-O-Fish | $3.49 |
| 6 | Egg McMuffin | $1 |
| 7 | Chicken McNuggets (4 piece) | $2.99 |
| 8 | World Famous Fries (small) | $1 |
| 9 | 1% Low Fat Milk Jug | $1 |
| 10 | Ketchup Packet | $0 |

Specifically, consider these twelve items from the menu. Go to the McDonald’s website and look up the nutritional information for each item, specifically:

* Calories
* Total Fat “Bad stuff”
* Carbs
* Sodium
* Dietary Fiber
* Protein
* Vitamin D

“Good stuff”

* Calcium
* Iron
* Potassium

Hint: <https://www.mcdonalds.com/us/en-us/about-our-food/nutrition-calculator.html> . Click “Show Details” to get all the facts. Build a table with the menu items and the ten nutritional facts for each. For example, a Big Mac has 550 calories, 30 grams of fat, 45 grams of carbs, 1010 mg of sodium, …, and 8% of daily value of potassium. For the Chicken McNuggets, makes sure to use 4 pieces and make sure to use the small fries.

Now, go to the FDA website and determine daily requirements (DV) for each of the nine nutritional facts (which are based on a 2000 calorie per day diet). Hint: <http://www.netrition.com/rdi_page.html>. For example, the DV for fat is at most 78 grams, the DV for Sodium is at most 2300 mg, the DV for protein is at least 50 grams and for the last four constraints, since McDonald’s list them as percentages, each one should be at least 100%.

**Assignment:**

Set up an LP with 10 variables and ten constraints with the goal of minimizing cost subject to a) not exceeding the limits on the **bad stuff** (calories, fat, carbs and sodium) while b) meeting or exceeding the requirements for the **good stuff** (fiber, protein, vitamins and minerals).

a) Attach a clear copy of your LP Model to this page. Work together to very carefully enter the data into Excel, double-checking your numbers versus the actual values to ensure accuracy.

b) Try to solve the LP Model on Excel with the ten food items as they are above as variables and ten constraints. What do the Solver results say? (DO NOT JUST WRITE DOWN THE ANSWER THAT POPS UP, READ THE SOLVER RESULTS!!!). What does this mean about eating a healthy diet at McDonald’s by eating regular menu items?

c) Until this summer, McDonald’s sold side salads. Read this [article](https://www.msn.com/en-us/foodanddrink/eatingout/the-surprising-reason-mcdonalds-ditched-salads-for-good/ar-BB15Sg3k). Why did they stop selling them?

d) Add a new food item variable for a side salad that costs $1. Each side salad has only 35 calories, 0 fat, 3 carbs, 20 sodium, 1 fiber, 1 protein, 0% vitamin D, 2% calcium, 6% iron and 2% potassium. Re-solve the LP Model. What items should you eat at McDonald’s daily to meet FDA requirements **and** what is the minimum cost? (It’s OK that the menu item answers are not integers, **round them to one decimal place**.)

e) How many of the items in your answer to d) cost $1 (or less). **Why?**

[](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.com%2Fpin%2F291326669617007141%2F&psig=AOvVaw0epyPKeW11kL4MXyFEMwg4&ust=1603120605940000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCOjSk-W3vuwCFQAAAAAdAAAAABAD)f) Add a constraint that all the menu items must be integers (since you can’t buy half an Egg McMuffin). Re-solve the LP Model. Now what should you eat **and** what’s the minimum cost? Would you feel even remotely “healthy” after eating like this for a day?

g) Eliminate the integer constraint, again allowing fractional items. Assume that you take a supplemental vitamin pill every day that meets your requirements for vitamin D, calcium, iron and potassium (but not protein or fiber). In other words, eliminate the last four constraints. Now what should you eat **and** what’s the minimum cost?

h) What’s the integer solution for part g)?

i) Eliminate the integer constraint, again allowing fractional items. Requiring all ten constraints to be met, maximize the number of free ketchup packets you can include in your diet. What should you eat **and** what’s the minimum cost if you have the bizarre goal of eating a lot of free ketchup?

j) Enough of these side salads!!! As a McDonald’s *purist*, you want to develop a meal plan that only includes the first five sandwiches (from Big Mac to Filet-O-Fish), fries and ketchup packets. Require menu items to be integers. Of course, this is infeasible. So, make your goal *now* to minimize calories, ignoring the first four constraints and making sure to meet the last six constraints. What should you eat and what’s the cost? What are your percentages of calories, fat, carbs and sodium compared to FDA limits?