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

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

Is it possible to eat healthy for a day cheaply 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> . Build a table with the menu items and the ten nutritional facts for each. For example, a Big Mac has 520 calories, 26 grams of fat, 42 grams of carbs, 1140 mg of sodium, …, and 420mg of potassium. For the Chicken McNuggets, makes sure to use 4 pieces and make sure to use the small fries. For the ketchup packet, type “ketchup” or “condiments” into the search bar and the info should come up.

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.

**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) Paste the LP model here. 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 imply about eating a healthy diet at McDonald’s by eating regular menu items?

c) Until recently, McDonald’s sold side salads. Read this [article](https://www.eatthis.com/mcdonalds-ditched-salads/) and this [article](https://www.businessinsider.com/mcdonalds-salads-disappeared-from-menu-april-2020-2020-12). Why did they stop selling them? According to the second article, what is McDonald’s primary goal?

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, 1/2 vitamin D, 26 calcium, 1 iron and 140 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? (Allow the answers to not be integers, **round them to one decimal place**.)

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

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 want to eat at least one burger (Big Mac, DQPwC or Cheeseburger). Add a constraint that forces at least one burger into the mix. Now what should you eat **and** how much does it cost? Is it feasible to require two burgers in the mix? What is the mix and cost? Is it feasible to require three burgers?

h) Eliminate the constraint requiring burgers. 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?