HW 7

1. Formulate an optimization model (a linear program) to find the cheapest diet that satisfies the maximum and minimum daily nutrition constraints, and solve it using PuLP. Turn in your code and the solution. (The optimal solution should be a diet of air-popped popcorn, poached eggs, oranges, raw iceberg lettuce, raw celery, and frozen broccoli. UGH!)

Below is the optimization model.
cj=cost per unit of food
aij= amount of nutrient i per unit of food
mi= minimum amount of nutrient i required
Mi= maximum amount of nutrient i required

Variables: xj= amount of food j eaten

Objective: Minimize $\sum_j c_j x_j$ (minimize total cost)

Constraints: $\sum_j a_{ij} x_j \geq m_i$ for each nutrient I (minimum of each nutrient)
$\sum_j a_{ij} x_j \leq M_i$ for each nutrient i(Max nutrient)
$x_j \geq 0$ for each food j (no negative food)

Below is the solution.
Celery = 52.64371 units
Raw Frozen Broccoli = 0.25960653 units
Raw Lettuce Iceberg = 63.988506 units
Oranges = 2.2929389 units
Poached Eggs = 0.14184397 units
Popcorn Air Popped = 13.869322 units
Total Cost of Foods per person= $4.34

2. Please add to your model the following constraints (which might require adding more variables) and solve the new model:
a. If a food is selected, then a minimum of 1/10 serving must be chosen. (Hint: now you will need two variables for each food *i*: whether it is chosen, and how much is part of the diet. You'll also need to write a constraint to link them.)
Below is the optimization model.
cj=cost per unit of food
aij= amount of nutrient i per unit of food
mi= minimum amount of nutrient i required
Mi= maximum amount of nutrient i required

Variables: xj= amount of food j eaten
Yi = 1 (if food j is eaten, or 0)

Objective: Minimize $\sum_j c_j x_j$ (minimize total cost)

Constraints: ∑j aijxj≥ mi for each nutrient I (minimum of each nutrient)
∑jaijxj≤ Mi for each nutrient i(Max nutrient)
xj≥0 for each food j (no negative food)
xi ≥ .1yi (if food j is eaten)
.0000001 xi ≤ yi for each food j (if any of food j is eaten)

b. Many people dislike celery and frozen broccoli. So at most one, but not both, can be selected.

Y frozen broccoli+ y raw celery ≤1

c. To get day-to-day variety in protein, at least 3 kinds of meat/poultry/fish/eggs must be selected. [If something is ambiguous (e.g., should bean-and-bacon soup be considered

y Roasted Chicken+ y Poached Eggs+ y Scrambled Eggs+ y Bologna, Turkey+ y Frankfurter, Beef + y Ham , Sliced , Extralean +y Kielbasa + y Pizza Pepperoni

Below is the solution

Bologna Turkey = 0.1 units
Raw Celery = 42.423026 units
Raw Iceberg Lettuce = 82.673927 units
Oranges = 3.0856009 units
Peanut Butter = 1.9590978 units
Poached Eggs = 0.1 units
Air Popcorn = 13.214473 units
Scrambled Eggs = 0.1 units
Total cost of food = $4.51