Question 15.2

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!)

Answer:
Code in optimization.py. Set variable problem_number to 1

Ingredients	Amount
Celery,_Raw	52.64
Frozen_Broccoli	0.26
Lettuce,Iceberg,Raw	63.99
Oranges	2.29
Poached_Eggs	0.14
Popcorn,Air_Popped	13.87
Total Cost	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.)
b. Many people dislike celery and frozen broccoli. So at most one, but not both, can be selected.
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 consideredmeat?), just call it whatever you think is appropriate)

Answer:
Code in optimization.py. Set variable problem_number to 2

Ingredient	Amount
n_Bologna,Turkey	1.00
n_Poached_Eggs	1.00
n_Scrambled_Eggs	1.00
Bologna,Turkey	0.10
Celery,_Raw	51.52
Frozen_Broccoli	0.23
Lettuce,Iceberg,Raw	66.96
Oranges	2.38
Poached_Eggs	0.10
Popcorn,Air_Popped	13.85
Scrambled_Eggs	0.10
Total Cost	4.38

If you want to see what a more full-sized problem would look like, try solving your models for the file diet_large.xls, which is a low-cholesterol diet model (rather than minimizing cost, the goal is to minimize cholesterol intake). I don't know anyone who'd want to eat this diet – the optimal solution includes dried chrysanthemum garland, raw beluga whale flipper, freeze-dried parsley, etc. – which shows why it's necessary to add additional constraints beyond the basic ones we saw in the video! [Note: there are many optimal solutions, all with zero cholesterol, so you might get a different one. It probably won't be much more appetizing than mine.]

Answer:
Code in optimization_large.py

Ingredient	Amount
Blackberries,_raw_(Alaska_Native)	0.78
Cereals,_NESTUM,_prepared_with_water	3.63
Cereals_ready_to_eat,_KRAFT,_POST_TOASTIES_Corn_Flakes	0.26
Cereals_ready_to_eat,_composite_character_cereals_(movies,_TV),	0.04
Chrysanthemum,_garland,_raw	0.01
Dandelion_greens,_cooked,_boiled,_drained,_with_salt	0.60
Fish,_lingcod,_liver_(Alaska_Native)	0.22
Fish,_salmon,_king_or_chinook,_smoked_and_canned_(Alaska_Native	0.01
Gelatin_desserts,_dry_mix,_reduced_calorie,_with_aspartame,_add	0.10
Gelatin_desserts,_dry_mix,_reduced_calorie,_with_aspartame,_no_	2.48
Jew's_ear,_(pepeao),_raw	13.77
KRAFT,_CRYSTAL_LIGHT_Sugar_Free_Low_Calorie_Iced_Tea_Mix,_with_	2.11
Leavening_agents,_baking_powder,_double_acting,_sodium_aluminum	0.04
Leavening_agents,_baking_soda	0.00
Margarine,_industrial,_soy_and_partially_hydrogenated_soy_oil,_	0.03
Water,_bottled,_non_carbonated,_DASANI	19.72
Whale,_beluga,_eyes,_raw_(Alaska_Native)	0.00
Total Cholesterol	0.00