ENGRI 1101 **Engineering Applications of OR** **Fall 2020** **Prelab 10**

The Diet Problem - LP, IP, and LP Duality

Name: _____

Objectives:

- Practice in formulating linear programming problems
- Introduce the idea of linear relaxation
- Demonstrate the relationship between an integer program and its linear relaxation
- Demonstrate the idea of sensitivity analysis in linear programming

Key Ideas:

- Objective function
- Constraints
- Optimal solution
- Fractional solution
- Integer solution
- Linear Program
- Integer Program
- Linear relaxation
- Sensitivity analysis

Reading Assignment:

- Read Handout 11 on LP Duality

Brief description: In this lab we will consider one of the most famous (and one of the earliest) applications of linear programming — the diet problem.
With the holidays nearly upon us, the opportunities to gorge ourselves with sweets presents nearly inescapable challenges. However, one group of clever OR student wonder about how best one might meet a desired consumption of calories, chocolate, sugar, and fat. Each person is making a choice among Brownie, Chocolate Ice Cream, Chestnut Praline Latte, and Pineapple Cheesecake.

The table of their "nutritional" contents along with their cost, per serving, as well as the daily requirement for each nutritional content type, is given below:

Food	Calories	Chocolate (oz)	Sugar (oz)	Fat (oz)	Cost ($)
Brownie	400	3	2	2	.5
Chocolate Ice Cream	200	2	2	4	.2
Chestnut Praline Latte	250	0	1	.5	2
Pineapple Cheesecase	500	0	4	5	.8
Requirements	500	6	10	8	

The aim is to decide the number of servings of each offering that meets (at least) the stated minimum requirement in each of the types of nutritional components, and does so at minimum total cost. Fractional servings are allowed. Write a linear programming formulation for which the optimmal solution would provide this dietary recipe.