Linear Programming Class Work

✸ **Objective:** *You will be able to solve problems involving maximization/minimization of real world situations via designing and solving systems of inequalities to model the situations.*

★ *Example:* Emily is taking a test in which multiple-choice questions are worth 10 points and open-ended questions are worth 15 points each. It takes Emily 2 minutes to answer each multiple-choice question and four minutes to answer each open-ended question. Emily is allowed one hour to complete the test, and she is only allowed to answer at most 20 questions. How many items of each type should Emily answer to achieve the highest score, assuming all of her answers are correct?

➔ *First determine what we call an **objective function**. This function is **not** one of the constraints, but is rather the function that involves the variable that needs to be maximized / minimized.*

➔ *Next, determine and graph the constraints. We call this a **feasible** region. Remember to define the variables.*

➔ *Finally, test each vertex of the feasible region in the objective function. One of the vertices will be a maximum and one will be a minimum (this is an accepted algebraic theorem).*

1. A group of friends are creating blankets and bags of toiletries to hand out to the less fortunate. It costs $5 per blanket and $3 per bag of toiletries. They were told to bring at least 20 blankets (which take 15 minutes each to make) and 30 bags of toiletries (which take 3 minutes each to put together). They also need twice as many bags as blankets. The group only has $500 to spend on this project. Determine the number of blankets and bags the group should make to minimize the amount of time they spend on making the goods, so that they can spend more time socializing with the less fortunate at the event.

2. Paula and her friends are creating bracelets and necklaces to sell as a way to fundraise for their favorite charity. They agreed that they will work for at least five hours. Due to their supplies, Paula realizes that they cannot make more than 240 pieces of jewelry and must make at least triple as many necklaces as bracelets. Each bracelet takes 8 minutes to make, and each necklace takes 12 minutes to make. The profit per bracelet is $2.50, and the profit per necklace is $2.83. How much of each type of jewelry should Paula and her friends make to maximize profit, assuming they will sell all of the items and that they make at least 20 bracelets?

3. Harry needs to purchase some filing cabinets for the offices he is in charge of. One type of cabinet costs $15 per unit, requires four square feet of floor space, and can hold 64 cubic feet of files. Another type of cabinet requires ten feet of floor space and can hold 70 cubic feet of files, but costs $35 per unit. Harry has a total of $1000 to spend on the filing cabinets, and must buy at least five of each.
a. Assume Harry would not like the cabinets to take up more than 520 square feet of floor space. Determine how many of each type of cabinet Harry should purchase in order to maximize the amount of storage volume.
b. Harry's friend David who manages a different firm needs at least 804 cubic feet of storage volume. How many of each cabinet type should he order in order to minimize the amount of floor space used, assuming he has a limit of a $1095 budget for cabinets and must purchase at least ten of each type?

4. Annie is planting some zucchini and tomato plants on a 500 square foot plot of land. She needs two square feet of land per tomato plant and three square feet of land per zucchini plant. Zucchini plants cost $2.50 each, and yield a profit of $1.38 per plant. Tomato plants cost $3.00 each, and yield a profit of $1.27 per plant.
a. Annie does not want to spend more than $650. How many of each vegetable should she plant in order to yield maximum profit, assuming she plants at least 100 plants?
b. Now assume Annie needs to raise at least $138. How many of each vegetable should she plant to minimize her cost, if she plants at least 100 vegetables?

5. Joey is writing two books, and would like for his books to be published. In order to make one copy of the books to send to publishers, Joey is going to hire someone to type and arrange the books. The charge for pages that have pictures is $3.35, and the charge for pages without pictures is $2.23. Joey knows that the first book has less than 80 pages, but at least 20 pages with pictures. The second book has less than 50 pages, but at least 25 of the pages have pictures. What is the greatest possible cost that Joey should expect to pay for his book to be arranged?

6. Sarah is baking rice crispie treats that also have white chocolate and fruity pebbles in them for her friends, her family, her students, and people at some homeless shelters for the holidays. She is planning on making some batches "extra chocolatey" (using three cups of white chocolate chips and three cups of fruity pebbles), and some batches "extra fruity" (using four cups of fruity pebbles and two cups of white chocolate). Sarah has a total of 25 cups of white chocolate chips and 38 cups of fruity pebbles available. Determine the number of each type of batch Sarah should make so that the leftover items do not go to waste. (Batches can be partial)

7. One juice contains three cups of banana juice and two cups of mango juice. Another juice calls for two cups of banana juice and five cups of mango juice. Alex has 20 cups of banana juice and 32 cups of mango juice. He is going to make at least one batch of each juice. How many of each juice should Alex make to minimize the amount he has left over?

8. Kyle would like to burn the maximum amount of calories during his workout today. While running, Kyle burns 11 calories per minute, and while lifting weights, Kyle burns 8.5 calories per minute. Kyle would like to run for at least 7 minutes, but no longer than 30 minutes. Kyle would also like to lift weights for at least 10 minutes, and is planning on working out for no more than one hour. How many minutes of each exercise should Kyle do in order to maximize his calorie burn?

- *In your own words, describe the difference between a constraint and the objective function.*

- *In your own words, describe how to determine the vertices of the feasible region.*

- *Write down any questions you still have regarding linear programming.*