**ECON 251: Problem Set 2**

Due Friday September 23 by 11:00 PM

**Instructions.** This problem set is two pages long. Each part of a problem is worth one point (so Problem 2 is worth four points in total, but all other questions are worth one point). Don't forget to answer Problem 11 and Problem 12, as they ar each worth one point. Unless otherwise stated, you can always assume that goods are continuously divisible: there is no need to consume an integer number of units of any good. Once you have finished, please submit your completed problem set on gradescope. To do this, you will either need to upload a pdf of your entire problem set or an image (for example, a picture that you take with your phone) of your work for each problem. If you upload a pdf, you will need to tag each problem on the appropriate page of the document. Please show your work and draw a box around your final answer. You are free to work together with your classmates, but the work that you upload must be your own.

1. Consider the budget set
$$\left\{(x_1, x_2) \in \boldsymbol{R}^2_+ : 2x_1 + 8x_2 \leq 24\right\}$$
What is the slope of the budget line?

2. Which of the following sets are convex?

   (a) $\left\{(x_1, x_2) \in \boldsymbol{R}^2_+ : 5x_1 + 13x_2 = 137\right\}$
   (b) $\left\{(x_1, x_2) \in \boldsymbol{R}^2_+ : 5x_1 + 13x_2 \leq 137\right\}$
   (c) $\left\{(x_1, x_2) \in \boldsymbol{R}^2_+ : 3x_1^2 + 4x_2^2 = 32\right\}$
   (d) $\left\{(x_1, x_2) \in \boldsymbol{R}^2_+ : 3x_1^2 + 4x_2^2 \leq 32\right\}$

3. Using no more than three sentences (and you should only need one), describe a situation that would give rise to a kinked (but otherwise linear) budget set that is not convex.

4. Suppose demand for Good 1 is given by:
$$x_1(m, p_1, p_2) = \frac{m}{p_1 + p_2}$$
Calculate the income elasticity of demand for Good 1.

5. Suppose demand for Good 1 is given by:
$$x_1(m, p_1, p_2) = \frac{3m}{3p_1 + 2p_2}$$
Calculate the cross-price elasticity of demand for Good 1.

6. In the question above, are Good 1 and Good 2 complements or substitutes? How do you know?

7. Consider the demand function:
$$x(m, p_1, p_2) = \begin{bmatrix} 2m/3p_1 \\ m/3p_2 \end{bmatrix}$$
Does this demand function satisfy the adding up property? Show that it does, or prove that it does not.

8. Suppose demand for Good 1 is given by:

$$x_1(m, p_1, p_2) = \frac{p_2 m}{p_1^2 + p_1 p_2}$$

Is demand for Good 1 homogeneous of degree zero? Show that it is, or prove that it is not.

9. Hardworking Hal has 16 hours in his day which he divides between working ($h$ hours) and relaxing ($\ell$ hours). For every hour that he works, he is paid a wage; he spends all of his earnings on consumption of a single good which costs one dollar per unit consumed. Hal's base wage is two dollars per hour. However, if he works overtime – more than eight hours on a given day – he earns two times his base wage for each hour (or partial hour) above eight. Draw Hardworking Hal's budget set over leisure (Good 1) and consumption (Good 2).

10. *This problem is challenging, and it is only worth one point. You may want to skip it.*

Consider the budget set from Example 4 in the Budget Sets Lecture Notes:

> Super Mom and Super Dad spend their Saturdays doing housework, specifically cooking and cleaning. $x_1$ indicates the number of rooms cleaned, and $x_2$ indicates the number of meals cooked. After sleeping, showering, and taking their kids to all of their sporting events, they have $H > 0$ hours left. It takes them $x_1^2$ hours to clean $x_1$ rooms, and it takes them $x_2^2$ hours to cook $x_2$ meals.

Prove that the Super Parents' (time) budget set is a convex set.

11. Which of your classmates did you work with on this problem set?

12. Did you attend Jamie's TA office hours, or get help from her over email or outside of her regular office hours?