

## Data 88E: Economic Models, Fall 2021

### Lab 5

*Due Date: Monday, October 11th, at 11:59 PM*

Please read all the instructions carefully before you start working on the assignment.

- Please typeset your submissions in L<sup>A</sup>T<sub>E</sub>X and submit your assignment as a PDF document. Use the template provided for your answers. Please include your name with your submission.
- Please submit your assignment on Gradescope. Make sure to assign all questions to the corresponding page(s) of your assignment, or else it will not be graded.

#### 1. Basic L<sup>A</sup>T<sub>E</sub>X Equations

Type out the following mathematical expressions in L<sup>A</sup>T<sub>E</sub>X. Google may be your friend for some of these.

- (a) The quadratic formula:  $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
- (b) A partial derivative:  $\frac{\partial u}{\partial x} = \frac{1}{2}x^{20} + \ln 3 - \pi$
- (c) An integral:  $\int_{-\infty}^{\infty} xp(x)dx$  (does this seem familiar?)
- (d) Using `align`, simplify the following on multiple lines:  $(x+1)(x-1)$ . Make sure to show all of your steps.

#### 2. Budget Constraints

Eric has an income of \$24 and he can buy either vegemite, which costs \$4, or boomerangs, which cost \$8 dollars.

- (a) What is Eric's budget constraint? Make sure to use L<sup>A</sup>T<sub>E</sub>X.
- (b)
  - i. Can Eric afford to buy 1 boomerang and 2 vegemite?
  - ii. What about 1 boomerang and 4 vegemite?
  - iii. What about 2 boomerangs and 4 vegemite?
  - iv. Which consumption bundle would Eric choose and why?
- (c) Vegemite has now decreased to \$3, while boomerangs remain at \$8. If the quantity

of vegemite was on the  $x$ -axis and the quantity of boomerangs was on the  $y$ -axis, what will happen to the slope and  $x$  and  $y$ -intercepts of Eric's budget constraint?

- (d) What will happen to the slope and intercepts of Eric's budget constraint if his income increases to \$32, while the price of vegemite and boomerangs stay the same at \$4 and \$8, respectively?

### 3. Marginal Utility

Consider the utility function:

$$u(x_1, x_2) = x_1 + x_2$$

- (a) What is the marginal utility function with respect to  $x_1$ ? What is the marginal utility function with respect to  $x_2$ ? Make sure to write out the expressions as L<sup>A</sup>T<sub>E</sub>X formulas.
- (b) Given your results in (a), what is significant about this utility function?

### 4. Perfect Complements

Consider the utility function:

$$u(x_1, x_2) = \min(x_1, x_2)$$

In other words, the function simply outputs the minimum between  $x_1$  and  $x_2$ . Note that this function is not directly differentiable, so its marginal utility functions are not straightforward. Nonetheless, we will examine consumer utility optimization behavior in this problem.

*Note:* For the drawing portions of this question, please include this as part of your L<sup>A</sup>T<sub>E</sub>X submission. To learn more about how to include images in L<sup>A</sup>T<sub>E</sub>X, check out this [link](#).

- (a) Draw out the indifference curves for this utility function.
- (b) Assume that  $x_1$  and  $x_2$  have the same price, and you have the ability to purchase one more unit of  $x_1$  or  $x_2$ . If you currently consume 5 units  $x_1$  and 3 units of  $x_2$ , which good would you purchase? Why?
- (c) Why is this function known as the perfect complements function? ([hint](#))
- (d) Add a budget constraint to your indifference curve(s) from part (a). Assume that  $x_1$  and  $x_2$  have the same price.

- (e) At which point on the utility curve will individuals tend to choose as their optimal consumption bundle?