Data 88E: Economic Models, Fall 2022

Lab 5

Due Date: Monday, October 10, at 11:59 PM

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

- Please typeset your submissions in LaTeX 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 LaTeX Equations**

   Type out the following mathematical expressions in LaTeX. 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: $\int_{-\infty}^{\infty} xp(x)\mathrm{d}x$ (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 LaTeX.

   (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 LaTeX 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 LaTeX submission. To learn more about how to include images in LaTeX, 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?