

## Lab 5

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

- Please typeset your submissions in  $\text{\LaTeX}$  and submit your assignment as a PDF document. Use the template provided for your answers. Please include your name with you submission.
- This assignment is due at 11:59 pm on Monday, March 2nd.
- 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.

## Problem 1: Basic $\text{\LaTeX}$ Equations

Type out the following mathematical expressions in  $\text{\LaTeX}$ . Google may be your friend for some of these:

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

## Problem 2: Budget Constraints

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

### Question 2.1

What is Eric's budget constraint? Make sure to use  $\text{\LaTeX}$ .

### Question 2.2

1. Can Eric afford to buy 1 boomerang and 2 vegemite?
2. What about 1 boomerang and 4 vegemite?
3. What about 2 boomerangs and 4 vegemite?
4. Which consumption bundle would Eric choose, and why?

### Question 2.3

Vegemite has now decreased to 3 dollars, while boomerangs remain at 8 dollars. 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?

### Question 2.4

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

## Problem 3: Marginal Utility

Consider the utility function:

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

### Question 3.1

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  $\text{\LaTeX}$  formulas.

### Question 3.2

Given your results in (a), what is significant about this utility function?

## Problem 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  $\text{\LaTeX}$  submission. To learn more about how to include images in  $\text{\LaTeX}$ , check out this [link](#).

### Question 4.1

Draw out the indifference curves for this utility function.

### Question 4.2

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?

### Question 4.3

Why is this function known as the perfect complements function? ([hint](#))

### Question 4.4

Add a budget constraint to your indifference curve(s) from part a). Assume that  $x_1$  and  $x_2$  have the same price.

### Question 4.5

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