Outline

- Math Review
  - Algebra: Graphing
  - Calculus: Derivatives
  - Calculus: Partial Derivatives
- Economics Review
 - Marginal Cost = Marginal Benefit
- Video On Calculus:
  https://www.youtube.com/watch?v=OVGyHhW_73g

Math Review: Algebra

- You will NEED to know the shapes of the following:
    - Straight lines
    - Parabolas
    - Horizontal lines
    - Vertical lines
- Even if the variables we use are not called "y" and "x" like you might be used to.
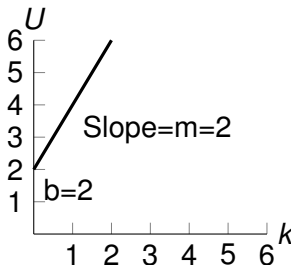
Algebra Review: Graphing Lines

- Equation: $y = m \cdot x + b$
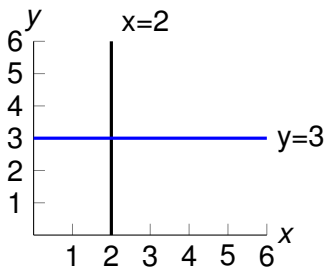- m is the slope.
- b is the y-intercept.
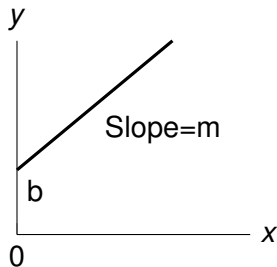
Algebra Review: Graphing Lines Example

- Example: $U = 2 \cdot k + 2$
- U is our "y" or our dependent variable, and k is our "x" or indepedent variable.
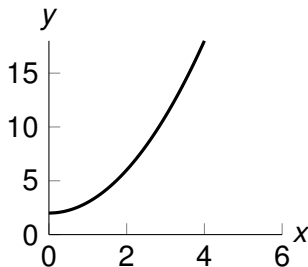- The slope or "m" is 2, and the intercept or "b" is 2.

Algebra Review: Vertical and Horizontal Lines

- Vertical lines take the form $x = c$.
- Horizontal lines take the form $y = c$.

Algebra Review: Parabolas

- Parabolas take the form $y = a \cdot x^2 + b$.

Calculus Review: Derivative Rules

- These are the calculus rules you need to know for Economics broadly. These slides review the rules in bold.
  - **Power rule.**
  - **Product rule.**
  - Quotient rule.
  - **Chain rule.**
  - **Derivative of natural logs.**
  - **Derivative of exponential functions.**
- We will also learn how to apply these rules with partial derivatives this semester.

Calculus Review: Power Rule

The derivative of the function $a \cdot x^k$ is

$$k \cdot a \cdot x^{k-1}.$$

Example: The derivative of $2x^3$ is

$$3 \cdot 2 \cdot x^2 = 6 \cdot x^2.$$

Calculus Review: Product Rule

The derivative of the function $f(x) \cdot g(x)$ is

$$f'(x) \cdot g(x) + f(x) \cdot g'(x).$$

Example: The derivative of $(x^2) \cdot (5x)$ is

$$2x \cdot (5x) + (x^2) \cdot 5 = 10x^2 + 5x^2 = 15x^2.$$

Note We could have used the power rule.

$$(x^2) \cdot (5x) = 5x^3 \implies (5x^3)' = 15x^2.$$

Calculus Review: Log and Exponential Rules

- The derivative of $\ln(x) = \frac{1}{x}$.
- The derivative of $\exp(x) = \exp(x)$.

Calculus Review: Chain Rule

The derivative of the function $a \cdot (b + cx)^k$ is

$$k \cdot (b + cx)^{k-1} \cdot c = kc \cdot (b + cx)^{k-1}.$$

More Generally: The derivative of $f(g(x))$ is

$$f'(g(x)) \cdot g'(x).$$

Example: The derivative of $y = (3x)^2$ is

$$2 \cdot (3x) \cdot 3 = 18x.$$