

# Handout #5: Cheat Sheet for Derivatives

ECON 300: Intermediate Price Theory

Fall 2023

## Topic 1. Basic Differentiation Rule

When taking partial derivatives, you may refer to the following rule:

$$\frac{\partial}{\partial \text{variable}} (\text{constant} \cdot \text{variable}^{\text{power}}) = \text{constant} \cdot \text{power} \cdot \text{variable}^{\text{power}-1}$$

## Topic 2. Special Rule

When the variable is not present, the partial derivative is zero:

$$\frac{\partial}{\partial \text{variable}} (\text{constant}) = 0$$

## Topic 3. When terms are “Added”

When there is an addition + involved, we can “divide” the added terms into two parts:

$$\begin{aligned} & \frac{\partial}{\partial \text{variable}} (\text{constant}_1 \cdot \text{variable}^{\text{power}_1} + \text{constant}_2 \cdot \text{variable}^{\text{power}_2}) \\ &= \frac{\partial}{\partial \text{variable}} (\text{constant}_1 \cdot \text{variable}^{\text{power}_1}) + \frac{\partial}{\partial \text{variable}} (\text{constant}_2 \cdot \text{variable}^{\text{power}_2}) \\ &= \text{constant}_1 \cdot \text{power}_1 \cdot \text{variable}^{\text{power}_1-1} + \text{constant}_2 \cdot \text{power}_2 \cdot \text{variable}^{\text{power}_2-1} \end{aligned}$$

#### Topic 4. Examples

We use **Topic 1** when finding the marginal utility of good  $x$  when the utility function is given as  $u(x, y) = 10x^2y^3$ :

$$MU_x = \frac{\partial}{\partial x}(10x^2y^3) = 10y^3 \cdot 2 \cdot x^{2-1} = 20xy^3$$

We use **Topic 2** and **Topic 3** when finding the marginal utility of good  $x$  when we deal with the linear utility function  $u(x, y) = 10x + 3y$ :

$$\begin{aligned} MU_x &= \frac{\partial}{\partial x}(10x^1 + 3y) \\ &= \frac{\partial}{\partial x}(10x^1) + \frac{\partial}{\partial x}(3y) && \because \text{Topic 3} \\ &= 10 \cdot 1 \cdot x^{1-1} + 0 && \because \text{Topic 2} \\ &= 10 \end{aligned}$$