Handout #5: Cheat Sheet for Derivatives

ECON 300: Intermediate Price Theory

Fall 2024

Topic 1. Basic Differentiation Rule

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

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

Topic 2. Special Rule

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

$$\frac{\partial}{\partial \texttt{variable}} \left(\texttt{constant}\right) = 0$$

Topic 3. When terms are "Added"

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

$$\frac{\partial}{\partial \texttt{variable}} \left(\texttt{constant}_1 \cdot \texttt{variable}^{\texttt{power}_1} + \texttt{constant}_2 \cdot \texttt{variable}^{\texttt{power}_2}\right)$$

$$= \frac{\partial}{\partial \texttt{variable}} \left(\texttt{constant}_1 \cdot \texttt{variable}^{\texttt{power}_1}\right) + \frac{\partial}{\partial \texttt{variable}} \left(\texttt{constant}_2 \cdot \texttt{variable}^{\texttt{power}_2}\right)$$

$$= \texttt{constant}_1 \cdot \texttt{power}_1 \cdot \texttt{variable}^{\texttt{power}_1 - 1} + \texttt{constant}_2 \cdot \texttt{power}_2 \cdot \texttt{variable}^{\texttt{power}-1}$$

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 $u(x, y) = 10x + 3y$:

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