AMES Class Notes – Week 8, Weds: Review

Andie Creel

9th October, 2024

1 Derivative and Integral Rules

Function	Derivative	Anti-Derivative	Name
$F(x)$	$F'(x)$	$\int F'(x)dx$	
x	$\frac{dx}{dx} = 1 \rightarrow dx = 1dx$	$\int dx = x + c$	wrt variable
αx	$\alpha \frac{dx}{dx} = \alpha \rightarrow \alpha dx$	$\int \alpha dx = \alpha \int dx = \alpha x + c$	constant
x^N	$\frac{dF}{dx} = Nx^{N-1} \rightarrow dF = Nx^{N-1}dx$	$\int Nx^{N-1}dx = \frac{1}{N}x^N + c$	power rule
$g(x) + h(x)$	$\frac{dg(x)}{dx} + \frac{dh(x)}{dx} \rightarrow dF = (g'(x) + h'(x))dx$	$\int (g'(x) + h'(x))dx = \int g'(x)dx + \int h'(x)dx$	linear operator
e^x	$\frac{dF}{dx} = e^x \rightarrow dF = e^x dx$	$\int e^x dx = e^x + c$	exponentials
$ln(x)$	$\frac{dln(x)}{dx} = \frac{1}{x} \rightarrow dF = \frac{1}{x}dx$	$\int \frac{1}{x}dx = \int \frac{dx}{x} = \int x^{-1}dx = ln(x) + c$	logs
$g(h(x))$	$\frac{dF}{dg}\frac{dg}{dg}\frac{dh}{dx}$	$\int g(h(x))dx$ $u = h(x), \frac{du}{dx} = h'(x) \implies dx = \frac{du}{h'(x)}$ $\int g(u)\frac{du}{h'(x)}$	chain rule/ u-substitution
$ln(F(x))$	$\frac{dF}{dx} = \frac{1}{F(x)}F'(x) = \frac{F'(x)}{F(X)}$	do a u-sub	percent change
$g(x)h(x)$	$g'(x)h(x) + g(x)h'(x)$	integration by parts	product rule
$g(x)^{-1}h(x)$	$\frac{h'(x)g(x_- g'(x)h(x)}{g(x)^2}$	integration by parts	quotient rule

2 Implicit function theorem

Consider

$$F(x, y) \tag{1}$$
$$dF = F_x dx + F_y dy \tag{2}$$
$$\tag{3}$$

where

$$F_x = \frac{\partial F}{\partial x} \tag{4}$$
$$F_y = \frac{\partial F}{\partial y} \tag{5}$$

When you're at an equilibrium, F will not be changing

$$0 = F_x dx + F_y dy \implies \tag{6}$$
$$-\frac{F_x}{F_y} = \frac{dy}{dx} \tag{7}$$

Interpretation: When at an equilibrium, the change in y w.r.t x will equal the negative ratio of the partial derivatives.