Prior Knowledge for Regression
Partial Derivative Review

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Definition of ordinary derivative

$$\frac{df}{dx} = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$f(x)$

Definition of partial derivatives

$f = f(x, y)$

$$\frac{\partial f}{\partial x} = \lim_{\Delta x \to 0} \frac{f(x + \Delta x, y) - f(x, y)}{\Delta x}$$

$$\frac{\partial f}{\partial y} = \lim_{\Delta y \to 0} \frac{f(x, y + \Delta y) - f(x, y)}{\Delta y}$$

Example

Given

$$f(x,y) = 2x^3y^2 + 7x^2y^2,$$

find

$$\frac{\partial f}{\partial x} \text{ and } \frac{\partial f}{\partial y}.$$

a) $f = 2x^3y^2 + 7x^2y^2$

$$\frac{\partial f}{\partial x} = \frac{\partial}{\partial x}(2x^3y^2 + 7x^2y^2)$$

$$= 2y^2 \frac{\partial}{\partial x}(x^3) + 7y^2 \frac{\partial}{\partial x}(x^2)$$

$$= 2y^2(3x^2) + 7y^2(2x)$$

$$= 6x^2y^2 + 14xy^2$$

b) $f = 2x^3y^2 + 7x^2y^2$

$$\frac{\partial f}{\partial y} = \frac{\partial}{\partial y}\left(2x^3y^2 + 7x^2y^2\right)$$

$$= \frac{\partial}{\partial y}(2x^3y^2) + \frac{\partial}{\partial y}(7x^2y^2)$$

$$= 2x^3\frac{\partial}{\partial y}(y^2) + 7x^2\frac{\partial}{\partial y}(y^2)$$

$$= 2x^3(2y) + 7x^2(2y)$$

$$= 4x^3y + 14x^2y$$

END

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