

Advanced Microeconomics

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Problem Set 1: Math for Economists, Preferences

1. Math

a) Determine the first derivative of the following functions (according to the independent variable given in each case):

$$a)f(x) = (x + 2)\sqrt{x}$$

$$b)f(x) = \frac{x^2 + 2}{2x}$$

$$c)f(x) = \sqrt{3x^2 - 1}$$

$$d)k(x) = x^a \cdot e^{-ax}$$

$$e)P(w) = \left(\ln \frac{w^2 + 1}{e^w} \right)^{20}$$

$$f)Q(s) = \ln \sqrt{\frac{1 + s^4}{6 + s^2}}$$

b) Find the first through third derivatives of the following functions:

$$a)f(x) = x^{10}$$

$$b)g(y) = y \cdot \ln y$$

$$c)p(t) = t \cdot e^t$$

$$d)h(z) = \frac{z + 1}{(z - 1)^2}$$

$$e)k(r) = e^{\frac{1}{r}}$$

c) Form all the first-order partial derivatives of the following functions.

$$a)f(x, y) = 3x^2 - 4y^2 + 5xy + 4y$$

$$b)f(x, y) = \frac{x^4 - 3x^2y}{3x + 2y^2}; \quad \left(x \neq -\frac{2}{3}y^2 \right)$$

$$c)f(x, y) = 2y^{3x} \cdot \ln \frac{x}{y}; \quad (x, y > 0)$$

d) Find all partial derivatives of first and second order for the following functions:

$$a) K(x, y) = 150 + 3x^2 - 3xy - 6x + \frac{3}{2}y^3 + 3y$$

$$b) P(A, K) = \frac{1}{2}A^{\frac{1}{3}} \cdot K^{\frac{2}{3}}$$

$$c) K(x, y) = x + \ln \frac{y}{x} \quad (x, y, > 1)$$

$$d) K(x, y) = \frac{1}{2}(x - a)^2 \cdot (y - 1) + \frac{b}{2}y^2 - 3y + 20 \quad (a, b \in \mathbb{R})$$