Department of Economics Boston College

Economics 2202 (Section 05)
Macroeconomic Theory
Practice Problem Set 1
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1. **Partial Derivatives.** For each of the following multi-variable functions, compute the partial derivatives with respect to both *x* and *y*.
   a. $f(x,y) = xy$
   b. $f(x,y) = 2x + 3y$
   c. $f(x,y) = x^2 y^4$
   d. $f(x,y) = \ln x + 2\ln y$
   e. $f(x,y) = 2\sqrt{x} + 2\sqrt{y}$
   f. $f(x,y) = \dfrac{x}{y}$
   g. $f(x,y) = \dfrac{y}{x}$

2. **Properties of Indifference Maps.** For the general model of utility functions and indifference maps developed in class, explain why no two indifference curves can ever cross each other. Your answer must explain the economic logic here, and may also include appropriate equations and/or graphs.

3. **A Canonical Utility Function.** Consider the utility function

$$u(c) = \frac{c^{1-\sigma} - 1}{1-\sigma},$$

   where c denotes consumption of some arbitrary good and σ (the Greek letter "sigma") is known as the "curvature parameter" because its value governs how curved the utility function is. In the following, restrict your attention to the region $c > 0$ (because "negative consumption" is an ill-defined concept). The parameter σ is treated as a constant.
   a. Plot the utility function for $\sigma = 0$. Does this utility function display diminishing marginal utility? Is marginal utility ever negative for this utility function?
   b. Plot the utility function for $\sigma = 1/2$. Does this utility function display diminishing marginal utility? Is marginal utility ever negative for this utility function?

c. Consider instead the natural-log utility function $u(c) = \ln(c)$. Does this utility function display diminishing marginal utility? Is marginal utility ever negative for this utility function?
d. Determine the value of σ (if any value exists at all) that makes the general utility function presented above collapse to the natural-log utility function in part c. (**Hint:** Examine the derivatives of the two functions.)