

### Section 9.3

1) It is estimated that the weekly output of a certain plant is given by the function

$Q(x, y) = 1200x + 500y + x^2y - x^3 - y^2$  units, where  $x$  is the number of skilled workers and  $y$  the number of unskilled workers employed at the plant.

a) Find  $\frac{\partial Q}{\partial x}$

b) Find  $\frac{\partial Q}{\partial y}$

c) Find and interpret  $\frac{\partial Q(100,50)}{\partial x}$

d) When there are 30 skilled workers and 60 unskilled workers employed at the plant, how rapidly is weekly output increasing with respect to the number of skilled workers.

2) Referring to the beef consumption example of section 9.1, when the household income is \$20,000 and the price of beef is \$4.50, how rapidly is beef consumption changing with respect to household income?

3) Referring to the function  $Q(x, y) = 1200x + 500y + x^2y - x^3 - y^2$  from example 1, find the second partial derivatives  $Q_{xx}(x, y)$ ,  $Q_{xy}(x, y)$ ,  $Q_{yx}(x, y)$ , and  $Q_{yy}(x, y)$ .

### Section 10.2

1) Evaluate the determinant of each matrix:

a)  $\begin{vmatrix} 3 & 10 \\ 2 & 1 \end{vmatrix}$

b)  $\begin{vmatrix} 6 & -1 \\ 1 & 0 \end{vmatrix}$

2) The annual cost for labor and specialized robotics equipment for an automobile manufacturer, in millions of dollars, is given by  $C(x, y) = 5x^2 + 5xy + 7.5y^2 - 40x - 45y + 135$ , where  $x$  is the amount (in millions of dollars) spent each year on labor and  $y$  is the amount (in millions of dollars) spent each year on robotics equipment. Determine how much should be spent on each, per year, to minimize cost. Determine the minimum cost.

3) Determine the relative extrema of  $f(x, y) = x^3 + 3x^2 - y^2 + 2y + 4$

4) The only grocery store in a small rural community carries two brands of frozen apple juice, a local brand that it obtains at the cost of 30 cents per can and a well-known national brand that it obtains at the cost of 40 cents per can. The grocer estimates that if the local brand is sold for  $x$  cents per can and the national brand for  $y$  cents per can, approximately  $70 - 5x + 4y$  cans of the local brand and  $80 + 6x - 7y$  cans of the national brand will be sold each day. How should the grocer price each brand to maximize the profit from the sale of the juice?