

# EE320 Introductory Mathematical Economics

## Quiz 2

1. (15 points total) Suppose that the demand function is given by  $Q_d = 18 - 3P$  and the supply function is given by  $Q_s = 5 + 2P$ .
- a. (3 points) If the government imposes a \$1 tax per unit of output on the consumer, write the after-tax demand function.

$$Q'_d = 18 - 3(P + 1) = 15 - 3P$$

- b. (3 points) Write the system of equations that characterizes this partial market equilibrium in the matrix form.

$$\begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & -2 \\ 1 & -1 & 0 \end{bmatrix} \begin{bmatrix} Q'_d \\ Q_s \\ P \end{bmatrix} = \begin{bmatrix} 15 \\ 5 \\ 0 \end{bmatrix}$$

- c. (9 points) Based on the matrix in part b, use Cramer's rule to determine the equilibrium price paid by the consumer, the equilibrium price received by the producer, and the equilibrium quantity.

$$Q_d^* = Q_s^* = \frac{\begin{vmatrix} 15 & 0 & 3 \\ 5 & 1 & -2 \\ 0 & -1 & 0 \end{vmatrix}}{\begin{vmatrix} 1 & 0 & 3 \\ 0 & 1 & -2 \\ 1 & -1 & 0 \end{vmatrix}} = 9;$$

$$P_{seller}^* = \frac{\begin{vmatrix} 1 & 0 & 15 \\ 0 & 1 & 5 \\ 1 & -1 & 0 \end{vmatrix}}{\begin{vmatrix} 1 & 0 & 3 \\ 0 & 1 & -2 \\ 1 & -1 & 0 \end{vmatrix}} = 2; \quad P_{buyer}^* = 3$$

2. (5 points) Differentiate the following function

$$f(x) = \ln\left(\frac{2x^2+1}{2x}\right)$$

$$\text{Let } g(x) = \frac{2x^2+1}{2x}.$$

$$f'(x) = \frac{1}{g(x)} \cdot g'(x)$$

$$g'(x) = \frac{(2x)(4x) - (2x^2+1)(2)}{(2x)^2} = \frac{4x^2-2}{4x^2} = \frac{2x^2-1}{2x^2}$$

$$f'(x) = \frac{1}{\frac{2x^2+1}{2x}} \cdot \frac{2x^2-1}{2x^2} = \frac{2x^2-1}{(2x^2+1)x}$$