AEB 6533 Static and Dynamic Optimization
Assignment 1

I. Second order Taylor Series expansion.

$$f(x) = 1 - 2x + 3x^2 - \tfrac{1}{2}x^3$$

$$h(x) = -\exp\left(-0.0050x + 0.0025x^2\right)$$

A. Solve for a second order Taylor Series expansion at 4.

B. Graph the approximation for $x = [0,8]$.

C. Does the approximation have a maximum or minimum in the range $x = [0,8]$? (Remember Weierstrauss's Theorem).

II. Assume that you have an agricultural market with a clearing price of \$3.50 at which 100 units are bought and sold. Assume an elasticity of supply of 1.5 and an elasticity of demand of –1.0. What is the impact of a \$0.25/unit tax on each good sold?

A. Assuming that the supply and demand curves are linear, derive the supply and demand curve from the market equilibrium and the elasticities.

1. Derive the demand curve:

$$a + bp = q$$

$$\varepsilon_d = \frac{\%\Delta Q}{\%\Delta P} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P}\frac{P}{Q} \Rightarrow b = -1.0\frac{100}{3.5} = -28.57$$

$$a - 28.57p = q \Rightarrow a - 28.57 \bullet 3.50 = 100 \Rightarrow a = 200$$

$$200 - 28.57p = q \Rightarrow p = 7.000 - 0.035q$$

The consumer surplus is then defined as:

$$CS(q) = \int_0^q \left(7.000 - 0.035z\right)dz = 7.000q - 0.0175q^2$$

2. Supply curve

$$\varepsilon_s = 1.5 \Rightarrow b = 1.5\frac{100}{3.5} = 42.857$$

$$a + 42.857p = q$$

$$a + 42.857 \bullet 3.50 = 100$$

$$a = -50.000$$

$$-50.000 + 42.857p = q \Rightarrow p = 0.0233q + 1.1667$$

The consumer surplus is then defined as:

$$PS(q) = \int_0^q \left(1.1667 + 0.0233z\right)dz = 1.1667q + 0.011665q^2$$

3. The total surplus relationship then becomes:

$$S(q) = \left[7.000q - 0.0175q^2\right] - \left[1.1667q + 0.011665q^2\right] - 0.25q$$