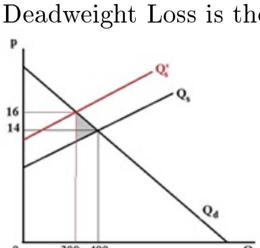
EC 501: Final Exam (Fall 2017), Solutions

1. (a) Each firm's MC is:
$$\frac{dC}{dq} = q + 10,$$
so each firm's supply curve is
$$p = q + 10 \qquad or \qquad q = p - 10 \quad for \quad p \geqslant 10.$$
The market supply curve is then the sum of all the individual firm supply curves:
$$Q_s = 100p - 1000.$$

(b) Equilibrium is where demand and supply are equal:
$$1100 - 50p = 100p - 1000,$$
which yields:
$$p^* = 14, \quad Q^* = 400.$$

(c) The excise tax would cause the market supply curve to shift upwards vertically by \$3. The new (tax-inclusive) supply curve would then be
$$Q_s^{'} = 100p^{'} - 1300.$$
Equilibrium would now be where
$$100p^{'} - 1300 = 1100 - 50p^{'}$$
which yields
$$p^{'} = 16, \quad Q^{'} = 300.$$
Tax revenue is then
$$TR' = 3 * 300 = 900.$$
Deadweight Loss is the shaded area in the figure:



This can be calculated as:
$$DWL = \frac{1}{2} \cdot 3 \cdot 100 = 150.$$

(d) A per unit excise tax of T would cause the supply curve to shift up vertically by T. The supply curve would then become

$$Q_s" = 100p" - 1000 - 100T.$$

Equilibrium would be where

$$100p" - 1000 - 100T = 1100 - 50p"$$

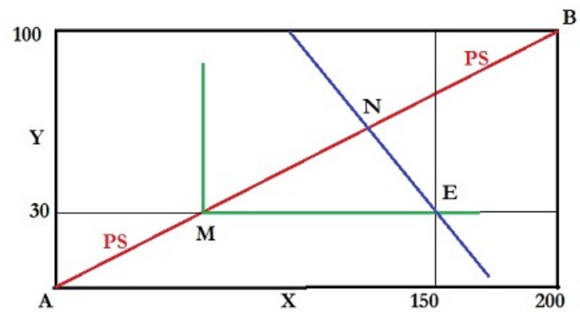
which yields

$$p" = 14 + \frac{2}{3}T \qquad \rightarrow \qquad Q" = 400 - \frac{100}{3}T.$$

Tax revenue collected would then be

$$TR" = (400)(6) - \frac{100}{3}(6)(6) = 1200.$$

2. (a) The graph shows the Edgeworth Box. A's indifference curves are L-shaped, with the green line being the one through E. B's indifference curves are linear; the blue line is her indifference curve through E. The contract curve PS is the diagonal of the box (red line).



(b) Pareto improvements over the endowment E that are also efficient are on the line segment MN where A's allocations are, at M: $(60, 30)$, and at N: $\left(\frac{1380}{11}, \frac{690}{11}\right)$.

(c) The red line MN is A's offer curve and the blue line EN is B's offer curve. Since they intersect at N, that would have to be the competitive equilibrium. The prices p_x and p_y would satisfy

$$\frac{p_x}{p_y} = \frac{4}{3}$$

and the allocations are

$$x^A = \frac{1380}{11}, y^A = \frac{690}{11}, \quad x^B = \frac{820}{11}, y^B = \frac{410}{11}.$$

3. (a) Widget Corp's profit is given by

$$\pi = \left(100 - 3Q + 4\sqrt{A}\right) Q - \left(4Q^2 + 10Q + A\right).$$

Profits are maximized where

$$\frac{\partial Q}{\partial \pi} = 100 - 6Q + 4\sqrt{A} - 8Q - 10 = 0$$

and

$$\frac{\partial Q}{\partial A} = \frac{4Q}{2\sqrt{A}} - 1 = 0.$$

Solving these two equations simultaneously yields

$$Q* = 15, A* = 900.$$

Then it is easy to find that

$$p* = 175 \qquad \textit{and} \qquad \pi* = 675.$$

(b) The Lerner index of the degree of monopoly is a measure of how much market power the firm has and is defined by

$$L = \frac{p - MC}{p}.$$

At the optimum, $p* = 175$. We can find MC by differentiating the cost function with respect to Q:

$$\frac{\partial C}{\partial Q} = 8Q + 10 = 130.$$

Then the Lerner index is

$$L = \frac{175 - 130}{175} = \frac{45}{175} = \frac{9}{35}.$$

4. (a) If Able adopts technique 1, its profit will be

$$\pi_1 = Q(20 - Q) - 10 - 8Q = 20Q - Q^2 - 10 - 8Q.$$

This is maximized when:

$$\frac{d\pi_1}{dQ} = 20 - 2Q - 8 = 0 \qquad \rightarrow \qquad Q_1 = 6, \quad p_1 = 14, \quad \pi_1 = 26.$$

If Able adopts technique 2, its profit will be

$$\pi_2 = Q(20 - Q) - 60 - 2Q = 20Q - Q^2 - 60 - 2Q.$$

This is maximized when:

$$\frac{d\pi_2}{dQ} = 20 - 2Q - 2 = 0 \qquad \rightarrow \qquad Q_2 = 9, \quad p_2 = 11, \quad \pi_2 = 21.$$

Since Able's profits are higher with technique 1, it will adopt that technique.

(b) If Able adopts technique 1 now, its profit will be

$$\pi_1^A = q^A(20 - q^A - q^B) - 10 - 8q^A.$$

This is maximized when:

$$\frac{d\pi_1^A}{dq^A} = 20 - 2q^A - q^B - 8 = 0 \qquad \rightarrow \qquad 2q^A = 12 - q^B.$$

Baker's profits will be

$$\pi_1^B = q^B(20 - q^A - q^B) - 10 - 8q^B.$$

This is maximized when:

$$\frac{d\pi_1^B}{dq^B} = 20 - 2q^B - q^A - 8 = 0 \qquad \rightarrow \qquad 2q^B = 12 - q^A.$$

Solving the two best response functions simultaneously, we find

$$q_1^A = q_1^B = 4, \quad p_1 = 12, \quad \pi_1^A = \pi_1^B = 6.$$

If Able adopts technique 2, its profit will be

$$\pi_2^A = q^A(20 - q^A - q^B) - 60 - 2q^A.$$

This is maximized when:

$$\frac{d\pi_2^A}{dq^A} = 20 - 2q^A - q^B - 2 = 0 \qquad \rightarrow \qquad 2q^A = 18 - q^B.$$

Baker's best-response function remains the same as in the previous case, as it must adopt technique 1 if it enters. Solving the two best response functions simultaneously, we find

$$q_2^A = 8, q_2^B = 2, \quad p_2 = 10, \quad \pi_2^A = 4, \pi_2^B = -6.$$

Clearly this is not a tenable equilibrium since $\pi_2^B < 0$, Baker would not enter. Therefore, $q_2^B = 0$. Substituting this in Able's best response function, we find

$$q_2^A = 9, p_2 = 11, \pi_2^A = 21.$$

Since Able's profits are higher with technique 2, it will adopt that technique.

(c) In Scenario (a):

$$CS = \frac{1}{2} \bullet 6 \bullet 6 = 18 \qquad \textit{and} \qquad \pi_1 = 26 \qquad \textit{so} \qquad W(a) = 44.$$

In Scenario (b):

$$CS = \frac{1}{2} \bullet 9 \bullet 9 = 40.5 \qquad \textit{and} \qquad \pi_2^A = 21 \qquad \textit{so} \qquad W(b) = 61.5.$$

Thus society is better off in Scenario (b).

5. (a) In the competitive equilibrium, average catch will be equalized on the two lakes:

$$10 - \frac{1}{2}L_x = 5 \qquad \to \qquad L_x = 10 \qquad \to \qquad Q_x = 50.$$

Then

$$L_y = 10 \qquad \to \qquad Q_y = 50.$$

The total catch will be 100.

(b) In the efficient allocation, the marginal catch would be equalized across the two lakes:

$$10 - L_x = 5 \qquad \to \qquad L_x = 5 \qquad \to \qquad Q_x = 37.5$$

Then

$$L_y = 15 \qquad \to \qquad Q_y = 75.$$

The total catch will be 112.5.

(c) Since we want to reduce the number of fisherman on lake X, we need to levy a fee on those who choose that lake. The fee F should be such that

$$AP_x - F = AP_y \qquad \to \qquad 10 - \frac{1}{2}L_x - F = 5.$$

Since we want $L_x = 5$, this becomes:

$$10 - \frac{1}{2}(5) - F = 5 \qquad \to \qquad F = 2.5.$$

This is the required fee.