Mid-Term Exam—Answer Sheet

Below you will find the answers to the mid-terms as well as a listing of some common mistakes that students made in trying to answer the questions.

Problem #1. True, False, Uncertain

1a) Uncertain or False The cost of the last unit produced represents the marginal cost, while economies of scale refers to falling average cost. In this question, the marginal cost of aluminum cans is rising as output expands, though economies of scale may still be present. As long as the rising marginal cost is below the average cost, average cost will fall with increased output.

Common Mistakes:
- Failing to recognize that the costs described are marginal costs, not average costs
- Assuming that if MC is increasing, there must be EOS. To determine EOS, you must know AC.
- Confusing EOS and RTS. EOS refers to costs whereas RTS refers to output.

1b) False The estimated demand curve shows that the own-price elasticity of demand is -0.40. Meanwhile, the price increased from $1.00 to $1.50, a 50% increase. This implies that quantity demanded would drop by approximately 20% (=50%*(-.4)). This is much greater than the 1% stated in the problem.

There are two other calculations that we accepted:
Using $1.50 as the base price instead of $1.00:

Change in Price: 33% (=1 – (1.00/1.50))
Decline in Quantity Demanded: -.4 * (.33) = 13%

Exact Calculation: Let Q0=quantity demanded before the fire, Q1=quantity after the fire

$$\ln Q1 - \ln Q0 = -0.4 \ln (1.5) + 0.4 \ln (1.0)$$
$\Leftrightarrow$ $\ln (Q1/Q0) = -0.4 \ln (1.5) + 0$
$\Leftrightarrow$ $Q1/Q0 = 1.5^{(-0.4)} = 0.85$ $\Leftrightarrow$ Quantity demanded fell by 15%.

Common Mistakes:
- Not realizing that .4 was the elasticity of demand
- Unsure of application of elasticity despite correctly identifying .4 as elasticity of demand
- Not calculating price change correctly (ie not 50% or 33%)

Problem #2.

For the passengers market, the marginal revenue is
$$MR_p = 8 - 0.01Q_p$$
Since MC=0, at the optimum $8 = 0.01Q_p$ or $Q_p = 800$. From the demand curve it then follows that $P_p = 8-0.005(800) = 4$.

> So the optimal price for passenger service is $P_p = \$4$

Total revenue from passenger service is $3,200.

For the freight market, the marginal revenue is
$$MR_f = 10 - 0.002Q_f$$
Since MC=0, at the optimum $10 = 0.002Q_f$ or $Q_f = 5000$. From the demand curve it then follows that $P_f = 10 - 0.001(5000) = 5$.

> So the optimal price of freight service is $P_f = 5$.

Total revenue from freight service is $25,000.

Total profits for the firm are $28,200 - 19,000 = \$9,200$.

> Since total profits are positive, the firm should not shut down.

The argument of the accountants does not make any sense since fixed costs should not be considered in the choice of the optimal price or quantity (assuming the firm does not shut down). Fixed costs do play a role in the decision to shut down or not.

If the joint fixed costs are $30,000, then the daily profit is $28,200 - 30,000 = -\$1,800$, i.e. the firm makes a loss.

> The firm should therefore shut down.

Common Mistakes:
- Failing to recognize that this is a monopoly in *two* markets. As a result, the MC of freight should be set equal to the MR of freight *and* the MC of passengers should be set equal to the MR of passengers. Two separate prices are then obtained. (People and freight are like apples and oranges: you can't add them.)
- Not explicitly evaluating the accountants' arguments. Simply noting that "the accounts were wrong because prices should actually drop" is not an evaluation of their arguments.
- Not noting that fixed costs were irrelevant for calculating prices.
- Not stating that when fixed costs rise to $30,000 the business no longer is profitable and, all else equal, should not operate.

Problem #3.

The demand can be at most 400. Afterwards, demand is perfectly inelastic (e.g. if you lower the price, the same amount will be demanded: 400). Re-arranging the supply and demand functions: $P = 5000 - 4 \, Qd$; $P = 3000 + Qs$, The market can be graphed as:
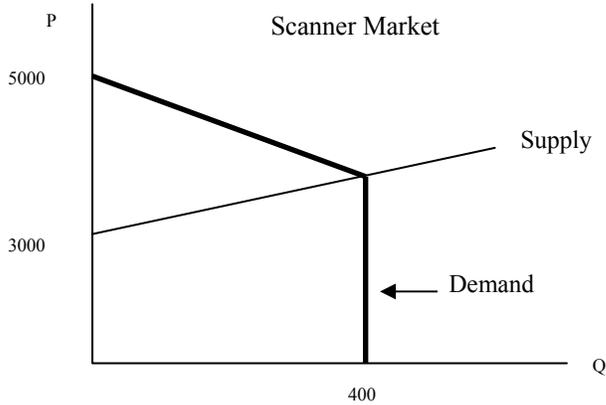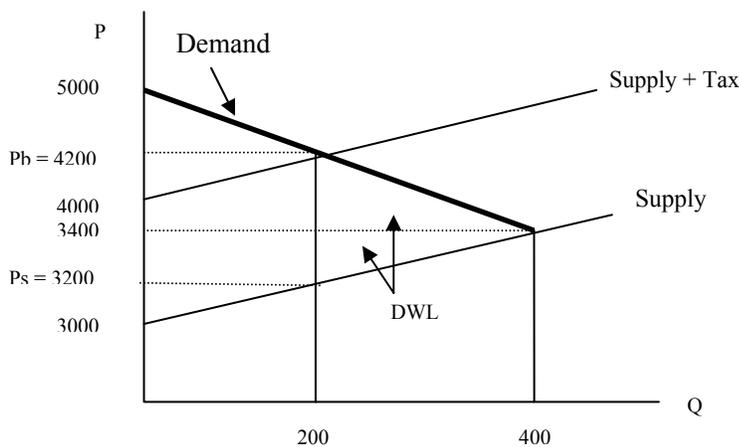

3a) Equilibrium Price and Quantity are determined by setting $Qs = Qd$ and then checking to make sure that $Qd \leq 400$: $\quad -3000 + P = 1250 - (1/4) \, P \Leftrightarrow P = \$3400$

From the demand curve: $Q = 1250 - (1/4)P = 1250 - (1/4)*(3400) = 400$

> $Q = 400$ scanners, $P = \$3400$ per scanner

3b) Now there is a tax. Quantity will not increase with a tax, so consider the elastic portion of the demand curve. Graphically, "shift" the supply curve:

Let $\quad Ps$ = price received by seller, Pb = price paid by the buyer, and the tax is $Pb - Ps = \$1000$.

$Qs = Qd \rightarrow -3000 + Ps = 1250 - (1/4) \, Pb$

⇔ -3000 + Ps = 1250 – (1/4) (Ps + 1000)
⇔ (5/4)Ps = 4000 ⇔ Ps = $3200

Q = -3000 + Ps = -3000 + 3200 = 200.

| 200 scanners are sold, and the price that firms receive is $3200 per scanner. |

[Note that the price buyers pay is Pb = Ps +1000 = $4200]

To calculate deadweight loss of a tax, calculate the area of the DWL triangle, or calculate the change in total surplus.

Area of DWL triangle: ½ * (4200 – 3200) * (400-200) = $100,000

| The tax results in a Deadweight Loss of $100,000. |

Common Mistakes:
  • Omitting tax revenues to Government in the calculation for dead weight loss.
  • Assuming 100% of the tax will be borne by the consumer i.e. assuming Pb=$4400, Ps=$3400.

3c) Now there is a subsidy in the amount of $1000 per machine. Quantity will not decrease with a subsidy, so consider the perfectly inelastic portion of the demand curve: Graphically, "shift" the supply curve:
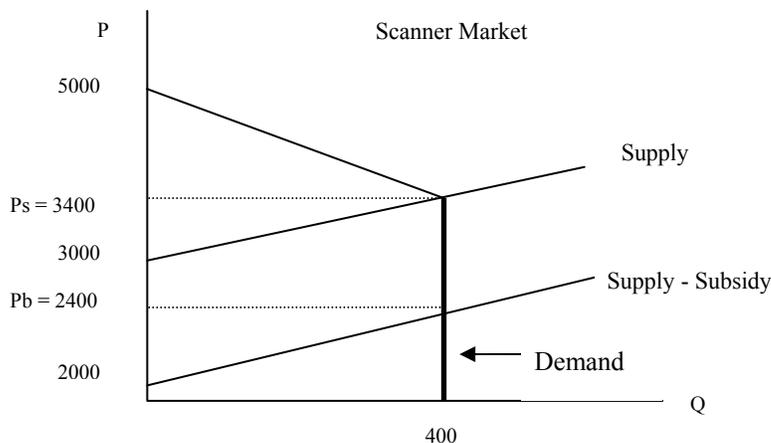
With a perfectly inelastic demand, the quantity demanded and sold does not change with the subsidy, so there is no distortion and no deadweight loss. The entire subsidy is passed on to the consumers. $400,000 is simply transferred from taxpayers to teaching hospitals.

| There is no deadweight loss. |

For those who decided to nevertheless do the calculations. Quantity demanded and supplied remains 400. The price paid by the buyer (read off the demand curve) is 3400 – 1000 = $2400. The price received by the seller (read off the original supply curve) is $3400.

Let Ps = price received by seller, Pb = price paid by the buyer and the subsidy is Ps – Pb = $1000.   Qs = Qd ➔ -3000 + Ps = 400, or Ps = $3400

> The price that firms receive is $3400 per scanner, Q = 400 scanners.

[Note that the price buyers pay is $2400 (=Ps – 1000)]

Common Mistakes:
- Failing to realize that the demand curve was inelastic (i.e., vertical) for Q > 400.

Problem #4.

The inverse demand curve is
  $p = 11 - Q/10,000$
where p is expressed in GM.

4a) To maximize social surplus, the government should put the price equal to marginal cost (which is the competitive solution). The government should charge

> p=1 GM

The demand for mail is then 100,000 pieces of mail, and total surplus is 10*100,000/2 = 500,000 GM.

Common Mistakes:
- Setting price = 0. This may maximize consumer surplus, but it doesn't take into account the costs to the government by doing this.
- Setting MC = MR to get quantity then price. Setting MC = MR and solving for quantity is what monopolies do to maximize their total profits, not what a government should do to maximize social welfare.

4b) For a monopolist, the marginal revenue is
  $MR = 11 - 2Q/10,000$
so that the optimal quantity follows from MR= 11 - 2Q/10,000=1=MC, or 10=2Q/10,000 or Q=50,000. The monopolist's optimal price is then 11-50,000/10,000 or

> p= 6 GM.

Its profits are 50,000 (6-1) = 250, 000 GM.

> The maximum the government can charge for the monopoly is thus 250,000 GM.

Consumer welfare in this case is 5*50,000/2 = 125,000. Total surplus is thus 250,000+125,000 = 375,000.

> There is a welfare loss of 125,000 GM due to this privatization.

Common Mistakes:
- Setting the price that the government could charge for the monopoly rights equal to revenue (instead of the profit) from monopoly operations.
- Forgetting to take into account the change in producer surplus when calculating the DWL.

4c) With the subsidy, it is *as if* the firm's marginal cost is now -1 GM. The firm will thus set MR= 11 - 2Q/10,000=-1=MC, or 12=2Q/10,000 or Q=60,000. The monopolist's optimal price is then 11-60,000/10,000 = 5 GM. Its profits are 60,000 (5-(-1)) = 60,000 *6= 360, 000 GM.

> So firm profits increased by 110,000 GM.

Consumer surplus is 6*60,000/2 = 180,000.

> Consumer surplus increased by 55,000 GM.

Government subsidies are 2*60,000 = 120, 000 GM. Total surplus is thus 360,000 + 180,000- 120,000= 420,000 GM.

> Total social surplus increased by 45,000 GM versus the monopoly situation.

But social surplus still 80,000 GM below the government solution.

(Alternative solution: We could also shift the demand curve. The new demand curve would be 13-Q/10,000, so that MR=13-2Q/10,000. This gives the same results as above.)

Common Mistakes:
- Assuming that, since the subsidy is 2GM, the new price will be reduced by 2GM compared to the answer in b (6-2=4GM). The new price should be determined by setting the adjusted MR=MC.
- Solving the MC=MR correctly, but using the wrong prices to calculate surplus.
- Failing to discuss the change in surplus and social welfare.