**Solution (Assignment 7)**

**I/ Problems**

**Problem 1**

The following curve is a production function for a firm that uses one input, L. It shows total product (output) for every level of input.

1. Derive and graph the marginal product curve
2. Suppose the wage rate is $4. Derive and graph the firm’s marginal cost curve
3. If output sells for $6, what is the profit-maximizing level of output? How much labor will the firm hire?

Q

200

100

Units of L

300

100

1. The MP is the additional output (change in total output) induced by a change of (one) L 🡺 MP = ΔQ/ΔL 🡺

For the first 100 units of output, the MP = (100/100) = 1Q 🡸🡺 each additional L increases output by one unit.

For the next 100 units (between 100 and 200 units), the MP = (100/200) = 0.5Q 🡸🡺 each additional L increases output by half a unit of output

Q

1

0.5

Units of L

300

100

1. To derive the firm’s MC curve, we need to compute the cost of an additional unit of output produced:
2. For the range (0 – 100) units of output; each additional unit requires 1 unit of L (recall that the MP = 1) 🡺

Each additional unit of output costs $4 × 1 = $4 🡸🡺 the production of an additional unit induces an increase in the cost of $4 🡺 the MC is $4 for this range of output

1. For the range (100 – 200) units of output, each additional unit requires 2 units of L (the MP = 0.5) 🡺

Each additional unit of output costs $4 × 2 = $8 🡸🡺 the MC is $8 for this range of output

MC

P = $6

8

4

Q

200

100

1. To maximize its profit, the firm will increase its production as long as the price covers the MC 🡺 if market price is $6 🡺 the firm will produce 100 units (for the rest of the units, the MC exceeds the price).

We know that to produce 100 units of output, the firm needs 100 workers 🡺 it will hire 100 L

**Problem 2**

A firm’s cost curves (in $) are given in the following table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Q | TC | TFC | TVC (TC – TFC) | AVC (TVC/Q) | ATC (TC/Q) | MC (∆TVC/∆Q) |
| 0 | 100 | 100 |  0 | – | – | – |
| 1 | 130 | 100 |  30 | 30 | 130 | 30 |
| 2 | 150 | 100 |  50 | 25 | 75 | 20 |
| 3 | 160 | 100 |  60 | 20 | 53.33 | 10 |
| 4 | 172 | 100 |  72 | 18 | 43 | 12 |
| 5 | 185 | 100 |  85 | 17 | 37 | 13 |
| 6 | 210 | 100 | 110 | 18.3 |  35 | 25 |
| 7 | 240 | 100 | 140 | 20 | 34.29 | 30 |
| 8 | 280 | 100 | 180 | 22.5 | 35 | 40 |
| 9 | 330 | 100 | 230 | 25.56 | 36.67 | 50 |
| 10 | 390 | 100 | 290 | 29 | 39 | 60 |

1. Complete the table (done)
2. Suppose market price is $30. How much will the firm produce? How much are total profits?

To maximize its profit, the firm will produce the level of output where P = MC 🡺 if p = $30, the level of output can either be 1 unit or 7 units. However, the level of output that maximizes its profit (minimizes its loss) is 7 units. To see why, let us compute its profit at a level of output of 7 units:

Profit = TR – TC; where TR = p × Q, and TC = 240 when Q = 7: profit = (30 × 7) – 240 = 210 – 240 = - $30 → at this level of output the firm minimizes its loss

If the firm produces 1 unit of output, the profit will be equal to: 30 – 130 = -$100 🡺 the firm will suffer a greater loss if it produces 1 unit rather than 7 units.

1. If market price is $50. How much will the firm produce? How much are total profits?

The level of output that maximizes the firm’s profit at the market price of $50 is 9 units 🡺 Profit = (9 × 50) – 330 = 450 – 330 = $120

**Problem 3** (*the 1 million dollar question*)

Usually, while charging admission most days of a week, Parisian museums offer free admission on Wednesday evenings.

1. Why do museums often price this way?
2. Why do they choose Wednesday rather than Saturday? (*Hint*: use marginal analysis)
3. Assuming that museums are interested in developing art appreciation, a free night per week would encourage potential art-lovers to visit museums (who can come back which will increase the museum’s revenue in the future).
4. On Wednesday nights, museums are usually not crowded. Moreover, few people would be willing to go out and visit museums on Wednesday nights even if the visit is for free.

These additional people (who will profit from free visits) are likely to visit the museum without added expenses (electricity, staff…etc.): the visit-related expenses would not go up 🡸🡺 the MC of receiving these additional visitors on these nights is likely $0.

On Saturday nights, museums usually receive more visitors. In addition, if free entry was scheduled on Saturday night; the number of potential visitors is likely to be substantially higher than on Wednesday 🡺 the visit-related expenses are likely to increase 🡺 the marginal cost of receiving additional visitors is likely to increase.

This is why museums do not choose Weekend nights for free entry.

**II/ Multiple choice questions**

1. As output level increases, the difference between average total cost and average variable cost

(a) increases, because total cost includes fixed costs.

(**b**) decreases, because additional units of output spread fixed cost over a larger number of units and reduce its importance.

(c) remains constant, because total fixed cost (which is included in total cost) is a constant.

(d) decreases and then increases, because they are U-shaped curves.

Recall that ATC = AVC + AFC. Since AFC decreases as output level increases (that is, fixed cost is spread over a larger amount of output) 🡺 the difference between ATC and AVC (equal to AFC) decreases with the level of output

2. When average cost is greater than marginal cost,

(a) average cost is rising.

(**b**) average cost is falling.

(c) marginal cost is rising.

(d) marginal cost is falling.

This is an application of the “average-marginal rule”: if the extra value is less than the average value, the average is pulled down. Options (c) and (d) are incorrect because when MC is below the average cost, it first decreases before increasing.

3. Tom and Jerry produce mugs. They can sell their mugs at $2 each. They find that the marginal cost of production of the first, second, third, fourth, and fifth mug is 50¢, $1.00, $1.50, $2.00, and $2.50, respectively. Assuming that Tom and Jerry do produce some mugs, which of the following statements is true?

(a) The profit-maximizing output level is three mugs.

(b) Tom and Jerry can make a positive profit from selling their mugs.

(**c**) Tom and Jerry should produce the fourth mug.

(d) Because marginal cost is increasing by 50 cents per mug, there is a constant rate of increase in total cost.

The fourth mug allows Tom and Jerry to maximize profits. Option (b) is wrong because we have no information about total cost, only how it’s changing.

4. Hansen and Gretel own small factories producing decorative boxes. Hansen uses a production process that has high fixed costs and low variable costs, and Gretel uses a process that has low fixed costs and high variable costs. Each factory is producing 100 boxes per week, and the total costs are equal. If each firm increases output by 10 boxes per week

(a) Hansen’s total cost will increase more than Gretel’s.

(**b**) Hansen’s total cost will increase less than Gretel’s.

(c) Hansen’s total fixed cost will increase more than Gretel’s.

(d) Hansen’s total fixed cost will increase less than Gretel’s.

An increase in output will only increase variable costs (total fixed costs do not change as output changes). Since Gretel’s variable costs are higher, Gretel’s total cost will increase more Hansen’s total cost.