

# Sessions 7-8

Costs, and Revenues

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# Topics to be Discussed

- Revenues
- Measuring Costs
  - Opportunity costs
  - Average costs
  - Marginal costs
  - Sunk costs
  - Revenues
  - Economic and accounting profits
- Solved problems

# Introduction

- The production technology measures the relationship between input and output.
- Production technology, together with prices of factor inputs, determine the firm's cost of production
- Given the production technology, managers must choose how to produce.

# Revenues

What is a firm's profit? The amount that the firm receives for the sale of its output (cookies) is called **total revenue**. The amount that the firm pays to buy inputs (flour, sugar, workers, ovens, and so forth) is called **total cost**. Caroline gets to keep any revenue that is not needed to cover costs. **Profit** is a firm's total revenue minus its total cost:

$$\text{Profit} = \text{Total revenue} - \text{Total cost}$$

To see how a firm goes about maximizing profit, we must consider fully how to measure its total revenue and its total cost. Total revenue is the easy part: It equals the quantity of output the firm produces multiplied by the price at which it sells its output. If Caroline produces 10,000 cookies and sells them at \$2 a cookie, her total revenue is \$20,000. The measurement of a firm's total cost, however, is more subtle.

# Measuring Cost: Which Costs Matter?

- For a firm to minimize costs, we must clarify what is meant by *cost* and how to measure them
  - It is clear that if a firm has to rent equipment or buildings, the rent they pay is a cost
  - What if a firm owns its own equipment or building?
    - How are costs calculated here?

# Measuring Cost: Which Costs Matter?

- Accountants tend to take a retrospective view of firms costs, where as economists tend to take a forward-looking view
- Accounting Cost
  - Actual expenses plus depreciation charges for capital equipment
- Economic Cost
  - Cost to a firm of utilizing economic resources in production, including opportunity cost

# Opportunity costs

- Opportunity costs

- Cost associated with opportunities that are foregone when a firm's resources are not put to their highest-value use.
- The *opportunity cost of an* item refers to all the things that must be forgone to acquire that item. When economists speak of a firm's cost of production, they include all the opportunity costs of making its output of goods and services
- Explicit costs are input costs that require an outlay of money by the firm
- Implicit costs are input costs that **do not** require an outlay of money by the firm

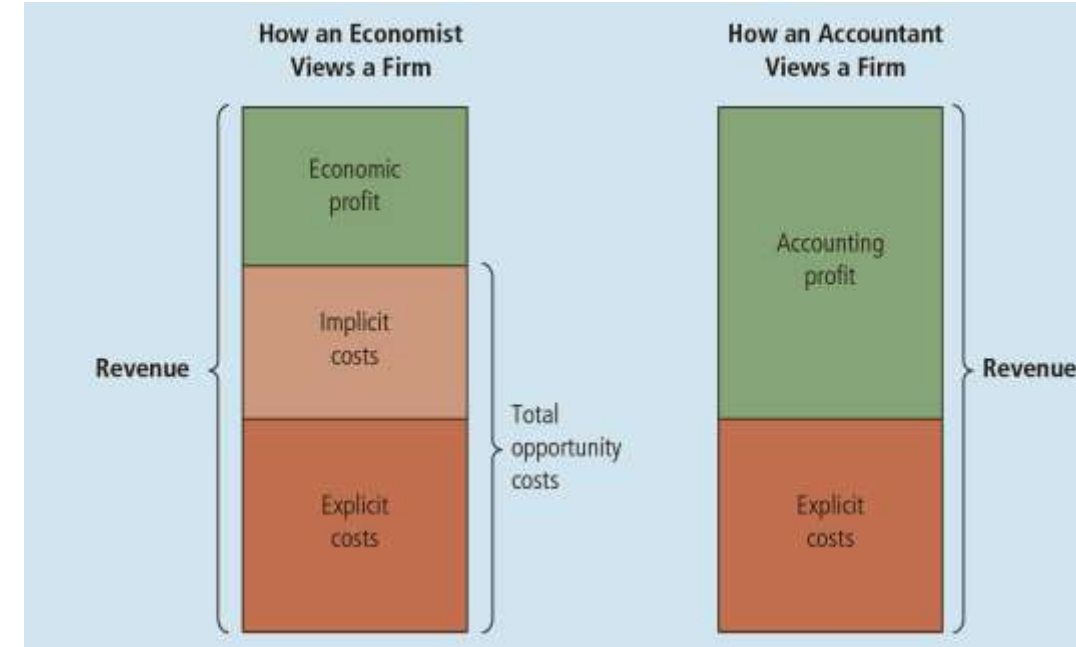
# Opportunity Cost

- An Example
  - A firm owns its own building and pays no rent for office space
  - Does this mean the cost of office space is zero?
  - The building could have been rented instead
  - Foregone rent is the opportunity cost of using the building for production and should be included in economic costs of doing business



# Opportunity Cost

- Because economists and accountants measure costs differently, they also measure profit differently
- An economist measures a firm's **economic profit as the firm's total revenue minus all the opportunity costs** (explicit and implicit) of producing the goods and services sold.
- An accountant measures the firm's **accounting profit as the firm's total revenue** minus only the firm's explicit costs
- The accompanying figure summarizes this difference
  - Notice that because the accountant ignores the implicit costs, accounting profit is usually larger than economic profit
  - For a business to be profitable from an economist's standpoint, total revenue must exceed all the opportunity costs, both explicit and implicit



# Measuring Cost: Which Costs Matter?

- Although opportunity costs are hidden and should be taken into account, sunk costs should not
- **Sunk Cost**
  - Expenditure that has been made and cannot be recovered
  - Should not influence a firm's future economic decisions.

# Sunk Cost

- Firm buys a piece of equipment that cannot be converted to another use
- Expenditure on the equipment is a sunk cost
  - Has no alternative use so cost cannot be recovered – opportunity cost is zero
  - Decision to buy the equipment might have been good or bad, but now does not matter

# Measuring Cost: Which Costs Matter?

- Some costs vary with output, while some remain the same no matter amount of output
- Total cost can be divided into:
  1. Fixed Cost
    - Does not vary with the level of output
  2. Variable Cost
    - Cost that varies as output varies

# Fixed and Variable Costs

- Total output is a function of variable inputs and fixed inputs.
- Therefore, the total cost of production equals the fixed cost (the cost of the fixed inputs) plus the variable cost (the cost of the variable inputs), or...

$$TC = FC + VC$$

# Fixed and Variable Costs

- Which costs are variable and which are fixed depends on the time horizon
- Short time horizon – most costs are fixed
- Long time horizon – many costs become variable
- In determining how changes in production will affect costs, must consider if affects fixed or variable costs

# Fixed Cost Versus Sunk Cost

- Fixed cost and sunk cost are often confused
- Fixed Cost
  - Cost paid by a firm that is in business regardless of the level of output
- Sunk Cost
  - Cost that have been incurred and cannot be recovered

# Measuring Cost: Which Costs Matter?

- Personal Computers
  - Most costs are variable
  - Largest component: labor
- Software
  - Most costs are sunk
  - Initial cost of developing the software



# Marginal and Average Cost

- In completing a discussion of costs, must also distinguish between
  - Average Cost
  - Marginal Cost
- After definition of costs is complete, one can consider the analysis between short-run and long-run costs

# Measuring Costs

- Marginal Cost (MC):
  - The cost of expanding output by one unit.
  - Fixed cost have no impact on marginal cost, so it can be written as:

$$MC = \frac{\Delta VC}{\Delta q} = \frac{\Delta TC}{\Delta q}$$

# Measuring Costs

- Average Total Cost (ATC)
  - Cost per unit of output
  - Also equals average fixed cost (AFC) plus average variable cost (AVC).

$$ATC = \frac{TC}{q} = AFC + AVC$$

$$ATC = \frac{TC}{q} = \frac{TFC}{q} + \frac{TVC}{q}$$

# Measuring Costs

- All the types of costs relevant to production have now been discussed
- Costs that are fixed in the short run may not be fixed in the long run
- Typically in the long run, most if not all costs are variable

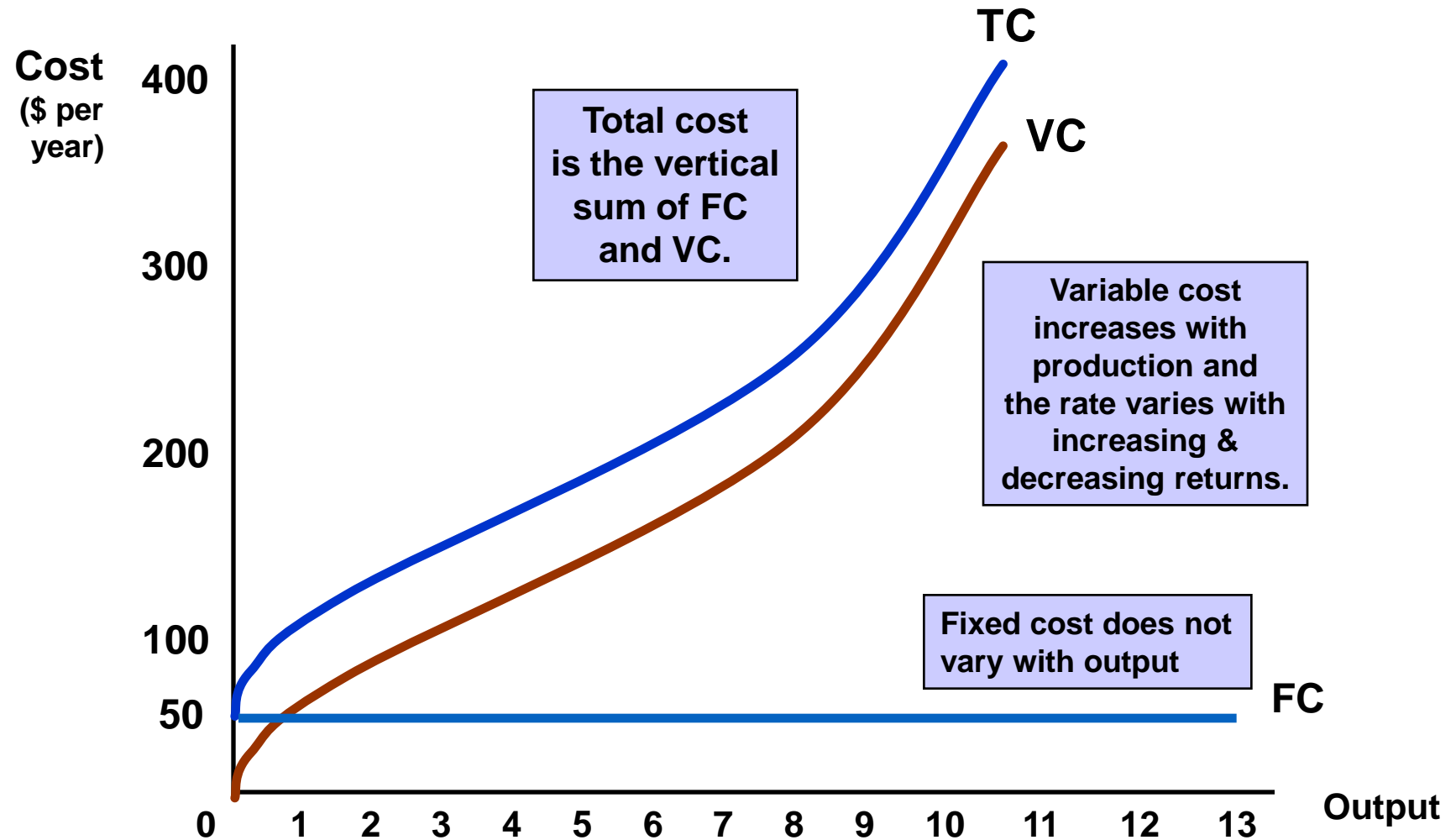
# A Firm's Short Run Costs

<i>Rate of Output (Units per Year)</i>	<i>Fixed Cost (Dollars per Year)</i>	<i>Variable Cost (Dollars per Year)</i>	<i>Total Cost (Dollars per Year)</i>	<i>Marginal Cost (Dollars per Unit)</i>	<i>Average Fixed Cost (Dollars per Unit)</i>	<i>Average Variable Cost (Dollars per Unit)</i>	<i>Average Total Cost (Dollars per Unit)</i>
	<i>(FC) (1)</i>	<i>(VC) (2)</i>	<i>(TC) (3)</i>	<i>(MC) (4)</i>	<i>(AFC) (5)</i>	<i>(AVC) (6)</i>	<i>(ATC) (7)</i>
0	50	0	50	—	—	—	—
1	50	50	100	50	50	50	100
2	50	78	128	28	25	39	64
3	50	98	148	20	16.7	32.7	49.3
4	50	112	162	14	12.5	28	40.5
5	50	130	180	18	10	26	36
6	50	150	200	20	8.3	25	33.3
7	50	175	225	25	7.1	25	32.1
8	50	204	254	29	6.3	25.5	31.8
9	50	242	292	38	5.6	26.9	32.4
10	50	300	350	58	5	30	35
11	50	385	435	85	4.5	35	39.5

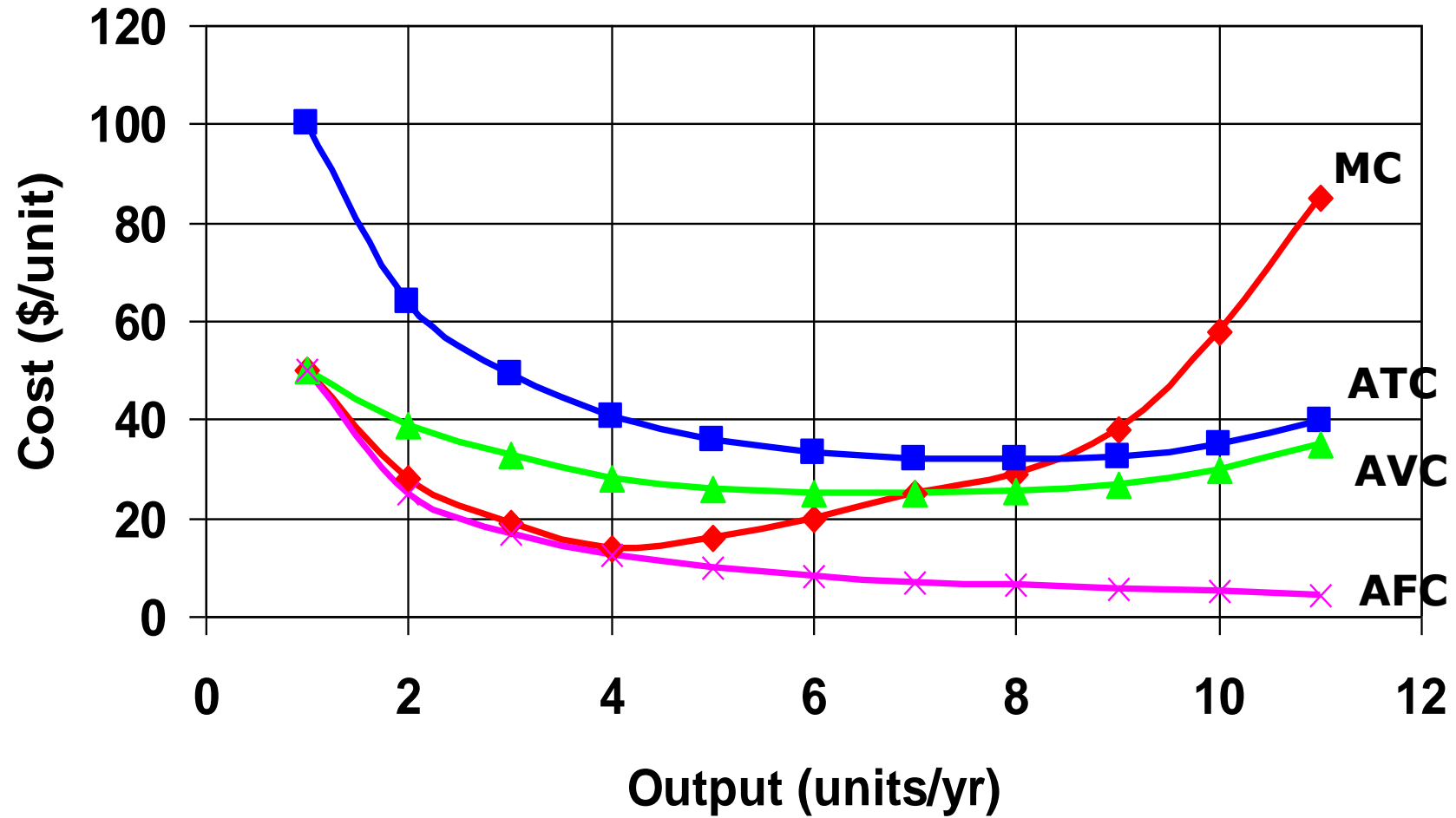
# Cost Curves

- The following figures illustrate how various cost measure change as output change
- Curves based on the information in table (slide 21) discussed earlier

# Cost Curves for a Firm



# Cost Curves





# Cost Curves -

## The Average – Marginal relationship

- When MC is below AVC, AVC is falling
- When MC is above AVC, AVC is rising
- When MC is below ATC, ATC is falling
- When MC is above ATC, ATC is rising
- Therefore, MC crosses AVC and ATC at the minimums

# Problem 1

A commercial fisherman notices the following relationship between hours spent fishing and the quantity of fish caught:

Hours	Quantity of Fish (in pounds)
0 hours	0 lb.
1	10
2	18
3	24
4	28
5	30

- What is the marginal product of each hour spent fishing?
- Use these data to graph the fisherman's production function. Explain its shape.
- The fisherman has a fixed cost of \$10 (his pole). The opportunity cost of his time is \$5 per hour. Graph the fisherman's total-cost curve. Explain its shape.

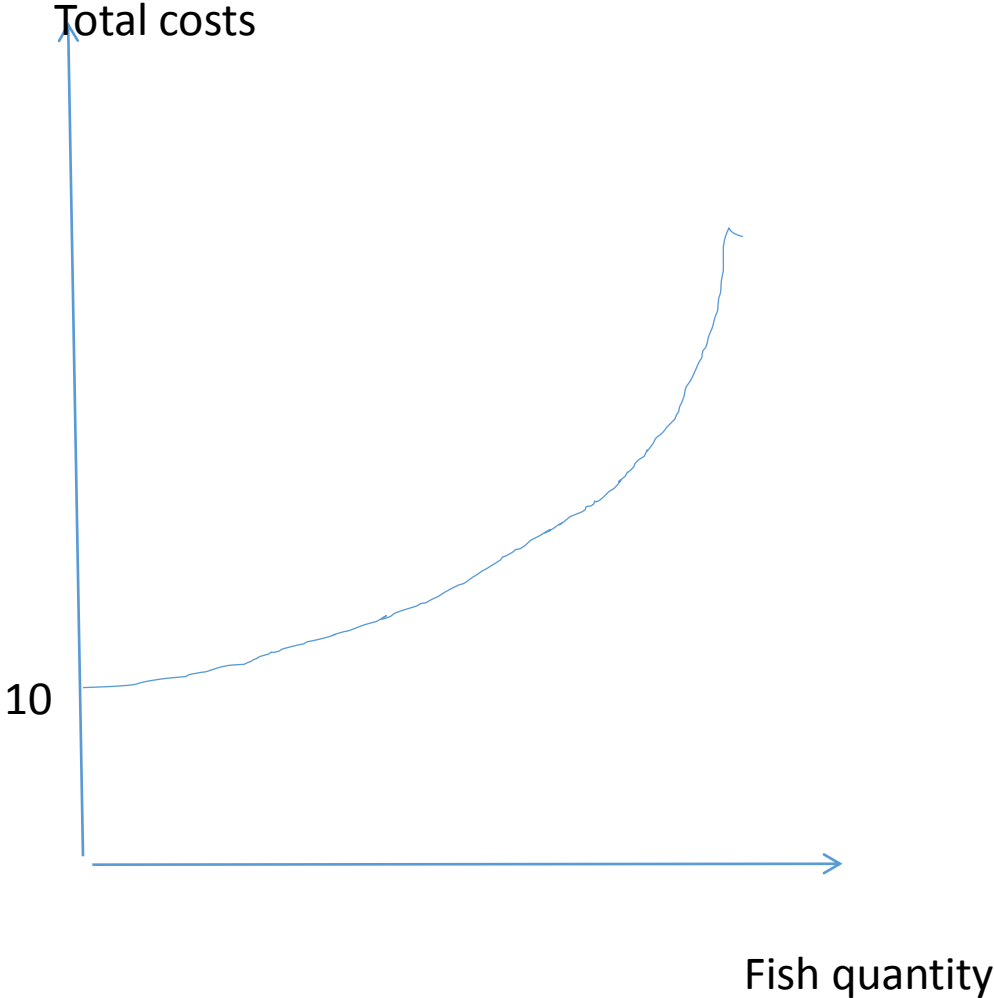
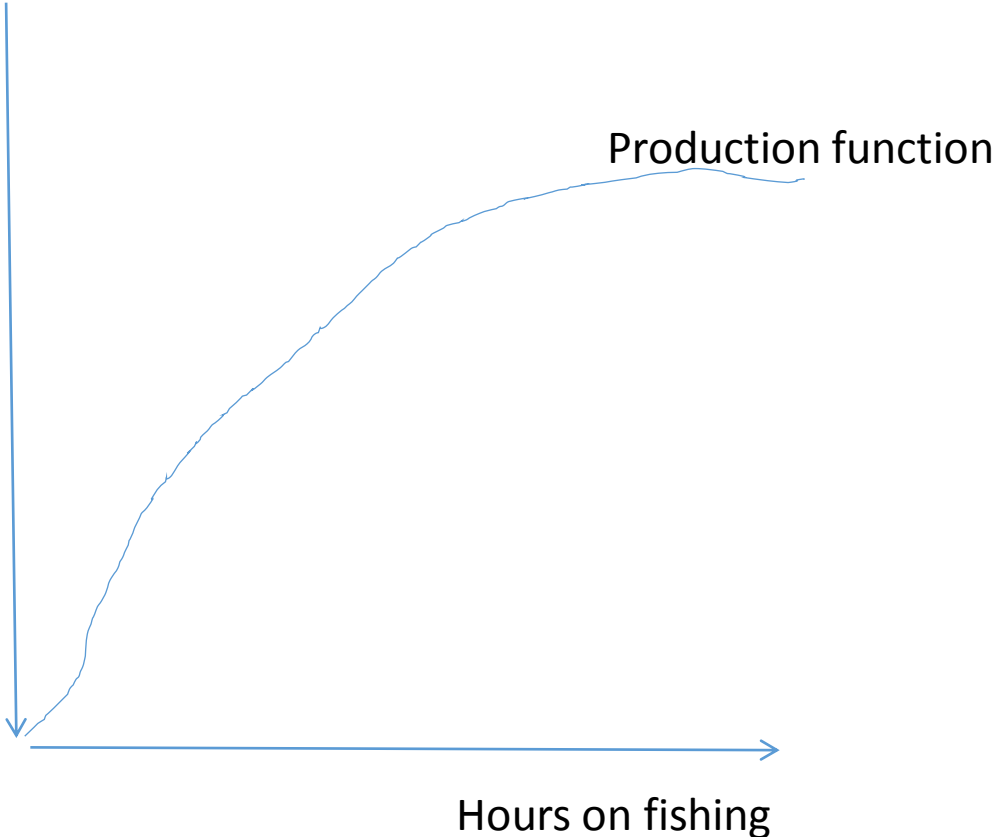
# Problem 1-solution (a)

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Hours	Fish	MP	FC	VC	TC
0	0		10	0	10
1	10	10	10	$5*1 = 5$	15
2	18	8	10	$5*2 = 10$	20
3	24	6	10	15	25
4	28	4	10	20	30
5	30	2	10	25	35

# Problem 1-solution...b and c

Fish quantity  $F$



## Problem 2

Joe quits his computer programming job, where he was earning a salary of \$50,000 per year, to start his own computer software business in a building that he owns and was previously renting out for \$24,000 per year. In his first year of business he has the following expenses: salary paid to himself, \$40,000; rent, \$0; other expenses, \$25,000. Find the accounting cost and the economic cost associated with Joe's computer software business.

# Problem 2-solution

- The accounting cost is  $40,000 + 25,000 = 65,000$  -----(1)
- Economic costs
  - Includes (1) + opportunity costs
  - The money Joe gave up by not renting = 24,000
  - He also lost out 10,000 ( $50,000 - 40,000$ ) = 10,000
- Economic cost is  $65,000$  (from (1) ) + 24,000 + 10,000 = 99,000.

# Problem 3

The cost of flying a passenger plane from point  $A$  to point  $B$  is \$50,000. The airline flies this route four times per day at 7 AM, 10 AM, 1 PM, and 4 PM. The first and last flights are filled to capacity with 240 people. The second and third flights are only half full. Find the average cost per passenger for each flight. Suppose the airline hires you as a marketing consultant and wants to know which type of customer it should try to attract—the off-peak customer (the middle two flights) or the rush-hour customer (the first and last flights). What advice would you offer?

# Problem 3-solution

- For the full flight, AC / passenger is  $50,000 / 240 = 208.33$
- For the half full flight, AC / passenger is  $50,000 / 120 = 416.67$
- The airline must focus on attracting more off peak customers (10 am and 1 pm flights) because:
  - There is excess capacity
  - Peak flights are full
  - MC of an additional passenger in off peak flights is zero.



# Problem 4

The short-run cost function of a company is given by the equation  $TC = 200 + 55q$ , where  $TC$  is the total cost and  $q$  is the total quantity of output, both measured in thousands.

- a. What is the company's fixed cost?
- b. If the company produced 100,000 units of goods, what would be its average variable cost?
- c. What would be its marginal cost of production?
- d. What would be its average fixed cost?
- e. Suppose the company borrows money and expands its factory. Its fixed cost rises by \$50,000, but its variable cost falls to \$45,000 per 1000 units. The cost of interest ( $i$ ) also enters into the equation. Each 1-point increase in the interest rate raises costs by \$3000. Write the new cost equation.

# Problem 4-solution

- A) Fixed cost is the cost when  $q=0$  in the cost equation.  $FC = 200$  or \$200,000
- B) At 100,000 units,  $q = 100$ ; In the cost equation,  $VC = 55q = 55 * 100 = 5500$   
Or \$ 5500,000;  $AVC = VC/q = 5500,000/100,000 = 55$ , or \$55,000
- C)  $MC = d(TC) / dq = 55$ , or \$ 55,000
- D)  $TC = 250 + 45q + 3i$ , where  $i =$  interest rate.

The End

Thanks