UN1105 Principles of Economics

Recitation 4: Inputs and Costs, and Perfect Competition

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Outline

- Review of Concepts
  - Inputs and Costs
  - Perfect Competition
- Analytical Questions
  - Q1: K&W Problem 11.6
  - Q2: K&W Problem 11.16
  - Q3: K&W Problem 12.13
- Short-answer Questions
  - Q4: K&W Problem 11.8
  - Q5: K&W Problem 12.6

Review of Concepts, Inputs and Costs

- Production function: $Output = f(Inputs)$
  - What are the units?
  - Marginal Product: $\frac{\Delta Output}{\Delta Inputs}$
  - Diminishing marginal product. (Caveat: specialization).
- Inputs
  - Fixed v Variable inputs.
  - Concept: long run v Short run.
- Costs
  - Total Cost(Q) = Variable Cost(Q) + Fixed Cost(Q)
  - Per unit: $AFC(Q) = \frac{FC(Q)}{Q}$; $AVC(Q) = \frac{VC(Q)}{Q}$; $ATC(Q) = \frac{TC(Q)}{Q}$.
    - Spreading effect v diminishing returns effect.
  - Marginal Cost(Q): $\frac{\Delta TC(Q)}{\Delta Q}$
  - General comment on marginals v averages.
    - Sample of N observations: $x_1, ..., x_{N-1}, x_N$
    - Average: $\bar{x}_{(N)} = \frac{1}{N}(x_1 + ... + x_{N-1} + x_N) = \frac{N-1}{N}\bar{x}_{(N-1)} + \frac{1}{N}x_N$
    - Thus, if $\bar{x}_{(N-1)} < x_N \Rightarrow \bar{x}_{(N-1)} < \bar{x}_{(N)}$.
  - Long-run v short-run costs.
  - Returns to scale.

Review of Concepts, Inputs and Costs

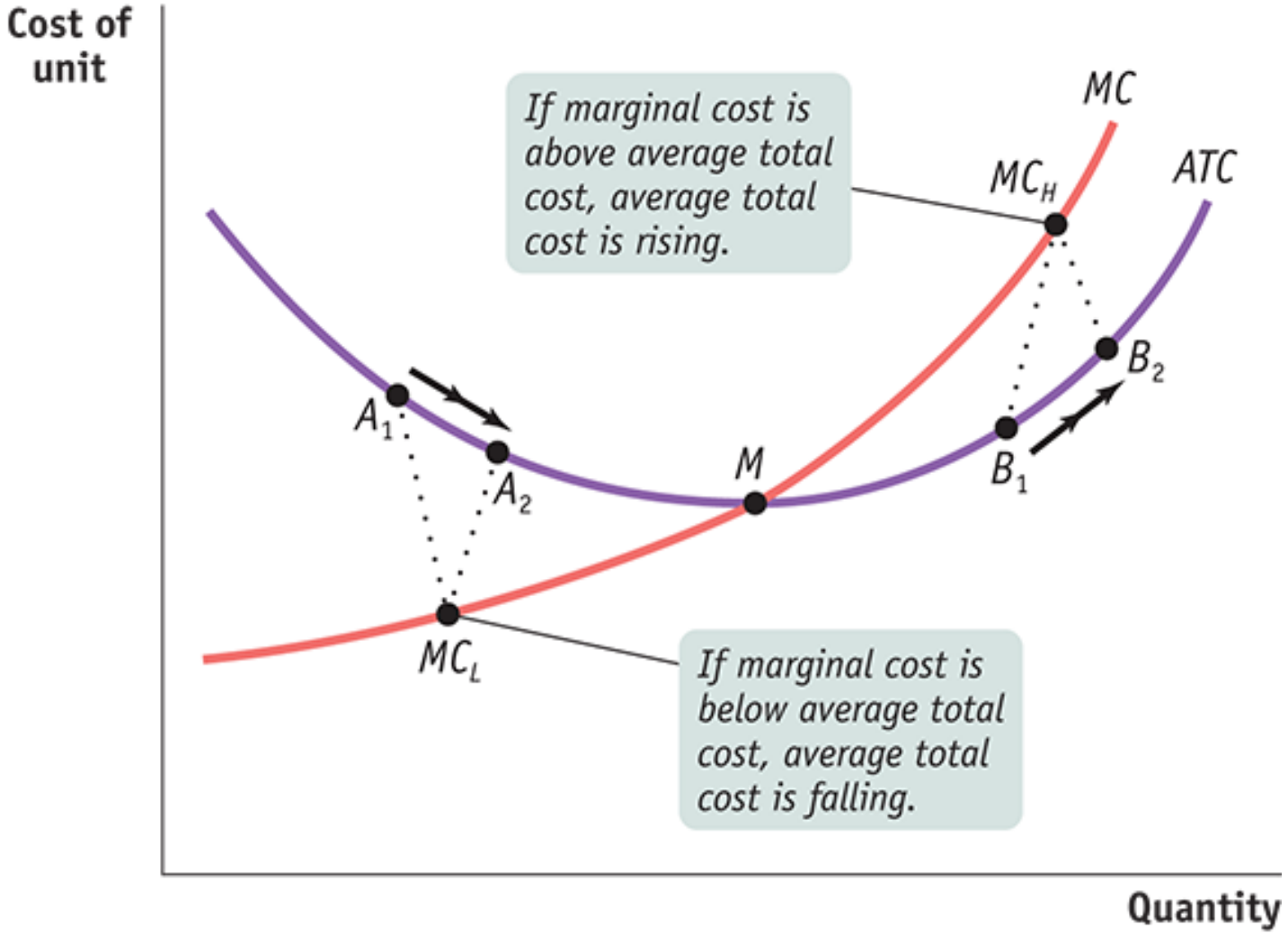


FIGURE 11-9
Krugman/Wells, *Microeconomics*, 5e, © 2018 Worth Publishers

Review of Concepts, Inputs and Costs

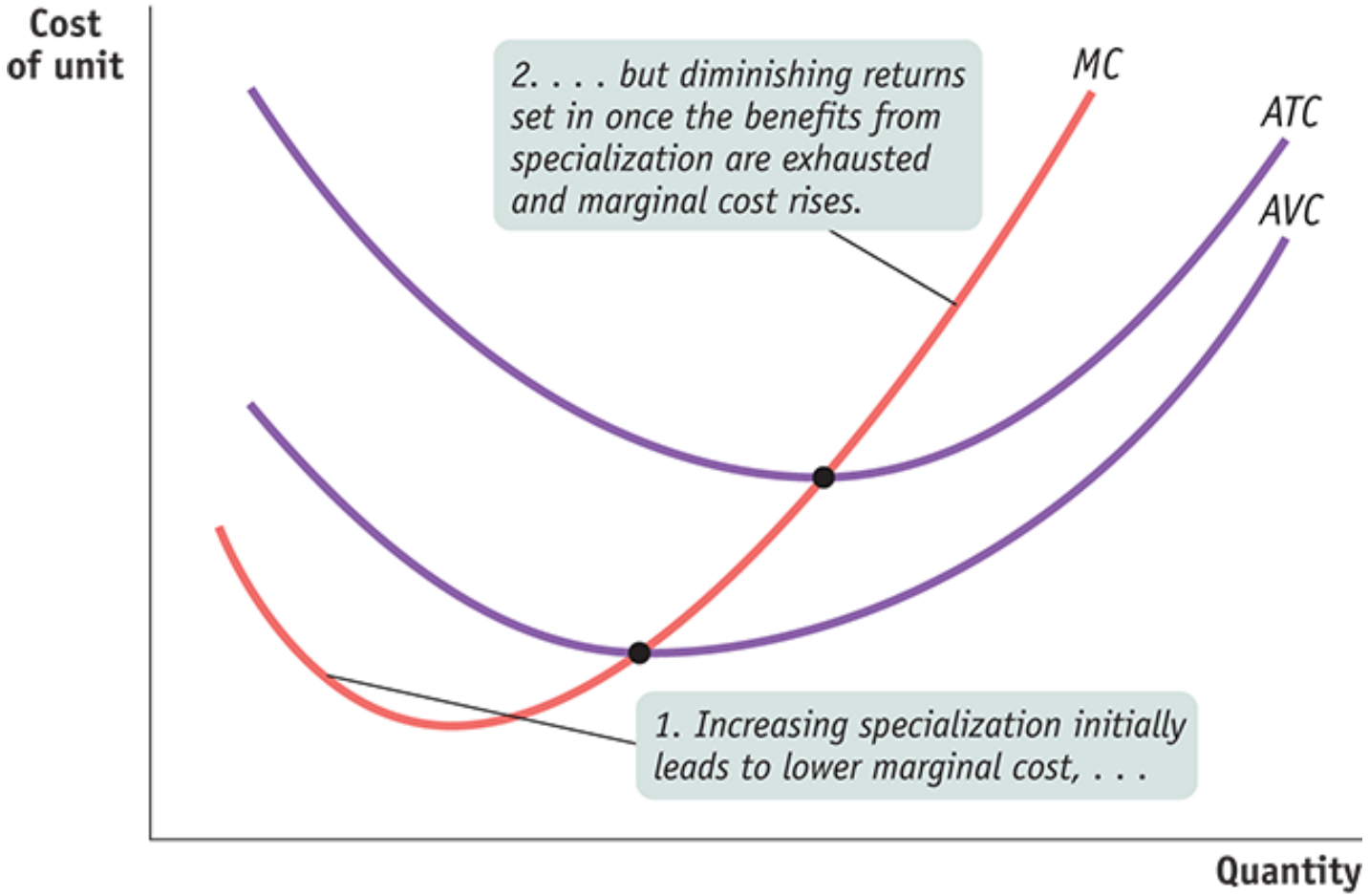


FIGURE 11-10
Krugman/Wells, *Microeconomics*, 5e, © 2018 Worth Publishers

Review of Concepts, Inputs and Costs

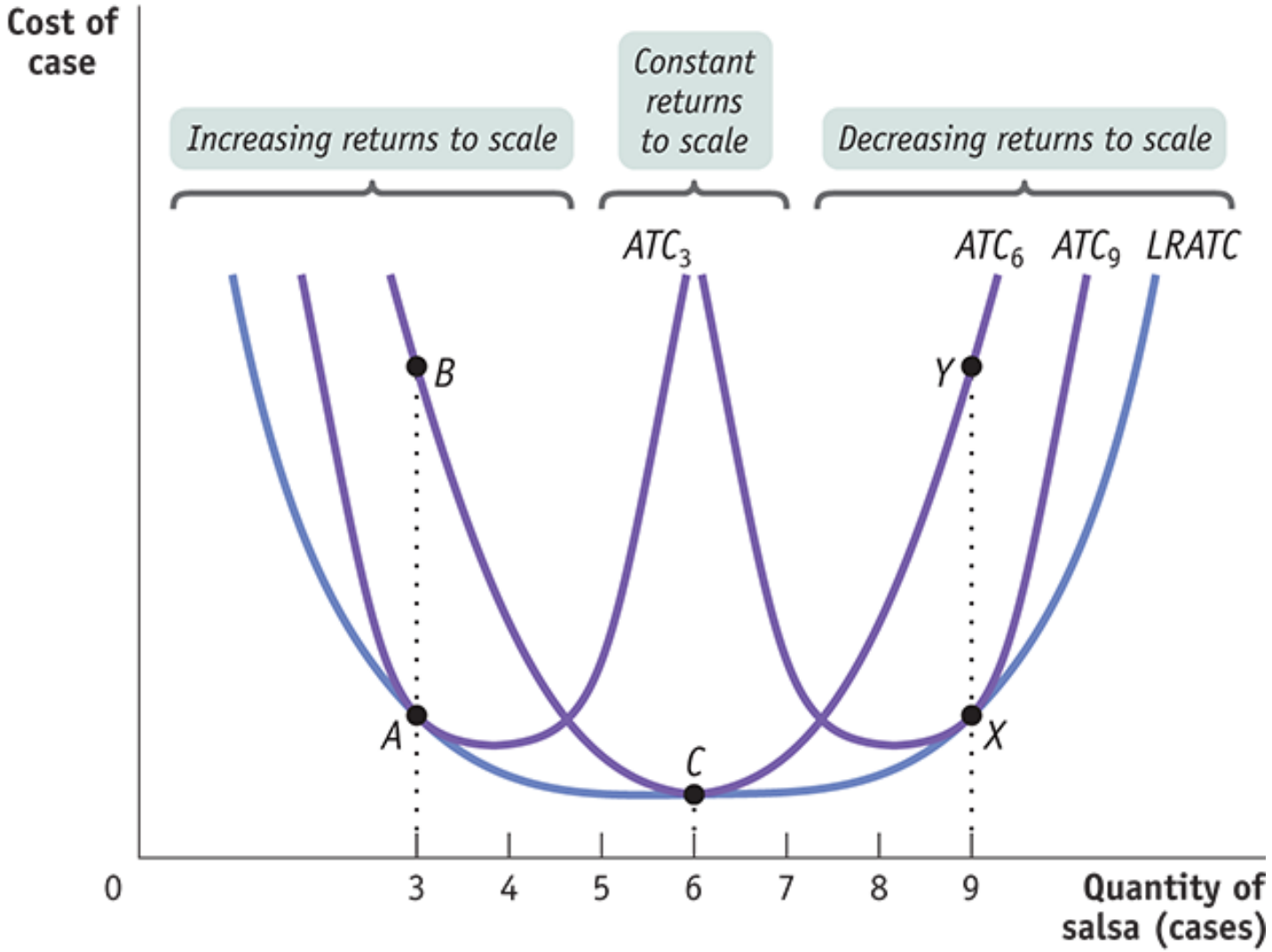


FIGURE 11-12
Krugman/Wells, *Microeconomics*, 5e, © 2018 Worth Publishers

Review of Concepts, Perfect Competition (i)

- Introduction
  - Comparison to other markets.
  - Price-taking consumers/producers.
  - Necessary conditions for perfect competition:
    - (i) Many firms, each having a small market share,
    - (ii) the industry produces a standardized product.
    - (iii) (Commonly characterized by free entry and exit, but not necessary.)
  - Horizontal demand curve for an individual firm.

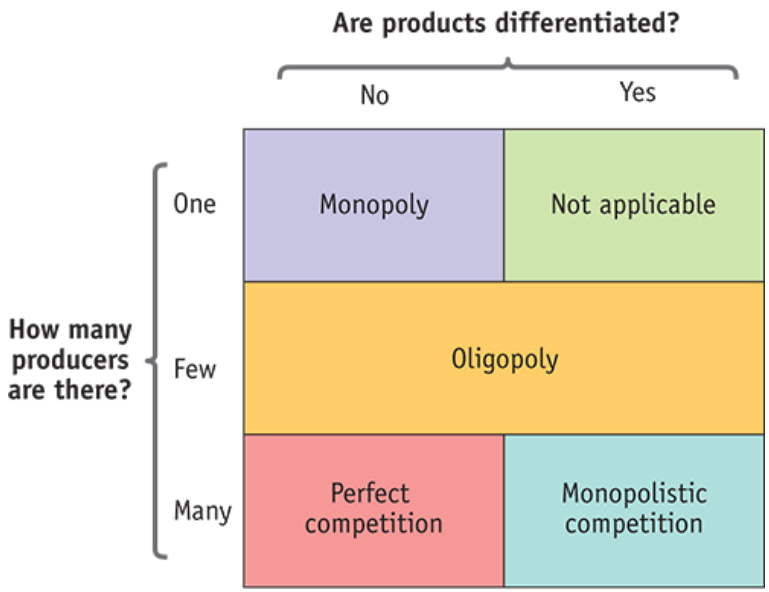


FIGURE 13-1
Krugman/Wells, *Microeconomics*, 5e, © 2018 Worth Publishers

Review of Concepts, Perfect Competition (ii)

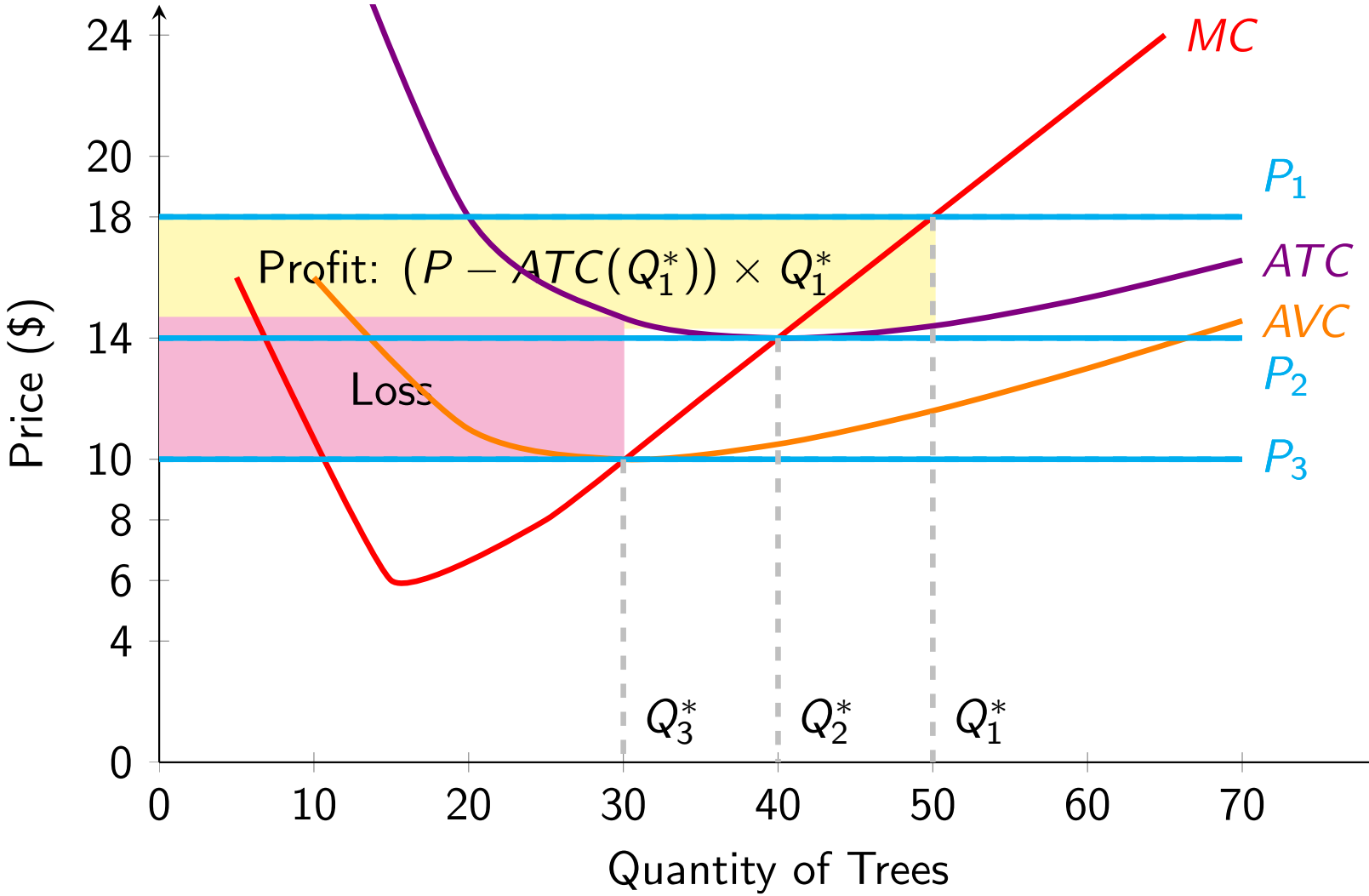
- Optimal production
  - Revenue: $R(Q) = P \times Q$
  - Marginal revenue: $MR(Q) = \frac{\Delta R(Q)}{\Delta Q} = P$, as demand is horizontal.
  - Profit: $\Pi(Q) = R(Q) - TC(Q)$
  - $\Delta\Pi(Q+1) = \Pi(Q+1) - \Pi(Q)$
    $$= (R(Q+1) - TC(Q+1)) - (R(Q) - TC(Q))$$
    $$= P - MC(Q)$$
  - If $P > MC(Q) \Rightarrow$ increase production; if $P < MC(Q) \Rightarrow$ decrease production; profit-maximizing production: $P = MC(Q)$
  - But is profit positive?
    - Note: $\Pi(Q) = R(Q) - TC(Q) = (P - ATC(Q)) \times Q$, or, equivalently
      $$= R(Q) - (FC + VC(Q)) = (P - AVC(Q)) \times Q - FC$$
    - Break-even price: If $P < \min_Q ATC(Q)$ production is not profitable in the LR.
    - Shut-down price: If $P < \min_Q AVC(Q)$ sales does not even cover variable costs. Fixed costs are owed in the SR, but losses are even greater with production.

Review of Concepts, Perfect Competition (iii)

- Supply curve
  - Short run:
    - Firm level: equal to MC curve above $\min_Q AVC(Q)$, and zero otherwise.
  - Long run:
    - Firm level: equal to MC curve above $\min_Q ATC(Q)$, and zero otherwise.
  - Market level: horizontal sum of the above.
    - However, with free entry and exit, the market supply curve shifts.
- Long-run equilirbium
  - Zero profits, given free entry/exit
  - This tells us that the LR equilibirum in a P.C. market is efficient.

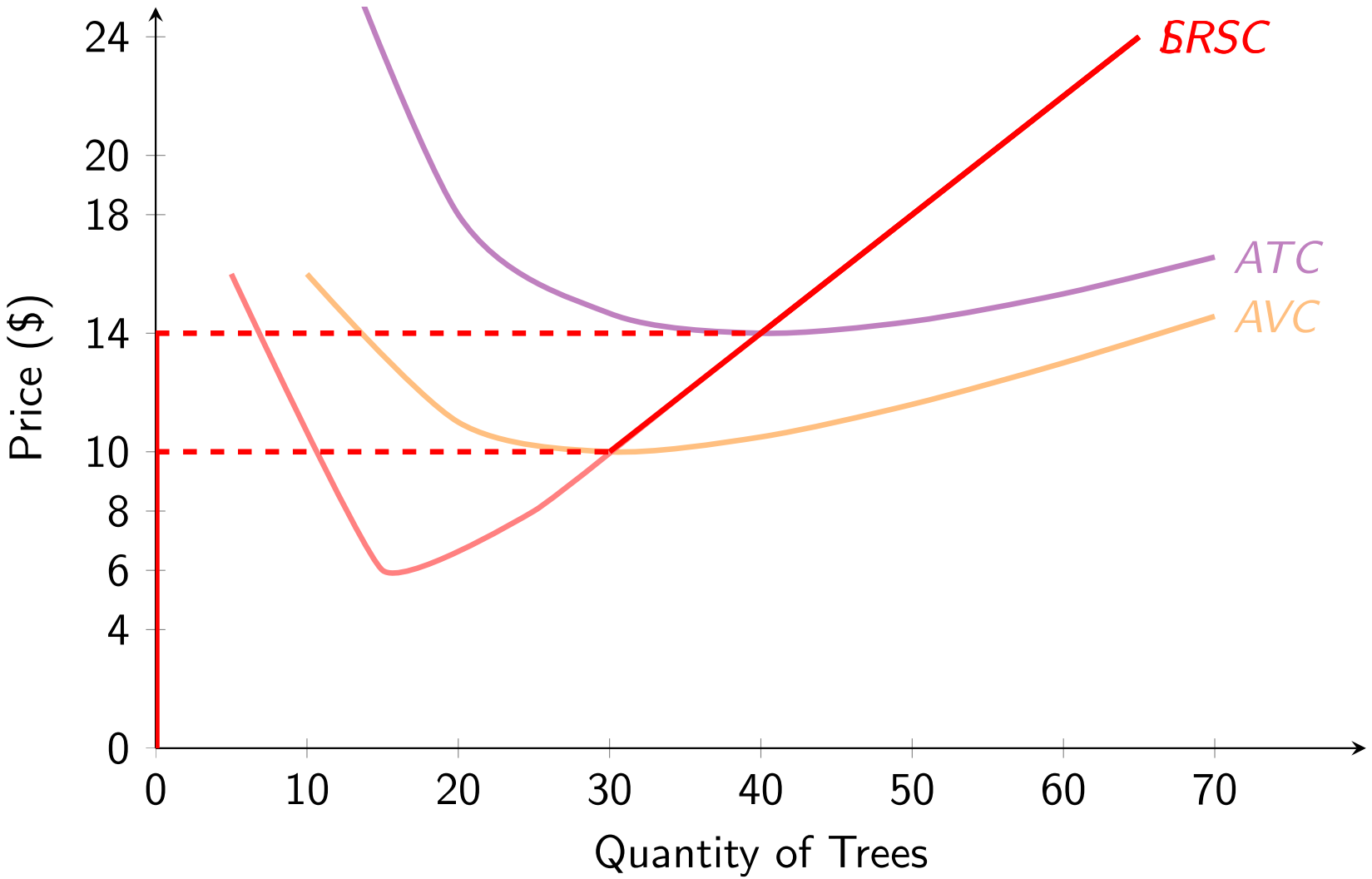
Review of Concepts, Perfect Competition (iv)

Figure 1: Profit-maximizing Production for a Christmas Tree Farm



Review of Concepts, Perfect Competition (v)

Figure 2: Profit-maximizing Production for a Christmas Tree Farm



Analytical Questions, Q1: K&W Problem 11.6

Magnificent Blooms is a florist specializing in floral arrangements for weddings, graduations, and other events. Magnificent Blooms has a fixed cost associated with space and equipment of \$100 per day. Each worker is paid \$50 per day. The daily production function for Magnificent Blooms is shown in the accompanying table.

Quantity of labor (workers)	Quantity of floral arrangements	Marginal Product of Labor ($\frac{\Delta Q}{\Delta L}$)	Variable Cost	Total Cost	Marginal Cost ($\frac{\Delta TC}{\Delta Q}$)
0	0		$0 \times 50 = 0$	100	
		$\frac{5-0}{1-0} = 5$			$\frac{150-100}{5-0} = 10$
1	5		$1 \times 50 = 50$	150	
		$\frac{9-5}{2-1} = 4$			$\frac{200-150}{9-4} = 12.5$
2	9		100	200	
		3			16.67
3	12		150	250	
		2			25
4	14		200	300	
		1			50
5	15		250	350	

Analytical Questions, Q1: K&W Problem 11.6

(a) Calculate the marginal product of each worker. What principle explains why the marginal product per worker declines as the number of workers employed increases?
MPL is the change in output resulting from the employment of one additional worker per day. MPL falls as the quantity of labor increases due to the principle of diminishing returns.

(b) Calculate the marginal cost of each level of output. What principle explains why the marginal cost per floral arrangement increases as the number of arrangements increases?
The marginal cost, MC, of floral arrangements is the change in total cost divided by the change in output. So, to compute MC, we first need to compute total cost, TC = FC + VC, as shown in the table. MC per floral arrangement is also shown in the table. MC increases as output increases due again to the principle of diminishing returns.

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Analytical Questions, Q2: K&W Problem 11.16

The accompanying table shows a car manufacturer's total cost of producing cars.

Table 1: Car Manufacturer's Cost Structure

Quantity	TC ($000s)	VC ($000s)	ATC ($000s)	AVC ($000s)	AFC ($000s)	MC ($000s)
0	500	0	-	-	-	
						40
1	540	40	540	40	500	
						20
2	560	60	280	30	250	
						10
3	570	70	190	23.3	166.7	
						20
4	590	90	147.5	22.5	125	
						30
5	620	120	124	24	100	
						40
6	660	160	110	26.7	83.3	
						60
7	720	220	103	31.4	71.4	
						80
8	800	300	100	37.5	62.5	
						120
9	920	420	102	46.7	55.6	
						180
10	1100	600	110	60	50	

Analytical Questions, Q2: K&W Problem 11.16

(a) What is this manufacturer's fixed cost?
$FC = TC(0) = \$500,000$

(b) For each level of output, calculate the variable cost (VC). For each level of output except zero output, calculate the average variable cost (AVC), average total cost (ATC), and average fixed cost (AFC). What is the minimum-cost output?

- $TC = FC + VC \Rightarrow VC = TC - FC$
- $ATC = TC/Q$; $AVC = VC/Q$; $AFC = FC/Q$
- Minimum-cost output is 8 cars, the level at which ATC is minimized at \$100.

(c) For each level of output, calculate this manufacturer's marginal cost (MC).
$MC = \Delta TC/\Delta Q$.
Notice that MC is below (conversely, above) ATC for levels of output less (greater) than the minimum-cost output.

(d) On one diagram, draw the manufacturer's AVC, ATC, and MC curves.
Next slide.

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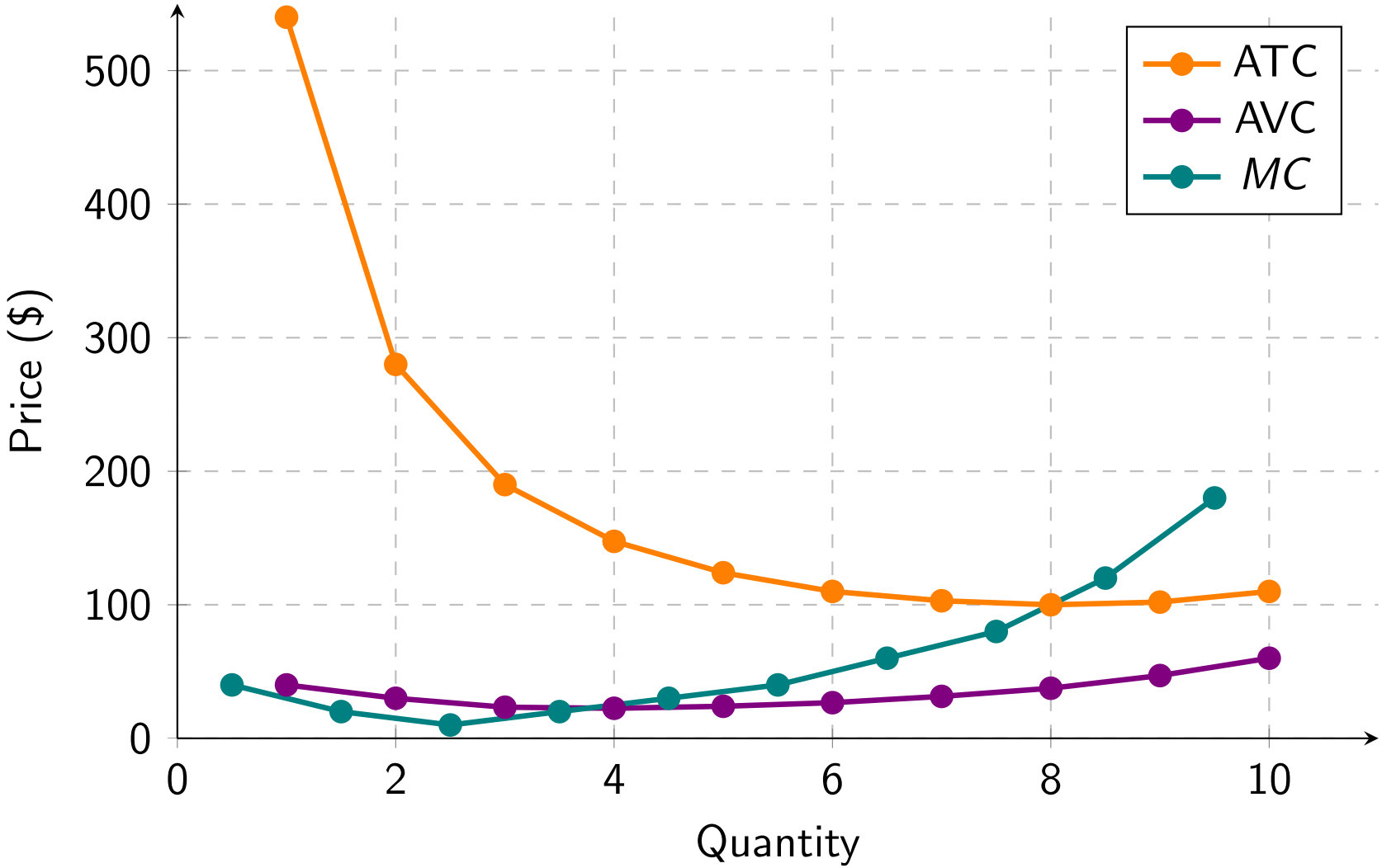
Next slide.

Analytical Questions, Q2: K&W Problem 11.16

Figure 3: Production Costs for a Car Manufacturer



Analytical Questions, Q3: K&W Problem 12.13

Kate's Catering provides catered meals, and the catered meals industry is perfectly competitive. Kate's machinery costs $100 per day and is the only fixed input. Her variable cost consists of the wages paid to the cooks and the food ingredients. The variable cost per day associated with each level of output is given in the accompanying table. The blank columns will be completed in the sub-questions below.

Table 2: Kate's Catering Cost Structure

Quantity	VC ($s)	TC ($s)	AVC ($s)	ATC ($s)	MC ($s)
0	0	100	-	-	
					20
10	200	300	20	30	
					10
20	300	400	15	20	
					18
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- $TC = FC + VC$
- $AVC = VC/Q$; $ATC = TC/Q$
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(b) What is the break-even price and quantity? What is the shut-down price and quantity?

- Kate's break-even price, the minimum average total cost, is \$19.33, at an output quantity of 30 meals.
- Kate's shut-down price, the minimum average variable cost, is \$15, at an output of 20 meals.

(c) Suppose that the price at which Kate can sell catered meals is \$21 per meal. In the short run, will Kate earn a profit? In the short run, should she produce or shut down?

When the price is \$21, Kate will make a profit: the price is above her break-even price. And since the price is above her shut-down price, Kate should produce in the short run, not shut down.

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Analytical Questions, Q3: K&W Problem 12.13

(d) Suppose that the price at which Kate can sell catered meals is \$17 per meal. In the short run, will Kate earn a profit? In the short run, should she produce or shut down?
When the price is \$17, Kate will incur a loss: the price is below her break-even price. But since the price is above her shut-down price, Kate should produce in the short run, not shut down.

(e) Suppose that the price at which Kate can sell catered meals is \$13 per meal. In the short run, will Kate earn a profit? In the short run, should she produce or shut down?
When the price is \$13, Kate would incur a loss if she were to produce: the price is below her break-even price. And since the price is also below her shutdown price, Kate should shut down in the short run.

Short-answer Questions, Q4: K&W Problem 11.8

Evaluate each of the following statements. If a statement is true, explain why; if it is false, identify the mistake and try to correct it.

(a) A decreasing marginal product tells us that marginal cost must be rising.
True. If each additional unit of the input adds less to output than the previous unit (decreasing marginal product), then in order to produce additional output, the firm needs to use increasingly more of the input.

(b) An increase in fixed cost increases the minimum-cost output.
True. As the fixed cost rises, the average fixed cost also rises; that is, the spreading effect is now larger. It is the spreading effect that causes average total cost to decline. Since this effect is now larger, it dominates the diminishing returns effect over a greater quantity of output.

(c) An increase in fixed cost increases marginal cost.
False. An increase in fixed cost does not change marginal cost. Marginal cost is the additional cost of producing an additional unit of output. Fixed cost does not change as output is increased, by definition.

(d) When marginal cost is above average total cost, average total cost must be falling.
False. When marginal cost is above average total cost, average total cost must be rising.

Short-answer Questions, Q5: K&W Problem 12.6

(a) A profit-maximizing business incurs an economic loss of $10,000 per year. Its fixed cost is $15,000 per year. Should it produce or shut down in the short run? Should it stay in the industry or exit in the long run?
In the short run, the business should produce. If it shuts down, the short-run annual loss will be $15,000, its fixed cost; but if it produces, the loss will be only $10,000. So the business minimizes its short-run loss by producing. In the long run, the business should exit the industry because it is incurring a loss.

(b) Suppose instead that this business has a fixed cost of $6,000 per year. Should it produce or shut down in the short run? Should it stay in the industry or exit in the long run?
In the short run, the business should shut down. If it shuts down, the short-run loss will be $6,000, its fixed cost; if it continues to produce, the loss will be $10,000. So the business minimizes its short-run loss by shutting down. In the long run, the firm should exit the industry because it is incurring a loss.