

AP® Microeconomics – The Nature and Function of Factor Markets

Student activity: 3.4 Combining Factor Inputs



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3.4 COMBINING FACTOR INPUTS: STUDENT LEARNING ACTIVITY

Answer the questions that follow.

1. DEFINITIONS/CONCEPTS

Define/explain the following terms and concepts:

[10 marks]

- Complements in the production process
- Demand for capital
- Demand for labor
- Derived demand
- Diminishing marginal returns to capital
- Diminishing marginal returns to labor
- Factor demand
- Factor of production
- Factor payments
- Labor market
- Labor productivity
- Marginal benefits
- Marginal costs
- Marginal factor cost of capital
- Marginal factor cost of labor
- Marginal product of capital
- Marginal product of labor
- Marginal product per dollar
- Marginal revenue product of capital
- Marginal revenue product of labor
- Maximizing profit when employing capital
- Maximizing profit when employing labor
- Monopsonist
- Monopsony
- $MPL/Wage < MPK/Rental\ rate$
- $MPL/Wage = MPK/Rental\ rate$
- $MPL/Wage > MPK/Rental\ rate$
- Productivity
- Rental rate
- Substitutes in the production process
- The cost-minimization rule
- Total product
- Value of the marginal product of capital
- Value of the marginal product of labor
- Wage rate

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2. SHORT-ANSWER QUESTIONS

1. Use examples to explain that firms use different combinations of factors of production in producing their goods and services. **[4 marks]**

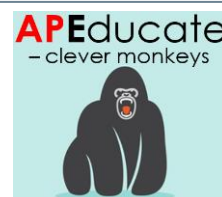
2. Use examples to distinguish between substitutes **and** complements in factor markets. **[4 marks]**

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3. Use examples to explain how the quantity and quality of capital available increases the marginal product of labor. **[4 marks]**

4. Using the concept of **marginal product of labor**, outline how capital inputs increase the demand for labor. **[4 marks]**

5. Regarding factor input combinations of labor and capital, outline the cost minimization rule. **[2 marks]**



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6. Explain why a firm's costs are minimized when they employ units of capital and labor to the point where $MPL/Wage = MPK/Rental\ rate$. **[4 marks]**

7. When combining units of capital, outline what the profit maximizing firm should do in the following situations, and justify your answer: **[4 marks]**

i. $MPL/Wage < MPK/Rental\ rate$

ii. $MPK/Rental\ rate < MPL/Wage$

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Quantity of labor (workers)	Quantity of pencils produced
0	0
1	40
2	90
3	120
4	140
5	150
6	160
7	166

8. Assume that the wage is \$10 per day and the price of pencils is \$1. Use the information in the table above to answer the following questions: **[4 marks]**

i. What is the MPL of the 4th and 5th workers?

ii. How many workers would the firm hire if it hired every worker for whom the marginal product per dollar is greater than or equal to 1 pencil per dollar?

iii. If the marginal product per dollar spent on labor is 1 pencil per dollar, the marginal product of the last unit of capital hired is 100 pencils per dollar, and the rental rate is \$50 per day, is the firm minimizing its cost?

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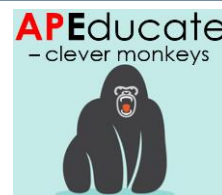
9. A consulting firm has just finished a study for a manufacturer of wine. It has determined that an additional man-hour of labor would increase wine output by 1000 gallons per day. Adding an additional machine hour of fermentation capacity would increase output by 200 gallons per day. The price of a man-hour of labor is \$10 per hour. The price of a machine-hour of fermentation capacity is \$0.25 per hour. Is there a way for the wine manufacturer to lower its total costs of production and yet keep its output constant? If so, what is it? **[4 marks]**

L	TP _L	MP _L	MP _L /W _L	K	TP _K	MP _K	MP _K /R _K
0	0	–	–	0	0	–	–
1	12	12	\$1.20	1	20	20	\$1.00
2	22	10	\$1.00	2	36	16	\$0.80
3	30	8	\$0.80	3	48	12	\$0.60
4	36	6	\$0.60	4	56	8	\$0.40
5	40	4	\$0.40	5	60	4	\$0.20

10. Given the information in the table above, and that W = \$10, R = \$20, and target output = 66 units, answer the following questions: **[4 marks]**

i. How many units of labor and capital should the firm employ?

ii. Determine the minimum cost to produce the target output of 66 units.



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11. A firm uses two inputs, capital and labor, to produce output. Its production function exhibits a diminishing marginal rate of technical substitution.

- i. If the price of capital and labor services both increase by the same percentage amount (e.g., 20 percent), what will happen to the cost-minimizing input quantities for a given output level? **[2 marks]**

- ii. If the price of capital increases by 20 percent while the price of labor increases by 10 percent, what will happen to the cost-minimizing input quantities for a given output level? **[2 marks]**

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L	TP _L	MP _L	MRP _L	MRP _L /MRC _L	K	TP _K	MP _K	MRP _K	MRP _K /MRC _K
0	0	–	–	–	0	0	–	–	–
1	12				1	22			
2	22				2	36			
3	30				3	46			
4	36				4	54			
5	40				5	58			

12. Given an output price of \$3 per unit, labor cost of \$20 per unit and capital cost of \$30 per unit, answer the following questions: **[10 marks]**

i. State the meaning of MRP_L/MRC_L .

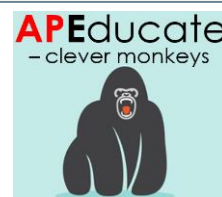
ii. State the meaning of MRP_K/MRC_K .

iii. Calculate the missing information.

iv. Determine the profit maximizing combination of resources.

v. Determine the profit maximizing output level.

vi. Determine the maximum profit that can be obtained.



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13. Acme, Inc. has just completed a study of its production process for gadgets. It uses labor and capital to produce gadgets. It has determined that 1 more unit of labor would increase output by 200 gadgets. However, an additional unit of capital would increase output by 150 gadgets. If the current price of capital is \$10 and the current price of labor is \$25, is the firm employing the optimal input bundle for its current output? Why or why not? If not, which input's usage should be increased? **[4 marks]**

14. A firm operates with a technology that is characterized by a diminishing marginal rate of technical substitution of labor for capital. It is currently producing 32 units of output using 4 units of capital and 5 units of labor. At that operating point the marginal product of labor is 4 and the marginal product of capital is 2. The rental price of a unit of capital is 2 when the wage rate is 1. Is the firm minimizing its total long-run cost of producing the 32 units of output? If so, how do you know? If not, show why not and indicate whether the firm should be using (i) more capital and less labor, or (ii) less capital and more labor to produce an output of 32. **[4 marks]**

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- ii. When a firm hires more labor and less capital, what happens to the marginal product of labor per dollar and the marginal product of capital per dollar? Explain. **[2 marks]**
