

University of Algiers 3
**Faculty of Economics,
Commercial Sciences and
Management**



Handout in Microeconomics 2

LECTURES AND EXERCISES WITH SOLUTION

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2024 -2025



Introduction:

Welcome to **the Microeconomics 2 handout**. As a continuation and complement to Handout 1, which covered the first five chapters of the course—including fundamental concepts such as supply and demand and consumer behavior—this second installment focuses on three core areas: producer behavior, cost analysis, and market structure. This resource has been thoughtfully developed to support and enhance your understanding of these intermediate microeconomic concepts. It is designed to clarify complex ideas and provide practical insights into the decision-making processes of firms and the functioning of different market environments. Whether you're a student delving deeper into microeconomics or an instructor seeking complementary teaching materials, this handout aims to serve as a reliable guide throughout this stage of your academic journey.

Objectives

This handout has two main goals: to deepen your grasp of microeconomic theory and to bridge that knowledge with real-world applications. Combining clear theoretical explanations with practical exercises, it will help you develop both a strong conceptual foundation and critical analytical skills. By exploring how economic agents operate and interact in various markets, you'll gain valuable tools for understanding and evaluating individual-level decision-making in economic contexts.

Course Overview

Throughout the remaining 15 weeks of the course, we will build upon the foundational knowledge established in the first handout. This handout introduces more advanced topics, beginning with the theory of the firm and production decisions, moving into cost structures, and concluding with an in-depth look at various market structures. Each chapter has been carefully sequenced to offer a coherent and comprehensive perspective on microeconomic analysis.

Guidance for Students and Instructors This handout is more than a learning aid—it is a partner in your pursuit of economic knowledge. For students, it offers a clear structure and supportive content to help navigate and master the material. For instructors, it serves as a versatile teaching tool, enhancing the learning experience with well-curated content and pedagogical support. Together, we aim to create a stimulating and effective academic environment where ideas are explored and understanding is deepened.



Microeconomics 2 Syllabus

1 - Course Description and Overall Objectives:

Microeconomics 2 builds upon the foundational principles introduced in **Microeconomics 1** (Handout 1), which covered the basics of economic thinking, market mechanisms, and consumer behavior. This second part of the course shifts focus to the **behavior of producers, cost structures**, and the analysis of **market forms**, offering students a deeper understanding of how firms make decisions and how different market environments affect outcomes.

The course begins by exploring how firms organize production, respond to input costs, and seek to optimize output. It then transitions into a detailed examination of **cost analysis** in both the short and long run, before culminating in a study of various **market structures** such as perfect competition, monopoly, monopolistic competition, and oligopoly.

Prerequisite(s):

Students should have a solid grasp of the basic microeconomic concepts covered in Microeconomics 1, including supply and demand analysis, elasticity, and consumer theory.

Course Objectives:

- A. Equip students with a comprehensive understanding of the economic behavior of firms and how production decisions are made.
- B. Enhance analytical skills by applying cost and market structure models to real-world situations.
- C. Provide students with tools to evaluate how firms operate under different competitive conditions and regulatory environments.



2 - Intended Learning Outcomes of the Course:

(A) Knowledge and Understanding:

1. Explain the production process and the behavior of firms in different time horizons (short run and long run).
2. Distinguish between various cost concepts and how they influence firm decisions.
3. Describe the characteristics and outcomes of different market structures.

(B) Intellectual Skills:

1. Analyze how firms make output and pricing decisions under different market conditions.
2. Compare and contrast the efficiency and welfare outcomes across various types of market structures.

(C) Professional and Practical Skills:

1. Apply theoretical models to assess real-world business behavior and market performance.
2. Interpret cost and revenue data to evaluate firm strategy.
3. Use microeconomic tools to justify firm-level decisions in competitive and non-competitive environments.

3 - Teaching and Learning Methods:

The course comprises a combination of lectures, direct reading, case studies & Problems.

Required facilities: Overhead Projector and Data Show.

Course Meeting Times:

Lecture: 2 sessions per week, 1.5 Per session, total 3 hours.

Tutorials: 1 session per week, 1.5 Per session



4 – Student Assessment Methods, Schedule and Grad in :

Assessment No.	Type	Lecture	Tutorial
1	Attendance	-	2
2	Participation/discipline	-	3
3	Test/ Homework	-	5
4	Final Examination	-	10
Total		20	20

- Attendance is expected and will be taken each class. Students are allowed to miss **1** class during the semester without penalty. Any further absences will result in point and/or grade deductions.
- Students are responsible for all missed work, regardless of the reason for absence. It is also the absentee's responsibility to get all missing notes or materials.



5 – Course Outline:

Week	Content
Week 1	General Presentation about Microeconomics 2 Syllabus and course organization
Week 2	Chapter 1: The Producer Behavior Theory Introduction 1.Definition Of Production 2.Factors of Production
Week 3	Chapter 1: The Producer Behavior Theory Production in the short run
Week 4	Chapter 1: The Producer Behavior Theory Production in the short run (cont)
Week 5	Chapter 1: The Producer Behavior Theory Production in the Long run
Week 6	Chapter 1: The Producer Behavior Theory Production in the Long run (cont)
Week 7	Chapter 2: Analysis of Costs Explicit and Implicit Costs, and Accounting and Economic Profit
Week 8	Chapter 2: Analysis of Costs The Structure of Costs in the Short Run
Week 9	Chapter 2: Analysis of Costs The Structure of Costs in the Long Run
Week 10	Chapter 3: Producer Behavior in Different Markets Introduction
Week 11	Chapter 3: Producer Behavior in Different Markets Major Market Forms
Week 12	Chapter 3: Producer Behavior in Different Markets Analyzing firms under perfect competition
Week 13	Chapter 3: Producer Behavior in Different Markets Analyzing firms under perfect competition
Week 14	General Revision
Week 15	Final Examination



6 - List of References:

(a) Course Notes:

Students are required to write their lessons and notes will be distributed to the students throughout the semester.

(b) Essential Books (Text Books):

- Michael PARKIN, Microeconomics, Pearson education, 13th edition, 2019
- Case, K., Fair, R. and Oster, S., Principles of Economics, Pearson Education, 10th Edition, 2014.

(c) Recommended Books:

- Kolstad, C.D., Microeconomics, Oxford University Press, 2nd Edition, 2010.
- Lipsey, R. and Chrystal, A., Economics, Oxford University Press, 12th Edition, 2011.
- Christopher T.S. Ragan, Ragan Microeconomics, Pearson, Canada, 2019.
- Martin Kolmar; Magnus Hoffmann, Workbook for Principles of Microeconomics, 2018.
- R Frank and E Cartwright, Microeconomics and Behaviour (2nd ed), McGraw-Hill, Springer Texts in Business and Economics, 2016.



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Chapter N° 1 : The Producer Behavior Theory

CHAPTER OBJECTIVES

In this chapter, you will learn about :

- Production in the Short Run
- Production in the Long Run

By the end of this section, you will be able to:

1. Understand the terms associated with the short-run production function—total product, average product, and marginal product—and explain and illustrate how they are related to each other.
2. Explain the concepts of increasing, diminishing, and negative marginal returns and explain the law of diminishing marginal returns.
3. Understand how long run production differs from short run production.

Introduction :

In Chapter 5 (Last semester), we explored the underlying behaviours of the consumers, and how consumers make consumption decisions based on preferences and budget constraints. Now, we will examine the underlying behaviours of individual firms in our supply Side. This chapter is the first of three chapters that explores the *theory of the Producer or firm*. This theory explains how producers (firms) behave. What does that mean? The producers theory is concerned with the behavior of firms in hiring and combining productive inputs to supply commodities at appropriate prices.



1. Definition Of Production :

Let's define what we mean by the Production.

Production is an important economic activity. It is the process (or processes) a firm uses to transform inputs (e.g. labour, capital, raw materials) into outputs, i.e. the goods or services the firm wishes to sell. This activity of **production** goes beyond manufacturing goods (i.e., making things). It includes any process or service that creates value, including transportation, distribution, wholesale and retail sales.

Example :

Consider pizza making. The pizzaiolo (pizza maker) takes flour, water, and yeast to make dough. Similarly, the pizzaiolo may take tomatoes, spices, and water to make pizza sauce. He or she rolls out the dough, brushes on the pizza sauce, and adds cheese and other toppings. The pizzaiolo uses a peel—the shovel-like wooden tool—to put the pizza into the oven to cook. Once baked, the pizza goes into a box (if it's for takeout) and the customer pays for the good.

2. Factors of Production :

Production of a commodity or service requires the use of certain resources or factors of production. Resources, which we shall call factors of production, are combined in various ways, by firms or enterprises, to produce an annual flow of goods and services.

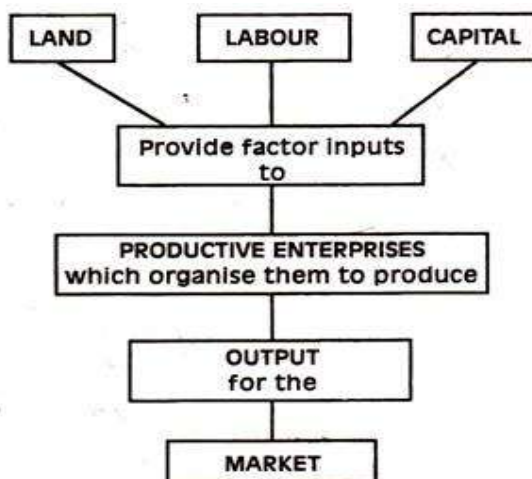


Fig. 5.1. The organisation of production



- **Natural Resources (Land and Raw Materials)** – The ingredients for the pizza are raw materials.
- **Labour** – When we talk about production, labour means human effort, both physical and mental.
- **Capital** – When economists use the term capital, they do not mean financial capital (money); rather, they mean physical capital, the machines, equipment, and buildings that one uses to produce the product. In the case of pizza, the capital includes the peel, the oven, the building, and any other necessary equipment (for example, tables and chairs).
- **Management or Entrepreneurship** – Production involves many decisions and much knowledge, even for something as simple as pizza. Who makes those decisions? Ultimately, it is the entrepreneur, the person who creates the business, whose idea it is to combine the inputs to produce the outputs.

Fixed Inputs and Variable Inputs :

Variable inputs are those that can easily be increased or decreased in a short period of time. The pizzaiolo can order more ingredients with a phone call, so ingredients would be variable inputs. The owner could hire a new person to work the counter pretty quickly as well. So labour is a variable input.

Fixed inputs are those that can't easily be increased or decreased in a short period of time. In the pizza example, the building is a fixed input. Once the entrepreneur signs the lease, he or she is stuck in the building until the lease expires. Fixed inputs define the firm's maximum output capacity.

Economists also differentiate between short and long-run production.

The **short-run** is the period of time during which at least one or more factors of production are fixed. During the period of the restaurant lease, the pizza restaurant is operating in the short run, because it is limited to using the current building (an example of capital) —the owner can't choose a larger or smaller building. Plant size or capital is a fixed factor of production in the short run.

The **long run** is the period of time during which all factors are variable. Once the lease expires for the restaurant, the shop owner can move to a larger or smaller place.



1. Production in the short run :

In microeconomics, the short-run production period examines scenarios where at least one factor of production remains fixed. Note that we have introduced some new languages in the above example.

Expressing Production :

We can summarize the idea of production so far in terms of a **production function**, a mathematical relation that explains the relationship between inputs and outputs.

We call Output (Q) as **Total Product (TP)**. TP is the amount of output produced with a given amount of labour and a fixed amount of capital.

Production function :

A production function is a mathematical relationship that expresses the maximum quantity of output that can be obtained from a given set of inputs, often within a specific time frame.

Assuming labour (L) is main input used in the production, we can write the production function as :

$$Q = f(L)$$

Production Schedule :

A production schedule in microeconomics represents the relationship between the quantities of input factors (such as labour and capital) and the corresponding total output of a good or service. It is commonly associated with the short run, where at least one factor of production is fixed.

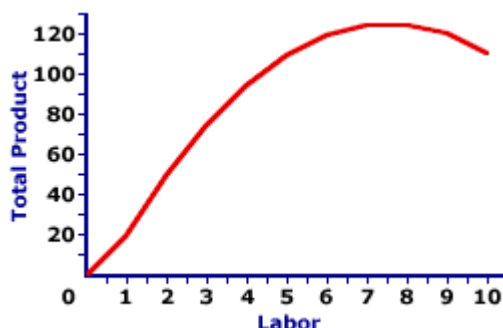
For example, a production schedule might look like this:

Factors of Production		Total Product
L	K	
0	6	0
1	6	50
2	6	120
3	6	180
4	6	220



Production Curve :

The production curve, specifically the Total Product (TP) curve, is a graphical representation of the relationship between the quantity of a variable input (usually labour) and the resulting total output. In the short run, where at least one factor of production is fixed, the Total Product curve illustrates how the total output changes as the variable input is increased.



The Average Product of Labour (APL) :

The Average Product of Labour (APL) is a measure in economics that represents the average output produced by each unit of labour employed in the production process. It is calculated by dividing the total output (product) by the quantity of labour input. Mathematically, the Average Product of Labour (APL) is expressed as :

$$APL = \frac{TP}{L} = \frac{Q}{L}$$

The Marginal Product of Labour (MPL) : Marginal product is the additional output of one more worker. Mathematically, Marginal Product is the change in total product divided by the change in labour :

$$MP_L = \frac{\Delta TP}{\Delta L} = \frac{\Delta Q}{\Delta L} \quad or \quad MP_L = \frac{\partial Q}{\partial L}$$

In other words, it is derivative of the production function for a specific productive factor (labour).



Example :

Let's explore production in the short run using a specific example: offering haircuts in a salon.

Since capital (the salon space) is fixed, the amount of Total Product (TP) (haircuts per day) depends only on the amount of labour employed (e.g. number of barbers working). We can express this production function numerically as the table below shows.

Labour (L) Number of barbers	Total Product (TP) Number of haircuts per day (TP)	Marginal Product of labour (MPL)	Average Product of Labour (APL)
0	0	-	-
1	8	8	8
2	17	9	8.5
3	24	7	8
4	27	3	6.75
5	28	1	5.6

We can note that increasing one factor leads to an increase in total output at a decreasing rate (decreasing marginal product of labour). This is called the **Law of Diminishing Marginal Return** and it's a characteristic of production in the short run.

The Law of Diminishing Marginal Return :

The Law of Diminishing Marginal Return is a fundamental concept in economics that states that as the quantity of one input (e.g., labour) is increased while keeping other inputs constant, the marginal product of that input will eventually decrease. In other words, the additional output or contribution to production from each additional unit of the variable input will diminish.

To enhance comprehension of the connection between total product and different production factors within the short-run production function, consider the following example of bag production in a factory. In this scenario, various production factors are deemed fixed, with the exception of the labour element,

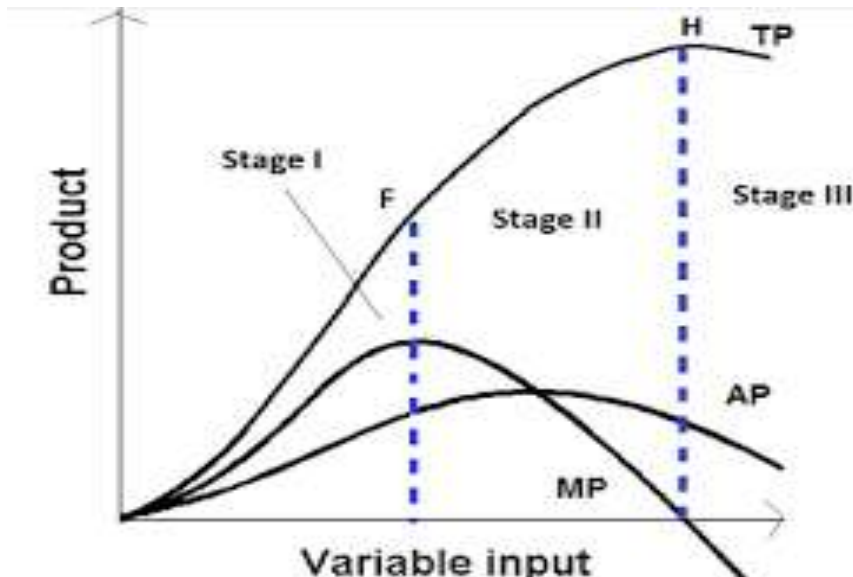


which is variable. The table below illustrates the varying levels of labour input and the resulting total production, offering insights into the dynamics of short-run production for bag manufacturing.

L	TP	MPL	(APL	Production Stage
0	0	0	0	Increasing Marginal Returns
1	15	15	15	
2	34	19	17	
3	60	26	20	
4	80	20	20	Diminishing Marginal Returns
5	95	15	19	
6	108	13	18	
7	112	4	16	
8	112	0	14	Negative Marginal Returns
9	99	-13	10	

Here are some key characteristics of the Total Product curve:

- 1. Increasing Marginal Returns:** Initially, as more units of the variable input are added to the fixed input(s), the total product increases at an increasing rate. This is often referred to as the stage of increasing marginal returns.
- 2. Diminishing Marginal Returns:** After a certain point, the total product may continue to increase but at a diminishing rate. This is known as the stage of diminishing marginal returns. The law of diminishing marginal returns states that, in the short run, successive increases in a variable input will eventually lead to smaller and smaller increases in total output.
- 3. Negative Marginal Returns:** In some cases, if the variable input is increased beyond a certain point, the total product may start to decline. This is known as the stage of negative marginal returns.



The producer point of equilibrium (maximum production) is when the TP (Point H) reaches its peak (the highest possible output), which corresponds to the end of the second stage when the marginal product of labour is zero.

2. Production in the Long run :

In the long run, all factors (including capital) are variable, inputs used in the production process can be varied or adjusted by a firm. This includes inputs such as labor, capital, technology, and raw materials. so our production function is $Q=f[L,K]$.

Consider a secretarial firm that does typing for hire using typists for labor and personal computers for capital. To start, the firm has just enough business for one typist and one PC to keep busy for a day. Say that's five documents. Now suppose the firm receives a rush order from a good customer for 10 documents tomorrow. Ideally, the firm would like to use two typists and two PCs to produce twice their normal output of five documents. However, in the short turn, the firm has fixed capital, i.e. only one PC. The table below shows the situation:

Labor (# Typists)	1	2	3	4	5	6	
Total Product (Letters/hr)	5	7	8	8	8	8	For K = 1 PC
Marginal Product	5	2	1	0	0	0	
Short Run Production Function for Typing							



In the short run, the only variable factor is labor so the only way the firm can produce more output is by hiring additional workers. What could the second worker do? What can they contribute to the firm? Perhaps they can answer the phone, which is a major impediment to completing the typing assignment. What about a third worker? Perhaps he or she could bring coffee to the first two workers. You can see both total product and marginal product for the firm above. Now here's something to think about: at what point (e.g. after how many workers) does diminishing marginal productivity kick in, and more importantly, why?

In this example, marginal productivity starts to decline after the second worker. This is because capital is fixed at one PC. The production process for typing works best when each worker is combined with one PC. If you add more than one typist, you get seriously diminishing marginal productivity.

Now consider the long run. Suppose the firm's demand increases to 15 documents per day. What might the firm do to operate more efficiently? If demand has tripled, the firm could acquire two more PCs, which would give us a new short run production function as Table 2 below shows.

Labor (# Typists)	1	2	3	4	5	5	
Total Product (Letters/hr)	5	6	8	8	8	8	For K = 1 PC
Marginal Product	5	2	1	0	0	0	
Total Product (Letters/hr)	5	10	15	17	18	18	For K = 3 PC
Marginal Product	5	5	5	2	1	0	
Long Run Production Function for Typing							

With more capital, the firm can hire three workers before diminishing productivity comes into effect. More generally, because all factors are variable, the long run production function shows the most efficient way of producing any level of output.

Law of returns to scale

The Law of Returns to Scale describes the relationship between changes in all input quantities (like labor, capital, and resources) and the resulting change in output in the long run. In simpler terms, it examines how increasing all your production factors affects your overall production level., and it takes three cases :



1) **increasing returns to scale:** This means that the percentage of increase in total production is greater than the percentage of increase in the quantities of production factors used.

2) **constant return to scale:** This means that the percentage of increase in total production is equal to the percentage of increase in the quantities of production factors used.

3) **diminishing returns to scale:** If the quantities of factors of production increase by a certain percentage, total production increases by a smaller percentage.

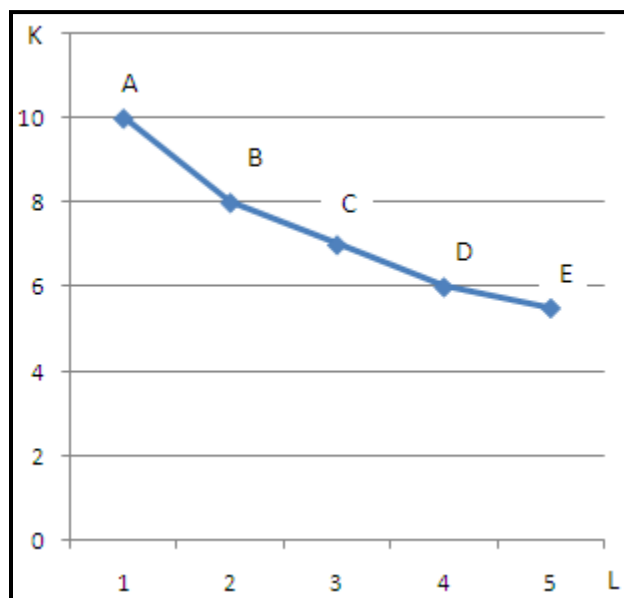
Isoquants: Equal Output Curves

Isoquants are curves on a graph that depict all the different combinations of two inputs (typically labor and capital) that produce the same level of output.

Example

The following table shows the different combinations of the two factors of production, labor L and capital K, to produce the same quantity of good x.

Combinations	TP	L	K
A	200	1	10
B	200	2	8
C	200	3	7
D	200	4	6
E	200	5	5,5



Assumptions :

- Isoquants assume a constant level of output, meaning each curve represents a specific quantity of output, and any point on the curve yields the same output level.

Characteristics :

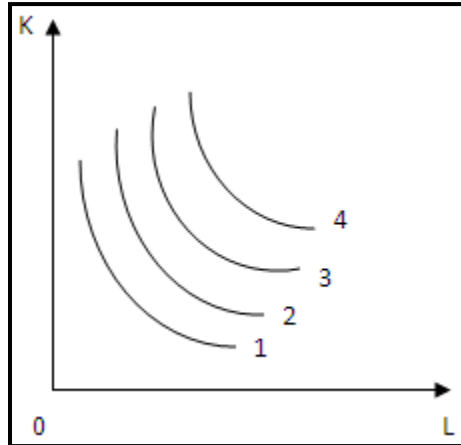
- Isoquants slope downward from left to right, indicating the trade-off between inputs. As one input increases, the other must decrease to maintain the same output level.

Convex Shape :

- Isoquants are typically convex to the origin. This curvature reflects the diminishing marginal rate of technical substitution, meaning that as one input is substituted for another, the marginal rate of substitution decreases.

Isoquant Map :

- A collection of isoquants for various output levels creates an isoquant map. This map provides a comprehensive view of the different input combinations available to produce varying levels of output.



Marginal Rate of Technical Substitution (MRTS) :

The slope of an isoquant, known as the MRTS, represents the rate at which one input can be replaced by another while keeping output constant. Understanding MRTS is crucial for firms in making input substitution decisions.

$$MRTS_{L,K} = \left| \frac{\Delta K}{\Delta L} \right| = \frac{MP_L}{MP_K} = \frac{P_L}{P_K}$$

Referring to the previous example, find the marginal rate of technical substitution of labor for capital when moving from point A to point B.

$$MRTS_{L,K} = \left| \frac{\Delta K}{\Delta L} \right|$$

$$MRTS_{L,K} = \left| \frac{8 - 10}{2 - 1} \right| = 2$$

Certainly! Isocost lines are a crucial concept in microeconomics, particularly in the context of cost minimization and the optimal combination of inputs. Here's an explanation of isocost lines:

Isocost Lines:

- An isocost line represents all the combinations of inputs (usually labor and capital) that result in the same total cost for a firm. In other words, it shows the different input combinations that a firm can choose from, while still incurring the same overall cost of production.

- The equation of an isocost line is typically expressed as : $TC = LP_L + KP_K$



where:

- TC is the total cost of production,
- (L) is the quantity of labor - P_L is the wage rate (cost of labor per unit),
- (K) is the quantity of capital. - P_K is the rental rate of capital (cost of capital per unit),

Characteristics:

- Isocost lines are straight lines on a graph, reflecting the linear relationship between the quantities of labor and capital that can be hired at different cost levels.
- Each isocost line represents a specific total cost, and as you move along the line, the combination of labor and capital changes while maintaining the same overall cost.

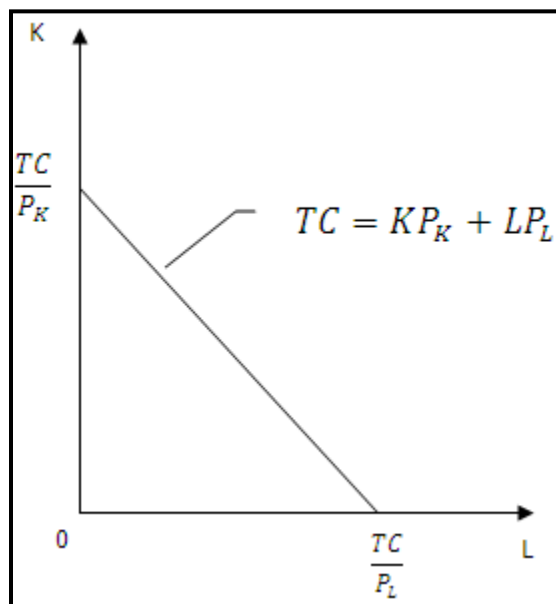
Graphical Representation:

- On a graph where the x-axis represents the quantity of labor (L) and the y-axis represents the quantity of capital (K), each isocost line shows the combinations of labor and capital that result in the same total cost.

$$\begin{aligned} \text{When } K = 0 &\Leftarrow TC = LP_L \Leftarrow L = \frac{TC}{P_L} \\ \text{when } L = 0 &\Leftarrow TC = KP_K \Leftarrow K = \frac{TC}{P_K} \end{aligned}$$

Slope of Isocost Line:

- The slope of an isocost line is given by : $\frac{TC/P_K}{TC/P_L} = \frac{P_L}{P_K}$





Shifts in Isocost Lines :

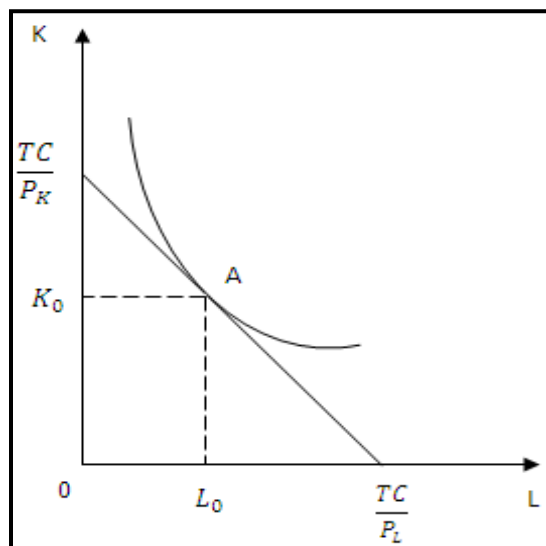
- Changes in input prices (w and r) or technological advancements can lead to shifts in the position of the isocost lines. An increase in input prices will make the isocost lines steeper, while a decrease will make them flatter.

Understanding isocost lines is essential for firms as they navigate production decisions, allowing them to find the most cost-effective combination of inputs for a given level of output. It's a key concept in cost minimization theory within microeconomics.

Optimal Input Combination : Producer equilibrium

Producer equilibrium is achieved when a firm optimally combines inputs to minimize the cost of producing a given level of output. The graphical representation involves the concept of an isocost line and its tangent point with an isoquant.

- Firms aim to minimize their costs while producing a given level of output. The optimal input combination occurs where the isocost line is tangent to an isoquant (a curve representing the same level of output). This point signifies the least-cost way to produce a specific quantity of output.





Let's break down the steps mathematically:

Slope of Isocost Line = Slope of Isoquante

$$MRTS_{L,K} = \frac{P_L}{P_K} = \frac{MP_L}{MP_K}$$

Producer equilibrium, which is the maximization of production under a given cost level constraint, is determined in the case of a production function or schedule by meeting two conditions:

First condition:

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$

Second condition:

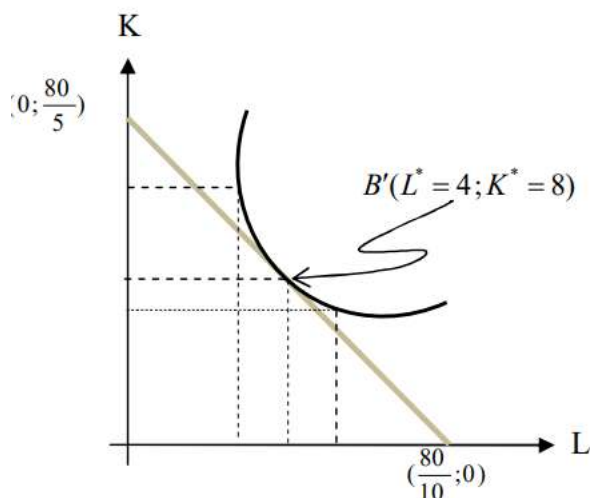
The condition Isocost Line is met: $TC = LP_L + KP_K$

Example N°1 :

Combinations	L	K	MRTS
A	3	10	/
B	4	8	2
C	5	6,3	1.7

$$TC = 80 \quad P_L = 10 \quad P_K = 5 \quad 80 = 10L + 5K$$

$$MRTS_{L,K} = \frac{P_L}{P_K} = \frac{MP_L}{MP_K} = 2 \quad L = 4 \text{ and } K = 8$$



Example N°2 : $Q_X = (l)(k)$

$$TC = 200 \quad P_L = 4 \quad P_K = 2 \quad 200 = 4L + 2K$$

First condition:

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$

$$MP_L = \frac{\epsilon Q_X}{\epsilon L} = \frac{\epsilon L \cdot K}{\epsilon L} = K \quad MP_K = \frac{\epsilon Q_X}{\epsilon K} = \frac{\epsilon L \cdot K}{\epsilon K} = L$$

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K} \Rightarrow \frac{k}{4} = \frac{L}{2} \Rightarrow 2K = 4L \Rightarrow K = 2L \dots\dots\dots(1)$$

Second condition:

The condition Isocost Line is met: $200 = 4L + 2K$

$$2K = 200 - 4L \Rightarrow K = 100 - 2L \dots\dots\dots(2)$$

$$\circ = (2) \Rightarrow 2L = 100 - 2L \Rightarrow 4L = 100 \Rightarrow L = 25$$

So, $K = 50$

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K} = \frac{50}{4} = \frac{25}{2} = 12.5$$

$$200 = 4L + 2K \Rightarrow 200 = 4 \times 25 + 2 \times 50 = 200$$

**Case Study : Cobb-Douglas Production Function :**

The Cobb-Douglas production function is a widely used mathematical model in economics to describe the relationship between inputs (typically labor and capital) and output in a production process. The Cobb-Douglas function takes a specific form, known for its simplicity and flexibility in capturing various aspects of production. The general form of the Cobb-Douglas production function is:

$$Q = f(K, L) = AL^\alpha K^\beta$$

Where: $0 < A$, $0 < \alpha < 1$, $0 < \beta < 1$

- Q is the level of output.
- A is a positive constant representing total factor productivity.
- L is the quantity of labor.
- K is the quantity of capital.
- α and β are positive constants representing the output elasticity of labor and capital, respectively.

$$\alpha = E_L = \frac{\% \Delta Q}{\% \Delta L} = \frac{\partial Q}{\partial L} \times \frac{L}{Q} = A \alpha L^{\alpha-1} K^\beta \frac{L}{Q} = \alpha \frac{Q}{Q}$$

$$\beta = E_K = \frac{\% \Delta Q}{\% \Delta K} = \frac{\partial Q}{\partial K} \times \frac{K}{Q} = A L^\alpha \beta K^{\beta-1} \frac{K}{Q} = \beta \frac{Q}{Q}$$

Example N°2 : $Q = 50L^{\frac{1}{3}}K^{\frac{2}{3}}$

$$TC = 72 \quad P_L = 4 \quad P_K = 6 \quad 72 = 4L + 6K$$

First condition:

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$

$$\frac{MP_L}{P_L} = \frac{50K^{\frac{2}{3}}}{12L^{\frac{2}{3}}} \quad \frac{MP_K}{P_K} = \frac{100L^{\frac{1}{3}}}{18K^{\frac{1}{3}}}$$

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K} \Rightarrow \frac{50K^{\frac{2}{3}}}{12L^{\frac{2}{3}}} = \frac{100L^{\frac{1}{3}}}{18K^{\frac{1}{3}}} \Rightarrow 1200L = 900K \Rightarrow L = 0.75K \dots\dots\dots(1)$$



Second condition:

The condition Isocost Line is met: $72 = 4L + 6K$

$$4L = 72 - 6K \Rightarrow L = 18 - 1.5K \dots\dots\dots(2)$$

$$(1) = (2) \Rightarrow 0.75K = 18 - 1.5K \Rightarrow 2.25K = 18 \Rightarrow K = 8$$

$$\text{So, } L = 6$$

$$72 = 4 \times 6 + 6 \times 8 \Rightarrow 72 = 72$$

Example N°3: $Q = 10L^{\frac{1}{2}}K^{\frac{1}{2}}$

$$TC = 400 \quad P_L = 100 \quad P_K = 200 \quad 400 = 100L + 200K$$

First condition:

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$

$$\frac{MP_L}{P_L} = \frac{K^{\frac{1}{2}}}{20L^{\frac{1}{2}}} \quad \frac{MP_K}{P_K} = \frac{L^{\frac{1}{2}}}{40K^{\frac{1}{2}}}$$

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K} \Rightarrow \frac{K^{\frac{1}{2}}}{20L^{\frac{1}{2}}} = \frac{L^{\frac{1}{2}}}{40K^{\frac{1}{2}}} \Rightarrow 40K = 20L \Rightarrow L = 2K \dots\dots\dots(1)$$

Second condition:

The condition Isocost Line is met: $500 = 100L + 200K$

$$100L = 500 - 200K \Rightarrow L = 5 - 2K \dots\dots\dots(2)$$

$$(1) = (2) \Rightarrow 2K = 5 - 2K \Rightarrow 4K = 5 \Rightarrow K = 1.25$$

$$\text{So, } L = 2.5$$

$$500 = 100 \times 2.5 + 200 \times 1.25 \Rightarrow 500 = 500$$



Series of Exercises No. 1 in Microeconomics 2 - Tutorials

Exercise °1: choose the correct answer

1. In a production function, what does the term "total product" refer to?
 - a) The output per unit of input
 - b) The sum of all variable inputs
 - c) The total output produced from all inputs
 - d) The profit generated by the production process
2. Which of the following is a fixed factor of production?
 - a) Raw materials
 - b) Labor
 - c) Capital
 - d) Energy
3. Which of the following is a characteristic of the short run-in production?
 - a) All factors of production are variable
 - b) All factors of production are fixed
 - c) At least one factor of production is fixed
 - d) The production function is constant
4. What does the Average Product of Labor (APL) represent in short-run production?
 - a) Total output divided by total labor input
 - b) Marginal product of labor at a specific point
 - c) Total labor input divided by total output
 - d) Average output per unit of labor input
5. The Law of Diminishing Marginal Returns states that as a firm increases the quantity of a variable input in the short run, what happens to the marginal returns?
 - a) They remain constant
 - b) They increase indefinitely
 - c) They initially increase but eventually decrease
 - d) They decrease and never recover
6. In the short run, at least one factor of production is fixed. Which of the following is typically considered a fixed factor?
 - a) Labor
 - b) Capital
 - c) Raw materials
 - d) Technology



Exercise °2: True or false (and correct it if false)

1. In the short run, all factors of production are variable.
2. The Average Product of Labor (APL) is calculated by dividing total output by the quantity of labor input.
3. The Marginal Product of Labor (MPL) is calculated as the change in total product divided by the change in the quantity of labor.
4. The Law of Diminishing Marginal Returns suggests that marginal returns will continually increase as more of a variable input is added.
5. The short run is a time period during which all factors of production can be adjusted.
6. The law of diminishing marginal returns implies that each additional unit of a variable input contributes less to total output than the previous unit.
7. Producer equilibrium in the short run is achieved when APL equals MPL.
8. The Total Product (TP) curve in short-run production has a constant upward slope.

Exercise °3 : complete it with appropriate answer

In a bakery operating in the short run, the ovens and baking space are considered _____, as expanding or reducing these elements involves significant time and resources. Following the law of diminishing marginal returns, when additional bakers are hired to work on the existing fixed baking infrastructure, the marginal returns in terms of the number of loaves of bread initially _____. However, with limited oven capacity and workspace, the marginal returns eventually _____ (peak/decline) as the operation becomes constrained. Calculating the Average Product of Labor (APL) involves dividing the total number of loaves produced by the _____. As the bakery reaches producer equilibrium, it finds the optimal balance when the _____ and _____.

Exercise ° 4:

Answer the following questions by determine the stage of Production

Imagine you're planting tomatoes. At first, as you add more fertilizer, the number of tomatoes you harvest increases significantly. What stage of production does this represent ?	
As you continue to add more of fertilizer, how does the increase in TP change ?	
What happens if you keep adding input beyond the point of maximum marginal return ?	



Exercise °5

To cultivate potatoes (Q), the utilization of the land factor (T) is imperative, which is confined to an estimated area of 5 hectares. Additionally, the labor factor (L) is essential for the cultivation process. Consequently, the overall change in production can be presented in the following table:

T	5	5	5	5	5	5	5	5	5
L	0	1	2	3	4	5	6	7	8
TP	0	3	8	18	22	25	27	28	28

- Which factor are variable and which one are fixed
- Calculate the marginal product MPL and average product APL
- Graphically represent both TP, MPL, APL.
- Label when TP is Max, MPL= APL and MPL =0 and determine the stages of production.
- When does the law of diminishing returns appear?
- What does it mean to have positive, negative, and zero marginal product?

Exercise °6

Suppose the short-period production function takes the following form: $Q = -L^2 + 10LK$

- Calculate the marginal product MPL and average product APL if he uses one unit of capital (K=1)
- Determine the equilibrium point of the producer if he uses one unit of capital (K=1)
- Graphically represent both TP, MPL, APL determine the stage of production

Exercise °7

In the long run, all inputs, including _____ and _____, are considered variable. The production function in the long run illustrates the relationship between inputs and the maximum _____ that a firm can produce. Isoquants represent various combinations of inputs that yield the same _____ of output. The slope of an isoquant at any point in the long run represents the _____ between labor and capital. An _____ illustrates various combinations of inputs that a producer can choose to produce a given output at the minimum cost. In producer equilibrium, the producer selects the combination of inputs where the _____ equals the _____.



Exercise °8

- Draw the isoquant curve for the following combinations of labor and capital:
- $(L, K) = (4, 8), (5, 6), (6, 3), (7, 1, 5)$
- Find the marginal rate of technical substitution of labor for capital **MRTS** for each combination.
- Assuming that the isocost line equation is defined as follows: $80 = 10L + 5K$
- What is the wage that the worker receives for his contribution to production?
- Draw the the isocost line curve and find the producer equilibrium points graphically and mathematically;

Exercise °9

We have the following production function: $f(k, L) = k^2 - kl + 2l^2$

What is the organization's optimal production if: $TC = 100$ $P_L = 4$ $P_K = 2$

Exercise °10

A textile company produces shirts using two inputs: labor (L) and capital (K), represented by sewing machines. Their production function is given by: $Q = 50L^{\frac{1}{3}}K^{\frac{2}{3}}$

Assume the wage rate for labor is \$4 per hour and the rental cost of a sewing machine is \$6 per day, and total cost is 72\$

What is the organization's optimal production

Exercise °11

A bakery produces bread using two inputs: flour (F) and labor (L). The bakery's production function is given by: $Q = 8L^{\frac{1}{2}}F^{\frac{1}{2}}$

Assume the bakery faces a price of \$2 per kg of flour and \$5 per hour of labor and total cost 100\$

What is the organization's optimal production



Solution of Series of Exercises No. 1 in Microeconomics 2 - Tutorials

Exercise °1: choose the correct answer

7. In a production function, what does the term "total product" refer to?
- a) The output per unit of input
 - b) The sum of all variable inputs
 - c) The total output produced from all inputs
 - d) The profit generated by the production process
8. Which of the following is a fixed factor of production?
- a) Raw materials
 - b) Labor
 - c) Capital
 - d) Energy
9. Which of the following is a characteristic of the short run-in production?
- a) All factors of production are variable
 - b) All factors of production are fixed
 - c) At least one factor of production is fixed
 - d) The production function is constant
10. What does the Average Product of Labor (APL) represent in short-run production?
- a) Total output divided by total labor input
 - b) Marginal product of labor at a specific point
 - c) Total labor input divided by total output
 - d) Average output per unit of labor input
11. The Law of Diminishing Marginal Returns states that as a firm increases the quantity of a variable input in the short run, what happens to the marginal returns?
- a) They remain constant
 - b) They increase indefinitely
 - c) They initially increase but eventually decrease
 - d) They decrease and never recover
12. In the short run, at least one factor of production is fixed. Which of the following is typically considered a fixed factor?
- a) Labor
 - b) Capital
 - c) Raw materials
 - d) Technology



Exercise °2: True or false (and correct it if false)

9. The Average Product of Labor (APL) is calculated by dividing total output by the quantity of labor input. **True**
10. The Marginal Product of Labor (MPL) is calculated as the change in total product divided by the change in the quantity of labor. **True**
11. The Law of Diminishing Marginal Returns suggests that marginal returns will continually increase as more of a variable input is added. **False**
The law states that marginal returns will initially increase but eventually decrease.
12. The short run is a time period during which all factors of production can be adjusted. **False**
13. **In the short run, at least one factor of production is fixed**
14. In the short run, all factors of production are variable. **False**
In the short run, at least one factor of production is fixed
15. The law of diminishing marginal returns implies that each additional unit of a variable input contributes less to total output than the previous unit. **True**
16. Producer equilibrium in the short run is achieved when APL equals MPL. **False**
Producer equilibrium in the short run is achieved when TP is MAX and MPL=0
The Total Product (TP) curve in short-run production has a constant upward slope. **False**
The TP curve may increase initially but will eventually flatten and may even decline.

Exercise °3

In a bakery operating in the short run, the ovens and baking space are considered (**fixed**). Following the law of diminishing marginal returns, when additional bakers are hired to work on the existing fixed baking infrastructure, the marginal returns in terms of the number of breads initially (**increase**). However, with limited oven capacity and workspace, the marginal returns eventually (**decline**) as the operation becomes constrained. Calculating the Average Product of Labor (APL) involves dividing the total production of loaves by the (**number of bakers**). As the bakery reaches producer equilibrium, it finds the optimal balance when the (**total bread production is max or peaked and MP of bakers is zero**).

Exercise ° 4: answer the following questions:

Imagine you're planting tomatoes. At first, as you add more fertilizer, the number of tomatoes you harvest increases significantly. What stage of production does this represent?	This is the increasing marginal returns stage . Adding more fertilizer (the input) leads to a larger increase in tomato harvest (the output).
As you continue to add more of fertilizer fertilizer, how does the increase in TP change?	The output increases at a decreasing rate , Diminishing Marginal Returns stage
What happens if you keep adding input beyond the point of maximum marginal return ?	The output will actually start to decrease. This is causing congestion, inefficiency, or even damage to existing resources. Negative Marginal Returns stage

Exercise °5

1. Variable and Fixed Factors

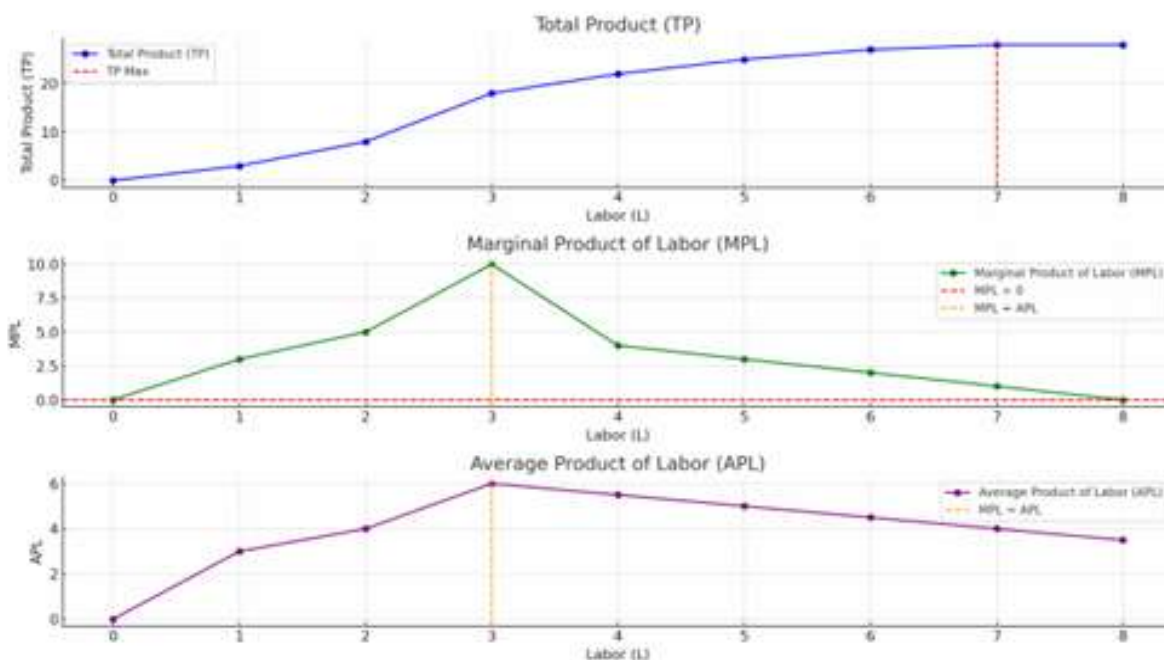
- **Fixed Factor:** Land (T), as it remains constant at 5 hectares throughout the production process.
- **Variable Factor:** Labor (L), as it varies from 0 to 8 workers.

2. Marginal Product (MPL) and Average Product (APL)

T	5	5	5	5	5	5	5	5	5
L	0	1	2	3	4	5	6	7	8
TP	0	3	8	18	22	25	27	28	28
MPL	0	3	5	10	4	3	2	1	0
APL	0	3	4	6	5.5	5	4.5	4	3.5

3. Graphical Representation

- **Total Product (TP):** The blue line in the first graph represents the total product.
- **MPL:** The green line in the second graph represents the marginal product of labor.
- **APL:** The purple line in the third graph represents the average product of labor.



4. Key Points on the Graphs

- **When TP is Maximum:** At L = 7, TP reaches its maximum (28 units).
- **When MPL = APL:** At L = 3, MPL and APL are both 6.0.
- **When MPL = 0:** At L = 8, MPL becomes zero, indicating that additional labor does not increase output.



Stages of Production

- **Stage I:** From $L = 0$ to $L = 3$, where $MPL > APL$ and both are increasing.
- **Stage II:** From $L = 3$ to $L = 7$, where $MPL > 0$ but decreasing, and TP is still increasing.
- **Stage III:** From $L = 7$ to $L = 8$, where $MPL < 0$, and TP is constant, indicating negative returns.

5. Law of Diminishing Returns

The law of diminishing returns appears after $L = 3$ when MPL starts to decline, even though additional labor is being added.

7. Interpretation of Marginal Product

- **Positive MPL:** Indicates that additional labor increases output.
- **Negative MPL:** Indicates that additional labor reduces total output.
- **Zero MPL:** Indicates that additional labor does not change the total output, meaning maximum production capacity has been reached.

Exercise °6

Production Function and Setup

Given the short-period production function: $Q = -L^2 + 10L$

When $K=1$, the production function simplifies to: $Q = -L^2 + 10L$

1. Calculate the Marginal Product (MPL) and Average Product (APL)

Marginal Product of Labor (MPL): The derivative of Q with respect to L : $MPL = \frac{dQ}{dL} = -2L + 10$

Average Product of Labor (APL): The total product divided by the number of labor units L .

$$APL = \frac{dQ}{L} = \frac{-L^2 + 10L}{L} = -L + 10$$

3. Determine the Equilibrium Point

The equilibrium point occurs where the Marginal Product (MPL) is equal to zero, indicating that adding more labor does not increase output.

$$\text{Set } MPL=0: -2L+10=0 \quad 2L=10 \quad L=5$$

4. Graphically Represent TP, MPL, and APL and Determine the Stage of Production

Now, let's calculate the TP, MPL, and APL values for different values of L and plot the graphs (make



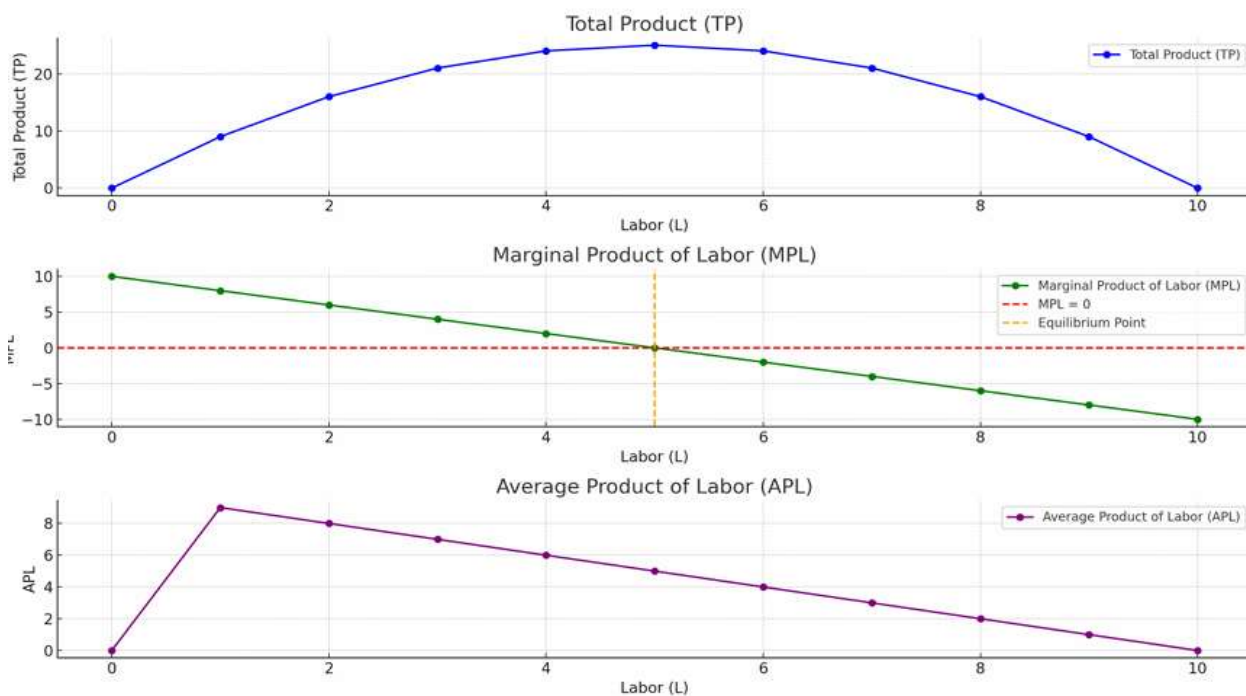
a Schedule). The equilibrium point, where $MPL = 0$, occurs at:

- $L=5$

Total Product (TP) at equilibrium: $TP=25$

- **Average Product (APL) at equilibrium: $APL=5$**

Labor (L)	Total Product (TP)	MPL	APL
0	0	10	0
1	9	8	9
2	16	6	8
3	21	4	7
4	24	2	6
5	25	0	5
6	24	-2	4
7	21	-4	3
8	16	-6	2
9	9	-8	1
10	0	-10	0



Graphical Representation



- Total Product (TP): The first graph shows the relationship between labor and total product, peaking at $L=5$.
- Marginal Product of Labor (MPL): The second graph shows the decline in MPL, reaching zero at $L=5$, and becoming negative afterward.
- Average Product of Labor (APL): The third graph shows the linear decrease in APL as labor increases.

Stages of Production

- **Stage I:** From $L=0$ and $L=5$, where MPL is positive and declining.
- **Stage II:** Beyond $L=5$, where MPL becomes negative, indicating diminishing returns.

Interpretation

- **Positive MPL:** Indicates increasing production with additional labor.
- **Zero MPL:** Occurs at the equilibrium point ($L=5$), where maximum production is reached.
- **Negative MPL:** Indicates that adding more labor reduces total output, signaling the start of Stage II.

Exercise °7

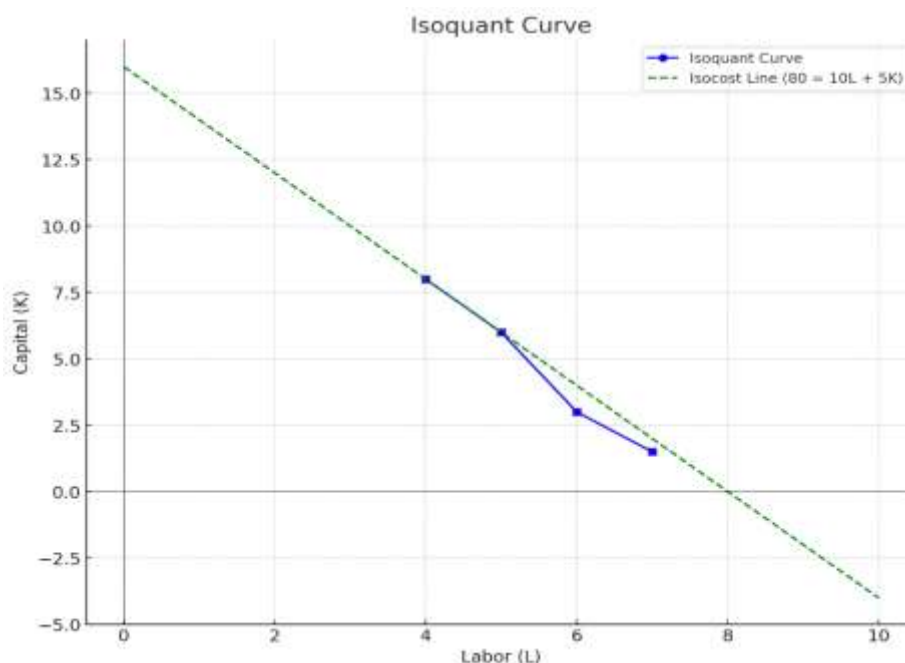
In the long run, all inputs, including capital and labor, are considered variable. The production function in the long run illustrates the relationship between inputs and the maximum output that a firm can produce. Isoquants represent various combinations of inputs that yield the same level of output. The slope of an isoquant at any point in the long run represents the Marginal Rate of Technical Substitution (MRTS) between labor and capital. An isocost illustrates various combinations of inputs that a producer can choose to produce a given output at the minimum cost. In producer equilibrium, the producer selects the combination of inputs where the MRTS equal the ratio of input prices (or input price ratio)

**Exercise °8****1. Drawing th isoquant curve**

The isoquant curve, plotted using the given combinations of labor (L) and capital (K), is shown in the graph above. The red dots represent the specific combinations.

2. Marginal Rate of Technical Substitution (MRTS) : $MRTS = \frac{\Delta K}{\Delta L}$ (in Absolute Value)

L	K	MRST
4	8	-
5	6	2
6	3	3
7	1.5	1.5

**3. Isocost Line and Wage Rate**

The isocost line equation is given as: $80 = 10L + 5K$ it means Total cost = 80 \$ Wage : $P_L = 10$ \$ and $P_K = 5$ \$

Wage rate (w): The coefficient of L in the isocost equation is 10, indicating that the wage rate is \$10 per unit of labor.



4. Equilibrium Point

Graphically the equilibrium point is where the isoquant curve touches the isocost line, indicating the most cost-effective combination of labor and capital for the given budget.

Let's now calculate this equilibrium point mathematically:

$$MRTS = \frac{\Delta K}{\Delta L} = \frac{PL}{PK} = \frac{10}{5} = 2$$

The producer equilibrium is the combination of $L = 5$ and $K = 6$ units, where the firm maximizes its output subject to the cost constraint, with the MRTS equal to the ratio of input prices.

$$80 = 10(5) + 5(6) = 80 \text{ Confirmed}$$

Exercise °9

We are given the production function: $f(k, L) = k^2 - kl + 2l^2$

under the following conditions: $TC = 100$ $P_L = 4$ $P_K = 2$

Step 1: Express the Cost Constraint

The total cost (TC) is given by the sum of the costs of labor and capital: $TC = PL \cdot L + PK \cdot k$

Substituting the given values: $100 = 4L + 2k$ We can simplify this equation by dividing by 2:

$$50 = 2L + k$$

This simplifies to: $k = 50 - 2L$

Step 2: Substitute the Cost Constraint into the Production Function

We substitute $k = 50 - 2L$ into the production function: $f(k, L) = (50 - 2L)^2 - (50 - 2L)L + 2L^2$

$$f(L) = 2500 - 200L + 4L^2 - 50L + 2L^2 = 6L^2 - 250L + 2500$$

Step 4: Find the Optimal Labor Input (L)

To maximize the production function, take the derivative of $f(L)$ with respect to L and set it to zero:

$$f(L)' = 12L - 250 = 0 \quad \text{Solving for } L: \quad 12L = 250 \quad : L \approx 20.83$$

Step 5: Find the Corresponding Capital Input (k) : Now substitute $L = 20.83$

back into the cost constraint equation to find k : $k = 50 - 2(20.83) \approx 50 - 41.67 \approx 8.33$

$$50 = 2(20.83) + (8.33) \approx 49.99 \approx 50 \text{ Confirmed}$$

Exercise °10

We are given the production function: $Q = 50L^{\frac{1}{3}}K^{\frac{2}{3}}$

The total cost is given as \$72, with the cost of labor (PL) being \$4 per hour and the cost of capital (PK) being \$6 per day.



The cost constraint is: $72=4L+6K$

Step 1: Marginal Product of Labor (MPL) and Marginal Product of Capital (MPK)

The Marginal Product of Labor (MPL) is the partial derivative of Q with respect to L:

$$MPL = \frac{\partial Q}{\partial L} = 50 \times \frac{1}{3} L^{-\frac{2}{3}} K^{\frac{2}{3}} = \frac{50}{3} L^{-\frac{2}{3}} K^{\frac{2}{3}}$$

The Marginal Product of Capital (MPK) is the partial derivative of Q with respect to K:

$$MPK = \frac{\partial Q}{\partial K} = 50 \times \frac{2}{3} L^{\frac{1}{3}} K^{-\frac{1}{3}} = \frac{100}{3} L^{\frac{1}{3}} K^{-\frac{1}{3}}$$

Step 2: Set Up the Cost-Minimization Condition

To minimize the cost for a given level of production, the ratio of the marginal products should be

equal to the ratio of input prices: $\frac{MPL}{MPK} = \frac{PL}{PK} = \frac{\frac{50}{3} L^{-\frac{2}{3}} K^{\frac{2}{3}}}{\frac{100}{3} L^{\frac{1}{3}} K^{-\frac{1}{3}}} = \frac{4}{6} = \frac{2}{3}$

Simplifying: $\frac{L^{-\frac{2}{3}} K^{\frac{2}{3}}}{L^{\frac{1}{3}} K^{-\frac{1}{3}}} = \frac{2}{3}$ Simplifying further: $\frac{k^{\frac{1}{3}} K^{\frac{2}{3}}}{2 L^{\frac{1}{3}} L^{\frac{2}{3}}} = \frac{2}{3} : \frac{k}{2l} = \frac{2}{3}$

This tells us that the optimal ratio of capital to labor should be: $K = \frac{4}{3} L$

Step 3: Substitute K into the Cost Constraint : Substitute $K = \frac{4}{3} L$ into the cost constraint:

$$72=4L+6K : 72=4L+6\left(\frac{4}{3}L\right) = 72=4L+8L = 12L = 72 : L = \frac{72}{12} = 6$$

Step 4: Find the Corresponding Capital Input K

Now, substitute $L=6$ back into the equation $K = \frac{4}{3} L$: $K = \frac{4}{3} (6) = \frac{24}{3} = 8$

$$72=4(6) + 6(8) = 24+48 = 72 \text{ Confirmed}$$

Step 5: Calculate the Optimal Production Level

Finally, substitute $L=6$ and $K=8$ back into the production function:

$$Q = 50 L^{\frac{1}{3}} K^{\frac{2}{3}} = 50 6^{\frac{1}{3}} 8^{\frac{2}{3}} = 363.42 \text{ units of shirts}$$

**Exercise °11**

We are given the production function: $Q = 8L^{\frac{1}{2}}F^{\frac{1}{2}}$

The total cost is \$100, with the price of flour (PF) being \$2 per kg and the price of labor (PL) being \$5 per hour. The cost constraint is: $100 = 5L + 2F$

Step 1: Marginal Product of Labor (MPL) and Marginal Product of Capital (MPK)

The Marginal Product of Labor (MPL) is the partial derivative of Q with respect to L:

$$MPL = \frac{\partial Q}{\partial L} = 8 \times \frac{1}{2} L^{-\frac{1}{2}} F^{\frac{1}{2}} = 4 L^{-\frac{1}{2}} F^{\frac{1}{2}}$$

The Marginal Product of Capital (MPF) is the partial derivative of Q with respect to F:

$$MPF = \frac{\partial Q}{\partial F} = 8 \times \frac{1}{2} L^{\frac{1}{2}} F^{-\frac{1}{2}} = 4 L^{\frac{1}{2}} F^{-\frac{1}{2}}$$

Step 2: Set Up the Cost-Minimization Condition

To minimize the cost for a given level of production, the ratio of the marginal products should be

equal to the ratio of input prices: $\frac{MPL}{MPF} = \frac{PL}{PF} = \frac{4 L^{-\frac{1}{2}} F^{\frac{1}{2}}}{4 L^{\frac{1}{2}} F^{-\frac{1}{2}}} = \frac{5}{2}$

Simplifying: $\frac{F^{\frac{1}{2}} F^{\frac{1}{2}}}{L^{\frac{1}{2}} L^{\frac{1}{2}}} = \frac{5}{2}$ Simplifying further: $\frac{F}{L} = \frac{5}{2}$

This tells us that the optimal ratio of capital to labor should be: $F = \frac{5}{2} L$

Step 3: Substitute F into the Cost Constraint: Substitute $F = \frac{5}{2} L$ into the cost constraint:

$$100 = 5L + 2F: 100 = 5L + 2\left(\frac{5}{2}L\right) = 5L + 5L = 10L = 100: L = \frac{100}{10} = 10$$

Step 4: Find the Corresponding Input F

Now, substitute $L=10$ back into the equation $F = \frac{5}{2} L$: $F = \frac{5}{2} (10) = \frac{50}{2} = 25$

$$100 = 5(10) + 2(25) = 50 + 50 = 100 \quad \text{Confirmed}$$

Step 5: Calculate the Optimal Production Level :

Finally, substitute $L=10$ and $K=25$ back into the production function:

$$Q = 8L^{\frac{1}{2}}F^{\frac{1}{2}} = 8 (10)^{\frac{1}{2}} (25)^{\frac{1}{2}} = 126.49 \text{ units of loaves}$$



Chapter N° 2 : Analysis of Costs

CHAPTER OBJECTIVES

In this chapter, you will learn about :

- Explicit and Implicit Costs, and Accounting and Economic Profit
- The structure of costs in the short run
- The structure of costs in the long run

By the end of this section, you will be able to:

- Analyze short-run costs as influenced by total cost, fixed cost, variable cost, marginal cost, and average cost.
- Calculate average profit
- Evaluate patterns of costs to determine potential profit
- Calculate total cost
- Identify economies of scale, diseconomies of scale, and constant returns to scale
- Interpret graphs of long-run average cost curves and short-run average cost curves
- Analyze cost and production in the long run and short run

Introduction :

In this lesson, we explore the essential concepts of costs analysis including Explicit and Implicit Costs, along with Accounting and Economic Profit.

Moving on, we will explore the short-run cost structure which is dissected into fixed and variable costs. Fixed costs remain constant, while variable costs fluctuate with production. Understanding this dynamic is crucial for optimizing short-term resource allocation.

In the long run, all costs become variable, allowing firms to adjust production levels and operational scale. This flexibility introduces complexity, shaping strategic planning for long-term sustainability. This lesson serves as a foundation for understanding how cost analysis influences economic decisions, guiding businesses towards efficiency and profitability in the microeconomic realm.



1. Explicit and Implicit Costs, and Accounting and Economic Profit :

We can distinguish between two types of cost: explicit and implicit.

Explicit costs are out-of-pocket costs, that is, payments that are actually made. Wages that a firm pays its employees or rent that a firm pays for its office are explicit costs.

Implicit costs are more subtle, but just as important. They represent the **opportunity cost** of using resources already owned by the firm. Often for small businesses, they are resources contributed by the owners; for example, working in the business while not getting a formal salary, or using the ground floor of a home as a retail store. Implicit costs also allow for depreciation of goods, materials, and equipment that are necessary for a company to operate.

These two definitions of cost are important for distinguishing between two conceptions of profit, accounting profit and economic profit.

Accounting profit is a cash concept. It means total revenue minus explicit costs—the difference between dollars brought in and dollars paid out.

Economic profit is total revenue minus total cost, including both explicit and implicit costs. The difference is important because even though a business pays income taxes based on its accounting profit, whether or not it is economically successful depends on its economic profit.

2.The Structure of Costs in the Short Run

When a firm looks at its **total costs** of production in the short run, a useful starting point is to divide total costs into two categories: fixed costs that cannot be changed in the short run and variable costs that can be changed.

Fixed and Variable Costs

Fixed costs (FC) are expenditures that do not change regardless of the level of production, at least not in the short term. Whether you produce a lot or a little, the fixed costs are the same. One example is the rent on a factory or a retail space. Once you sign the lease, the rent is the same regardless of how much you produce, at least until the lease runs out. Fixed costs can take many other forms: for example, the cost of machinery or equipment to produce the product, research and development costs to develop new products, even. The level of fixed costs varies according to the specific line of business : for instance, manufacturing computer chips requires an expensive factory, but a local moving and hauling business can get by with almost no fixed costs at all if it rents trucks by the day when needed.

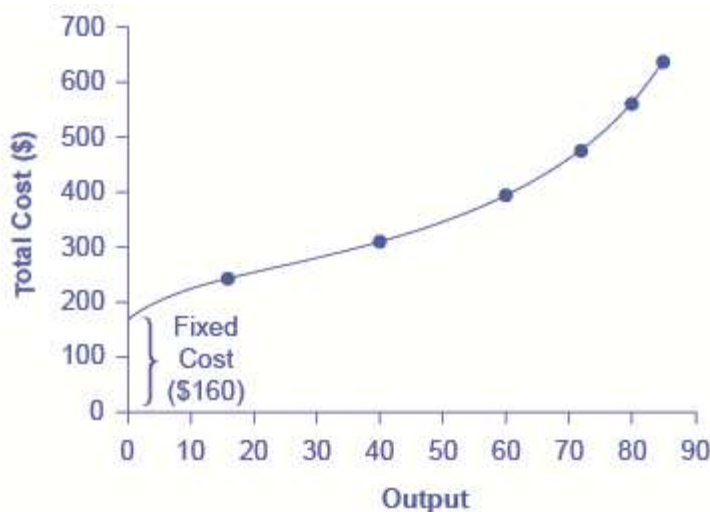


Variable costs (VC), on the other hand, are incurred in the act of producing—the more you produce, the greater the variable cost. Labor is treated as a variable cost, since producing a greater quantity of a good or service typically requires more workers or more work hours. Variable costs would also include raw materials.

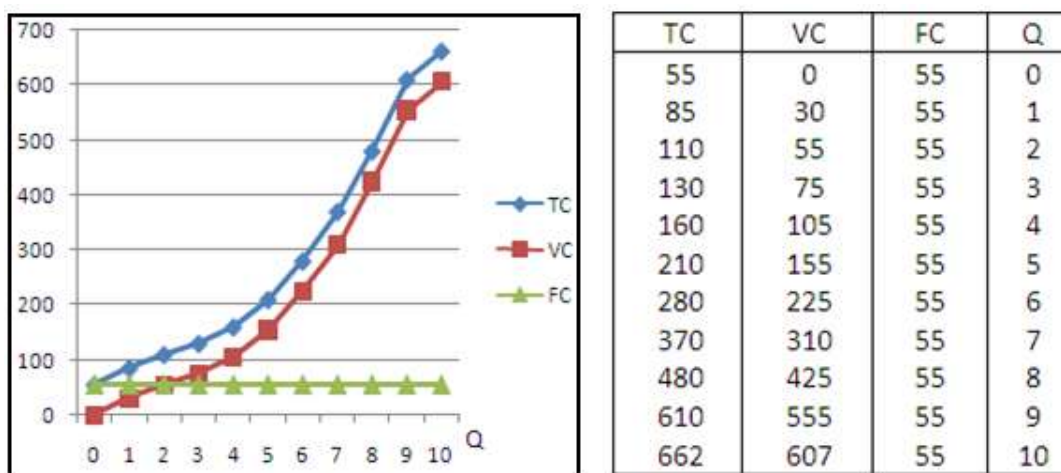
As a concrete example of fixed and variable costs, consider the barber shop called “The Clip Joint” shown in [Figure 1](#). The data for output and costs are shown in [Table 1](#). The fixed costs of operating the barber shop, including the space and equipment, are \$160 per day. The variable costs are the costs of hiring barbers, which in our example is \$80 per barber each day. The first two columns of the table show the quantity of haircuts the barbershop can produce as it hires additional barbers. The third column shows the fixed costs, which do not change regardless of the level of production. The fourth column shows the variable costs at each level of output. These are calculated by taking the amount of labor hired and multiplying by the wage. For example, two barbers cost: $2 \times \$80 = \160 . Adding together the fixed costs in the third column and the variable costs in the fourth column produces the total costs in the fifth column. So, for example, with two barbers the total cost is: $\$160 + \$160 = \$320$.

Labor	Quantity	Fixed Cost	Variable Cost	Total Cost
1	16	\$160	\$80	\$240
2	40	\$160	\$160	\$320
3	60	\$160	\$240	\$400
4	72	\$160	\$320	\$480
5	80	\$160	\$400	\$560
6	84	\$160	\$480	\$640
7	82	\$160	\$560	\$720
Table 1. Output and Total Costs				

$$\text{Total cost : } TC = FC + VC$$



To study the shape of the fixed, variable and total cost curves, we take an example, where we draw the curves of the various types of costs in the corresponding figure:



From the graphic curve it is clear that:

- o The fixed costs curve is parallel to the horizontal axis because they are independent of the volume of production and are constant at all levels of production.
- o The variable costs curve starts from the origin because variable costs are related to the volume of production.
- o The total costs curve takes the same behavior as the variable costs curve, as it rises above it by a fixed amount that represents the amount of fixed costs at all levels of production.

**Average Variable Cost , Average Fixed Cost ,Average Total Cost, & Marginal Cost :**

The breakdown of total costs into fixed and variable costs can provide a basis for other insights as well. The first five columns of Table 2 duplicate the previous table, but the last three columns show average total costs, average variable costs, and marginal costs. These new measures analyze costs on a per-unit (rather than a total) basis and are reflected in the curves shown in [Figure 2](#).

Labor	Quantity	Fixed Cost	Variable Cost	Total Cost	Marginal Cost	Average Variable Cost	Average Fixed Cost	Average Total Cost
1	16	\$160	\$80	\$240	\$5.00	\$5.00	\$10.00	\$15.00
2	40	\$160	\$160	\$320	\$3.30	\$4.00	\$4.00	\$8.00
3	60	\$160	\$240	\$400	\$4.00	\$4.00	\$2.66	\$6.60
4	72	\$160	\$320	\$480	\$6.60	\$4.44	\$2.22	\$6.60
5	80	\$160	\$400	\$560	\$10.00	\$5.00	\$2.00	\$7.00
6	84	\$160	\$480	\$640	\$20.00	\$5.71	\$1.90	\$7.60
Table 3. Different Types of Costs								

Average variable cost (AVC) : obtained when variable cost is divided by quantity of output.

$$AVC = \frac{VC}{Q}$$

For example, the variable cost of producing 80 haircuts is \$400, so the average variable cost is \$400/80, or \$5 per haircut.

Average fixed cost (AFC): It is the share of fixed costs per unit produced and takes the following formula:

$$AFC = \frac{FC}{Q}$$



Average total cost (ATC) : (sometimes referred to simply as average cost) is total cost divided by the quantity of output.

$$ATC = \frac{TC}{Q} = \frac{FC + VC}{Q} = AFC + AVC$$

Since the total cost of producing 40 haircuts is \$320, the average total cost for producing each of 40 haircuts is \$320/40, or \$8 per haircut.

Average total and variable costs measure the average costs of producing some quantity of output.

Marginal cost (MC) : is the additional cost of producing one more unit of output. So it is not the cost per unit of *all* units being produced, but only the next one (or next few). Marginal cost can be calculated by taking the change in total cost and dividing it by the change in quantity.

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta(FC + VC)}{\Delta Q} = \frac{\Delta FC}{\Delta Q} + \frac{\Delta VC}{\Delta Q}$$

$$\Delta FC = 0 \quad \text{so,} \quad MC = \frac{\Delta VC}{\Delta Q}$$

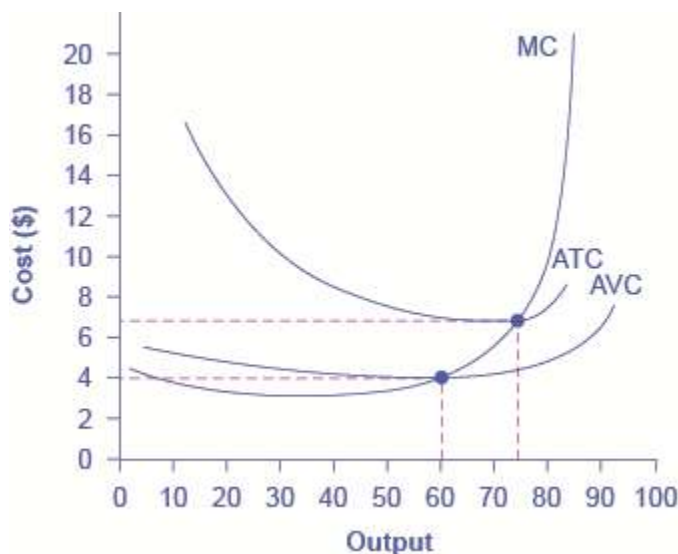
For example, as quantity produced increases from 40 to 60 haircuts, total costs rise by 400 – 320, or 80. Thus, the marginal cost for each of those marginal 20 units will be 80/20, or \$4 per haircut.

Average cost curves are typically U-shaped, as [Figure 2](#) shows. Average total cost starts off relatively high, because at low levels of output total costs are dominated by the fixed cost; mathematically, the denominator is so small that average total cost is large. Average total cost then declines, as the fixed costs are spread over an increasing quantity of output. In the average cost calculation, the rise in the numerator of total costs is relatively small compared to the rise in the denominator of quantity produced. But as output expands still further, the average cost begins to rise. At the right side of the average cost curve, total costs begin rising more rapidly as diminishing returns kick in.



Note that at any level of output, the average variable cost curve will always lie below the curve for average total cost, as shown in [Figure 2](#). The reason is that average total cost includes average variable cost and average fixed cost. Thus, for $Q = 80$ haircuts, the average total cost is \$8 per haircut, while the average variable cost is \$5 per haircut. However, as output grows, fixed costs become relatively less important (since they do not rise with output), so average variable cost sneaks closer to average cost.

The marginal cost curve is generally upward-sloping, because diminishing marginal returns implies that additional units are more costly to produce. A small range of increasing marginal returns can be seen in the figure as a dip in the marginal cost curve before it starts rising. There is a point at which marginal and average costs meet, as the following Clear it Up feature discusses.





2.The Structure of Costs in the Long Run :

In the previous parts, you have learnt about different cost concepts used by managers in decision-making process, the relationship between these concepts, and the distinction between accounting costs and economic costs, and short run cost analysis and its applications in managerial decision making. We will continue the analysis of costs in this part also, and long term cost analysis will be discussed.

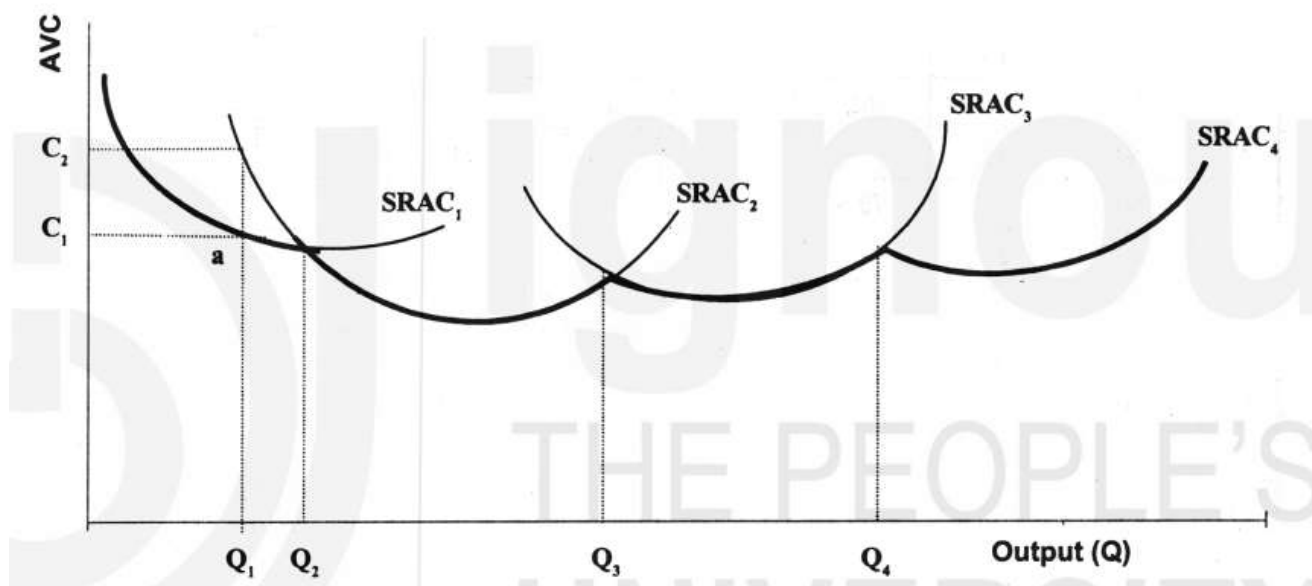
The long run is the period of time when all costs are variable. The long run depends on the specifics of the firm in question—it is not a precise period of time. If you have a one-year lease on your factory, then the long run is any period longer than a year, since after a year you are no longer bound by the lease. No costs are fixed in the long run. A firm can build new factories and purchase new machinery, or it can close existing facilities.

Long-Run Cost functions and Curves

In the long run, all inputs are variable, and a firm can have a number of alternative factory sizes and levels of output that it wants. There are no fixed cost functions (total or average) in the long run, since no inputs are fixed. A useful way of looking at the long run is to consider it a planning horizon. The long run cost curve is also called planning curve because it helps the firm in future decision-making process.

The long run cost output relationship can be shown with the help of a longrun cost curve. The *long run average cost curve* (LRAC) is derived from *short run average cost curves* (SRAC). Let us illustrate this with the help of a simple example. A firm faces a choice of production with three different plant sizes viz. plant size-1 (small size), plant size-2 (medium size), plant size-3 (large size), and plant size-4 (very large size). The short run average cost functions shown in Figure 2.1 ($SRAC_1$, $SRAC_2$, $SRAC_3$, and $SRAC_4$) are associated with each of these plants discrete scale of operation. The long run average cost function for this firm is defined by the minimum average cost of each level of output. For example, output rate Q_1 could be produced by the plant size-1 at an average cost of C_1 or by plant size-2 at a cost of C_2 .

Figure 2.1: Short-Run and Long Run Average Cost Curves

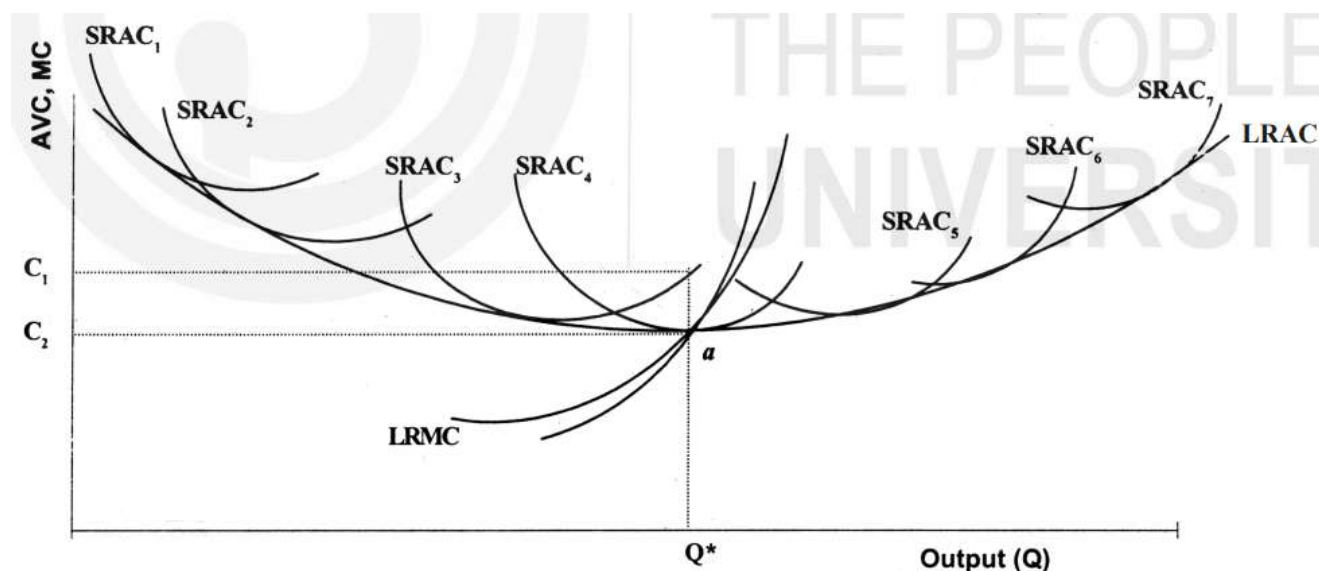


Clearly, the average cost is lower for plant size-1, and thus point a is one point on the long run average cost curve. By repeating this process for various rates of output, the long run average cost is determined. For output rates of zero to Q_2 plant size-1 is the most efficient and that part of $SRAC_1$ is part of the long run cost function. For output rates of Q_2 to Q_3 plant size-2 is the most efficient, and for output rates Q_3 to Q_4 , plant size-3 is the most efficient. The scallop-shaped curve shown in bold face in Figure 9.1 is the long run average cost curve for this firm. This bold-faced curve is called an **envelope curve** (as it envelopes short run average cost curves). Firms plan to be on this envelope curve in the long run. Consider a firm currently operating plant size-2 and producing Q_1 units at a cost of C_2 per unit. If output is expected to remain at Q_1 , the firm will plan to adjust to plant size-1, thus reducing average cost to C_1 .

Most firms will have many alternative plant sizes to choose from, and there is a short run average cost curve corresponding to each. A few of the short run average cost curves for these plants are shown in Figure 9.2, although many more may exist. Only one point of a very small arc of each short run cost curve will lie on the long run average cost function. Thus, long run average cost curve can be shown as the smooth U-shaped curve.

Corresponding to this long run average cost curve is a long run marginal cost (LRMC) curve, which intersects LRAC at its minimum point a , which is also the minimum point of short run average cost curve 4 (SRAC₄). Thus, at a point a and only at a point a , the following unique result occurs:

Figure 2.2 : Short – Run and Long – Run Average Cost and Marginal Cost Curves



The long run cost curve serves as a long run planning mechanism for the firm. It shows the least per unit cost at any output can be produced after the firm has had time to make all appropriate adjustments in its plant size. For example, suppose that the firm is operating on short run average cost curve SRAC₃ as shown in Figure 9.2, and the firm is currently producing an output of Q^* . By using SRAC₃, it is seen that the firm's average cost is C_2 . Clearly, if projections of future demand indicate that the firm could expect to continue selling Q^* units per period at the market price, profit could be increased significantly by increasing the scale of plant to the size associated with short run average cost curve SRAC₄. With this plant, average cost for an output rate of Q^* would be C_2 and the firm's profit per unit would increase by $C_2 - C_1$. Thus, total profit would increase by $(C_2 - C_1) \cdot Q^*$.

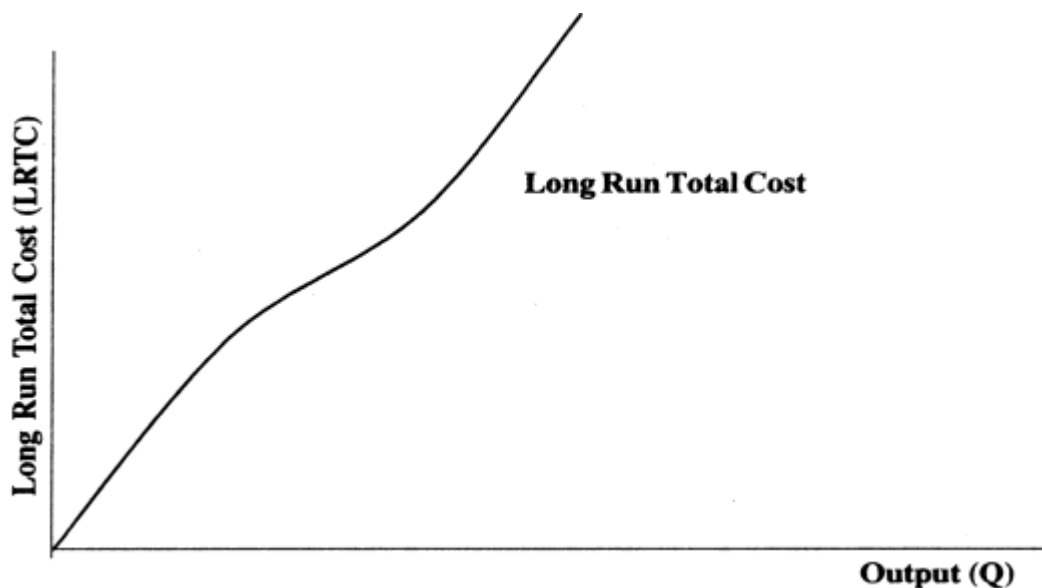
The U-shape of the LRAC curve reflects the laws of returns to scale. According to these laws, the cost per unit of production decreases as plant size increases due to the economies of scale, which the larger plant sizes make possible. But the economies of scale exist only up to a certain size of



plant, known as the optimum plant size where all possible economies of scale are fully exploited. Beyond the optimum plant size, diseconomies of scale arise due to managerial inefficiencies. As plant size increases beyond a limit, the control, the feedback of information at different levels and decision-making process becomes less efficient. This makes the LRAC curve turn upwards. Given the LRAC in Figure 9.2, we can say that there are increasing returns to scale up to Q^* and decreasing returns to scale beyond Q^* . Therefore, the point Q^* is the point of optimum output and the corresponding plant size is the optimum plant size. If you have long run average cost of producing a given output, you can readily derive the long run total cost (LRTC) of the output, since the long run total cost is simply the product of long run average cost and output. Thus, $LRTC = LRAC * Q$.

Figure 3.3 shows the relationship between long run total cost and output. Given the long run total cost function you can readily derive the long run marginal cost function, which shows the relationship between output and the cost resulting from the production of the last unit of output, if the firm has time to make the optimal changes in the quantities of all inputs used.

Figure 3.3 : Long Run Total Cost Function





LONG-RUN AVERAGE AND MARGINAL COSTS

Two other types of cost play an important role in microeconomics: long-run average cost and long-run marginal cost. **Long-run average cost** is the firm's cost per unit of output. It equals long-run total cost divided by Q :

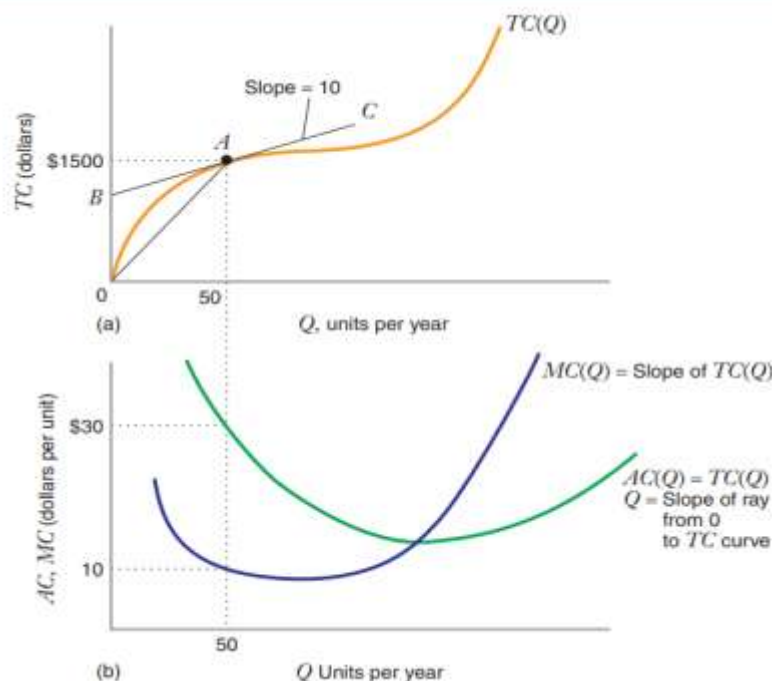
$$AC(Q) = \frac{TC(Q)}{Q}.$$

Long-run marginal cost is the rate of change at which long-run total cost changes with respect to output:

$$\begin{aligned} MC(Q) &= \frac{TC(Q + \Delta Q) - TC(Q)}{\Delta Q} \\ &= \frac{\Delta TC}{\Delta Q}. \end{aligned}$$

Although long-run average and marginal cost are both derived from the firm's long-run total cost curve, the two costs are generally different. Average cost is the cost per unit that the firm incurs in producing all of its output. Marginal cost, by contrast, is the increase in cost from producing an additional unit of output.

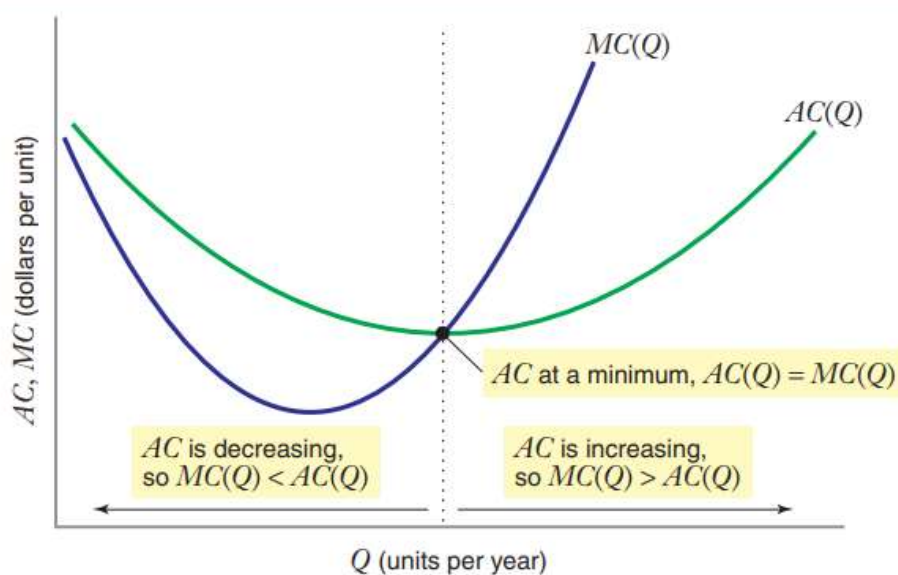
Figure 2.3 illustrates the difference between marginal and average cost. At a particular output level, such as 50 units per year, average cost is equal to the slope of ray OA . This slope is equal to $\$1,500/50$ units, so the firm's average cost when it produces 50 units per year is $\$30$ per unit. By contrast, the marginal cost when the firm produces 50 units per year is the slope of the total cost curve at a quantity of 50. In Figure 8.7 this is represented by the slope of the line BAC that is tangent to the total cost curve at a quantity of 50 units. The slope of this tangent line is 10, so the firm's marginal cost at a quantity of 50 units is $\$10$ per unit. As we vary total output, we can trace out the long-run average cost curve by imagining how the slope of rays such as OA change as we move along the long-run total cost curve. Similarly, we can trace out the long-run marginal cost curve by imagining how the slope of tangent lines such as BAC change as we move along the total cost curve. As Figure 8.7 shows, these two "thought processes" will generate two different curves.



RELATIONSHIP BETWEEN LONG-RUN MARGINAL AND AVERAGE COST CURVES

As with other average and marginal concepts you will study in this book (e.g., average product versus marginal product), there is a systematic relationship between the long-run average and long-run marginal cost curves. Figure 8.9 illustrates this relationship:

- When marginal cost is less than average cost, average cost is decreasing in quantity. That is, if $MC(Q) < AC(Q)$, $AC(Q)$ decreases in Q .
- When marginal cost is greater than average cost, average cost is increasing in quantity. Thus is, if $MC(Q) > AC(Q)$, $AC(Q)$ increases in Q .
- When marginal cost is equal to average cost, average cost neither increases nor decreases in quantity. Either its graph is flat, or we are at a point at which $AC(Q)$ is minimized in Q .



The relationship between marginal cost and average cost is the same as the relationship between the marginal of anything and the average of anything. To illustrate this point, suppose that the average height of students in your class is 160 cm. Now, a new student, Mike Margin, joins the class, and the average height rises to 161 cm. What do we know about his height? Since the average height is increasing, the “marginal height” (Mike Margin’s height) must be above the average. If the average height had fallen to 159 cm, it would have been because his height was below the average. Finally, if the average height had remained the same when Mr. Margin joined the class, his height had to exactly equal the average height in the class.



Series of Exercises No. 2 in Microeconomics 2 - Tutorials

Exercise °1: True or false (With short explanation)

1. Explicit costs are the actual out-of-pocket expenses a firm incurs in the production process.
2. Implicit costs are the opportunity costs associated with using resources owned by the firm for a particular activity rather than for the next best alternative.
3. Accounting profit includes both explicit and implicit costs.
4. Economic profit is always equal to or greater than accounting profit.
5. Total fixed costs change as production levels fluctuate in the short run.
6. Average fixed costs decrease as production levels rise in the short run.
7. Total variable costs increase proportionally with the level of production in the short run.
8. If total variable costs are increasing, average variable costs must be decreasing in the short run.
9. Marginal cost is the additional cost incurred by producing one more unit of output in the short run.
10. Marginal cost represents the average cost of producing one unit of output in the short run

Exercise °2 : complete it with appropriate answer

XYZ Consulting Firm provides management consulting services to various clients. The firm's explicit costs include _____, _____, and _____. These are measurable, out-of-pocket expenses that contribute to the overall cost of running the consulting business.

In addition to explicit costs, the firm also faces an _____. For instance, the owner of XYZ Consulting Firm has an MBA and could potentially earn a higher salary working as a senior executive at a large corporation. The foregone salary that the owner could have earned is an example of an _____, which is sometimes referred to as an _____.

Now, let's calculate the accounting profit. If the _____ generated by XYZ Consulting Firm in a given year is \$500,000, and _____ costs amount to \$300,000, the accounting profit can be calculated using the formula:

Accounting Profit = _____ - _____; So, Accounting Profit = \$_____ - \$_____ = \$_____.

However, to determine the _____, we need to consider both _____ and _____. If _____ (_____) is \$50,000, then _____ can be calculated using the formula:

_____ = _____ - (_____ + _____), So, _____ = _____ - (\$_____ + \$_____) = _____ (9).

In this scenario, the accounting profit represents the firm's financial performance based on _____ costs, while _____ provides a more comprehensive view by accounting for both _____ and _____ costs.



Exercise ° 3:

ABC Bakery specializes in producing artisanal cakes and pastries. The bakery has been operating for a few months. The owner, Othmane, is keen on understanding the different components of costs involved in running the bakery.

One significant for ABC Bakery is the monthly rent for the storefront, which amounts to \$2,000. This cost remains constant regardless of the quantity of cakes and pastries produced. Additionally, Othmane has purchased baking equipment for \$5,000.

The primary variable cost for ABC Bakery is the cost of ingredients such as flour, sugar, eggs, and flavorings. For each cake produced, the bakery incurs an average variable cost of \$10.

- Calculate the average fixed cost per cake
- Calculate the total cost for ABC Bakery in a given month If it produces 200 cakes in a month
- Calculate the average total cost per cake.

Exercise °4

If the fixed costs of an industrial firm are 5,000 \$, and its variable costs are as follows:

Quantity	Variable Cost	Fixed Cost	Total Cost	Average Total Cost	Average Variable Cost	Marginal Cost
10	\$2000					
20	\$3600					
30	\$5000					
40	\$7000					
50	\$10000					
60	\$18000					

- Calculate total costs, average costs, average fixed costs, Average variable cost and marginal cost.
- Graphically represent the total, variable, fixed costs. Then average fixed, average Variable costs, average total costs and marginal cost.
- What is the average cost to the firm when 40 units are produced.
- What is the firm 's average fixed cost when 50 units are produced.
- What is the firm 's average variable cost when 20 units are produced.
- What is the firm's marginal cost for the sixtieth unit (60)



Exercise °5

The WipeOut Ski Company manufactures skis for beginners. Fixed costs are \$30. Fill in Table for total cost, average variable cost, average total cost, and marginal cost.

Quantity	Variable Cost	Fixed Cost	Total Cost	Average Total Cost	Average Variable Cost	Marginal Cost
0	0	\$30				
1	\$10	\$30				
2	\$25	\$30				
3	\$45	\$30				
4	\$70	\$30				
5	\$100	\$30				
6	\$135	\$30				

Now imagine a situation where the firm produces a quantity of 5 units that it sells for a price of \$25 each.

1. What will be the company's profits or losses?
2. How can you tell at a glance whether the company is making or losing money at this price by looking at average cost?

Exercise °6

If the total cost function for production is: $TC = Q^3 - 6Q^2 + 15Q + 2$ and Q took values from 1 to 6

- Find the fixed cost, the average fixed cost, the average total cost, the variable cost.
- Determine the average variable cost. Where does it reach its minimum ?
- Determine the marginal cost. Where does it reach its minimum ?
- Graphically represent these functions.



Exercise °7: (True or false (With short explanation))

1. In the long run, all costs are considered to be variable.
2. Long-run costs include both explicit and implicit costs.
3. Economies of scale imply that as a firm increases its production in the long run, the average cost per unit decreases.
4. In the long run, a firm can adjust its level of capital and labor to achieve the most cost-effective production process.
5. Sunk costs play a crucial role in the decision-making process in the long run.

Exercise °8: Fill in gaps

economies of scale - opportunity costs - long run – decreased – labor - marginal cost – capital – cost - diseconomies of scale

XYZ Manufacturing Company produces electronic gadgets, and it is assessing its cost structure in the long period. In the _____, the firm has the flexibility to adjust both its _____ and _____ inputs to optimize production processes and achieve cost efficiency.

The firm has experienced _____ as it increased its production levels. As a result, the average cost per unit has _____, showcasing the benefits of efficient resource utilization, increased specialization, and improved overall production efficiency.

In the long run, XYZ Manufacturing can make strategic decisions about its _____ structure, determining the optimal combination of capital and labor to minimize costs. The firm carefully evaluates both explicit and implicit costs, recognizing that implicit costs involve _____ associated with alternative uses of resources.

One challenge the company faces is the potential for _____ if it expands too rapidly. This could lead to inefficiencies, coordination problems, and an increase in average costs. Thus, careful analysis and planning are essential to avoid _____ and maintain a competitive edge.

In decision-making, XYZ Manufacturing focuses on _____ cost, as it represents the additional cost of producing one more unit. This allows the company to make informed choices about production levels and resource allocation in the dynamic environment of the long run.



Solution of Series of Exercises No. 2 in Microeconomics 2 - Tutorials

Exercise °1: True or false (With short explanation)

1. Explicit costs are the actual out-of-pocket expenses a firm incurs in the production process.

Answer: True

Explanation: Explicit costs are tangible, measurable expenses, such as wages, rent, and raw materials.

2. Implicit costs are the opportunity costs associated with using resources owned by the firm for a particular activity rather than for the next best alternative.

Answer: True

Explanation: Implicit costs represent the forgone opportunities and benefits that result from using resources for a specific purpose instead of the next best alternative.

3. Accounting profit includes both explicit and implicit costs.

Answer: False

Explanation: Accounting profit only considers explicit costs, as it focuses on monetary transactions and expenses recorded in financial statements.

4. Economic profit is always equal to or greater than accounting profit.

Answer: False

Explanation: Economic profit can be equal to, greater than, or less than accounting profit, depending on whether implicit costs are included.

5. Total variable costs increase proportionally with the level of production in the short run.

Answer: True

Explanation: In the short run, variable costs vary with the level of production. As production increases, total variable costs also increase.

6. Total fixed costs change as production levels fluctuate in the short run.

Answer: False

Explanation: Total fixed costs remain constant in the short run regardless of changes in production levels.

7. Average fixed costs decrease as production levels rise in the short run. (True/False)

Answer: True

Explanation: Average fixed costs spread over a larger quantity of output decrease, resulting in a decline in average fixed costs as production increases in the short run.

8. If total variable costs are decreasing, average variable costs must also be decreasing in the short run.

Answer: False

Explanation: Average variable cost can still increase if the rate of decrease in total variable costs is not sufficient to offset the increase in the quantity of output.

9. Marginal cost is the additional cost incurred by producing one more unit of output in the short run.

Answer: True

Explanation: Marginal cost represents the change in total cost when one more unit of output is



produced in the short run.

10. Marginal cost represents the average cost of producing one unit of output in the short run.

Answer: False

Explanation: Marginal cost represents the additional cost of producing one more unit of output, not the average cost.

Exercise °2: Fill in the gaps:

XYZ Consulting Firm provides management consulting services to various clients. The firm's explicit costs include _____ (1), _____ (2), and _____ (3). These are measurable, out-of-pocket expenses that contribute to the overall cost of running the consulting business.

In addition to explicit costs, the firm also faces an _____ (4). For instance, the owner of XYZ Consulting Firm has an MBA and could potentially earn a higher salary working as a senior executive at a large corporation. The foregone salary that the owner could have earned is an example of an _____ (4), which is sometimes referred to as an _____ (5).

Now, let's calculate the accounting profit. If the total revenue generated by XYZ Consulting Firm in a given year is \$500,000, and the explicit costs amount to \$300,000, the accounting profit can be calculated using the formula:

Accounting Profit = Total Revenue - Explicit Costs; So, Accounting Profit = \$500,000 - \$300,000 = _____ (6).

However, to determine the _____ (7), we need to consider both explicit and implicit costs. If the implicit cost (opportunity cost of the owner's foregone salary) is \$50,000, then the economic profit can be calculated using the formula:

Economic Profit = _____ (8) - (Explicit Costs + Implicit Costs), So, Economic Profit = \$500,000 - (\$300,000 + \$50,000) = _____ (9).

In this scenario, the accounting profit represents the firm's financial performance based on _____ (10) costs, while the economic profit provides a more comprehensive view by accounting for both explicit and implicit costs.

Fill in the gaps:

1. Rent

2. Employee Salaries

3. Office Supplies

4.implicit cost

5.opportunity cost

6. \$200,000

7.economic profit

8.Total Revenue

9. \$150,000

10. explicit



Exercise °3

Total Costs:

Now, let's calculate the total cost for ABC Bakery in a given month. The total cost (TC) is the sum of fixed costs (FC) and variable costs (VC).

$$TC = FC + VC$$

So, $TC = \$2,000$ (rent) + $\$5,000$ (equipment) + $\$10$ (average variable cost per cake * number of cakes produced).

Total Output:

If ABC Bakery produces 200 cakes in a month, the total variable cost would be $\$10 * 200 = \$2,000$.

Calculate Total Cost:

Now, calculate the total cost for producing 200 cakes in a month:

$$TC = \$2,000 \text{ (rent)} + \$5,000 \text{ (equipment)} + \$2,000 \text{ (variable cost for 200 cakes)} \quad TC = \$9,000$$

Average Cost:

Finally, calculate the average cost per cake by dividing the total cost by the number of cakes produced.

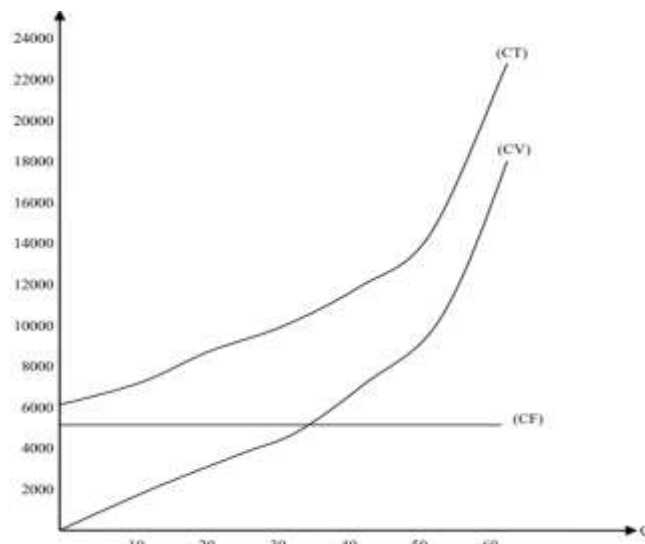
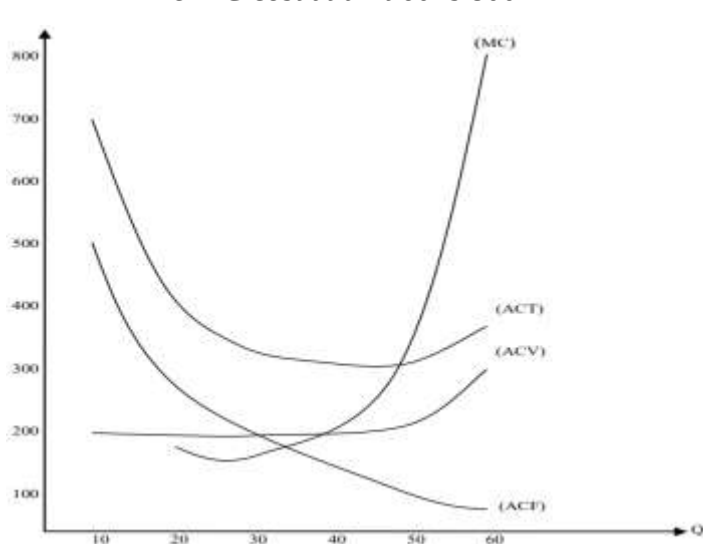
$$\text{Average Cost (AC)} = TC / \text{Total Output} \quad AC = \$9,000 / 200 \quad AC = \$45 \text{ per cake}$$

Exercise ° 4:

Q	10	20	30	40	50	60
CV	2000	3600	5000	7000	10000	18000
CT	7000	8600	10000	12000	15000	23000
ACT	700	430	333,3	300	300	383,3
ACV	200	180	166,6	175	200	300
ACF	500	250	166,6	125	100	83,3
MC	-	160	140	200	300	800



- The average cost of the enterprise when production reaches 40 units is 300
- The average fixed cost for the organization when producing 50 units is 100
- The ACV cost when producing 20 units is 180
- The MC cost at unit 60 is 800



Exercise °5

Quantity	Variable Cost	Fixed Cost	Total Cost	Average Total Cost	Average Variable Cost	Marginal Cost
0	0	\$30	\$30	–	–	
1	\$10	\$30	\$40	\$10.00	\$40.00	\$10
2	\$25	\$30	\$55	\$12.50	\$27.50	\$15
3	\$45	\$30	\$75	\$15.00	\$25.00	\$20
4	\$70	\$30	\$100	\$17.50	\$25.00	\$25
5	\$100	\$30	\$130	\$20.00	\$26.00	\$30
6	\$135	\$30	\$165	\$22.50	\$27.50	\$35

1. Total revenues in this example will be a quantity of five units multiplied by the price of \$25/unit, which equals \$125. Total costs when producing five units are \$130. Thus, at this level of quantity and output the firm experiences losses (or negative profits) of \$5.
2. If price is less than average cost, the firm is not making a profit. At an output of five units,



the average cost is \$26/unit. Thus, at a glance you can see the firm is making losses. At a second glance, you can see that it must be losing \$1 for each unit produced (that is, average cost of \$26/unit minus the price of \$25/unit). With five units produced, this observation implies total losses of \$5.

3. When producing five units, marginal costs are \$30/unit. Price is \$25/unit. Thus, the marginal unit is not adding to profits, but is actually subtracting from profits, which suggests that the firm should reduce its quantity produced.

Exercise °6

$TC = Q^3 - 6Q^2 + 15Q + 2$ and Q took values from 1 to 6

Fixed Cost (FC): The fixed cost is the constant term in the total cost function. In this case, it is **FC = 2**

Average Fixed Cost (AFC): AFC is calculated by dividing the fixed cost by the quantity produced (Q). In this case, **AFC = 2/Q**

Average Total Cost (ATC): ATC is the total cost divided by the quantity produced (Q). In this case, **ATC = $Q^2 - 6Q + 15 + 2/Q$**

Variable Cost (VC): Variable cost is the part of the total cost that varies with the quantity produced. In this case, it is **VC = $Q^3 - 6Q^2 + 15Q$**

Average Variable Cost (AVC): AVC is calculated by dividing the variable cost by the quantity produced (Q). In this case, **AVC = $Q^2 - 6Q + 15$**

- To find where AVC reaches its minimum, take the derivative of AVC with respect to (Q) and set it equal to zero to find critical points. Then, analyze the second derivative to determine if it's a minimum. **AVC' = $2Q - 6 = 0$ Q = 3**

Marginal Cost (MC): MC is the derivative of the total cost function with respect to (Q). In this case, **MC = $3Q^2 - 12Q + 15$**

Similar to the AVC case, find where MC reaches its maximum by taking the derivative of MC with respect to (Q) and setting it equal to zero. **MC' = $6Q - 12 = 0$ Q = 2**
Graphically represent these functions



Q	TC	VC	AVC	FC	AC	MC
1	12	10	10	2	12	6
2	16	14	7	1	8	3
3	20	18	6	0,66	6,66	6
4	30	28	7	0,5	7,5	15
5	52	50	10	0,4	10,4	30
6	92	90	15	0,33	15,3	51

Exercise °7: (True or false (With short explanation))

1. In the long run, all costs are considered to be variable.

- Answer: True

- Explanation: In the long run, a firm can adjust its production level, including both capital and labor inputs, making all costs variable.

2. Long-run costs include both explicit and implicit costs.

- Answer: True

- Explanation: Explicit costs are direct monetary expenses, while implicit costs are opportunity costs. Both are considered in the long run.

3. Economies of scale imply that as a firm increases its production in the long run, the average cost per unit decreases.

- Answer: True

- Explanation: Economies of scale occur when increased production leads to lower average costs due to factors like specialization and efficiency.

4. Long-run average cost curve is U-shaped, indicating the presence of both economies and diseconomies of scale.

- Answer: False

- Explanation: The long-run average cost curve is typically downward-sloping, representing economies of scale. Diseconomies of scale may occur at extremely high production levels.

5. In the long run, a firm can adjust its level of capital and labor to achieve the most cost-effective production process.

- Answer: True

- Explanation: The long run allows firms to vary all inputs, enabling them to optimize their production processes for cost efficiency.



6. Sunk costs play a crucial role in the decision-making process in the long run.

- Answer: False

- Explanation: Sunk costs are irrelevant in decision-making in the long run, as they are costs that cannot be recovered and should not affect future decisions.

Exercise °8

Answers:

1. __ long run __
2. __ capital __
3. __ labor __
4. __ economies of scale __
5. __ decreased __
6. __ cost
7. __ opportunity __
8. __ diseconomies of scale __
9. __ diseconomies of scale __
10. __ marginal cost __



Chapter N°3 : Producer Behavior in Different Markets

CHAPTER CONTENT AND OBJECTIVES

In this chapter, you will learn about :

- Perfect Competition
- Monopoly
- Monopolistic Competition
- Oligopoly

By the end of this section, you will be able to:

- Explain the characteristics of a perfectly competitive market
- Discuss how perfectly competitive firms react in the short run and in the long run
- Calculate profits by comparing total revenue and total cost
- Determine the price at which a firm should continue producing in the short run
- Distinguish between a natural monopoly and a legal monopoly.
- Explain how economies of scale and the control of natural resources led to the necessary formation of legal monopolies
- Calculate marginal revenue and marginal cost
- Describe how a monopolistic competitor chooses price and quantity
- Discuss entry, exit, and efficiency as they pertain to monopolistic competition
- Explain why and how oligopolies exist



Introduction :

understanding producer behavior in different market structures is essential for comprehending how firms operate, make decisions, and ultimately influence market outcomes. This chapter delves into the intricacies of four primary market structures : Perfect Competition, Monopoly, Monopolistic Competition, and Oligopoly.

Perfect Competition represents an idealized market structure characterized by a large number of firms producing identical goods or services, perfect information availability, ease of entry and exit, and price-taking behavior by firms. Here, we explore how firms maximize profits in this competitive environment and how market equilibrium is achieved through the forces of supply and demand.

Monopoly, on the other hand, presents a scenario where a single firm dominates the entire market, holding significant control over pricing and output levels. Through our examination of monopolistic behavior, we uncover the implications for consumer welfare, potential inefficiencies, and the role of government intervention in regulating monopolies.

Monopolistic Competition blends elements of both perfect competition and monopoly, featuring a multitude of firms producing similar yet differentiated products. This section explores how firms in this structure engage in product differentiation, and non-price competition to capture market share and sustain profitability.

Lastly, Oligopoly represents a market structure characterized by a small number of interdependent firms, often engaged in strategic decision-making regarding pricing, output levels, and product differentiation.

By studying producer behavior across these diverse market structures, we gain valuable insights into the dynamics of competition, pricing strategies, consumer welfare, and the broader implications for market efficiency and societal welfare. Through this exploration, we aim to develop a nuanced understanding of how firms navigate various market conditions and the implications for economic outcomes.



1. Major Market Forms

In microeconomics, **market structures** describe the organization and characteristics of different types of markets in which firms operate. These structures influence how prices are determined, how much output is produced, and how firms interact with each other and consumers. The **four major market forms** are:

1.1 Perfect Competition

Definition:

Perfect competition is a market structure where a large number of small firms sell **identical (homogeneous)** products. No single firm can influence the market price, and all firms are **price takers**.

Main Features:

- **Number of Firms:** Very large
- **Type of Product:** Homogeneous
- **Barriers to Entry and Exit:** None (free entry and exit)
- **Control Over Price:** None (price is determined by the market)
- **Information:** Perfect knowledge for both buyers and sellers
- **Examples:** Agricultural markets (e.g., wheat, corn)

1.2 Monopolistic Competition

Definition:

Monopolistic competition is a market structure where **many firms** sell similar but **differentiated products**. Firms compete on price, quality, and marketing.

Main Features:

- **Number of Firms:** Many
- **Type of Product:** Differentiated (branding, packaging, etc.)
- **Barriers to Entry:** Low to moderate
- **Control Over Price:** Some (due to product differentiation)
- **Information:** Reasonably good
- **Examples:** Restaurants, clothing brands, toothpaste



1.3. Oligopoly

Definition:

An oligopoly is a market structure where a **few large firms** dominate the market. Products may be **homogeneous or differentiated**, and firms are **mutually interdependent** in their decision-making.

Main Features:

- **Number of Firms:** Few (often 3 to 10 major firms)
- **Type of Product:** Homogeneous or differentiated
- **Barriers to Entry:** High (economies of scale, capital requirements)
- **Control Over Price:** Considerable, but constrained by rivals
- **Strategic Behavior:** Firms may engage in collusion or price wars
- **Examples:** Automobile industry, smartphones, airlines, soft drinks

1.4. Monopoly

Definition:

A monopoly exists when a **single firm** dominates the entire market and is the **sole producer** of a unique product with **no close substitutes**.

Main Features:

- **Number of Firms:** One
- **Type of Product:** Unique product
- **Barriers to Entry:** Very high (legal, technological, or economic)
- **Control Over Price:** High (firm is a price maker)
- **Information:** Imperfect
- **Examples:** Utility companies (electricity, water), patented products



2. Analyzing firms under perfect competition

All businesses face two realities: no one is required to buy their products, and even customers who might want those products may buy from other businesses instead. Firms that operate in perfectly competitive markets face this reality. In this chapter, you will learn how such firms make decisions about how much to produce, how much profit they make, whether to stay in business or not, and many others. Industries differ from one another in terms of how many sellers there are in a specific market, how easy or difficult it is for a new firm to enter, and the type of products that are sold. This is referred to as the **market structure** of the industry. In this chapter, we focus on perfect competition.

Firms are said to be in **perfect competition** when the following conditions occur:

- (1) many firms produce identical products;
- (2) many buyers are available to buy the product, and many sellers are available to sell the product;
- (3) sellers and buyers have all relevant information to make rational decisions about the product being bought and sold; and
- (4) firms can enter and leave the market without any restrictions—in other words, there is free entry and exit into and out of the market.

A **perfectly competitive firm** is known as a **price taker**, because the pressure of competing firms forces them to accept the prevailing equilibrium price in the market. If a firm in a perfectly competitive market raises the price of its product by so much as a penny, it will lose all of its sales to competitors. When a wheat grower, as discussed in the Bring it Home feature, wants to know what the going price of wheat is, he or she has to go to the computer or listen to the radio to check. The market price is determined solely by supply and demand in the entire market and not the individual farmer. Also, a perfectly competitive firm must be a very small player in the overall market, so that it can increase or decrease output without noticeably affecting the overall quantity supplied and price in the market.

This chapter examines how profit-seeking firms decide how much to produce in perfectly competitive markets. Such firms will analyze their costs as discussed in the chapter on [Cost and Industry Structure](#).



Perfect Competition In the short run

In the short run, the perfectly competitive firm will seek the quantity of output where profits are highest or, if profits are not possible, where losses are lowest. In this example, the “short run” refers to a situation in which firms are producing with one fixed input and incur fixed costs of production. (In the real world, firms can have many fixed inputs.)

A **perfectly competitive firm** has only one major decision to make—namely, what quantity to produce. To understand why this is so, consider a different way of writing out the basic definition of **Profit** = Total revenue–Total cost

$$\text{Profit} = (\text{Price})(\text{Quantity produced}) - (\text{Average cost})(\text{Quantity produced})$$

Since a perfectly competitive firm must accept the price for its output as determined by the product’s market demand and supply, it cannot choose the price it charges. This is already determined in the profit equation, and so the perfectly competitive firm can sell any number of units at exactly the same price. It implies that the firm faces a perfectly elastic demand curve for its product: buyers are willing to buy any number of units of output from the firm at the market price. When the perfectly competitive firm chooses what quantity to produce, then this quantity—along with the prices prevailing in the market for output and inputs—will determine the firm’s total revenue, total costs, and ultimately, level of profits.

Determining the Highest Profit by Comparing Total Revenue and Total Cost

A perfectly competitive firm can sell as large a quantity as it wishes, as long as it accepts the prevailing market price. Total revenue is going to increase as the firm sells more, depending on the price of the product and the number of units sold. If you increase the number of units sold at a given price, then total revenue will increase. If the price of the product increases for every unit sold, then total revenue also increases. As an example of how a perfectly competitive firm decides what quantity to produce, consider the case of a small farmer who produces raspberries and sells them frozen for \$4 per pack. Sales of one pack of raspberries will bring in \$4, two packs will be \$8, three packs will be \$12, and so on. If, for example, the price of frozen raspberries doubles to \$8 per pack, then sales of one pack of raspberries will be \$8, two packs will be \$16, three packs will be \$24, and so on.



Total revenue and **total costs** for the raspberry farm, broken down into fixed and variable costs, are shown in [Table 1](#) and also appear in [Figure 1](#). The horizontal axis shows the quantity of frozen raspberries produced in packs; the vertical axis shows both total revenue and total costs, measured in dollars. The total cost curve intersects with the vertical axis at a value that shows the level of fixed costs, and then slopes upward. All these cost curves follow the same characteristics as the curves covered in the [Cost and Industry Structure](#) chapter.

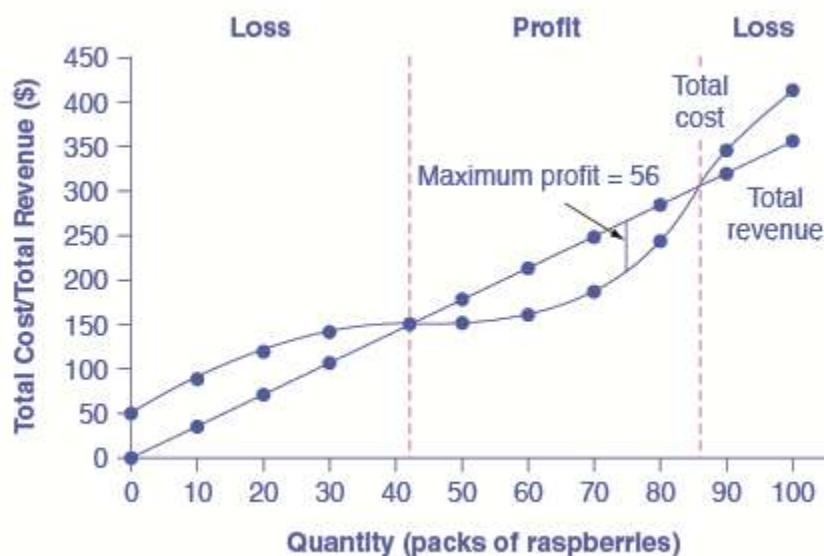


Figure 1. Total Cost and Total Revenue at the Raspberry Farm.

Based on its total revenue and total cost curves, a perfectly competitive firm like the raspberry farm can calculate the quantity of output that will provide the highest level of profit. At any given quantity, total revenue minus total cost will equal profit. One way to determine the most profitable quantity to produce is to see at what quantity total revenue exceeds total cost by the largest amount. On [Figure 1](#), the vertical gap between total revenue and total cost represents either profit (if total revenues are greater than total costs at a certain quantity) or losses (if total costs are greater than total revenues at a certain quantity). In this example, total costs will exceed total revenues at output levels from 0 to 40, and so over this range of output, the firm will be making losses. At output levels from 50 to 80, total revenues exceed total costs, so the firm is earning profits. But then at an output of 90 or 100, total costs again exceed total revenues and the firm is making losses. Total profits appear in the final column of [Table 1](#).



Quantity (Q)	Total Cost (TC)	Fixed Cost (FC)	Variable Cost (VC)	Total Revenue (TR)	Profit
0	\$62	\$62	—	\$0	−\$62
10	\$90	\$62	\$28	\$40	−\$50
20	\$110	\$62	\$48	\$80	−\$30
30	\$126	\$62	\$64	\$120	−\$6
40	\$144	\$62	\$82	\$160	\$16
50	\$166	\$62	\$104	\$200	\$34
60	\$192	\$62	\$130	\$240	\$48
70	\$224	\$62	\$162	\$280	\$56
80	\$264	\$62	\$202	\$320	\$56
90	\$324	\$62	\$262	\$360	\$36
100	\$404	\$62	\$342	\$400	−\$4
Table 1. Total Cost and Total Revenue at the Raspberry Farm					

The highest total profits in the table, as in the figure that is based on the table values, occur at an output of 70–80, when profits will be \$56.

A higher price would mean that total revenue would be higher for every quantity sold. A lower price would mean that total revenue would be lower for every quantity sold. What happens if the price drops low enough so that the total revenue line is completely below the total cost curve; that is, at every level of output, total costs are higher than total revenues? In this instance, the best the firm can do is to suffer losses. But a profit-maximizing firm will prefer the quantity of output where total revenues come closest to total costs and thus where the losses are smallest.

(Later we will see that sometimes it will make sense for the firm to shutdown, rather than stay in operation producing output.)



Comparing Marginal Revenue and Marginal Costs

Firms often do not have the necessary data they need to draw a complete total cost curve for all levels of production. They cannot be sure of what total costs would look like if they, say, doubled production or cut production in half, because they have not tried it. Instead, firms experiment. They produce a slightly greater or lower quantity and observe how profits are affected. In economic terms, this practical approach to maximizing profits means looking at how changes in production affect marginal revenue and marginal cost.

[Figure 2](#) presents the marginal revenue and marginal cost curves based on the total revenue and total cost in [Table 1](#). The **marginal revenue** curve shows the additional revenue gained from selling one more unit. As mentioned before, a firm in perfect competition faces a perfectly elastic demand curve for its product—that is, the firm’s demand curve is a horizontal line drawn at the market price level. This also means that the firm’s marginal revenue curve is the same as the firm’s demand curve: Every time a consumer demands one more unit, the firm sells one more unit and revenue goes up by exactly the same amount equal to the market price. In this example, every time a pack of frozen raspberries is sold, the firm’s revenue increases by \$4. [Table 2](#) shows an example of this. This condition only holds for price taking firms in perfect competition where:

Marginal revenue = price

The formula for marginal revenue is:

$$\text{marginal revenue} = \frac{\text{change in total revenue}}{\text{change in quantity}}$$

Price	Quantity	Total Revenue	Marginal Revenue
\$4	1	\$4	—
\$4	2	\$8	\$4
\$4	3	\$12	\$4
\$4	4	\$16	\$4

Table 2. Marginal Revenue



Notice that marginal revenue does not change as the firm produces more output. That is because the price is determined by supply and demand and does not change as the farmer produces more (keeping in mind that, due to the relative small size of each firm, increasing their supply has no impact on the total market supply where price is determined).

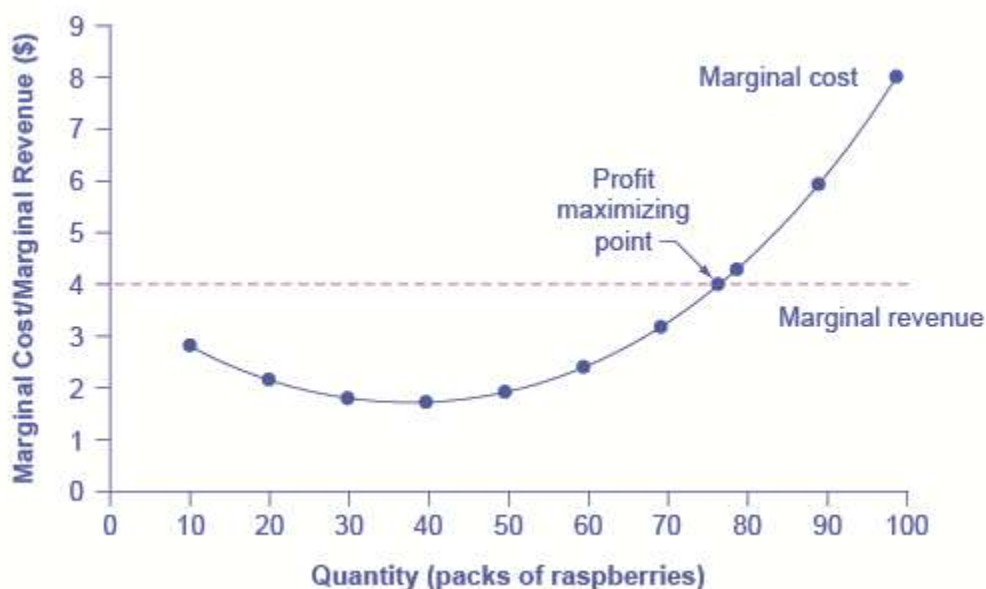
Since a perfectly competitive firm is a price taker, it can sell whatever quantity it wishes at the market-determined price. Marginal cost, the cost per additional unit sold, is calculated by dividing the change in total cost by the change in quantity. The formula for marginal cost is:

$$\text{marginal cost} = \frac{\text{change in total cost}}{\text{change in quantity}}$$

Ordinarily, marginal cost changes as the firm produces a greater quantity.

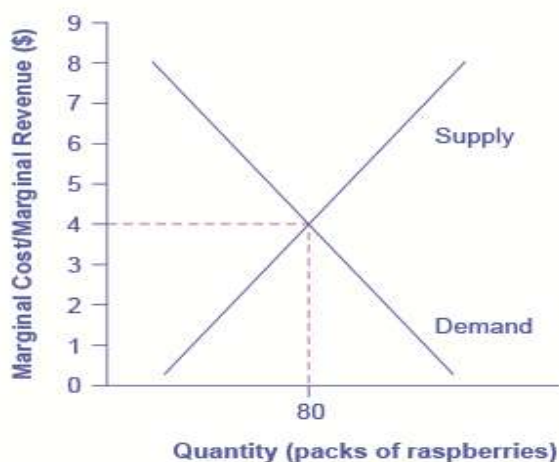
In the raspberry farm example, shown in [Figure 2](#), [Figure 3](#) and [Table 3](#), marginal cost at first declines as production increases from 10 to 20 to 30 packs of raspberries—which represents the area of increasing marginal returns that is not uncommon at low levels of production. But then marginal costs start to increase, displaying the typical pattern of diminishing marginal returns. If the firm is producing at a quantity where $MR > MC$, like 40 or 50 packs of raspberries, then it can increase profit by increasing output because the marginal revenue is exceeding the marginal cost. If the firm is producing at a quantity where $MC > MR$, like 90 or 100 packs, then it can increase profit by reducing output because the reductions in marginal cost will exceed the reductions in marginal revenue. The firm's profit-maximizing choice of output will occur where $MR = MC$ (or at a choice close to that point). You will notice that what occurs on the production side is exemplified on the cost side. This is referred to as duality.

Figure 2. Marginal Revenues and Marginal Costs at the Raspberry Farm: Individual Farmer.



For a perfectly competitive firm, the marginal revenue (MR) curve is a horizontal straight line because it is equal to the price of the good, which is determined by the market, shown in [Figure 3](#). The marginal cost (MC) curve is sometimes first downward-sloping, if there is a region of increasing marginal returns at low levels of output, but is eventually upward-sloping at higher levels of output as diminishing marginal returns kick in.

Figure 3. Marginal Revenues and Marginal Costs at the Raspberry Farm: Raspberry Market.



The equilibrium price of raspberries is determined through the interaction of market supply and market demand at \$4.00.



Quantity	Total Cost	Fixed Cost	Variable Cost	Marginal Cost	Total Revenue	Marginal Revenue
0	\$62	\$62	—	—	—	—
10	\$90	\$62	\$28	\$2.80	\$40	\$4.00
20	\$110	\$62	\$48	\$2.00	\$80	\$4.00
30	\$126	\$62	\$64	\$1.60	\$120	\$4.00
40	\$144	\$62	\$82	\$1.80	\$160	\$4.00
50	\$166	\$62	\$104	\$2.20	\$200	\$4.00
60	\$192	\$62	\$130	\$2.60	\$240	\$4.00
70	\$224	\$62	\$162	\$3.20	\$280	\$4.00
80	\$264	\$62	\$202	\$4.00	\$320	\$4.00
90	\$324	\$62	\$262	\$6.00	\$360	\$4.00
100	\$404	\$62	\$342	\$8.00	\$400	\$4.00

Table 3. Marginal Revenues and Marginal Costs at the Raspberry Farm

In this example, the marginal revenue and **marginal cost** curves cross at a price of \$4 and a quantity of 80 produced. If the farmer started out producing at a level of 60, and then experimented with increasing production to 70, marginal revenues from the increase in production would exceed marginal costs—and so profits would rise. The farmer has an incentive to keep producing. From a level of 70 to 80, marginal cost and marginal revenue are equal so profit doesn't change. If the farmer then experimented further with increasing production from 80 to 90, he would find that marginal costs from the increase in production are greater than marginal revenues, and so profits would decline.

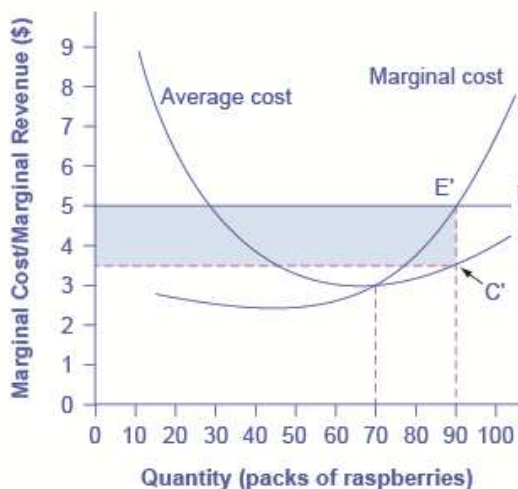


The profit-maximizing choice for a perfectly competitive firm will occur where marginal revenue is equal to marginal cost—that is, where $MR = MC$. A profit-seeking firm should keep expanding production as long as $MR > MC$. But at the level of output where $MR = MC$, the firm should recognize that it has achieved the highest possible level of economic profits. (In the example above, the profit maximizing output level is between 70 and 80 units of output, but the firm will not know they've maximized profit until they reach 80, where $MR = MC$.) Expanding production into the zone where $MR < MC$ will only reduce economic profits. Because the marginal revenue received by a perfectly competitive firm is equal to the price P , so that $P = MR$, the profit-maximizing rule for a perfectly competitive firm can also be written as a recommendation to produce at the quantity where $P = MC$.

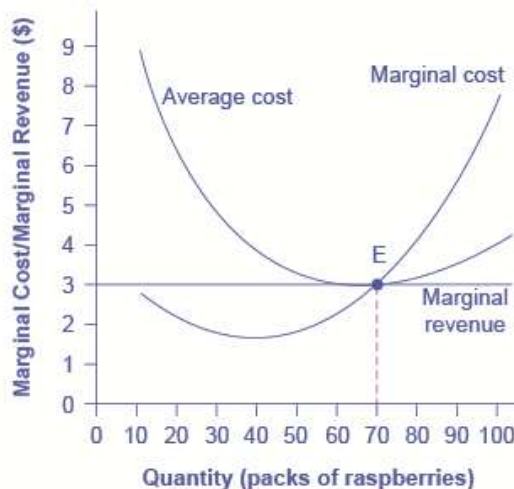
Profits and Losses with the Average Cost Curve

Does maximizing profit (producing where $MR = MC$) imply an actual economic profit? The answer depends on the relationship between price and average total cost. If the price that a firm charges is higher than its average cost of production for that quantity produced, then the firm will earn profits. Conversely, if the price that a firm charges is lower than its average cost of production, the firm will suffer losses. You might think that, in this situation, the farmer may want to shut down immediately. Remember, however, that the firm has already paid for fixed costs, such as equipment, so it may continue to produce and incur a loss. [Figure 4](#) illustrates three situations: (a) where price intersects marginal cost at a level above the average cost curve, (b) where price intersects marginal cost at a level equal to the average cost curve, and (c) where price intersects marginal cost at a level below the average cost curve.

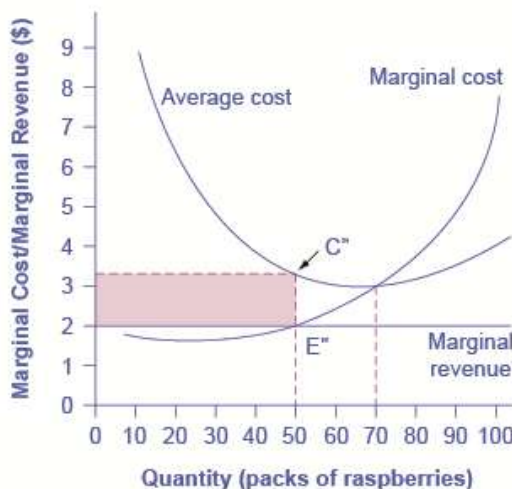
Figure 4. Price and Average Cost at the Raspberry Farm.



(a) Price is above average cost



(b) Price equals cost



(c) Price is below average cost

In (a), price intersects marginal cost above the average cost curve. Since price is greater than average cost, the firm is making a profit. In (b), price intersects marginal cost at the minimum point of the average cost curve. Since price is equal to average cost, the firm is breaking even. In (c), price intersects marginal cost below the average cost curve. Since price is less than average cost, the firm is making a loss.



First consider a situation where the price is equal to \$5 for a pack of frozen raspberries. The rule for a profit-maximizing perfectly competitive firm is to produce the level of output where $\text{Price} = \text{MR} = \text{MC}$, so the raspberry farmer will produce a quantity of 90, which is labeled as e in [Figure 4](#) (a). Remember that the area of a rectangle is equal to its base multiplied by its height. The farm's total revenue at this price will be shown by the large shaded rectangle from the origin over to a quantity of 90 packs (the base) up to point E' (the height), over to the price of \$5, and back to the origin. The average cost of producing 80 packs is shown by point C or about \$3.50. Total costs will be the quantity of 80 times the average cost of \$3.50, which is shown by the area of the rectangle from the origin to a quantity of 90, up to point C , over to the vertical axis and down to the origin. It should be clear from examining the two rectangles that total revenue is greater than total cost. Thus, profits will be the blue shaded rectangle on top.

The Shutdown Point

The possibility that a firm may earn losses raises a question: Why can the firm not avoid losses by shutting down and not producing at all? The answer is that shutting down can reduce variable costs to zero, but in the short run, the firm has already paid for fixed costs. As a result, if the firm produces a quantity of zero, it would still make losses because it would still need to pay for its fixed costs. So, when a firm is experiencing losses, it must face a question: should it continue producing or should it shut down?

As an example, consider the situation of the Yoga Center, which has signed a contract to rent space that costs \$10,000 per month. If the firm decides to operate, its marginal costs for hiring yoga teachers is \$15,000 for the month. If the firm shuts down, it must still pay the rent, but it would not need to hire labor. [Table 5](#) shows three possible scenarios. In the first scenario, the Yoga Center does not have any clients, and therefore does not make any revenues, in which case it faces losses of \$10,000 equal to the fixed costs. In the second scenario, the Yoga Center has clients that earn the center revenues of \$10,000 for the month, but ultimately experiences losses of \$15,000 due to having to hire yoga instructors to cover the classes. In the third scenario, the Yoga Center earns revenues of \$20,000 for the month, but experiences losses of \$5,000.



In all three cases, the Yoga Center loses money. In all three cases, when the rental contract expires in the long run, assuming revenues do not improve, the firm should exit this business. In the short run, though, the decision varies depending on the level of losses and whether the firm can cover its variable costs. In scenario 1, the center does not have any revenues, so hiring yoga teachers would increase variable costs and losses, so it should shut down and only incur its fixed costs. In scenario 2, the center's losses are greater because it does not make enough revenue to offset the increased variable costs plus fixed costs, so it should shut down immediately. If price is below the minimum average variable cost, the firm must shut down. In contrast, in scenario 3 the revenue that the center can earn is high enough that the losses diminish when it remains open, so the center should remain open in the short run.

Scenario 1

If the center shuts down now, revenues are zero but it will not incur any variable costs and would only need to pay fixed costs of \$10,000.

$$\begin{aligned}\text{profit} &= \text{total revenue} - (\text{fixed costs} + \text{variable cost}) \\ &= 0 - \$10,000 - \$10,000 \\ &= -\$10,000 - \$10,000\end{aligned}$$

Scenario 2

The center earns revenues of \$10,000, and variable costs are \$15,000. The center should shut down now.

$$\begin{aligned}\text{profit} &= \text{total revenue} - (\text{fixed costs} + \text{variable cost}) \\ &= \$10,000 - (\$10,000 + \$15,000) - \$15,000 \\ &= \$10,000 - (\$10,000 + \$15,000) - \$15,000\end{aligned}$$

Scenario 3

The center earns revenues of \$20,000, and variable costs are \$15,000. The center should continue in business.

$$\begin{aligned}\text{profit} &= \text{total revenue} - (\text{fixed costs} + \text{variable cost}) \\ &= \$20,000 - (\$10,000 + \$15,000) = \$20,000 - (\$10,000 + \$15,000) \\ &= -\$5,000 = -\$5,000\end{aligned}$$



Series of Exercises No. 3 in Microeconomics 2 - Tutorials

Exercise °1: True or false (and correct it if false)

1. All firms in a perfectly competitive market sell identical products.
2. Individual firms in a perfectly competitive market can influence the market price.
3. Monopolistic competition features standardized products and few sellers.
4. Barriers to entry always exist in monopolistic competition, preventing new firms from entering the market.
5. Oligopoly refers to a market structure with a small number of large firms dominating the industry.
6. In oligopoly, firms are interdependent and consider each other's actions when making production decisions.
7. Monopolies typically produce goods or services that have no close substitutes.
8. Monopolies are price takers in the market.

Exercise °2: complete it with appropriate answer

1. The market for bottled water is an example of _____ because there are numerous _____ producing identical products.
2. The market for wheat in regions where there are numerous small-scale farmers is considered a perfect competition market because each farmer produces a _____ product.
3. In a small town, there are multiple bakeries selling _____ types of bread at the same price. This scenario demonstrates _____ because there is a large number of _____ and no single bakery can influence the market price.
4. In a _____ market, firms are considered _____ because they must accept the prevailing market price as given.
5. In a _____ market, buyers and sellers operate with the assumption of _____, where all relevant _____ about prices, quantities, and market conditions is readily available.



Exercise ° 3: complete it with appropriate answer

In the realm of market structures, various industries showcase distinct characteristics. _____ is exemplified by industries like fast food, retail clothing, and personal care products, where multiple firms offer _____ but differentiate themselves through branding and marketing strategies. On the other hand, _____ is evident in sectors such as the _____, _____, _____, where a few major players dominate the market. For instance, in the _____, companies like Coca-Cola and PepsiCo fiercely compete for market share through advertising and product innovation. Finally, _____ is observed in cases like De Beers Group, which historically monopolized the diamond industry, controlling production, distribution, and pricing. Another example is _____, which has faced scrutiny for its dominance in the market for Computer operating systems with its Windows operating system, and _____, which holds a near-monopoly in the online search engine market.

Exercise ° 4: Look the following table.

Quantity	Total Cost	Fixed Cost	Variable Cost				Profit
0		\$62	—				
10		\$62	\$28				
20		\$62	\$48				
30		\$62	\$64				
40		\$62	\$82				
50		\$62	\$104				
60		\$62	\$130				
70		\$62	\$162				
80		\$62	\$202				
90		\$62	\$262				
100		\$62	\$342				

1. What would happen to the firm's profits if the market price increases to \$6 per pack of product? (Use Total and Marginal Approach to Find firm's profit maximization in this market)
2. What would happen to the output level ?
3. Explain in words why a profit-maximizing firm will not choose to produce at a quantity where marginal cost exceeds marginal revenue.



Exercise °5

The AAA Aquarium Co. sells aquariums for \$20 each. Fixed costs of production are \$20. The total variable costs are \$20 for one aquarium, \$25 for two units, \$35 for the three units, \$55 for four units, and \$80 for five units. In the form of a table, calculate total revenue, marginal revenue, total cost, and marginal cost for each output level (one to five units).

What is the profit-maximizing quantity of output ? On one diagram, sketch the total revenue and total cost curves. On another diagram, sketch the marginal revenue and marginal cost curves.

Exercise °6

A computer company produces affordable, easy-to-use home computer systems and has fixed costs of \$250. The variable cost of producing computers is \$500 for the first computer, The marginal cost of producing computers is \$250 for the second, \$300 for the third, \$350 for the fourth, \$400 for the fifth, \$450 for the sixth, and \$500 for the seventh.

- Create a table that shows the company's output, total cost, marginal cost, average cost, variable cost, and average variable cost.
- If the company sells the computers for \$500, is it making a profit or a loss? How big is the profit or loss?
- what is the zero-profit point ? what is the shutdown point ?



Solution of Series of Exercises No. 3 in Microeconomics 2 - Tutorials

Exercise °1: True or false (and correct it if false)

1. **True:** All firms in a perfectly competitive market sell **identical products**, eliminating product differentiation and creating perfect substitutes.

2. **False:** Individual firms in a perfectly competitive market can influence the market price.

Answer: Individual firms in a perfectly competitive market are **price takers**, meaning they have **no control** over the market price due to the large number of sellers and identical products.

3. **False:** Monopolistic competition features standardized products and few sellers.

Answer: Monopolistic competition involves differentiated products and numerous sellers, offering similar but not identical goods. This creates some brand loyalty but still maintains competitive pressure.

4. **False:** Barriers to entry always exist in monopolistic competition, preventing new firms from entering the market.

Answer: Monopolistic competition typically has relatively low barriers to entry, meaning new firms can introduce competing products with sufficient product differentiation.

5. **True:** Oligopoly refers to a market structure with a small number of large firms dominating the industry.

6. **True:** In oligopoly, firms are interdependent and consider each other's actions when making production decisions.

Answer: Due to the limited number of players, each firm's actions significantly impact the others. They engage in strategic decision-making, considering competitor responses and potential price wars.

7. **True:** Monopolies typically produce goods or services that have no close substitutes.

8. **False:** Monopolies are price takers in the market.

Answer: Monopolies are price makers, meaning they have control over the price of their product



Exercise °2: complete it with appropriate answer

1. The market for bottled water is an example of (perfect competition) because there are numerous (firms) producing identical products.
2. The market for wheat in regions where there are numerous small-scale farmers is considered a perfect competition market because each farmer produces a (homogeneous) product.
3. In a small town, there are multiple bakeries selling (identical) types of bread at the same price. This scenario demonstrates (perfect competition) because there is a large number of (sellers) and no single bakery can influence the market price.
4. In a perfectly competitive market, firms are considered (Price taker) because they must accept the prevailing market price as given.
5. In a perfectly competitive market, buyers and sellers operate with the assumption of perfect information, where all relevant information about prices, quantities, and market conditions is readily available.

Exercise ° 3:

In the realm of market structures, various industries showcase distinct characteristics. Monopolistic competition is exemplified by industries like fast food, retail clothing, and personal care products, where multiple firms offer similar products but differentiate themselves through branding and marketing strategies. On the other hand, oligopoly is evident in sectors such as the automobile industry, soft drink industry, and airline industry, where a few major players dominate the market. For instance, in the soft drink industry, companies like Coca-Cola and PepsiCo fiercely compete for market share through advertising and product innovation. Finally, monopoly is observed in cases like De Beers Group, which historically monopolized the diamond industry, controlling production, distribution, and pricing. Another example is Microsoft, which has faced scrutiny for its dominance in the market for Computer operating systems with its Windows operating system, and Google (Alphabet Inc.), which holds a near-monopoly in the online search engine market.

**Exercise °4**

Quantity	Total Cost	Fixed Cost	Variable Cost	MC	Total Revenue	MR	Profit
0	\$62	\$62	0	-	\$0	-	-\$62
10	\$90	\$62	\$28	2.8	\$60	6	-\$30
20	\$110	\$62	\$48	2	\$120	6	\$10
30	\$126	\$62	\$64	1.6	\$180	6	\$54
40	\$144	\$62	\$82	1.8	\$240	6	\$96
50	\$166	\$62	\$104	1.2	\$300	6	\$134
60	\$192	\$62	\$130	2.6	\$360	6	\$168
70	\$224	\$62	\$162	3.2	\$420	6	\$196
80	\$264	\$62	\$202	4	\$480	6	\$216
90	\$324	\$62	\$262	6	\$540	6	\$216
100	\$404	\$62	\$342	8	\$600	6	\$196

1. Holding total cost constant, profits at every output level would increase.
2. When the market price increases, marginal revenue increases. The firm would then increase production up to the point where the new price equals marginal cost, at a quantity of 90.
3. If marginal costs exceeds marginal revenue, then the firm will reduce its profits for every additional unit of output it produces. Profit would be greatest if it reduces output to where $MR = MC$.

**Exercise °5**

Output (Units)	Price (\$) \ \$	Total Revenue ()	Marginal Revenue (\$) \ \$	Variable Cost ()	Fixed cost	Total Cost (\$) \ \$	Marginal Cost ()	Profit (\$)
1	20	20	-	20	20	40	-	- 20
2	20	40	20	25	20	45	5	-5
3	20	60	20	35	20	55	10	5
4	20	80	20	55	20	75	20	5
5	20	100	20	80	20	100	25	0

Calculations:

- **Total Revenue (TR):** Price per unit * Quantity
- **Marginal Revenue (MR):** Change in Total Revenue due to selling one more unit (always the same as the price in a perfectly competitive market)
- **Total Cost (TC):** Fixed Cost + Variable Cost
- **Marginal Cost (MC):** Change in Total Cost due to producing one more unit

Profit-Maximizing Quantity:

The profit-maximizing quantity is the point where Marginal Revenue (MR) equals Marginal Cost (MC). From the table, this occurs when **4 units** are produced.

Diagram of Total Revenue (TR) and Total Cost (TC):

This diagram will have two lines. The TR line will be a straight line with a positive slope (since revenue increases proportionally with each unit sold). The TC line will also be a straight line, but with a fixed cost component initially causing it to be higher than the TR line at the origin. The two lines will eventually intersect, and the point of intersection represents the break-even point (where total revenue equals total cost).

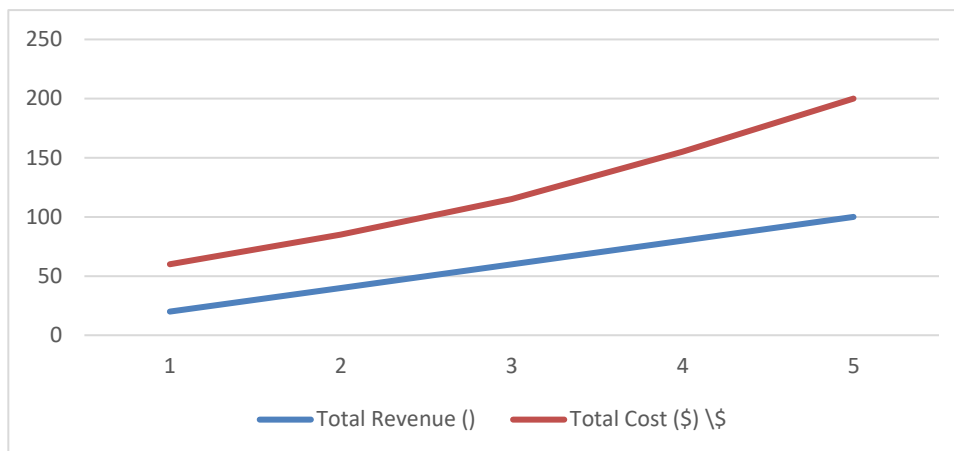
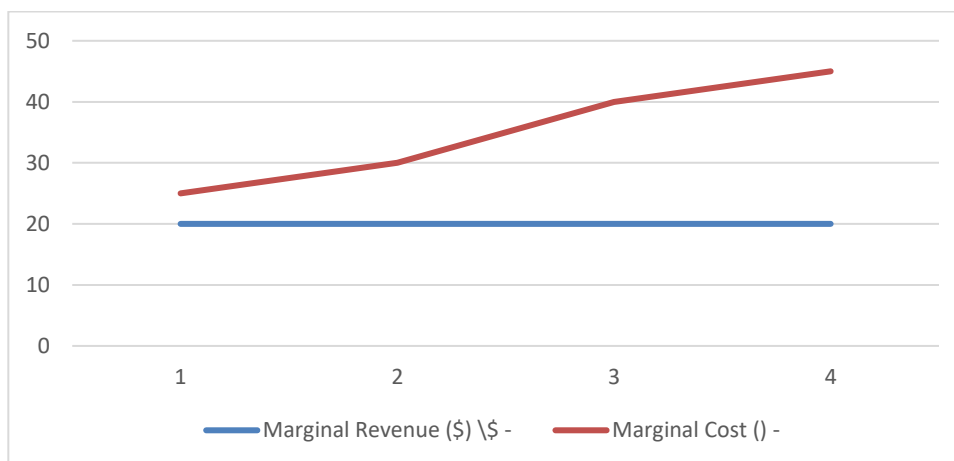


Diagram of Marginal Revenue (MR) and Marginal Cost (MC):

This diagram will also have two lines. Since marginal revenue is constant (equal to the price), the MR line will be a horizontal line at the price level (\$20). The MC line will typically have an increasing slope, reflecting the increasing costs of production as more units are produced. The profit-maximizing point occurs where the MR and MC lines intersect.



**Exercise °6****a. Table:**

Output (Units)	Fixed Cost	Variable Cost ()	Total Cost (\$)	Marginal Cost (\$)	Average Cost (\$)	Average Variable Cost (\$)	Total Revenue	MR	Profit
1	250	500	750	-	750	500	500	-	-250
2	250	750	1000	250	500	375	1000	500	0
3	250	1050	1300	300	433.33	350	1500	500	200
4	250	1300	1650	350	412.50	325	2000	500	350
5	250	1800	2050	400	410	360	2500	500	450
6	250	2250	2500	450	416.67	375	3000	500	500
7	250	2700	2950	500	421.43	385.71	3500	500	550

Calculations:

- **Total Cost (TC):** Fixed Cost (250) + Variable Cost (Marginal Cost of all previous units)
- **Marginal Cost (MC):** Information provided in the problem
- **Average Cost (AC):** Total Cost (TC) / Output (Units)
- **Variable Cost (VC):** TC - Fixed Cost
- **Average Variable Cost (AVC):** VC / Output (Units)

b. Profit or Loss at \$500 Selling Price:

- To determine profit or loss, we need to compare the Total Cost with the Revenue generated from selling the computers.
- Since the selling price is \$500 per computer, we can calculate the revenue for each production level by multiplying the selling price by the number of computers produced.

For example, if the company produces 2 computers:

- Revenue = Selling Price * Number of Computers = \$500 * 3 = \$1500
- Profit = Revenue - Total Cost = 200

Following this approach for different production levels, we can see if the company makes a profit or a loss.

- **Zero-Profit Point:** The production level where the Total Cost equals the Revenue (Profit = 0).
- **Shutdown Point:**

The shutdown point occurs when the Marginal Cost (MC) is greater than the price. Looking at the marginal cost data:

- The lowest Marginal Cost is \$250 (for the second unit).

Therefore, the **shutdown point is at a price below \$250**. In other words, if the price falls below \$250, the company would incur a loss by producing even a single unit (since the marginal cost would be higher than the revenue).