NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF BUSINESS AND HUMAN RESOURCES

COURSE CODE:BHM 200:

COURSE TITLE:BUSINESS ECONOMICS (MICROECONOMICS)

COURSE GUIDE

BHM 200: BUSINESS ECONOMICS (MICROECONOMICS)

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1.0 INTRODUCTION

You are welcome to BHM 200: Business Economics (Microeconomics). BHM 200 is a two credit unit course at 200 level B.Sc. in Entrepreneur and Business Management. It is an introduction to the study of microeconomics and the course has fifteen units.

This course guide is intended for the distant learners enrolled in the B.Sc. Programme of National Open University of Nigeria (NOUN). The guide is one of the diverse resource tool made available to the learner to facilitate timely completion of the programme.

The guide provides quite useful information on the course aims, objectives, what the course is all about, the course materials that the learner will be using, available support services for learning, information guidelines on assignments and examination, such as planning of the timing on the assignments and each unit. This guide also provides answers to several questions that you may ask. Thus, it is strongly recommended that the learner go through this course guide.

The learner is however advised to contact his/her study centre if there are further questions. I wish you all the very best in your experience and successful completion of this study.

Course Aims

The course applies analytical approach, aim at developing the economic way of thinking, makes the careful step-by-step introduction of different analytical models in microeconomics. The primary aim of this course is to acquaint you with the basic theoretical, principles, concepts and practical knowledge of microeconomics

2.0. Course Objectives

At the end of this course, you should be able to:

- Discuss the concept of microeconomics.
- Discuss the basic concepts of microeconomics
- Analyse the theories of demand and supply.
- Analyse the concept of elasticity
- Discuss the basic market structures
- Discuss the theory of production and consumption.
- Discuss linear programming.

3.0. Course Materials and Structure

The learner is admonished to read through this course guide to familiarize him/herself with the structure of the course. This is to be done by reading the study units properly and attempting all self assessment exercises, completing and submitting all tutor marked assignments for the course and consulting recommended sources for further reading.

Each unit contains self-assessment exercises and in appropriate places you are required to submit assignments for assessment purposes. There will be a final examination at the end of the course. Each unit should take you about four (4) hours to complete, giving you a total of about sixty (60) hours to complete the course. In order to successfully complete the course on time, you are advised to draw up a personal time schedule that will enhance the achievement of this goal.

Below are the components of this course.

Study Units

MODULE 1
MEANING AND INTRODUCTORY MICROECONOMIC ANALYSIS

UNIT 1: Meaning, Scope, Methods and Importance of Microeconomics
UNIT 2: Some Basic Concepts of Economics
UNIT 3: The Theory of Demand
UNIT 4: The Theory of Supply
UNIT 5: The Theory of Market Price
UNIT 6: The Concept of Elasticity

MODULE 2
MARKET STRUCTURE

UNIT 7: Theory of Perfect Competition
UNIT 8: Theory of Monopoly
UNIT 9: Theory of Monopolistic Competition
UNIT 10: Theory of Oligopoly
UNIT 11: Natural Monopoly

MODULE 3

UNIT 12: Theory of Consumer Behaviour
UNIT 13: Theory of Production
UNIT 14: Theory of Cost
UNIT 15: Linear Programming

Course Summary

Module 1 introduces you to the meaning and introductory microeconomic analysis. Module 2 discusses market structure, and Module 3 discusses consumer behaviour and production analysis.

There are fifteen study units in the course and each unit consists of one week's work which requires about three to four hours (3-4 hrs) to complete. There are specific objectives, guidance for the study, reading materials, self assessment exercises and tutor marked assignments to assist you in achieving the learning objectives in each individual study unit and the course in general.

4.0. STUDY PLAN

Find below the presentation of the course and how long it takes you to complete each study unit and the assignment that accompany each unit. This is to help you plan your own personal timetable.

Unit/Module	Title of Study Unit	Week/Activity	Assignment
	Course guide	1	Course guide form
Module 1			
Unit 1	Meaning, Scope and Importance of Microeconomics	2	Tutor-marked Assignment
Unit 2	Basic concepts of Microeconomics	3	Tutor-marked Assignment
Unit 3	The Theory of Demand	4	Tutor-marked Assignment
Unit 4	The Theory of Supply	5	Tutor-marked Assignment
Unit 5	The Theory of Market Price	6	Tutor-marked Assignment
Unit 6	The Concept of Elasticity	7	Tutor-marked Assignment
Module 2			
Unit 7	The Theory of Perfect Competition	8	Tutor-marked Assignment
Unit 8	The Theory of Monopoly	9	Tutor-marked Assignment
Unit 9	The Theory of Monopolistic Competition	10	Tutor-marked Assignment
Unit 10	The Theory of Oligopoly.	11	Tutor-marked Assignment
Unit 11	Natural Monopoly	12	Tutor-marked Assignment
Module 3			
Unit 12	Theory of Consumer Behaviour	13	Tutor-marked Assignment
Unit 13	Theory of Production	14	Tutor-marked Assignment
Unit 14	Theory of Cost	15	Tutor-marked Assignment
Unit 15	Linear Programming	16	Tutor-marked Assignment
	Revision	17	
	Examination	18	
	Total	18	

References/Further Readings

Although the course material is the main text for this course, you are however encourage to consult other sources as provided in the list of references and further readings blow;

Aboyade, O. (1983): Intergrated Economics, a Study of Developing Economies (Addison-Wesley London).

Ahuja, H. L. (2006): Advanced Economic theory; Microeconomic Analysis (15th Ed). S. Chand & Company Ltd. New Delhi, India.

Arrow, K. J. (1959): Toward a Theory of Price Adjustment. In M. Abrahmovitz (Ed). The Allocation of Economic Resources, Stanford; Stanford University Press, Pp. 41 – 55.

Barndis, R (1972): Principles of Economics (Irwin, Homewood)

Berg, Banford. (1988). Natural Monopoly Regulation: Principles and Practices. Cambridge University Press.

Clifton, J. A. (1977): "Competition and the Evolution of Capitalist Mode of Production." Cambridge Journal of Economics, Vol. 1, No. 2, Pp. 137 – 151.

Friedman, M. (2002): "VIII: Monopoly and the Social Responsibility of Business and Labor" (Paperback). Capitalism and Freedom. (40th Anniversary Ed).

John Black (2002) : A Dictionary of Economics (2nd Ed). Oxford University Press.

Kreps, D. M. (1990): A Course in Microeconomic Theory, New York: Harvester Wheatsheaf.

Lipsey, R. G. (1978): An Introduction to Positive Economics. (Weidenfield and Nicolson, London).

Mai-Lafia, D. I. (2005): Understanding Economics 2nd ed. Data Quest Publishers, Lagos, Nigeria.

Osagie, E. (1978): Elements of Economics, Principles, Policies and Essays (Ogios, Ibadan).

Oyeniyi, T. A (1988): Micro-economics (Challenge, Jos).

Petri, F. (2004): General, Equilibrium, Capital and Microeconomics. Cheltenham: Edward Elgar.

Samuelson, P. A. (1947): Foundations of Economic Analysis. Cambridge, Mass. P. 257.

Samuelson, P. A. (1980): Economics, 11th Ed. (Mac Graw-Hill Tokyo).

Train, K. E. (1991). Optimal Regulation: The Economic Theory of Natural Monopoly. Cambridge, MA, USA: MIT Press. ISBN 978–0262200844.

Waterson, M (1988). Regulation of the Firm and Natural Monopoly. New York, NY, USA: Blackwell. ISBN 0–631–14007–7.

5.0 HOW TO GET THE MOST FROM THIS COURSE

In distance learning, the study units replace the lecturer. There is the advantage of reading and working through the course material at the pace that suits the learner best. You are advised to think of it as reading the lecture as against listening to the lecturer. The study units provide exercises for you to do at appropriate periods instead of receiving exercises in the class.

Each unit has common features which are designed purposefully to facilitate your reading. The first feature being an introduction to the unit, the manner in which each unit is integrated with other units and the entire course. The second feature is a set of learning objectives which let the learner to know what should be done by the time the unit is completed. These objectives should guide your study. After completing the unit, you should go back and check whether you have achieved the objectives or not. The next feature is self assessment exercises, study questions which are found throughout each unit.

The exercises are designed basically to help you recall what you have studied and to assess your learning by yourself. You should do each self-assessment exercise and the study question as you come to each in the study unit. The next features are conclusion and summary at the end of each unit. These help you to recall all the main topics discussed in the main content of each unit. There are also tutor-marked assignments at the end of appropriate units. Working on these questions will help you to achieve the objectives of the unit and to prepare for the assignments which you will submit and the final examination.

It should take you between three to four hours (3-4 hrs) to complete a study unit including the exercises and assignments. Upon the completion of the first unit, you are advised to note the length of period it took you and use this information to draw up a timetable to guide your study of the remaining units. The margins on either sides of each page are meant for you to make notes on main ideas or key points for your usage when revising the course. These features are for your usage to significantly increase your chances of passing the course.

Course Delivery

There are many ways of learning as an open distant learner. You learn when you interact with the content in your course material just as a student interacts with the teacher in a conventional institution. You also learn when you are guided through the course. Though you are not taught the course, your course material is however your teacher and as such you will not be able to get answers to any questions which may arise from your study of the material. For this reason, apart from the course material which you have received, the delivery of this course is aided by tutorial, facilitation and counselling support services. There services are not compulsory but you are encouraged to maximally take advantage of them.

Tutorial Sessions

A total of eight (8) hours are set aside for this course and they form a part of your learning process as you have an opportunity to receive face-to-face interaction with your informal facilitator and to receive answers to questions or classifications which you may have. Also, you may contact your tutorial facilitator by telephone or e-mail.

As an open and distant learner, you are expected to prepare ahead of time by studying the relevant study units, write your questions so as to gain maximum benefit from tutorial sessions. Information about the location and time schedule for facilitation will be available at your study centre.

Note that tutorial sessions are flexible arrangements between you and your tutorial facilitator. You will need to contact your study centre to arrange the time schedule for the sessions. You will also need to obtain your tutorial facilitator's phone number and e-mail address.

Tutorial sessions are optional however; participating in them provides tremendous benefits because they provide a forum for interaction and group discussions which will maximise the isolation you may experience as an open and distant learner.

Facilitation

This is a learning process that takes place both within and outside of tutorial sessions. Your tutorial facilitator guides your learning by doing the following things.

- Providing answers to your questions during tutorial sessions on phone or by e-mail
- Coordinating group discussions
- Providing feedback on your assignments
- Posing questions to confirm learning outcomes
- Coordinating, marking and recording your assignments/examination score(s)
- Monitoring your progress.

English language is the language of instruction for this course. The course material is available both in print and in CD. It is also on the National Open University if Nigeria website. However, on your part, you are to prepare ahead of time by studying and writing your questions so as to maximally benefit from facilitation.

Information about the location and time of facilitation will be available at your study course. This is a flexible arrangement between you and your tutorial facilitator. You should contact your tutorial facilitator whenever:

a. You do not understand any part of the study unit

b. You have difficulty with the self assessment exercises
c. You have a question or a problem with an assignment, with your tutorial facilitator's comments on an assignment or with the grading of an assignment.

Counselling

Counselling is your part of learning which helps to facilitate the learning process. This service is available to you at two levels-academic and personal. At the study centre, student counsellors are available to provide guidance for personal issues that may affect your studies. In addition, your tutorial facilitators and study centre manager can assist you with questions on academic matters such as course materials, grades, facilitation, etc. Endeavour to have the telephone numbers and e-mail addresses of your study centre and these different individuals who provide counselling services to you at an open and distant learning study centre.

Assessment

The self-assessment exercise assignments at the end of each unit, the tutor-marked assignments and the final written examination form three components of assessment for this course. In doing these assignments, you are required to use the information gathered during your study of the course. Find below detailed explanations on how to do each assignment.

Self Assessment Exercises (SAEs)

There are several self-assessment exercises spread through your course material; you are expected to attempt each immediately after reading the section that precedes it. Possible answers to the exercises are sometimes given at the end of the course book. Nevertheless, you are advised to refer to them only after you must have attempted the exercises. This is because the exercises are meant to evaluate your learning. They are not to be submitted. There are also study questions spread through the study units. You are expected to attempt these questions after reading a study unit. These questions are to aid you assess knowledge of the contents of the unit only. You are not required to submit the answers to them too.

6.0. Tutor-Marked Assignments (TMAs)

There are twelve selected tutor-marked assignments for this course. These TMAs are designed to cover areas treated in the course. You will be assessed on all twelve, but only the best three will constitute your continuous assessment. Each of these three carries 10% and altogether will court for 30% of your total score for the course. You will be given these assignments and the dates for submitting them at the study centre. The assignments must be submitted to your tutorial facilitator for formal assessment on or before the stipulated dates for submission.

The twelve selected TMA questions to be answered are

(ii) Unit 1, Question 3
(iii) Unit 3, Question 3
(iv) Unit 5, Question 2
(v) Unit 6, Question 2
(vi) Unit 7, Question 2
(vii) Unit 7, Question 3
(viii) Unit 8, Question 2
(ix) Unit 10, question 2
(x) Unit 10, Question 3
(xi) Unit 12, Question 2
(xii) Unit 13, Question 3
(xiii) Unit 15, Question 2

Guidelines for Writing Tutor Marked Assignments

- The cover page of your tutor-marked assignment, should look like this:

  Course code _____

  Course title _____

  Tutor marked assignment number _____

  Name _____

  Date of submission _____

  Matriculation number _____

2. You should ensure to be brief and straight to the point in your answers. Such answers should be based on your course material, further readings and experiences. However, you are **NOT** to copy from any of these materials. In the event that you copy from these materials, you will be penalised. You are to give relevant examples and illustrations.

3. Use ruled foolscap-sized paper for writing your answers. Remember to make and keep a copy of your assignments

4. Your answers are to be hand written by you and using a margin of about 1.5 inches of the left side and about 5 lines before the answer to the next question for your tutorial facilitator's comments.

5. Upon the completion of each assignment, ensure it reaches your tutorial facilitator on or before the deadline.

You are to contact your study centre manager and tutorial facilitator if for any reason you cannot complete your work on time before the assignment is due to discuss the possibility of any extension Remember that no extension will be granted after the due date unless under exceptional circumstances.

7.0. Final Examination and Grading

The final examination for BHM 200 will be for 2½ hours duration and will carry 70% of to the total course grade. The examination will be made up of questions which reflect the kinds of self assessment exercises, study questions and tutor marked assignments which you have previously encountered. Remember that all areas of the course will be assessed. The period between finishing the last unit and taking the examination should be used to revise the entire course. You are advised to review your answers to the self-assessment exercises and the tutor marked assignments before the commencement of the examination. You are to note that the following determine your eligibility to sit for the final examination.

- Your submission of all the tutor-marked assignments
- Your registration to sit for the examination. The dateline for this registration will be provided at your study centre. Where you sit for the examination without having met these conditions means you will not have a score for the course.

Course Marking Scheme

The marks that make up the total score for this course are as shown in the table below:

Assessment	**Marks**
Assignments (four submitted but the best three will be selected	10% of the selected marked assignments, totalling 30%
Final examination	Examination score 70%
Total	Overall course score 100%.

8.0. CONCLUSION

All the features of this course guide have been designed to facilitate your learning process in order that you achieve the aims and objectives of this course. There features include the aims, objectives, course summary, course overview, self assessment exercises and study questions. You should endeavour to make maximum use of them in your study to achieve maximum results.

MAIN COURSE

BHM 200: BUSINESS ECONOMICS (MICROECONOMICS)

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MEANING AND INTRODUCTORY MICROECONOMIC ANALYSIS

MODULE 2

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MODULE 3

UNIT 1 MEANING, SCOPE, METHODS AND IMPORTANCE OF MICROECONOMICS

CONTENTS

1.0 INTRODUCTION

The subject - matter of economics has been divided into two parts: Microeconomics and Macroeconomics. This terms were first coined and used by Ragnar Frisch and have now been adopted by economist all over the world. Microeconomics deals with the analysis of small individual units of the economy while macroeconomics concerns itself with the analysis of the economy as a whole and its large aggregates such as national output and income, total employment, total consumption and aggregate investment. We will confine ourselves to microeconomics.

In this unit therefore, we shall examine the concept of microeconomics, scope of microeconomics, methodology of economics, uses of microeconomics and the importance of microeconomics to businesses.

2.0 OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of microeconomics
- Discuss the scope of microeconomics
- Discuss the methodology of microeconomics
- Discuss the use of microeconomics
- Explain the importance of microeconomics to businesses.

3.0 MEANING, SCOPE, METHODS AND IMPORTANCE OF MICROECONOMICS

3.1 The Meaning of Microeconomics

The term microeconomics is derived from the Greek word “micros” meaning ‘small’. Thus, microeconomics deals with the analysis of small individual units of the economy individual consumers, individual firms and small aggregates of individual units such as various industries and markets. In microeconomic theory, we discuss how the various cells of economic organism, that is, the various units of the economy such as, many

consumers, many producers or firms, various workers and resource suppliers in the economy do their economic activities and reach their equilibrium.

In other words, microeconomics makes a microscopic study of the economy. We discuss equilibrium of the innumerable units of the economy piecemeal and their interrelationship to each other. For instance, in microeconomic analysis, we study the demand of an individual consumer for a good and from there go on to derive the market demand for the good (i.e demand of a group of individuals consuming a particular good). It also study's the behavior of firms in regard to the fixation of price and output and their reactions to changes in market conditions. From there, we proceed to price-output fixation by the entire industry (a group of firms producing the same product).

SELF- ASSESSMENT EXERCISE
What is microeconomics?

THE SCOPE OF MICROECONOMICS

There has been a lot of controversy among economist about the true scope of economics or the subject - matter. In general, the scope and subject matter of economics (be it microeconomics or macroeconomics) can be better known by spelling out the questions economist have been asking and the basic economic problems they have concerned with. The fundamental questions are;

(i) What goods to be produced and the quantity that will be produced with scarce resources.
(ii) What production methods to employ
(iii) How is the total output distributed in the economy
(iv) Are the use of productive resources economically efficient
(v) Whether all productive resources are fully utilized
(vi) Is the economy's productive capacity increasing, decreasing or static over time.

All these problems arise from the fundamental problem of scarcity. Thus, microeconomics study's how decisions are taken, at the micro level, on solving the above basic problems. Microeconomics seeks to determine the mechanism by which the different economic units attain the position of equilibrium proceeding from the individual units to a narrowly defined group as follows;

(i) ***The Study of Resource Allocation, Product and Factor Pricing:*** It takes the total quantity of resources as given and seeks to explain how they are allocated to the production of particular goods. It is this allocation that determines what goods shall be produced and how they shall be produced. Also, in a free market economy, the prices of the various goods and the prices of the various factors of production determines the allocation of resources to the production of various goods. Prices of the goods and factors of production in turn depends on t he forces of demand and supply which microeconomics study's.

(xiv) ***A Study of Economic Efficiency:*** Besides analyzing pricing and the allocation of resources, it seeks to explain whether the allocation of resources is efficient. Efficiency is attained when the resources are so allocated that

maximizes the satisfaction of the society. Economic efficiency involves three efficiencies; Efficiency in production, Efficiency in the distribution of goods or consumption and allocative efficiency, that is, efficiency in the direction of production. Efficiency in production involves minimization of cost and the maximization of profits. Efficiency in consumption involves distributing goods in such a way as to maximize the total satisfaction of the society. Efficiency of allocation involves producing those goods, which are most desired so as to maximize total welfare.

(xv) ***Microeconomics and the Economy as a Whole:*** Microeconomics is concerned with the discussion of the problem of the allocation of resources in the society and judging the efficiency of the same. Both microeconomics and macroeconomics analyse the economy in two different ways. Microeconomics examines the economy as a whole 'microscopically', that is, it analysis the behavior of individual economic units, their interrelationships and equilibrium adjustment to each other, which determines the allocation of resources in the society. This is known as general equilibrium analysis.

SELF-ASSESSMENT EXERCISE

Discuss the scope of microeconomic analysis.

3.3 Methodology of Economics

There are certain methodologies, principles and assumptions employed in economic analysis. They are:

(i) ***Deductive or abstract method:-*** The deductive method deduces conclusions from certain fundamental axioms or assumptions established through other methods by logical process of reasoning. Using this method, economist proceed from reasoning to the study of facts and verifications of conclusions arrived at. This method is referred to as hypothetical because some assumptions may not correspond to facts. They may however, be so near to facts that they may be used as premises for reasoning and deriving conclusions. It is called "abstract" because the problem is simplified, removing call irrelevant facts.

The advantages of the deductive method include;

- Useful mathematical techniques can be used to develop economic theories through the process of deduction.
- Economic theories can be derived without the tedious and detailed data collection under inductive method.
- Controlled experiment is not possible in economics hence deduction is useful.
- The use of mathematical methods in this approach makes economists introduce exactness and accuracy in economic theories and principles.

A disadvantage of this method is that it is difficult to test results obtained in economic science through deductive reasoning. At times, the problems are so complex that confirmation is almost impossible. Finally, one advantage of this method is that it is very useful in mathematics particularly geometry; but what is useful in geometry cannot be at all times applied to economics.

ii. ***The inductive or Historical method:-*** The inductive method is based on prior examination of facts. The concrete, realistic, historical or inductive method start with facts

or collected data and on their basis attempt at a generalization. Inductive involves three steps. They are: (a) Experimentation, (b) Observations, (c) Statistical or econometric method.

The advantages of this method include:

- It is used to check and verify the conclusions of old "deductive" economists.
- This method emphasizes the fact that any generalization will have validity only under certain conditions, in certain places and at a particular period of time.
- It stresses the importance of relativity.

However, it has some disadvantages, one of which is the absence of hypothesis, that is, a working explanation to guide and direct the enquirer in his study. Though later writers of this school of thought avoided this difficulty by using hypothesis. Although arbitrary assumptions should be avoided but some hypothesis and some general ideas will be necessary to guide the economist, otherwise he will find facts difficult to handle.

i. ***Intergration of the two methods:-*** The controversy existing among the earlier economist have been resolved that both inductive and deductive methods are complementary rather than competitive in developing economic theories. The modern economists first derive economic hypothesis through the process of logical deduction and then empirically test them through statistical or econometric methods. However, empirical studies made through statistical or inductive method without a theoretical hypothesis to serve as a guide for the selection of data are quite useless. If the predictions on the hypothesis are tested through inductive method and it is found out that they are consistent with facts, the hypothesis or theory (based on deduction) stands proved, and if the predictions of the theory are found to be inconsistent with facts, it stands rejected.

SELF ASSESSMENT EXERCISE

Differentiate between the deductive and the inductive methods. How is the controversy resolved?

3.4. Uses of Microeconomics

The importance and uses of microeconomics include;

i. It is helpful for the formulation of economic policies that promotes the welfare of the masses. It tells us how free market economy works to decide about the allocation of productive resources among goods and services. It further tells us how these goods and services are distributed in the economy through price mechanism.

ii. Again, it explains the conditions of efficiency in production and consumption and highlights the factors, which are responsible for the departure from the efficiency or economic optimum. It suggests suitable policies to promote economic efficiency and the welfare of the people.

Importance of Microeconomics

i. Modern economy is so complex that a central planning authority will find it too difficult to get all the information required for the optimum allocation of resources. Microecomics reveals how a discentralised system of a free private enterprise economy functions without any central control.

ii. It shows how monopoly leads to misallocation of resources resulting to loss of efficiency and welfare and also shows how perfect competition in the product and factors markets leads to optimum welfare.

iii. Externalities exist when the production and consumption of a commodity affects other people than those who produce, sell or buy it. Microeconomics reveals that when externalities exist, free working of the price mechanism fails to achieve economic efficiency.

SELF ASSESSMENT EXERCISE

Discuss the uses of microeconomics

3. Importance of Microeconomics to businesses

The importance of microeconomics to businesses include;

i. It studies resource allocation which determines what goods shall be produced and how they shall be produced. Therefore it helps businesses decide the good to produce and how the are to be produce to meet the needs of consumers and for optimal gains for the firms.

ii. The theory of product pricing falls within the domain of microeconomics. This helps business in setting the prices of their products for their optimal benefit and that of the society.

iii. The theory of factor pricing also fall under the domain of microeconomics. The theory of distribution or factor pricing explains how wages, rent, interest and profits are determined. These payments to factors of production are crucial for every business.

iv. Demand depends an behaviour patterns of consumers and supply depends on production cost and the behaviour patterns of firms. Thus, demand and supply analysis is needed to explain the determination of prices of goods and factors.

v. Microeconomic analysis help businesses in minimization of cost and maximization of profits.

SELF- ASSESSMENT EXERCISE

Discuss the importance of microeconomics to business.

4.0. CONCLUSION

In conclusion, microeconomics is the study of how the various cells of economic organization, that is, the various units of the economy such as consumers, producers, workers and resource suppliers in the economy do their activities and reach equilibrium states. It is therefore, not only vital for policy formulation by the government but crucial for the welfare of individual consumers and maximization of profits for business.

5.0. SUMMARY

This unit examined the concept of microeconomics and its scope. It further looked at its methodology and its importance to the economy.

6.0. TUTOR – MARKED ASSIGNMENT

What is microeconomics?
2 Brief discuss the scope of microeconomics
3 Brief discuss the uses of microeconomics

7.0. REFERENCES/ FURTHER READINGS

Ahuja, H. L. (2006). Advanced Economic theory: Microeconomic Analysis (15th Ed.). New Delhi: S. Chand & Company Ltd.

Samuelson, P. A. (1947). Foundations of Economic Analysis. Cambridge, Mass. P. 257.

Mai-Lafia, D. I. (2005). Understanding Economics (2nd Ed.). Lagos: Data Quest Publishers.

UNIT 2 SOME BASIC CONCEPTS IN MICROECONOMICS

CONTENTS

1.0. INTRODUCTION

There are so many concepts involved in the discipline of economics hence, microeconomics cannot be an exception. Some of these concepts are so important that their understanding services as a beginning to the study of economics.

In this unit therefore, we shall examine such concepts in microeconomics as, scarcity, resources, factors of production and utility. Other concepts to be considered are, costs in puts and outputs, firms and industry, short run and long run and the concept of equilibrium.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Theoretically explain these concepts
- Graphically demonstrate these relationships if they exist
- Mathematically demonstrate how these relationship work in case they exist.

3.0. SOME BASIC CONCEPTS IN MICROECONOMICS

3.1. The Concept of Scarcity and Choice

Scarcity refers to the relative unavailability of resources in terms of defined catalogue of wants. Choice is on the other hand is an act of choosing between two or more possibilities. An economy exists because of two basic facts. First, human wants. For goods are unlimited, and secondly, productive resources with which to produce goods and services are scarce. With our wants unlimited and resources to satisfy all our wants by producing everything we desire hence the choice of utilization of scare resources for the maximum possible satisfaction of the society.

Since resources are relatively scarce in relation to numerous wants, the society is faced with the problem of choice among the vast array of wants that are to be satisfied. The scarcity of resources relative to human wants gives rise to the struggle of man for substance and efforts by him to promote his well - being. Thus, the problem of scarcity gives rise to some problems generally known as "basic economic problems" which a society has to solve so as to promote material well – being of its people.

SELF- ASSESSMENT EXERCISE
Discuss the concepts of scarcity and choice

3.2. The concept of resources

A resource refers to anything, which can contribute to economic activity. They are means or instruments for the production of goods and services for human consumption. They include natural resources, including both those located on land and those in or under the sea; human resources, including labour of various skills and qualifications, and capital goods or man – made means of production. In fact, economics can be defined as the study of how resources are allocated or utilized.

The characteristics of resources include;

i. Unavailability i.e. are limited
ii. Usage in the production of a wide variety of goods
iii. They can be combined indifferent proportions to produce a given good.

SELF ASSESSMENT EXERCISE
What are resources?

3.3. Utility

The concept of utility is used to represent the satisfaction an individual derives from consuming a given good or service. It is a synonym for individual welfare. Economics have differenced to whether utility should be regarded as cardinal (measurable) or ordinal can only be ordered. There are two basic concepts of utility; Total utility and marginal utility. Total utility and marginal utility. Total is the measure of total satisfaction resulting from a given amount of goods. As we increase the amount of goods consumed, total utility increases but at a decreasing rate. It is a measure of the total welfare of an individual on the other hand, marginal utility is the increment to total utility resulting from a unit increase in quantity. It measures how much utility a consumer derives as a result of the consumption of an additional unit of a commodity.

SELF ASSESSMENT EXERCISE
What is Utility?

3.4. Factors of production

A factor production refers to any resource used in the production of goods or services. They are broad categories of economic resources enumerated as follows:

i. ***Labour***: It refers to human beings as factors of production. It encompasses human physical and mental effort used in the production of goods and services. It can be either skilled or unskilled.

ii. ***Land:*** This may be defined to include all natural resources such as water, mineral deposits and soil for cultivation of crops. They are used in the production of goods and services.

iii. ***Capital:-***It is man made means of production. They are designed to be used in production such as machinery, equipment, factory buildings and transport facilities. They also include a stock of financial assets, which can be used to provide an income.

iv. ***Entrepreneurship:-*** It is the human ability to organize the combination of other factors of production in the process of producing goods and services, to take business decisions, introduce innovation and to risk funds.

SELF ASSESSMENT EXERCISE
What are factors of production?

3.5. The concept of costs

Cost (s) generally refers to the value of the inputes (usually in monetary terms) needed to produce any good or service. When economist talk of cost, they in most cases, refer to opportunity cost which refers to the cost of the alternative foregone. The accountant regards exploit costs which are outlays made by a firm or company such as wages and salaries, raw materials etc. on the other hand, the cost of the best alternative use of owners time or the cost of self owned resources in production i.e. implicit costs are ignored by the accountant. Cost to an economist includes both explicit and the implicit costs of production.

SELF ASSESSMENT EXERCISE
What is cost?

3.6. Inputs and Outputs

Inputs refer to economic resources combined and used in the production process. They are intermediate products used in the production of goods and services such as capital, raw materials and labour. On the other hand, outputs are the final results of the production process. Where a process produces goods, measurement of output is straight forward, but where a process produces services, measurement of output raises problems. Therefore inputs are used in the production process as intermediate products in producing the final goods and services (Output).

SELF-ASSESSMENT EXERCISE
Differentiate between inputs and outputs?

3.7. Short – run and long – run

In the short – run, a firm employs a given (fixed) amount of some resources known as fixed cost (FC), and also other resources that can be varied or are variable refereed to as variable cost (VC). Therefore, in the short – run total cost of production (TC) is equal to fixed cost (FC) plus variable cost (VC) i.e. TC = FC + VC. In this regard, the short – run is a production period where a firm cannot vary the utilization of its fixed cost.

The long – run represents a period within which a firm can vary the utilization of all its productive resources. Hence in the long – run, there are no fixed costs, all costs are variable. This implies that total cost (TC) is equal to variable cost (CV) i.e. TC = VC

SELF ASSESSMENT EXERCISE
Differentiate between the short – run and long – run periods

3.8. The concept of equilibrium

The concept of equilibrium was derived from the Latin Words, acqus Libra. 'Acqus' means equal and 'Libra' means balance, thus the term equilibrium means equal balance. It is a position of rest. It is the most cosy position toward which every economic; firm, resource owner industry, the economy has a tendency to move or from which it has no incentive to deviate from. Thus, the attainment of equilibrium is the ultimate goal of all economic activities in the economy.

Inspite of the fact that it is a position of rest, it not characterized by absence of activity. There are economic activities in a state of equilibrium. In this state, consumers purchase goods and services and producers supply goods and services. A system therefore, is in equilibrium when the various determinant forces behave in such a fashion that the system shows no tendency towards any change. Different types of equilibrium include; short and long-run equilibrium, stable, unstable, neutral, single, multiple, static, dynamic, partial and general equilibrium.

SELF-ASSESSMENT EXERCISE
What is equilibrium?

3.9 Firms and industry

A firm is the basic unit of decision taking in a decentralized economy. It is an organization or a company that specializes in the production of a good or service. An example is Zenith Bank which is a firm supplying banking services, and Ashaka Cement supplying building materials (Cement).

On the other hand, an industry is the collection of firms producing same or identical goods or services. it is a sector of the economy in which firms use similar factor inputs to make a group of related products. An example is the Banking Industry.

SELF ASSESSMENT EXERCISE
Differentiate between a firm and an industry.

4.0 CONCLUSION

In conclusion, these concepts are important in the study of microeconomics. These concepts are among concepts that understanding them serves as the beginning of the study of microeconomics.

5.0 SUMMARY

This unit basically looked at some of the basic concepts in microeconomics. Concepts such as; Scarcity and Choice, Utility, Resources, Factors of Production and Costs were

examined. Others include, inputs and output, Short-run and Long-Run, Firms and Industry, and the concept of equilibrium.

6.0 TUTOR-MARKED ASSIGNMENT

(1) Differentiate between the following;
   (a) Firms and Industry
   (b) Inputs and Output
   (c) Short-run and Long-run

(2) What is Equilibrium?

(3) Write short notes on the following;
   (a) Resources
   (b) Factors of Production
   (c) Costs

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UNIT 3 THE THEORY OF DEMAND

CONTENTS

1.0. INTRODUCTION

The market price of a commodity is influenced by the demand of consumers or their ability to purchase a product, and by the supply of the commodity that firms offer for sale. The demand schedule shows the quantities of a good or service that people want to buy at different prices. Therefore, the demand function relates demand to factors determining it.

In this unit, we shall examine the concept of demand, the demand schedule and the demand curve the reasons for the downward sloping demand curve, the determinants of demand and the difference between shift in demand and change in quantity demanded.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of demand
- Explain demand schedule and the demand curve
- Discuss the reason for the downward sloping demand curve
- Discuss the determinants of demand
- Differentiate between shift in demand and change in quantity demanded

3.0. THE THEORY OF DEMAND

3.1. The Concept of Demand

The demand for a commodity is the quantity of that commodity, consumers are willing and able to buy at a given point in time and at a given price. This implies that consumer purchases are linked with various commodity prices. However, the purchase of a commodity does not depend, on price alone. Other factors do affect the demand for a commodity.

The law of demand states that, “The higher the price, the lower the quantity demand and vice versa, all other factors affecting demand remaining constant”. The assumption of ceteris paribus (all other factors remaining constant) is important. This is due to the fact that consumer demand can change even if the price of the commodity remains unchanged.

SELF- ASSESSMENT EXERCISE
Q Define demand and state the law of demand

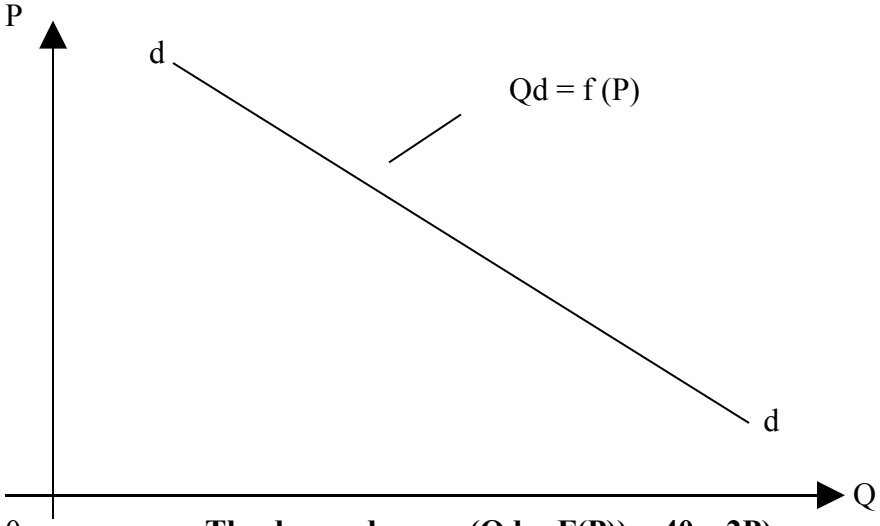
3.2. DEMAND SCHEDULE AND THE DEMAND CURVE

Demand schedule means the relationship between the market prices and the amount of goods that consumers are willing and able to buy. In line with the law of demand, there exist a negative relationship between quantity demanded and the price of that commodity. When price increases, the demand will reduce (all other factors affecting demand remaining constant). Hence the demand function is Qd = F/P), where the coefficient of P is negative.

The demand curve is the geometrical representation of the demand schedule. It is a negative function of price i.e. the curve slopes downward from left to right. Assuming the following demand function Qd = 40 – 2p, when price is equal to N1.00, quantity demanded is Qd = 40 – 2 (1) = 40 – 2 = 38untis

Example of the demand schedule

Price of good (x)	1	2	3	4	5	6
Quantity demand of good (x)	38	36	34	32	30	28



The demand curve (Qd = F(P)) = 40 – 2P)

SELF ASSESSMENT EXERCISE
1 What is demand schedule and demand curve?
2 Given the demand function for a commodity as Qd = 20 - 6P with P as 7, 8, 9, 10, 11, draw the demand curve.

3.3. Reasons For The Downward Sloping Demand Curve

According to the law of demand, the higher the price, the lower the quality demanded and vice versa (certeris paribus). When the price of a commodity reduces, more people can afford it hence those new buyers will increase the total demand for the product. Again, each extra reduction in price may be met by extra

purchases from existing consumers and when the price goes up, a consumer can afford fewer quantities of that commodity.

SELF-ASSESSMENT EXERCISE
What causes the downward sloping demand curve?

3.4. The determinants of demand

There are several factors that affect the demand for a commodity. They include;

i. ***Price of the commodity:-*** In line with the law of demand, when the price of a commodity is high, it lowers the quantity demanded of that commodity due to the fact that the consumer doesn't just lower the quantity he buys but look to alternatives he can switch to. But in case of luxury and inferior goods, the situation becomes different because they are not normal goods.

ii. ***Price of related commodities:-*** There are two major categories of commodities; complements and substitutes in the case of complementary goods (X and Y), an increase in the price of X results in a decrease in the quantity demanded of Y and vice versa.

On the other hand, if X and Y are substitutes, an increase in the price of "X" results in an increase in the quantity demanded of "Y" because people will switch their demand or substitute X for Y. therefore, beside the price of the commodity, the demand for that commodity will largely depend on the price of related commodities.

iii. ***Consumers income:*** Income refers to the sum total of earnings of a given consumption unit. These earnings are usually made up of salaries and wages, dividends and interest earned. For almost all commodities and individuals, the greater the income, the greater the demand for a particular commodity. In the case of interior goods, a rise in income of the consumer leads to a reduction in the demand for that commodity.

iv. ***Consumers taste and preferences:-*** At a given price and income level, the demand for a commodity depends upon the taste and preference of consumers. The tastes and preference are in turn influenced by advertisement, brand quality, religion and customs. When these change in favour of a commodity, the demand for that commodity will increase.

v. ***Availability of credit facilities:-*** The availability of credit facilities means the possibility of purchasing commodities and payments for them to be made later. If there exist easy access to credit, the demand for commodities will increase. Indeed, consumers who could not afford goods and services with cash can purchase them late.

vi. ***Changes in distribution of income:-*** There are usually these three income groups in any economy. High income group, middle income group and low income group. If income is evenly distributed, it will affect demand for commodities different from the way it would be if distribution were skewed.

vii. ***Government Policies:-*** Government policies change from time to time. The government may issue a policy advising consumers against the consumption of certain goods due to certain reasons. Taxes can be imposed on certain items to make them dearer and reduce their demand.

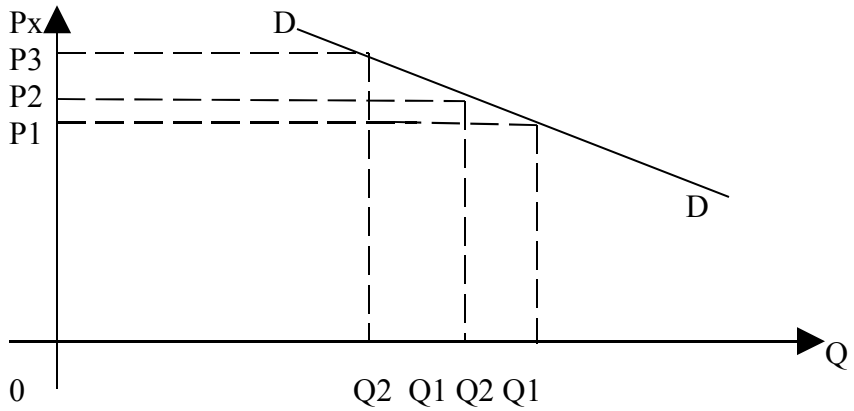
viii. ***Seasonal/Geographical factors:-*** Season or geographical factors affect the demand for commodities. Consumers are compelled to demand certain goods due to climatic or weather conditions of certain areas or regions.

SELF-ASSESSMENT EXERCISE

Discuss the determinants of demand

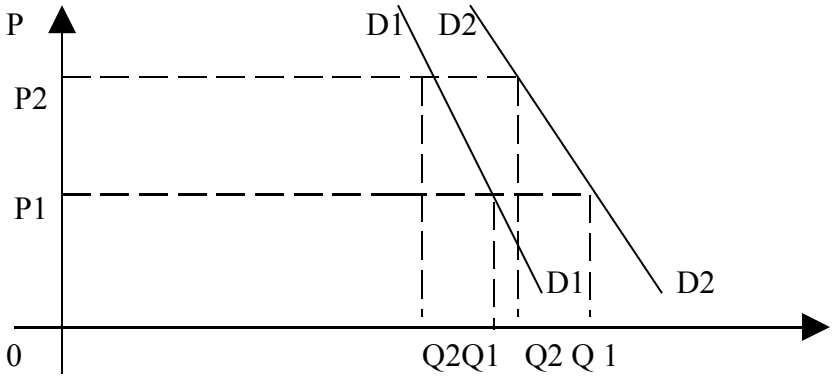
3. Shifts in Demand and Change in Quantity Demand

Change in quantity demanded refers to a situation where more quantities of a commodity are demanded for at lower prices. This price – quantity relationship will result in a movement along the demand curve.



Change in Quantity Demanded

On the other hand, shift in demand refers to situations when demand changes even without a change in price. A shift in demand occur when there is a bodily shift of the demand curve either to the left or to the right. It arises when a different quantity is demanded at each an every price. The change in the quantity demanded at each and every price may be due to changes in other factor that affect demand apart from price such as income.



Shift in Demand

SELF- ASSESSMENT EXERCISE
Differentiate between shifts in demand and change in quantity demanded

4.0. CONCLUSION

Demand is not want because human wants are unlimited. Demand is then want backed by the ability to pay. Therefore, there should be willingness to buy and the ability to pay before demand can be executed.

5.0. SUMMARY

This unit examined the concept of demand, the law of demand and the factors affecting demand. It also examined the reason for downward sloping demand curve and the differences between shifts in demand and change in quantity demand.

6.0. TUTOR - MARKED ASSIGNMENT

1 Define demand and the law of demand.
2 What are the determinants of demand
3 Differentiate between shifts in demand and changes in quantity demanded

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UNIT 4 THE THEORY OF SUPPLY

CONTENTS

1.0. INTRODUCTION

The market price of a commodity is influenced by the demand of consumers or their ability to purchase a product, and by the supply of the commodity. The supply schedule shows the quantities of a good or service that suppliers are willing and able to supply at different prices. Therefore, the supply function relates supply to factors determining it.

In this unit, we shall examine the concept of supply, the supply schedule and the supply curve, the determinants of supply and the difference between shift in supply and change in quantity supplied.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of supply
- Explain supply schedule and the supply curve
- Discuss the determinants of supply
- Explain the differences between shifts in supply and changes in quantity supplied

3.0. THE THEORY OF SUPPLY

3.1. THE CONCEPT OF SUPPLY

The supply of a commodity refers to the quantity of that commodity a producer is willing and able to offer for sale at a given point in time and at a given price. It indicates the relationship between price and quantities offered for sale at a given period of time.

The law of supply states that "the higher the price, the higher the quantity supplied and vice versa (all other factors affecting supply remaining constant i.e. ceteris paribus). Therefore, unlike demand, a negative relationship exists between quantity supplied and price.

SELF- ASSESSMENT EXERCISE
Define supply and state the law of supply

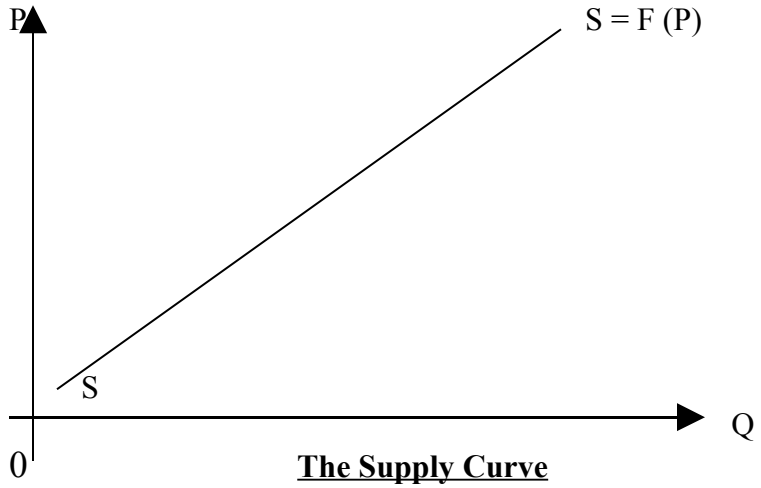
3.2. The Supply Schedule and Supply Curve

Supply schedule means the relationship between the market prices and the amount of goods that producers are willing to offer for sale. In line with the law of supply, there exist a positive relationship between the price of a commodity and its quantity supplied.

On the other hand, the supply curve is the geometrical representation of the supply schedule. It is a positive function of price i.e. the curve slopes upwards from left to right indicating an increase in amount supplied as price increase.

Example of a supply schedule

Price of X	1	6	12	24	30
Quantity supplied	5	20	30	70	80



The Supply Curve

SELF ASSEMENT EXERCISE
Differentiate between a supply schedule and a supply curve

3.3. The determinants of supply

The factors influencing the supply of a product include;

i. ***Price of the commodity***:- In line with the law of supply, the higher the price, the higher the quantity supplied (Ceteres paribus). Therefore, the quantity supplied is a positive function of price.

ii. ***The prices of other related goods:-***The law of supply obviously assumes the case of one commodity. If the price of goods the producer can otherwise produce rise indicating an increase in the profitability of selling them, then the firm may transfer some of its resources to the production of those goods. The implication of the is that the supply of the original commodity will fall.

iii. ***The prices of factors of production:-***The price of a commodity must cover the cost of its production since the goal of every producer is profit maximization.

This means that the price most at least equal to the money outlays spent for its production. Thus, a rise in the cost of production will be reflected in a higher supply price.

iv. ***Goals of the firm:***- If the aim of producers is to sell as much as possible to capture the market, even if it cost some profits more, will be produced than if the aim is to maximize profit.

v. ***State of technology:-*** In economics, technology is classified into two main categories, labour intensive and capital intensive. While labour intensive lays emphasis on the use of labour, capital intensive lays emphasis on the use of machinery and other advanced method of production. A change in production technique from a less efficient one to a more efficient or advanced technique increases supply.

vi. ***Government Policies:-*** A government policy may boost or frustrate the supply of a commodity. If the government subsidies the factors of production, it reduces cost and boost supply. On the other hand, when there is a ban or tariff on certain factors of production, it increases the cost of production and reduces production hence supply reduces.

vii. ***Extraneous factors:*** Natural disasters, wars and ecosystem affect the supply of goods. The occurrence of any of these factors reduce the supply of goods and for agricultural products, certain weather conditions are not favorable for their production hence reducing the supply of these products.

SELF- ASSESSMENT EXERCISE
What are the determinants of supply

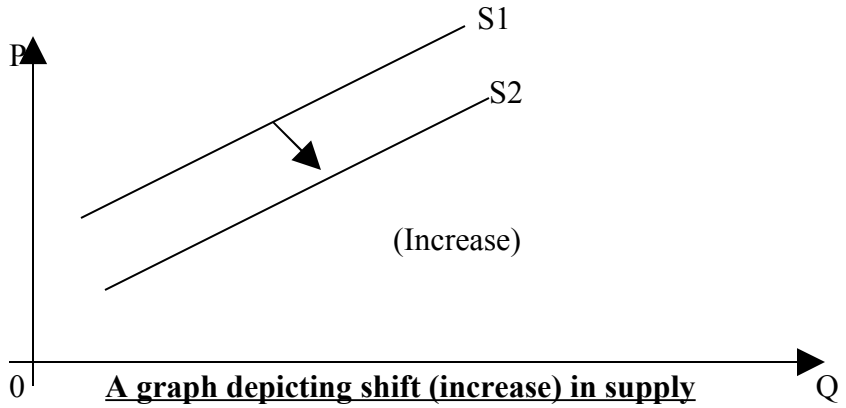
3.4. SHIFT IN SUPPLY AND CHANGE IN QUANTITY SUPPLIED

A change in the price of a given commodity – other factors remaining constraint, will change the quantity supplied of that commodity in the same direction with price. This is a situation of movement along the supply curve (i.e. change in quantity supplied). This situation is in line with the law of supply hence QSx = F (Px) i.e. quantity supplied of good 'X' is a function of price of good 'X'.

On the other hand, a change in any of the components of supply other than the price of that particular commodity will cause a bodily shift of the supply curve either to the left or to the right of the original curve. A shift to the right indicates an increase in supply with a shift to the left indicating a decrease in supply. Therefore, there is not just one quantity for a particular price but different quantities for a given price and so the change is not due to price changes but they occur within the same price.

SUPPLY SCHEDULE FOR GOOD 'X'

PRICE OF X IN N	3	4	4.4	4.6	5	5.6
ORIGINAL QUANTITY SUPPLIED	10	16	2.4	30	40	50
NEW QUANTITY SUPPLIED	16	24	30	40	50	80



A graph depicting shift (increase) in supply

SELF- ASSESSMENT EXERCISE
Differentiate between shift in supply and change in quantity supplied

4.0. CONCLUSION

In establishing the market price, not just the demand is important, supply of that particular commodity is also important as market conditions need provide incentive for producers to produce or supply.

5.0. SUMMARY

This unit examined the concept of supply and the law of supply. It also examined supply schedule and supply curve and then concluded by looking at the determinants of supply and the difference between shift in supply and movement along the supply curve.

6.0. TUTOR MARKED ASSIGNMENT

1 Define supply and the law of supply?
2 Discuss the determinants of supply?
3 Differentiate between shift in supply and change in quantity supplied

7.0. REFERENCES / FURTHER READINGS

Barndis, R. (1972). Principles of economics. Homewood: Irwin

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UNIT 5 THEORY OF MARKET PRICE

CONTENTS

1.0. INTRODUCTION

In the two previous chapters, we looked at the analysis of demand and supply. In this chapter, we extend the analysis to include the fact that price will function to equalize the quantity demanded by consumers and the quantity supplied by producers, resulting in an economic equilibrium of price and quantity.

In the unit therefore, we shall examine the concept of market price, the determination of equilibrium price and finally look at changes in market equilibrium.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of market price,
- Discuss the determination of market equilibrium, and,
- Discuss changes in market equilibrium.

3.0 THEORY OF MARKET PRICE

3.1 The concept of market price,

Price refers to the amount of money paid per unit for a good or serves. In any ordinary shop, customers will find displayed a price at which as many or few units as they wish can be purchased. For some goods and services, however, price is less easy to observe. Special terms may be available for large orders, for repeat orders, or for particular types of customers. In some markets buyers and sellers haggle over the price of each item. The price of similar goods vary over time and place, and goods with the same name vary in quality.

The theories of demand and supply are used in understanding the behaviour of market agents in determining the market price. The interaction between demand and supply help in setting the market price, hence equilibrium price refers to the price at which the quantity of a good supplied is equal to the quantity demanded. It is the price that clears the market, the situation when supply and demand are equal.

SELF ASSESMENT EXERCISE
What is market price.

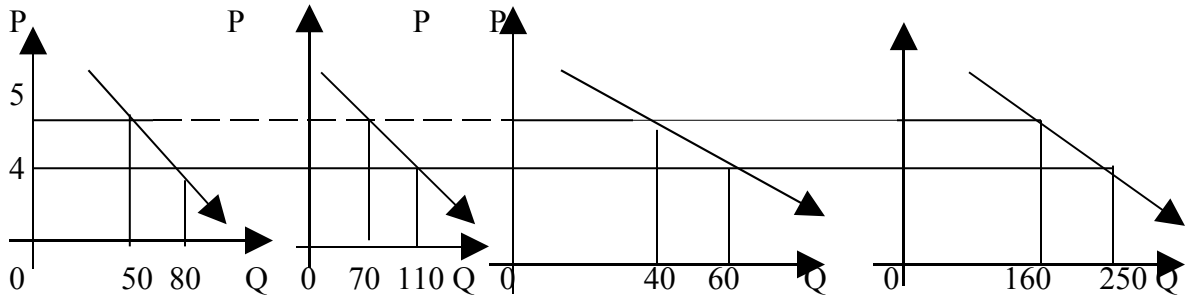
3.2 Market demand and market supply

Market demand refers to the summation or the addition of individual or household demand at a given point in time and at a given price. Suppose there are three consumers A, B and C with a demand schedule for a product (x) as follows;
The demand schedule for good (x) at two different periods

Per unit price (₦)	Quantity Demanded by consumers			Market Demand
	A	B	C	A+ B+C
5	50	70	40	160
4	80	110	60	250

This information can be expressed geometrically as follows;

A's Demand B's Demand C's Demand Market Demand

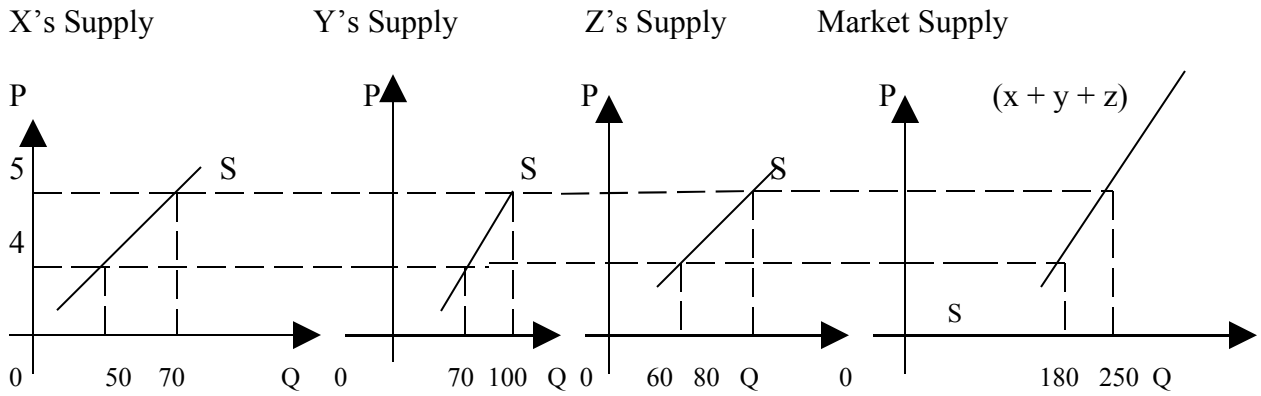


This can be estimated using econometric techniques in the form Qd =fp where quantity demand is expressed as a function of price (Qd = a – bp).

On the other hand, market supply is the aggregate supply individual firm is willing and able to produce and offer for sale at a given period and a given price. Suppose there are three forms X, Y, and Z with the following supply schedule;

Per unit price (₦)	Quantity Demanded by consumers			Market Demand
	X	Y	Z	(X + Y + Z)
5	70	100	80	250
4	50	70	60	80

This can be represented diagrammatically as follows; X's supply Y's supply Z's supply market supply.

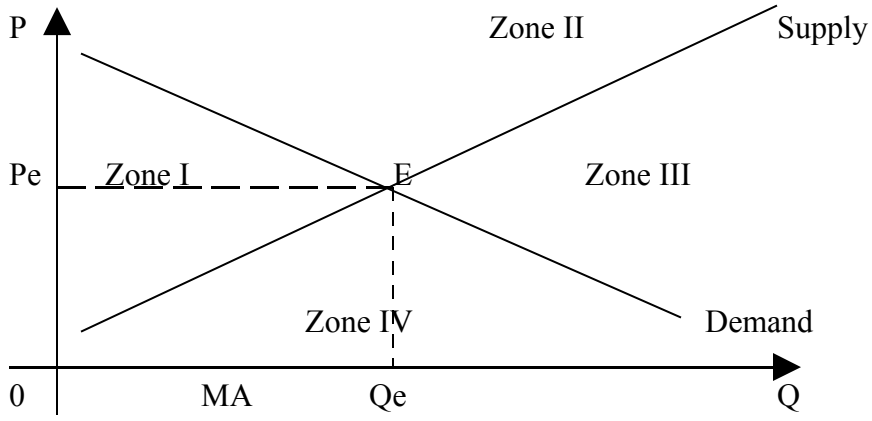


It can be estimated using econometric technique in the form QS = F (P) = a +bP.

SELF ASSESMENT EXERCISE
Differentiate between market demand and market supply.

3.3 The determination of market equilibrium.

Market equilibrium is the situation when supply and demand in a market are equal at the prevailing price. The equilibrium price is determined by supply and demand.



MARKET EQUILIBRIUM

The market demand curve slopes downwards form left to right whole the market supply curve slopes upwards from left to right. The two curve intersect at point at point E where market demand is equal to market supply (Equilibrium point). At any other point, there exist some form of disequilibrium. The following points can be deduced from the graph above;

- In zone I, the is an excess of price which consumers are willing to pay over the price at which producers are willing to provide suppliers, this leads to an increase in quantity.
- In zone II, an excess of supply over demand at a given price leads market makers to cut price.
- In zone III, an excess of the price at which producers are willing to provide supplies over the price which consumers are willing to pay leads to a fall in quantity.
- In zone IV, and excess of demand over supply leads markets to increase prices.

The above discussion can be summarize mathematically as follows;

iv. When the price is than the equilibrium price (P_E <Pe) than Qd >Qs (Excess supply)

v. When $P_E > P_e$, then Qd <Qs (Excess Supply)

vi. When $P_E > P_e$, then Qd = Qs (No excess) demand or excess supply)

Example;

Assuming the market demand function for a particular product is Qd = 9 – bP function and the supply as Qs = C + dP. Determine the equilibrium price and quantity.

Solution; At equilibrium, Qd = Qs

Therefore a- bP = C + dP

a – c – dP + bP

a – c = (d +b)P

Hence; $P = \frac{a - c}{d + b}$

Substitute in any of the equations

$Qd = a - b\left[\frac{a - c}{[a + b]}\right] = q - \frac{ba + bc}{d + b}$

$= \frac{ad + ab - ba + bc}{d + b} = \frac{ad + bc}{d + b}$

$Qs = c + d\left[\frac{a - c}{d + b}\right] = C + \frac{da + dc}{d + b} = \frac{cd + cb + ad - dc}{a + b}$

$Qs = \frac{cb + ad}{d + b} = Q^d$

SELF ASSESSMENT EXERCISE

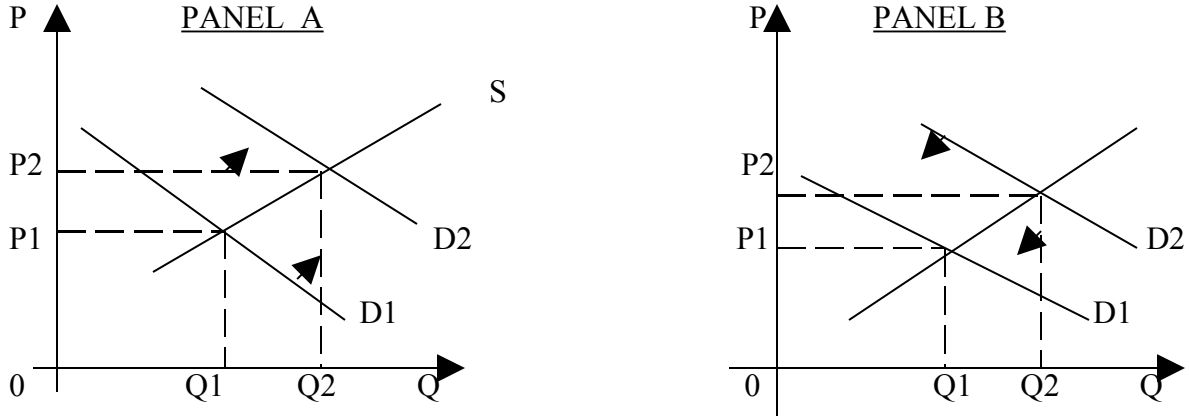
How is market equilibrium determined?

3.4. Change in market equilibrium

We earlier looked at excess demand and excess supply. We will now concentrate on how shifts in the demand and supply curves affects equilibrium price and quantity.

(i) Shift in demand curve; there are two types of shifts in demand curves, to the left (decreased) or to the right (increase in demand), with the supply curve remaining constant, there will be an increase in both equilibrium price and

quantity. On the other hand, when there is a left ward shift of the demand curve with supply remaining constant, there will be a decrease in both equilibrium price and quantity.

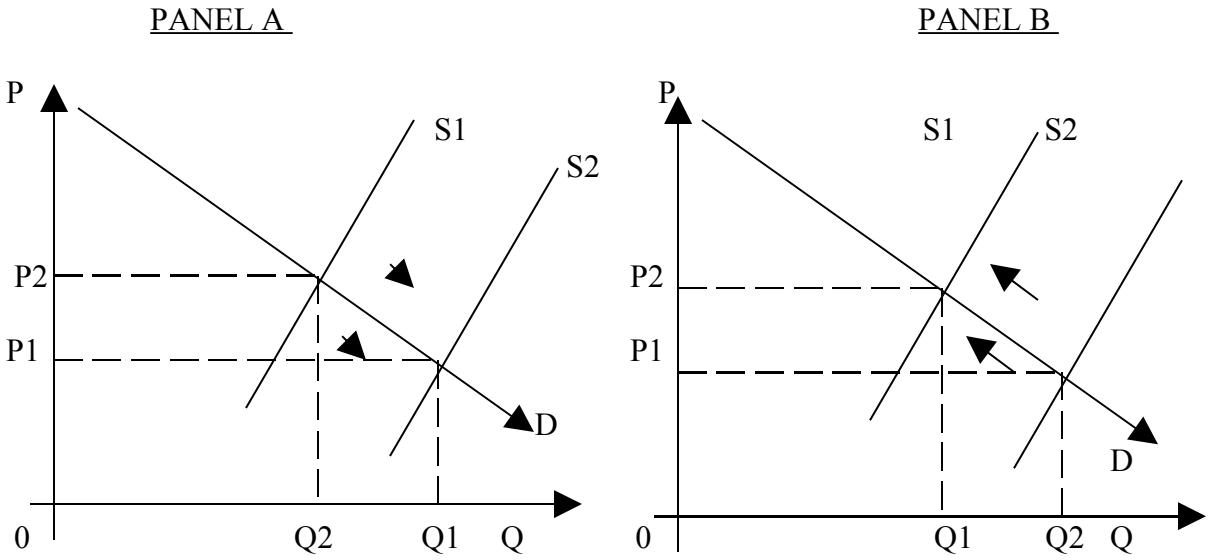


Effects of Shifts in Demand When Supply is Constant

From panel A, original demand curve was D1 when equilibrium price and quantity as P1 and Q1 respectively. With a shift in the demand curve to the right (increase in demand) i.e d2, equilibrium price and quantity increased to P2 and Q2 respectively. This is because the supply curve remains constant.

On the other hand, in panel B, a shift in the demand curve to the left i.e from D2 to D1 reduces both equilibrium price and quantity from P2 to P1 and Q2 to Q1 respectively.

ii. ***Shift in supply curve:-*** There are two types of shifts in the supply curve i.e. shift to the left (decrease in supply) shift to the right (increase in supply). When there is a shift in the supply curve to the right with the demand curve remaining constant, the equilibrium price will decrease while the equilibrium quantity will increase. On the other hand, when the supply curve shifts to the left, with the demand curve remaining constant, there will be an increase in price but a decrease in equilibrium quantity.



Effects of Shifts in Supply When Demand is Constant

From Panel A, original supply curve was S, and equilibrium price & and quantity as P2 and Q1. With an increase in supply to S2 price droped to P1 and quantity increased to Q2. On the other hand, when there is a decrease in supply (Panel B) from S2 to S1, equilibrium price increased to P2 and quantity reduced to Q1.

SELF ASSEMENT EXERCISE

Briefly discuss the changes in market equilibrium due to the interaction between demand and supply.

4.0. CONCLUSION

From the above analysis, equilibrium is a point of rest. At this point, there is no incentive to deviate. It is arrived at as a result of the interaction between market agents.

5.0. SUMMARY

In this unit, we examined the concept of market price and how it is determined (equilibrium). We further looked at the effects of changes in both the demand and the supply curve on equilibrium price and quantity.

6.0. TUTOR-MARKED ASSIGNMENT

Q 1. What is market price?

2. (a) Given the demand and supply functions for a commodity as Qd = 100 - 3p and Qs = 80 + 2p respectively, determine the equilibrium price and quantity.

(b) If the price of the commodity is decreased by 25%, explain whether this will lead to excess demand or supply.

1. Briefly discuss the effects of changes in the demand and supply curves on market equilibrium.

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UNIT 6: ELASTICITY

CONTENTS

1.0. INTRODUCTION

The relationship between prices of commodities and the quantities demanded of these commodities is a very important one in the field of economics. From the consumer who makes decisions on how much less of a commodity he should buy given a rise in the price of that commodity, to the producer who tries to see the impact of changes in the price of his output on its demand, the concept of elasticity helps in the process of economic decision making.

Elasticity seeks to measure the degree of the relationship existing between two variables. It measures the responsiveness of a dependent variable to a change in the independent variable. By this, elasticity measures to what extent a dependent variable would change following a change in the independent variable that brought about the change in the dependent variable. Elasticity is therefore defined as "the percentage change in a dependent variable resulting from a one percent change in the value of an independent variable."

2.0. OBJECTIVES

At the end of this unit, you should be able to:

- Explain the term "elasticity"
- Measure elasticity

- Explain the different types of elasticity

3.0 ELASTICITY

3.1 MEASUREMENT OF ELASTICITY

The equation for calculating elasticity is

$$\varepsilon_x = \frac{Percentage\ change\ in\ the\ dependent\ variable, Y}{Percentage\ change\ in\ the\ independent\ variable, X}$$

$$\varepsilon_x = \frac{\frac{\Delta Y}{Initial\ Y} \times 100}{\frac{\Delta X}{Initial\ X} \times 100}$$

$$\varepsilon_x = \frac{\left(\frac{\Delta Y}{Y}\right)}{\left(\frac{\Delta X}{X}\right)}$$

$$\varepsilon_x = \frac{\Delta Y}{Y} \times \frac{X}{\Delta X}$$

$$\varepsilon_x = \frac{\Delta Y}{\Delta X} \times \frac{X}{Y}$$

$$\varepsilon_x = \frac{\partial Y}{\partial X} \times \frac{X}{Y}$$

This formula measures the responsiveness of the dependent variable, Y, to a very small (infinitesimal) change in the independent variable, X. It is called the *point elasticity*.

To measure the responsiveness of the dependent variable, Y, to a larger change in the independent variable, X, we make use of the *arc elasticity* formula which is given as

$$\epsilon_x = \frac{\left(Change\ in\ the\ dependent\ variable, Y \Big/ Average\ Y\right)}{\left(Change\ in\ the\ independent\ variable, X \Big/ Average\ X\right)}$$

$$\epsilon_x = \frac{\left(\frac{Y_2 - Y_1}{\left(Y_2 + Y_1 \Big/ 2\right)}\right)}{\left(\frac{X_2 - X_1}{\left(X_2 + X_1 \Big/ 2\right)}\right)}$$

$$\epsilon_x = \frac{\Delta Y}{Y_2 + Y_1} \div \frac{\Delta X}{X_2 + X_1}$$

$$\epsilon_x = \frac{\Delta Y}{Y_2 + Y_1} \times \frac{X_2 + X_1}{\Delta X}$$

$$\epsilon_x = \frac{\Delta Y}{\Delta X} \times \frac{X_2 + X_1}{Y_2 + Y_1}$$

For the purpose of this course, we shall restrict our study to the elasticity of demand and the elasticity of supply.

3.2 Elasticity of Demand

Elasticity of demand measures the degree of responsiveness of quantity demanded of a commodity to changes in the price of the commodity, income or prices of other commodities and so on. The measures of elasticity of demand are as varied as the determinants of demand. The most important of these are the price elasticity, the income elasticity and the cross-price elasticity of demand.

3.2.1 Price Elasticity of Demand

The theory of demand postulates an inverse relationship between the price of a commodity and the quantity of it that is demanded. The question that arises is: By how much would the quantity demanded of a commodity change given that its price has changed by one unit? Price elasticity of demand measures the responsiveness of the quantity demanded (dependent variable) to changes in the price of the commodity (independent variable), holding constant the values of all other variables in the demand function. It is the most widely used measure of elasticity.

The point elasticity of demand takes account of the effect of infinitesimal (very small) changes in price on the quantity demanded, and is given as

$$\varepsilon_p = \frac{Percentage\ change\ in\ the\ quantity\ demanded, Q}{Percentage\ change\ in\ price, P}$$

$$\varepsilon_p = \frac{\frac{\Delta Q_x^d}{Initial\ Qty\ dd} \times 100}{\frac{\Delta P_x}{Initial\ Price} \times 100}$$

$$\varepsilon_p = \frac{\left(\frac{\Delta Q}{Q}\right)}{\left(\frac{\Delta P}{P}\right)}$$

$$\varepsilon_p = \frac{\Delta Q}{Q} \times \frac{P}{\Delta P}$$

$$\varepsilon_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

Using the ∂-notation, we have

$$\varepsilon_p = \frac{\partial Q}{\partial P} \times \frac{P}{Q}$$

The arc price elasticity of demand which measures elasticity over a wider range is given by

$$\epsilon_p = \frac{\left(Change\ in\ the\ quantity\ demanded, Q / Average\ quantity\right)}{\left(Change\ in\ the\ price, P / Average\ price\right)}$$

$$\epsilon_p = \frac{\left(\frac{Q_2 - Q_1}{\left(Q_2 + Q_1/2\right)}\right)}{\left(\frac{P_2 - P_1}{\left(P_2 + P_1/2\right)}\right)}$$

$$\epsilon_p = \frac{\Delta Q}{\Delta P} \times \frac{P_2 + P_1}{Q_2 + Q_1}$$

There are five specific ranges of price elasticity. They include:

1. $1\epsilon_p$ □ †

   When elasticity is equal to zero, it is said to be *perfectly inelastic* and as such the quantity demanded remains unchanged whatever change there may be in the price of the commodity. The demand curve vertical.

2. 1 ϵ_p ,

   The price elasticity of demand here is greater than zero but less than one. The demand is therefore said to be *inelastic* as a change in price results in a less proportionate change in the quantity demanded of the commodity. The demand curve is almost vertical.

3. $1\epsilon_p$ □ †

   With a value equal to one, price elasticity is said to be *unitary*. A proportionate change in price leads to an equal proportionate change in the quantity demanded of the commodity.

4. 1 ϵ_p ,

   A change in price here leads to greater change in the quantity demanded of the commodity as elasticity is greater than one. It is however less than infinity. Demand is therefore said to *elastic* and the demand curve is almost horizontal.

5. $1\epsilon_p$ □∞†

   Demand is said to be *perfectly elastic* or *infinitely elastic*. At some given price, an infinite quantity of the commodity would be demanded and the demand curve is

horizontal. This is particularly the case of the demand curve of a single firm in a perfect competition.

Example

The price of a loaf of bread changed from N180 to N200 while the quantity demanded per week fell from 1000 units to 950 units. Determine the price elasticity of demand for bread and comment on your answer.

We proceed by the use of the formula for arc elasticity of demand.

$$\epsilon_p = \frac{\left(Change\ in\ the\ quantity\ demanded, Q / Average\ quantity\right)}{\left(Change\ in\ the\ price, P / Average\ price\right)}$$

$$\epsilon_p = \frac{\left(\frac{Q_2 - Q_1}{\left(Q_2 + Q_1/2\right)}\right)}{\left(\frac{P_2 - P_1}{\left(P_2 + P_1/2\right)}\right)}$$

$$\epsilon_p = \frac{\left(\frac{950 - 1000}{\left(950 + 1000/2\right)}\right)}{\left(\frac{200 - 180}{\left(200 + 180/2\right)}\right)}$$

$$\epsilon_p = \frac{-50}{20} \times \frac{200 + 180}{950 + 1000}$$

$$\epsilon_p = \frac{-50}{20} \times \frac{380}{1950}$$

$$\epsilon_p = -2.5 \times 0.195$$

$$\epsilon_p = -0.487$$

The absolute value of the price elasticity (0.487) is greater than zero but less than one. Demand is therefore inelastic. Also, the inverse relationship between price and the quantity demanded, as depicted by the negative sign (-), shows that bread is a normal good.

Determinants of Price Elasticity of Demand

The factors which determine the price elasticity of demand for a commodity include:

1. **Availability of close substitutes**

   The demand for a commodity tends to be more elastic when close substitutes are available. When the price of the commodity rises, consumers easily move their demand to its substitutes leading to a fall in the demand of the original commodity. Examples include the demand of tea and coffee or between brands of tea such as *Lipton Tea* and *Top Tea*.
   Where close substitutes do not exist, the demand for a commodity tends to be inelastic. Common salt is an example in this case.

2. **The proportion of the consumer's income spent on the commodity**

   When the proportion of a consumer's income spent on a particular commodity is very small, its demand tends to be inelastic. The demand for matches, pens and salt tend to be inelastic. The demand for clothing and furnishings are however more elastic as a larger proportion of income is spent on these commodities and the consumer tries to cut-back on expenditure as prices rise.

3. **The number of uses of a commodity**

   The greater the number of uses to which can be put, the greater will be its price elasticity of demand. When the price of such a commodity rises, consumers would tend to put it to its most important uses leading to a fall in its demand. Milk is used for feeding children, baking, cream and sweets. If the price milk were to rise, the consumer, depending on the most important need, may restrict its use to feeding children.

4. **Complementarily between goods**

   Demand is usually inelastic for goods which are used as complements to other commodities. Changes in price therefore result in les proportionate changes in the quantity demanded. An increase in the price of petrol would lead to a fall in its demand and this would imply a reduction in driving hence a fall in the demand of complements like engine oil.

5. **Time for adjustment**

   Generally, demand in the short-run tends to be inelastic and it usually takes a longer time before consumers manage to economize on the commodities they use and also discover substitutes. In the long-run however, consumers are able to adjust by finding new ways of using commodities economically and also finding substitutes. Demand eventually tends to be elastic in the long-run.

SELF-ASSESSMENT EXERCISE 1
What is elasticity of demand?

3.2.2 CROSS-PRICE ELASTICITY OF DEMAND

The demand for a commodity may be influenced by the prices of other commodities. The direction of that influence may however depend on whether the commodities involved are substitutes or complements.

When an increase in the price of commodity X (chicken) leads to an increase in the quantity demanded of commodity Y (beef), the direct relation between the price of chicken and the quantity demanded of beef shows that the commodities are substitutes. The increase in the price of chicken makes the commodity relatively more expensive leading to a fall in its demand and a rise in the demand for beef, its substitute.

On the other hand, an increase in the price of commodity A (camera) may lead to a fall in the demand for commodity B (film). The inverse relation between the price of camera and the demand for film shows that the two commodities are complements; they are used together rather than in place of each other.

Cross-price elasticity is used to determine the degree of responsiveness of demand for one commodity to changes in the price of another. Point cross-price elasticity of demand for commodity X is given as

$$\varepsilon_{px} = \frac{Percentage\ change\ in\ the\ quantity\ demanded\ of\ Y}{Percentage\ change\ in\ the\ price\ of\ X}$$

$$\varepsilon_{px} = \frac{\left(\frac{\partial Q_y}{Q_y}\right)}{\left(\frac{\partial P_x}{P_x}\right)}$$

$$\varepsilon_{px} = \frac{\partial Q_y}{\partial P_x} \times \frac{P_x}{Q_y}$$

The arc cross-price elasticity of demand is given as

$$\epsilon_{px} = \frac{Percentage\ change\ in\ the\ quantity\ demanded\ of\ Y}{Percentage\ change\ in\ the\ price\ of\ X}$$

$$\epsilon_{px} = \frac{\left(Change\ in\ the\ quantity\ demanded\ of\ Y \Big/ Average\ quantity\ of\ Y\right)}{\left(Change\ in\ the\ price\ of\ X \Big/ Average\ price\ of\ X\right)}$$

$$\epsilon_p = \frac{\left(\frac{Q_{y2} - Q_{y1}}{\left(Q_{y2} + Q_{y1}/2\right)}\right)}{\left(\frac{P_{x2} - P_{x1}}{\left(P_{x2} + P_{x1}/2\right)}\right)}$$

$$\epsilon_{px} = \frac{\Delta Q_y}{\Delta P_x} \times \frac{P_{x2} + P_{x1}}{Q_{y2} + Q_{y1}}$$

Cross-price elasticity for substitutes is always positive, while it is negative for complements. Also cross-price elasticity is zero for unrelated goods where the variations in the price of one commodity have no effect on the demand for the second.
The classifications with regard to inelastic, unitary, elastic and infinitely elastic are similar to those of price elasticity of demand.

SELF-ASSESSMENT EXERCISE 2
Cameras and films are complementary goods. What sign is their cross-price elasticity expected to take (positive or negative)?

3.2.3 INCOME ELASTICITY OF DEMAND
Income is an important determinant of demand. Changes in consumer income normally lead to changes in the demand for some commodities. 'Normal goods', for example, are said, in economic theory, to have a direct relationship with income. However the degree of that relationship is not given. Luxury goods and items like expensive cars and golf club membership tend to be more income elastic than basic commodities like salt and bread, as changes in the prices of the former usually bring about a larger change in the quantity demanded, than would be the case with the latter.
Income elasticity of demand measures the responsiveness of demand to changes in income, holding constant the effects of all other determinants of demand. Point income elasticity of demand is given as

$$\varepsilon_y = \frac{Percentage\ change\ in\ the\ quantity\ demanded, Q}{Percentage\ change\ in\ income, Y}$$

$$\varepsilon_y = \frac{\partial Q}{\partial Y} \times \frac{Y}{Q}$$

Arc income elasticity of demand is given as

$$\epsilon_y = \frac{\left(Change\ in\ the\ quantity\ demanded, Q / Average\ quantity\right)}{\left(Change\ in\ income, Y / Average\ income\right)}$$

$$\epsilon_y = \frac{\Delta Q}{\Delta Y} \times \frac{Y_2 + Y_1}{Q_2 + Q_1}$$

There is usually an inverse relation between income and demand for inferior goods while for normal goods, the relation is direct.

SELF-ASSESSMENT EXERCISE 3

Mrs. Dung's demand for 'Kuli-kuli' per week was 40 units when her income was N2,000. At presently, her income is N5,000 and she demands 10 units of the product per week. Determine Mrs. Dung's income elasticity of demand for 'kuli-kuli' and state whether 'kuli-kuli' is a normal good or an inferior good.

3.3 ELASTICITY OF SUPPLY

Just as much as a change in the price, for example, of a commodity would have an effect on the quantity demanded of that commodity, that change in price would simultaneously have an effect on the quantity of the commodity that the producer (or supplier) would be willing to offer for sale. Economic theory holds that price has a direct relationship with the quantity of commodity supplied; the degree of that relationship is the object of elasticity.

The elasticity of supply is the degree of responsiveness of supply to changes in the price of a good. It is the relative change in quantity supplied of a good to a relative change in the price of the good.

Point elasticity of supply is given as

$$\varepsilon_s = \frac{Percentage\ change\ in\ the\ quantity\ supplied, Q}{Percentage\ change\ in\ price, P}$$

$$\varepsilon_s = \frac{\partial Q}{\partial P} \times \frac{P}{Q}$$

Arc or mid-point elasticity of supply is given as

$$\epsilon_s = \frac{\left(Change\ in\ the\ quantity\ demanded, Q \Big/ Average\ quantity \right)}{\left(Change\ in\ price, P \Big/ Average\ price \right)}$$

$$\epsilon_s = \frac{\Delta Q}{\Delta P} \times \frac{P_2 + P_1}{Q_2 + Q_1}$$

Like the elasticity of demand, the following rules apply

1ϵ_s□ †	-	Perfectly inelastic supply
✐ ✤ 1 ϵ_s, ✤ ✐	-	Inelastic supply
1ϵ_s□ † ✐	-	Unitary elasticity
✐ ✤ 1 ϵ_s, ∝✤	-	Elastic supply
1ϵ_s□∞†	-	Perfectly elastic supply

SELF-ASSESSMENT EXERCISE 4

How would you describe a commodity having a supply elasticity ϵ_s † 1.01?

4.0 CONCLUSION

It should be clear by now that the concept of elasticity is very important in economics. You should have been able to understand the concept of elasticity and the need for it. Also, its application in determining variations in demand and supply should have become clear to you.

5.0 SUMMARY

The concept of elasticity provides us with a tool for the measurement of the degree of relationship between economic variables. Measurements for the elasticity of demand are as varied as the determinants of demand, the most important of which are the own-price elasticity, cross-price elasticity and income elasticity of demand. They respectively measure the degree of change in the quantity demanded of a commodity resulting from changes in the price of the commodity, prices of related commodities or the income of the consumer.

The elasticity of supply measures the degree of change in the quantity demanded of a commodity resulting from a change in the price of the commodity, holding other determinants constant.

The results from these measurements can be classified as perfectly inelastic, inelastic, unitary elastic, elastic or infinitely elastic.

6.0 TUTOR-MARKED ASSIGNMENT

1. What are the factors that determine price elasticity of demand?

2. The demand for bread in a month by a consumer was 25 units when the price per unit was ₦50. However, when the price rose to ₦100, her demand fell to 20 units a month. Determine the elasticity of demand. Comment on your answer.

3. Two goods have a cross-price elasticity of demand of -1.2. Would you describe the goods as substitutes or complements? If the price of one of the goods were to rise by 5 per cent, what will happen to the demand of the other good, holding other factors constant?

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UNIT 7 THEORY OF PERFECT COMPETITION

CONTENTS

1.0. INTRODUCTION

In economics, market structure describes the state of a market with respect to competition. Competition is useful because it reveals actual customer demand and induces the seller (Operator) to provide service quality levels and price levels that buyers (Customers) want, typically subject to the sellers' financial needs to cover its costs. In other words, competition can align the sellers' interest with the buyers' interests and can cause the seller to reveal his true costs and other private information.

In the absence of perfect competition, three basic approaches can be adopted to deal with problems related to the control of market power and an asymmetry between the government and the operator with respect to objectives and information: (a) Subjecting the operator to competitive pressures, (b) Gathering information on the operator and the market, and (c) Applying incentive regulation.

In this unit therefore, the concept of perfect competition and its assumptions shall be examined. Also, equilibrium and shut – down point shall be examined.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of perfect competition and its assumptions/characteristics
- Explain equilibrium and shut – down point.

3.0. THEORY OF PERFECT COMPETITION

3.1. Concept of perfect competition

Perfect competition refers to a market structure with many small firms, all producing homogenous goods. It is an ideal market situation in which buyers and sellers are so numerous and well informed that each can act as a price–taker, able to buy or sell any desired quantity without affecting the market price. Although very few real world markets are like this, perfect competition is often regarded by economists as a bench–mark with which to compare actual market situations.

SELF ASSESSMENT EXERCISE

What is perfect competition?

3.2 Assumptions/Characteristics of Perfect Competition

Perfect competition, as is generally understood, is said to prevail when the following conditions are found in the market.

1. ***Large number of buyers and sellers:-*** The first condition of perfect competition is that there must be numerous firms in the industry and many buyers. This condition is necessary so that the position of a buyer or seller in the market is like a drop in the ocean. As a result, no individual buyer or seller is in a position to influence the price of the product by changing the output demanded or supplied.
2. ***Homogenous Products:-*** This means that the product of various firms are indistinguishable from each other i.e. they are perfect substitutes for one another. In other words, cross elasticity between the products of the firms is infinite. In this case, trade marks, patents, special brand labels etc. do not exist since these things make the products differentiate. Again, any thing which makes buyers prefer one seller to another, be it personality, reputation, convenient location or the tone of his shop, differentiates the product to that degree, since what is bought is really a bundle of utilities of which these things are a part. Therefore, for the products to be homogenous, utilities offered by all sellers to buyers must be identical.
3. ***Perfect information about the prevailing price:-***Sellers and buyers must have complete knowledge of the conditions of the market. Because only when all buyers know fully the current price of the product in the market, sellers cannot charge more than the prevailing price. If any seller tries to charge a higher price than that ruling in the market, the buyers will shift to some other sellers to buy at a lower price. Similarly, no seller can charge a price lower than the ruling price since they know the prevailing market conditions.
4. ***Free Entry and exit:-*** It requires that there must be complete freedom for the entry of new firms and the exit of existing firms from the industry in the long run. Since in the short run, firms can neither change the size of their plants nor new firms can enter or old firms can leave the industry. The condition of free entry and free exit therefore applies only to the long–run equilibrium under perfect competition.
5. ***Firms aim to maximize profit:-***The goal of firms under perfect competition is to maximize profit. They aim to sell where marginal costs meet marginal revenue, where they generate the most profit.
6. ***Transactions are costless:-*** Buyers and sellers incur no costs in making an exchange.
7. ***Perfectly elastic demand curve:-*** The assumption of large number of buyers and sellers and that of product homogeneity implies that the individual firm is a price taker. Its demand curve is perfectly elastic indicating that the firm can sell any amount of output at the prevailing market price but with any increase in market price, buyers do not buy anything from that particular firm that increased the price.

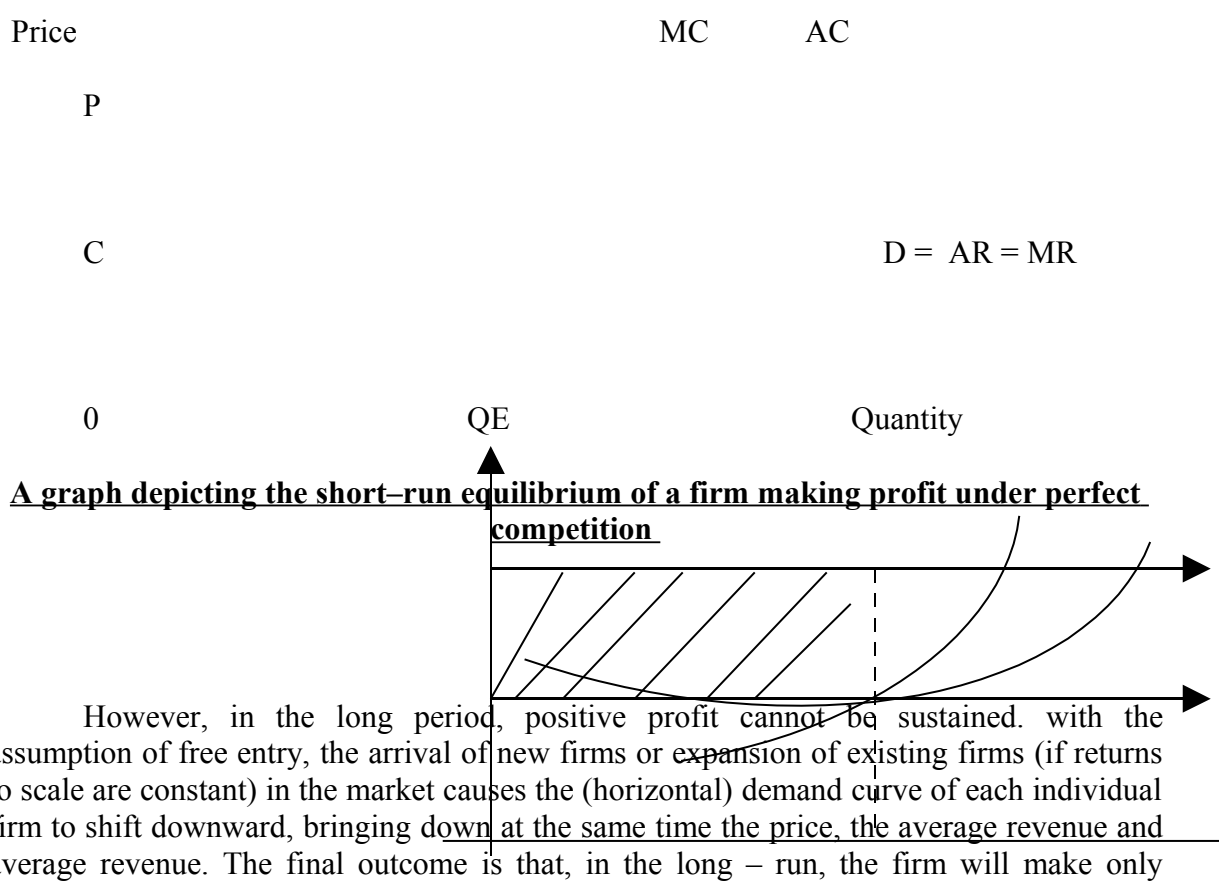
SELF ASSESSMENT EXERCISE

Discuss the assumption/characteristics of perfect competition.

3.3. EQUILIBRIUM UNDER PERFECT COMPETITION

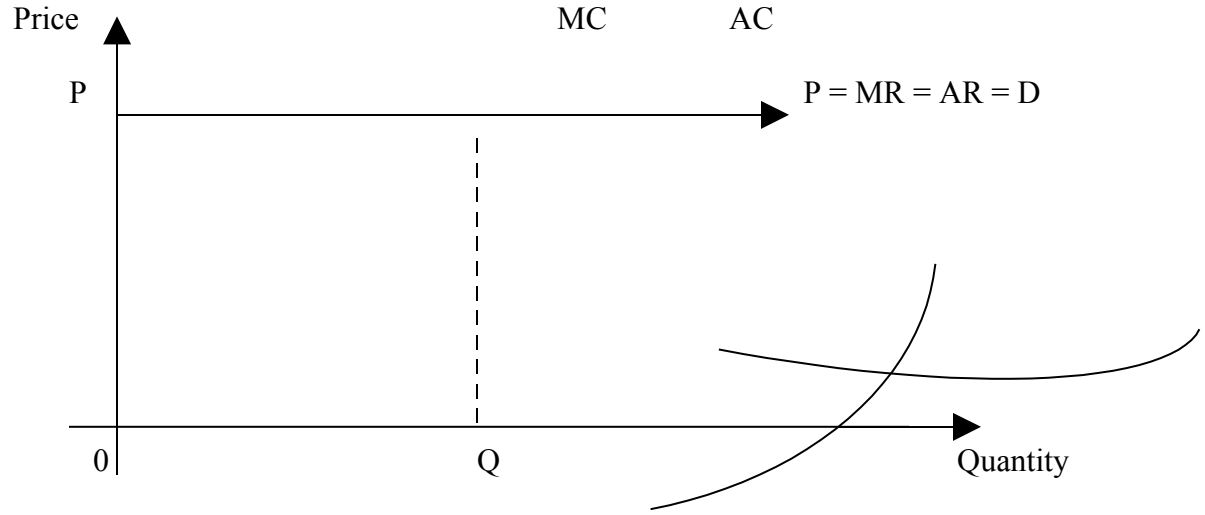
As stated earlier in the assumptions, in a perfectly competitive market, a firm's demand curve is perfectly elastic. Profit maximization requires that marginal cost (MC) must be equal to marginal revenue (MR). And so also, at the point of equilibrium, the slope of the MC curve most be greater than the slope of MR. These two conditions are the necessary and sufficient conditions of profit maximization.

In the short-run, it is possible for an individual firm to make profit. This situation is shown in the figure below as the price or average Revenue (AR), denoted by 'P' is above the Average Cost (AC) denoted by "C".



A graph depicting the short–run equilibrium of a firm making profit under perfect competition

However, in the long period, positive profit cannot be sustained. with the assumption of free entry, the arrival of new firms or expansion of existing firms (if returns to scale are constant) in the market causes the (horizontal) demand curve of each individual firm to shift downward, bringing down at the same time the price, the average revenue and average revenue. The final outcome is that, in the long – run, the firm will make only normal profit (Zero economic profit). In the case of short – run loses, firms will exit the market. This scenario is demonstrated in the figure below.



Firms Adjustment to long – run positions of normal profit under perfect competition

That a competitive firm will maximize its total profits when marginal cost (MC) equals to marginal revenue (MR) can be easily proved by differential calculus. Note that both the total cost (TC) and the total revenue (TR) are functions of output (Q). This implies that total profits are also function of output. Thus;

$\overline{\Lambda}$ = F (Q)

$\overline{\Lambda}$ = TR – TC But TR = P. Q

Hence $\overline{\Lambda}$ = P. Q – TC

For the maximization of profits, the first derivative of the profit function has to be set equal to zero. Thus, for maximum profits,

$d\Lambda / dQ = 0$

Since $d\overline{\Lambda}$ = d (P. Q) – dTC, for maximization of profits,

$$\frac{d\overline{\Lambda}}{dQ} = \frac{d(P.Q)}{dQ} - \frac{d(TC)}{dQ} = 0$$

but d (P. Q) / dQ = MR and d (TC) / dQ = MC
hence MR = MC
but since MR = P, it then follows that price (P) = MC

Example;

For a perfectly competitive firm, the following short – run cost function is given, TC = 2 + 4Q + Q2. If the price of the product prevailing in the market is N8.00, at what level of output will the firm maximize profit?

Solution : TR = P. Q = 8Q
TC = 2 + 4Q + Q2

Using the TR – TC approach,
Profits Λ = TR – TC
= 8Q – (2 + 4Q = Q2)
= 8Q – 2 – 4Q – Q2
: . II = 4Q – 2 – Q2

Profits are maximized at the output level at which the derivative of the profit function with respect to output (Q) equals to zero. Hence dΛ/dQ = 4 – 2Q = 0
4 = 2Q
: . Q = 2

Using the MR – MC approach, profits are maximized at the output level where MR = MC
TR = 8Q
MR = d (TR)/dQ = 8
TC = 2 + 4Q + Q2
MC = d (TC) / dQ = 4 + 2Q
In order to maximize profit, set MR = MC. Hence 8 = 4 + 2Q
4 = 2Q
Therefore Q = 2

SELF ASSESSMENT EXERCISE

1 Explain the short–run and long–run equilibrium under perfect competition.

2 Suppose a firm is operating under perfectly competitive conditions in the market. It faces the following revenue and cost conditions.
TR = 12Q
TC = 2 + 4Q + Q2
Determine the equilibrium level of output and total profits made.

3.4. SHUT – DOWN POINT

When a firm is making a loss, it will have to decide whether to continue production or not. This decision will, in fact, depend on the different total costs levels and whether the firm is operating in the short run or in the long-run. If the firm is in the short run, and is making a loss whereby;

-Total Costs (TC) is greater than Total Revenue (TR),

- And Total Revenue is greater or equal to Total Variable Cost (TVC),

It is advisable for the firm to continue production. If it fails to achieve these conditions, it is advised to close down so that the only costs the firm will have to pay will be the Fixed Costs (FC). Even if the firm stops producing, it will have to continue to meet the level of Fixed Costs (FC). Since whether the firm produces or not, it will have to pay fixed costs, it is better for it to continue production in an attempt to decrease total cost and increase total revenue, thus making profit. This can be done by;

- ***Increasing Productivity:-*** The most obvious methods involve automation and computerization which minimize the tasks that must be performed by employees. All else constant, it benefits a business to improve productivity, which over time lowers cost and (hopefully) improves ability to compete and make profit.
- ***Adopting new methods of production like just in time or lean manufacturing:-*** In an attempt to reduce costs and wastages.

In the long run, the condition to continue producing requires the price (P) to be higher than Average Cost (AC) i.e. the line representing market price should be above the minimum point of Average Cost (AC) curve. If price (P) is equal to Average Cost (AC), the firm is indifferent between shutting down and continuing to produce. This case is different from the short run shut down case because in the long run, there is no longer a fixed cost (everything is variable).

Example: A firm producing a product is operating in a perfectly competitive market. The firm's variable cost function is given by: TVC = 150Q – 20Q2 + Q3 where Q is level of output. Determine the price that below it the firm should shut – down production in the short – run.

Solution : In the short run, the firm will shut down production if the price falls below the level of minimum average variable cost. To determine the minimum average cost;

AVC = TVC/Q = 150 Q/Q – 20Q2/Q x Q3/Q
AVC = 150 – 20Q + Q2

To determine the level of output at minimum AVC, take the first derivative of the AVC function and set equal to zero.
d (AVC)/dQ = - 20 + 2Q = 0
2Q = 20
: . Q = 10units

Substitute Q into AVC therefore
AVC = 150 - 20 (10) + (10)2
= 150 – 200 + 100
:. AVC = N50.00 per unit

Therefore, if the price falls below N50.00 per unit, the firm will shut down.

SELF ASSESMENT EXERCISE
1 Discuss the shut down point under perfect competition
2 A firm's total variable cost is given by the following:
TVC = 75Q – 10Q2 + Q3
Will the firm produce the product if the price of the product is below N40.00?

4.0. CONCLUSION

The above analyses show that a firm operating in a perfectly competitive market can enjoy normal profits in the long run at the prevailing market price. In an event of short run losses, so long as revenue covers average variable cost, the firm should continue production hoping that in the long run, it activities will decrease total cost and increase total revenue.

5.0. SUMMARY

This unit has thrown light on the concept of perfect competition and its assumptions. Also, the equilibrium position and shut down point under perfect competition were highlighted.

6.0. TUTOR – MARKED ASSIGNMENT

1 Discuss the concept of perfect competition and its assumptions.
2 Suppose a firm is operating under perfectly competitive conditions in the market. It faces the following revenue and cost conditions;

TR = 12Q
TC = 2 + 4Q + Q2

Determine the equilibrium level of output and total profits made.
3 A firms total variable cost is given by the following' TVC = 75Q – 10Q2 + Q3 will the firm produce the product if the price of the product falls below N40.00.

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UNIT 8 THEORY OF MONOPOLY

CONTENTS

1.0. INTRODUCTION

Another important form of market structure is monopoly. Some decades ago, it was thought that the existence of monopoly was an exceptional case. But nowadays, monopoly form of market structure extensively prevails in capitalist economies of the world and in mixed developing economies like Nigeria. Monopolistic market structure prevails in many large – scale manufacturing industries and public utility services. Therefore, the analysis of price and output determination under monopoly has assumed vital importance.

In this unit, we shall analyze the concept of monopoly, its causes and characteristics. We shall also discuss the equilibrium and price discrimination under monopoly.

2.0. OBJECTIVES

At the end of this unit, you should be able to:

- Explain the concept of monopoly, its causes and characteristics.
- Derive the demand curve and marginal revenue curve and equilibrium under monopoly.
- Discuss price discrimination as practiced by the monopolist.

3.0. THEORY OF MONOPOLY

3.1. Concept of Monopoly

Monopoly is said to exist when one of firm is the sole producer or seller of a product that has no close substitutes. Three points are worth nothing in this definition, first, there must be a single producer or seller of a product if there is to be monopoly. This single producer may be in the form of an individual owner or a single partnership or a joint stock company. Secondly, there are no close substitutes for the product of that firm because monopoly implies absence of competition. Thirdly, there must be strong barrier to the entry of new firms wherever one firm has a sole control over the production of a commodity.

In other words, a monopoly exists when a specific individual or an enterprise has sufficient control over a particular product or service to determine significantly the terms on which other individuals shall have access to it. Monopolies are thus characterized by a lack of economic competition for the good or service that they provide and a lack of viable substitute goods. The verb "monopolize" refers to the process by which a firm gains persistently greater market share than what is expected under perfect competition.

SELF-ASSESSMENT EXERCISE
QUESTION: What do you understand by the term Monopoly?

3.2. Causes and Characteristics Monopoly

There are five major reasons or sources of monopoly. These sources relate to the factors, which prevent the entry of new firms in an industry. These major sources are:

1. ***Patents or copyright:*** First important source of monopoly is that a firm may posses a patent or copyright which prevents others to produce the same product or use a particular production process. When a firm introduces a new product, they get patent right from the Government so that others cannot produce them. This patent right will be granted for a certain period of time.
2. ***Control over the essential raw material:-*** If a firm gains control over an essential raw material or input used in the production of a commodity, it gains monopoly power. It is just denying others the use of the material (s) thus becoming a monopoly.
3. ***Grant of Franchise by the Government:-*** A firm may be granted exclusive legal right to produce a given product or service in a particular area or region. The government on its part keeps the right to regulate its price and quality.
4. ***Economies of Scale (Natural Monopoly):***- When significant economies of scale are present over a wide range of initial output, long – run average cost of production goes on falling cover a wide range of output and reaches a minimum at an output rate that is large enough for a single firm to meet the entire market demand at a price that is profitable. If other firms are unable to reach the long – run average cost, they are forced out resulting in a situation of natural monopoly.
5. ***Advertising and Brand Loyalties of the established firms:-***Huge advertising campaigns and customer service programmes are often undertaken to enhance the market power of the producer and prevent the entry of potential competitors. Besides, if well established firms are expecting new potential competitors, they cut prices of their products so that potential competitors find it unprofitable to enter the industry.

After examining the causes of monopoly, it is imperative to briefly look at the characteristics of monopoly. They are:

1. There is a single seller (i.e. one firm) and the firm is the industry. The firm is the only firm producing such good or service and since no any other firm produces such a good or service, the firm is also the industry.
2. There are no close substitutes for the commodity produced under monopoly.
3. There are barriers to entry this means that other firms cannot produce the same commodity either because they are not allowed or because of monopolistic conditions that make entry into the industry difficult.
4. It is faced with a negatively down – ward sloped demand curve. This means that the monopolist is a price setter, that is, the monopolist sets price but quantity demanded is dictated by the buyers (consumers). Under this, the demand curve of the monopolist is not equal to its marginal revenue.

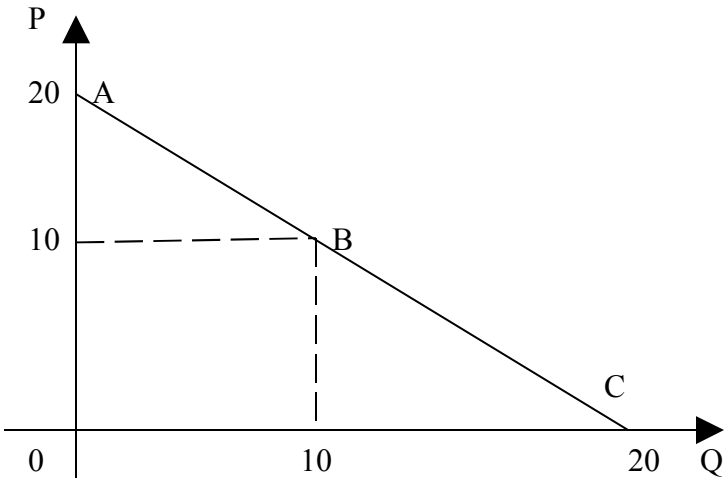
SELF-ASSESSMENT EXERCISE

Discuss the causes and characteristics of Monopoly.

3.3. Demand Curve, Marginal Revenue Curve and Equilibrium of the Monopolist

It is important to understand the nature of the demand curve facing a monopolist. Whereas the demand curve facing an industrial firm under perfect competition is a horizontal straight line, the demand curve facing the whole industry under perfect competition is sloping downwards. This is so because the demand is of the consumers and the demand curve of consumers for a product usually slopes downward. The downward sloping curve of the consumers faces the whole competitive industry. But an individual firm under perfect competition does not face a downward slopping demand curve. In the case of monopoly, one firm constitutes the whole industry. Therefore, the entire demand of the consumers for a product faces the monopolist and since the demand curve of the consumers for a product slopes downwards, the monopolist faces a downward sloping demand curve.

The monopolist demand curve is a linear curve with; $Q = a – bP$. This is the same as the industry demand curve because he is the only producer in the industry. From the function $Q = a – bP$, we can derive the slope by taking the derivative of the function; slope $= dQ / dP = - b$



Price elasticity of demand is given as;

ep = dQ/dP x P/Q

= -b P/Q

Here, the same demand curve produces different elasticities. At point A where price is highest and quantity is zero, the elasticity of demand tends to infinity;

ep = -b – (P/Q) = 000(infinity)
= - 1 (20/0) = - 000 (Anything devide by zero is infinity)

At point B which is the midpoint of the demand curve, the price elasticity of demand is unity:

ep = -1 (10/10) = -1
/ep/ = 1

At point C, where price is zero and quantity is highest, the price elasticity of demand is zero.

ep = -1 (0/20) = 0

Thus, though the slope is the same, the elasticity differs.

It is important to know the relationship between marginal revenue and price under monopoly, which faces a downward sloping demand curve (i.e. average revenue curve).

Total revenue

TR = P. Q, Q = a – bP. Make P the subject

$P = a/b - 1/bQ$

Let $a/b = a_0$ and $1/b = b_1$

$\therefore P = a_0 - b_1Q$

$TR = (a_0 - b_1Q)\, Q = a_0\, Q - b_1Q^2$

$AR = TR/Q = \frac{a_0\, Q - b_1Q^2}{Q} = a_0 - b_1Q$

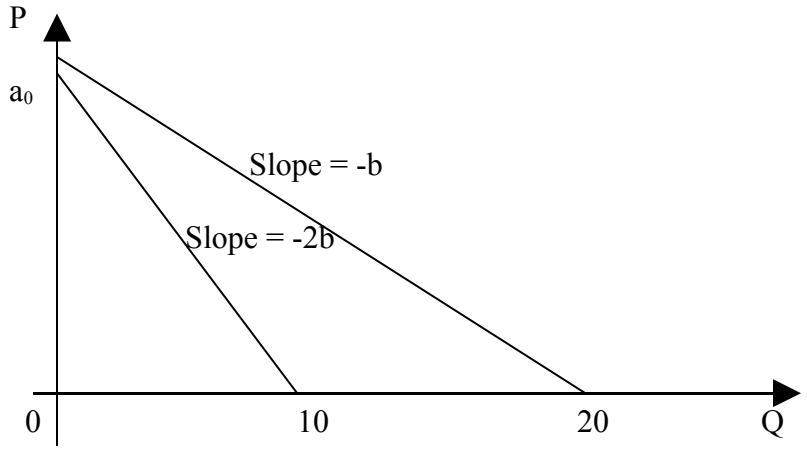
Average Revenue (AR) is the same as the demand curve.

Marginal Revenue (MR) = dTR/dQ

$= \frac{d\,(a_0\, Q - b_1Q^2)}{dQ}$

$= a_0 - 2b_1Q$

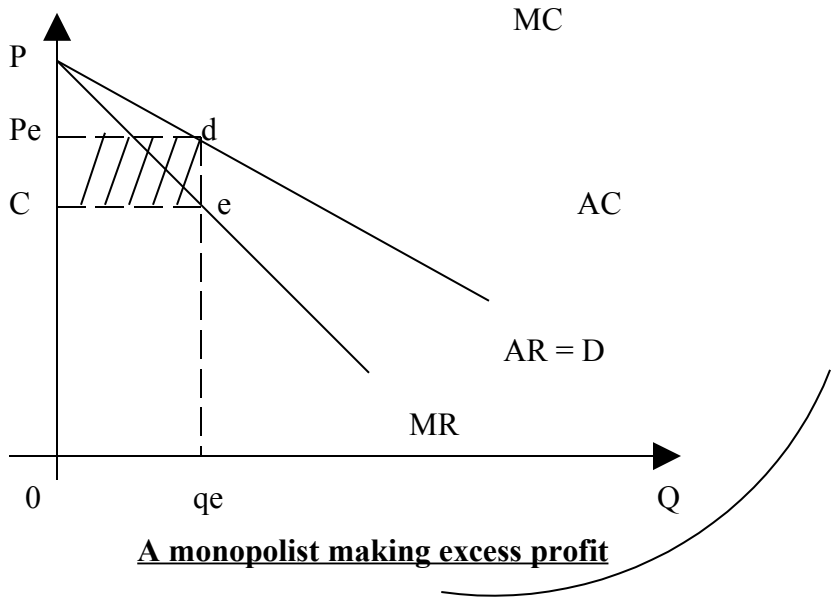
MR Curve has the same intercept as the AR curve but has twice the slope of the AR curve.



For the equilibrium of the monopolist, there are generally two (2) conditions;

1. The point where MR = MC

2. At the point where MR = MC, MC must cut the MR from below or the slope of the MC curve must be greater than the slope of the MR curve at the point of equilibrium.



A monopolist making excess profit

In the diagram above, the monopolist attained equilibrium at point 'e' where MR = MC. Also, the MC curve cuts the MR curve from below and is rising or the slope of MC is greater than that of MR at that point, hence the two conditions are met. At any output level below 'qe', MR is greater than MC hence it pays the producer to increase output. Any output level above 'qe' implies MC > MR hence it pays to reduce the level of output. Pe and qe are equilibrium price and quantity respectively. Since unit price is greater than unit cost, the monopolist is making excess profit as given by the shaded area PeDEC. Because there are barriers to entry, the monopolist can make excess profit even in the long run.

Example:

Given the following demand and total cost functions of a monopolist;

$Q = 50 - 0.5p$

$C = 50 + 40Q$

1. Find the equilibrium price and quantity
2. Determine whether this is the profit maximizing or profit maximizing output level.

SOLUTION Q1

$Q = 50 - 0.5p$ ……(1)

$C = 50 + 40Q$……(2)

From equation (1) we make 'P' the subject

$0.5P = 50 - Q$

$P = 100 - 2Q$ ……..(3)

$TR = P.Q = (100 - 2Q)Q$

$= 100Q - 2Q^2$

$MR = dTR/dQ = 100 - 4Q$

From equation (2) where $C = 50 + 40Q$

MC = dc/dQ = 40
At equilibrium, MR = MC
100 – 4Q = 40
100 – 40 = 4Q
60 = 4Q
Q = 60/4 = 15units
Substitute the value of Q = 15 into equation (3)
P = 100 – 2Q = 100 – 2 (15)
= 100 – 30 = 70
:. P = N70.00
Q 2 units
Profit (Λ) = TR - TC
Λ = (P. Q) – C
Λ= PQ – C = (70 x 15) – (50 + 40 (15)
Λ= 1050 – (50 + 600) = 1050 – 650 = 400
:. Λ= N400.00

The second order condition for profit maximization, the slope of MC is greater than the slope of MR.

i.e. $\frac{d2TR}{dQ^2} < \frac{d2TC}{dQ^2}$

$\frac{dMR}{dQ} < \frac{dMC}{dQ}$

MR = 100 – 4Q

$\frac{dMR}{dQ} = \frac{d^2TR}{dQ^2} = -4$

MC = $\frac{dC}{dQ}$ = 40

$\frac{dMC}{dQ} = \frac{d^2C}{dQ^2} = 0$

:. – 4 < 0

Hence P = N70 and q = 15units are the profit maximizing price and quantity respectively.

SELF- ASSESSMENT EXERCISE

Suppose the following demand and total cost function of a monopolist are given;

Q = 360 – 20P (demand function)

TC = 6Q + 0.05Q^2 (Cost function)

i. Determine the output he will produce and the price he will charge to maximize profit?
ii. What will be the amount of profit made by him?

3.4. PRICE DISCRIMINATION

Price discrimination refers to the practice of charging different prices to different customers for the same good or service. This is possible only if the supplier has some monopoly power, and can identify the customer, and if the customer cannot resell the good, or it is expensive to do so. A seller will only make price discrimination between different buyers when it is both possible and profitable for him to do so.

Price discrimination is not a very common phenomenon as it is very difficult to charge different prices for the identical good from the different buyers. More often, the product is slightly differentiated to successfully practice price discrimination. Thus, the concept of price discrimination can be broadened to include the sale of the various varieties of the same good at prices, which are not proportional to their marginal costs. Thus, Prof Stigler defines price discrimination as "the sales of technically similar products at prices which are not proportional to marginal cost".

Price discrimination may be **personal** when a seller charges different prices from different persons. It is **local** when a seller charges different prices from people of different localities or places. And it is **according to use or trade** when different prices of a commodity are charged according to the uses to which the commodity is put. However, Prof. A. C Pigou has distinguished between the following three types of price discrimination;

i. ***Price discrimination of the first Degree:-*** First degree price discrimination defines an upper limit to what producers can gain. It occurs when the monopolist is able to sell each separate unit of the product at a different price. Under this, every buyer is forced to pay the price which is equal to the maximum amount he is willing to pay rather than do without the good altogether. In other words, it is known as "perfect price discrimination" because it involves maximum possible exploitation of each buyer in the interest of the seller's profits, leaving no consumer surplus to any buyer.

ii. ***Price Discrimination of the second degree:***- It occurs when producers cannot tell which group customers belong to, but offer alternative contracts which include consumers to identify themselves. In this case, buyers are divided into different groups and from each group a different price is charged which is the lowest demand price of that group. In this way, from each group of buyers, he charges a different price and the price which he charges from each group is that which a marginal individual of that group is just willing to pay.

iii. ***Price discrimination of the third degree:-*** It occurs when sellers can identify different groups of customers, and offer different prices to each group or sub-market. The price charged in a sub-market need not be the lowest demand price of that sub-market or group, in contrast to price discrimination of the second degree. It is the most common and an example being a producer who charges a lower price abroad than in a home (local) market.

SELF -ASSESSMENT EXERCISE
Explain Price Discrimination and the Degrees of Price Discrimination.

4.0. CONCLUSION

In conclusion, monopoly is an extreme form of imperfect competition and with perfect competition, they serve as the two extreme opposite market structures and between them, the various intermediate market situations lie. Monopolies don't just exist, the presence of some factors make it inevitable, the existence of monopolies. And finally, from the point of view of expansion in output, as well as for making the distribution of real incomes equitable, price discrimination, a practice by monopolist, is socially justified.

5.0. SUMMARY

This unit explained the concept of monopoly, its characteristics and the factors that cause the emergence of monopolies. It further examined the derivation of the demand curve, marginal revenue and the equilibrium under monopoly. The unit concluded by examining price discrimination as practiced by the monopolist and the different degrees of price discrimination.

6.0. TUTOR – MARKED ASSIGNMENT

1 Brief discuss monopoly and the causes of monopoly.
2 Suppose the following demand and total cost function of a monopolist are given:

$Q = 360 - 20P$ (Demand function)
$TC = 6Q + 0.05Q^2$

i. Determine the monopolist's output and price that will maximize profit.
ii. What will be the profit made by him?

3 Explain price discrimination and discuss what you understand by the degrees of price discrimination

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UNIT 9 THEORY OF MONOPOLISTIC COMPETITION

CONTENTS

1.0. INTRODUCTION

In the previous units, we have analysed the price and output equilibrium under perfect competition and monopoly. But the perfect competition is rarely found in the real world and thus it does not represent, for the most part, the actual market situations. The urgent need was therefore felt to reformulate the theory of price so as to bring it nearer to the actual world. This was accomplished by Prof. E. H. Charnberlin and Joan Robinson who worked quite independently and brought out simultaneously," The theory of monopolistic competition" and "the economics of imperfect competition" respectively.

In this unit, we shall examine the concept of monopolistic competition, its characteristics, equilibrium and its effects.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of monopolistic competition
- Discuss its characteristics and the equilibrium (in both short – run and long – run)
- Discuss the effects of monopolistic competition

3.0. THEORY OF MONOPOLISTIC COMPETITION

3.1. Concept of Monopolistic Competition

Monopolistic competition is a market structure where many competing producers sell products that are differentiated from one another (i.e. the products are substitutes, but are not exactly alike). It's a market situation with a limited number of sellers, where each believes that the price that can be charged is a decreasing function of the quantity sold. Monopolistic competitors believe they face downward – sloping demand curves, but do not attempt to anticipate the reactions of individual competitors, as opposed to the case of oligopoly which we shall see in the succeeding unit.

Chamberlin's concept of monopolistic competition is a blending of competition and monopoly. He says, "monopolistic competition is a challenge to the traditional view point of economics that competition and monopoly are alternatives. By contrast, most economic situations are composites of both competition or monopoly. The distinguishing feature of

monopolistic competition which makes it blending of competition and monopoly is the differentiation of the product. This means that the products of various firms are not homogenous but different though they are closely related to each other.

Product differentiation does not mean that the products of various firms are altogether different. They are only slightly different so that they are quite similar and serve as close substitutes of each other. When there is any degree of differentiation of products, monopoly element enters into the situation. The greater the differentiation, the greater the monopoly element involved in the market situation. Thus, products are not identical as the case with perfect competition, but neither are they remote substitutes as the case with monopoly. We thus find that in monopolistic competition, there are various monopolists competing with each other.

SELF -ASSESSMENT EXERCISE
What is monopolistic competition?

3.2. Characteristics of monopolistic competition

Monopolistically competitive markets have the following characteristics;

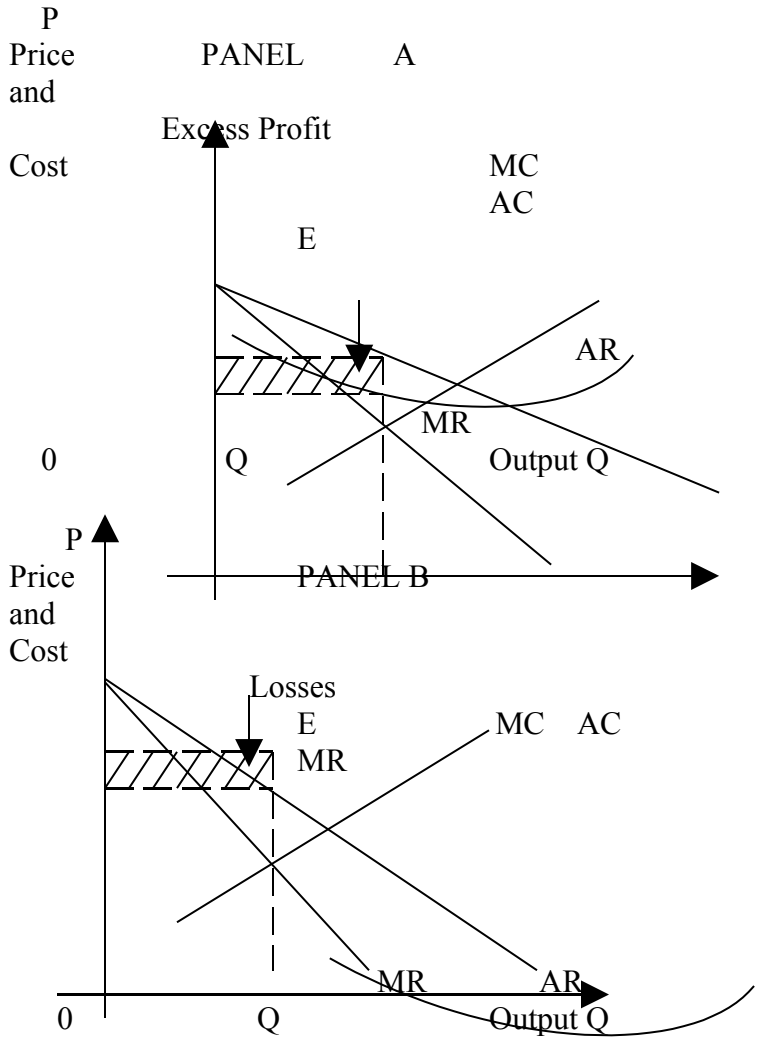
- There are many producers (Sellers) and many consumers in a given market and no business has total control over the market price.
- The products of the sellers are differentiated, yet they are close substitutes of one another, product differentiation takes the form of labeling, Brand names, colour etc.
- There are few barriers to entry and exit.
- The firm is faced with downward sloping demand and marginal revenue curves.
- The goal of the firm is profit maximization.

An industry with the above types of arrangement is referred to as monopolistic competition. It is monopolistic because each producer specializes in the production of a particular good and will not allow another producer to engage in the production of the same product. It is competitive because each producer is actively competing with one another to capture a wider market.

SELF -ASSESSMENT EXERCISE
Discuss the characteristics of monopolistic competition

3.3. Equilibrium under Monopolistic Competition

The short – run equilibrium of the firm under monopolistic competition is the same with that of the monopoly in terms of the curves. The only difference being that a firm under monopolistic competition can make a loss.



Short – Run Equilibrium of a Firm under Monopolistic Competition

In panel A, the firm is making profit while in panel B, the firm is making losses. The conditions for profit maximization are the same with those of monopoly and perfect competition. The conditions for profit maximization are:

(1) MC = MR

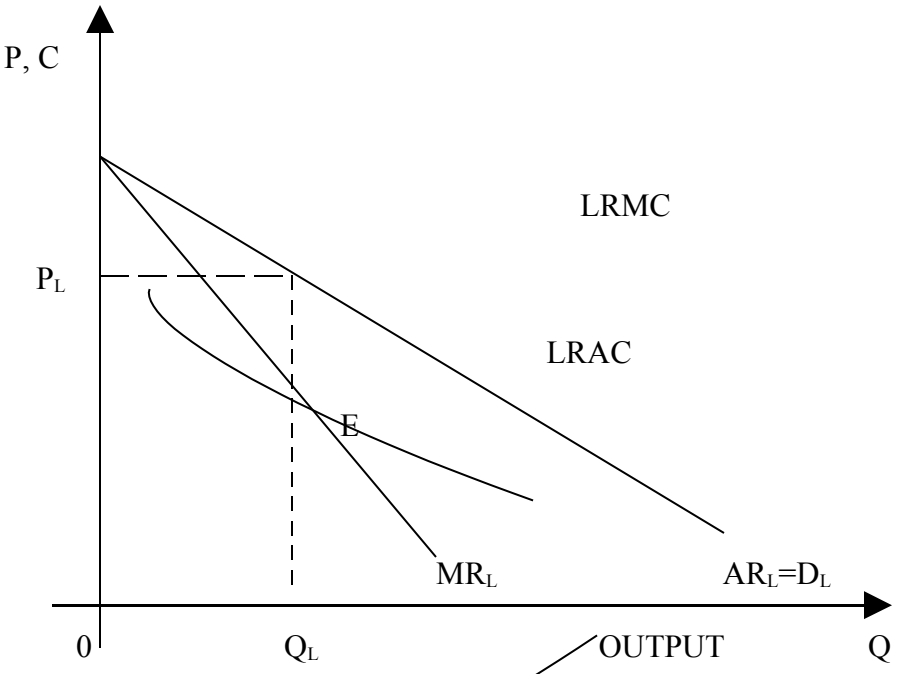
(2) At the point of equilibrium, MC must cut MR from below or the slope of MC must be greater than the slope of MR at that point (Point E on A and B).

The demand curve is downward slopping because of the relationship between changes in price and quantity demanded. The demand though downward – sloping is highly elastic because of the fact that there are a large number of sellers. If it reduces its price,

there will be increase in its sales which are more or less equal to the loss of sales distributed over all the other firms.

In the long run, if firms are enjoying profits, other firms will be attracted into the industry thereby increasing the industry's cost of production. This situation will wipe-off excess profits and all firms will enjoy normal profits. On the other hand, if firms are making losses, some firms will exit the market thereby reducing pressure on cost hence wiping the losses and all firms enjoy normal profits. At the long – run;

i. Average Cost (AC) is tangent to the demand curve
ii. There is normal profit
iii.



Long run equilibrium under monopolistic competition

SELF ASSESSMENT EXERCISE
Briefly discuss the equilibrium under monopolistic competition

3.4. Effects of Monopolistic Competition

The effects of monopolistic competition include:

1. Resources are wasted in advertising and in differentiating a firm's product from others. These costs are added to the production cost thus making the prices higher.
2. Firms produce at costs higher than minimum average cost (AC) thus, production is not efficient.
3. In monopolistic competition, firms offer a wider variety of products in the market thereby enhance the utility of consumers.
4. It ensures quality of products to meet up with competition.

SELF ASSESSMENT EXERCISE
Discuss the effects of monopolistic competition

4.0. CONCLUSION

As perfect competition and monopoly were found to be inapplicable to the behavior of business firms in the actual world, monopolistic competition offers a more realistic form of market structure. It is a blending of perfect competition and monopoly and provides explanation to relationship between business firms in the real world.

5.0. SUMMARY

This unit throws light on the concept of monopolistic competition. This was done through examining its characteristics, equilibrium and its effects.

6.0. TUTOR – MARKED ASSIGNMENT

1 Explain monopolistic competition and its characteristics
2 Discuss equilibrium under monopolistic competition
3 What are the effects of monopolistic competition

7.0. REFERENCES / FURHTER READINGS

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UNIT 10 THE THEORY OF OLIGOPOLY

CONTENTS

1.0. INTRODUCTION

In the earlier units, we have studied price and output determination under three market forms, namely, perfect competition, monopoly, and monopolistic competition. However, in the real world, we find that many of the markets or industries are oligopolistic. Oligopoly is an important form of imperfect competition. It is said to prevail when there are few firms or sellers in the market producing or selling a product.

In this unit therefore, we shall consider the concept and characteristics of oligopoly. Also, the two types of oligopoly; collusive and non collusive oligopoly, shall be considered.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Explain the concept of oligopoly
- Discuss the characteristics of oligopoly
- Explain collusive and non collusive oligopoly

3.0. THE THEORY OF OLIGOPOLY

3.1. The Concept of Oligopoly

Oligopoly is a market structure where there exist few sellers of a commodity. The simplest form is ‘duopoly’ i.e. two sellers of a product which may be homogenous or differentiated. If the product is not differentiated e.g. steel, cement, transport etc. it is referred to as pure oligopoly. If however, the product is differentiated, it is called differentiated oligopoly.

Oligopoly arises as a result of the same general reasons as monopoly. They include control over the source of raw materials by few firms, technological factors, high initial cost of entry, economics of large scale of production limit pricing policy of existing few firms and patent rights and other factors policies which tend to limit the number of firms that enter the industry.

In some cases, oligopolistic firms are interdependent or tend to cooperate with each other. This makes it difficult for a new firm to enter the industry and compete with them in other cases, they tend to act independently or react differently to the actions of each other. Each firm has a sufficiently large share of the market to need to consider the individual reactions of the others to changes in its price or output. Equilibrium thus depends on how each oligopolist forecasts the others reactions.

SELF- ASSESSMENT EXERCISE
What is oligopoly?

3.2. Characteristics of Oligopoly

The characteristics of oligopoly are;

i. ***Interdependence:-*** Interdependence in the decision – making of the few firms in the industry is the most important feature of oligopoly. This is because when the number of competitors is few, any change in price, output, product etc. by a firm will have a direct effect on the fortune of its rivals, which will then retaliate in changing their own prices, output or products as the case may be. It is therefore clear that the oligopolistic firm must consider not only the market demand for the industry's product but also the reactions of the other firms in the industry to any action or decision it may take.

ii. ***Importance of advertising and selling costs-*** A direct effect of interdependence of oliogopolists is that the various firms have to employ various aggressive and defensive marketing. Weapons to gain a greater share in the market or to prevent a fall in the share. For this reason, various firms have to incur a good deal of costs on advertising and on other measures of sales promotion. Unlike the previous market structures, under oligopoly, advertising can become a life – and death matter where a firm which fails to keep up with the advertising budget of its competitors may find its customers drifting off to rival products. To an oligopolist, true competition consists of the life of constant struggle, rival against rival, which can only be found under oligopoly (or on a smaller scale, under conditions of monopolistic competition).

iii. ***Group Behaviour:-*** Unlike others forms of market structure, oligopoly is a theory of group behavior not of mass or individual behavior and to assume profit maximizing behavior on his part may not be very valid. In oligopoly, there are few firms in a group which are very much interdependent. Given the present state of our economic and social science, there is no generally acceptable theory of group behavior. Do the members of a group agree to pull together for a common interest or will they fight to promote their individual interests? Does the group posses any leader? If so, how does he get the others to follow him? These are some of the questions that need to be answered by the theory of group behavior.

iv. ***Indeterminateness of demand curve facing an oligopolist:-*** Under the previous market structures, the demand curve for a firm is definite.

Under oligopoly, because of interdependence, of the firms, a firm cannot assume that its rivals will keep their prices unchanged when it makes changes in its own price. As a result, the demand curve for a firm under oligopoly losses its definiteness and determinateness. Since it goes on constantly shifting as the rivals change their prices in reaction to price changes by a firm.

SELF-ASSESSMENT EXERCISE
Discuss the characteristics of oligopoly

3.3. Collusive Oligopoly

In order to avoid the uncertainty arising out of interdependence and to avoid price wars and cut-throat competition, firms under oligopolistic conditions often enter into agreement regarding a uniform price – output policy to be pursued by them. The agreement may be either formal (open) or tacit (Secret). But since formal or open agreements to form monopolies are illegal in most countries, agreements reached between oligopolists are generally tacit or secret. When the firms enter into such collusive agreements formally or secretly, collusive oligopoly prevails. Collusions are of two types;

a) Cartels and
b) Price leadership

CARTELS

In a cartel type of collusive oligopoly, firms jointly fix a price and output policy through agreements. Formal collusion or agreement among the oligopolists may itself take various forms. An extreme form of collusion is found when the member firms agree to surrender completely their rights of price and output determination to a "central administrative agency" so as to secure maximum joint profits for them. Such a formal collusion is generally designated as perfect cartel. Thus, under perfect cartel, the price and output determination of the whole industry as well as of each member firm is determined by the common administrative authority so as to achieve many joint profits for the member firms. The total profits are then distributed among the member firms in a way already agreed between them.

The central authority determines the separate outputs to be produced by the various members and the price and also produce at a level where total cost is made minimum. Total cost will be minimized when the various firms in the cartel produce such separate outputs that their marginal costs are equal.

PRICE LEADERSHIP

Under price leadership, one firm sets the price and others follow it. The one who set the price is the leader and the others are his followers. The follower firms adopt the price of the leader, even though they have to depart from the profit – maximizing position, as they think that it is to their advantage not to compete with their leader and between themselves. Price leadership is of various types;

ii. ***Price leadership by a low cost firm:*** The low cost firm sets the price below the profit maximizing price for the high cost firm. Since they cannot sell their product at a higher price, they are forced to agree to the low price but the price leader sets a price which must yield some profits to his follower(s).

iii. ***Price leadership by the dominant firm:-*** Few firms in an industry may dominate because they produce a large proportion of the total output in the industry. The dominant firm wields a great influence hence estimates its own demand curve and fixes a price which maximizes its own profits. The other firms which are small, having no individual influence accepts the price set and adjust their output accordingly.

iv. ***Barometric price leadership:-*** Under this, an old, experienced, largest or most respected firm assumes the role of a custodian who protects the interest of all. He assesses changes in market conditions and makes changes in price which are best from the view point of all the firms in the industry. Naturally, other firms follow him willingly.

v. ***Exploitative or Aggressive price leadership:-*** Under this, a dominant firm establishes its leadership by following aggressive price policies and thus compel the other firms in the industry to follow him. Such a firm threatens to compete others out of the market if they don't follow him in setting the price.

SELF ASSESSMENT EXERCISE

1. What is a cartel?

2. Discuss the various types of price leadership

3.4. Non Collusive Oligopoly

It refers to a situation where firms in an oligopolisitic industry behave independently of each other and therefore tend to compete or react to each other. Models of non collusive oligopoly include; cournot model, Edgeworth model, and sweezy kinked demand model. In this unit, we shall concentrate on the cournot model and the kinked demand model.

COURNOT'S DUOPOLY MODEL

An American mathematician put forward a concept of equilibrium known after his name as Nash Equilibrium. According to Nash, firms reach their equilibrium state when they are doing their best, given what its competitors are doing. In cournot's model, equilibrium is achieved when each firm produces an output that maximizes its profits, given the output produced by the rival firm and hence neither firm has any incentive to change its output. Hence cournot's equilibrium is an example of Nash equilibrium.

Assume the linear demand function;

$P = a - bQ$, where Q is output of both firms. The above demand function can be written as; $P = a - b (Qa + Qb)$ where Qa and Qb are the outputs of firm A and B respectively. Since Total Revenue TR = P x Q, then TRa = P x Qa and TRb = P x Qb. Therefore, TRa = P x Q, then TRq = P x Qa and TRb = P x Qb. Therefore, TRa = PQ = (a – bQa – bQa) Qa TRa = aQa –bQa2 – bQaQb.

The marginal revenue function for A corresponding to the demand function is MRa = dTRa/dQa = a – 2bQb – bQb. To maximize profits, firm A will set marginal revenue (MR) equal to marginal cost (MC). Assume MC = K

A – bQb – 2bQa = K

$$Qa = \frac{a - k - bQb}{2b}$$

It states that the profit maximizing output Qa of firm A depends on what other firm is producing that is, Qb. It describes how firm A will react to a rate of output produced by the rival firm. Therefore, the equation is called reaction function. Similarly, reaction function of firm B can be derived as follows.;

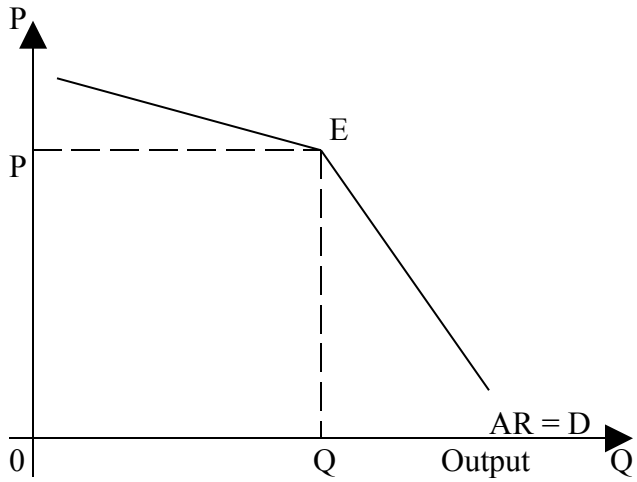
$$Qb = \frac{a - k - bQa}{2b}$$

Equilibrium can then be determined by solving the two reaction functions simultaneously.

THE KINKED DEMAND CURVE THEORY OF OLIGOPOLY

It has been observed that many oligopolistic industries exhibit an appreciable degree of price rigidity and stability. In other words, in many oligopolistic industries, prices remain sticky or inflexible, that is, there is no tendency on the part of the oligopolist to change price of the commodity produced by them even if the economic condition undergo a change. The kinked demand curve hypothesis is an explanation of this price rigidity. Economists often use the kinked demand curve hypothesis in explaining price and output especially under oligopoly with product differentiation.

The demand curve facing an oligopolist, according to the kinked demand curve hypothesis has a 'kink' at the level of the prevailing price. The kink is formed at the prevailing price level because the segment of the demand curve below the prevailing price level is less elastic. This difference in elasticities is due to the particular competitive reaction pattern assumed by kinked demand hypothesis. Each oligopolist believes that if he lowers the price below the prevailing level, his competitors will follow him and will accordingly lower their prices, whereas if he raises the price above the prevailing level, his competitors will not follow his increase in price.



The best option for the oligopolist is to produce at point E which is the equilibrium point and the kink point. This due to the fact that above the kink, demand is relatively elastic because all other firms prices remain unchanged. Below the kink, demand is relatively inelastic because all other firms will introduce a similar price cut, eventually leading to a price war. Following the fierce price competitiveness created by this sticky-upward demand curve, firms use non-price competition in order to accrue revenue and market share.

The motivation behind this kink is, that in an oligopolistic market, firms will not raise their prices because even a small price increase will result in loss of customers. This is because competitors with comparatively lower prices will gain larger market share. However, even a large price decrease will gain only a few customers because such an action will trigger a price war with other firms. This curve is therefore more price – elastic for price increases and less for price decreases. Firms will often enter the industry in the long – run.

SELF- ASSESSMENT EXERCISE
Q Discuss the cournot model and the kinked demand model of non collusive oligopoly.

4.0. CONCLUSION

In conclusion, the simplest case of oligopoly is duopoly which prevails only when there are only two producers or sellers of a product. Analysis of duopoly raises all those basic problems which are confronted in explaining oligopolies with more than two firms.

5.0. SUMMARY

This unit started by explaining the concept of oligopoly and its characteristics. It further examined the two types of collusive oligopoly i.e. cartel and price leadership. The unit ended with examining the cournot model and the kinked demand model of oligopoly.

6.0. TUTOR – MARKED ASSIGNMENT

1 What is oligopoly? Discuss its characteristics.
2 Discuss the types of price leadership under oligopoly
3 Suppose the market demand curve for a homogeneous product is given by P = 100 – Q. And suppose there are two firms each with a constant marginal cost N10.00. Find if these two firms behave as cournot duopolists and determine the equilibrium price and total industry output.

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UNIT 11 NATURAL MONOPOLY

CONTENTS

1.0. INTRODUCTION

Natural monopolies arise where the largest supplier in an industry, often the first supplier in the market, has an overwhelming cost advantage over other actual or potential competitors. This tends to be the case in industries where capital cost predominates, creating economies of scale, which are large in relation to the size of the market, hence high barriers to entry. Some free – market – oriented economists argue that natural monopolies exist only in theory and not in practice, or that they only exist as transient state.

This unit will examine the concept of natural monopoly, historical example and industry with natural monopoly and the regulation of natural monopolies.

2.0. OBJECTIVES

At the end of this unit, you should be able to;

- Analyse the concept of natural monopoly
- Discuss industries with natural monopoly and historical example of natural monopoly
- Discuss the regulation of natural monopoly

3.0. NATURAL MONOPOLY

3.1. The Concept of Natural Monopoly

Natural monopoly occurs when, due to the economies of scale of a particular industry, the maximum efficiency of production and distribution is realized through a single supplier. It arises where the largest supplier in an industry, often the first supplier in a market, has an overwhelming advantage over other actual or potential competititors. It normally predominates in industries where firms require large capital investment to enter the market. This creates economies of scale which are large in relation to the market, and hence high barriers to entry, e.g. water service and electricity.

In other words, it is a monopoly based an overwhelming cost advantage for the incumbent firm. This may be because it possess some unique natural resource e.g. a mine

tapping the only known deposits of a particular mineral, or because of past capital installations which would have to be duplicated by a competitor e.g. domestic electricity supply. This is contrasted with a statutory monopoly where the incumbent's position is based on laws to exclude possible rivals.

SELF -ASSESSMENT EXERCISE
What is Natural Monopoly

3.2. Industries with a Natural Monopoly and Historical Example of Natural Monopoly

Utilities are often natural monopolies. In industries with a standardized product and economies of scale, a natural monopoly will often arise. In the case of electricity, all companies provide the same product, the infrastructure required is immense, and the cost of adding one more customer is negligible, up to a point. Adding one more customer may increase the company's revenue and lowers the average cost of providing for the company's customer base. So long as the average cost of saving customers is decreasing, the larger firm will more efficiently serve the entire customer base. Of course, this might be circumvented by differentiating the product making it no longer pure commodity. For example, firms may gain customers who will pay more by selling "green" power, or nonpolluting power, or locally – produced power.

Such a process happened in the water industry in the nineteenth century Britain. Up untle the mid – nineteenth century, parliament discouraged municipal involvement in water supply; in 1851 private companies had 60% of the market. Competition among the companies in larger industrial towns lowered profit margins, as companies were less able to charge a sufficient price for installation of networks in new areas. In areas with direct competition (with two sets of mains), usually at the edge of company's territories, profit margins were lowest of all. Such situations resulted in higher costs and lower efficiency, as two networks, neither used to capacity, were used. With a limited number of households that afford their services, expansion of networks slowed, and many companies were barely profitable. With a lack of water and sanitation claiming thousands of lives in periodic epidemics, municipalisation proceeded rapidly after 1860, and it was municipalities who were able to raise the finance for investment, which private companies in many cases could not. A few well – run private companies which worked together with their own towns and cities (Gaining legal monopolies and thereby the financial security to invest as required) did survive, providing around 20% of the population with water even today. The rest of the water industry in England and Wales was reprivatised in the form of 10 regional monopolies in 1989.

SELF -ASSESSMENT EXERCISE
Discuss any industry with natural monopoly. Any Historical example?

3.3. Regulation of Natural Monopoly

As with all monopolies, a monopolist who has gained his position through natural monopoly effects may engage in behavior that abuses his market position, which often leads to calls from consumers for government regulation. Government regulation may also come about at the request of a business hoping to enter a market otherwise dominated by a natural monopoly. Common arguments in favor of regulation include the desire to control market power, facilitate competition, promote investment or system expansion or stabilize markets. In general though, regulation occurs when the government believes that the operator, left to his own devices, would behave in a way that is contrary to the government's objectives. Regulatory responses include;

i. ***Doing nothing:-*** Because the existence of a natural monopoly depends on an industry's cost structure, which can change dramatically through new technology (both physical and organizational/ institutional), the nature or even existence of natural monopoly may change over time. Noble economist, Milton Friedman, took a strong stance that "over time I have gradually come to a conclusion that antitrust laws do far more harm than good and that we would be better off if we didn't have them at all, if we could get rid of them".

ii. ***Common carriage competition:-***This involves different firms competing to distribute goods and services via the same infrastructure for example different electricity companies competing to provide services to customers, over the same electricity network. For this to work requires government intervention to breakup vertically intergrated monopolies, so that for instance in electricity, generation is separated from distribution and possibly from other parts of the industry such as sales. The key element is that access to the network is available to any firm that needs it to supply its services, with the price the infrastructure owner is permitted to charge being regulated. Such a system may be considered a form of deregulation, but in fact it requires active government creation of a new system of competition rather than simply the removal of existing legal restrictions.

iii. ***Stock market:***- One regulatory response is to require that private companies running natural monopolies be quoted on the stock market. This ensures they are subject to certain financial transparency requirements, and maintains the possibility of a take over if the company is mismanaged. The later in theory should help ensure that the company is efficiently run.

iv. ***Public ownership:-*** A traditional solution to the regulation problem, especially in Europe is public ownership instead of government regulating a firms behaviour, it simply takes it over (usually by buy – out), and sets itself limits within which to act.

v. ***Network effects:***- Network effects are considered separately from natural monopoly statues. Natural monopoly effects are a property of the producers cost curves, whilst network effects arise from the benefit to the consumers of a good

from standardization of the good. Many goods have both prosperities, like operating system software and telephone networks.

SELF-ASSESSMENT EXERCISE
Discuss the regulation of natural monopolies

4.0. CONCLUSION

We shall conclude with the original concept of natural monopoly as attributed to John Stuart Mill. Writing before the marginalist revolution, he believed that prices would reflect the costs of production in the absence of artificial or natural monopoly. In the light of his assertion, it may be clear that regulation may be necessary to avoid or prevent exploitation.

5.0. SUMMARY

This unit examined the concept of natural monopoly, industries with natural monopoly and historical examples. It concluded by examining the regulation of natural monopolies.

6.0. TUTOR – MARKED ASSIGNMENT

Q1 What are natural monopolies?
Q2 Briefly discuss the regulation of natural monopolies?

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UNIT 12: THEORY OF CONSUMER BEHAVIOUR

CONTENTS

1.0 INTRODUCTION

Consumer behaviour is a study of how individuals make decisions to spend their available resources or consumption related aspects such as what, when and how they buy. It is concerned with the allocation of the resources owned by individuals as they pursue the goal of satisfying their needs. However, heterogeneity among people makes understanding consumer behaviour a challenging task. Consumer behaviour is influenced by culture, society, family, friends and reference groups, and this provides a wide range of diversities in trying to understand the patterns of individual decision making and hence the choices the individuals make in consumption.

These diversities in the behaviour of consumers have been curbed with the development of a series of assumptions by which an evaluation is made of these economic behaviours thereby providing an empirical means of processing the consumption patterns of consumers. These models which include the cardinal marginal utility analysis and the indifference curve analysis, theorize that the consumer is assumed to be rational and conscious about economic calculations, and therefore follows the law of marginal utility. An individual buyer seeks to spend his money on such goods which give maximum satisfaction (utility) according to his interests and at relative cost. The buying behaviour is determined by the income – its distribution and level – which affects the purchasing power. Consumer behaviour is therefore based on the assumption that consumers have stable preferences, and they attempt to do as well as possible given those preferences and the constraints placed on their resources, and that changes in behaviour are due to changes in these constraints.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Explain the diverse theories propounded to explain the behaviour of the consumer
- Be critical of the theories and the validity of the basis of their assumptions.

3.0 THEORY OF CONSUMER BEHAVIOUR

3.1 CARDINAL MARGINAL UTILITY ANALYSIS

Amongst the different theories that have been advanced to explain the consumer's demand for a good, the cardinal marginal utility analysis is the oldest theory. The cardinal marginal utility analysis provides an explanation of consumer's demand for a product and derives the law of demand which establishes an inverse relationship between price and quantity demanded of the product.

It may be noted that, in economic theory, utility hypothesis forms the basis for the theory of demand. The cardinalists postulated that utility can be measured. Various suggestions have been made for the measurement of utility. Some economists have suggested that utility can be measured in monetary units, by the amount of money the consumer is willing to sacrifice for another unit of a commodity. Others suggested the measurement of utility in subjective units, called utils.

In examining this approach to the problem of comparison of utilities, the assumptions underlying it will be stated and its weaknesses pointed out.

Assumptions of the Cardinal Marginal Utility Analysis

a. **Rationality**

The consumer is rational. He aims at the maximization of his utility subject to the constraints imposed by his given income. The consumer therefore, given the prices of commodities, plans the spending of his income so as to attain the highest possible satisfaction or utility.

b. **Cardinal Utility**

Utility is regarded to be a cardinal concept. The utility derived from each commodity is measurable. In other words, utility is a measurable and quantitative entity. A person can express the utility or satisfaction he derives from a commodity in quantitative terms. Thus, a person can say that he derives utility equal to 7 utils from the consumption of a unit of good A, and 14 utils from the consumption of a unit of good B. It also assumes that a person can compare in respect of size how much one level of utility is greater than another, that is, a person can say that the utility he gets from the consumption of one unit of good B is double the utility he obtains from the consumption of one unit of a good A. Utility is thus measurable on a ratio scale.

Moreover, according to the cardinalists, utility is not only conceivable in quantitative terms but can also be actually, measured in quantitative terms. Thus, marginal utility, measurable in principle, is also measurable in terms of money. The utility is measured by the monetary units that the consumer is prepared to pay for another unit of the commodity.

c. **Cardinal Marginal Utility of Money**

This is another important assumption of the marginal utility analysis. While the marginal utility analysis assumes that marginal utilities of commodities diminish as more of them are purchased and consumed, the marginal utility of money remains constant throughout when the individual is spending money on a good and the amount of money with him varies. This assumption is necessary if the monetary unit is used as the measure of utility. The essential feature of a standard unit of measurement is that it be constant. If the marginal utility of money changes as income increases (or decreases) the measuring rod for utility becomes like an elastic ruler, inappropriate for measurement.

d. **Diminishing Marginal Utility**

As regards this assumption, the marginal utility of a commodity diminishes as an individual consumes more units of the commodity. In other words, as a consumer takes in more and more units of a commodity, the extra utility or satisfaction that he derives from an extra unit of the commodity falls relative to that of the preceding unit. The total utility thus increases but at a decreasing rate and the intensity of the consumer's want for the commodity goes on falling until a point is reached where the individual no longer wants any more units of the commodity. That is, when saturation point is reached, marginal utility of the commodity becomes zero. Zero marginal utility of a commodity implies that the individual has all that he wants of the commodity in question.

e. **Total Utility is Additive**

Total utility is regarded to be additive. This implies that separate utilities of different goods can be added to obtain the total sum of the utilities of all goods purchased and consumed. The utility which an individual derives from the consumption of a good is the function of the quantity of that good and of that good alone. In other words, the utility an individual derives from the consumption of a good does not depend upon the quantity consumed of other goods; it depends upon the quantity consumed of that good alone. On this assumption then, the total utility which a person gets from the whole collection of goods purchased by him is simply the total sum of the separate independent utilities of the goods.

$$U = U_1(x_1) + U_2(x_2) + \cdots + U_n(x_n)$$

This assumption was however relaxed in later versions of the cardinal utility theory. Total utility of a 'basket of goods' depends on the quantities of the individual commodities. Utility is therefore dependent on the entire bundle (or basket) of goods consumed and not on the independent and separate utilities of the individual goods.

$$U = f(x_1, x_2, \ldots, x_n)$$

Equilibrium of the Consumer

For a single commodity *x*, the consumer is in equilibrium when the marginal utility of *x* is equated to its market price (*Px*). This is given as

$$MU_x = P_x$$

This implies that if the marginal utility of *x* is greater than its price, the consumer can increase his welfare by purchasing more quantities of *x* until the marginal utility equates the price. If, however, the marginal utility of *x* is less than its price the consumer can increase his total utility by reducing the quantity of *x* he consumes.
For the range of commodities x, y,…, n, the condition for the equilibrium of the consumer is the equality of the ratios of the marginal utilities of the individual commodities to their prices.

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = \cdots = \frac{MU_n}{P_n}$$

The demand curve of the consumer can be derived from the positive segment of the marginal utility curve. With consumption of successive units of the commodity, the total utility of the consumer increases but at a decreasing rate. This implies that as extra units of the commodity are consumed, the marginal utility of the consumer diminishes. If consumption continues, total utility starts to decline at the point where marginal utility reaches zero, beyond which, consuming any more units of x provides a negative utility or disutility to the consumer.

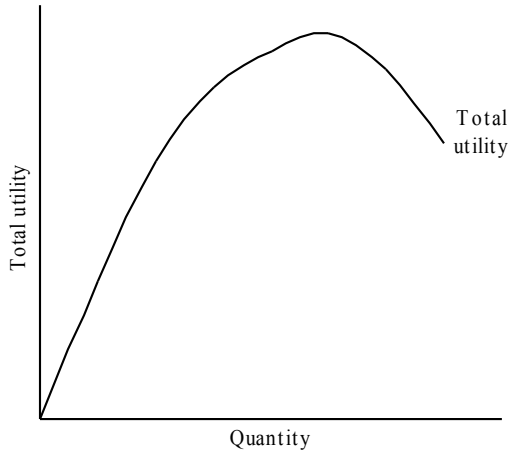


Figure 1a: Total utility

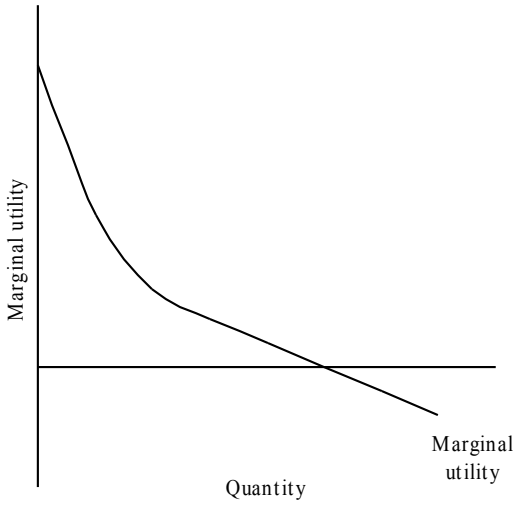


Figure 1b: Marginal utility

Figures 1a and 1b show the total utility and marginal utility respectively. The positive segment of figure 1b is identical with consumer's demand curve for commodity x.

Critique of the Cardinal Marginal Utility Analysis

The cardinalist analysis has been criticized; its shortcomings and drawbacks have also been pointed out.

The assumption of cardinal utility is extremely doubtful. The satisfaction derived from various goods cannot be measured objectively. Measurability of utility is unrealistic, thus, cannot be expressed or stated in cardinal numbers. Since utility is a psychic feeling and a subjective thing, it cannot therefore be measured in quantitative terms. In real life, individuals are only able to compare the satisfactions derived from the consumption of

various goods or combination of goods. A consumer can state only whether a good or a combination of goods gives him more, or less, or equal satisfaction as compared to another.

The assumption of constant utility of money is also unrealistic. As income increases the marginal utility of money falls as opposed to the assumption of the cardinalists which holds that the marginal utility of money remains constant at any given outlay of income or varying prices of commodities. As such, money cannot be used as a measuring rod since its own utility changes.

The axiom of diminishing marginal utility has been established from introspection. Introspection is the ability of the observer to reconstruct events which go on in the mind of another person with the help of self observation. This form of comprehension may be just guess work or intuition or the result of long lasting experience. It is a psychological law which must be taken for granted.

The assumption that total utility is additive cannot stand. The cardinalists assume that utilities derived from various goods are independent. This means that utility which an individual derives from the consumption of a good is a function of the quantity of that good and of that good alone. The utility from the consumption of a good therefore, does not depend upon the quantity consumed of other goods; it depends on the quantity consumed of that good alone. On this assumption, the total utility which a person gets from the whole collection of goods consumed by him is simply the total sum of the separate utilities of the goods. Utility functions are thus additive. But in actual life, it is not so. The utility or satisfaction derived from a good depends on the availability of some other goods which may either be substitutes for or complementary with the former.

SELF-ASSESSMENT EXERCISE 1

Why is constant marginal utility of money necessary for the cardinal utility theory?

3.2 ORDINAL UTILITY THEORY

The ordinal school of thought does not agree with the cardinal approach that utility is measurable; rather, it believes utility to be an ordinal magnitude. Utility cannot be measured in quantitative cardinal terms. It cannot be subjective (utils) or given monetary values, that is, it is not quantitative, being a psychological feeling. According to the ordinalists, cardinal utility is not attainable.

The consumer is believed to be capable of simply “comparing” the different levels of satisfaction. The consumer may thus not be able to exact amounts of utilities derived from commodities or any combination of them, but is capable of judging whether the satisfaction obtained from a good or combination of goods is equal to, lower than, or higher than another.

The way a consumer ranks or orders various alternative commodities or baskets of commodities from among the vast number of goods and services available to him, provides information about his preference, which are, his likes and dislikes. Consumer preference indicates what alternatives he prefers over others and between which he is indifferent. These preferences for various commodities or indifference between various commodities or alternative baskets of commodities is the result of the working of various factors such as

heritage, geographical environment, education, social culture, and information about products. How these preferences are formed are not explained, they are only described.
In addition to the consumer's preferences, his income and prices of goods also determine his choice of an alternative.
There are two main ordinal theories. These are the *Indifference Curves Theory* and the *Revealed Preference Hypothesis*.

3.2.1 INDIFFERENCE CURVES THEORY

This theory evolved to supersede the cardinal utility analysis. Some assumptions of the cardinal marginal utility analysis were retained. The assumptions of the indifference curve theory are however less stringent than those of the cardinal utility approach. Only ordinality is required while the assumption of constant utility of money is dropped.

Assumptions of the Indifference Curves Theory

d. **Rationality**

The consumer is assumed to be rational. He aims at maximizing his utility given his income and market prices. It is assumed that the consumer has full knowledge of, and is certain of all the relevant information which includes knowledge of all available commodities, their prices and his income.

e. **Utility is ordinal**

This means there is complete ranking in the consumer's preferences. It is taken as axiomatically true (an accepted principle) that the consumer can rank his preferences (order the various "baskets of goods") according to the satisfaction derived from each basket.

Between two bundles or combinations of goods, a consumer is able to decide whether he prefers good A to B, prefers B to A, or is indifferent between the two. If the consumer prefers A to B, it is inferred that he gains greater satisfaction from bundle A than B. If the consumer is indifferent between bundles A and B, it can be inferred that he gains the same level of satisfaction from the two bundles of goods. The consumer can therefore rank every pair of bundles or combinations of commodities. Consumer's preferences are independent of costs. A consumer may prefer A to B but might buy B because it is cheaper. The consumer does not need to know the precise amount of satisfaction gained. It is enough that he expresses his preference for the various bundles of commodities. It is therefore not necessary to assume that he can measure the intensity of his preference.

f. **Diminishing Marginal Rate of Substitution**

Indifference curves are assumed to be convex to the origin and preferences are ranked in terms of indifference curves. The slope of the indifference curve is called the marginal rate of substitution of the commodities. The indifference curve theory is based on the axiom or accepted principle of diminishing marginal rate of substitution.

The marginal rate of substitution of two commodities is the negative of the slope of the indifference curve at any point. It is defined as the number of units

of commodity A that must be given up in exchange for an extra unit of commodity B so that the consumer maintains the same level of satisfaction.

g. The total utility of the consumer is dependent on the quantities of the commodities consumed.

$$U = f(q_1, q_2, \ldots, q_n)$$

e. **Consistency and Transitivity of Choice**

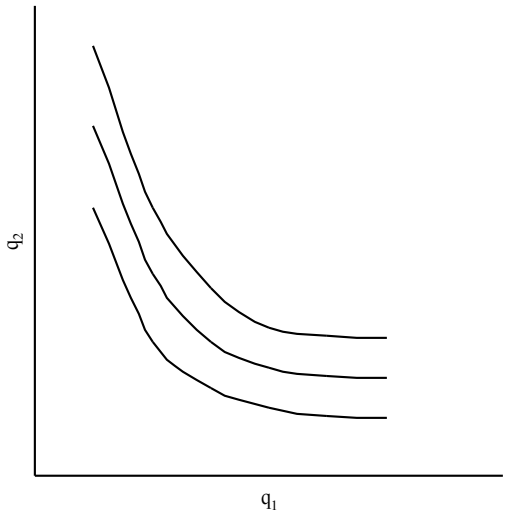
The consumer's tastes and preferences are consistent. If in one period the consumer chooses commodity A over B, he will not choose B over A in another period if both bundles are available to him. This can be symbolically written as: if A > B, then B < A.

The consumer is also assumed to be transitive in the choices he makes. If a consumer prefers good A to B and B to C, then he will also prefer A to C. Also, if he is indifferent between A and B and between B and C, then he will also be indifferent between A and C.

When a consumer prefers good A to B, it implies that he gets more satisfaction from good A as compared to good B.

Equilibrium of the consumer

The equilibrium of the consumer is determined through the indifference curve. An *indifference curve* is a locus of particular combinations or bundles of goods which yield the same level of satisfaction or utility to the consumer, so that he is indifferent as to the particular combination consumed. An *indifference map* is a collection of indifference curves corresponding to different levels of satisfaction. On an indifference map, given that indifference curves do not intersect, combinations of goods lying on a higher indifference curve yield a higher level of satisfaction and are preferred to the lower indifference curve.



Indifference curve II is preferred I. Similarly, indifference curve III is preferred to II. The slope of the indifference curve at any point is called the marginal rate of substitution of the two commodities.

$$[Slope\ of\ the\ indifference\ curve] = -\frac{dy}{dx} = MRS_{xy}$$

The marginal rate of substitution of *x* for *y* is the number of units of commodity *y* that must be forgone in exchange for an extra unit of commodity *x* so that the consumer maintains the same level of satisfaction. It is equal to the ratio of the marginal utilities of the commodities involved in the utility function:

$$MRS_{x,y} = \frac{MU_x}{MU_y}$$

The consumer is also recognized to have budget or income constraint which limits his maximizing behaviour. This constraint is made up of the income of the consumer and the prices and quantities he may be able to consume of the respective commodities, and may be written as

$$Y = p_x q_x + p_y q_y$$

The consumer is in equilibrium when he maximises his utility, given his income and the market prices. The first condition for this to take place is that the marginal rate of substitution be equal to the ratio of the commodity prices

$$MRS_{x,y} = \frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

The second (and sufficient) condition is that the indifference curve be convex to the origin. This condition is fulfilled by the axiom of diminishing $MRS_{x,y}$, which states that the slope of the indifference curve decreases as we move along the curve downwards from the left to the right.

Critique of the Indifference Curves Approach

The indifference curves theory has its weaknesses despite the importance of the theory. First, the theory of its axiomatic assumption of the existence and the convexity of the indifference curves, does not establish the actual existence or shape of the indifference curve, it just assumes that they exist and are convex in shape.

Secondly, it is questionable whether the consumer is able to order his preferences as precisely and rationally as the theory implies. The preferences of consumers change continuously, due to the influence of various factors. This causes ordering of these preferences, where possible, to be considered valid for the very short run.

Thirdly, the indifference curve theory has retained most of the weaknesses of the cardinal utility theory with the assumption of rationality and the concept of the marginal utility implicit in the definition of the marginal rate of substitution.

Another problem with the indifference curve theory is that it does not analyse the effects of advertising, past behaviour (habits), stocks, interdependence of the preferences of the consumer, which lead to behaviour that would be considered as irrational, hence these effects are ruled out by the theory.

SELF-ASSESSMENT EXERCISE 2
Two indifference curves do not intersect. Why?

3.2.2 REVEALED PREFERENCE HYPOTHESIS

The cardinal utility theory and the indifference curve theory provide a psychological explanation of consumers' demand. They derive law about consumer's demand from how the consumer would react psychologically to certain hypothetical changes in price and income.

The revealed preference theory however seeks to explain consumer's demand from his actual behaviour in the market in various price-income situations. This theory is therefore not a psychological or introspective explanation, but a behaviouristic explanation of consumer's demand. The revealed preference theory is also based on the concept of ordinal utility and therefore regards utilities to be merely comparable and not quantifiable.

The revealed preference theory has made possible the establishment of the "law of demand" directly on the revealed preference axiom, without the use of indifference curves and all their restrictive assumptions. This theory has the advantage over the indifference curves approach by establishing the existence and the convexity of the indifference curve, it does not accept them axiomatically.

In this theory, choice reveals preference.

Assumptions of the Revealed Preference Theory

a. **Rationality**

The consumer is assumed to behave rationally, in that he prefers bundles of goods that include more quantities of the commodities. The consumer is assumed to make an optimum choice among his available choices.

b. **Consistency**

The consumer behaves consistently. If a person chooses commodity A rather than B, which he could purchase with the given budget constraint, then it cannot happen that he would choose or prefer commodity B over A in some other situation in which he could have bought A if he so wished. Symbolically, it can be written as: if $A > B$, then $B < A$.

c. **Transitivity**

If an optimizing consumer prefers commodity A to commodity B of the goods and commodity B to commodity C of the goods, then he will also prefer commodity A to commodity C of the goods. This can also be symbolically written as: if $A > B$ and $B > C$, then $A > C$.

d. **The Revealed Preference Axiom**

By choosing a collection of goods in any one budget situation, the consumer reveals his preference for that particular collection. The chosen bundle is

revealed to be preferred among all other alternative bundles available under the budget constraint. The utility of the consumer is maximized by the chosen bundle of goods. The revealed preference for a particular collection of goods implies, axiomatically, the maximization of the utility of the consumer.

When a consumer is observed to choose a commodity A out of various alternative commodities available to him, he "reveals" his preference for A over all other alternative commodities which he could have purchased. This means, he considers all other alternative commodities which he could have purchased to be inferior to A.

Critique of the Revealed Preference Hypothesis

This theory is a major advancement to the theory of demand. It provides a direct way to the derivation of the demand curve, which does not require the use of the concept of utility. The theory can prove the existence and convexity of the indifference curves under weaker assumptions than the earlier theories. It has also provided the basis for the construction of index numbers of the cost of living and their use for judging changes in consumer welfare in situations which prices change.

SELF-ASSESSMENT EXERCISE 3

In the revealed preference hypothesis the consumer reveals his choice at the point of purchase. Discuss.

4.0 CONCLUSION

This topic has discussed the processes involved in the decisions of the consumer with regard to his consumption behaviours. The student should have learnt the different theoretical frameworks of the theory of consumer behaviour from which a broad application to economic theory can be made possible.

5.0 SUMMARY

The theories of consumer behaviour discussed above have all been based on the assumption that the consumer is a rational being who is aware of his wants and seeks to maximize his welfare within the constraints placed on his decisions by his income and the prices of the desired commodities.

The cardinal marginal utility theory postulates that the utility derived by the consumer is a measurable quantity; measured in terms of the money spent or in subjective terms called utils. To measure utility in terms of the money spent requires that the marginal utility of money be constant over the entire range incomes.

The ordinal marginal utility theories on the other hand oppose cardinality in the measurement of utility and propose that the consumer can only rank the utility he derives from the consumption of the different commodities; as one being more or less than another. These require consistency and transitivity in the preferences of the consumer. But while the indifference curves theory, like the cardinal marginal utility theory, is based on introspection, the revealed preference theory is based on the choices of the consumer at the point of purchase and consumption of the bundles of commodities.

6.0 TUTOR-MARKED ASSIGNMENT

1. Distinguish cardinal utility and ordinal utility.
2. a. What are indifference curves?

   b. Explain why the consumer's indifference curves (i) have negative slope, (ii) do not intersect and (iii) are convex to the origin.

   c. What is a budget line?
3. State and explain the assumptions of the revealed preference hypothesis.

7.0 REFERENCES / FURTHER READING

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UNIT 13: THEORY OF PRODUCTION

CONTENTS

1.0 INTRODUCTION

Having had discussions on demand, we now turn our attention to the product that is being demanded by the consumer. The theory of demand holds that human wants are unlimited but clearly points out that the resource necessary to satisfy those wants are limited. So is the case with production. The motive of a producer is to make maximum profit from his output. However the resources needed to produce whatever desired level of output are limited. The producer now has to grapple with the problem of having to manage the available resources (or inputs) in such a manner as to make as little use of the available resources as possible, while producing the most amount of output from these resources. This will guarantee that he maximizes his profit through minimizing the cost of producing the desired output.

Production involves the transformation of input into output. It is the process of transforming natural, human and man-made resources into valuable goods and services output which people want, and making them available where and when they are wanted. It is the process that brings about the creation or addition of utility.

Since production involves the meeting of wants which are unlimited while at the same time the resources required to meet those wants are themselves limited, a successful production process must reflect an efficient use of these resources in the creation of the needed output. The output produced which includes not only tangible goods like cars and shoes but also intangible services like the services of a driver or a cobbler, can be produced in a variety of

ways called production processes. The theory of production therefore seeks to use that production process which ensures efficient technical and economic use of inputs.

2.0. OBJECTIVES

At the end of this unit, you should be able to:

- Explain the term production
- Construct a production function
- Distinguish the concepts of returns to scale and returns to a factor
- Discuss the processes in the choice of input combination.

3.0 THEORY OF PRODUCTION

3.1 THE PRODUCTION FUNCTION

A production function is a technical statement, which relates factor inputs to output. It specifies the maximum possible output that can be produced for a given amount of input or in another sense, the minimum quantity of input necessary to produce a given level of output. The production function is determined by the technology of a firm of an industry, or of the economy as a whole and it includes all the technically efficient methods of production.

A production process or activity is a combination of factor inputs required for the production of one unit of output. This can be illustrated using a two-input, one-output model. To produce a product Q, two inputs X and Y, which may represent capital and labour may be employed. The product Q could be a tangible (physical) good like a shoe, car or television set, or Q could be a service such as that of a cobbler, a driver or an electrician.

The production function, which may be discrete or continuous, could thus be written as

$$Q = f(x, y)$$

Varying combinations of X and Y, called processes, can be used to produce a given output Q. For example, Q may be produced through the following processes:

	Process 1	Process 2	Process 3
Labour units	3	2	1
Capital units	2	3	4

These activities can be graphically represented as follows:

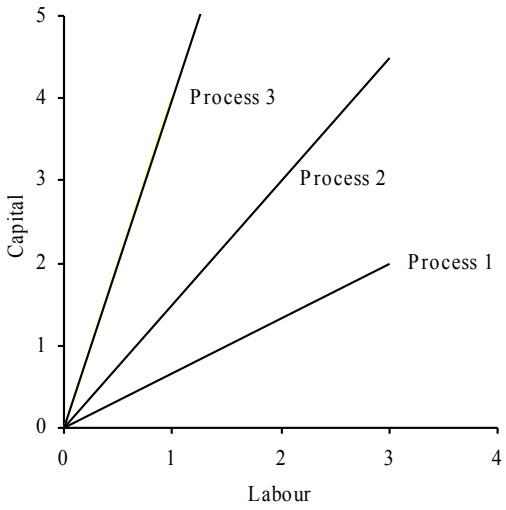

Figure 2: Map of Production Processes

The choice of the production process to employ will depend on the technical and economic efficiency of that process. This will be discussed below.

SELF ASSESSMENT EXERCISE 1
What is a production process?

3.2 RETURNS TO A FACTOR

Returns to a factor measures the relationship between the level of output and variations in only one factor input. Most commodities typically exhibit diminishing returns. This implies that with increases in the quantity of any one factor input, the output increases initially, but as the factor input continues to be increased, the output only increases at a diminishing rate. The principle of diminishing returns states that *as the quantity of a variable input increases, with the quantities of all other factors being held constant, the resulting rate of increase in output eventually diminishes*. The marginal product of a variable factor must eventually decline as increasing quantities of the variable factor are combined with other fixed factors, which if allowed to continue will lead to an eventual decline in the total product of the commodity, as will be shown below.

Total, Marginal and Average Product

Total Product

The total product is the total output produced by all the factors of production applied during a given period of time. It is the entire output from a production system. This is synonymous with Q in the function above.

$$Q = f(x, y)$$

Marginal Product

The marginal product of a factor, MP_x, is the change in output resulting from a one-unit change in the factor input, holding all other input levels constant. It is expressed as

$$MP_x = \frac{\partial Q}{\partial X}$$

where ∂Q is the change in output resulting from a one-unit change, ∂X, in the variable factor, X.

Average Product

The average product derived by dividing the total product, which is obtained, by the quantity of the variable input.

$$AP_x = \frac{Q}{X}$$

Given a table showing varying quantities of the variable factor, X, which is employed in the production of commodity, Q, we can discern the total, marginal and average product.

Input quantity (X)	Total product of the input (Q)	Marginal product of the input X ($MP_x = \Delta Q/\Delta X$)	Average product of the input X ($AP_x = Q/X$)
1	15	15	15
2	48	33	24
3	68	20	22.67
4	73	5	18.25
5	70	-3	14

SELF ASSESSMENT EXERCISE 2

Distinguish between returns to scale and returns to a factor.

3.3 LAW OF VARIABLE PROPORTIONS

The law of variable proportions examines the relationship in a production function when only one factor is varied while all other factors are left fixed. This law, also known as the law of diminishing returns, studies the effect on output of changes in the use of only one factor, holding all other factors constant. The law, according to Samuelson (1980), states that "*an increase in some inputs relative to other fixed inputs will, in a given state of technology, cause output to increase; but after a point the extra output resulting from the same additions of extra inputs will become less and less.*"

Assumptions of the Law of Variable Proportions

1. The state of technology is assumed to be given and unchanged.
2. The quantity of only one factor input is varied while all others all others are kept fixed.
3. The proportions in which the various factors can be combined to produce a product can be varied.

The example above shows us that as the quantity of the variable factor X is increased in successive units, the total product initially increases at an increasing rate but afterwards it increases at a diminishing rate. This relation is made clearer by the initial increase in the

marginal product, which eventually diminishes with increasing quantities of the variable factor.

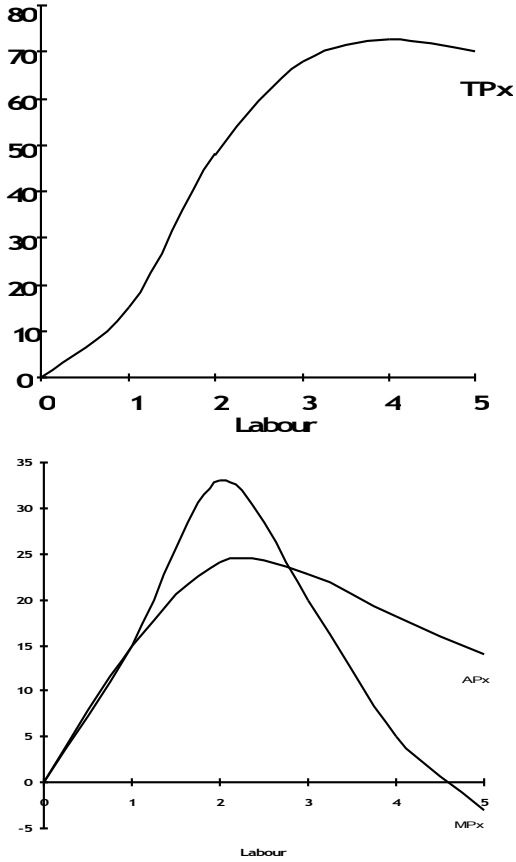

Figure 3: Illustration of the Three Stages of Production

Three Stages of the Law of Variable Proportions

The behaviour of the total product, marginal product and average product can be graphically decomposed into the three stages the firm encounters in production when only one factor is varied holding the other factors fixed.

Stage 1: The firm at this stage experiences an *increasing return* to scale. As the variable factor is increased, the total product increases at an increasing rate as can be seen in the increase in the marginal product and average product. The incremental unit of input produces an output that is relatively larger than that produced by the preceding unit of input.

Stage 2: At this stage, the firm experiences *diminishing returns* as increasing quantities of the variable factor increase output but at a diminishing rate. This is the region the intersection of the marginal product and average product, and where the marginal product touches the x-axis.

Stage 3: Beyond the point where the marginal product touches the x-axis, the firm experiences *negative returns*. The total product begins to diminish with increases in the variable factor.

SELF ASSESSMENT EXERCISE 3
Within which of the three production stages should the firm base its output?

3.4 RETURNS TO SCALE

The concept of returns to scale measures the changes in the level of output of a commodity as quantities of all the factor inputs vary. With returns to scale, we are concerned with how the returns will vary when all the factors are increased in the same proportion. Returns to scale may be constant, increasing or decreasing.

Constant Returns to Scale

Constant returns to scale occur if factor inputs and the output produced increase in the same proportion. If the factor inputs are doubled, for example, with constant returns to scale, the output produced in the process are expected to also double.

Increasing Returns to Scale

Where an increase in all the factor inputs by a given proportion increases output to a proportion higher than that of the factor inputs, returns to scale are said to be increasing. Hence, in a situation where the output trebles, for example, when factor inputs have only been doubled, the production is said to be experiencing increasing returns to scale.

Decreasing Returns to Scale

Contrary to a situation of increasing returns to scale, when output expands in a proportion less than the increase in factor inputs, there is a situation of decreasing returns to scale. In this case, a trebling of the amount of input may only double the output produced.

It should be noted however that different production functions do not always exhibit different types of returns to scale. Practically, a single production function may relate three phases of increasing, constant and diminishing returns to scale as the scale of production expands.

SELF ASSESSMENT EXERCISE 4
If the prices of factors were to remain constant at all production levels, which type of returns to scale would the firm find most profitable? Why?

3.5 INPUT COMBINATION CHOICE

In production, the choice regarding the levels of the respective factor inputs to be employed in producing a commodity is a crucial one. Here, for two-input, one-output production system, isoquants of varying shapes, may be used. An isoquant is a locus of all the technically efficient methods for producing a given level of output. There are different shapes of production isoquants depending on the degree of substitutability of the factor inputs. These include: the linear isoquant; input-output isoquant; kinked isoquant; and the smooth, convex isoquant

The smooth, convex isoquant assumes the continuous substitutability of the two factor inputs over a certain range, beyond which factors cannot substitute each other. Here, there are an infinite number of possible input combinations in the production of a given level of output. All points on the given isoquant are said to be technically efficient and as such, to produce a given level of output, it is impossible to increase the use of one input without reducing the use of the other input. Some important characteristics of the smooth, convex isoquant include: it is convex to the origin; it has negative downward slope from left to the right; the production space contains an infinite number of production isoquants each

depicting a different level of output; higher isoquants depict higher levels of output; and no two isoquants intersect.

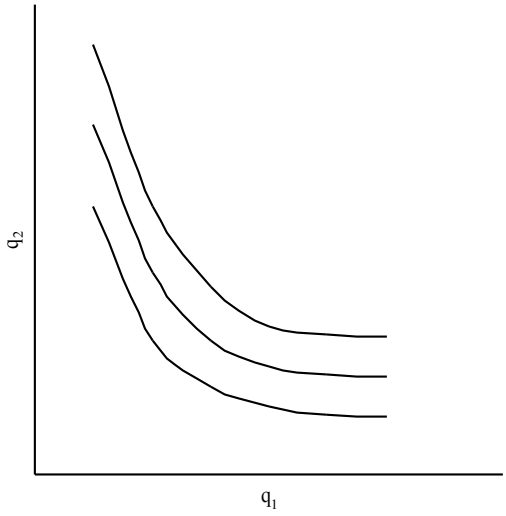

Figure 4: A map of smooth, convex isoquants

The slope of the isoquant, -∂K/∂L defines the rate of substitution of factors of production. The slope of the isoquant decreases in absolute terms in a leftward movement down the slope of an isoquant, showing the increasing difficulty in the substitution of capital for labour. The slope of the isoquant is called the Marginal Rate of (Technical) Substitution of the factors of production.

$$-\frac{dK}{dL} = MRTS_{L,K}$$

Similarly, the marginal rate of technical substitution is equal to the ratio of the marginal products of the factors of production.

$$-\frac{dK}{dL} = MRTS_{L,K} = \frac{MP_L}{MP_K}$$

Factor Intensity

The slope of the production process line through the origin measures factor intensity in production.

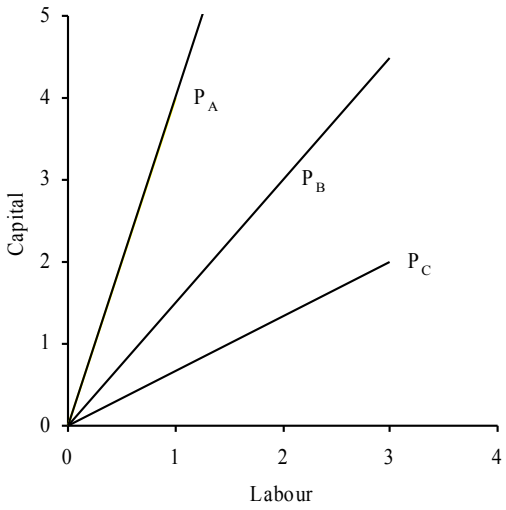

Figure 5: Map of production process

From the diagram, production process P_A is more capital intensive than production process P_B, implying that the process uses more capital resources than process P_B which uses more labour resources relative to P_A. Also, P_B is equally more capital intensive than P_C. On the other hand, P_C is more labour intensive than both P_A and P_B.

Production theory concentrates on the argument that production is feasible where the marginal product (MP) of the factors is positive. This ensures that any increase to the stock of productive factors adds to the total output of the firm. The theory of production therefore operates on the range of isoquants over which their slopes are negative and convex to the origin.

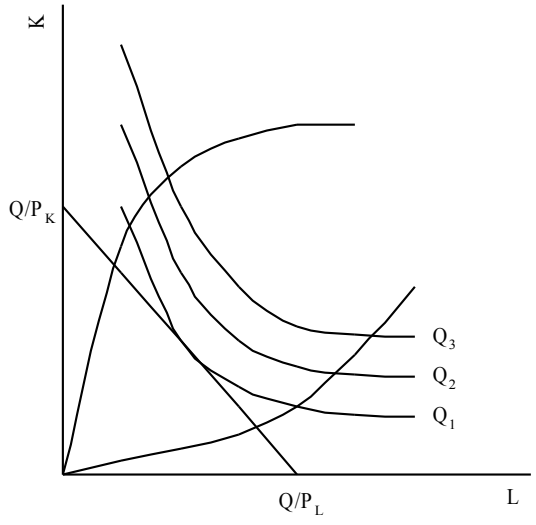

Figure 6: Economic region of production

In the diagram, the production function is shown in the form of a set of isoquants. The higher the isoquant, the higher the level of output, hence Q_2 is preferred to Q_1 while Q_3 is preferred to both Q_2 and Q_1.

The locus of points on the isoquants where the marginal product (MP) of the factors of production is zero forms the ridge lines. The upper ridge line is the locus of points on the isoquant where the marginal product of capital (MP_K) is zero while the lower ridge line is the locus of points on the isoquant where the marginal product of labour (MP_L) is zero. Production techniques are only efficient in the region within the upper ridge line and the lower ridge line. Outside this region, production processes are inefficient owing to the fact that the marginal products of the respective factors are negative.

We stated earlier that the choice of the production process to employ depends on the technical and economic efficiency of that process, relative to other process. A process *A* is said to be technically efficient if it uses less of one any factor (say labour) and no more from the other factors (say capital) as compared to method *B*. If however process *A* uses less of one input (say labour) but more of the other input (say capital) relative to process *B*, both activities are not directly comparable, but are both considered to be technically efficient and are included in the production function. In this case, the process to use shall depend on the economic efficiency of that activity.

An economically efficient process is determined from among the technically efficient production processes. It is that process for which the total cost of factor inputs is the lowest in the production of the same level of output as compared to the alternative process.

Thus given the following production processes *A*, *B* and *C* for the production of unit of product *Q*, with *X* and *Y* representing quantities of labour and capital employed in the production respectively, we may proceed as follows.

	Process *A*	Process *B*	Process *C*
Labour unit *L*	8	6	12
Capital unit *K*	5	7	9

From the table above, process *B* utilizes 6 units of labour, the lowest, while processes *A* and *C* utilize 8 and 12 units of labour respectively. For capital, it is process *A* which utilizes the lowest quantity of 5 units, whereas, processes *B* and *C* utilize larger quantities of 7 and 9 units respectively. It can be shown that process *B* utilizes less labour relative to process *A* and *C* while it utilizes more capital relative to only process *A*, while process *A* utilizes less capital than processes *B* and *C* while it utilizes more labour relative only to process *B*, the two processes *A* and *B* are thus said to be technically efficient. Process *C*, which utilizes larger quantities of both labour and capital, is therefore said to be technically inefficient.
Taking the technically efficient processes, *A* and *B*, to determine which of the processes to employ in the production of one unit of product *Q*, we now seek the economically efficient of the two processes. Assuming that a unit of labour costs 15 naira while a unit capital costs 20 naira, we compute thus:

	Process *A*	Process *B*
Labour unit	8 * ₦15 = ₦120	6 * ₦15 = ₦90

X		
Capital unit *Y*	5 * ₦20 = ₦100	7 * ₦20 = ₦140
Total cost	₦220	₦230

Process *A*, whose total production cost of ₦220 is less than that of ₦230 for process *B* is the least-cost method of production. It said to be economically efficient and thus employed in the production of product *Q*.

SELF ASSESSMENT EXERCISE 5

Identify the processes in determining the most economical means of producing a quantity of output.

4.0 CONCLUSION

Production is an important aspect in the creation of value, which is used in the satisfaction of human wants and that of the society as a whole. It is therefore necessary to develop means of maximizing the efficiency of the production process so that it becomes profitable while it minimizes avoidable wastages. With this the society maximizes the welfare it can derive from the use of its resources.

5.0 SUMMARY

The unit has discussed the theory of production. The production function was discussed, as well as, the concepts of returns to scale and returns to a factor. There were also discussions on the law of variable proportions and the choice of input combination.

6.0 TUTOR-MARKED ASSIGNMENT

1. What is production function? Distinguish between fixed inputs and variable inputs.
2. State the law of variable proportions and its assumptions.
3. Given the following processes, determine which of the processes is economically efficient if labour cost per unit is ₦15 and capital cost per unit is ₦20.

	Process *A*	Process *B*	Process *C*
Labour unit *L*	9	7	9
Capital unit *K*	8	8	6

8.0 REFERENCES / FURTHER READING

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UNIT 14: THEORY OF COST

CONTENTS

1.0. INTRODUCTION

As the firm produces value, it encounters costs that are related to its production. These costs could include the cost of management, raw materials, labour and capital that are invariably a part of the firm's production.

The firm, being a profit maximizing entity, can only maximize its profits by ensuring that it produces its output at the minimum possible cost. This it does by ensuring that its operations are not only technically efficient but are economically efficient as well. The firm also optimizes the scale of production so as to minimize avoidable costs.

2.0. OBJECTIVES

You, at the end of this unit, should be able to:

- Explain the cost function
- Distinguish between short-run and long-run costs
- Explain the effects of internal and external economies or diseconomies on the costs of the firm.

3.0 THEORY OF COST

3.1 COST FUNCTION

Costs in economic theory are distinguished into short-run costs and long-run costs. The short-run typically is a period when the firm experiences some fixed costs, where the availability of at least one input is fixed in availability. On the other hand, long-run costs are incurred over a period long enough to permit the change of all factors of production, and hence all factors are variable. The firm is able to be flexible and vary its factor inputs resulting in variations in all its cost components.

The short-run total cost function is given as

$$C = f(Q, T, P_f, K)$$

and the long-run function is

$$C = f(Q, T, P_f)$$

where C = total cost
Q = output
T = technology
P_f = prices of factors of production
K = fixed factors of production

Output (Q) has a direct relationship with the total cost as an increase in the output leads to an increase in the total cost and vice versa. An improvement in the state of technology usually provides the producer with cost saving techniques of producing the output. Technology therefore has an indirect relationship with the total cost. Rises in the prices of the factors of production directly lead to increases in the total cost of production, hence, a direct relationship.

Graphically, the other factors of the total cost (or cost) function apart from the output (Q), act as shift factors as changes in any or all of them shift the cost curve outwards or inwards, depending on the direction of change. The relationship between total cost and output can be plotted on a two-dimensional diagram allowing for movements along the cost curve, holding all other factors constant. This implies that the cost function may be written as

$$C = f(Q)$$

Fixed and Variable Costs

Fixed or overhead costs are those costs, which do not vary with changes in the quantity of output. They remain the same over a given range of output, whether the producer produces at the lower limit of that range or at its upper limit. Rental payments and depreciation on plant and machinery do not change over a given range of output. They are fixed costs.

Variable costs, on the other hand, are subject to change with changes in the level of output. They rise as more output is produced and fall with less output. Payments for labour, raw materials, fuel and power are examples of variable costs, as they change with varying levels of output. It should be noted that variable costs do not change at a constant rate over the range of production level, but at the initial levels, the rise at a decreasing rate, beyond which, they rise at an increasing rate.

Depending on whether the firm is in the short-run or the long-run, it may experience either fixed and variable costs, or variable costs alone.

SELF-ASSESSMENT EXERCISE 1

What are the components of the fixed cost?

3.2 SHORT-RUN COST

We have said that short-run costs are those incurred over a period where some factors of production are fixed and cannot be altered by the firm. Short-run cost curves reflect the optimal or least-cost input combination for producing output where there are some fixed production circumstances. Here, we encounter cost concepts that include total cost, average cost and marginal cost.

The total cost is a sum of all costs, that is, the total fixed cost and the total variable cost. This relationship is expressed as

$$TC = TFC + TVC$$

The average cost which shows the cost per unit of the output, is useful in comparing product prices of rival firms. It is categorized as follows:

Average fixed cost: Dividing the total fixed cost by the level of output derives the average fixed cost:

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

Given that the total fixed cost is constant, the average fixed cost declines as output increases, as it is spread out over a larger output.

Average variable cost: The average variable cost is the ratio of the total variable cost to the level of output:

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

Being subject to the law of diminishing returns, the average variable cost initially declines as output increases, but it eventually rises after a point.

Average total cost: The average total cost is the sum of the average fixed cost and the average variable cost. In other words, it is the ratio of the total cost to the level of output:

$$ATC = AFC + AVC$$

or

$$ATC = \frac{TC}{Q}$$

Marginal cost is the increase in total cost as a result of producing one more unit of output. The marginal cost may be calculated by either the change in the total cost or the change in the total variable cost, as fixed costs are generally constant. It is important in the decision of the firm in determining the level of its output, as it shows the cost reduction or increment resulting from the increase in output by one unit. Using calculus, marginal cost is given as

$$MC = \frac{\partial TC}{\partial Q}$$

These cost relationships can be expressed in the table below:

Output Q	Total fixed cost TFC (₦)	Total variable cost TVC (₦)	Total cost TC (₦)	Marginal cost MC (₦)	Average fixed cost AFC (₦)	Average variable cost AVC (₦)	Average total cost ATC (₦)
0	100	0	100	-	-	-	-
1	100	30	130	30	100	30	130
2	100	55	155	25	50	27.5	77.5
3	100	75	175	20	33.3	25	58.3
4	100	100	200	25	25	25	50
5	100	130	230	30	20	26	46
6	100	175	275	45	16.67	29.2	45.83

This table can be represented graphically to show the total cost (TC), total variable cost (TVC) and the total fixed cost (TFC).

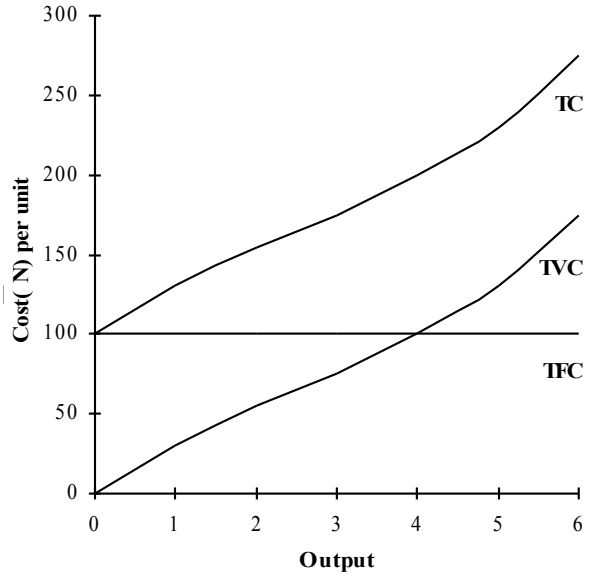

Figure 7: Total Cost (TC), Total Variable Cost (TVC) and Total Fixed Cost (TFC) Curves

SELF-ASSESSMENT EXERCISE 2

Why does the total variable cost curve have the origin as its intercept?

3.3 LONG-RUN COST

In the long-run the firm has complete flexibility in the input usage levels. Consequently all long-run costs are variable. The long-run cost curve shows the minimum cost impact of output changes for the optimal plant size in the present operating environment.

Long-Run Total Costs

The total cost curve of a firm, in the long-run, slopes out from the origin, depicting the absence of any fixed costs. Since all costs during this period are said to be variable, when there is no output being produced costs are expected to be zero, and they grow as the level

of output grows. This gives the total cost curve the following shape, assuming a state of constant returns to scale.

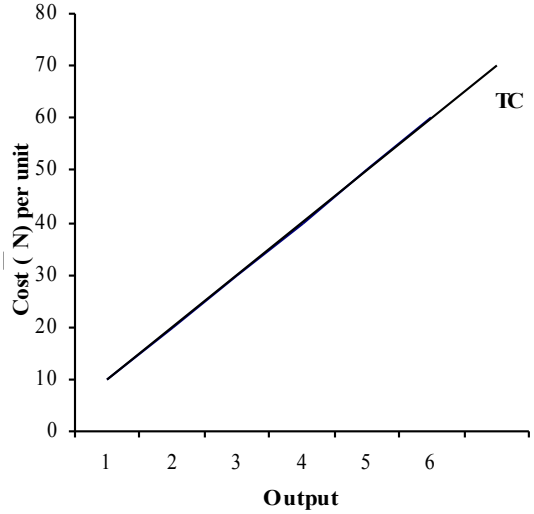

Figure 8: Long-Run Total Cost Curve

Long-Run Average Costs

The long-run average cost curve of the firm is an envelope of short-run average cost curves of the firm. The short-run cost curves relate costs and output for a specific scale of plant while the long-run cost curves identify optimal scales of plant for each level of production. The long-run average cost curve is therefore a locus of all the optimal (minimum cost) points of the short-run cost curves of the firm for each plant size.

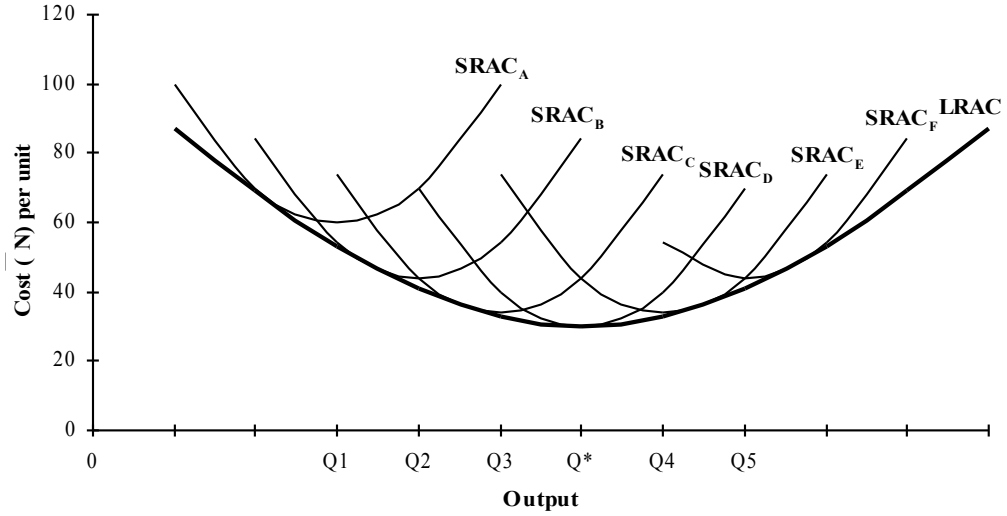

Figure 9: Deriving Long-Run Average Cost Curve from a Family of Short-Run Average Cost Curves

From the diagram, Q_1, Q_2, Q_3, Q^*, Q_4 and Q_5 represent the least-cost points of the respective short-run average cost curves: $SRAC_A$, $SRAC_B$, $SRAC_C$, $SRAC_D$, $SRAC_E$ and $SRAC_F$. The U shape of these short-run average cost curves shows that for each plant, the firm first experiences increasing returns to scale, then constant returns to scale at the base, and then diminishing returns to scale. This implies that costs initially start to decline and get to a

minimum before they begin to rise again. As the firm produces on plant A with short-run average cost curve $SRAC_A$ it may find it profitable to change to plant B as average costs begin to rise after point Q_1. Similarly, after point Q_2 on the curve $SRAC_B$, the firm may find it profitable to change plant to one with higher capacity (plant C) with optimal cost at Q_3 on $SRAC_C$. This process continues until the firm produces an output of Q^* where it becomes necessary change to plant D with short-run average cost curve $SRAC_D$. At any level of output after point Q^*, the firm can only increase output at a higher average cost as any successive plant ($SRAC_E$ and $SRAC_F$) produces output at a minimum average cost that is higher than that of the preceding plant.

The long-run average cost curve (LRAC) is an envelope of all the possible short-run average cost curves. The optimal scale of the firm is found at Q^* which coincides with the minimum point of the short-run average cost curve $SRAC_D$. It is at this point therefore that the firm should produce its output in order to minimize per-unit cost of production.

SELF-ASSESSMENT EXERCISE 3

Distinguish between the long-run and the short-run.

3.4 ECONOMIES AND DISECONOMIES OF SCALE

Depending on the scale of production of the firm, it will encounter some economies or diseconomies, which may be internal or external to the firm. These economies or diseconomies have been related by the downward and upward slopes respectively of the average cost curves of the firm in our discussions above.

Internal Economies or Diseconomies of Scale

By *internal*, we refer to the cost components that are internal to the firm. These include the cost of labour and management, among others.

Internal Economies of Scale

Internal economies of scale occur as the firm expands it production up to a certain point. From our discussions of the average cost curves, as the output of the firm expands, the cost of producing each unit of output continually diminishes until it gets to a certain point where it rises. As the firm increases its scale of production, it becomes possible to use more specialized and technically more efficient form of all factors, and it also becomes possible to introduce division of labour and specialization, both of which expand output but at relative lower cost. While the cost continues to diminish, the firm is said to experience internal economies of scale.

Internal Diseconomies of Scale

Beyond a certain point the long-run average cost curve rises indicating a rise in per unit cost of production. The cost of management typically rises as the size of the firm expands as more assistants and supervisors must be employed to manage the system, thus adding to production costs. When this happens, the firm experiences internal diseconomies of scale.

External Economies or Diseconomies of Scale

Since the firm operates as part of an industries producing similar products, economies or diseconomies which the industry experiences have effects on the firm. These economies or

diseconomies could arise with changing cost of factors, wages and interest rates in the economy, which may or may not be connected with the level of output of the industry as whole.
External economies or diseconomies bring about shifts in the average cost curves of the firm, both in the short-run and the long-run, as well as the marginal cost curves of the firm. External economies therefore shift the cost curves downward while external diseconomies shift the cost curves upwards.

SELF-ASSESSMENT EXERCISE 4
What cost components form internal economies or diseconomies to the firm?

4.0 CONCLUSION
The discussions above show that the firm in profit maximizing quest must seek the optimal level of output that minimizes the cost of production. It therefore needs to understand its cost components so as to determine whether it is operating in the short-run or the long-run. This will enable the firm know what areas of its operations are generating the most cost so as to find means of minimizing these operations, hence minimize costs.

5.0 SUMMARY
The unit discussed the theory of cost. It looked at the production function and dissected it into the short-run and long-run costs. It also discussed the concept of economies and diseconomies of scale.

6.0 TUTOR-MARKED ASSIGNMENT

1. Distinguish between short-run and long-run costs
2. What form of economy or diseconomy of scale would a general increase in wages in the economy bring to the firm? Why?
3. Given the following table of costs, provide the missing details in (a) to (f)

Output Q	Total fixed cost TFC (₦)	Total variable cost TVC (₦)	Total cost TC (₦)	Marginal cost MC (₦)	Average fixed cost AFC (₦)	Average variable cost AVC (₦)	Average total cost ATC (₦)
0	50	0	50	-	-	-	-
1	50	a	85	35	50	35	85
2	50	60	b	25	25	30	55
3	50	80	130	c	16.67	26.67	43.3
4	50	105	155	25	d	26.25	38.75
5	50	135	185	30	10	e	37
6	50	180	230	45	8.33	30	f

7.0 REFERENCES / FURTHER READING

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Hirschley, M., Pappas, J. L. and Whigham, D. (1995). Managerial Economics: European Edition. London: The Dryden Press.

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UNIT 15: LINEAR PROGRAMMING

CONTENTS

1.0. INTRODUCTION

The study of economics is centred largely on achieving optimal situations with regard to consumption decisions of the individual, as well as the business goals of the firm as regards maximizing profit while minimizing production costs, or maximizing the market share of the firm. For the consumer, given an income and the prices of the commodities, the objective is to find the appropriate combination of goods whose consumption will bring about the highest level of satisfaction possible. The profit maximizing firm on the other hand, seeks that combination of output that maximizes profit (while minimizing costs) given the resource constraints placed on the firm's activities.

This topic shall concentrate on the concept of linear programming excluding other forms of programming like the non-linear programming.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Explain the concept of linear programming
- Construct a linear programming problem
- Find optimal solutions to a linear programming problem.

3.0. LINEAR PROGRAMMING

3.1 THE CONCEPT AND STRUCTURE OF LINEAR PROGRAMMING PROBLEMS

Programming is a method of solving problems of optimization. There is linear and non-linear programming. The solutions are suited to rational behaviour because they are optimal solutions. Programming is defined as a mathematical method for the analysis and computerization of optimal decisions, which do not violate the limitations imposed by inequality conditions.

Linear programming involves maximizing or minimizing a problem or set of equations subject to a constraint or set of constraints, which are linear. The linear programming solution to a problem such as that of maximizing output always has limitations such as the limited supply of labour or capital. It is useful in economic planning as well as in economic theory (for example, production theory).

The linear programming problem has three major parts:

1. **The objective function**

   This is the function that expresses the goal of the linear programming problem, whose value is to be maximized or minimized. It could be the maximization of a profit function or a production, or the minimization of a cost function.
   For the maximization of the profit of a firm producing two products, *X* and *Y*, where the profit per unit of *X* is ₦5 while the same value for *Y* is ₦3, the objective function is

   Where x and y represent the quantities of each product produced. The total profit is the sum of the per-unit profit contribution from *X* times the quantity produced of *X* and *Y* times the quantity of *Y*.

2. **The structural constraint**

   The structural constraint includes the resources whose values are limited and so become constraints to our objective function.
   For our example we assume that the production of *X* and *Y* requires the use of inputs *A* and *B*. If 32 units of *A* are available and 4 units of *A* are required in the production of each unit of *X*, whereas 2 units of *A* are required to produce each unit of *Y*, then our constraint condition would be

   For *B*, if the total amount available is 10 units and the requirement for each unit of *X* is 2 units of *B* while for each unit of *Y*, it is also 2 units then we have

These constraints can be represented on a table as follows

Input	Quantity available	Quantity required per unit of *X*	Quantity required per unit of *Y*
A	32	4	2
B	10	1	2

3. **Non-negativity conditions**

The linear programming problem assumes that the variables to be maximized or minimized are not less than zero. As such, they may be greater than or equal to zero. This is in conformity with real-life economic situations.
Here,

$$x \geq 0$$

and

$$y \geq 0$$

SELF-ASSESSMENT EXERCISE 1
What is programming?

3.2 PRESENTATION OF A LINEAR PROGRAMMING PROBLEM

A linear programming problem can be presented in the standard form, using sigma notation or by matrix algebra.

Standard form

With n variables and m constraints the coefficient a_{ij} will form a rectangular matrix of the form m × n so we have m rows and n constraints. The standard form for the presentation of a linear programming problem is as follows.
Maximize

$$\pi = c_1 x_1 + c_2 x_2 + \cdots + c_n x_n$$

subject to

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n &\leq r_1 \\ a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n &\leq r_2 \\ \vdots \quad\quad \vdots \quad\quad\quad\quad \vdots \quad\quad \vdots & \\ a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n &\leq r_n \end{aligned}$$

and

$$x_1, x_2, \ldots, x_n \geq 0$$

where

π = the objective function to be maximized
c_i = the coefficients of the objective function
x_i = the decision variable
a_{ij} = coefficients of the decision variables
r_i = constraint restriction set imposed on the programme

The minimization problem (the dual) in the standard form may be presented as below
Minimize

subject to

$$a_{11}y_1 + a_{21}y_2 + \cdots + a_{m1}y_n \leq c_1$$
$$a_{12}y_1 + a_{22}y_2 + \cdots + a_{m2}y_n \leq c_2$$
$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots$$
$$a_{1n}y_1 + a_{2n}y_2 + \cdots + a_{mn}y_n \leq c_n$$

and

where

C = the objective function to be minimized
r_i = the coefficients of the objective function
y_i = the decision variable
a_{ij} = coefficients of the decision variables
c_i = constraint restriction set imposed on the programme

Sigma notation
Using sigma notation, the linear programming problem may be presented as
Maximize
subject to
where

For a minimization problem, we may present it as
Minimize
subject to
where

Matrix Algebra
The linear programming problem can be expressed in matrix algebra of the form

In the standard matrix form then, we may present a maximization linear programming problem as
Maximize

subject to

$$\begin{bmatrix} a_{11} & a_{12} & \cdots a_{1n} \\ a_{21} & a_{22} & \cdots a_{2n} \\ \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots a_{mn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \leq \begin{bmatrix} r_1 \\ r_2 \\ \vdots \\ r_n \end{bmatrix}$$

and

Similarly, the dual (minimization) problem may be presented as
Minimize
subject to

$$\begin{bmatrix} a_{11} & a_{21} & \dots a_{m1} \\ a_{12} & a_{22} & \dots a_{m2} \\ \vdots & \vdots & \vdots \\ a_{1n} & a_{2n} & \dots a_{mn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \geq \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{bmatrix}$$

and

[illegible]

All variables remain as defined above.

SELF-ASSESSMENT EXERCISE 2
What does the objective function signify?

3.3 GRAPHIC SOLUTION OF THE LINEAR PROGRAMMING PROBLEM

The analytic expression of the problem in our example is given as
Maximize

[illegible]

subject to the constraints

Input *A*: [illegible]
Input *B*: [illegible]

where

[illegible] and [illegible]

Graphing the Feasible Space

The feasible space is a graphical region satisfies both constraints and non-negativity conditions and includes the optimal solution. For the constraint equation of input *A*, we replace the inequality sign by and equality sign and proceed as follows:

[illegible]

If no *Y* is produced then

[illegible]

and if no *X* is produced

[illegible]

Plotting this on a graph, we have

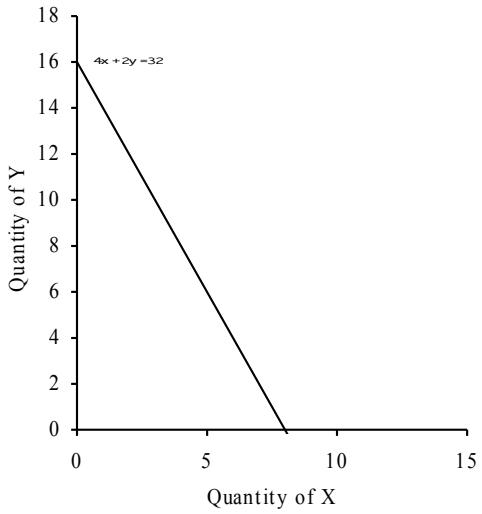


Figure 10: Graph of the constraint 4x + 2y = 32 showing feasible combinations of input A

Carrying out the same procedure above for input B provides us with a similar result. Putting both constraints in graph, we have

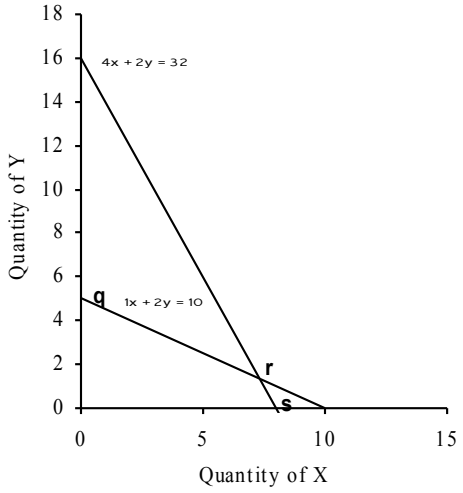


Figure 11: Diagram showing the feasible space 0, q, r, s

The area 0, *q*, *r*, *s* is the area of feasible solutions. The solution to our linear programming problem would lie within this region given that it is a maximization problem. Our optimal solution would therefore occur at any of the corner points: *q*, *r*, or *s*, which have the following respective co-ordinates for *x* and *y*: (0,5); (7.33,1.33); and (8,0).

Graphing the Objective Function

Is profit lines may graphically present the objective function in our example. This line may be constructed by solving for the objective function for *y*. hence,

solving for *y* yields

The slope of the is profit line is

∂ı═∂ ı † ✍ ⊓ı ═ ⊓ı † ✕═✓ † ✎✎✖✗

By assuming different values to the level of total profit (π) we can compute the whole map of is profit lines. These lines have a negative slope and are parallel as the unit profits of the two commodities are assumed constant at whatever level of output. The further away from the origin an is profit line is the greater the total profit it denotes. To form the is profit lines, we proceed as follows.

Assuming ⊓ † ✓✎, then ✕/ ☞ ✓ı † ✓✎

hence / † ✖✌ ❄❄ ı † ✎

ı † ✎✎✌ ❄❄ / † ✎

Assuming ⊓ † ✔✎, then ✕/ ☞ ✓ı † ✔✎

hence / † ✘✌ ❄❄ ı † ✎

ı † ✎✓✎✓✓✌ ❄❄ / † ✎

Assuming ⊓ † ✕✎, then ✕/ ☞ ✓ı † ✕✎

hence / † ✎✎✌ ❄❄ ı † ✎

ı † ✎✖✎✕✗✌ ❄❄ / † ✎

These co-ordinates of *x* and *y* give us the following is profit lines on the graph below.

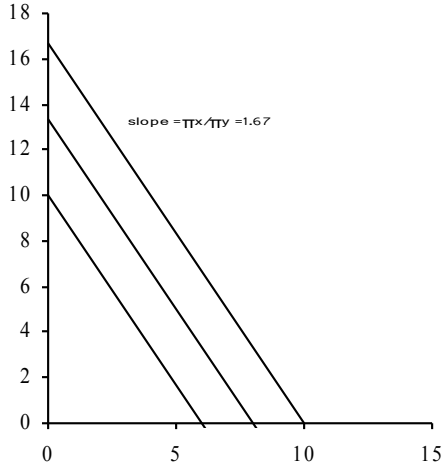


Figure 12: Isoprofit map

Graphing the Optimal Solution

For the optimal solution, we incorporate the isoprofit lines on the graph showing the feasible solutions.

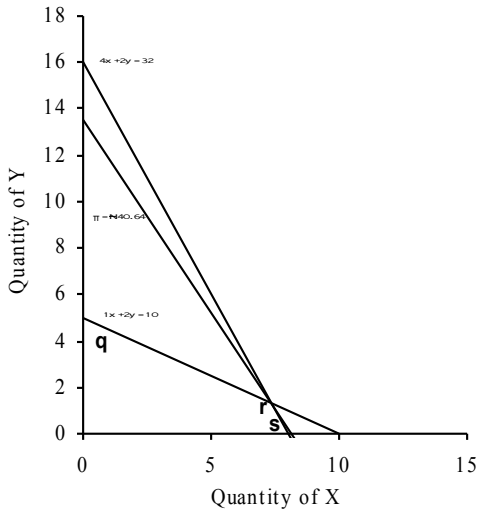


Figure 13: Graphic solution to the linear programming problem: Maximize $\pi = 5x + 3y$, subject to the constraints: $4x + 2y \leq 32$; $1x + 2y \leq 10$

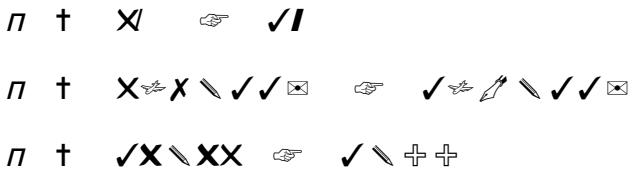
Profit is maximized at the point *r* where the isoprofit line (π = ₦40.64) intersects the constraint conditions. Point *r* therefore becomes the optimal solution to the linear programming problem, generating the maximum profit of N40.64 with an output of 7.33 units of *X* and 1.33 units of *Y*.

Alternative Means of Finding the Optimal Solution

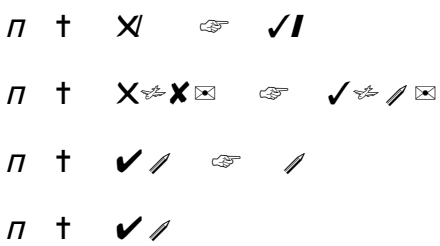
We may also find our optimal solution by substituting the respective values of *x* and *y* at *q*, *r*, and *s* for *x* and *y* in the objective function.

At point *q* ✍✐✌✕✉

At point *r* ✍✗✎✓✓✌✐✎✓✓✉



At point *s* ✍✘✌✐✉



From the above calculations, it is clear that the optimal solution lies at the point *r* where 7.33 units of *X* and 1.33 units of *Y* are produced to give a maximum profit of ₦40.64.

SELF-ASSESSMENT EXERCISE 3

What is feasible space?

3.4 THE DUAL IN LINEAR PROGRAMMING

We have so far discussed the primal problem of linear programming. To every primal linear programming problem there is however a dual problem, which is an inverse of the primal problem. As such, if the primal problem is a maximization problem, its dual is a minimization problem; and if the primal problem is a minimization problem its dual is a maximization problem.

The dual of the profit maximization problem in our example would now be a minimization problem. Since profit is calculated as the difference between revenue and cost (Profit = Revenue – Cost), the objective of the dual would be to minimize cost, which at any given revenue, would maximize profit for that level of revenue.

The constraint restrictions of the primal (r_i) become the coefficients of the objective function, which in this case, the producer seeks to minimize. On the other hand, the coefficients of the objective function in the primal (c_i) replace the constraint restrictions of the primal in the dual as its constraint restrictions.

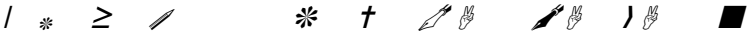
The coefficients of the decision variables of the primal problem (a_{ij}) are simply transposed in the dual. Additionally, the inequality sign changes in the dual. For our present case, it changes from a *less-than or equal to* sign (≤) in the primal to a *more-than or equal to* sign (≥) in the dual.

With these transformations, the primal problem converts into its dual, which (going by our example) takes the standard form:

Minimize

subject to

and



where

C = the objective function to be minimized
r_i = the coefficients of the objective function
y_i = the decision variable
a_{ij} = coefficients of the decision variables

c_i = constraint restriction set imposed on the programme

Note: the dual may not necessarily be a minimization problem, as it could also be a maximization problem depending on its primal.

Using the same system of transformation of the primal problem to its dual, the sigma notation and matrix algebra expression of the linear programming problem can be constructed.

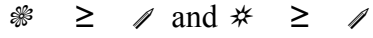
The analytic expression of the dual of our linear programming problem would be:
Minimize

subject to the constraints

Output *X*: 

Output *Y*: 

where



SELF-ASSESSMENT EXERCISE 4

What is the dual of a linear programming problem?

3.5 MATRIX SOLUTION TO LINEAR PROGRAMMING PROBLEM

The solution to our linear programming problem above can be found through the use of matrix algebra. We must note however, that using matrix algebra, solutions exist for only square matrices, that is, the coefficient matrix must be of the form $m \times m$ or $n \times n$. This implies that the number of constraints must be equal to the number of variables.

Restating the dual of our linear programming problem in matrix form, we have:
Minimize

subject to

$$\begin{bmatrix} 4 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} \geq \begin{bmatrix} 5 \\ 3 \end{bmatrix}$$

where

❁ ≥ ⁄ and ✲ ≥ ⁄

We proceed by Cramer's rule to get the determinant of the coefficient matrix

$$|A| = \begin{vmatrix} 4 & 1 \\ 2 & 2 \end{vmatrix} = 6$$

$$|A_1| = \begin{vmatrix} 5 & 1 \\ 3 & 2 \end{vmatrix} = 7$$

$$|A_2| = \begin{vmatrix} 4 & 2 \\ 2 & 3 \end{vmatrix} = 2$$

Therefore, we have

$$a^* = \frac{|A_1|}{|A|} = \frac{7}{6} = 1.167$$

$$b^* = \frac{|A_2|}{|A|} = \frac{2}{6} = 0.33$$

Substituting these values of a* and b* into the objective function, we have

⌘ † ✓✒❁ ☞ ✎ ⁄ ✲

† ✓✒✍✎ ✓ ✎ ✗✗✉

☞✎ ⁄ ✍ ⁄ ✓✓✉

† ✓✗✓✔✔ ☞ ✓✓

† ✔⁄ ✗✔✔

≈ ✔⁄ ✗✔

This presents the same result as that of the primal function but with the additional information that 1.167 units of input *a*, and 0.33 units of input *b* be applied in the production in order to minimize cost.

From the analysis of our linear programming problem, it can be seen that the result of objective function of our primal problem and that of the dual are identical. This shows that for the firm to maximize profit, it must simultaneously minimize its costs.

Furthermore, while the primal problem shows us how much output must be produced to maximize profit, the dual shows the amount of input necessary to minimize the costs of the firm, and hence maximize profit.

SELF-ASSESSMENT EXERCISE 5

Can a linear programming problem with a 2 × 3 constraint matrix be solved using the matrix algebra? Give reasons for your answer.

4.0 CONCLUSION

Linear programming is very useful in the analysis of rational economic behaviour. It is expected that you should have grasped a good understanding of the need for it, as well as, the tools for carrying out its processes.

5.0 SUMMARY

Linear programming is a method of solving problems that involve an objective function to be maximized or minimized, where the relevant objective function is subject to a variety of underlying constraints that are of a linear form. The expression of these problems could in the standard, sigma notation or matrix forms and their solutions could be found through the graphical method or matrix algebra, among others.

The dual of the linear programming problem is the inverse of the original (primal) problem. Although it yields the same result for the objective function, it provides additional information that the programmer will find useful in understanding the system.

6.0 TUTOR-MARKED ASSIGNMENT

1. State and explain the major parts of a linear programming problem

2. State the processes for transforming a primal linear programming problem into its dual? Transform the following linear programming problem into its dual.

   Maximize

   $$\pi = 10x + 8y$$

   subject to

   $$4x + 2y \leq 1600$$
   $$3x + 5y \leq 2000$$

   where

   $$x, y \geq 0$$

3. Find the optimal solution values for the linear programming problem below.

   Minimize

   $$C = 20000C + 60000T$$

   Subject to

   $$10S + 40T \geq 160$$
   $$6S + 3T \geq 36$$
   $$4S + 8T \geq 48$$

   And

   $$S \geq 0, T \geq 0$$

7.0 REFERENCES / FURTHER READING

Ahuja, H. L. (2006). Advanced Economic Theory: Microeconomic Analysis (Revised 15th Ed.). New Delhi: S. Chand and Company Ltd.

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Koutsoyiannis, A. (1979). Modern Microeconomics (2nd Ed.). Hampshire: Macmillan Press Ltd.