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Master Of Commerce

(MCOM)

MCO-11

Managerial Economics

Block-1

Introduction to Managerial Economics

Unit-1 Scope of Managerial Economics

Unit-2 Firm: Stakeholders, Objectives & Decision Issues

Unit-3 Basic Techniques of Managerial Economics

UNIT 1 SCOPE OF MANAGERIAL ECONOMICS

Objectives

After studying this unit, you should be able to:

- **understand** the nature and scope of managerial economics;
- **familiarize** yourself with economic terminology;
- **develop** some insight into economic issues;
- **acquire** some information about economic institutions;
- **understand** the concept of trade-offs or policy options facing society today.

Structure

- 1.1 Introduction
- 1.2 Fundamental Nature of Managerial Economics
- 1.3 Scope of Managerial Economics
- 1.4 Appropriate Definitions
- 1.5 Managerial Economics and other Disciplines
- 1.6 Economic Analysis
- 1.7 Basic Characteristics: Decision-Making
- 1.8 Summary
- 1.9 Self-Assessment Questions
- 1.10 Further Readings

1.1 INTRODUCTION

For most purposes economics can be divided into two broad categories, microeconomics and macroeconomics. Macroeconomics as the name suggests is the study of the overall economy and its aggregates such as Gross National Product, Inflation, Unemployment, Exports, Imports, Taxation Policy etc. Macroeconomics addresses questions about changes in investment, government spending, employment, prices, exchange rate of the rupee and so on. Importantly, only aggregate levels of these variables are considered in the study of macroeconomics. But hidden in the aggregate data are changes in output of a number of individual firms, the consumption decision of consumers like you, and the changes in the prices of particular goods and services.

Although macroeconomic issues are important and occupy the time of media and command the attention of the newspapers, micro aspects of the economy are also important and often are of more direct application to the day to day problems facing a manager. Microeconomics deals with individual actors in the economy such as firms and individuals. Managerial economics can be thought of as applied microeconomics and its focus is on the interaction of firms and individuals in markets.

When you read a newspaper or switch on a television, you hear economic terminology used with increasing regularity. For a manager, some of these economic terms are of direct relevance and therefore it is essential to not only understand them but also apply them in relevant situations. For example, GDP growth rate could impact the product a manager is marketing, change in money

supply by the RBI could impact inflation and affect the demand for your product, fiscal deficit could affect interest rates and therefore investment spending by a manager etc. The focus of managerial economics is on how the firm reacts to changes in the economic environment in which it operates and how it predicts these changes and devises the best possible strategies to achieve the objectives that underlie its existence.

The economy is the institutional structure through which individuals and firms in a society coordinate their desires. Economics is the study of how human beings in a society go about achieving their wants and desires. It is also defined as the study of allocation of scarce resources to satisfy individual wants or desires. The latter is perhaps the best way to broadly define the study of economics in general. The emphasis is on allocation of scarce resources across competing ends. You should recognize that human wants are unlimited and therefore choice is necessary. Choices necessarily involve trade-offs. For example, if you wish to acquire an MBA degree, you must take time off to devote to study. Your time has many uses and when you devote more time to study you are allocating it to a particular use in order to achieve your goal. Economics would be a most uninteresting subject if resources were unlimited and no trade offs were involved in decision making.

There are many general insights economists have gained into how the economy functions. Economic theory ties together economists' terminology and knowledge about economic institutions. An economic institution is a physical or mental structure that significantly influences economic decisions. Corporations, governments, markets are all economic institutions. Similarly cultural norms are the standards people use when they determine whether a particular activity or behaviour is acceptable. For example, Hindus avoid meat and fish on Tuesdays. This has an economic dimension as it has a direct impact on the sale of these items on Tuesdays. Further, economic policy is the action usually taken by the government, to influence economic events. And finally, economic reasoning helps in thinking like an economist. Economists analyse questions and issues on the basis of trade-offs i.e. they compare the cost and the benefits of every issue and make decisions based on those costs and benefits.

The market is perhaps the single most important and complex institution in our economy. A market is not necessarily a physical location, but a description of any state that involves exchange. The exchange could be instantaneous or it could be over time i.e. exchange which is agreed today but where the transaction takes place, say after 3 months. You will learn in this course the myriad functions that markets perform, most significantly bringing buyers and sellers together. Markets could be competitive or monopolistic, with a large number of firms or a small number of firms, with free entry and exit or government licensing restricting entry of firms and so on. The major point is that firms operate in different types of markets and use the well-established principles of managerial economics to improve profitability. Managerial economics draws on economic analysis for such concepts as cost, demand, profit and competition. It attempts to bridge the gap between the purely analytical problems that intrigue many economic theorists and the day-to-day decisions that managers must face. It offers powerful tools and approaches for managerial policy-making. It will be relevant to present here several examples illustrating the problems that managerial economics can help to address. These also explain how managerial economics is an integral part of business. Demand, supply, cost, production, market, competition, price etc. are important concepts in real business decisions.

1.2 FUNDAMENTAL NATURE OF MANAGERIAL ECONOMICS

A close relationship between management and economics has led to the development of managerial economics. Management is the guidance, leadership and control of the efforts of a group of people towards some common objective. While this description does inform about the purpose or function of management, it tells us little about the nature of the management process. Koontz and O'Donell define management as the creation and maintenance of an internal environment in an enterprise where individuals, working together in groups, can perform efficiently and effectively towards the attainment of group goals. Thus, management is –

- Coordination
- An activity or an ongoing process
- A purposive process
- An art of getting things done by other people.

On the other hand, economics as stated above is engaged in analysing and providing answers to manifestations of the most fundamental problem of scarcity. Scarcity of resources results from two fundamental facts of life:

- Human wants are virtually unlimited and insatiable, and
- Economic resources to satisfy these human demands are limited.

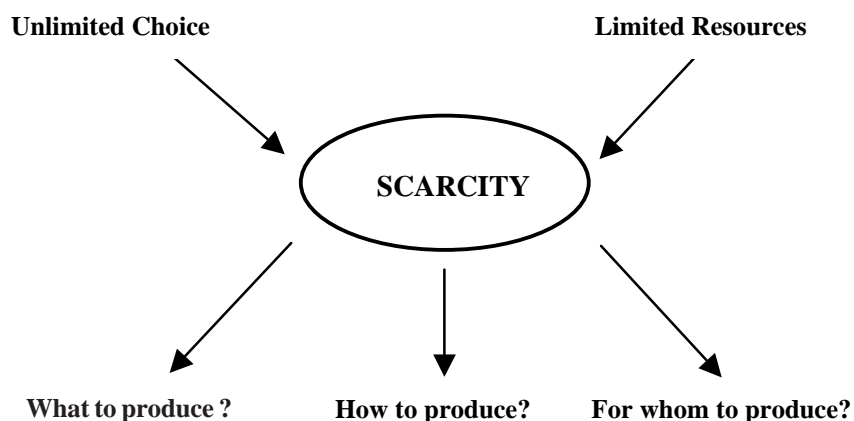
Thus, we cannot have everything we want; we must make choices broadly in regard to the following:

- What to produce?
- How to produce? and
- For whom to produce?

These three choice problems have become the three central issues of an economy as shown in figure 1.1. Economics has developed several concepts and analytical tools to deal with the question of allocation of scarce resources among competing ends. The non-trivial problem that needs to be addressed is how an economy through its various institutions solves or answers the three crucial questions posed above. There are three ways by which this can be achieved. One, entirely by the market mechanism, two, entirely by the government or finally, and more reasonably, by a combination of the first two approaches. Realistically all economies employ the last option, but the relative roles of the market and government vary across countries. For example, in India the market has started playing a more important role in the economy while the government has begun to withdraw from certain activities. Thus, the market mechanism is gaining importance. A similar change is happening all over the world, including in China. But there are economies such as Myanmar and Cuba where the government still plays an overwhelming part in solving the resource allocation problem. Essentially, the market is supposed to guide resources to their most efficient use. For example if the salaries earned by MBA degree holders continue to rise, there will be more and more students wanting to earn the degree and more and more institutes wanting to provide such degrees to take advantage of this opportunity. The government may not force this to happen, it will happen on its own through the market mechanism. The government, if anything, could provide a regulatory function to ensure quality and consumer protection.

According to the central deduction of economic theory, under certain conditions, markets allocate resources efficiently. 'Efficiency' has a special meaning in this context. The theory says that markets will produce an outcome such that, given the economy's scarce resources, it is impossible to make anybody better-off without making somebody else worse-off.

Figure 1.1: Three Choice Problems of an Economy



In rich countries, markets are too familiar to attract attention. Yet, a certain awe is appropriate. Let us take an incident where Soviet planners visited a vegetable market in London during the early days of perestroika, they were impressed to find no queues, shortages, or mountains of spoiled and unwanted vegetables. They took their hosts aside and said: “We understand, you have to say it’s all done by supply and demand. But can’t you tell us what’s really going on? Where are your planners and what are their methods?”

The essence of the market mechanism is indeed captured by the supply-and-demand diagram that you will become familiar with in Block 4. At the place where the curves intersect, a price is set such that demand equals supply. There, and only there, the benefit from consuming one more unit exactly matches the cost of producing it. If output were less, the benefit from consuming more would exceed the cost of producing it. If output were higher, the cost of producing the extra units would exceed the extra benefits. So the point where supply equals demand is “efficient”.

However, the conditions for market efficiency are extremely demanding—far too demanding ever to be met in the real world. The theory requires “perfect competition”: there must be many buyers and sellers; goods from competing suppliers must be indistinguishable; buyers and sellers must be fully informed; and markets must be complete—that is, there must be markets not just for bread here and now, but for bread in any state of the world. (What is the price today for a loaf to be delivered in Timbuktu on the second Tuesday in December 2014 if it rains?)

In other words, market failure is pervasive. It comes in four main varieties:

Monopoly: By reducing his sales, a monopolist can drive up the price of his good. His sales will fall but his profits will rise. Consumption and production are less than the efficient amount, causing a deadweight loss in welfare.

Public goods: Some goods cannot be supplied by markets. If you refuse to pay for a new coat, the seller will refuse to supply you. If you refuse to pay for national defence, the “good” cannot easily be withheld. You might be tempted to let others pay. The same reasoning applies to other “non-excludable” goods such as law and order, clean air, and so on. Since private sellers cannot expect to recover the costs of producing such goods, they will fail to supply them.

Externalities: Making some goods causes pollution: the cost is borne by people with no say in deciding how much to produce. Consuming some goods (education, anti-lock brakes) spreads benefits beyond the buyer; again, this will be ignored

when the market decides how much to produce. In the case of “good” externalities, markets will supply too little; in the case of “bads”, too much.

Information: In some ways a special kind of externality, this deserves to be mentioned separately because of the emphasis placed upon it in recent economic theory. To see why information matters, consider the market for used cars. A buyer, lacking reliable information, may see the price as providing clues about a car’s condition. This puts sellers in a quandary: if they cut prices, they may only convince people that their cars are rubbish.

The labour market, many economists believe, is another such ‘market for lemons’. This may help to explain why it is so difficult for the unemployed to price themselves into work.

When markets fail, there is a case for intervention. But two questions need to be answered first. How much does market failure matter in practice? And can governments put the failure right? Markets often correct their own failures. In other cases, an apparent failure does nobody any harm. In general, market failure matters less in practice than is often supposed.

Monopoly, for instance, may seem to preclude an efficient market. This is wrong. The mere fact of monopoly does not establish that any economic harm is being done. If a monopoly is protected from would-be competitors by high barriers to entry, it can raise its prices and earn excessive profits. If that happens, the monopoly is undeniably harmful. But if barriers to entry are low, lack of actual (as opposed to potential) competitors does not prove that the monopoly is damaging: the threat of competition may be enough to make it behave as though it were a competitive firm. Many economists would accept that Microsoft, for instance, is a near-monopolist in some parts of the personal-computer software business—yet would argue that the firm is doing no harm to consumers because its markets remain highly contestable. Because of that persistent threat of competition, the company prices its products keenly. In this and in other ways it behaves as though it were a smaller firm in a competitive market.

Even on economic grounds (never mind other considerations), there is no tidy answer to the question of where the boundary between state i.e. governments and market should lie. Markets do fail because of monopoly, public goods, externalities, lack of information and for other reasons. But, more than critics allow, markets find ways to mitigate the harm—and that is a task at which governments have often been strikingly unsuccessful. All in all, a strong presumption in favour of markets seems wise. This is not because classical economic theory says so, but because experience seems to agree. And as stated above, the real world seems to be moving in the direction of placing more reliance on markets than on governments.

1.3 SCOPE OF MANAGERIAL ECONOMICS

From the point of view of a firm, managerial economics, may be defined as economics applied to “problems of choice” or alternatives and allocation of scarce resources by the firms. Thus managerial economics is the study of allocation of resources available to a firm or a unit of management among the activities of that unit. Managerial economics is concerned with the application of economic concepts and analysis to the problem of formulating rational managerial decisions. There are four groups of problem in both decisions-making and forward planning.

Resource Allocation: Scarce resources have to be used with utmost efficiency to get optimal results. These include production programming and problem of transportation etc. How does resource allocation take place within a firm?

Naturally, a manager decides how to allocate resources to their respective uses within the firm, while as stated above, the resource allocation decision outside the firm is primarily done through the market. Thus, one important insight you can draw about the firm is that within it resources are guided by the manager in a manner that achieves the objectives of the firm. More will be said about this in Unit 2.

Inventory and queuing problem: Inventory problems involve decisions about holding of optimal levels of stocks of raw materials and finished goods over a period. These decisions are taken by considering demand and supply conditions. Queuing problems involve decisions about installation of additional machines or hiring of extra labour in order to balance the business lost by not undertaking these activities.

Pricing Problem: Fixing prices for the products of the firm is an important decision-making process. Pricing problems involve decisions regarding various methods of prices to be adopted.

Investment Problem: Forward planning involves investment problems. These are problems of allocating scarce resources over time. For example, investing in new plants, how much to invest, sources of funds, etc.

Study of managerial economics essentially involves the analysis of certain major subjects like:

- The business firm and its objectives
- Demand analysis, estimation and forecasting
- Production and Cost analysis
- Pricing theory and policies
- Profit analysis with special reference to break-even point
- Capital budgeting for investment decisions
- Competition.

Demand analysis and forecasting help a manager in the earliest stage in choosing the product and in planning output levels. A study of demand elasticity goes a long way in helping the firm to fix prices for its products. The theory of cost also forms an essential part of this subject. Estimation is necessary for making output variations with fixed plants or for the purpose of new investments in the same line of production or in a different venture. The firm works for profits and optimal or near maximum profits depend upon accurate price decisions. Theories regarding price determination under various market conditions enable the firm to solve the price fixation problems. Control of costs, proper pricing policies, break-even analysis, alternative profit policies are some of the important techniques in profit planning for the firm which has to work under conditions of uncertainty. Thus managerial economics tries to find out which course is likely to be the best for the firm under a given set of conditions.

1.4 APPROPRIATE DEFINITIONS

According to McNair and Meriam, “Managerial economics is the use of economic modes of thought to analyse business situations.” According to Prof. Evan J Douglas, ‘Managerial economics’ is concerned with the application of economic principles and methodologies to the decision making process within the firm or organisation under the conditions of uncertainty”. Spencer and Siegelman define it as “The integration of economic theory with business practices for the purpose of facilitating decision making and forward planning by management.” According to

Hailstones and Rothwel, “Managerial economics is the application of economic theory and analysis to practice of business firms and other institutions.” A common thread runs through all these descriptions of managerial economics which is using a framework of analysis to arrive at informed decisions to maximize the firm’s objectives, often in an environment of uncertainty. It is important to recognize that decisions taken while employing a framework of analysis are likely to be more successful than decisions that are knee jerk or gut feel decisions.

Activity 1

a) Development of managerial economics is the result of close interrelationship between management and economics. Discuss.

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.....

b) Which statement is true of the basic economic problem?

- (i) The problem will exist as long as resources are limited and desires are unlimited.
- (ii) The problem exists only in less developed countries.
- (iii) The problem will disappear as production expands.
- (iv) The advancement of technology will cause the problem to disappear.

c) Why is decision making by any management truly economic in nature?

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.....
.....

1.5 MANAGERIAL ECONOMICS AND OTHER DISCIPLINES

Managerial economics is linked with various other fields of study like–

Microeconomic Theory: As stated in the introduction, the roots of managerial economics spring from micro-economic theory. Price theory, demand concepts and theories of market structure are few elements of micro economics used by managerial economists. It has an applied bias as it applies economic theories in order to solve real world problems of enterprises.

Macroeconomic Theory: This field has little relevance for managerial economics but at least one part of it is incorporated in managerial economics i.e. national income forecasting. The latter could be an important aid to business condition analysis, which in turn could be a valuable input for forecasting the demand for specific product groups.

Operations Research: This field is used in managerial economics to find out the best of all possibilities. Linear programming is a great aid in decision making in business and industry as it can help in solving problems like determination of facilities on machine scheduling, distribution of commodities and optimum product mix etc.

Theory of Decision Making: Decision theory has been developed to deal with problems of choice or decision making under uncertainty, where the applicability of figures required for the utility calculus are not available. Economic theory is based on assumptions of a single goal whereas decision theory breaks new grounds by recognizing multiplicity of goals and persuasiveness of uncertainty in the real world of management.

Statistics: Statistics helps in empirical testing of theory. With its help, better decisions relating to demand and cost functions, production, sales or distribution are taken. Managerial economics is heavily dependent on statistical methods.

Management Theory and Accounting: Maximisation of profit has been regarded as a central concept in the theory of the firm in microeconomics. In recent years, organisation theorists have talked about “satisficing” instead of “maximising” as an objective of the enterprise. Accounting data and statements constitute the language of business. In fact the link is so close that “managerial accounting” has developed as a separate and specialized field in itself.

1.6 ECONOMIC ANALYSIS

Economic activity is the constant effort to match ends to means because of scarcity of resources. The optimal economic activity is to maximise the attainment of ends, the means and their scarcities or to minimise the use of resources, given the ends and their priorities.

Decision making by management is truly economic in nature because it involves choices among a set of alternatives - alternative courses of action. The optimal decision making is an act of optimal economic choice, considering objectives and constraints. This justifies an evaluation of managerial decisions through concepts, precepts, tools and techniques of economic analysis of the following types:

Micro and Macro Analysis: In micro-analysis the problem of choice is focused on single individual entities like a consumer, a producer, a market etc. Macro analysis deals with the problem in totality like national income, general price level etc.

Partial and General Equilibrium Analysis: To attain the state of stable equilibrium, the economic problem may be analysed part by part - one at a time - assuming “other things remaining the same.” This is partial equilibrium analysis. In general equilibrium analysis the assumption of “given” or “other things remaining equal” may be relaxed and interdependence or interactions among variables may be allowed.

Static, Comparative Static and Dynamic Analysis: This is in reference to time dimension. A problem may be analysed

- allowing no change at a point of time (static)
- allowing once for all change at a point of time (comparative static)
- allowing successive changes over a period of time (dynamic).

Positive and Normative Analysis: In positive economic analysis, the problem is analyzed in objective terms based on principles and theories. In normative economic analysis, the problem is analyzed based on value judgement (norms). In simple terms, positive analysis is ‘what it is’ and normative analysis is ‘what it should be.’ For example, CEOs in private Indian enterprises earn 15 times as much as the lowest paid employee is a positive statement, a description of what is. A normative statement would be that CEOs should be paid 4-5 times the lowest paid employee.

Activity 2

- a) The major groups of problems in decision making are:
- (i)
 - (ii)
 - (iii)
 - (iv)
- b) The 3 choice problems of an economy are:
- (i)
 - (ii)
 - (iii)
- The problems arise due to.....
- c) Name the kind of economic analysis that is appropriate for each of the following:
- (i) The ONGC has expansion plans
 - (ii) The NTC is making loss
 - (iii) The textile industry is facing recession
 - (iv) The population growth in India is alarming
 - (v) There is a bearish trend in the stock market

1.7 BASIC CHARACTERISTICS: DECISION-MAKING

Managerial Economics serves as ‘a link between traditional economics and the decision making sciences’ for business decision making.

The best way to get acquainted with managerial economics and decision making is to come face to face with real world decision problems.

Tata’s Vision 2000

Presently there are about 87 firms in the Tata empire. As many as 16 recorded losses in 1995-96. The Tata’s companies that are in the limelight are TISCO, TELCO, ACC, Tata Exports and Tata Chemicals.

Contribution of bottom 20 companies	–	In terms of turnover : 35% of total of group.
	–	In terms of net profit : 0.2% of total sales of group.
	–	In terms of assets & net worth <1% of total sales of group.
The question is	–	Do such non-performers warrant an existence or will the group be better off if it could hive off the divisions, or else amalgamate them with other existing units.
On the three basic indications	–	Last two companies are way below the group as a whole; providing 4.2% return on shareholders; 1.9% return on capital employed.

Keeping these figures in mind, Tata’s planned refocusing exercises like

- Divestment - mergers
- Amalgamations - takeovers.
- To create a learner and suggestive group with an estimated turn- over of Rs. 1,10,000 crore by 2000.

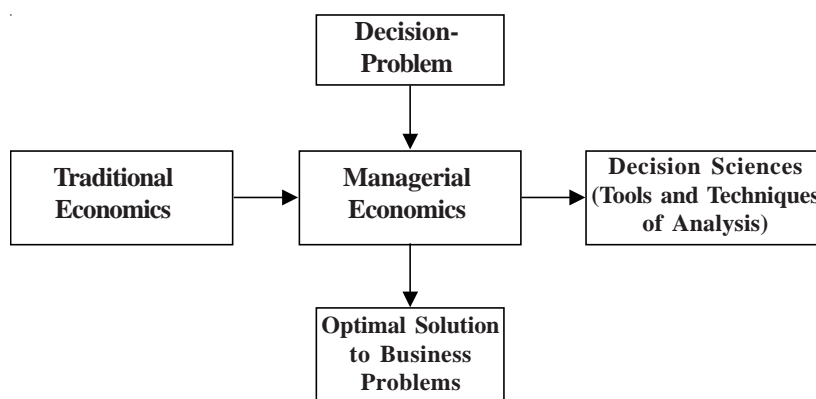
- From being production-led to being consumer and market-led; being up in top three in every segment.

Tata's "Vision 2000" is a group. Why not give someone else a chance to run your business more efficiently if you cannot do so? It makes better economic as well as business sense. But then, the ball is in the court of Tata's. The What and How to do is their prerogative.

The basic characteristics of managerial economics can now be enumerated as:

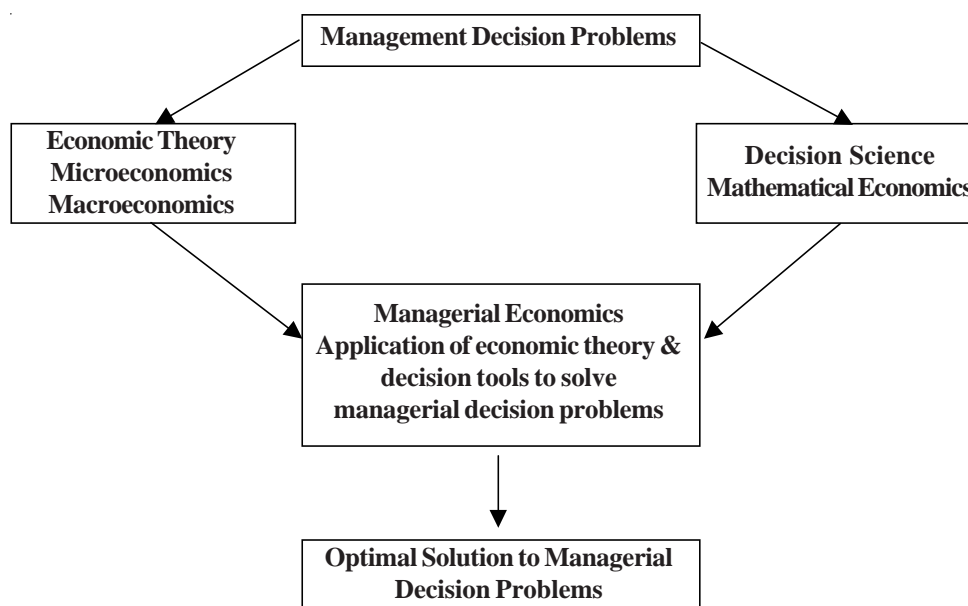
- It is concerned with "decision making of an economic nature."
- It is "micro-economic" in character.
- It largely uses that body of economic concepts and principles, which is known as "theory of the firm."
- It is "goal oriented and prescriptive"
- Managerial economics is both "conceptual and metrical". It includes theory with measurement.

Figure 1.2: Decision-Making



Managerial economics should be thought of as applied microeconomics, which focuses on the behavior of the individual actors on the economic stage; firms and individuals.

Figure 1.3: Basic Characteristics



1.8 SUMMARY

Managerial economics is used by firms to improve their profitability. It is the economics applied to problems of choices and allocation of scarce resources by the firms. It refers to the application of economic theory and the tools of analysis of decision science to examine how an organisation can achieve its objective most efficiently. Managerial decisions are evaluated through concepts, tools and techniques of economic analysis of various types. It is linked with various fields of study.

1.9 SELF-ASSESSMENT QUESTIONS

1. Discuss the nature and scope of managerial economics.
2. “Managerial economics is the integration of economic theory with business practice for the purpose of facilitating decision-making and forward planning by manager”. Explain and comment.
3. Define scarcity and opportunity cost. What role do these two concepts play in the making of management decisions?
4. Managerial economics is often said to help the business student integrate the knowledge gained in other courses. How is this integration accomplished?
5. Compare and contrast microeconomics with macroeconomics. Although managerial economics is based primarily on microeconomics, explain why it is also important for managers to understand macroeconomics.
6. Justify that managerial economics is economics applied in decision-making.
7. What is the role of managerial economics in preparing managers?
8. How is managerial economics related to different disciplines?

1.10 FURTHER READINGS

Haynes, W.W., *Managerial Economics: Analysis and Cases*, Business Publications, Inc., Texas, Ch. 1.

Adhikary, M., *Managerial Economics*, Khosla Publishers: Delhi, Ch. 1.

Baumol, William, J., *Economic Theory and Operations Analysis*, Prentice-Hall of India Pvt. Ltd., New Delhi.

UNIT 2 THE FIRM: STAKEHOLDERS, OBJECTIVES AND DECISION ISSUES

Objectives

After studying this unit, you should be able to :

- **understand** the rationale for existence of firms;
- **understand** the concept of economic profit and accounting profit;
- **appreciate** the use of opportunity cost;
- **differentiate** between various objectives of the firm.

Structure

- 2.1 Introduction
- 2.2 Objective of the Firm
- 2.3 Value Maximisation
- 2.4 Alternative Objectives of the Firms
- 2.5 Goals of Real World Firms
- 2.6 Firm's Constraints
- 2.7 Basic Factors of Decision-Making: The Incremental Concept
- 2.8 The Equi-Marginal Principle
- 2.9 The Discounting Principle
- 2.10 The Opportunity Cost Principle
- 2.11 The Invisible Hand
- 2.12 Summary
- 2.13 Self-Assessment Questions
- 2.14 Further Readings

2.1 INTRODUCTION

The firm is an organisation that produces a good or service for sale and it plays a central role in theory and practice of Managerial Economics. In contrast to non-profit institutions like the 'Ford Foundation', most firms attempt to make a profit. There are thousands of firms in India producing large amount of goods and services; the rest are produced by the government and non-profit institutions. It is obvious that a lot of activities of the Indian economy revolve around firms.

One of the crucial determinants of a firm's behaviour is the state of technology. Technology imposes a limit on how much a firm can produce. It is the sum total of society's pool of knowledge concerning the industrial and agricultural arts. Production is any activity that transforms inputs into output and is applicable not only to the production of goods like steel and automobiles, but also to production of services like banking and insurance.

The firm changes hired inputs into saleable output. An input is defined as anything that the firm uses in its production process. Most firms require a wide array of inputs. For example, some of the inputs used by major steel firms like SAIL or TISCO are iron ore, coal, oxygen, skilled labour of various types, the services of blast furnaces, electric furnaces, and rolling mills as well as the services of the people managing the companies. To give another example, the inputs in production and sale of "chaat" by a street vendor are all the ingredients that go into making of the "chaat", i.e. the stove, the "carrier", and the services of the vendor. The inputs

or the factors of production are divisible into two broad categories - human resources and capital resources. Labour resource and entrepreneurial resource are the two human resource inputs while land, man-made capital forests, rivers, etc. are the two capital resources. Thus the four major factors of production (FOP) are land, man made capital, labour, and entrepreneur (organisation) while the remuneration they get is rent, interest (capital rental), wage, and profit, respectively.

The function of the firm, thus, is to purchase resources or inputs of labour services, capital and raw materials in order to convert them into goods and services for sale. There is a circular flow of economic activity between individuals and firms as they are highly interdependent. Labour has no value in the market unless there is a firm willing to pay for it. In the same way, firms cannot rationalise production unless some consumer is willing to buy their products. However, there is some incentive for each. Firms earn profits in turn satisfying the consumption demand of individuals and resource owners get wage, rent and interest payment. In the process of supplying the goods and services that consumers demand, firms provide employment to workers and also pay taxes that government uses to provide service (education, defense) that firms could not provide at all or as efficiently.

Essentially a firm exists because the total cost of production of output is lower than if the firm did not exist. There are several reasons for lower costs. Firstly, long-term contract with labour saves the transaction costs because no new contract has to be negotiated every time a labour is to be hired or given new assignment. Secondly, there are government regulations like price-control and sales taxes also saved by having the transaction within the firm. Recall that sales tax is levied for transaction between firms and not within firms. When transactions take place within a firm they may be cheaper and hence such savings decrease the total cost of production of an output. In other words, the existence of firms could be explained by the fact that it saves transaction costs.

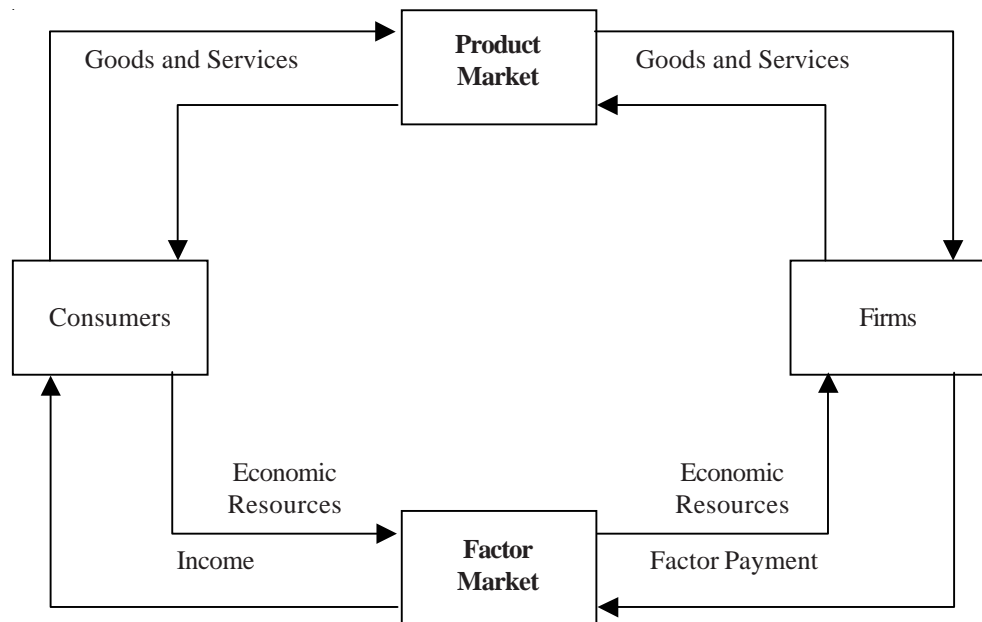
However, the size of the firm has to be limited because as the firms grow larger, a point is reached where the cost of internal transaction becomes equal to or greater than the cost of transaction between firms. When such a stage is reached, it puts a limit to the size of the firm. Further, the cost of supplying additional services like legal, medical etc. within the firm exceeds the cost of purchasing these services from other firms; as such services may be required occasionally.

Let us consider the size of different kinds of firms around us and try to understand the reasons for such differences. Why are service firms generally smaller than capital-intensive firms like SAIL, Maruti Udyog, and ONGC etc? What is the reason that a number of firms are choosing the BPO route? A part of the explanation must lie in the fact that it is cheaper to outsource than to absorb that activity within the firm. Consider a firm that needs to occasionally use legal service. Under what conditions will it choose to hire a full time lawyer and take her on its rolls and under what conditions will the firm outsource the legal activity or hire legal services on a case-by-case basis. Naturally, the answer depends upon the frequency of use for legal services. The transaction cost framework demonstrates that the firm will contract out if the cost of such an arrangement is lower and will prefer in-house legal staff when the opposite is true.

Firms are classified into different categories as follows:

- a) Private sector firms.
- b) Public sector firms.
- c) Joint sector firms.
- d) Non-profit firms.

Figure 2.1: Interdependence of Consumers and Firms



Firms can also be classified on the basis of number of owners as:

- a) Proprietorship.
- b) Partnership.
- c) Corporations.

Some firms mentioned below are different from above. They may provide service to a group of clients for example, patients or to a group of its members only.

- a) Universities.
- b) Public Libraries.
- c) Hospitals.
- d) Museums.
- e) Churches.
- f) Voluntary Organisations.
- g) Cooperatives.
- h) Unions.
- i) Professional Societies, etc.

The concept of a firm plays a central role in the theory and practice of managerial economics. It is, therefore, valuable to discuss the objectives of a firm.

2.2 OBJECTIVE OF THE FIRM

The traditional objective of the firm has been profit maximisation. It is still regarded as the most common and theoretically the most plausible objective of business firms. We define profits as revenues less costs. But the definition of cost is quite different for the economist than for an accountant. Consider an independent businessperson who has an MBA degree and is considering investing Rs.1 lakh in a retail store that she would manage. There are no other employees. The projected income statement for the year as prepared by an accountant is as shown below:

Sales:			Rs. 90,000
Less: Cost of Goods sold		Rs. 40,000	
Gross Profit :			Rs. 50,000
Less:	Advertising	Rs. 10,000	}
	Depreciation	Rs. 10,000	
	Utilities	Rs. 3,000	
	Property Tax	Rs. 2,000	
	Misc.	Rs. 5,000	
Net Accounting Profit			= Rs. 30,000
			Rs. 20,000

This accounting or business profit is what is reported in publications and in the quarterly and annual financial reports of businesses.

The economist recognises other costs, defined as implicit costs. These costs are not reflected in cash outlays by the firm, but are the costs associated with foregone opportunities. Such implicit costs are not included in the accounting statements but must be included in any rational decision making framework. There are two major implicit costs in this example. First, the owner has Rs.1 lakh invested in the business. Suppose the best alternative use for the money is a bank account paying a 10 per cent interest rate. This risk less investment would return Rs.10,000 annually. Thus, Rs.10,000 should be considered as the implicit or opportunity cost of having Rs.1 lakh invested in the retail store.

Let us consider the second implicit cost, which includes the manager’s time and talent. The annual wage return on an MBA degree may be taken as Rs.35,000 per year. This is the implicit cost of managing this business rather than working for someone else. Thus, the income statement should be amended in the following way in order to determine the economic profit:

Sales :			Rs. 90,000
Less: Cost of goods sold		Rs. 40,000	
Gross Profit :			Rs. 50,000
Less Explicit Cost:	Advertising	Rs. 10,000	}
	Depreciation	Rs. 10,000	
	Utilities	Rs. 3,000	
	Property Tax	Rs. 2,000	
	Misc.	Rs. 5,000	
Accounting Profit		Rs. 20,000	
Less : Implicit Costs :	Return on Rs.1 lakh of capital	Rs. 10,000	} = Rs.45,000
	Foreign wages	Rs. 35,000	
Net “Economic Profit”		Rs. 25,000	

Looking at this broader perspective, the business is projected to lose Rs.25,000 in the first year. Rs. 20,000 accounting profit disappears when all relevant costs are included. Another way of looking at the problem is to assume that Rs.1 lakh had to be borrowed at, say, 10 per cent interest and an MBA graduate hired at Rs.35,000 per year to run the store. In this case, the implicit costs become explicit and the accounting made explicit. Obviously, with the financial information reported in this way, an entirely different decision might be made on whether to start this business or not.

Thus, we can say that economic profit equals the revenue of the firm minus its explicit costs and implicit costs. To arrive at the cost incurred by a firm, a value

must be put to all the inputs used by the firm. Money outlays are only a part of the costs. As stated above, economists also define opportunity cost. Since the resources are limited, and have alternative uses, you must sacrifice the production of a good or service in order to commit the resource to its present use. For example, if by being the owner manager of your firm, you sacrifice a job that offers you Rs. 2,00,000 per annum, then two lakhs is your opportunity cost of managing the firm. Similarly, if he was not playing cricket, Sachin Tendulkar, could have earned a living (perhaps, not such a good one!) by being a cricket commentator. Sachin's opportunity cost of playing cricket is the amount he could have earned being a television commentator.

The assignment of monetary values to physical inputs is easy in some cases and difficult in others. All economic costing is governed by the principle of opportunity cost. If the firm maximises profits, it must evaluate its costs according to the opportunity cost principle. Assigning costs is straightforward when the firm buys an input on a competitive market. Suppose the firm spends Rs. 20,000 on buying electricity. For its factory, it has sacrificed claims to whatever else Rs 20,000 can buy and thus the purchase price is a reasonable measure of the opportunity cost of using that electricity. The situation is the same for hired factors of production. However, a cost must be assigned to factors of production that the firm neither purchases, nor hires because it already owns them. The cost of using these inputs is implicit costs and has to be imputed. Implicit costs arise because the alternative (opportunity) cost doctrine must be applied to the firm. The profit calculated after including implicit as well as explicit costs in total cost is called **economic profit**.

Profit plays two primary roles in the free-market system. First, it acts as a signal to producers to increase or decrease the rate of output, or to enter or leave an industry. Second, profit is a reward for entrepreneurial activity, including risk taking and innovation. In a competitive industry, economic profits tend to be transitory. The achievement of high profits by a firm usually results in other firms increasing their output of that product, thus reducing price and profit. Firms that have monopoly power may be able to earn above-normal profits over a longer period; such profit does not play a socially useful role in the economy.

Although, profit maximisation is a dominant objective of the firm, other important objectives of the firm, other than profit maximisation that we will discuss in this unit are:

1. Maximisation of sales revenue.
2. Maximisation of firm's growth rate
3. Maximisation of manager's own utility or satisfaction
4. Making a satisfactory rate of profit.
5. Long-run survival of the firm
6. Entry-prevention and risk avoidance.

Activity 3

a) "Among the various objectives of a modern firm, profit maximisation is the most important". Comment.

.....
.....
.....
.....

b) Outline the circular flow of economic activity between individuals and firms.

.....

- c) (i) profit is a cost of doing business and is the amount by which exceeds profit.
- (ii) When a firm earns just a normal rate of return, equals total economic cost and profit is zero.
- d) A firm collects Rs. 1.75 lakhs in revenue and spends Rs. 80 thousands on raw materials in a year. The owners of the firm have provided Rs. 5 lakhs of their own money to the firm instead of investing the money and earning a high rate of interest.
- (i) The firm earns economic profit of The firm's normal profit is
- (ii) The firm's accounting profit is
- (iii) If the firm's costs stay the same but its revenue falls to, only a normal profit is earned.

2.3 VALUE MAXIMISATION

Most firms have sidelined short-term profit as their objective. Firms are often found to sacrifice their short-term profit for increasing the future long-term profit. Thus, the theory states that the objective of a firm is to maximise wealth or value of the firm. For example, firms undertake research and development expenditure, expenditure on new capital equipment or major marketing programmes which require expenditure initially but are meant to generate future profits. The objective of the firm is thus to maximise the present or discounted value of all future profits and can be stated as:

$$PV(\pi) = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \dots + \frac{\pi_n}{(1+r)^n}$$

$$= \sum_{t=1}^n \frac{\pi_t}{(1+r)^t}$$

Where, PV = Present Value of all expected future profits of the firm.

π_1, \dots, π_n = Expected profit in 1, 2, n years.

r = Appropriate discount rate

t = Time period 1 n.

Assumed profit is equal to total revenue (TR) minus total cost (TC), then the value of the firm can also be stated as:

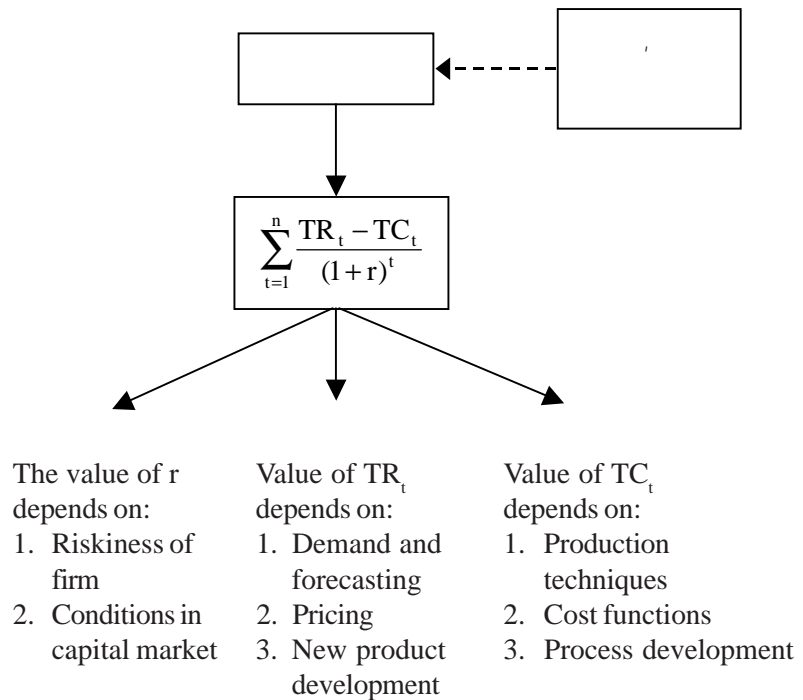
$$\text{Value of the firm} = \sum_{t=1}^n \frac{TR_t - TC_t}{(1+r)^t}$$

Thus maximising the discounted value of all future profits is equivalent to maximising the value of the firm.

A careful inspection of the equation suggests how a firm's managers and workers can influence its value. For example, in a company, the marketing managers and sales representatives work hard to increase its total revenues, while its production managers and manufacturing engineers strive to reduce its total costs. At the same time, its financial managers play a major role in obtaining capital, and hence

influence the equation, while its research and development personnel invent and reduce its total costs. All of these diverse groups affect the company's value, defined here as the present value of all expected future profits of the firm.

Figure 2.2: Determination of the value of the firm



2.4 ALTERNATIVE OBJECTIVES OF FIRMS

Economists have also examined other objectives of firms. We shall discuss some of them here. According to Baumol, most managers will try to maximise sales revenue. There are many reasons for this. For example, the salary and other earnings of managers are more closely related to sales revenue than to profits. Banks and financiers look at sales revenue while financing the corporation. The sales revenue trend is a readily available indicator of performance of the firm. Growth in sales increases the competitive strength of the firm. However, in the long run, sales maximisation and profit maximisation may converge into one objective.

Another economist Robin Marris assumes that owners and managers have different utility functions to maximise. The manager's utility function (U_m) and Owner's utility functions (U_o) are:

$$U_m = f(\text{Salary, job, power, prestige, status})$$

$$U_o = f(\text{Output, capital, profit, share})$$

By maximising the variables, managers maximise both their own utility function and that of the owners. Most of the variables of both managers and owners are correlated with a single variable, namely, the size of the firm. Maximisation of these variables depends on the growth rate of the firm. Thus, Marris argues that managers will attempt to maximise growth rate of firms. However, this objective does not completely discard the profit maximisation objective.

According to Oliver Williamson, managers seek to maximise their own utility function subject to a minimum level of profit. The utility function which managers seek to maximise include both quantifiable variables like salary and slack earnings and non-quantifiable variables like power, status, security of job, etc. The model developed by Cyert-March focuses on satisficing behaviour of managers. The firm has to deal with an uncertain business world and managers have to satisfy a variety

of groups—staff, shareholders, customers, suppliers, authorities, etc. All these groups have often-conflicting interests in the firm. In order to reconcile between the conflicting interests and goals, managers form an aspiration level of the firm combining the following objectives – production, sales and market share, inventory and profit. The aspiration levels are modified and revised on the basis of achievements and changing business environment.

As is true with most economic models, the application will depend upon the situation and one cannot say that a particular model is better than the other. In general, one can assert that the profit maximising assumption seems to be a reasonable approximation of the real world, although in certain cases there might be a deviation from this objective.

2.5 GOALS OF REAL WORLD FIRMS

By now we know that firms that maximise profits are not just concerned about short-run profits, but are more concerned with long-term profits. They may not take full advantage of a potential monopolistic situation, for example, many stores have liberal return policies; many firms spend millions on improving their reputation and want to be known as ‘good’ citizens. The decision maker’s income is often a cost of the firm. Most real-world production takes place in large corporations with 8-9 levels of management, thousands of stockholders and boards of directors. Self-interested decision makers have little incentive to hold down their pay. If their pay is not held down, firm’s profit will be lower. Most firms manage to put some pressure on managers to make at least a pre-designated level of profit.

In the modern corporation, the owners or stockholders (i.e. the principals) hire managers (i.e., agents) to conduct the day-to-day operations of the firm. These managers are paid a salary to represent the interest of the owners, ostensibly, to maximize the value of the firm. A board of directors is elected by the owners to meet regularly with the managers to oversee their activity and to try to ensure that the managers are, in fact, acting in the best interest of the owners.

Because of the difficulty of monitoring the managers on a continual basis, it is possible that goals other than profit-maximization may be pursued. In addition to those mentioned earlier, the managers may seek to enhance their positions by spending corporate funds on fancy offices, excessive and expensive travel, club memberships, and so forth. In recent years, many corporations have taken action to align the interests of owners with the interests of the managers by tying a large share of managerial compensation to the financial performance of the firm.

For example, the manager may be given a basic salary plus potentially large bonuses for meeting such goals as attaining a specified return on capital, growth in earnings, and/or increase in the price of the firm’s stock. With regard to the latter, the use of stock options awarded to top managers is a most effective way to ensure that managers act in the interest of the shareholders. Typically, the arrangement provides that the manager is to receive an option to buy a specified number of shares of common stock at the current market price for a specified number of years. The only way the executives can benefit from such an arrangement is if the price of stock rises during the specified term. The option is exercised by buying the shares at the specified price, and the gain equals the increase in share price multiplied by the number of shares purchased. Sometimes the agreement specifies that the stock must be held for several years following purchase. Essentially, this option arrangement makes the manager a *de facto* owner, even if the option has not been exercised. In almost every case of a report of unusually high executive compensation, the largest part of that compensation is associated with gains from stock options.

Emergence of oligopoly, a market structure characterized by the existence of a few large firms, mergers and amalgamations have made the structure of industries concentrated so that few large (dominant) firms account for a major portion of an industry's output. This shifts the pressure on each firm to maximise profit independently and leads to joint profit maximizations through cartels and collusions. Profit maximization may not be the only inevitable objective.

India's Global Companies and their Objectives: One of the most significant business and economic trends of the late twentieth century is the rise of 'global' or 'stateless' corporation. The trends toward global companies are unmistakable and are accelerating. The sharpest weapon that a corporation can develop to survive and thrive, in the globalised market place is competitiveness. Its corner stone as articulated by strategy guru Michael Porter is its ability to create more value on a sustainable basis, for the customer than its rivals can.

For the first time, many Indian corporations such as Reliance Industries, Ranbaxy, Sundaram Fasteners, Arvind Mills and Bajaj Auto among others are competing on the world stage. Whatever product or service a company offers it must meet the customers wants in the most satisfactory manner. This should be the aim of the company. The competitiveness of Reliance in the global market place comes from both quality and scale. The challenge is to remain at the top. That challenge is linked with productivity. Ranbaxy's greatest strength lies in the fact that it is strongly backward integrated. It helps them manage cost across the entire value chain making them extremely cost competitive. Cost leadership is a function of scale and technology. By upgrading technology, Ranbaxy could continue to be a cost leader. A company has to continuously upgrade itself on several parameters: production efficiency, product development, quality management and marketing skills. Sundaram has programmes to address all these parameters.

This competitiveness - defined by Michael Porter as the sustained ability to generate more value for customers than the cost of creating that value - is what will keep India's Companies alive in the bitter battle for survival that they are waging even on their home turf with rivals pouring in from all corners of the globe.

2.6 FIRM'S CONSTRAINTS

Decision-making by firms takes place under several restrictions or constraints, such as:

Resource Constraints: Many inputs may be available in a limited or fixed quantity e.g., skilled workers, imported raw material, etc.

Legal Constraints: Both individuals and firms have to obey the laws of the State as well as local laws. Environmental laws, employment laws, disposal of wastes are some examples.

Moral Constraints: These imply to actions that are not illegal but are sufficiently consistent with generally accepted standards of behaviour.

Contractual Constraints: These bind the firm because of some prior agreement such as a long-term lease on a building or a contract with a labour union that represents the firm's employees.

Decision-making under these constraints with optimal results is a fundamental part of managerial economics.

2.7 BASIC FACTORS OF DECISION-MAKING: THE INCREMENTAL CONCEPT

Incremental reasoning involves estimating the impact of decision alternatives. The two basic concepts in the incremental analysis are:

- Incremental Cost (IC)
- Incremental Revenue (IR)

Incremental cost is defined as the change in total cost as a result of change in the level of output, investment etc. Incremental revenue is defined as the change in total revenue resulting from a change in the level of output, prices etc. A manager always determines the worth of a decision on the basis of the criterion that $IR > IC$.

A decision is profitable if

- it increases revenue more than it increases cost
- it reduces some costs more than it increases others
- it increases some resources more than it decreases others
- it decreases costs more than it decreases revenues.

To illustrate the above points, let us take a case where a firm gets an order that can get it additional revenue of Rs. 2,000. The normal cost of production of this order is–

Labour	:	Rs. 600
Materials	:	Rs. 800
Overheads	:	Rs. 720
Selling and administration expenses	:	Rs. 280
Full cost	:	Rs. 2,400

Comparing the additional revenue with the above cost suggests that the order is unprofitable. But, if some existing facilities and underutilised capacity of the firm were utilised, it would add much less to cost than Rs. 2,400. For example, let us assume that the addition to cost due to this new order is, say, the following:

Labour	:	Rs. 400
Materials	:	Rs. 800
Overheads	:	Rs. 200
Total incremental Cost	:	Rs. 1,400

In the above case the firm would earn a net profit of Rs. 2000 – Rs. 1400 = Rs. 600, while at first it appeared that the firm would make a loss of Rs. 400 by accepting the order.

The worth of such a decision can be judged on the basis of the following theorem.

Theorem I: A course of action should be pursued upto the point where its incremental benefits equal its increment costs.

According to the theorem, the firm represented in Table 2.1 will produce only seven units of output as its Marginal Revenue (MR)= Marginal Cost (MC)¹ at that level of output. As can be calculated from the Table, the MC of 8th unit is more than its

¹ Marginal Revenue is the additional revenue from selling one more unit, while Marginal Cost is the additional cost of producing one more unit.

MR. Hence the firm gets negative profit from 8th unit and thus is advised not to produce it.

The acceptance or rejection of an order by a firm for its product depends on whether the resultant costs are greater or less than the resultant revenue. If these principles are not followed, the equilibrium position would be disturbed. But the problem with the concept of marginalism is that the independent variable may be subject to “bulk changes” instead of “unit changes”. For example, a builder may not change one labourer at a time, but many of them together. Similarly, the output may change because of a change in process, pattern or a combination of factors, which may not always be measured in unit terms. In such cases, the concept of marginalism is changed to incrementalism. Or, in other words, incrementalism is more general, whereas marginalism is more specific. All marginal concepts are incremental concepts, but all incremental concepts need not be marginal concepts.

Table 2.1 : Profit Function of a Firm

Unit of Output	Total Revenue	Total Cost	Total Profit	Average Profit	Marginal Profit
1	2	3	4	5	6
1	20	15	5	5.0	-
2	40	29	11	5.5	6
3	60	42	18	6.0	7
4	80	52	28	7.0	10
5	100	65	35	7.0	7
6	120	81	39	6.5	4
7	140	101	39	5.6	0
8	160	125	35	4.4	- 4

2.8 THE EQUI-MARGINAL PRINCIPLE

According to this principle, different courses of action should be pursued up to the point where all the courses provide equal marginal benefit per unit of cost. It states that a rational decision-maker would allocate or hire his resources in such a way that the ratio of marginal returns and marginal costs of various uses of a given resource or of various resources in a given use is the same. For example, a consumer seeking maximum utility (satisfaction) from his consumption basket, will allocate his consumption budget on goods and services such that

$$\begin{aligned}
 MU_1/MC_1 &= MU_2 / MC_2 = \dots\dots\dots = MU_n / MC_n, \\
 \text{Where } MU_1 &= \text{marginal utility from good one,} \\
 MC_1 &= \text{marginal cost of good one and so on.}
 \end{aligned}$$

Similarly, a producer seeking maximum profit would use the technique of production (input-mix.) which would ensure

$$MRP_1/MC_1 = MRP_2/MC_2 = \dots = MRP_n/MC_n$$

Where MRP_1 =Marginal revenue product of input one (e.g. Labour), MC_1 = Marginal cost of input one and so on.

It is easy to see that if the above equation was not satisfied, the decision makers could add to his utility/profit by reshuffling his resources/input e.g. if $MU_1/MC_1 > MU_2/MC_2$ the consumer would add to his utility by buying more of good one and less of good two. Table 2.2 summarises this principle for different sellers.

Example: A multi-commodity consumer wishes to purchase successive units of A,B and C. Each unit costs the same and the consumer is determined to have a combination including all the three items. His budget constraint is such that he cannot buy more than six units in all. Again, he is subject to diminishing marginal utility i.e. as he has more of an item, he wants to consume less of it. Table 2.3 shows the optimisation example:

Table 2.2: The Equi-Marginal Principle

Unit	Equi-Marginal Principle
Multi-market seller	$MR_1=MR_2=MR_3=\dots=MR_n$
Multi-plant monopolist	$MC_1=MC_2=MC_3=\dots=MC_n$
Multi-factor employer	$MP_1=MP_2=MP_3=\dots=MP_n$
Multi-product firm	$Mp_1=Mp_2=Mp_3=\dots=Mp_n$
Multi-commodity consumer	$MU_1=MU_2=MU_3=\dots=Mu$

MR=marginal revenue; MC=marginal cost; MP=marginal product;
Mp=marginal profit; MU=marginal utilities.

Table 2.3 : Optimisation Example

Units	MARGINAL UTILITIES		
	Item A	Item B	Item C
1	10	9	8
2	9	8	7
3	8	7	6
4	7	6	5
5	6	5	4
6	5	4	3

The utility maximising consumer will end up with a purchase of 3A+2B+1C because that combination satisfies equimarginalism:

$$MU_a = MU_b = MU_c = 8$$

In the real world, often the equi-marginalism concept has to be replaced by equi-incrementalism. This is because, changes in the real world are discrete or lumpy and therefore the concept of marginal change may not always apply. Instead, changes will be incremental in nature, but the decision rule or optimising principle will remain the same.

2.9 THE DISCOUNTING PRINCIPLE

Many transactions involve making or receiving cash payments at various future dates. A person who takes a house loan trades a promise to make monthly payments for say, fifteen or twenty years for a large amount of cash now to pay for a home. This case and other similar cases relate to the time value of money. The time value of money refers to the fact that a rupee to be received in the future is not worth a rupee today. Therefore, it is necessary to have techniques for measuring the value today (i.e., the present value) of rupees to be received or paid at different points in the future. This section outlines the approach to analyzing problems that involve payment and/or receipt of money at one or more points in time.

One may ask how much money today would be equivalent to Rs. 100 a year from now if the rate of interest is 5%. This involves determining the present value of Rs. 100 to be received after one year. Applying the formula –

$$PV = \frac{100}{1.05}$$

we obtain Rs. 95.24,

Rs. 95.24 will accumulate to an amount exactly equal to Rs. 100 in one year at the interest rate of 5 per cent. Looked at another way, you will be willing to pay maximum of Rs. 95.24 for the benefit of receiving Rs. 100 one year from now if the prevailing interest rate is 5 per cent.

The same analysis can be extended to any number of periods. A sum of Rs. 100 two years from now is worth:

$$PV_2 = \frac{100}{1.05^2}$$

= Rs.90.70 today.

In general, the present value of a sum to be received at any future date can be found by the following formula:

$$PV = \frac{Rn}{(1+i)^n}$$

PV = present value, Rn = amount to be received in future, i = rate of interest, n = number of years lapsing between the receipt of R.

If the receipts are made available over a number of years, the formula becomes:

$$PV = \frac{R_1}{1+i} + \frac{R_2}{(1+i)^2} + \frac{R_3}{(1+i)^3} + \dots + \frac{R_n}{(1+i)^n}$$

$$PV = \sum_{k=1}^n \frac{R_k}{(1+i)^k}$$

In the above formula if $R_1 = R_2 = R_3$ etc., it becomes an ‘annuity’. An annuity has been defined as series of periodic equal payments. Although the term is often thought of in terms of a retirement pension, there are many other examples of annuities. The repayment schedule for a home loan is an annuity. A father’s agreement to send his son Rs. 1000 each month while he is in college is another example. Usually, the number of periods is specified, but not always. Sometimes retirement benefits are paid monthly as long as a person is alive. In other case, the annuity is paid forever and is called ‘perpetuity.’

It must be emphasized that the strict definition of an annuity implies equal payments. A contract to make 20 annual payments, which increase each year by, say, 10 per cent, would not be an annuity. As some financial arrangements provide for payments with periodic increase, care must be taken not to apply an annuity formula if the flow of payments is not a true annuity.

The present value of an annuity can be thought of as the sum of the present values of each of several amounts. Consider an annuity of three Rs. 100 payments at the end of each of the next three years at 10 percent interest. The present value of each payment is

$$PV_1 = 100 \frac{1}{1.10}$$

$$PV_2 = 100 \frac{1}{1.10^2}$$

$$PV_3 = 100 \frac{1}{1.10^3}$$

and the sum of these would be

$$PV = 100 \frac{1}{1.10} + 100 \frac{1}{(1.10)^2} + 100 \frac{1}{(1.10)^3}$$

OR

$$PV = 100 \left[\frac{1}{1.10} + \frac{1}{(1.10)^2} + \frac{1}{(1.10)^3} \right]$$

The present value of this annuity is

$$PV = 100 (0.9091 + 0.8264 + 0.7513) = 100 (2.4868) = 248.68$$

Although this approach works, it clearly would be cumbersome for annuities of more than a few periods. For example, consider using this method to find the present value of a monthly payment for forty years if the monthly interest rate is 1 per cent. That would require evaluating the present value of each of 480 amounts! In general, the formula for the present value of an annuity of A rupees per period for n periods and a discount rate of i is

$$PV = A \frac{1}{(1+i)} + A \frac{1}{(1+i)^2} + \dots + A \frac{1}{(1+i)^n}$$

2.10 THE OPPORTUNITY COST PRINCIPLE

The opportunity cost of anything is the return that can be had from the next best alternative use. A farmer who is producing wheat can also produce potatoes with the same factors. Therefore, the opportunity cost of a quintal of wheat is the amount of the output of potatoes given up. The opportunity costs are the 'costs of sacrificed alternatives.'

Whenever the manager takes a decision he chooses one course of action, sacrificing the other alternative courses. We can therefore evaluate the one, which is chosen in terms of the other (next best) alternative that is sacrificed. A machine can produce either X or Y. The opportunity cost of producing a given quantity of X is the quantity of Y which it would have produced.

The opportunity cost of holding Rs.1000 as cash in hand for one year is the 10% rate of interest, which would have been earned had it been invested in the form of fixed deposits in the bank.

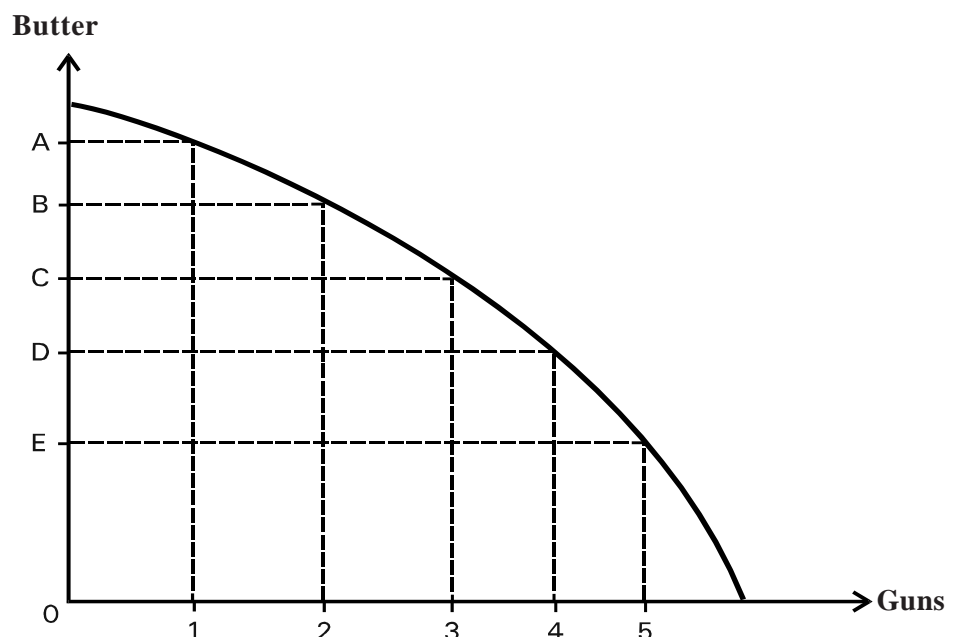
- all decisions which involve choice must involve opportunity cost calculation,
- the opportunity cost may be either real or monetary, either implicit or explicit, either non-quantifiable or quantifiable.

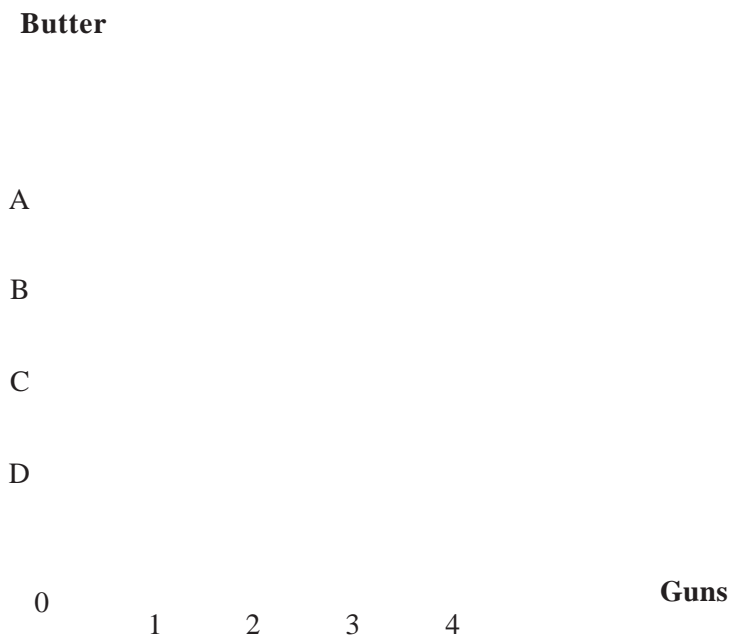
Opportunity costs' relevance is not limited to individual decisions. Opportunity costs are also relevant to government's decisions, which affect everyone in society. A common example is the guns-versus-butter debate. The resources that a society has are limited; therefore its decisions to use those resources to have more guns (more weapons) means that it must have less butter (fewer consumer goods). Thus when society decides to spend 100 crore on developing a defence system, the opportunity cost of that decision is 100 crores not spent on fighting drugs, helping the homeless, or paying off some of the national debt.

For the country as a whole, the production possibility reflects opportunity costs. Figure 2.1 shows the Production Possibility Curve (PPC) reflecting the different combinations of goods, which an economy can produce, given its state of technology and total resources. It illustrates the menu of choices open to the economy. Let us take the example that the economy can produce only two goods, butter and guns. The economy can produce only guns, only butter or a combination of the two, illustrating the trade offs or choice inherent in such a decision. The opportunity cost of choosing guns over butter increases as the production of guns is increased. The reason is that some resources are relatively better suited to producing guns. The quantity of butter, which has to be sacrificed to produce an additional unit of guns, is called the opportunity cost of guns (in terms of butter). Due to the increasing opportunity cost of guns, the PPC curve will be concave to the origin. Increasing opportunity cost of guns means that to produce each additional unit of guns, more and more units of butter have to be sacrificed. The basis for increasing opportunity costs is the following assumptions:

- i) Some factors of production are more efficient in the production of butter and some more efficient in production of guns. This property of factors is called specificity. Thus specificity of factors of production causes increasing opportunity costs.

Figure 2.1: Production Possibility Curve





- ii) The production of the goods require more of one factor than the other. For example, the production of guns may require more capital than that of butter. Hence, as more and more of capital is used in the manufacture of guns, the opportunity cost of guns is likely to increase.

Let us assume that an economy is at point A where it uses all its resources in the production of butter. Starting from A, the production of 1 unit of guns requires that AC units of butter be given up. The production of a second unit of guns requires that additional CD units of butter be given up. A third requires that DE be given up, and so on. Since $DE > CD > AC$, and so on, it means that for every additional unit of guns more and more units of butter will have to be sacrificed, or in other words, the opportunity cost keeps on increasing.

The opportunity cost of the first few units of guns would initially be low and those resources, which are more efficient in the production of guns move from, butter production to gun production. As more and more units of guns are produced, however, it becomes necessary to move into gun production, even for those factors, which are more efficient in the production of butter. As this happens, the opportunity cost of guns gets larger and larger. Thus, due to increasing opportunity costs the PPC is concave.

If the PPC curve were to be a straight line, the opportunity cost of guns would always be constant. This would mean equal (and not increasing amounts of butter) would have to be forgone to produce an additional unit of guns. The assumption of constant opportunity costs is very unrealistic. It implies that all the factors of production are equally efficient either in the production of butter or in the production of guns.

For many of the choice society make opportunity costs tend to increase as we choose more and more of an item. Such a phenomenon about choice is so common, in fact, that it has acquired a name: the principle of increasing marginal opportunity cost. This principle states that in order to get more of something, one must give up ever-increasing quantities of something else. In other words, initially the opportunity costs of an activity are low, but they increase the more we concentrate on that activity.

2.11 THE INVISIBLE HAND

Adam Smith, the father of modern economics believed that there existed an “invisible hand” which ruled over the economic system. According to him the economic system, left to itself, is self-regulating. The basic driving force in such a system is trying to enhance its own economic well-being. But the actions of each unit, acting according to its own self-interest, are also in the interests of the economy as a whole.

Producers are led by the profit motive to produce those goods and services which the consumers want. They try to do this at the minimum possible cost in order to maximize their profits. Moreover, if there is competition among a number of producers, they will each try to keep the price of their product low in order to attract the consumers. The goods produced are made available in the market by traders. They also act in their own self-interest. However, in a self-regulating economy, there is rarely any shortage of goods and services.

Decisions to save and invest are also taken by the individual economic units. For example, households save some of their income and deposit part of it in the banks, or invest it in shares and debentures and so on. The producers borrow from the banking system and also issue shares and debentures to finance their investments. In turn, they reinvest a part of their profits.

All the economic functions have been carried out by individuals acting in isolation. There is no government or centralized authority to determine who should produce what and in what quantity, and where it should be made available. Yet in a self-regulating economy there is seldom a shortage of goods and services. Practically everything you want to buy is available in the market. Thus according to Adam Smith, the economic system is guided by the “invisible hand”. In a more technical way we can say that the basic economic problems in a society are solved by the operation of market forces.

2.12 SUMMARY

There is a circular flow of economic activity between individuals and firms as they are highly interdependent. The firms’ existence is based on manifold reasons. Firms are classified into different categories. Different firms belonging to the same industry, facing the same market environment, behave differently. Thus, the necessity for theories of the firm. Profit is defined as revenues minus costs. But the definition of cost is quite different for economist than for the accountant. Short-term profit has been sidelined by most firms as their objective for increasing the future long-term profit. Real world firms often have a set of complicated goals. The basic factors of decision making can be outlined by various principles.

2.13 SELF-ASSESSMENT QUESTIONS

1. Write notes in about 200 words on the following:
 - a) The incremental concept
 - b) Opportunity cost
 - c) Scope of managerial economics
 - d) The Invisible Hand
2. ‘Managerial Economics serves as a link between traditional economics and decision sciences for business decision-making.’ Elucidate.
3. Calculate, using the best estimates you can make:
 - a) Your opportunity cost of attending college.

- b) Your opportunity cost of taking this course.
c) Your opportunity cost of attending yesterday's lecture of your course.
4. The following is the hypothetical production possibility table of India:

Resources Devoted to Clothing	Output of Clothing	Output of Food
100%	20	0
80 %	16	5
60 %	12	9
40 %	8	12
20 %	4	14
0 %	0	15

- a) Draw India's production possibility curve.
b) What is happening to marginal opportunity costs as output of food increases?
c) If the country gets better at the production of food, what will happen to the production possibility curve?
d) If the country gets equally better at producing food and producing clothing, what will happen to the production possibility curve?
5. Use the following interest rates for government bonds for the risk-free discount rate and answer the following:

Time of Maturity (years)	Interest Rate (%)
1	5.75
2	6.00
3	6.25
4	6.50
5	6.75

- (i) Calculate the PV of a Rs. 1 lakh payment to be received at the end of one year, 2 years, 3 years, 4 years and 5 years.
(ii) What is the present value of a firm with a 5 years life span that earns the following stream of expected profit at the year-end?

Years	Expected Profit (in Crores)
1	10
2	20
3	50
4	25
5	50

6. Value maximisation has become the major objective of a modern firm.
Comment.

2.14 FURTHER READINGS

Joel Dean, *Managerial Economics*, Asia Publishing House, Bombay.

Mote, Paul Gupta, *Managerial Economics*, Tata McGraw Hill.

Koutsoyiannis, *Modern Microeconomics*, The Macmillan Press Pvt. Ltd.

UNIT 3 BASIC TECHNIQUES

Objectives

After studying this unit, you should be able to:

- **identify** a wide range of techniques used in managerial economics;
- **apply** the techniques to understand the meaning of the results;
- **identify** the strengths and weaknesses of the different methods.

Structure

- 3.1 Introduction
- 3.2 Opportunity Set
- 3.3 Variables and Constants
- 3.4 Derivatives
- 3.5 Partial Derivatives
- 3.6 Optimisation Concept
- 3.7 Regression Analysis
- 3.8 Specifying the Regression Equation
- 3.9 Estimating the Regression Equation
- 3.10 Decision Under Risk
- 3.11 Uncertainty Analysis and Decision Making
- 3.12 Role of Managerial Economist
- 3.13 Summary
- 3.14 Self-Assessment Questions
- 3.15 Further Readings

3.1 INTRODUCTION

The manager needs various techniques to assist and help him in making decisions that will ultimately maximise the value of the firm. These techniques and tools are quantitative in nature. The introduction of some commonly used tools used in managerial decision making becomes imperative.

In this unit we are going to discuss some basic techniques which would be helpful in understanding the concept of managerial economics, in turn helping us to apply these techniques as and when required.

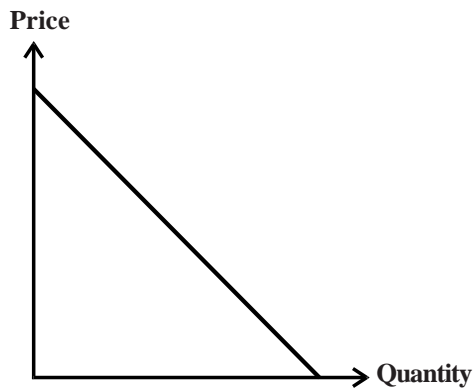
3.2 OPPORTUNITY SET

A set is a collection of distinct or well defined objects like (5, 6, 7) or (a, b, c). For example listing of all residents of Delhi or all animals in a zoo is difficult. Thus a set is also formed by developing a criterion for membership. For example the set of all positive numbers between 1 and 10 or set of all points lying on the line $x + y = 4$.

In managerial economics the need is to define an opportunity set of a decision maker, i.e., the set of alternative actions which are feasible. For example, the opportunity set of a consumer is the set of all combinations of goods which the consumer can buy with his given income. Given the consumer's budget and prices of all goods, the opportunity set is well defined, and we can find out whether the

1. Demand (Linear)

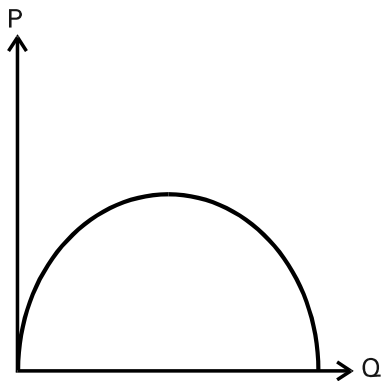
Figure 3.6



LINEAR
 $Q = a - bP$
 $P = a + bQ$

2. Total Revenue (Quadratic)

Figure 3.7

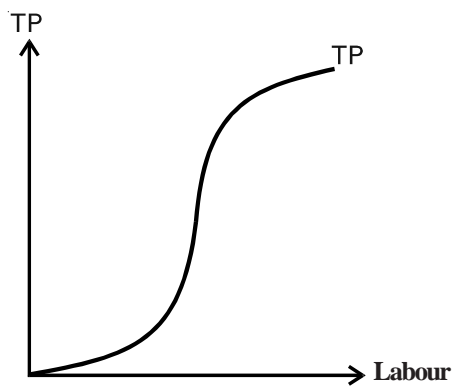


$$TR = a + bQ - CQ^2$$

(a = 0)

3. Production (Short run) (Cubic)

Figure 3.8

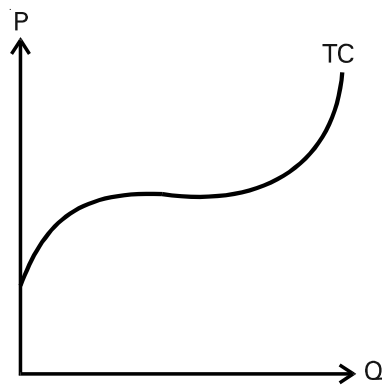


$$TP = a + bL + cL^2 - dL^3$$

(a = 0)

4. Cost (Short run) (Quadratic)

Figure 3.9

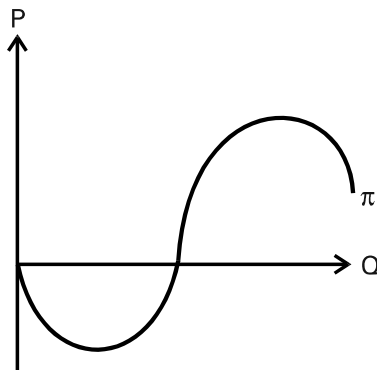


$$TC = a + bQ + cQ^2 - dQ^3$$

(a = 0)

5. Profit (Short run) (Quadratic)

Figure 3.10



$$T = a + bQ + cQ^2 + dQ^3$$

(a < 0)

3.4 DERIVATIVES

The “slope” in mathematical use is the concept of ‘marginalism’ in economic use. Thus if $Y=Y(x)$, dy/dx stands for change in Y as a result of one unit change in X , i.e. marginal y of x . This slope or marginal function has enormous use in managerial economics. Thus,

Marginal demand of price, when $Q = Q(P)$

$$\frac{dS}{dA} = \text{Marginal sales of advertisement, when } S=S(A)$$

$$\frac{dR}{dQ} = \text{Marginal revenue of output, when } R=R(Q)$$

$$\frac{dC}{dQ} = \text{Marginal cost of output, when } C=C(Q)$$

In case of ‘averages’

Average demand

$$\frac{S}{A} = \text{Average sales}$$

$$\frac{R}{Q} = \text{Average revenue}$$

$$\frac{C}{Q} = \text{Average costs}$$

When marginal concept is divided by corresponding average concept, we get the measure of economic concept of elasticity.

$$\frac{dQ}{dP} * \frac{P}{Q} = \text{Price elasticity of demand}$$

$$\frac{dC}{dQ} * \frac{Q}{C} = \text{Output elasticity of cost}$$

$$\frac{dS}{dA} * \frac{A}{S} = \text{Advertisement elasticity of sales revenue}$$

Thus, such elasticities measure the proportion of change, e.g., if the percentage change in demand is greater than the percentage change in price, then

$$\left[\frac{dQ}{dP} * \frac{P}{Q} \right] > 1 \text{ is elastic demand.}$$

$$\left[\frac{dQ}{dP} * \frac{P}{Q} \right] < 1 \text{ is inelastic demand.}$$

$$\left[\frac{dQ}{dP} * \frac{P}{Q} \right] = 1 \text{ is unitary elastic demand and so on.}$$

Elasticity is discussed in detail in Block 2.

The standard rules of differentiation in calculus are given in Appendix.

3.5 PARTIAL DERIVATIVES

In managerial economics, usually a function of several independent variables is encountered instead of a single variable case shown above. For example, a consumer's demand for a product depends on the price of the product, price of other related goods, income, tastes, etc. When price changes, the effect on quantity demanded of the goods can be analysed only when all other variables are kept constant. The functional relationship that is obtained between the quantity demanded of a product and its own price is called a Partial Function (a function of one variable when all other variables are kept constant). The derivative of the partial functions are known as partial derivatives of the original function and is shown as df/dx_1 or $f_1(x)$ or $f'(x)$. The conventional symbol used in maths for the partial derivative is delta, δ . Partial derivatives are functions of all variables entering into the original function $f(x)$.

Examples:

$$(i) \text{ if } Y = f(x_1; x_2) x_1^2 x_2^2$$

$$\text{Then } \frac{\delta y}{\delta x_1} = 2x_1 x_2^2$$

$$\text{And } \frac{\delta y}{\delta x_2} = x_1^2 2x_2 = 2x_2 x_1^2$$

$$\begin{aligned} \text{(ii) If } Y &= \sqrt{x_1 x_2} = (x_1 x_2)^{1/2} = x_1^{1/2} x_2^{1/2} \\ &= x_1^{1/2} x_2^{1/2} \end{aligned}$$

$$\text{Then } \frac{\delta y}{\delta x_1} = \frac{1}{2} x_1^{-1/2} x_2^{1/2} = \frac{1}{2} \frac{x_2^{1/2}}{x_1^{1/2}} = \frac{1}{2} \sqrt{\frac{x_2}{x_1}}$$

$$\text{And } \frac{\delta y}{\delta x_2} = \frac{1}{2} x_1^{1/2} x_2^{-1/2} = \frac{1}{2} \frac{x_1^{1/2}}{x_2^{1/2}} = \frac{1}{2} \sqrt{\frac{x_1}{x_2}}$$

$$\text{(iii) If } Z = 4x^2 + 3xy + 5y^2$$

$$\text{Then } \frac{\delta Z}{\delta y} = 8x + 3y$$

$$\text{Then } \frac{\delta Z}{\delta x} = 3x + 10y$$

Remember the derivative of a constant is 0, i.e., $\delta z/\delta x$ of $5y^2$ is 0. Thus in the above equation while calculating dz/dy we hold x constant and hence $\delta z/\delta x$ of $4x^2$ is 0. This gives $\delta z/\delta x$ to be $8x + 3y$; and $\delta z/\delta x$ to be $3 + 10y$.

$$\frac{\delta f}{\delta x}, \frac{\delta f}{\delta y}, \frac{\delta y}{\delta x}, \frac{\delta f}{\delta x_2}, \text{ are called first order partial derivatives.}$$

The second order partial derivatives indicate that the function has been differentiated partially twice with respect to a given variable, all other variables being held constant. These are shown (in case of function $Z = f(x, y)$ by

$\frac{\delta^2 f}{\delta x^2}$ or f_{xx} and $\frac{\delta^2 f}{\delta y^2}$. Thus $\frac{\delta^2 f}{\delta x^2}$ shows the rate of change of first order partial derivatives f_x with respect to x with y held constant.

Similarly $\frac{\delta^2 f}{\delta y^2}$ is the second order partial derivative of the function with respect to y with x held constant.

3.6 OPTIMISATION CONCEPT

Optimisation is the act of choosing the best alternative out of the available ones. It describes how decisions or choices among alternatives are taken or should be made. All such optimisation problems have 3 elements:

- a) **Decision Variables:** These are variables whose optimal values have to be determined. For example, a production manager wants to know at what level to set output in order to achieve maximum profit or maximum sales revenue. Here output is the decision or choice variable. Similarly labour, machine, time and raw materials are choice variables if a works manager wants to know what amount of these are to be used so as to produce a given output level at minimum cost. The quantity of any choice variable must be measurable (20kg, 5 labourers, 10 hours, etc.).

- b) **The Objective Function:** It is a mathematical relationship between the choice variables and some variables whose values are to be maximised or minimised. For example, the objective function could relate profit to level of output or cost to amount of labour, machine, time, raw materials, etc. in the above example.
- c) **The Feasible Set:** The available set of alternatives is called a feasible set.

A solution to an optimisation problem is that set of values of the choice variables which is in the feasible set and which yields maximum or minimum of the objective function over the feasible set.

Unconstrained Optimisation Technique

For unconstrained optimisation problem involving single independent variable, we need to satisfy some “conditions”. In economics, the necessary (first order) condition is called the equilibrium condition and sufficient (second order) condition is called the stability condition (continuation of state of equilibrium). There may be equilibrium but it may not be stable. Thus first order condition does not guarantee second order condition. This is summarised in Table 3.1.

Table 3.1: Optimisation Conditions

Order	Conditions	Optimisation	Unconstrained
First order	Necessary Conditions	Maximisation $\frac{\delta y}{\delta x} = 0$	Maximisation $\frac{\delta Y}{\delta X} = 0$
Second order	Sufficient Conditions	$\frac{\delta^2 y}{\delta x^2} < 0$	$\frac{\delta^2 y}{\delta x^2} > 0$
	$Y = y(x)$ (assumed)		

Some economic uses of these conditions are discussed below. Given a firm's demand function, $P = 45 - 0.5Q$ and the average cost function, $AC = Q^2 - 8Q + 57 + 2/Q$, we have to find the level of output Q which

- maximises total revenue
- maximises profits.

Solution

- a) Since demand function is $P = 45 - 0.5Q$ the total revenue function will be,
 $TR = PQ = (45 - 0.5Q)Q = 45Q - 0.5Q^2$

To maximise TR, we find the derivative and set it to 0 (the first order or necessary condition)

$$\begin{aligned} \text{Now, } \frac{dR}{dQ} &= 45 - 2(0.5)Q \\ &= 45 - Q = 0 \\ &\therefore Q = 45 \end{aligned}$$

The second order condition (sufficient condition) needs $\frac{d^2R}{dQ^2}$ to be negative

$$\text{Since } \frac{dR}{dQ} = 45 - Q$$

$$\therefore \frac{d^2R}{dQ^2} = -1$$

which is negative. Hence total revenue is maximised when output is 45 units.

b) From profit function

$$p = TR - TC$$

$$TC = (AC) \times Q$$

$$= (Q^2 - 8Q + 57 + 2/Q) Q = Q^3 - 8Q^2 - 57Q + 2$$

$$TR = (45 - 0.5 Q)Q$$

$$= 45 Q - 0.5 Q^2$$

After substituting TR and TC, we get

$$p = 45Q - 0.5Q^2 - Q^3 + 8Q^2 - 57Q - 2$$

$$\frac{dp}{dQ} = 45 - Q - 3Q^2 + 16Q - 57$$

$$= -3Q^2 + 15Q - 12$$

$$\text{Now set } \frac{d\pi}{dQ} = 0$$

$$-3Q^2 + 15Q - 12 = 0$$

dividing by -3

$$Q^2 - 5Q + 4 = 0$$

$$\text{or } (Q - 4)(Q - 1) = 0$$

$$\therefore Q = 4 \text{ or } 1$$

Constrained Optimisation Technique

There are many situations where the objective function has to be maximised or minimised subject to certain constraints present in the problem. Thus a consumer may be maximising utility subject to the income constraint.

The techniques used to analyse such problems are based on that used for unconstrained problems. The constrained problem is converted into unconstrained one with the help of Lagrange Multiplier Technique and then the latter is solved. In this technique, the objective function and constraint is combined in one expression (Lagrange expression) such that the constrained maximisation or minimisation problems are reduced to unconstrained ones.

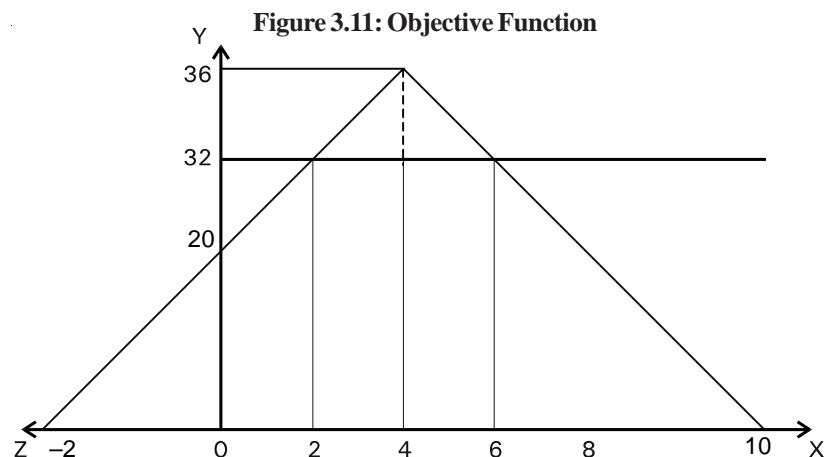
For example,

$$\text{Maximise } Y = -x^2 + 8x + 20$$

$$\text{subject to } x \leq 2$$

(function of single independent variable)

The objective function (function to be optimised) is $Y = -x^2 + 8x + 20$, plotted on graph:



The objective function $y = -x^2 + 8x + 20$ can be written as $y = -(x-4)^2 + 36$

Now $-(x-4)^2$ has an unconstrained maximum value of zero at $x = 4$. However, our objective function is $-(x-4)^2 + 36$, and hence will have an unconstrained maximum of 36 (at $x=4$). This is so for the first derivative test

The second derivative test $\frac{d^2y}{dx^2}$ gives -2 since $\frac{dy}{dx} = 2x + 8$ $\frac{dy}{dx} = -2x + 8$ $\frac{d^2y}{dx^2} = -2$

Thus both tests give $x=4$ as the value of the variable. This is the value at which the objective function attains unconstrained maximum. However, the problem has a constraint $x=2$. Thus we have to consider the function only up to value of $x=2$ (graph) starting from $x=-2$. The maximum value of the function is then 32 which occurs when $x=2$. Thus the constrained maximum of the function $y = -(x-4)^2 + 36$ with constraint $x=2$ would occur at $x=2$ and not $x=4$.

The Lagrange expression for constrained maximisation is formed as follows

$Y = -(x-4)^2 + 36$ with constraint $x=2$ or $x-2=0$.

Combining, we get the Lagrange expression $L = [-(x-4)^2 + 36] + \lambda (x-2)$.

adding objective function and product of λ (Lagrange Multiplier) and the constraint function $x-2=0$. Now L is a function of x and λ .

We find

$\frac{\delta L}{\delta x}$ and $\frac{\delta L}{\delta \lambda}$ set them to 0

$$\frac{\delta L}{\delta \lambda} = -2(x-4) + \lambda = 0$$

$$\frac{\delta L}{\delta x} = (x-2) = 0$$

The last equation gives $x=2$. Hence the constrained maximum occurs at $x=2$.

In this problem $\lambda = 2(x-4) = 2(2-4) = -4$

When applying Lagrange technique to solve economic decision problem, λ will have an economic significance. For example in consumer's utility maximising problem (where quantities of commodities are choice problems), λ will be the marginal utility of money income. In producer's cost minimisation problem, λ will be the marginal cost of production. In complex problems, as many λ 's as many there are constraints have to be used.

The problem with two independent variables can also be solved with Lagrangian technique. To find out whether the optimised value is maximum or minimum however, requires second derivative test as well as use of some more determinants not to be discussed here.

Activity 1

a) Draw graph of the following functions:

i) $Q = 10 - 0.4 P$

ii) $Q = 15 - 2P + 4P^2$

iii) $C = 100 + 0.8 Y$

- b) A firm's fixed costs are Rs. 6000.00 regardless of output (they do not change when output changes)-, variable cost is Rs. 5 per unit of output (variable cost is dependent on output). Total cost = fixed costs + variable costs. The selling price of the goods is Rs. 100 per unit. Let Q be the output. State the
- Firms fixed cost function
 - Variable cost function
 - Total cost function
 - Total revenue function
- c) Maximise $Z = 10xy - 2y^2$
subject to $x + y = 12$
- d) Maximise $R = 737 - 8Q^2 + 14A + QA - 4a^2 + 20Q$
Subject to $2Q + A = 2$.

Answers:

- c) $x = 7, y = 5, l = -50$
d) $Q = 0.52, A = 0.96, l = -6.36$

3.7 REGRESSION ANALYSIS

A manager must often determine the total cost of producing various levels of output. The relation between total cost (C) and quantity (Q) is,

$$C = a + bQ + cQ^2 + dQ^3$$

Where a, b, c and d are parameters of the equation. Parameters are coefficients in an equation that determine the exact mathematical relation among the variables in the equation. If the numerical values of parameters are determined, the manager knows the quantitative relation between output and total cost. If the value of parameters of cost equation are calculated to be $a = 1262, b = 1, c = -0.03$ and $d = 0.005$, the equation becomes,

$$C = 1262 + 1Q - 0.03Q^2 + 0.005Q^3$$

This equation can be used to compute the total cost of producing various levels of output. If, for example, the manager wishes to produce 30 units of output, the total cost can be calculated as

$$C = 1262 + 30 - 0.03(30)^2 + 0.005(30)^3 = \text{Rs. } 1400.$$

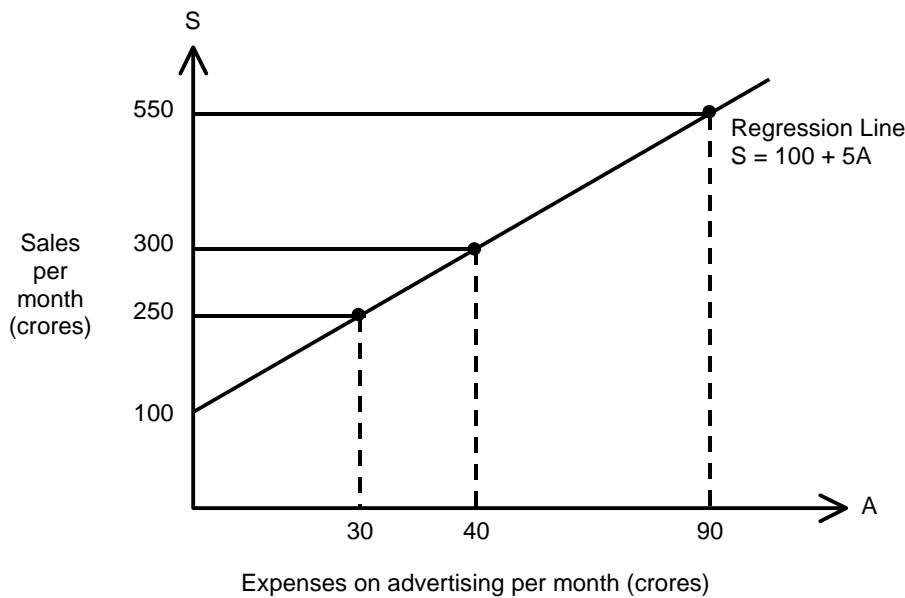
Thus, in order for the cost function to be useful for decision making, the manager must know the numerical value of the parameters.

The values of the parameters are often obtained by using a technique called regression analysis. It determines the mathematical relation between a dependent variable and one or more explanatory variables.

- *Dependent variable:* The variable whose variation is to be explained.
- *Explanatory variables:* The variables that are thought to cause the dependent variable to take on different values.

In the simple regression model, the dependent variable Y is related to only one explanatory variable X, and the relation between X and Y is linear:

$$Y = a + bX$$



This is the equation for a straight line, with X plotted along the horizontal axis and Y along the vertical axis. The parameter a is called the intercept parameter because it gives the value of Y at the point where the regression line crosses the Y-axis. (X is equal to zero at this point). The parameter b is called the slope parameter because it gives the slope of the regression line. The slope of a line measures the rate of change in Y as X changes (DY/DX); it is therefore the change in Y per unit change in X.

Intercept parameter: The parameter that gives the value of Y at the point where the regression line crosses the Y-axis.

Slope parameter: The slope of the regression line, $b = \frac{\Delta Y}{\Delta X}$, or the change in Y associated with a one-unit change in X.

Y and X are linearly related in a regression model. The effect of change in X on the value of Y is constant. A one-unit change in X causes Y to change by a constant b units.

The figure shows the true relation between sales and advertising expenditures. If a firm chooses to spend nothing on A, its sales are expected to be 100 crores per month. If the firm spends 30 crores on A then it can expect sales of 250 crores ($=100 + 5 \times 30$). $\frac{\Delta S}{\Delta A} = 5$, i.e., for every 1 unit increase on advertising, the firm can expect a 5 unit increase in sales. Regression involves identifying and calculating specific relationships between the independent variables and the dependent variable. It involves a number of stages which are described in another section.

Activity 2

- a) The slope parameter is and the intercept parameter is in the equation $R = a + bW$.
- b) In Figure 3.12, what will be the monthly sales of the firm, if the advertising expenditure is increased from 30 crores to 40 crores per month?

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.....

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.....

3.8 SPECIFYING THE REGRESSION EQUATION

The first thing that the organisation carrying out the regression analysis needs to do is to determine the range of variables which may affect demand for the product concerned. For example, the own price of a good might reasonably be expected to be a determinant of demand for most products, as would any advertising being done by the firm. The question of whether there are any substitute or complementary goods which need to be taken into account could then be raised. In the case of, an expensive consumer durable good, the cost and availability of credit might be a consideration. Any special 'other' factors affecting demand could then be identified and so on. This choice of variables has to be made before it is possible to progress to the next stage.

Data Collection

Once the relevant variables have been identified, quantitative data need to be assembled for each of them. This will be easier for some of the variables than for others. In dealing with an established product, for example, the firm might reasonably be expected to have access to a range of information regarding the variables which it controls such as own price and advertising. What may be more difficult to obtain, however, is information about competitors' products. On this front, price data can be obtained through observing retail prices, as this information by definition is in the public domain and cannot be hidden. This requires continued market observation, perhaps over a long period of time. Likewise, information about product design changes can be obtained by buying the competitors' product(s), but this may be expensive if there are many on the market. Confidential, commercially sensitive information such as actual advertising expenditure by competitors and their proposed new products present much more difficult problems in terms of access and may have to be left out of the process altogether. Data on levels of disposable income, population variables, interest rates and credit availability are easier to obtain, for example from government statistics, but other variables are more problematic. How can things like expectations and tastes be measured for instance? In these cases the available data, perhaps resulting from market surveys, may be qualitative rather than quantitative. Some means of conversion need to be found if they are to be included in the regression analysis at all. These are the things which the decision maker needs to keep in mind while collecting and selecting data on the relevant variables. Once the first two steps have been completed, the next stage is to specify the likely form of the regression equation. There are two main forms which are used in practice -the linear demand function and the non-linear or power function. Both treat the demand for the product as the dependent variable, while the independent variables are those which have previously been identified as having an effect on demand. If, for example, the firm had decided that the only variables affecting demand for a particular product with its own price and advertising levels then the linear demand function would be written as:

$$Q = a + bP + cA$$

Alternatively, under these conditions the exponential (power) function would be written as:

$$Q = a P^b A^c$$

In each case, the a term represents the intercept of the-line drawn from the equation with the vertical axis. The b and c terms represent the regression coefficients with respect to own price and advertising respectively. These show the impact of each of these variables on product demand. Once they have been estimated it is possible to predict the level of demand for any set of values of the independent variables simply by substituting them into the equation.

The exponential form of the equation has the advantage that it can be rewritten to give direct estimates of the respective elasticities of demand for the independent variables. This is done by taking the log-linear form of the equation which in this case would be:

$$\log Q = \log a + b \log P + c \log A$$

Where b and c are the own price and advertising elasticities of demand respectively. This is a much easier approach than calculating elasticities through use of the linear form which involves using the equation:

$$ED = b \quad .$$

to calculate the elasticities in each case. In this case values of P and Q need to be obtained from the data set. Usually average values are substituted in the above equation to estimate elasticities. This idea will be explored in greater detail in Block 2.

Which of the two forms of equation is chosen depends upon the expected relationship between the variables being included. In practice, however, the actual relationship between them may not be known in advance. In this case, the decision maker may experiment with both forms of equation in order to find the one which most closely fits the data.

Activity 3

1. What are the things which the decision maker needs to keep in mind while collecting and selecting data on the relevant variables?

.....

2. Show that estimated coefficients using a log-linear technique are estimates of elasticity with respect to the relevant variable.

.....

3.9 ESTIMATING THE REGRESSION EQUATION

Consider a firm with a fixed capital stock that has been rented under a long-term lease for Rs. 100 per production period. The other input in the firm’s production process is labour, which can be increased or decreased quickly depending on the firm’s needs. In this case, the cost of the capital input (Rs.100) is fixed and the cost of labour is variable. The manager of the firm wants to know the relationship between output and cost, that is, the firm’s total cost function. This would allow the manager to predict the cost of any specified rate of output for the next production period.

Specifically, the manager is interested in estimating the coefficients a and b of the function

$$Y = a + bX$$

where the dependent variable Y is total cost and the independent variable X is total output. If this function is plotted on a graph, the parameter a would be the vertical intercept (i.e., the point where the function intersects the vertical axis) and b would be the slope of the function. Recall that the slope of a total function is the marginal function. As $Y = a + bX$ is the total cost function, the slope, b, is marginal cost or the change in total cost per unit change in output.

Assume that data on cost and output have been collected for each of seven production periods and are reported in Table 3.2. Note that there is a cost of Rs. 100 associated with an output rate of zero. This represents the fixed cost of the capital input, which must be paid regardless of the rate of output. These data are shown as points in Figure 3.1. They suggest a definite upward trend, but they do not trace out a straight line. The problem is to determine the line that best represents the overall relationship between Y and X. One approach would simply be to “eyeball” a line through these data in a way that the data points were about equally spaced on both sides of the line. The coefficient a would be found by extending that line to the vertical axis and reading the Y-coordinate at that point. The slope, b, would be found by taking any two points on the line, $\{X_1, Y_1\}$ and $\{X_2, Y_2\}$ and using the slope formula

$$b = \frac{Y_2 - Y_1}{X_2 - X_1}$$

Although this approach could be used, the method is quite imprecise and can be employed only when there is just one independent variable. What if production cost depends on both the rate of output and the size of the plant? To plot the data for these three variables (total cost, output, and plant size) would require a three-dimensional diagram; it would be nearly impossible to eyeball the relationship in this case. The addition of another independent variable, say average skill levels of the employees, would place the data set in the fourth dimension, where any graphic approach is hopeless.

Table 3.2: Hypothetical Data on Total cost and Total Output

Production period	Total Cost (Yi) Rs.	Total Output (Xi)
	100	0
	150	5
	160	8
	240	10
	280	15
	370	23
	410	25

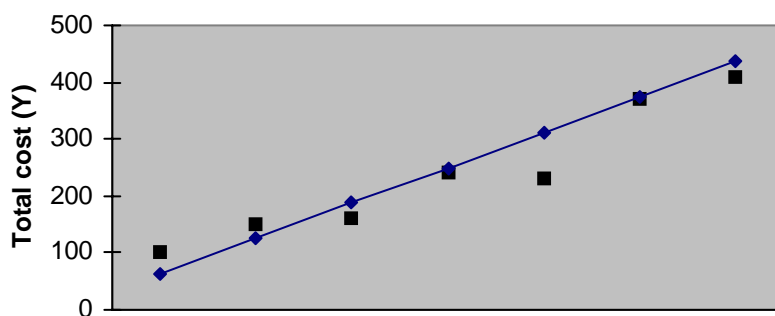
There is a better way. Statisticians have demonstrated that the best estimate of the coefficients of a linear function is to fit the line through the data points so that the sum of squared vertical distances from each point to the line is minimized. This technique is called ordinary least-squares regression (OLS) estimation and a number of statistical packages, including excel. Based on the output and cost data in Table 3.1, the least-squares regression equation will be shown to be

$$\hat{Y} = 87.08 + 12.21X$$

This equation is plotted in Figure 3.13. Note that the data points fall about equally on both sides of the line. Consider an output rate of 5. As shown in Table 3.2, the actual cost associated with this output level is 150. The value predicted by the regression equation, referred to as \hat{Y} , is 148.13. That is, $\hat{Y} = 87.08 + 12.21(5) = 148.13$. The deviation of the actual Y value from the predicted value (i.e., the

vertical distance of the point from the line), $\hat{Y}_i - Y_i$ is referred to as the residual or the prediction error.

Figure 3.13: Total Cost, Total Output and Estimated Regression Equation



There are many values that might be selected as estimators of a and b, but only one of those sets defines a line that minimizes the sum of squared deviations [i.e., that minimizes $\sum(Y_i - \hat{Y}_i)^2$]. The equations for computing the least-squares estimators and \hat{b} are

=

and

$$\hat{a} = \bar{Y} - \hat{b} \bar{X}$$

where \bar{Y} and \bar{X} are the means of the Y and X variables.

Using the basic cost and output data from the example, the necessary calculations are shown in table 3.3. Substituting the appropriate values into the following equations, the estimates \hat{a} of \hat{b} and are computed to be

$$\hat{b} = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sum (X_i - \bar{X})^2} = 12.21$$

=

Table 3.3: Summary Calculation for Computing the Estimates \hat{a} and \hat{b}

Cost (Y_i)	Output (X_i)	$Y_i - \bar{Y}$	$X_i - \bar{X}$	$(X_i - \bar{X})^2$	$(X_i - \bar{X})(Y_i - \bar{Y})$
100	0	-137.14	-12.29	151.04	1,685.45
150	5	-87.14	-7.29	53.14	635.25
160	8	-77.14	-4.29	18.40	330.93
240	10	-002.86	-2.29	5.24	-6.55
230	15	-7.14	2.71	7.34	-19.35
370	23	132.86	10.71	114.70	1,422.93
410	25	172.86	12.71	161.54	2,197.05
$\bar{Y} = 237.14$	$\bar{X} = 12.29$			$\sum (X_i - \bar{X})^2 = 511.40$	$\sum (X_i - \bar{X})(Y_i - \bar{Y}) = 6,245.71$

Thus the estimated equation for the total cost function is

$$\hat{Y} = 87.08 + 12.21X$$

The estimate of the coefficient a is 87.08. This is the vertical intercept of the regression line. In the context of this example, $\hat{a} = 87.08$ is an estimate of fixed cost. Note that this estimate is subject to error because it is known that the actual fixed cost is Rs.100. The value of \hat{b} is an estimate of the change in total cost for a one-unit change in output (i.e., marginal cost). The value of \hat{b} , Rs. 12.21, means that, on an average, a one-unit change in output results in Rs. 12.21 change in total cost. Thus \hat{b} is an estimate of marginal cost.

Activity 4

Suppose, for example, that the estimation process had given the following figures for the coefficients:

$$\log QD = \log 200 - 1.5 \log P + 2.4 \log A$$

where QD is quantity demanded
P is own price and
A is advertising expenditure

What can we deduce from the estimated equation?

.....

.....

.....

.....

.....

3.10 DECISION UNDER RISK

The focus of this section is decision making under risk. The objective will be to develop guidelines for making rational decisions given the decision makers attitudes towards risk Attitudes towards risk may be of three types: (a) A *risk-seeker* is one who prefers risk, given a choice between more or less risky investments, with identical expected money returns; he will select the riskier investment. (b) A *risk-averter* is one who faced with the same situation will select the less risky investment. (c) A *risk-neutral* person is one who faced with the same situation will be indifferent to the choice. For him any investment is equally preferable to the other. It is difficult to slot people in one of these categories. You would perhaps have observed both risk averse and risk seeking behaviour in the real world.

The analysis of risk is based largely on the concepts of probability and probability distribution that are commonly encountered in elementary statistics. First the terms strategy, states of nature and outcomes need to be defined. A strategy is one of the many alternative plans or courses of action that could be implemented in order to achieve managerial goal. A manager might be considering three strategies to increase profits - build a more modern plant which may produce at low cost, implement a new marketing programme to increase sales or change the design of product to decrease cost and increase sales.

A state of nature is a condition that may exist in the future and that will have a significant effect on the success of a strategy. For example, the manager may not be aware of the economic conditions in the future. The possible states of nature may be normal, recession or boom.

The outcome results in either gain or loss based on a particular combination of strategy and state of nature. The decision maker has no control over the states of nature that will prevail in future but the future states of nature will certainly affect the outcome of any strategy that he or she may adopt. The particular decision

made will depend, therefore, on the decision maker's knowledge or estimation of how a particular future state of nature will affect the outcome of each particular strategy.

Given a set of outcomes, X_i , and the probability of each occurring, P_i , three statistics relating to probability distributions can be used

- The expected value or mean is a measure of expected return. This is represented by

$$\mu = \sum_{i=1}^n P_i(X_i)$$

where P_i is the probability and X_i is the outcome.

- The standard deviation is a measure of risk. This is represented by

$$\sigma = \sqrt{\sum_{i=1}^n P_i(X_i - \mu)^2}$$

- The coefficient of variation is a measure of risk per unit of money of return.

These statistics have a direct application in measuring the expected return and risk associated with any business decision for which a set of outcomes and their probabilities have been determined. The expected value, standard deviation, and the coefficient will be referred to as risk-return evaluation statistics.

Having defined risk and reviewed some of the related terminology, the task now is to develop quantitative measures of return and risk and to show how they are applied in decision making. We know that individuals have different preferences concerning risk taking. It is also important that such preferences be identified and their effect on decisions evaluated. Rational decision making requires that the expected return be determined and the risk be measured, and that there be information about the manager's preference for risk. The expected value, the standard deviation, and the coefficient of variation will be referred to as risk-return evaluation statistics.

Let us take an example where two investments, I and II, are being considered. Both investments require an initial cash outlay of Rs.100 and have a life of five years. The return on each depends on the rate of inflation over the five-year period. Of course, the inflation rate is not known with certainty, but suppose that the collective judgment of economists is that the probability of no inflation is 0.20, the probability of moderate inflation is 0.50, and the probability of rapid inflation is 0.30. The outcomes are defined as the present value of net profits for the next five years. These outcomes for each state of nature (i.e., rate of inflation) for each investment are shown in table 3.3.

Analysis of these investments can be made by calculating and comparing the three evaluation statistics for each alternative. The expected value μ is an estimate of the expected return for the investment. Because risk has been defined in terms of the variability in outcomes, the standard deviation s is a measure of risk associated with the investment. The larger the m the greater is the risk. Risk per rupee of expected return is measured by the coefficient of variation (y).

The evaluation statistics for each investment alternative are computed as follows:

$$\mu_1 = \sum_{i=1}^n P_i X_i = 0.2(100) + 0.5(200) + 0.3(400) = 240$$

$$\sigma_I = \sqrt{\sum_{i=1}^n P_i (X_i - \mu)^2} = \sqrt{0.2(100 - 240)^2 + 0.5(200 - 240)^2 + 0.3(400 - 240)^2}$$

$$= 111.36$$

$$v_I = \frac{\sigma_I}{\mu_I} = \frac{111.36}{240} = 0.46$$

$$\mu_{II} = 0.2(150) + 0.5(200) + 0.3(250) = 205$$

$$\sigma_{II} = \sqrt{0.2(150 - 205)^2 + 0.5(200 - 205)^2 + 0.3(250 - 205)^2} = 0.35$$

$$v_{II} = \frac{35.00}{205} = 0.17$$

The expected return for investment I of Rs.240 is higher than for II (Rs.205), but I is a riskier investment because $s_I = 111.36$ is greater than $s_{II} = 0.35$. Also, risk per dollar of expected returns for I ($v_I = 0.46$) is higher than for ($v_{II} = 0.17$). Which is the better investment? The choice is not clear. It depends on the investor's attitude about taking risks. A young entrepreneur may well prefer I, whereas an older worker investing in a retirement account where risk ought to be minimized might prefer II. Generally higher returns are associated with higher risk.

Table 3.3: Probability Distribution for Two Investment Alternatives

<i>State of Nature</i>	<i>Probability (P_i)</i>		<i>Outcome(X_i)</i>
<i>Investment I</i>			
No inflation	0.20		100
Moderate inflation	0.50		200
Rapid inflation	0.30		400
<i>Investment II</i>			
No inflation	0.20		150
Moderate inflation	0.50		200
Rapid inflation	0.30		250

Decision Tree

Some strategic decisions are based on a sequence of decisions, states of nature and possibly even strategic decisions. Alternative strategies can be evaluated then, by using a decision tree, which traces sequences of strategies and states of nature to arrive at a set of outcomes. The probability of each outcome is found by multiplying the probabilities on each branch leading to that outcome.

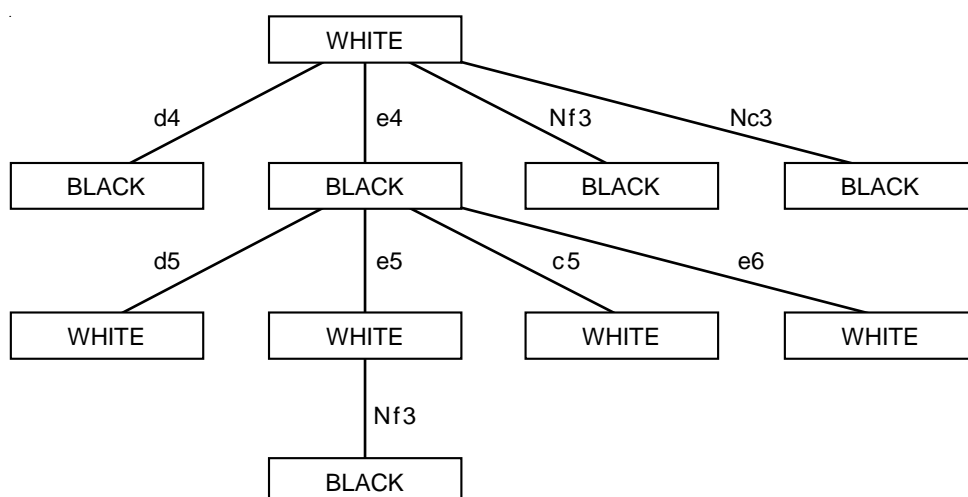
A decision tree shows two or more branches at each point where a decision or event (state of nature) leads to the various outcomes. The decision tree approach can be directly applied to managerial decision-making. A firm entering a new market may decide to build a small or large plant (managerial decisions). This has no probabilities. But there may be stochastic elements (an outcome determined by chance) associated with each decision e.g., reaction of a major competitor and the economic condition. The competitor may react by starting a national, regional, or a new advertising program. The probability of each occurrence will depend on the size of the plant.

The possible economic conditions and then probabilities may be recession, normal or boom. Here also the probability will depend on the size of the plant. The probability of each combination is found by multiplying the probability along each of the branches leading to the outcome. For example, if the manager decides to build a large plant there is a 70 per cent chance that the competitor will respond with a

national advertisement. We are given that there is a 30 per cent chance of a boom. The probability associated with the outcome of 80 is therefore 0.21 (=0.7*0.3). Similar for other entries in the decision tree.

Decision trees are particularly useful if sequential decision-making is involved. In a game of chess, white has the first move. White has several options at this stage. To keep the problem tractable, let us assume that there are four possible moves for white : (i) move the king’s pawn two squares; (ii) move the queen’s pawn two squares; (iii) move the king’s knight to king bishop three; and (iv) move the queen’s knight to queen bishop three. In chess notation, the four moves are - (i) e4; (ii) d4; (iii) Nf3; and (iv) Nc3. Once white has made the first move, Black has several different moves at his disposal. To keep the problem tractable, let us follow the decision tree only when white has moved e4. Even then, Black has several moves at his disposal. Let us assume that he has only four options - (i) move the king’s pawn two squares (e5), (ii) move the queen’s pawn two squares (d5); (iii) move the queen’s bishop’s pawn two squares (c5); and (iv) move the king’s pawn one square (e6). Once white has moved e4 on the first move and Black has moved e5 on the first move, white has several moves at his disposal. One of them is, move the king’s knight to bishop three (Nf3). And so the game goes on.

Figure 3.17: Decision Tree



Each vertex or node indicates a decision to be taken by one of the players, the number within the rectangle indicating whose turn it is to move. There need not actually be two players, one of the players can be regarded as nature or chance. The main advantage of using a decision tree is that it helps one to isolate each chain and follow it through to the very end.

3.11 UNCERTAINTY ANALYSIS AND DECISION MAKING

Certainty appears to be a theoretical and impractical state, as here the investor has perfect knowledge of the investment environment such that he is definite about the size, regularity and periodicity of flow of returns. Such situations may exist in the short-run (e.g. fixed deposit in a nationalised bank). However, long-run or long-range investments are not predictable as they are influenced by many kinds of changes taking place with time: political, economic, market and technology etc.

Risk is more common in the real world. A situation with more than one possible outcome to a decision such that the probability of each of these outcomes can be measured is a risk situation. For example, tossing of a coin (i.e. 50-50) or investing

in a stock. The greater the number and range of outcomes, the greater is the risk associated with the decision or action. Uncertainty is a situation where there is more than one possible outcome to a decision but the probability of each specific outcome occurring is not known or even meaningful. This may be due to insufficient information or instability in the nature of variables. In extremes cases of uncertainty, the outcomes may itself be not clear. Decision making under uncertainty is necessarily subjective.

The Risk Faced by Coca Cola in changing its secret formula.

On April 23, 1985, the Coca Cola Company announced that it was changing its 99-year old recipe for Coke. Coke is the leading soft drink in the world, the company took an unusual risk in tempering its highly successful product. The Coca Cola Company felt that changing its recipe was a necessary strategy to ward off the challenge from Pepsi - Cola, which had been chipping away at Coke's market over the years. The new Coke, with its sweeter less fizzy taste, was clearly aimed at reversing Pepsi's market gains. Coca Cola spent over \$. 4 million to develop its new Coke and conducted taste tests on more than 1,90,000 consumers over a three-year period. These seemed to indicate that consumers preferred the new Coke by 61 percent i.e. 39 percent over the old Coca Cola - Cola then spent over \$ 10 million on advertising its new product.

When the new Coke was finally introduced in May 1985, there was nothing short of a consumers' revolt against the new Coke, and in what is certainly one of the most stunning multimillion dollar about faces in the history of marketing, the company felt compelled to bring back the old Coke under the brand name of Coca Cola Classic. The irony is that with the Classic and new Cokes sold side by side, Coca Cola regained some of the market share that it had lost to Pepsi. While some people believe that Coca-Cola intended all along to reintroduce the old Coke and that the whole thing was part of a shrewd marketing strategy, yet most marketing experts are convinced that Coca Cola had underestimated consumers' loyalty to the old Coke. This did not come up in the extensive taste-tests conducted by Coca-Cola because the consumers tested were newer informed that the company intended to "replace" the old Coke with the new Cola, rather than sell them side by side. This case clearly shows that even a well conceived strategy is risky and can lead to results estimated to have a small probability of occurrence. Indeed, the failure rate for new products in the United States is a stunning 80 percent.

3.12 ROLE OF MANAGERIAL ECONOMIST

In general, managerial economics can be used by the goal-oriented manager in two ways. First, given an existing economic environment, the principles of managerial economics provide a framework for evaluating whether resources are being allocated efficiently within a firm. For example, economics can help the manager if profit could be increased by reallocating labour from a marketing activity to the production line. Second, these principles help the manager to respond to various economic signals. For example, given an increase in the price of output or the development of a new lower-cost production technology, the appropriate managerial response would be to increase output. Alternatively, an increase in the price of one input, say labour, may be a signal to substitute other inputs, such as capital, for labour in the production process.

Thus, the working knowledge of the principles of managerial economics can increase the value of both the firm and the manager.

3.13 SUMMARY

Various quantitative tools are used by the manager to help him in making decisions. An opportunity set is a set of alternative actions which are feasible. Variables are things which can change and can take a set of possible values within a given problem. A function shows the relation between two variables. It can take different forms-linear, quadratic, cubic. Partial derivatives are functions of all variables entering into the original function $f(x)$. Optimisation is the act of choosing the best alternative out of all available ones. Regression analysis helps to determine values of the parameters of a function - Economic analysis of risk becomes crucial with reference to decisions.

3.14 SELF-ASSESSMENT QUESTIONS

1. Find the present value of Rs.10,000 due in one year if the discount rate is 5 per cent, 8 per cent, 10 per cent, 15 per cent, 20 per cent and 25 per cent.
2. Apply the decision making model to your decision to attend college at MBA level.
3. Discuss with examples how managerial economics is an integral part of business activity.
4. Suppose a seller has two markets to serve. The demand schedules in them are given in the table. Suppose that he has 1400 units to sell and maximise profits thereby. What prices will he set in the two markets? Apply equi-incrementalism principle to get your answer. Could you have applied equi-marginalism.

Market A		Market B	
Price	Quantity	Price	Quantity
50	400	60	600
40	600	50	800
30	900	40	1100
20	1000	34	1400

[Hint: First get total revenue in each market by multiplying price with quantity.]

5. A firm is producing two products x and y , and has the following profit function $p = 64x - 2x^2 + 4xy - 4y^2 + 32y - 14$. Find the profit maximising levels of output for each of the two products. (Ans.: $x = 40$, $y = 24$, $p = 1650$).
6. Maximise $Z = 10xy - 2y^2$
Subject to $x + y = 12$
7. What are central or basic problems of an economy?
8. Which problems of an economy constitute the subject matter of microeconomics?

3.15 FURTHER READINGS

Koutsoyiannis, A., *Modern Microeconomics*, Macmillan.

Baumol, W.J., *Economic Theory and Operations Analysis*, Prentice Hall of India.

Peterson Lewis, *Managerial Economics, Fourth Edition*, Prentice Hall of India.

Appendix

The standard rules of differentiation in calculus are given below:

A. Basic rule: $Y = ax_n$

$$\frac{dy}{dx} = na X^{n-1}$$

B. Addition rule: $Y = u(x)+v(x)$

$$\frac{dy}{dx} = \frac{du}{dx} + \frac{dv}{dx}$$

C. Product rule: $Y = u(x)*v(x)$

$$\frac{dy}{dx} = u(x) \frac{dv}{dx} + v(x) \frac{du}{dx}$$

D. Quotient rule: $Y = \frac{u(x)}{v(x)}$

$$\frac{dy}{dx} = \frac{v(x) \frac{du}{dx} - u(x) \frac{dv}{dx}}{v^2}$$

E. Chain rule: $Y=y[u(x)]$

$$\frac{dy}{dx} = \frac{dy}{du} * \frac{du}{dx}$$

F. Logarithm rule: $Y = \log X$

$$\frac{dy}{dx} = \frac{1}{x}$$

G. Exponential rule: $Y = ex$

$$\frac{dy}{dx} = e^x$$

