FRM 515: FOREST ECONOMICS

Environmental Resources

Environmental resources are natural resource stocks, which exist in the environment from which economic activity draw flows of inputs. They are resources available to man as "gift of nature". The resources are further described in economic sense as living and non living endowment of the earth exploited by man as resources of food, raw materials and energy. Renewable resources are primarily biological resources capable of reproduction and they are often used at a constant rate and they are therefore indefinitely sustainable. They are never in use in such a way as to involve extinction for example there are numerous historical examples of over exploitation to the point of extinction. However, the point is that with renewable resources such exhaustion is not as it is with non-renewable resources which are of physical necessity.

Flow resources are also renewable resources. However, the consumption of a unit of the resource does not reduce the quantity to be consumed tomorrow while unconsumed resource at the right time is permanently lost e.g solar energy. The resources provide services. The problem of managing this type of resource is different from the management of the physical resources.

Non-renewable natural resources are defined by their virtue of the absence of their reproduction and are therefore identified as mineral deposits e.g deposits of coal, petroleum, gold, bauxite etc.

Operations Research

Introduction:

Operations research was developed during the Second World War to facilitate adequate distribution of resources among soldiers. Operations Research (OR) is also known as optimal allocation of resources. Under OR, we have linear programming which is a mathematical tool

for solving the problem of efficient resource allocation. The linear form of problem in forestry is maximization of yield i.e. Yield= f(vol, species, land, etc) subject to linear constant i.e to harvest trees of certain volume of certain height and age. Operation research is used in medicine and other areas. The use of operations research in forestry could be examined under the condition stated below:.

Here we have to look at the problem facing forestry and look at the corresponding operation research that could solve the problem. Allocation of scarce resources that is finance which is translated to capital shortage for forestry operations is a major problem in forestry. Forestry consists of many inter related values. Within the forestry system, there are many subsystems which even want to utilize out of the limited capital. This problem can be solved by using a mathematical programme MPXS e.g in establishing a plantation of a species, you have to consider land preparation, seedling production, pegging, planting and tending each of these components is very important in establishing the plantation therefore you do a sort of weighting. The advantage of this is that it enables you to see alternative actions. Other methods that could be used include;

1. CPM (Critical Path Method). What this does e.g moving a log from the forest to processing centre, the shortest economical route for transporting the load is called CPM. It is therefore the duty of operation researcher to tell the Sawmiller the quickest way of transporting the load from the forest to the Sawmill. Both CPM and MPXS are statistical packages.

2. Mixed products is another problem solving method i.e producing different output from a single raw material or combining agriculture with forestry. The problem can be solved using linear programming (LP). The assumptions of LP are divisibility, proportionality, additivity, etc.

In forestry, we are concerned with utilization of a piece of land for different uses i.e multiple land use. There are other methods such as goal programming which is also a statistical package for distribution of products.

Under this mixed product, we have what is called simplex algorithm as a system of working out the problem of mixed products i.e it is a system of alternating products.

Linear programming also enable us to see best alternative course of action for different activities..

Linear programming- LP

Expressing LP Problems

Before considering the detailed methods of solving LP problems it is necessary to be able to express a problem in a standardized manner, this not only helps the calculations required for a solution but also ensures that no important element of the problem is overlooked. The two major factors are: The objectives and the limitations or constraints.

Objectives: The first step in LP is to decide what result is required i.e the objective. This may be to maximize profit or contribution, or minimize cost or time or some other appropriate measure. Having decided upon the objective it is now necessary to state mathematically the elements involved in achieving this. This is called the objective function.

Example 1

A factory can produce two products, A and B. The contributions that can be obtained from these products are: A contributes N20 per unit, B contributes N30 per unit and it is required to maximize contribution.

The objective function for this factory can be expressed as:

Maximize : $20x_1 + 30x_2$

Where x_1 = number of units of A produced

x_2 = number of units of B produced

Notes: This problem has 2 unknowns, x_1 and x_2. These are sometimes known as the decision variables. Only a single objective at the time (in this case, to maximize contribution) can be dealt with in an LP problem.

Example 2

A factory can produce four products and wishes to maximize contribution. It has an objective function as follow:

$$\textit{Maximize:}\quad 5.5x_1 + 2.7x_2 + 6.0x_3 + 4.1x_4$$

Where x_1 = number of units of A produced

x_2 = number of units of B produced

x_3 = number of units of C produced

x_4 = number of units of D produced

and the coefficients of the objective function (i.e. 5.5., 2.7, 6.0 and 4.1) are the contributions per unit of the products.

The factory employs 200 skilled workers and 150 unskilled workers and works a 40 hour week. The time to produce 1 unit of each product by the types of labour is given below.

	Products			
	A	B	C	D
Skilled hours	5	3	1	8
Unskilled hours	5	7	4	11

The limitations as regards to labour can be stated as follows

$$\text{Skilled:}\quad 5x_1 + 3x_2 + x_3 + 8x_4 \leq 8{,}000$$

$$\text{Unskilled:}\quad 5x_1 + 7x_2 + 4x_3 + 11x_4 \leq 6{,}000$$

In addition, a general limitation applicable to all maximizing problems is that it is not possible to make negative quantities of a product, i.e. $x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0$

Notes:

a. The resource limitations in this maximizing problem follow a typical pattern being of the less than or equal type (≤).
b. The formal statement of the non-negativity constraints on the unknowns (x_1, x_2 etc) has to be made computer solutions but is normally inferred when solving by manual means.
c. This above restriction applies to labour hours: Machine hour restrictions would be dealt with in a similar fashion

Linear Programming using Graphical solution

Example 3

A manufacturer produces two products, Plywood and Particle Board. Plywood has a contribution of N3 per unit and Particle Board N4 per unit. The manufacturer wishes to establish the weekly production plan which maximises contribution.

Production data are as follows:

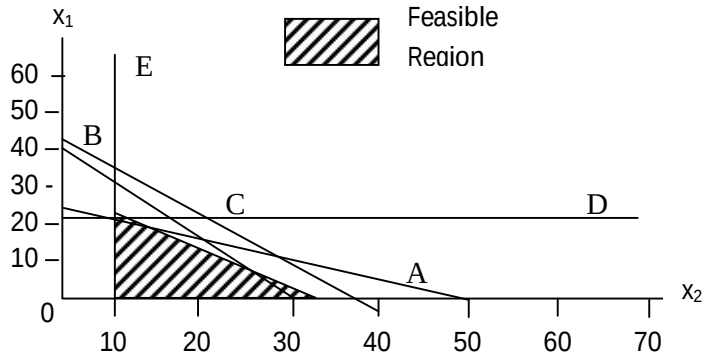
	Per unit		
	Machining (Hours)	**Labour (Hours)**	**Material (Kg)**
Plywood	4	4	1
Particle Board	2	6	1
Total available per week	100	180	40

Because of a trade agreement, sales of Plywood are limited to a weekly maximum of 20 units and to honour an agreement with an old established customer at least 10 units of Particle Board must be sold per week.

Formulate the LP model in the standardised manner.

	Maximise:	$3x_1 + 4x_2$
Subject to constraint	A	$4x_1 + 2x_2 \leq 100$ (Machining hours constraint)
	B	$4x_1 + 6x_2 \leq 180$ (Labour hours constraint)
	C	$x_1 + x_2 \leq 40$ (Materials constraint)
	D	$x_1 \leq 20$ (Plywood sales constraint)
	E	$x_2 \geq 10$ (Particle Board sales constraint)

All of the constraints (sales, production and material) can now be drawn on single graph and the resulting *feasible region* defined.



Notes:

a) The feasible region is the area which does not contravene any of the restrictions and is therefore the area containing all possible production plans.

b) The non-negativity restrictions (i.e. $x_1 \geq 0$, $x_2 \geq 0$) are automatically included in the graph because the graph quadrant used only shows positive values. It should be noted that as more restrictions are plotted the feasible region usually becomes smaller.

c) It will be noted that the material constraint C (line 40, 40) does not touch the feasible region. This is an example of redundant constraint, it is non binding.

Minimisation problems

Minimisation problems are normally concerned with minimizing the cost of fulfilling some objectives subject to limitations. The limitations are generally of the 'greater than or equal to' type (≥) for the logical reason that the best way to minimize costs would be to produce nothing, therefore the limitations must be set as to produce the minimum possible that fulfil certain requirements.

Example 4

A forest industry mixes three wood products to produce another product. Wood product M cost N20 per kg, Wood product Y costs N40 per kg and Woodproduct Z costs N55 per kg. Each wood product contributes some essential parts of the forest product and the industry wishes to produce the product as cheaply as possible.

The objective function is

$$\textit{Minimise}\ 20x_1 + 40x_2 + 55x_3$$

Where x_1 = Quantity of M (kg)

x_2 = Quantity of Y (kg)

x_3 = Quantity of Z (kg)

Note: This example has 3 decision variables. The number of decision variables can vary from 2 to many hundreds. For examination purposes 4 or 5 is the maximum that is likely to be encountered. Linearity has been assumed in the examples above and is assumed in all those that follow.

Example 5

A farmer feed his pigs a mixture of swill, vitamins and a proprietary brand of feedmix. He owns 100 pigs that eat at least 20 kilogrammes of food per day each. He wishes to minimize

the cost of feeding the pigs whilst at the same time ensuring that the animals receive a balanced diet. The following dietary and cost factors have been obtained.

	Calories	**Vitamins**			
		1	2	3	
Minimum Daily Dietary Requirements/ Pig	40	20	10	30	
Contents of foodstuffs					Costs
Swill/kg (x_1)	1.5	0.5	-	-	N5 / kg
Feed mix/kg (x_2)	2.0	0.5	-	1	N10/kg
Vitamins/bottle (x_3)	-	0.5	7	14	N20/bottle

The LP formation can be stated as follows:

Objective function: Minimise $5x_1 + 10x_2 + 20x_3$

Constraints:

Total Weights (i.e. 100 x 20)	$1.0x_1$	+	$1.0x_2$				$\geq$	2,000
Calories (i.e. 100 x 40)	$1.5x_1$	+	$2.0x_2$				$\geq$	4,000
Vitamin 1 (i.e. 100 x 20)	$0.5x_1$	+	$0.5x_2$	+	$0.5x_3$		$\geq$	2000
Vitamin 2 (i.e. 100 x 10)					$7x_3$		$\geq$	1000
Vitamin 3 (i.e. 100 x 30)			$1.0x_2$	+	$14x_3$		$\geq$	3000

$x_1 \geq 0, x_2 \geq 0$

Where x_1 = kilogrammes of swill

x_2 = kilogrammes of feedmix

x_3 = bottles of vitamins

Note:

a. The restrictions are all of the 'greater than or equal' type ($\geq$) which is typical of minimization problems.
b. In the total weight restriction the weight of the vitamins has been assumed to be negligible and has been ignored.
c. The non-negativity constraint for x_3 is not necessary in this problem because the vitamin 2 constraint is for x_3 only and is of the 'greater than or equal to' type.

Fixed costs

LP is concerned with changes in cost and revenues so it follows that factor such as fixed costs which would be unchanged over the range of output being considered should not be included in the LP formulation. To eliminate the effect of fixed costs and to maintain linear relationships it is normal to use contribution (i.e. sales less marginal cost) rather than profit in the objective function.

Summary

a). LP is a solution method to problems where an objective has to be optimized subject to constraints.

b). All factors concerned must be numeric and there must be linear relationships.

c). Before attempting to solve any LP problem it should be formulated in a standardized manner. The steps in the process are:

i. Decide upon the objective
ii. Calculate the contribution per unit for maximizing or the cost per unit for minimizing (ignoring fixed costs in both circumstances).
iii. State the objective function noting how many unknowns, or decision variables, appear.
iv. Consider what factors limit or constrain the quantities to be produced or purchased.

v. State these factors mathematically taking care to ensure that the inequalities (i.e. ≥ or ≤) are of the correct type.

vi. Before attempting to solve the problem ensure that all the relationships established are linear or can be reasonably approximated by a linear function.

vii. Solve the problem by either drawing a graph or by the use of what is known as the Simplex method.

Other Examples

A1. A factory produces four products A, B, C and D which earn contributions of N20, N25, N12 and N30 per unit respectively. The factory employs 500 workers who work a 40 hour week. The hours required for each product and the material requirements are set out below:

	Products			
	A	B	C	D
Hours per unit	6	4	2	5
Kgs Material X per unit	2	8.3	5	9
Kgs Material Y per unit	10	4	8	2
Kgs Material X per unit	1.5	-	2	8

The total availability of materials per week is:

X	100,000 kgs
Y	65,000 kgs
Z	220,000 kgs

The company wish to maximize contribution:

Formulate the LP problem in the standard manner.

A2. Green Bakeries Ltd have received a rush order from Camfam for high protein biscuits for famine relief. Cost must be minimized and the mix must meet minimum nutrition requirements.

The order will require 1,000 kgs of biscuits mix which is made from four ingredients R, S, T, U which cost N8, N2, N3 and N1 per kilogram respectively. The batch must contain a minimum of 400 kilos of protein, 250 kilos of fat, 300 kilos of carbohydrate and 50 kilos of sugar. The ingredients contain the following percentages by weight:

	Protein	**Fat**	**Carbohydrate**	**Sugar**	**Filler**
R	50%	30%	15%	5%	0
S	10%	15%	50%	15%	10%
T	30%	5%	30%	30%	5%
U	0	5%	5%	30%	60%

Only 150 kilos of S and 200 kilos of T are immediately available.

Formulate the LP problem in the standard manner.

Notes:

As it is impossible to make negative quantities of the products it is necessary formally to state the non-negativity constraint (i.e. $x_1 \geq 0$)

The resource and sales constraints include both types of restrictions (i.e $\geq$ and $\leq$).

As this is a problem with only 2 unknowns (i.e. x_1 and x_2) it can be solved graphically. The number of limitations does not exclude a graphical solution.

ELEMENTS OF THE MARKET SYSTEM

The elements of Market system are (1) Demand (2) Supply and (3) Price. The market system is a form of economic organization in which production resource allocation result from free individual choice. In such a system, private economy is dominant as supposed to government. The economic relationships between units of society are governed primarily by prices. In other words, price is relied upon to allocate resources in such a way to maximize individual and social satisfaction. Some economists have claimed that prices constitute a powerful tool for efficient resource allocation. This could be true because prices reflect consumer preferences at any given time and therefore direct production resources to their best uses.

The elements of market system are directly related to the circular flow.

A. Demand- There are two types of demand in the market:

i Demand for goods and services which include intermediate and final consumption.

Ii Demand for input (factors) service.

The first demand is by household and the second by firms.

B Supply:. The two components here are (a) supply of goods and services (by firms) and (b) supply of input (factors) service by household.

The sum total of these activities would be reflected in prices.

Therefore price is the resultant effect of supply and demand. Thus, in demand and supply, there are two markets (1) a and a for goods and services and (2) b and b for inputs.

DEMAND

Demand: Demand is the quantity of commodity that buyers are willing to buy at a given price and at a particular time. It should be stressed that demand is only defined as such when backed up by purchasing power (effective demand). Therefore demand is not equal to desire for commodity (ineffective demand).

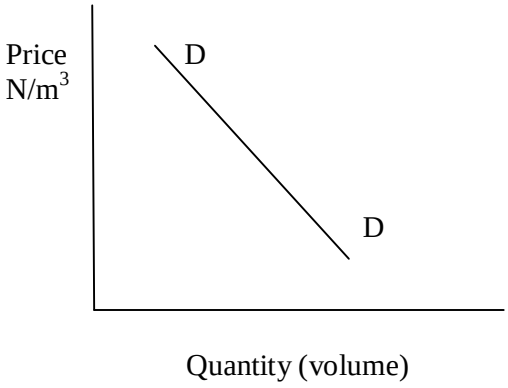
Thus, at various prices, different quantities of commodities will be demanded. Therefore, we can illustrate this relationship using a demand schedule which is simply a schedule showing the various quantities of commodities that will be purchased.

Demand Schedule for sawn wood

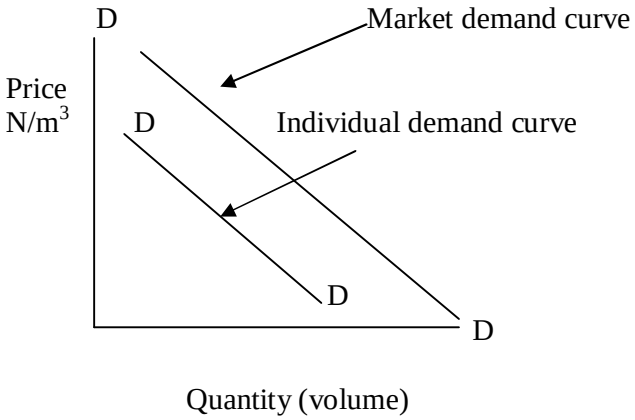
Quantity (m^3)	**Price (₦/m^3)**
500	100
800	80
1100	60
1500	40
2000	20

The graphical representation of the data is shown below. The graph also shows the relationship between price and quantity demanded.

Translation of data



We can construct demand curve for an individual and also for a whole market. The individual demand curve will only be smaller than the market demand curve.



However, if there is only one individual in the market, the individual and market demand will be equal. The convex shape of the curve and its downward sloping reflects the part of diminishing marginal utility in consumption whereby as individual obtains more of a commodity, they derive lower satisfaction progressively from further addition of the commodity and therefore willing to pay lesser price for more units of the commodity.

Factors influencing demand for a commodity

1. Price
2. Income:
3. Taste & preference:
4. Culture and tradition:
5. Religious beliefs
6. climate:

SUPPLY

Supply is used in two basic senses i.e. in terms of total quantity of a commodity that is available. This is called physical supply e.g. Nigeria has 100 million tons of coal, 500million metrics tons of crude oil in underground reserve.

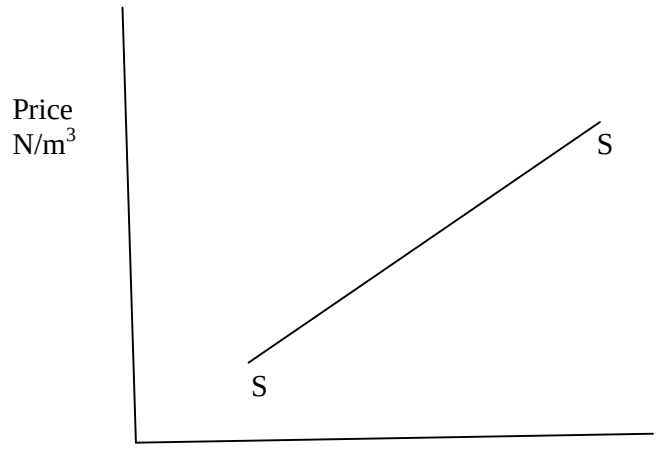
Supply is also used in economic sense which is the quantity of that commodity that producers will make available in the markets at a given price and at a particular time. In economics, Supply is therefore that portion of physical supply that is generated in response to price. Supply is the foundation of firms or producers responding generally to consumer wishes/ demand in terms of indicated relative prices. The objective of a firm is to supply a commodity to make profit where profit is the excess of sales prices of a commodity over the production cost

Sometimes, firms have other goals than profit maximization in terms of good and services. Firms sometimes supply goods and services or rendering a social service to the community in exchange for public image. However, at different prices, a firm will make available different quantities of a commodity. The schedule showing different prices and quantities of a given commodity is known as supply schedule.

Table showing the supply schedule for sawn wood

Qty (000)m^3	**Price (N/m^3)**
150	200
80	150
60	100
30	80

The schedule indicates that as the price rises, more of the commodity will be supplied and vice versa. There is a positive relationship between supply and price. The graphical representation of the data is presented below



Factors influencing supply of a commodity

1. Price:

2. Cost of production:
3. Physical availability:
4. Technological change:
5. Time:

   The time period are:

   i. Instantaneous Supply

   ii. Short run Supply

   iii. Long run Supply

   We can attribute the changing slopes with response to time periods with respect to change in price. While we have different time elements for supply in that a consumer can decide a time to purchase or not, this is not so with production.

   i. Instantaneous supply: Under this a supply curve is vertical at 90^0. It shows that quantity and supply cannot be changed no matter the changes in price.

      There is new response to price changes. This is so because in the period, the length of time is too short to vary the inputs in order to increase or decrease supply e.g. supply of fresh fish market at the end of the day, the fisherman have finished their catches and brought their catches to the market. Also we have spot market for timber sale. Certain quantities of timber will be offered for sale usually on the basis of option.

   ii. Short run supply: It has a slope of less than 90^0. The shape of the short run supply curve suggests increasing response to changes in price. However, the short run supply is a period short enough to vary some of the inputs required to change quantity supplied as price changes.

   iii. Long run supply: In the short run supply the scope of the curve is further increased to approach one. The long run is period that is long enough for the

producer to change any or all of the inputs required to change any or all a commodity as price changes.

In forestry, for timber productions, the long run period is the end of rotation. This is because at the end of the rotation, depending on price of timber in the market, the producer can decide to plant trees on a larger or smaller area of land to change species that will grow on the next rotation and he can choose between manual or mechanized technique in the next rotation. Therefore, in the long run, there is maximum response of supply to change in price.

Supply is a very complex aspect of a market system e.g. the determinant of cost of production and the basis of decision of suppliers are not always easily qualified / identified e.g. there are three major aspects of supply that make supply basis difficult.

i. Reservation demand ii. Speculation and iii. Dumping

These are external elements in supply of a commodity. They look at supply in a dynamic sense. They are extremely important.

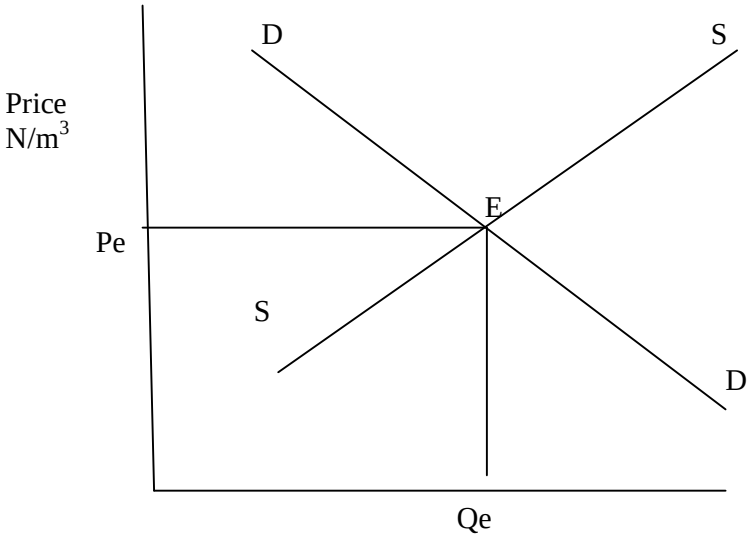
i. Reservation demand: means that the supplier of a commodity will deliberately hold back parts of the stock in anticipation of further increase in price. In Nigeria, we use political hoarding.
ii. Speculation: this is the pre-emptying buying of commodity by the supply as a weapon of competition e.g. a man can buy all the available land in an area to prevent other people who want to use it from buying it. Thus the pattern of supply changes.
iii. Dumping: this is the reverse of the speculation. It is the deliberate flooding of market with a commodity by a particular supplier with the aim of wiping off competing suppliers or a local industry. However, dumping/ flooding is associated with low price.

PRICE

Price is defined as the exchange value of a commodity. It is a measure of what people are willing to give up in order to exchange for a commodity. Price may be measured in variables amount but commonly measured in monetary unit. Price is the settlement exchanged value of commodity that ultimately results from the interaction of buyers and sellers in the market.

DETERMINATION OF PRICE OF A COMMODITY

In the static sense, the market price of a commodity is known as the equilibrium price where the equilibrium price of a commodity is that price at which demand equal supply for the commodity. We determine equilibrium price by super-imposing demand curve on a supply curve. Equilibrium price is the point of interception of the two curves.



In this diagram E is the equilibrium point, PE is equilibrium price and QE is the equilibrium quantity. PE is the price at which the market is cleared. The price at which the quantity that buyers are willing to buy is exactly merged by the quantity that seller wants to sell in a static sense. PE is always stable. PE is always stable if there is an observed tendency for PE of a commodity to be maintained. We can predict the possibility of fluctuation in price causing

divergences of supply and demand. The reason for this is that of price of a commodity away from PE. Supply and demand will move in different direction. These divergences affect movement of the price back to the equilibrium point. In looking at the diagram, we can illustrate the fluctuation as movement of demand and supply as shown below.

Diagram to be concluded during Lectures

As the suppliers reduce price, demand is again stimulated. This process of adjustment continue until demand and supply are brought again to a point (PE)

To look at the other side of the picture.

In this case, there is excess demand. Excess demand may sometimes be due to sudden increase in purchasing power of consumer or when suppliers withdraw their commodity from market.

When there is excess demand, competition among buyers for share of supply gradually raise price. At the same time, as a result of competition certain suppliers will leave to drop off from the market. This adjustment i.e. the incentives given to suppliers can take place. There is a zone of instability which definitely proves that market of certain commodity must be stable. In the dynamic sense, what is observed empirically is that there is usually not one price but different prices for a given commodity both overtime and in different places at a given time. This is an indication of efficiency of interaction between supply and demand but the interaction is never perfect. First, in buyers and sellers transaction, there is always an element of negotiation between two parties. Such negotiation is referred to in local market as Higgling and Haggling.

In forestry, negotiation is a stand value or process. In timber sales, there is a specialized market. There is counter sign between buyer and seller, as a result of negotiation, final price arrived at will be a reflection of the indicative bargaining power of the buyer and seller.

1. Market Situation Condition

The market situation could equally be described in terms of buyers market or sellers market. The buyer will only buy at their own price. Thus there is a buyers market, on the other hand a commodity might be in stock of few firms, the firms will like to hang on with the commodity but because the commodity is scarce in the market, the buyer will be anxious to buy. This eagerness of buyer to buy is greater than eagerness to sell. This condition creates sellers market.

2. Resources available to Buyers and Sellers

A firm that is just managing to make profit has less resources so it has to sell to make some fixed cost, so there is limited time to hold the market for long. Poor buyer of low income and small time buyer have limited resources for negotiation. The resources available depend on the ability of the buyer and seller to wait for right time to buy or sell.

3. Access to substitute product or alternative market.

If the buyer share access to a product, there is increase negotiation power. Also if there is an alternative market for the seller, the negotiation explicit or implicit describes various markets. There are 3 broad markets

i. Monopoly
ii. Imperfect competition
iii. Perfect competition.

1. **MONOPOLY:** One supplier and many buyers. It is obvious that in such market, seller will have a commendable bargaining power in term of selling prices, since it is the sole seller or producer.
2. **IMPERFECT COMPETITION:** This is ½ way between perfect and monopoly. In such a market, there is some degree of competition but there are also some elements of monopoly. This type of market is the most characteristic of the real world market.

3. **PERFECT COMPETITION:** This is the market with different buyers and sellers. There are numerous small buyers and sellers in the market. The price is perfectly set.

CHANGES IN SUPPLY AND DEMAND

This refers to market fluctuation. A careful examination of factors that affect both supply and demand will place them into two categories which are (i) Price factor and (ii) Non- price factors.

These changes that frequently affect price instability so that a change in price for non - price factor will lead to various changes in supply and demand.

Change in price of a commodity does affect changes in both demand and supply. These changes are represented by movement along the demand and supply curves.

We do the same thing with demand So there is a rise or fall in supply or demand.

The second type of change in supply and demand is represented by shifting of the whole curve to various positions in dictating that without a change in price the supply or demand has either increased or decreased.

Therefore, with respect to the second factor, we talk of increase or decrease of supply or demand. We can also use the term of contraction and expansion in non – price factor.

Price induced changes in supply and demand.

The extent of change along the curve is measured in terms of elasticity. There is elasticity of demand and supply and if it is understood that it is price elasticity and we use the term *E*P as the symbolic representation. Elasticity is a measure of the degree of the rise or fall in supply and demand in response to price changes.

Price elasticity of demand can be defined as the responsiveness of a quantity of commodity that is demanded to the unit change in price. So that this indicates quantity demanded changes when price change.

$$Ep = \frac{\Delta Q\%}{\Delta P\%} = \frac{\frac{Q_1 - Q_0}{Q_0}}{\frac{P_1 - P_0}{P_0}} \times 100 = -\frac{P\Delta Q}{Q\Delta P}$$

Q_0 = Original quantity demanded

Q_1 = New quantity demanded

P_0 = Starting price

P_1 = New price

Supposing for a commodity original quantity demanded = 50 with price = N5. A change in price to N4 per unit of the commodity (Q_1 = 80).

*E*p = Solve the problem

Negative signs introduced make the elasticity to be negative numbers

The values of price elasticity *E*P can range from 0 – infinity but usually two values are important, we can either say that the demand for a commodity is elastic or inelastic i.e. *E*P > 1 = elastic and *E*P <1>0 = inelastic. Various values which price elasticity can take are stated as follows 0, >0, >0<1, 1, >1< ∞, ∞

In practice, elasticity tends to be measured over a range in the demand curve rather than a given point.

Factors influencing *E*P.

i. Availability of substitutes –

ii. Regularity or frequency of purchase –

iii. Number of alternative uses of the commodity

PROJECT EVALUATION

The following are the features of investment decisions:

- The exchange of current funds for future benefits.
- The funds are invested in long-term assets.
- The future benefits will occur to the firm over a series of years.

It is significant to emphasise that expenditures and benefits of an investment should be measured in cash. In investment analysis, it is cash flow which is important, not the accounting profit. It may also be pointed out that investment decisions affect the firm's value. The firm's value will increase if investments are profitable and add to the shareholders' wealth. Thus, investments should be evaluated on the basis of a criterion which is compatible with the objective of the shareholders' wealth maximization. An investment will add to the shareholders' wealth if it yields benefits in excess of the minimum benefits as per the opportunity cost of capital.

INVESTMENT EVALUATION CRITERIA

Three steps are involved in the evaluation of an investment:

- Estimation of cash flows
- Estimation of the required rate of return
- Application of a decision rule for making the choice

Specifically, the focus here is on the merits and demerits of various decision rules.

The investment decision rules may be referred to as capital budgeting techniques, or investment criteria. A sound appraisal technique should be used to measure the economic worth of an investment project. The essential property of a sound technique is that it should

maximize the shareholders' wealth. The following other characteristics should also be possessed by a sound investment evaluation criterion:

- It should consider all cash flows to determine the true profitability of the project.
- It should provide for an objective and unambiguous way of separating good projects from bad projects.
- It should help ranking of projects according to their true profitability.
- It should recognize the fact that bigger cash flows are preferable to smaller ones and early cash flows are preferable to latter ones.
- It should help to choose among mutually exclusive projects that project which maximizes the shareholders' wealth.
- It should be a criterion which is applicable to any conceivable investments project independent of others.

ANALYTICAL TECHNIQUES FOR INVESTMENT ANALYSIS

1. Discounted Cash Flow (DCF) Methods.
    - Net Present Value (NPV)
    - Internal Rate of Return (IRR)
    - Benefit- Cost Ratio OR Profitability Index (PI)
2. Non- discounted Cash Flow Methods.
    - Average Rate of Return
    - Payback method

The table below provides annual net income and net cash flow figures for three projects X, Y, and Z. thus, for example, the initial investment for all three projects is N100, 000. For project X, net income in period 1 is N5, 000 and net cash flow is N25, 000. In the analysis of capital

projects, the techniques that could be used fall into two categories discounted cash flow methods and nondisounted method. For the data below, NPV calculation will be carried out.

Net income and Net Cash Flow Data (in Naira)

	Project X		**Project Y**		**Project Z**	
Period	Net Income	NCF	Net Income	NCF	Net Income	NCF
0	____	(100,000)	_____	(100,000)	_____	(100,000)
1	5,000	25,000	16,000	50,000	25,000	45,000
2	10,000	30,000	17,000	50,000	20,000	40,000
3	15,000	35,000	17,000	50,000	15,000	35,000
4	20,000	40,000	_____	_____	10,000	30,000
5	25,000	45,000	_____	_____	5,000	25,000

Three discounted cash flow procedures that are applicable to capital budgeting analyses are the net present value, benefit-cost ratio, and internal rate of return. All three methods take into consideration the time value of money.

Net Present Value. The Net Present Value (NPV) for a project is defined as the difference between the present value of the project's future cash flows and its initial investment. Or

$$\text{NPV} = \sum_{k=1}^{n} \frac{A_k}{(1+i)^k} - A_0$$

Where i = discount rate, A_o = initial investment and A_k = cash flow in time period k. Assuming that for projects X, Y, and Z in the Table, the appropriate discount rate is 10 percent. The net present value for project X is given by

$$NPV_x = \frac{\$25,000}{1+0.1} + \frac{\$30,000}{(1+0.1)^2} + \frac{\$35,000}{(1+0.1)^3} + \frac{+\$40,000}{(1+0.1)^4} + \frac{\$45,000}{(1+0.1)^5} - \$100,000$$

Use of NPV as an Investment Criterion. The decision rule applicable to NPV as an investment criterion is to consider all projects with positive NPV as acceptable, that is, project X is acceptable since $NPV_x > 0$. Projects would be ranked in the order of decreasing NPV. For projects X, Y, and Z, project Z with the largest NPV is the most preferred project and Y is the least preferredof the three. It should be emphasized that the preference for these projects is relative – in absolute terms all of them are acceptable, since their net present values are positive.

NPVs for mutually exclusive projects. If two projects are mutually exclusive, the one with the larger NPV would be selected. If projects X and Y are mutually exclusive, then project X would be selected since NPVx>NPVy.