2023
EDITION

Managment Decision & Control

STUDY TEXTBOOK

MANAGEMENT DECISION AND CONTROL

Study Textbook

By

MUGISHA INNOCENT

MBA (Finance), CPA(U), CIPS, B.COM(Hons)

Harvest Training and Consultancy (U) Limited

P.O. BOX 9449 KAMPALA

TEL: 0392894678 / 0772998049 / 0772690601 / 0701690601

Web: www.harvestuganda.com

Email: admin@harvestuganda.com

Second Edition 2015
Printed by Swamp Publishers Ltd
P.O.BOX 9449 Kampala (u)
TEL: 0392894678 / 0772998049 / 0701690601

OTHER PUBLICATIONS ON SALE:

	Paper Number	Professional Level
1. Quantitative Techniques	2	1
2. Cost and Management Accounting	7	1
3. Auditing & Professional Ethics and Values	12	2
4. Economic Environment	3	1
5. Business Communication	2	ATD(U) Level 1
6. Financial Reporting	8	2
7. Advanced Financial Management	16	3
8. Taxation	6	1
9. Advanced Taxation	9	2
10. Management Decision and Control	11	2
11. Advanced Financial Reporting	13	3
12. Public Sector Accounting	13	3

For Deliveries and further inquiries, contact Harvest Training and Consultancy on the above address.

THIS STUDY TEXT INCLUDES THE FULL CPA(U) MANAGEMENT DECISION AND CONTROL SYLLABUS

This book has been specially written and designed to help students preparing for their CPA(U) MANAGEMENT DECISION AND CONTROL (MDC) Paper 11 professional examinations and those undertaking a BUSINESS STUDIES and BSC ACCOUNTING AND FINANCE course at the University. It is also useful for lecturers preparing students for those examinations.

This book covers a variety of contents, exercises, model questions, test papers, mixed exercises and answers to equip and prepare students for their examinations.

This book contains

- ✓ Progressive notes targeted to the entire Management Decision and Control Syllabus and study Guide.
- ✓ Review exercises and Questions to check your understanding
- ✓ Clear layout and style designed to save your time
- ✓ Plenty of examination Questions from a variety of past papers.

We are grateful to all the examination councils for their permission to reproduce past examination questions.
The suggested solutions to the Illustrative questions have been prepared by the whole entire author Team.

TABLE OF CONTENTS

Page

PART G: BUDGETING AND BUDGETARY CONTROL

PART H: STANDARD COSTING AND VARIANCE ANALYSIS

PART I: PLANNING AND CONTROL OF INVENTORY

PART J: LINEAR PROGRAMMING

PART K: COST MANAGEMENT AND STRATEGIC MANAGEMENT ACCOUNTING

PART A
GENERAL INTRODUCTION TO MANAGEMENT ACCOUNTING

1.0
NATURE AND ROLE OF MANAGEMENT ACCOUNTING

UNIT 1 OVERVIEW:

- Key Definition
- Cost Accounting Vs Management Accounting
- Financial Accounting Vs Management Accounting.
- Management Decision Making process.
- Role of Management Accounting.

1.1 KEY DEFINITION – *MANGEMENT ACCOUNTING*

- During the 1950s, emphasis shifted from external users of cost accounting data to internal users of cost accounting information. This shift led to the emergence of management accounting.

- Management accounting represents a branch of accounting concerned with the provision and use of confidential accounting information to managers (who are internal users) within the organisation to assist management in making decisions and managerial control functions.

- Management accounting therefore involves the application of accounting techniques to provide information helpful to all levels of management in order to plan and control the activities of a business enterprise and make informed decisions.

1.2 KEY DEFINITION – *COST ACCOUNTING*

- **Cost Accounting** represents the branch of accounting concerned with provision of detailed information about the costs relating to products, services, operations and activities within the organisation.

- Cost Accounting is therefore a full cycle accounting process of determining and accumulating the cost of some product or service.

- It is simply the process of determining the cost of doing something. *External users are in most cases concerned with how much your service/product will cost them*.

1.2.1 Similarities between management accounting and cost accounting

In spite of the differing parameters of cost accounting and management accounting, cost accounting is generally indistinguishable from management accounting.

- The two accounting systems are closely linked as they use accounting information.
- Much of the information used to prepare accounting statements and reports in cost accounting is also used in management accounting reports.

- For example, management accounting utilises the same data to prepare; Budgets, Performance reports, Control reports, and data analyses for decision making, planning and control purposes.

- Like cost accounting, management accounting involved reporting at frequent intervals rather than at the end of the year.

- It is also concerned with units and segments of activity rather than the business as a whole.

- In view of the above similarities, management accounting may be regarded as an extension of the managerial aspects of cost accounting.

1.2.2 Differences between management accounting and cost accounting

Despite the above similarities, the following aspects distinguish management accounting from cost accounting;

- **Decision Vs control**

  - By definition, management accounting is that segment of accounting which aids management in its primary function of decision making. Decision making consists of choosing the optimal course of action out of a given set of alternative courses of action. However, the main focus of cost accounting is on cost control (*keeping costs within the budgeted and standard limits*).

- **Wider Scope**

  - For planning and control, management accounting employs many quantitative models from statistics, operations research and computers as well as research findings of behavioural sciences. Cost accounting is much less sophisticated, and use of these techniques, if any, is very limited.

  - Furthermore, management accounting considers both financial and non-financial performance measures (i.e. issues that cannot easily be quantified or expressed in monetary terms e.g. level of customer satisfaction, quality of the products etc.) whereas cost accounting concentrates mainly on financial performance measures (i.e. variables that can be expressed in monetary terms such as revenues and costs)

- **Use of financial accounting**

  - Management accounting also uses financial accounting techniques such as ratio analysis and funds flow analysis.

  - This therefore affirms the assertion that management accounting is a combination of cost and financial accounting. On the other hand, cost accounting does not use financial accounts as such though it supplies data to financial accounting.

1.3 KEY DEFINITION – *FINANCIAL ACCOUNTING*

Financial accounting is a branch of accounting concerned with providing information to both internal and external stakeholders such as shareholders, managers, employees, government banks etc.

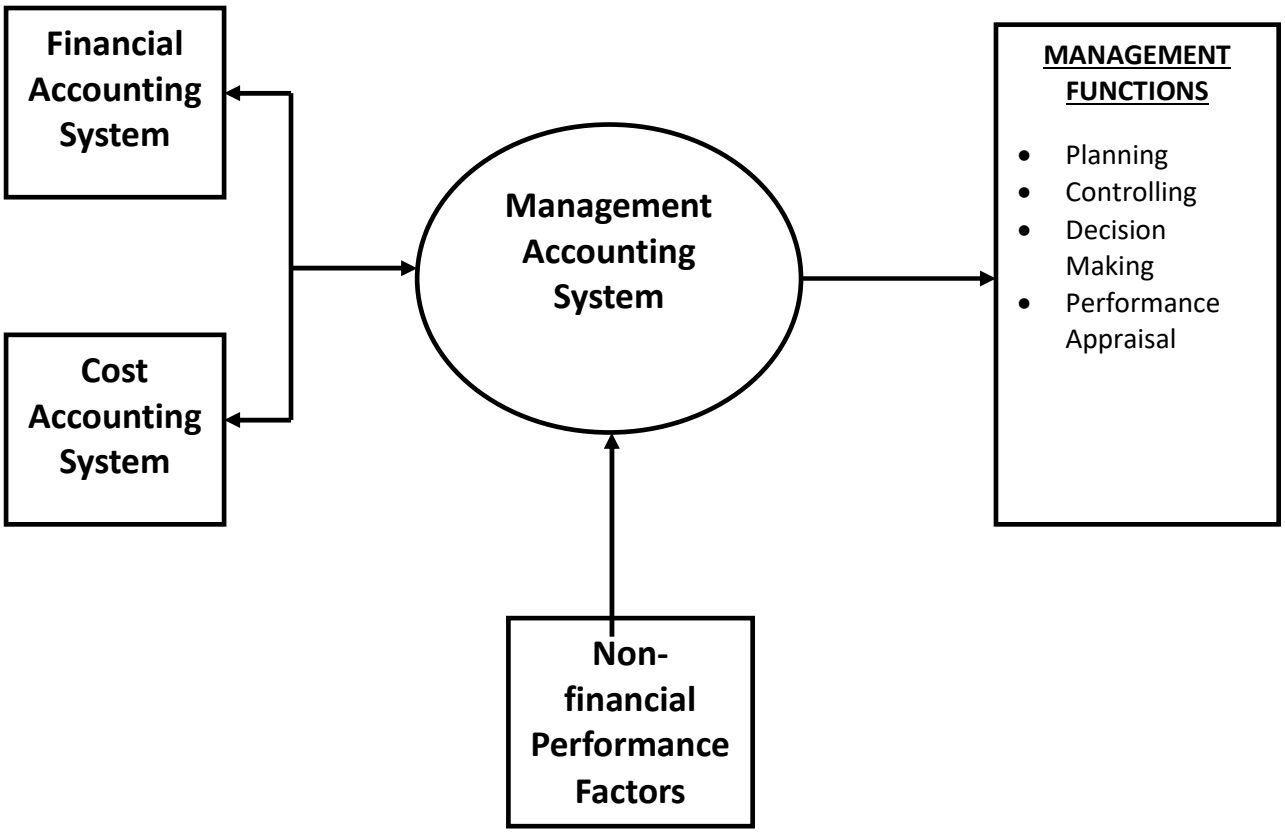
1.3.1 Similarities between management accounting and cost accounting

- **Primary users of information**
  - The users of financial accounting information are mainly external to the business enterprise such as shareholders and creditors whereas management accounting information is used by members of management at different levels.
- **Time dimension / span**
  - Financial accounting reports on the past events or occurrences while management accounting focuses on the future by providing predetermined information that can enhance or promote management functions.
- **Unit of measurement**
  - Financial accounting addresses financial performance measures (matters that can be expressed in monetary terms) whereas management accounting addresses financial and non-financial performance measures i.e. issues that are quantitative and qualitative.
- **Reporting frequency**
  - Financial accounts are usually prepared annually or semi-annually while management reports are more routine (frequently prepared).
- **Legal requirement**
  - Financial accounting is a statutory requirement for all public limited companies at the end of every financial year while management accounting is optional.
- **Reporting requirement**
  - Financial accounts must be prepared and presented in conformity with Generally Acceptable accounting Principles (GAAP) whereas management accounting is not based on any accounting rules/regulations and not bound to use GAAP.
- **Audit requirement**
  - Financial accounts must be subjected to an external audit since they are used by external parties whereas it is not a requirement to audit cost and management accounts.
- **Scope**
  - Financial accounting covers a smaller scope as compared to management accounting.

1.4 THE MANAGEMENT DECISION MAKING PROCESS

- Management Accounting disciplines are interconnected and it is the data sharing that enables such a relationship.
- As shown in the framework on the next slide, management accounting captures cost and financial data (financial performance measures) from cost and financial accounting systems that are accepted as inputs to management accounting system.

- Besides this, since management functions are affected by qualitative issues, the management accounting system is designed to capture qualitative data (i.e. non-financial performance measures) which is integrated with the quantitative data and processed to have meaningful information for decision and control.



- The above arrows do not show any other thing apart from the data/information flow within the accounting framework.

- Other than providing cost data to management accounting system, cost accounting also provides data to financial accounting system that enhances the preparation of financial statements because closing stock must be valued and what is sold has to be measured (i.e. cost of sales)

1.5 ROLE OF MANAGEMENT ACCOUNTING IN THE MANAGEMENT PROCESS

The cost and management accountant provides information which is expected to assist managers in undertaking various activities. The management Accountant plays a vital role in helping managers their management functions effectively as explained below;

- **Planning**

  - Management accountant provides information that helps management in the formulation of future plans more especially in deciding which products to sell, in what markets, what price among others.

  - He/she also assembles the various plans of various sections into one overall plan, which is quantified in monetary terms.

- **Controlling**

  - Management accountant provides performance reports that help management in making comparisons between the actual performance with the planned performance.

  - By making such comparisons, judgment can be made in regard to the efficiency of operations and the profitability of various products. This draws management attention to those specific activities that do not conform to the plan.

  - This management by exception approach frees managers from unnecessary concern with those areas or operations that are adhering to the plan.

  - Budgetary control and standard costing techniques are used to achieve the above requirements.

- **Decision making**
  - This refers to the process of selecting the best alternative that can add value to the business.

  - Management accountant provides information that is well researched and hence enhances management's decision making process.

- **Organizing**

  - The organizational structure is concerned with authority, responsibility and specialization. In order to ensure effective performance and internal reporting, a management accountant advises on the original design/structure to ensure efficiency of personnel in the organization

PART B
Cost-Volume-Profit (CVP) Analysis

2.0
COST-VOLUME-PROFIT (CVP) ANALYSIS

OUTLINE:
- General introduction
- The Breakeven point
- The Numerical Method of Determining the Breakeven point
- Breakeven Analysis in a multi-product environment

2.1 INTRODUCTION

- The profits of the firm are affected by many factors. Management theory asserts that most of these factors affect profits through 2 major economic variables; that is to say;
  - *Costs / expenses*
  - *Volume of output / level of activity*
- The CVP analysis hence aims at studying the connection between the 3 variables i.e. cost, volume and profits so that a mechanism is developed to predict their effect on the overall organizational strategy.
- Most organizations aim at profit maximization as a primary objective; this hence makes it inevitable for such entities to control costs and regulate the level of activity of the organization.

2.1.1 Key Definition

⇒ *Cost-Volume-profit analysis is an analytical technique or tool that is used to study the behavior of profit in response to the changes in volume, costs and price. Analysis of such factors on profit is an essential step in the financial planning and decision making.*

2.1.2 Objectives of CVP analysis

- Establish the effect of the level of activity or volume of output on the firm's profits.
- Determine the minimum sales volume to avoid losses.
- Establish the most profitable combination of costs and volume.
- Predict and evaluate the implications of the firm's short-run decisions about fixed costs, variable costs, volume and selling price for its profit plans on a continuous basis.

2.1.3 Methodology of the CVP analysis

- The CVP technique follows the **Contribution approach.** Under this approach, there is separation between fixed costs and variable costs.
- Contribution is then computed as: Contribution = Unit selling price – Unit variable cost.
- Where: variable costs are those expected to vary with the level of activity.

2.1.4 Importance of CVP Analysis

- Helps management ascertain the breakeven point of the entity. Here, management determines the minimum level of sales required to avoid losses.
- Helps management determine the sales level required to earn a target or desired profit.
- Helps management determine the firm's margin of safety.

2.2 THE BREAKEVEN POINT

2.2.1 Definition

- **The Breakeven Point** is the point at which the enterprise neither makes profits nor losses.
- At the breakeven point, the total revenue is equal to total costs (i.e. the intersection point of total revenue curve and total cost curve).
- The breakeven point can be determined using 2approaches, that is to say;
  - *(i) Numerically (Using mathematical models)*
  - *(ii) Graphically (Using the breakeven charts)*

2.3 THE NUMERICAL METHOD OF DETERMING THE BREAKEVEN POINT

2.3.1 The Breakeven point in units

At breakeven point, the units, **q**, that can be produced and sold are given by;

$$q = \frac{Fixed\ Costs}{Unit\ Selling\ Price - unit\ variable\ cost}$$

But, **contribution = (unit selling price – unit variable cost)**

Therefore;

$$q = \frac{Fixed\ Costs}{Contribution\ per\ unit}$$

2.3.2 The Break-even point in monetary terms (shillings)

The breakeven point in monetary terms gives the value of sales that must be made by the firm to breakeven. Therefore;

$$Sales\ at\ breakeven\ point\ (BEP\ in\ shillings) = \frac{Fixed\ costs}{Contribution\ to\ sales\ ratio\ (C/S\ ratio)}$$

The contribution to sales ratio is also referred to as the Profit / volume ratio (P/V ratio)

Therefore;

$$Sales\ at\ breakeven\ point\ (BEP\ in\ shillings) = \frac{Fixed\ costs}{P/V\ Ratio}$$

Where;

$$Profit - volume\ ratio\ (P/V) or\ C/S\ ratio = \frac{Total\ contribution}{Total\ sales} \times 100\%$$

Alternatively;

$$P/V \text{ or } C/S \text{ ratio} = \frac{selling\ price - variable\ cost}{selling\ price} = \frac{unit\ contribution}{unit\ selling\ price} \times 100\%$$

Example 2.1
A company makes a single product with the selling price of UGX20,000 and unit variable cost of UGX 12,000. Fixed costs incurred include production costs of UGX40,000,000 and administration costs of UGX20,000,000.

Required:
(a) *Calculate the number of units to breakeven*
(b) *Contribution sales ratio*
(c) *Sales at break even point*

2.4 BREAKEVEN ANALYSIS IN A MULTI-PRODUCT ENVIRONMENT

- The derivations made in the previous section have been based on a single product. However, under normal circumstances, a firm will produce and sell a variety of products and services.

- In such a situation, the following assumption is made;
  - *The products sales mix remains unchanged or*
  - *All products manufactured have the same C/S ratio*

- In other words, whenever X units of product A are sold, Y units of product B and Z units of product C are sold.
- The sales mix or product mix represents the relative proportion of sales of each product.
- The above assumption allows us to calculate a weighted average contribution per mix, the weighting being on the basis of the quantities of each product in the constant mix.

2.4.1 Steps followed in computing the breakeven point in a multiple product environment

Step 1: Calculate the contribution per unit
Step 2: Calculate the contribution per mix
Step 3: Calculate the breakeven point in terms of the number of mixes
Step4: Calculate the breakeven point in terms of the number of units of the product
Step 5: Calculate the breakeven point in terms of revenue.

Example 2.2

PKF (U) Ltd produces and sells two products Omo and Nomi. A unit of Omo sells for She. 700 and has a total variable cost of shs. 294 per unit while Nomi sells for shs. 1,500 per unit and has a total variable cost of shs. 450 per unit. The marketing department has estimated that for every five units of Omo sold, one unit of Nomi will be sold. The organisation's fixed costs amount to shs.6,160,000.

Required:
Calculate the breakeven point of PKF (U) Ltd in terms of number of units and sales revenue.

Example 2.3

Alpha (U) manufactures and sells three products, the beta, the gamma and the delta. Relevant information is as follows;

	Beta Shs per unit	Gamma Shs per unit	Delta Shs per unit
Selling price	13,500	16,500	22,000
Variable cost	7,350	5,890	14,620

Total fixed costs are Shs. 78,232,000

Analysis of the past trading patterns indicates that the products are sold in the ratio 3:4:5

Required:
Calculate the breakeven point of Alpha (U) Ltd in terms of units and sales revenue

2.4.2 Contribution to sales (C/S) ratio for multiple products

- If the firm's fixed costs are common to all the products produced and sold, then, to determine the firm's breakeven point, the multiple-product firm's C/S ratio can also be used.
- The total fixed costs will be divided by the calculated C/S ratio to determine the breakeven point.
- The multiple product's C/S ratio is the weighted average of the C/S ratios for all products, the weights being the relative proportion of each product's sale.
- The contribution ratio (C/S ratio) for multi-product firm can also be calculated by dividing the total contribution from all products by the total sales.
- The following simple steps can be followed;

Step 1: Calculate the revenue per mix
Step 2: Calculate the contribution per mix
Step 3: Calculate the average C/S ratio
Step4: Calculate the breakeven point (total)
Step 5: Calculate the revenue ratio of mix
Step 6: Calculate the breakeven sales

Example 2.4

Rework example 2.2 and 2.3 using the above approach

2.4.3 Further interpretation of C/S ratio for multiple products

Usually a firm might determine the individual product's C/S ratio. For example, if an organization sells two products A and B in the ratio 2:5. Assuming the C/S ratio of product A is 10% whereas that of product B is 50%, then the average C/S ratio is calculated as follows;

$$Average\ C/S\ ratio = \frac{(2 \times 10\%) + (5 \times 50\%)}{2 + 5} = 38.6\%$$

Example 2.5

TIM (U) Ltd produces and sells two products, the MK and KL. The organization expects to sell 1 MK for every 2 KLs and the monthly sales revenue of shs. 150,000,000. The MK has a C/S ratio of 20% whereas the KL has a C/S ratio of 40%. Budgeted monthly fixed costs are shs. 30,000.

Required
Compute the budgeted breakeven sales revenue.

2.5 TARGET PROFIT

To earn any amount of profit, the company has to operate beyond the breakeven point. The units to be produced and sold in order to get the planned or desired profit may be determined as follows;

$$q = \frac{Profit + fixed\ costs}{Unit\ contriobution}$$

Alternatively;

$$q = \frac{Profit + fixed\ costs}{Unit\ selling\ price - unit\ variable\ cost}$$

Example 2.6

ABC (U) Ltd produces and sales a single product to its customers. The following data were extracted from the books of the company covering the month of December 2014.

	UGX
Annual fixed costs	10,000,000
Expected selling price per unit	20,000
Variable cost per unit:	
Production cost	9,000
Selling & distribution	7,000

A profit of UGX 2,000,000 is planned.

Required
(a) How many units should be produced and sold in order to make the plan possible?
(b) Determine the amount of profit that can be made to get the profit above.

Example 2.7

A company expects to sale 10,000 units. The variable cost per unit is UGX 1,000 and annual fixed costs of UGX 20,000,000.

Required
(a) What price would be charged in order top breakeven at a given level of activity?
(b) Using the price calculated in (a) above, determine the amount of units that should be sold in order to yield a desired profit of UGX1,000,000.

2.5.1 Target profit after tax

The profit goal or desired profit may be stated in terms of profit after taxes. In such scenario, the following formula applies.

$$Amount\ of\ units\ that\ can\ be\ produced\ and\ sold = \frac{Fixed\ cost + \frac{Desired\ profit}{1-tax\ rate}}{Unit\ selling\ price - unit\ variable\ cost}$$

$$Sales\ value\ (to\ earn\ desired\ profits) = \frac{Fixed\ cost + \frac{Desired\ profit}{1-tax\ rate}}{Contribution\ ratio\ (C/S\ ratio)}$$

Example 2.8

XYZ (U) Ltd plans to earn an after tax profit of UGX. 1,200,000. The unit selling price and variable cost amount to UGX10,000 and UGX6,000 respectively. The fixed costs are estimated to amount to UGX20,000,000.

Required

Given that the corporation tax rate is 30%; compute

(i) The number of units that should be produced to enable the firm earns the desired profit.

(ii) What is the amount of sales value at the desired profit level?

2.5.2 Target profit for multiple products

- Where a firm produces a variety of products, the number of mixes of products required to be produced and sold to achieve a target profit are given as below;

$$\frac{Fixed\ Costs + Required\ profit}{Contribution\ per\ mix}$$

Example 2.9

MPK (U) Ltd produces and sells three products SUN, MOON and STAR. The products are sold in the proportions SUN:MOON:STAR = 2:1:3. The company's fixed costs amount to UGX8,000,000 per month. The details of the products are as follows;

Product	Selling Price (UGX)	Variable Cost (UGX)
SUN	2,200	1,600
MOON	1,500	1,200
STAR	1,900	1,300

MPK Ltd plans to earn a profit of UGX5,200,000 next month.

Required

Compute the required sales value and units of each product to achieve the above target profit.

2.6 MARGIN OF SAFETY

- This represents the difference between current operating activity level and the breakeven sales or quantity.
- The margin of safety measures how far the company is beyond the breakeven point. It is the level; of sales below which sales must drop before the company starts experiencing losses.

- The firm is safer where its margin of safety is high. A low margin of safety may result in the firm having a low C/S ratio. When both the margin of safety and the C/S ratio are low, management can think of the following possible intervention;
  (i) Increase the selling price on the premise that the sales volume will no be affected,
  (ii) Reduce on the variable costs by making some improvements in the manufacturing process

- Excess sales/revenue above the breakeven point is the margin of safety of sales (S-P) and excess amount above the optimum quantity is margin of safety in units.
- Therefore; using the mathematical approach, the margin of safety can be derived as follows;

- ***This gives a summary of the above derivatives as follows;***

$$Margin\ of\ safety\ (units) = \frac{Target\ profit}{Unit\ contribution}$$

$$Margin\ of\ sales\ (UGX) = \frac{Target\ profit}{C/S\ ratio}$$

Example 2.10
PQR (U) Ltd targets a profit of UGX500,000 in the month of February 2015. It has been established that the following data are available;

Unit selling price	5,000
Unit variable cost	1,000
Fixed costs	1,200,000

Required
(i) Determine the company's margin of safety in units and shillings.
(ii) Determine the relative margin of safety (in percentage terms).

2.6.1 Margin of Safety for Multiple products

- The margin of safety for multiple product organisations is equal to the budgeted sales in a standard mix less the breakeven sales in the standard mix.
- The process of determining the margin of safety for multiple products is exactly the same as for single products though under multiple products we use the standard mix.

Example 2.11
Harvest Co produces and sells two products. The W sells for She 800 per unit and has a total variable cost of shs. 380 per unit, while the R sells for shs. 1,400 per unit and has a total variable cost of shs. 420 per unit. For every five units of W sold, six units of R are sold. The company's fixed costs amount to 4,389,000.
The company's budgeted sales revenue for next period is shs. 7,440,000 in the standard mix.

Required
Calculate the margin of safety in terms of sales revenue and also as a percentage of budgeted sales revenue.

2.7 THE BREAKEVEN CHARTS

- This is a graph on the Cartesian plan showing costs and revenue on the Y-axis and activity (output) on the X-axis. The breakeven chart can be used to show how total cost, fixed cost, variable cost and revenue change as the level of output changes.

- Breakeven charts are useful for illustrating to managers the potential profits from the range of production and sales open to them. Under this approach, two models of CVP analysis include;

  - *The economist's model*

  - *The accountant's model*

2.7.1 The Economist's CVP Model

The economists' explanation is that the relationship between output and total cost or vital revenue is curve-linear (no clear relationship). The total revenue is curve linear indicating that more units of output can only be sold if price is reduced. Thus, the total revenue line does not increase proportionately without price reduction. Between points B and T, revenue is increasing at a decreasing rate up the point T (i.e. optimal point). The economists argue that beyond point T, more units can be sold if a selling price is reduced; the total revenue curve thus begins to fall. Beyond this point (T), the marginal revenue (MR) will be negative.

According to the economist, the total cost curve rises sharply at first i.e. between A and B because of trying to operate a plant designed for a much larger output volumes at very low capacity utilization i.e. unit cost is very high because of startup costs which are high and cannot be recovered at low volumes of output. In that range the firm is making losses because overhead costs cannot be fully covered by the revenue generated (total costs higher than the total revenue). After point B, the total cost curve flattens or rises less steeply because of

economies of scale or increasing returns to scale. The unit cost within this range is lower because of trade discounts result from bulk purchases, lower labour cost as a result of specialization and learning curves effects. The firm is operating at its most efficient output level. After point E, the total cost curve begins to rise steeply again because of trying to operate a plant beyond the plant installed capacity or the planned capacity and this results into bottle necks and plant breakdown that require major repairs. The effect of this is that output per direct labour hour causes the variable cost per unit to increase. This is described ad decreasing returns to scale.

However, economists recommend firms to operate at the point where Marginal revenue (MR) is exactly equal to Marginal cost (MC). At this point the gap between total revenue curve and total cost curve is so wide. The economist's model helps management in addressing both short and long term plans and decisions

2.7.2 The Accountant's CVP Model

The accountants' approach to Cost-Volume-Profit analysis cannot work out or is not applicable unless certain assumptions are in place. The assumptions that underlie the application of Accountants approach to CVF analysis include the following.

(i) **The assumption that total costs and total revenue are linear functions of output**- It is assumed that the selling price, variable cost per unit and total fixed costs do not change as output increases or decreases. Because of this, any increase in the level of output will influence revenue and costs in the same direction.

(ii) **The single product or constant sales mix assumption-** It is assumed that organization produces and sales a single product, and in any case many products are to be produced and sold (multi-product), the sales mix should remain constant.

(iii) **Production and sales are synchronized i.e. there are no stocks-** It is assumed that whatever the company manufactures are all sold in the same period, therefore no closing and opening stocks at the end of the period are expected

(iv) **Constant efficiency and productivity levels-** it is believed that the production methods and level of technology remain the same.

(v) **Volume of output –** it assumes that the only factor that influences total costs and total revenue is volume of output

(vi) **Separation of costs**- All costs and particularly the semi-variable costs can be separated into fixed and variable elements.

According to the accountant, the CVP model is baseless or meaningless in the absence of the above assumptions. The accountant's model introduces the concept of angel of incidence which represents the angel at which the revenue line cuts the total costs line. If the angle is large, it indicates that the profits are being made at a high rate. Likewise, they are being achieved under less favorable conditions.

According to the accountant's model, the output level that maximizes profits is the maximum practical capacity. However, the relevant range is always observed in determining the maximums level of the activity. Compared to economist model, the Accountant's model is not realistic in the long run. It is not logical to assume that the sales revenue will keep increasing up to infinity. However, the accountants defend their model by saying that it is not meant to provide accurate representation of the relationship between output, costs and revenues throughout all ranges of output but only over the relevant range. The term relevant range refers to the output range that is planned at which a firm expects to operate usually in one year or short run. The accountant's model is definitely not applicable in the long run but only in the short run. Over the relevant range, the accountants and economists model reconcile i.e. they are not in conflict.

REVISION QUESTIONS

Question 2.1 MALOBA Ltd

Maloba Ltd manufactures products P, Q, and R with the following selling prices and fixed costs per unit.

	PRODUCT		
	P	Q	R
	Shs	Shs	She
Selling price	400	900	1,000
Variable costs	230	720	960

Fixed costs:

Product specific	49	150	62
General	56	56	56

Unit fixed costs are based on the following annual sales and production volumes.

Product	Units
P	98,100
Q	42,100
R	111,800

Required

(a) Calculate the break-even point sales of Maloba Ltd based on the present product mix.
(b) Calculate the number of units of product Q at the break-even point determined in (a) above
(c) Comment on the viability of product Q.

Question 2.2 KWAGALANA Ltd

Kwagalana Ltd produces and sells three products; namely, A, B and C. The following data were obtained for the year 2014.

Products	**A**	**B**	**C**
Sales units	600	2,500	2,000
Unit selling price	2,500	1,000	3,000
Unit variable cost	1,000	400	2,200

The company incurs total fixed costs given below;

Production costs	UGX3,200,000
Selling and administration costs	UGX2,800,000

Required

(i) Calculate the break-even point sales of Kwagalana Ltd based on the present product mix.
(ii) Calculate the number of units of each product at the break-even point determined in (i) above.
(iii) Comment on the viability of each products.

Question 2.3 MPAIN Co

Mpain Company produces and sells soft drinks. The company has provided you with the following:

Products:	**Passion Jusi**	**Lemon Jusi**	**Apple Jusi**
Sales mix	2	4	4
Selling price per unit (Ushs)	30,000	25,000	16,000

Cost per unit (Ushs)			
Direct materials	8,000	7,000	5,000
Direct labour	6,000	6,000	3,000
Variable overheads	4,000	2,000	2,000

Fixed costs for the period for all the products; Ushs 60,000,000

Required:

i. Determine the breakeven point in units and in shillings, in total for each product.

ii. How many units of products passion Jusi, lemon Jusi and apple Jusi should be produced and sold to achieve a target net profit of ush.80,000,000

iii. Comment on the contribution margins of the three products.

QUESTION 2.4

A company sells two products A and B with contribution margin of 40% and 30% respectively, and selling prices of shs 50 and shs 25 per unit respectively. Fixed costs amount to shs 720,000 per month. Monthly average sales (in units) are 300,000 for product A and 400,000 for product B.

Required

(a) (i) Assuming that three units of product A are produced for every four units of product B, calculate the sales volume necessary to breakeven in shillings and units.

(ii) Calculate the margin of safety in shillings

(b) If the company spends an additional shs 9,300,000 on advertising, sales of product A can be increased to 400,000 units per month. Sales of product B will, however, fall to 320,000 units if this is done.
Advise management whether the proposal to advertise should be accepted.

QUESTION 2.5 BWISHO TRADING Co

Bwisho Trading Company produces two products P and Q and the following budget has been prepared:

	A	**B**	**Total**
Sales units	120,000	40,000	160,000
Sales (shs)	600,000	400,000	1,000,000
Variable costs (shs)	480,000	120,000	600,000
Contribution (shs)	120,000	280,000	400,000
Total fixed costs (shs)			300,000
Profit (shs)			100,000

Required

(a) Compute the break-even point in total and for each product

(b) The company proposes to change the sales mix in units to a ratio of 1:1 for products A and B. Advise on whether this change is desirable.

QUESTION 3 KAVULE GARMENTS LTD

Kavule Garments Limited (KGL) based in Makerere deals in the production of graduate gowns for commercial purposes. It has been approached by Makerere University to produce uniquely designed graduation gowns to be worn by all graduands on the 52nd graduation ceremony. The University intends to sell gowns for only three years, then award the tender to a private company at Shs 250,000,000. KGL will take responsibility for both the

design and production costs while the University will cater for the marketing and distribution costs. The production manager of KGL has stated that this order will cost Shs 12,000,000 to design.

The following cost information relates to the production of gowns:

	Total fixed costs each year shs	Variable costs per unit shs
Production costs	80,000,000	100,000
Marketing and distribution costs	100,000,000	50,000

Required
Suppose KGL decides to charge Makerere University shs. 200,000 for each gown produced, how many gowns will have to be produced for KGL to breakeven on this order?

QUESTION 4

Cost volume profit (CVP) analysis is commonly known for guiding business managers to make decisions about profitability using break-even chart analysis. However, economists believe that there are limitations due its underlying assumptions.

Required
Explain the limitations of CVP analysis. ***(10 marks)***

QUESTION 5

WORKOUT QUESTION 1 – CPA(U) AUGUST 2016 FROM THE QUESTION BANK

PART C

Application of Relevant Costs for Decision Making

3.0 RELEVANT COSTS FOR DECISION MAKING

UNIT 3 OVERVIEW:

- Key Definition
- Definition and meaning of relevance
- Importance of qualitative factors in decision making
- Relevance cost of materials
- Relevance cost of Labour
- Relevance cost of Overheads

3.1 INTRODUCTION

- Firms are continuously seeking for alternative courses of action to address numerous organisational challenges and make appropriate decisions. Because of the availability of various alternatives that can be used to address the problems facing the organization, managers are always forced to choose between these alternative courses of action.
- The aim of this unit is to bring out the various techniques that can be employed by management in decision making function to ensure that the best alternative that will add value to the organization is selected and implemented.
- Decision-making involves the process of evaluating two or more alternative courses of action leading to a final best choice. Decision-making is closely associated with planning for the future and is directed towards a specific objective or goal.
- Decision-making is a fundamental exercise of management in the managerial process. It is concerned with the future and involves a choice between alternative courses of action. Successful decision-making consists of the following steps:
    1. *Problem identification*
    2. *Identification of objectives*
    3. *Search for alternative courses of action*
    4. *Gathering data about the alternatives*
    5. *Evaluation and selection of a course of action*
    6. *Implementing the decision*
    7. *Monitor the results to ensure the desired results are achieved.*

3.2 RELEVANT COST FOR DECISION MAKING

3.2.1 Key definitions

- **A relevant cost** is a future cash flow arising as a direct consequence of a decision. It is therefore a future cash flow that will differ between the various alternatives being considered. Relevant

costing therefore examines both additional costs and additional revenues likely to result from each degree of change.

- **Relevant cost analysis** is the process of estimating the consequences of alternative actions that the decision maker may take. In each of these decisions, the financial implications of each alternative have to be weighed upon. Each decision requires the comparison of one or more proposed alternatives with the status quo.

3.2.2 Features of Relevant Costs

Specifically, fundamental features of relevant cost include the following;

- **Is a cash flow**: Only cash flow information is required for decision-making. Items such as depreciation, bad debts, and notional costs should be excluded.
- **Is a future cost**: Only future costs are relevant for decision-making. These are forward looking based on expected factor prices for the planning period. Costs that have been incurred i.e. past costs, Sunk costs and committed costs are irrelevant for decision-making.
- **Differential cost/revenue**: Only costs which differ among decision alternatives are relevant to a decision. They are different under one set of conditions than they would be under another set of conditions. The two elements or criteria of costs that differ among alternatives are
  (a) incremental costs and
  (b) Opportunity costs.

(a) Opportunity cost: An opportunity cost is a benefit foregone by choosing one option instead of the next best alternative. These represent the maximum income or benefits lost from not choosing the next best alternative.

(b) Incremental costs: In effect, differential costs are incremental costs. These are avoidable or escapable costs which are incurred only when the activity is extended beyond its present range. These could also be regarded as the difference in total costs resulting from a contemplated change. In effect, variable costs are incremental costs unless additional business also involves additional fixed costs outlay.

3.2.3 Fixed and variable costs

- **Variable costs will are relevant costs**

a) Directly attributable costs are those costs, although fixed within a relevant range of activity level are relevant to a decision for either of the following reasons.
   i. They could increase if certain extra activities were undertaken e.g. it may be necessary to employ an extra supervisor if a particular order is accepted. The extra salary would be an attributable fixed cost.
   ii. They would decrease or be eliminated entirely if a decision were taken either to reduce the scale of operations or shut down entirely.

- **Fixed costs are irrelevant to a decision**

b) General fixed overheads are those overheads which will be unaffected by decisions to increase or decrease the scale of operations. They are usually apportioned costs and are not relevant in decision making.

- **Absorbed overheads are notional (estimated/hypothetical) accounting costs and hence irrelevant.**

In summary;

Costs are relevant if:

i. They are future costs
ii. They are incremental/avoidable
iii. They arise out of cash flow
iv. They are variable and directly attributable fixed costs

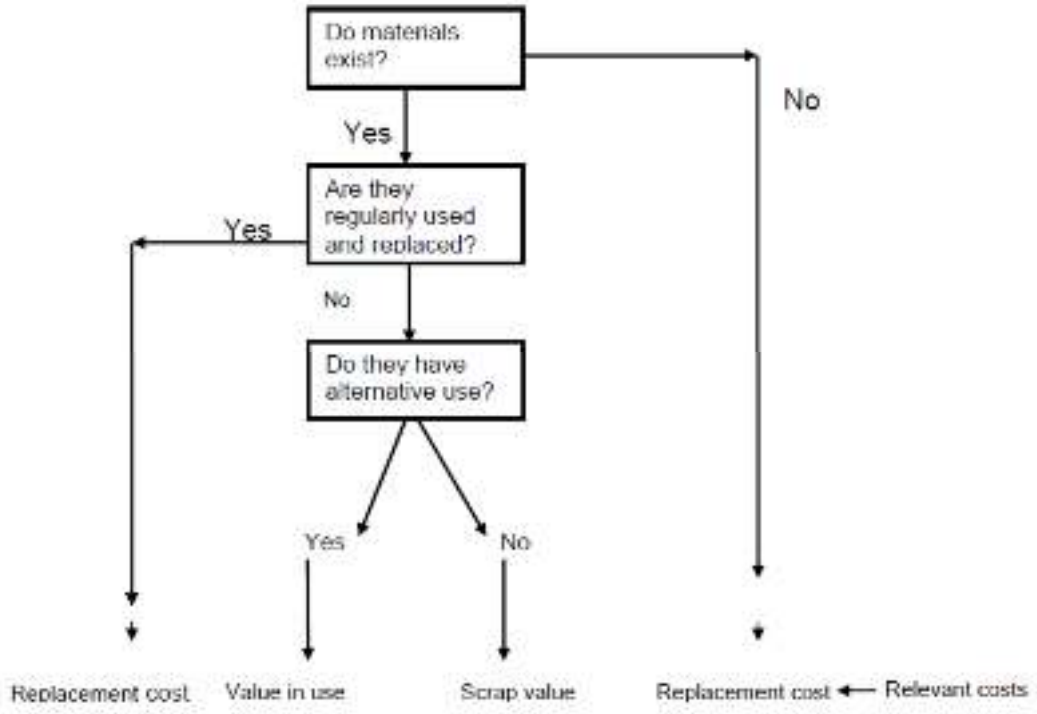
Costs are irrelevant if:

i. They are sunk/historical costs
ii. They are committed costs
iii. They are hypothetical accounting costs e.g. depreciation.
iv. They are general fixed costs

3.3 IDENTIFYING RELEVANT COSTS

3.3.1 MATERIALS

The relevant cost for materials rotates around the principle that once materials exist, it is because they are regularly used or have alternative use. Otherwise they should be scrapped – see figure below.



- The relevant cost of materials is generally their current replacement or purchase cost unless the materials have already been purchased and will be replaced once used.

- If the materials have already been purchased but will not be replaced, then the relevant cost of using them is either,(a)their current resale value,(b)the value they could obtain if they were put to the alternative use, if this is greater than their current resale value. The higher of (a) or (b) is then the opportunity cost of the materials.

Illustration1

Assume there is job B to be done. The company has materials worth UGX4,500,000 in the store.

Alternative 1: The Company can resale all the materials at UGX2,400,000.
Alternative 2: If not used on another job E this would have cost UGX2,800,000.

In alternative1 above the UGX4,500,000 is a sunk cost and is irrelevant to decision making. On the other hand, the opportunity cost of using materials on job is UGX2,400,000.

In alternative 2 above, the opportunity cost of using materials will be UGX2,800,000.

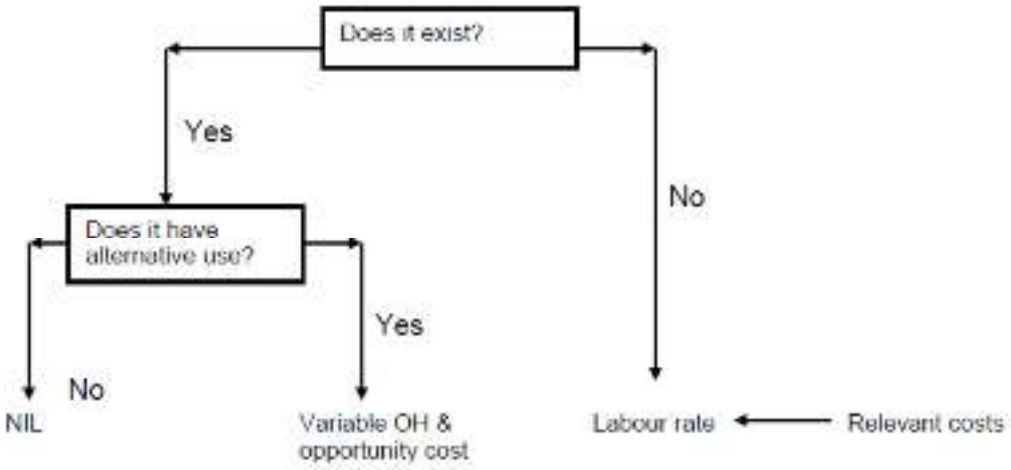
In the above case, since alternative 2 provides a higher saving that will be foregone if materials were used on job B, it represents a relevant cost.

Therefore,

1. Where the materials are in continuous use, the relevant cost is the future replacement cost.
2. Where the materials are not in continuous use, the relevant cost is the higher of the salvage value and the value for the alternative use.
3. However, if the materials had no resale value and no other possible use, then the relevant cost of using them for the option or opportunity under consideration would be zero.

3.3.2 LABOUR

- The relevant cost of labour is the replacement cost or the incremental cost or the hiring cost or all the above.
- However if the order under consideration necessitates the transfer of employees who are fully occupied on the existing job, and yet making a contribution, if affected, the company will register the loss on contribution. This lost contribution is always a relevant cost in decision-making (Opportunity cost).



.

3.3.3 OVERHEAD COSTS

- Only directly attributable overheads are relevant for decision-making, any non-cash overheads, fixed overheads and general overheads are irrelevant. General overheads refer to headquarters overheads charged to jobs.

Activity 3.1

Jomayi (U) Ltd deals in construction of houses to its clients. During the year 2014, the company got an order from Deal Enterprises for a house to be constructed around Muyenga Hill at a contract price of UGX45,000,000. In January 2015, when the company had done 40% of the work, it got information that Deal enterprises had gone into liquidation and there is no prospect that any money will be obtained from the winding up of the company.

Jomayi (U) Ltd had already spent UGX8,000,000 on the house and progress payments of UGX10,000,000 had been received from the customer (Deal) prior to liquidation.

Kazinda has however offered to purchase the same house at UGX28,000,000 once it is completed
Jomayi realized that to complete the house, the following costs will be incurred:-

Materials: These have been bought at cost of UGX6,000,000 .They have no other use and if the house is not completed, they will be sold for scrap at 2,000,000 Additional materials needed will cost UGX4,000,000.

Labour costs: The Management of Jomayi established that more workers will be hired at a total cost of UGX2,000,000 if the house is to be completed. Besides this, employees who are permanently employed their wage bill will increase by UGX2,500,000.

Labour is in short supply and if the house is not complete, the workforce will be switched to another job and will earn UGX3,000,000 in revenue and incur UGX1,200,000
If the work is not completed, Jomayi Ltd will pay subcontract fees amounting to UGX1,100,000 otherwise the fees will amount to UGX3,300,000.

Required:
Assess whether the new customers offer should be accepted and bring out the reasons for inclusion of any costs.

3.3.4 THE DEPRIVAL VALUE OF AN ASSET

The deprival value of an asset represents the amount of money that a company would have to receive if it were deprived of an asset in order to be no worse off than it already is.

Activity 3.2

A machine cost UGX14,000,000 ten years ago. It is expected that the machine will generate future revenues of UGX10,000,000. Alternatively, the machine could be scrapped for UGX8,000,000. An equivalent machine in the same condition would cost UGX9,000,000 to buy now. What is the deprival value of the machine?

3.4 SHORT TIME DECISIONS

The short-run decisions include:-

(a) Make or buy decision
(b) Operate or shut down decision
(c) Product mix under limiting factor decisions
(d) Accept or reject special order decisions
(e) Sell or process further decision

3.5 MAKE OR BUY DECISION.

Management sometimes may have to make a choice between manufacturing the component parts of the product or buying them from outside. Such a situation of make or buy decision may arise whenever the firm has the idle plant capacity and the technical capability of manufacturing the component parts. The economics of the two alternatives is examined on the basis of differential cost analysis.

3.5.1 The Make decision

Here, the firm has idle plant capacity (i.e. a machine is underutilized) and the technical capability of manufacturing the component part. To arrive at the make decision, the management of the firm should evaluate the costs associated with making the component part. These include;

(i) Differential variable costs of materials
(ii) Differential variable costs of labour
(iii) Differential variable overhead costs
(iv) Specific and any additional fixed costs (where applicable)
(v) The opportunity costs of suspending the production of existing products.

3.5.2 The Buy decision

Here, the firm has no spare capacity i.e. the machine is fully busy and the manufacture of the component part will require the withdrawal or suspending the production of existing products. In such a case, to arrive at the buy decision, management of the firm should evaluate the costs associated with the buy decision. These include;

(i) The purchase price,
(ii) Transportation costs,
(iii) Insurance costs and
(iv) Ordering costs

3.5.3 Irrelevant costs in the Make or buy decision

These are costs that cannot be relevant to the make or buy decision and include;

a. Allocated fixed costs that remain unchanged in total when components are produced.
b. The costs that will be incurred under both the buy and make alternatives.

- However, if the spare capacity that will be created in case the components are to be purchased can be utilized in the most effective way, the amount realized from that spare capacity is relevant to decision-making.

3.5.4 Qualitative factors / Non-financial factors which my influence the Make or buy decision

(i) The quality of the components supplied when the buy decision is taken,
(ii) The delivery time (Lead time). The possibilities of delays by the supplier should ve considered,
(iii) The morale of the existing workers especially those whose earnings are affected by the buy/make decision.
(iv) The reliability of the prospective suppliers.
(v) The financial and technical capacity of the prospective suppliers.

Activity 3.3

BMK (U) Ltd manufactures 1,000 components used to make the final product and the cost structure is as below.

	Cost per unit (UGX)
Direct material	2
Direct labor	6
Variable	3
Fixed over heads	4
Total	15

Debo who is outside supplier is offering to sell the component to BMK for shs16 each.
The labour force is in short supply and existing labour force is fully occupied. To produce the component the company will have to divert 2 workers who are currently producing product A and each worker currently contributes shs4 per unit if each component is to be produced. These 2 workers are part of the permanent staff but each workers salary will increase by shs1 for every component produced.

All the materials to make the required components are already in the warehouse and have no alternative use at all. The materials were purchased at a cost of shs 2 per unit.
If the components are to be manufactured, the purchasing manager's salary will decrease by shs2 for every component manufactured though the supervisor's salary will increase by shs3 per unit made.
For every component manufactured or purchased, quality test will be carried out at rate of shs3 per unit

Required:

(i) Advise the firm whether the component should be manufactured or purchased or whether the offer should be accepted.

(ii) Other than the cost criterion, what qualitative factors are likely to affect the decision made

3.6 OPERATE OR SHUT-DOWN DECISIONS

- Where the organization operates several production lines, one or more of these lines may appear to be unprofitable hence perpetuating management to reach a shut down or delete decision. Differential cost analysis is used when the firm or business is faced with the possibility of temporary shutdown.

- The type of analysis has to determine whether in the short-run a firm is better off operating than not operating. Before the decision of shut down is taken, its impact on overall profits must be assessed.

- As long as production line recovers all the variable costs and make a contribution towards the recovery of fixed costs, it may be preferable to operate and not to shut down.

- If the profits rise due to shutting down, then shut down otherwise maintain the production line. However, management should consider the investment in the training of its employees which would be lost in the event of a temporary shutdown.
- Another factor is the loss of established markets for the products the company has been selling. The danger of obsolescence of the plant cannot be ignored.

Activity 3.4

JESA (U) Ltd manufacturers three dairy products, Ghee, Ice and Butter. JESA's Income statement for the period ending 31 December 2014 is presented below.

	Ghee (UGX)	ICE (UGX)	Butter (UGX)	TOTAL (UGX)
Sales	150,000	180,000	160,000	490,000
Variable costs	90,000	172,000	110,000	372,000
contribution	60,000	8,000	50,000	118,000
Fixed costs	17,000	18,000	20,000	55,000
P&L	43,000	(10,000)	30,000	63,000

The company is concerned about its poor profit performance and is considering whether or not to cease selling Ice. It is felt that selling prices cannot be raised or lowered.
If the production of ice is suspended shs6,000 of fixed will be avoided because the cost is directly related to ice production. Assume that ice cannot be substituted by any other product and that investment in assets cannot be reduced if this product is dropped. All other fixed costs are considered to remain the same.

***Required**:*
Advise on the shutdown of ice and make any reservations.

3.7 PRODUCT MIX DECISION UNDER LIMITING (KEY) FACTOR.

When a company manufactures more than one product, a problem is faced by the management as to which product mix (*product composition*) will give the maximum profits. If there is demand for all the products that can be produced, the company may at times find it difficult to meet the needs of the customers especially if demand is in excess of its productive capacity.

The level output of the company may be restricted by shortage of resources known as limiting factors.

3.7.1 Key Term

A limiting factor is an element that restricts the output and the profit potential earning capacity of the firm. Limiting factors could be shortage of labor, materials, equipment or factory space. To make matters worse, within a short time it is unlikely that these production constraints can be removed and additional resource acquired.

Where the limiting factors apply, profit can be maximized when the greatest possible contribution to profit is obtained each time the scarce or limiting factor is used.

3.7.2 The contribution approach to limiting factors:-

In making the product mix decision, the following steps are followed:-
Step 1: Determine the contribution per product (i.e. Unit selling price-Variable cost)
Step 2: Determine contribution per limiting factor. This gives the measure of profitability for a unit of a limiting factor. This can be calculated by using the formula below;

$$Contribution\ per\ limiting\ factor\ = \frac{Unit\ contribution\ (Unit\ selling\ price - Variable\ cost)}{Units\ of\ scarce\ resource\ to\ make\ complete\ unit}$$

Step 3: Rank the products by contribution per limiting factor by assigning one to the product with highest contribution per limiting factor and in that order.

Step 4: Produce to full satisfaction of each product following the ranking order until the limiting factors units are used up.

Activity 3.5

A company produces three products and is reviewing the production and sales budgets for the next accounting period. The following information is available for the three products

	Oranges	Passion Fruits	Apples
Unit selling price	200	150	800
Variable cost per unit	140	70	600
Fertilizers per unit (Kgs)	¼	½	2
Estimated sales demand	500 units	1,000units	600units

Amount of fertilizers is limited to 1,700 kilograms for the period and is insufficient to meet total sales demand.

Required:

(i) Determine the product mix a company can produce and sell in order to maximize returns during the period.

(ii) Total contribution to be gained and lost because of the optimum mix selected

TEST YOUR UNDERSTANDING:

Workout Question 3.5: RINGTHO INV Ltd under revision questions to test your understanding of special orders

3.8 SPECIAL ORDER DECISION:

Special order decisions involve determining whether or not a special order from a customer outside the normal customer base should be accepted. The order usually involves an offer at a price less than the normal selling price.

From a business perspective, customers often approach a company and ask to buy a specified quantity of product at a specified price. Sometimes the customer will request modifications to the product as well, such as a special logo. This type of decision is usually a one-time order that will not impact the supplier's regular sales.

Before considered a special order, the company must have **idle capacity**, i.e., it should have the ability to complete the special order without expanding its operations. In other words, it must have resources that can be used to fulfill the order.

The special-order decision is based on the difference between **incremental revenue** and the **incremental costs**.

3.8.1 Incremental analysis components

Short-term management decisions such as special orders are best performed when based on an **incremental analysis**. While decisions can be made by examining side-by-side income statements and identifying the differences, incremental analysis is the straightest forward, the shortest, and the easiest approach. Incremental analysis enables managers to focus on the relevant parts of a decision. A manager that prepares side-by-side income statements wastes a lot of time capturing and listing costs that are not relevant as they will not impact the decision at hand.

- **Incremental Revenue**

Incremental revenues are the additional revenues generated from accepting the special order. The revenue can result from additional sales of products or from providing services. If the company is operating at less than capacity, revenue of regular customers will not be affected. If the company is operating at capacity, it will have to give up some regular sales in order to provide the special order.

- **Incremental Costs**

Incremental costs are the additional costs incurred from accepting a special order. Variable product costs are always incremental and cause profits to decline. Variable operating costs include selling costs such as commissions and shipping costs are relevant as well. Cost savings do not exist in special order decisions.

3.8.2 Amounts that are not relevant in special order decisions

Costs that will be incurred regardless if a special order decision is accepted or not are not relevant for special order decisions. Most often, a company's recurring fixed costs will remain the same in total if a special order is accepted.
Occasionally the acceptance of a special order may cause additional fixed costs. In these cases, these additional fixed costs are relevant and should be considered in an incremental analysis. Sunk costs are not relevant with any special order decision process.

3.8.3 Evaluating special order decisions

Special order decisions should be generally be accepted if the order is expected to increase profit. The following steps can be used in determining whether a special order should be accepted or rejected;

Step 1: - Determine whether the entity has any spare capacity to take up the special order.
Step 2: - Determine the incremental revenue from accepting the special order
Step 3: - Determine the incremental variable costs by considering the following factors of production;

Incremental costs:	**Shs**
Direct materials	xx
Direct labour	xx
Variable overheads	xx
Total relevant cost to take on special order	xx

Step 4: - Determine the incremental increase or decrease in profit if the special order is accepted by comparing the incremental revenue obtained in step 2 and the incremental variable costs obtained in step 3 above as follows;

	Shs
Incremental revenue	XX
Less: Incremental costs	XX
Increase in profit if the order is accepted	XX

3.8.4 Accept or Reject?

If incremental revenues **are less than** incremental costs, reject the special order unless qualitative characteristics overwhelmingly impact the decision.

If incremental revenues **are greater than** incremental costs, accept the special order unless qualitative characteristics overwhelmingly impact the decision.

If incremental revenues **are equal to** incremental costs, focus primarily on qualitative characteristics to evaluate the decision.

3.8.5 Qualitative factors to consider under special order decisions

Qualitative factors are non-monetary considerations a decision maker should put in mind before accepting the special order. These include;

- Possibility of getting repetitive business from the customer that has placed the special order.
- Customer loyalty issues from existing customers and how the special order may affect them.
- The need to associate with the specific events that the special order is being placed / produced for.
- The brand equity of the company products.
- The cost of employee redundancy during the current production capacity.
- The reliability of the sources/ suppliers and the quality of raw materials before accepting the order.

Activity 3.6

QPL Ltd manufactures medals for winners of athletic events and other contests. Its manufacturing plant has the capacity to produce 10,000 medals each month. Current production and sales are 7,500 medals per month in batches of 50. The company normally charges Shs. 15,000 per medal. Cost information for the current activity level is as follows:

Variable costs per batch	Shs
Direct materials	175,000
Direct manufacturing labour	200,000
Other variable costs	50,000
Fixed manufacturing costs	27,500,000
Fixed marketing costs	17,500,000

QPL has just received a special onetime order for 2,500 medals at Shs 10,000 per medal. Accepting the order would not affect the company's regular business. The special order requires the company to make the medals in batches of 100.

Required:

(a) Advise QPL whether it should accept this special order.

(b) QPL is concerned that if it accepts the special order, the delivery time to its existing customers will be affected. These customers are likely to immediately demand a discount of 6% in the month when the order will be fulfilled. With appropriate computations, advise the company whether it should accept the order.

*(c) Identify **three** non-monetary considerations the company should consider before accepting the special order.*

Activity 3.7

A one off order for shs 3,000 garden chairs has been received from an overseas customer for the coming period. Your budgeted production for the period is shs16,000 chairs which represent 80% of your special capacity to manufacture garden chairs. Budgeted data for the period is as follows.

		UGX
Sales		672,000
Materials	192,000	
Labor	196,000	
Overheads	200,000	588,000
Profit		84,000

You ascertain that UGX.20,000 of labour and 20% of overheads are fixed in nature and the rest of costs are variable.

Required;

(a) Prepare a cost statement to show whether the order should be accepted .If the customer was prepared to pay:

(i) shs 30 per chair

(ii) shs 36 per chair and give reasons for your answer.

(b) What other factors need to be taken into consideration before the order is accepted or rejected?

3.9 PROCESS FURTHER DECISION:

- At times organizations are faced with decisions of whether to improve on the condition of an item before it is sold or to sell it as it is. The decision to be taken in this case will be made after incremental revenue is compared with the incremental costs to be incurred in case the item is processed further.

- If the increment revenue outweighs the incremental costs it is advisable to process an item further before it is sold because the company's profits will increase.

Activity 3.8

Mugume intends to sell his Mitsubishi Pajero which he bought in 1998 at 7,000,000 and has so far got offers from two customers. First customer is offering to pay UGX.2,500,000 at that state. If he accepts that offer Mugume will only pay commission of UGX.100,000 to the brokers. However, the second customer is advising Mugume to Panel-beat the vehicle before he sells and is willing to payUGX.3,500,000 cash. Mugume has realized that if the panel –beating is to be done the following costs will be incurred;

	UGX
Spraying the Vehicle	120,000
Labour Costs	160,000
Spares	280,000
Tyres	380,000
	600,000

Mugume will not pay commission to the brokers since the vehicle will not be parked in their yard.
Mugume has approached you for advice. What offer should Mugume accept and why?

3.9.1 Further Processing: Joint Products

- **Brief introduction**

- Joint products are two or more products which are output from the same processing operation, but which are indistinguishable from each other up to their point of separation.
- Joint products have a substantial sales value and often require further processing before they are ready for sale. Joint products arise, for example in the oil refining industry where diesel fuel, petrol, paraffin and lubricants are all produced from the same process.
- A joint product is regarded as an important sealable item, and so it should be separately costed. The profitability of each joint product should be assessed in the cost accounts.
- The point at which joint products become separately identifiable is known as the spilt-off point or separation point.
- Costs incurred prior to this point of separation are common or joint costs, and these need to be allocated (apportioned) in some manner to each of the joint products.

- **Problems in accounting for joint products**

(i) How common costs should be apportioned between products, in order to put a value to closing inventory and to the cost of sale (an profit) for each product.

(ii) Whether it is more profitable to sell a joint product at one stage of processing, or to process the product further and sell it at a later stage.

- **The Decision to sale or process further**

- Suppose a manufacturing company carries out a process operation in which two or more joint products are made from a common process. If the joint products can be sold either in their existing condition at the 'split-off' point at the end of common processing or after further separate processing, a decision should be taken about whether to sell each joint product at the 'split-off point or after processing.

NOTE:
Joint (pre-separation) costs are included regardless of the decision and are therefore **irrelevant**.

Activity 3.9

The Poison Chemical Company produces two joint products. Alash and Pottum from the same process. Joint processing costs of Shs. 15,000,000 are incurred up to split-off point, when 100,000 units of Alash and 50,000 units of Pottum are produced. The selling prices at split-off point are Shs.125 per unit for Alash and Shs. 200 per unit for Pottum.

The units of Alash could be processed further to produce 60,000 units of a new chemical, Alashplus, but at an extra fixed cost of Shs.2,000,000 and variable cost of Shs.30 per unit of input. The selling price of Alashplus would be Shs.325 per unit.

Required
Advise whether the company should sell Alash or Alashplus.

3.10 OUTSOURCING

3.10.1 Definition

- This refers to the use of external suppliers for finished products, components or services.
- This is also known as contract manufacturing or sub-contracting.

3.10.2 Importance of outsourcing

- *Firms prefer outsourcing to other approaches because of the following reasons;*

(i) **Specialist contractors offer superior quality and efficiency.**
In most cases, the contractors' main business is making a specific component and hence a huge investment has been made by the contractor in the specialised machinery, labour and knowledge skills to make that component.

(ii) Outsourcing frees capital that can then be invested in core activities such as market research, product definition, product planning, marketing and sales.

(iii) Contractors have the capacity and flexibility to start production very quickly to meet variations in demand. In house facilities may not be able to respond a quickly because of the need to re-direct resources from elsewhere.

3.10.3 Internal Vs External Services

- The relevant costs to outsourcing decisions are little different to those that are taken into account in a 'conventional' make or buy situation: they will be differential costs between performing the service internally and using an external service provider.

- The decision maker should critically identify whether existing staff will be made redundant or whether they will be redeployed and whether there are alternative uses for the other resources made available by ceasing to perform the service internally.

REVISION QUESTIONS

QUESTION 3.1 MUKONO CONSTRUCTION Co

Mukono Construction Company Uganda (MCCU) has been asked to quote a price for a one-off contract for the repair of a hotel block in Mukono town. The company's management accountant has asked you for advice on the relevant costs for the contract. The following information is available:

Materials
The contract requires 5,000 bags of cement which is a material used regularly by MBU in other construction works. The company has 4,000 bags of cement currently in inventory which were purchased last month for a total cost of shs. 80 million. Since then, the price per bag of cement has increased by 10%.

The construction works also require 300 cans of paint. There are 350 cans of paint in inventory which are not required for normal construction works. These cans of paint originally cost a total of shs. 17.5 million. If not used on this contract, the inventory would be sold for shs. 4,350 per can of paint.

Labour
The contract requires 750 hours of skilled labour. Skilled labour is paid shs. 6,500 per hour. There is a shortage of skilled labour for this kind of job and all the available labour is fully employed in the company in the production of concrete blocks sold commercially within and outside Mukono town. The following information relates to the production of concrete blocks;

	Shs per unit
Selling price	100,000
Skilled labour	26,000
Other overheads	14,000

Required;
Using the principles of relevant cost analysis, advise the management accountant the total relevant cost of executing the one-off contract above.

QUESTION 3.2 THE TELEPHONE Co

The Telephone Co (T Co) is a company specialising in the provision of telephone systems for commercial clients. There are two parts to the business:

- installing telephone systems in businesses, either first time installations or replacement installations;
- supporting the telephone systems with annually renewable maintenance contracts.

T Co has been approached by a potential customer, Push Co, who wants to install a telephone system in new offices it is opening. Whilst the job is not a particularly large one, T Co is hopeful of future business in the form of replacement systems and support contracts for Push Co. T Co is therefore keen to quote a competitive price for the job. The following information should be considered:

(a) One of the company's salesmen has already been to visit Push Co, to give them a demonstration of the new system, together with a complimentary lunch, the costs of which totalled shs400,000.

(b) The installation is expected to take one week to complete and would require three engineers, each of whom is paid a monthly salary of shs4 million. The engineers have just had their annually renewable contract renewed with T Co. One of the three engineers has spare capacity to complete the work, but the other two

would have to be moved from contract X in order to complete this one. Contract X generates a contribution of shs5,000 per engineer hour.

There are no other engineers available to continue with Contract X if these two engineers are taken off the job. It would mean that T Co would miss its contractual completion deadline on Contract X by one week. As a result, T Co would have to pay a one-off penalty of shs500,000. Since there is no other work scheduled for their engineers in one week's time, it will not be a problem for them to complete Contract X at this point.

(c) T Co's technical advisor would also need to dedicate eight hours of his time to the job. He is working at full capacity, so he would have to work overtime in order to do this. He is paid an hourly rate of shs40,000 and is paid for all overtime at a premium of 50% above his usual hourly rate.

(d) Two visits would need to be made by the site inspector to approve the completed work. He is an independent contractor who is not employed by T Co, and charges Push Co directly for the work. His cost is shs20,000 for each visit made.

(e) T Co's system trainer would need to spend one day at Push Co delivering training. He is paid a monthly salary of shs1.5 million but also receives commission of shs120,000 for each day spent delivering training at a client's site.

(f) 120 telephone handsets would need to be supplied to Push Co. The current cost of these is shs18,200 each, although T Co already has 80 handsets in inventory. These were bought at a price of shs16,800 each. The handsets are the most popular model on the market and frequently requested by T Co's customers.

(g) Push Co would also need a computerised control system called 'Swipe 2'. The current market price of Swipe 2 is shs10.8 million, although T Co has an older version of the system, 'Swipe 1', in inventory, which could be modified at a cost of shs4.6 million. T Co paid shs5.4 million for Swipe 1 when it ordered it in error two months ago and has no other use for it. The current market price of Swipe 1 is shs5,450,000, although if T Co tried to sell the one they have, it would be deemed to be 'used' and therefore only worth shs3 million.

(h) 1,000 metres of cable would be required to wire up the system. The cable is used frequently by T Co and it has 200 metres in inventory, which cost shs1,200 per metre. The current market price for the cable is shs1,300 per metre.

NB: Assume that there are four weeks in each month and that the standard working week is 40 hours long.

Required:

(a) Prepare a cost statement, using relevant costing principles, showing the minimum cost that T Co should charge for the contract. Make DETAILED notes showing how each cost has been arrived at and EXPLAINING why each of the costs above has been included or excluded from your cost statement.

(b) Explain the relevant costing principles used in part (a) and explain the implications of the minimum price that has been calculated in relation to the final price agreed with Push Co.

QUESTION 3.3 RUBBER Co

Robber Co Manufactures control panels for burglar alarms, a very profitable product. Every product comes with a one year warranty offering free repairs if any faults arise in this period. It currently produces and sells 80,000 units per annum, with production of them being restricted by the short supply of labour. Each control panel includes two main components – one key pad and one display screen. At present, Robber Co manufactures both of these components in-house. However, the company is currently considering outsourcing the production of keypads and or display screens. A newly established company based in Burgistan is keen to secure a place in the market, and has offered to supply the key pads for the equivalent of UGX410 per unit and the display screens for the equivalent of UGX430 per unit. The price has been guaranteed to two years.
The current total annual costs of producing the keypads and the display screens are:

	Keypads	Display screens
Production	80,000 units	80,000 units
	UGX"000"	UGX"000"
Direct materials	160	116
Direct labour	40	60
Heat and power costs	64	88
Machine costs	26	30
Depreciation and insurance costs	84	96
Total annual production costs	**374**	**390**

Additional Information

(i) Materials costs for keypads are expected to increase by 5% in six month's time, materials costs for display screens are only expected to increase by 2% but with immediate effect.

(ii) Direct labour costs are purely variable and not expected to change over the next year.

(iii) Heat and power costs include an apportionment of the general factory overhead of heat and power as well as the costs of heat and power directly used for the production of keypads and display screens. The general apportionment included is calculated using 50% of the direct labour cost for each component and would be incurred irrespective of whether the components are manufactured in-house or not.

(iv) Machine costs are semi-variable; the variable element relates to set up costs, which are based upon the number of batches made. The keypads' machine has fixed costs of UGX4,000 per annum and the display screens' machine has fixed costs of UGX6,000 per annum. Whilst both components are currently made in batches of 500, this would need to change, with immediate effect, to batches of 400.

(v) 60% of depreciation and insurance costs relate to an apportionment of the general factory depreciation and insurance costs; the remaining 40% is specific to the manufacture of keypads and display screens.

Required

Advise Robber Co whether it should continue to manufacture the keypads and display screens in-house or whether it should outsource their manufacture to the supplier in Burgistan, assuming it continues to adopt the policy to limit manufacture and sales to 80,000 control panels in the coming year.

QUESTION 3.4 ABACUS Ltd

Abacus Ltd makes four components W, X, Y and Z of a product with the following information:

Component	**W**	**X**	**Y**	**Z**
Units	1,000	2,000	4,000	3,000
	Shs "000"	***Shs "000"***	***Shs "000"***	***Shs "000"***
Unit Variable costs:				
Direct Labour	4	5	2	4
Direct materials	8	9	4	6
Variable overhead	2	3	1	2
	14	**17**	**7**	**12**
Fixed costs	1,000	5,000	6,000	8,000

External sub-contractors have offered to make the above components for the following prices per unit:

Component	**W**	**X**	**Y**	**Z**
Sub-contractor prices (Shs "000")	12	21	10	14

Required

Advise the company whether it should make or buy the components. *(12 marks)*

QUESTION 3.5 RINGTHO INVESTMENTS Ltd

Ringtho Investments Limited (RIL) produces two products from different quantities of the same resources using a just-in-time production system. The selling price and resource requirements of each of the products are shown below:

Product	**R**	**T**
Unit selling price (Shs '000')	130	160
Resources per unit:		
Direct labour (hours)	3	5
Material A (kg)	5	4
Material B (litres)	2	1
Machine hours	3	4

The management accountant has stated that each direct labour hour costs Shs 8,000, material A costs Shs 3,000 per kilogram, material B costs Shs 7,000 per litre and each machine hour costs Shs 10,000.

Market research shows that the maximum demand for products R and T during June 2018 are 500 units and 800 units respectively. This does not include an order that RIL has agreed with a commercial customer for the supply of 250 units of R and 350 units of T at selling prices of Shs 100,000 and Shs 135,000 per unit respectively.

Although the customer can accept part of the order, failure by RIL to deliver the order in full by the end of June will cause RIL to incur a Shs 10,000,000 financial penalty.

At a recent meeting of the purchasing and production managers to discuss the production plans for RIL for June 2018, it was found out that the company will have only 7,500 hours for direct labour. In addition, the supplier for material A has stated that due to factory repairs, they can supply only 8,500 kg of material A. Furthermore, due to water shortage, only 3,000 liters of material B will be available. The production manager has also stated that in order to service all the machines on time, only 7,500 machine hours will be available.

Required:

(a) Assuming that RIL completes the order with the commercial customer, prepare computations to show the optimum production plan for June 2018 and the total contribution that would result from adopting this plan.

(b) Using appropriate analysis, show whether RIL should complete the order from the commercial customer

QUESTION 3.6 FLAKINESS GENERAL ENTERPRISES

Flakiness General Enterprises specializes in the production of one-litre plastic bottles but can also produce children's toys for the Ugandan market using a plastic moulding machine. The machine is capable of producing 100 bottles per hour. The company has estimated that the variable cost of producing a plastic bottle is Shs 400. The bottles are sold for Shs 1,000 per bottle.

Recently, management was approached by a local children play shop company that would like the firm to produce moulded plastic toys for them. The play shop company is willing to pay Shs 4,000 per toy. The variable cost per toy is estimated at Shs 2,400. In addition, the company will have to incur a one-off cost of Shs 20 million to set up the mould required specifically for this order.

Due to the fact that the toys use more plastic and the designs are more intricate, it is expected that the machine can only produce 40 toys per hour. However, the customer order is for 100,000 toys.

Assume that Flakiness General Enterprises has a total capacity of 10,000 machine hours available during the period in which the toy company wants delivery of the toys, and that the firm's fixed costs, excluding the costs to set up the toy mould during the same period would be Shs 200 million.

Required:

(a) *Supposing the demand for the bottles varies between the absolute values of 750,000 units and 850,000 units and the special order has to be taken either in full or rejected totally, advise management whether they should accept the special toy order.*

(b) *The marketing manager of the company has just told you that the demand for the bottles is forecast to be 900,000 bottles and the special order for the toys has to be accepted in full or totally rejected. He further informs you that to meet this special order for toys, the union of plastic workers has demanded from the company a special one-off fee of Shs 60 million. Advise management whether the special order for the toys should be accepted or rejected.*

QUESTION 3.7 PTN Ltd

PTN Ltd manufactures and sells two products X and Y. At an operating capacity of 75%, PTN Ltd produces and sells 80,000 units of product X and 50,000 units of product Y. The unit cost structure of PTN Ltd is as follows:

	Product X Shs '000'	Product Y Shs '000'
Direct materials	40	80
Direct labour	80	80
Factory overhead (35% fixed)	90	60
Administration and selling overhead (65% fixed)	120	90

PTN Ltd sells each unit of product X at Shs 450,000 and that of product Y at Shs 380,000.

The company has received offers from Rwanda and Burundi to supply products X and Y respectively. Rwanda is offering to purchase product X at Shs 300,000 per unit, while Burundi is offering Shs 280,000 per unit for product Y. The offers will result in an additional packaging cost of Shs 9,000 per unit.

PTN Ltd absorbs factory overheads on the basis of machine hours, and the hourly rate at the 75% capacity is Shs 40,000 per hour. The company can accept either offer by utilizing the 25% of its idle capacity.

Required:

(a) *Calculate the surplus machine hours available if PTN Ltd is to take up either of the offers.*
(b) *Compute PTN Ltd's fixed costs.*
(c) *Using relevant calculations, advise the management of PTN Ltd as to which offer they should take up.*
(d) *Using your answer in (c) above, compute the number of units that can be produced with the surplus machine hours.*
(e) *Prepare a statement showing the overall profitability of PTN Ltd after incorporating the offer suggested in (c) above.*

QUESTION 3.8 KAMA TRADING Ltd

Kama Trading Limited operating at 80% production capacity produces and sells two products M and N. The cost sheets of these products are as follows.

	Product	
	M	N
Units produced and sold	600	400
Costs/ selling price per unit:	Shs '000'	Shs '000'
Direct materials	5	10
Direct labour	10	10
Factory overheads (40% fixed)	20	15
Administrative & selling overheads (60% fixed)	20	12.5
Total	55	47.5
Selling price	85	65.0

All factory overheads are absorbed on the basis of machine hours, which are the limiting factor. The machine hour rate is Shs 5,000 per hour. The company has now received an offer from Rato Ltd for the purchase of product M at Shs 60,000 per unit and another from Kintu Ltd for the purchase of product N at Shs 50,000 per unit. In both cases a special packing charge of She 1,250 per unit has to be incurred by KTL.
KTL can accept either of the two offers by utilizing the balance of 20% of the capacity.

Required:

(a) Advise KTL as to which proposal should be accepted.
(b) Prepare an overall profitability statement for KTL after incorporating the proposal in (a) above.
(c) Giving at least one example in each case, distinguish between relevant costs and irrelevant costs.

QUESTION 3.9 UGANTIKO Ltd

The production manager of Ugantiko Ltd has approached you for costing advice on a project he has code-named Ntiko. Due to confidentiality issues, Ntiko is a one-off order from overseas that Ugantiko Ltd intends to tender for. The costs associated with the project are as follows:

		Shs '000'
Material RT		4,000
Material RX		8,000
Direct Labour	6,000	
Supervision		4,000
Overheads		12,000
		32,000

The following information has also been provided:

1. Material RT is in stock and the above was what it cost. There is no other use for the material, other than the above project, within the factory and it would cost Shs 1,750 per unit to dispose of. Material RX would have to be purchased at the cost shown above.
2. Direct labour costs of Shs 6 million relate to workers that would have to be transferred to this project from another project. Extra labour will need to be recruited to the other project at a cost of Shs 7 million.
3. Supervision costs are chargeable to the project at a rate of 66.7% of labour costs and will be carried out by the existing staff within their normal duties.
4. The company is currently operating at a point above break-even
5. Overheads are chargeable at 200% of labour costs.
6. The project will require utilization of machinery that will have no other use to the company after the project is completed. The machinery will have to be purchased at a cost of Shs 10 million and then disposed of for She 5,250,000 at the end of the project.

The production manager has informed you that the foreign customer is prepared to pay up to a maximum of Shs 30 million, and that a competitor is prepared to accept the order at that price. He has also informed you that the minimum he can charge is Shs 40 million because the cost of production as shown above is Shs 32 million excluding the cost of the machine and the profit to be taken on the project.

Required:

(a) Determine the cost for Ntiko, clearly showing how you arrive at those figures.
(b) Write a report to the production manager stating whether the organization should go ahead with the tender for the project.
(c) State four non-monetary factors that should be taken into account before tendering for the project.

QUESTION 3 YWEES (U) Ltd

YWEES (U) Ltd manufactures three types of toothpaste: Sira, Vaco and Mebo. The following is the company's income statement for the period ending 31 October 2015:

	Sira	**Vaco**	**Mebo**	**Total**
	Shs '000'	Shs '000'	Shs '000'	Shs '000'
Sales	75,000	90,000	80,000	245,000
Variable costs	(45,000)	(86,000)	(55,000)	(186,000)
Contribution	30,000	4,000	25,000	59,000
Fixed costs	(8,500)	(9,000)	(10,000)	(27,500)
Profit / (loss)	21,500	(5,000)	15,000	31,500

The company is concerned about its poor performance and is considering whether or not to cease selling Vaco. It is felt that selling prices cannot be raised or lowered. If the production of Vaco is suspended, Shs 3 million of fixed costs will be avoided because the cost is directly related to Vaco production. Assume that Vaco cannot be substituted by any other product and that investment in assets cannot be reduced if this product is dropped.

All other fixed costs are constant.

Required:

(i) Advise YWEES (U) Ltd whether it should stop the production of Vaco or not.
(ii) Identify the steps that should be followed in making a product mix decision in presence of a limiting factor.

PART D
COSTING SYSTEMS

4.0 COSTING SYSTEMS

UNIT 4 OVERVIEW:

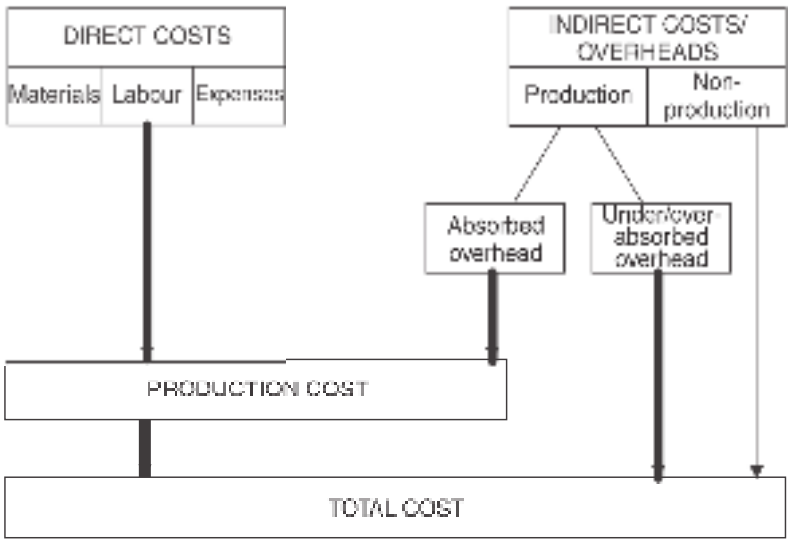
- Absorption Vs Marginal Costing
- Activity Based Costing (ABC)
- Target Costing
- Kaizen Costing

4.1 ABSORPTION Vs MARGINAL COSTING METHOD

4.1.1 Introduction to costing

Cost accounting is used to determine the cost of products, jobs or services (whatever the organisation happens to be involved in). Such costs have to be built up using a process known as **cost accumulation**.

In your earlier studies you will have learnt how to accumulate the various cost elements which make up total cost.



Absorption costing cost accumulation system

Key Terms

- ***A direct cost*** is a cost that can be traced in full to the product, service or department that is being costed.
- **An indirect cost or overhead** is a cost that is incurred in the course of making a product, providing a service or running a department, but which cannot be traced directly and in full to the product, service or department.

4.1.2 The Problem of overheads

If a company manufactures a product, the cost of the product will include the cost of the raw materials and components used in it and cost of the labour effort required to make it. These are direct costs of the product. The company would, however, incur many other costs in making the product which are not directly attributable to a single product, but which are incurred generally in the process of manufacturing a large number of product units. These are indirect costs or overheads. Such costs include the following.

(i) Factory rent and rates
(ii) Machine depreciation
(iii) Supervision costs
(iv) Heating and lighting

In some companies, total overhead costs may be substantially greater than the total of direct production costs.

It might seem unreasonable to ignore indirect costs entirely when accumulating the costs of making a product, and yet there cannot be a completely satisfactory way of sharing out indirect costs between the many different items of production which benefit from them.

4.1.3 Using absorption costing to deal with the problem of overheads

Traditionally, the view has been that a fair share of overheads should be added to the cost of units produced to obtain a full unit cost of production and sales. This fair share should include a portion of production overhead expenditure and possibly administration and marketing overheads too. This is the view embodied in the principles of absorption costing.

4.1.4 Theoretical justification for using absorption costing

In a manufacturing organisation, production overheads are incurred in making the output, so each unit of product receives some benefit from these costs. Each unit of output should therefore be charged with some of the overhead costs.

4.1.5 Practical reasons for using absorption costing

(a) Inventory valuations

Inventory in hand must be valued for two reasons.

(i) For the closing inventory figure in the statement of financial position
(ii) To calculate the cost of sales figure in the income statement

The valuation of inventories will affect profitability during a period because of the way in which the cost of sales is calculated.

Cost of goods sold = cost of goods produced + the value of opening inventories – the value of closing inventories

(b) Pricing decisions

Many companies attempt to set selling prices by calculating the full cost of production or sales of each product, and then adding a margin for profit. 'Full cost plus pricing' can be particularly useful for companies which do jobbing or contract work, where each job or contract is different, so that a standard unit sales price cannot be fixed. Without using absorption costing, it may be difficult to decide what the price should be to earn a satisfactory profit.

(c) Establishing the profitability of different products

This argument in favour of absorption costing states that if a company sells more than one product, it will be difficult to judge how profitable each individual product is, unless overhead costs are shared on a fair basis and charged to the cost of sales of each product.

4.1.6 Using marginal costing to deal with the problem of overheads

For many planning and decision-making purposes, absorption costing is less useful as a costing method than marginal costing. In some situations, absorption costing can actually be misleading in the information it supplies.

Advocates of marginal costing take the view that only the variable costs of making and selling a product or service should be identified. Fixed costs should be dealt with separately and treated as a cost of the accounting period rather than shared out somehow between units produced. However, some overhead costs are variable costs, which increase as the total level of activity rises; so the marginal cost of production and sales should include an amount for variable overheads.

4.1.7 Revision of absorption Costing

- **Absorption costing** is a traditional approach to dealing with overheads, involving three stages: **allocation**, **apportionment** and **absorption**.

- **Apportionment** has two stages, general overhead apportionment and service department cost apportionment.

- Absorption costing is a method of product costing which aims to include in the total cost of a product (unit, job and so on) an appropriate share of an organisation's total overhead, which is generally taken to mean an amount which reflects the amount of time and effort that has gone into producing the product.

Steps in the absorption costing method

- Product costs are built up using absorption costing by a process of **allocation**, **apportionment** and **overhead absorption**.

Step1: Allocation

Allocation is the process by which whole cost items are charged directly to a cost unit or cost centre. Direct costs are allocated directly to cost units. Overheads clearly identifiable with cost centres are allocated to those cost centres but costs which cannot be identified with one particular cost centre are allocated to general overhead cost centres. The cost of a warehouse security guard would therefore be charged to the warehouse cost centre but heating and lighting costs would be charged to a general overhead cost centre.

Step2: Overhead Apportionment

The first stage of overhead apportionment involves sharing out (or apportioning) the overheads within general overhead cost centres between the other cost centres using a fair basis of apportionment (such as floor area occupied by each cost centre for heating and lighting costs).

The second stage of overhead apportionment is to apportion the costs of service cost centres (both directly allocated and apportioned costs) to production cost centres.

After the apportionment of production overheads, all the overhead costs have been divided or shared between the production departments.

Step 3: Overhead Absorption

The final stage in absorption costing is the absorption into product costs (using overhead absorption rates) of the overheads that have been allocated and apportioned to the production cost centres.

An overhead absorption rate is calculated for each production department (or for production activity as a whole). Typically, this is an absorption rate per direct labour hour worked or an absorption rate per machine hour worked.

4.1.8 Revision of Marginal Costing

In marginal costing, inventories are valued at variable production cost whereas in absorption costing they are valued at their full production cost. Profit is calculated by deducting variable costs of sales from sales revenue to obtain contribution, and then deducting fixed costs to obtain a figure for profit.

Key Terms

- **Marginal cost** is the cost of one unit of a product/service which could be avoided if that unit were not produced/provided.
- **Contribution** is the difference between sales revenue and variable (marginal) cost of sales.
- **Marginal costing** is an alternative to absorption costing. Only variable costs (marginal costs) are charged as a cost of sales. Fixed costs are treated as period costs and are charged in full against the profit of the period in which they are incurred.

Marginal costing

- In marginal costing, closing inventories are valued at marginal (variable) production cost whereas, in absorption costing, inventories are valued at their full production cost which includes absorbed fixed production overhead.

- If the opening and closing inventory levels differ in an accounting period, the profit reported for the period will differ between absorption costing and marginal costing.

- But in the long run, total profit for a company will be the same whichever costing method is used, because in the long run total costs will be the same by either method of accounting. The different costing methods merely affect the reported profit for individual accounting periods.

4.2 ACTIVITY BASED COSTING SYSTEM (ABC)

4.2.1 Definition of ABC

ABC is a method of costing which involves identifying the costs of the main support activities and the factors that 'drive' the cost of each activity. Support overheads are charged to products by absorbing costs on the basis of the product's usage of the factor driving the overheads.

- ***The Major ideas behind activity based costing are as follows;***

(a) Activities cause costs: Activities include ordering, material handling, machining, assembly, production scheduling and dispatching.
(b) Manufacturing products creates demand for the support activities.
(c) Costs are assigned to a product on the basis of the product's consumption of these activities.

- **Activity** in this case is a distinct business operation, service or action such as ordering for materials, setting up a machine, inspection, making purchases, material handling etc.

- In this case, the underlying assumption of activity based costing is entirely different from that of conventional costing systems. The conventional costing system assumes that products cause costs. Activity based costing systems have activities as fundamental cost objects. Activity based costing systems also assumes that activities cause costs and that cost objects (products) create the demand for activities.

- The underlying foundation of all ABC systems is the perception that an organization is made up activities and they are these activities that cause costs. For instance when you make an order for materials, it is the activity ordering that cause costs and the costs incurred will depend on the number of orders made but not the amount or units of materials involved. Because of this, costs should be apportioned or assigned to products basing on the number of orders (activities) made by each cost center but not the volume obtained by the cost center.

- Hence, ABC emphases activities performed by each cost center as a basis of cost allocations as opposed to volume, that is preferred by the traditional approaches. Therefore, with activity perceptive, activities consume resources (hence causing costs) and cost objects (products) consume activities.

4.2.2 The Activity Based Costing System

There are five major steps involved in the ABC system. These include

Step 1: <u>Identify the major activities within the organization that support the manufacture of the organisation's products or the provision of its services.</u>

- This involves support activities that are not directly involved in the physical process of converting materials to finished products or the provision of services. Different types of activities include;
  - **(i) Unit level activities.** Activities that are performed each time a unit is produced. It is an activity performed on each individual product or service. These activities consume resources in relation to volume of output e.g. assembling plant. At this level, the cost drivers will be volume-based since the amount of activity will proportionally depend on the number of units produced.
  - **(ii) Batch level activities.** Activities that are performed each time a batch of units is produced. Batch level activities assume that inputs are consumed in direct proportions to the number of batches of each product produced regardless of the size of batch such as processing purchase orders, lecturing to

class i.e. costs of products change with the number of batches of output. In short, the emphasis is on number of batches regardless of how many units are in a batch. The amount of resource consumed depends on the number of batches run rather than on the number of units in the batch. Purchase orders, machine setup, and quality tests are examples of batch-level activities.

(iii) **Plant sustenance/facility level.** Activities connected with maintaining the machinery which produces products e.g. costs of upgrading software, machine upgrading. Such costs are not identifiable with a particular product line or product. These costs are either allocated on arbitrary basis or not allocated at all.

(iv) **Product level activities.** Are those activities that support an entire product line but not necessarily each individual unit. Examples of product-line activities are engineering changes made in the assembly line, product design changes, and warehousing and storage costs for each product line. These could also be activities perform to sustain a product line in the market e.g. beer promotional activities.

Step 2: Use cost allocation and apportionment methods to charge overhead costs to each of these activities.

The costs that accumulate for each activity cost centre is called a **cost pool**.

A cost pool is a point of focus for costs relating to a particular activity in an ABC system. They are links between a pool of costs in an activity center and the product. Therefore, in order to trace the overhead costs to products; appropriate cost drivers should be identified.

Step 3: Identify the factors which determine the size of the costs of an activity / affect the costs of an activity. These are known as cost drivers.

A cost driver is a factor which has an influence on the cost of an activity. Cost drivers are the actual activities that cause the total cost in an activity cost pool to increase. The number of times materials are ordered, the number of production lines in a factory, and the number of shipments made to customers are all examples of activities that impact the costs a company. The appropriate cost driver should always be selected in order to have an appropriate apportionment or distribution of overheads.
Other than identifying the cost drivers, this step also involves the identification of those costs that are specific to each activity that is, those costs which the activity actually causes. All the costs of each activity involved are collected into activity cost pools.

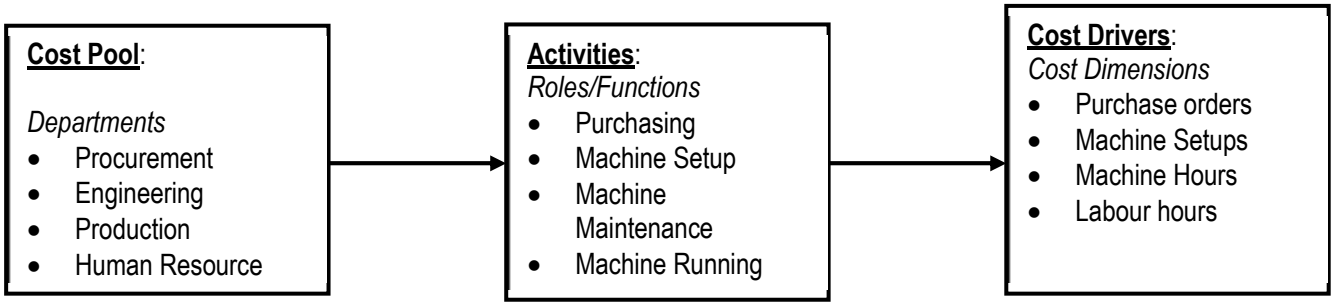
A cost pool is therefore like a cost center or activity center around which costs are accumulated.

Activity Cost Pools	**Activity Cost Drivers**
Purchasing department	Numbers of Purchase Orders
Receiving Department	Number of Purchase Orders
Materials Handling	Number of Materials Requisitions
Machine Setup	Number of Machine Setups Required
Inspection	Number of Inspections
Engineering Department	Number of Engineering Change Orders
Personnel Processing	Number of Employees Hired or Laid Off
Supervisors	Number of Direct Labour Hours

Step 4: For each cost pool / activity cost centre, calculate an absorption rate per unit of cost driver.

Step 5: Charge overhead costs to products for each activity, on the basis of their usage of the activity (number of cost drivers they use). Overheads are charged by absorbing them into product costs at a rate per unit of cost driver.

Illustration 1: - The ABC System



Activity 1: *ABC Vs Conventional absorption costing*

Suppose that Mukwano manufactures four products Nomi, Star, Omo, Jick. Output and cost data for the month of January 2020 are as follows;

	Number of units	Machine hours per unit	Direct labour hours per unit	Number of production runs	Material cost per unit
Nomi	10	1	1	2	20,000
Star	10	3	3	2	80,000
Omo	100	1	1	5	20,000
Jick	100	3	3	5	80,000

Additional information

(i) Overhead costs for the period are given as below;

	Shs "000"	**Cost Driver**
Short-run variable costs	3,080	Machine hours
Set-up costs	10,920	Production runs
Scheduling	9,100	Production runs
Materials handling	7,700	Production runs

(ii) The direct labour cost per hour is Shs. 5,000

Required: *Prepare unit costs for each product using;*

(a) Traditional absorption costing (using a direct labour rate to absorb overheads, and

(b) Activity based costing

4.2.3 Application of activity Based costing (ABC) system

1. ***Enables the company to evaluate the viability or profitability of product or customer***- An improved more accurate product cost may enable a company to concentrate on a more profitable mix of products or customers. ABC has been effectively used in identifying customers who are unprofitable to serve. The system therefore is used in carrying out product and customer profitability analysis.
2. ***Helps managers in the management of activities-*** It helps in identifying value added and non-value added activities or costs so that the non-value added items could be appraised effectively with a view to elimination. As such, it forces managers and supervisors to consider the drivers that affect costs and whether these cost drivers contribute to the final product. Thus, the manager will have better understanding of the economics of production and the economics of the activities performed by the company.
3. ***Promotes effective control***- ABC is flexible enough to trace costs to processes, customers, areas of managerial responsibility, as well as products. This promotes effective control through appropriate management of activities.
4. ***Enhances budget formulation***- ABC can be used to produce more useful overhead budgets. Activity budgets can be built up by multiplying the planned volumes of each product by the planned quantity of each cost driver consumed and expected cost per unit of cost driver. This is known as activity based budgeting (ABB).
5. ***Determination of transfer prices***- Activity based product costs can provide a basis for calculating inter-divisional transfer prices.
6. ***Enhances decision making***- ABC provides information that can enhance the process of decision making by more accurately assigning costs to cost objects, such as products, customers and locations.
7. ***Helps in setting of selling prices***- It helps fully in fixing of selling prices of products as more correct data of product cost is now readily available.

4.2.4 Merits and Criticisms of ABC

(a) The **complexity of manufacturing has increased**, with wider product ranges, shorter product life cycles and more complex production processes. **ABC recognizes this complexity with its multiple cost drivers.**

(b) In a more competitive environment, companies must be able to access product profitability realistically. **ABC facilitates a good understanding of what drives overhead costs**.

(c) In modern manufacturing systems, overhead functions include a lot of non-factory-floor activities such as product design, quality control, and production planning and customer services. ABC is concerned with all overhead costs and so it can take management accounting beyond its traditional factory floor boundaries.

4.2.5 ABC and decision making

Many of ABC's supporters claim that it can assist with decision making in a number of ways.

- It provides accurate and reliable cost information.
- It establishes a long-run product cost.
- It provides cost data which may be used to evaluate different ways of delivering business.

It is particularly suited to the following types of decision:

- Pricing, where selling prices are derived by adding a profit mark-up to cost.
- Promoting or discontinuing products or parts of the business, since ABC may help management to identify activity costs that may be either incurred or saved.

- Developing new products or new ways to do business, because ABC focuses attention on the support activities that would be required for the new product or business procedure.

Note, however, that an ABC cost is **not a variable cost**. ABC is a form of absorption costing that seeks to charge overheads to products on a more 'fair' basis than traditional absorption costing. An ABC cost is therefore **not a relevant cost** for decision-making purposes.

ABC attempts to **relate the incidence of costs to the level of activities undertaken. A hierarchy of activities** has been suggested.

Classification level	Cause of cost	Type of cost	Cost driver
Unit level	Product/acquisition of a single unit of product or delivery of single unit of service	Direct materials Direct labour	Units produced
Batch level	A group of things being made, handled ant processed	Purchase ordered Set-ups Inspection	Batches produced
Product level	Development, production or acquisition of different items	Equipment maintenance Product development	Product lines produced
Facility sustaining level	Some costs cannot be related to a particular product line; instead they are related to maintaining the buildings and facilities. These costs cannot be related to cost objects with any degree of accuracy and are often excluded from ABC calculations for this reason.	Building depreciation Organizational advertising	None-supports the overall production or service process

4.2.6 Criticisms of ABC

It has been suggested by critics that activity based costing has some weakness

(a) Cost apportionment may still be required at the cost of pooling stage for shared items of cost such as rent, rates and building depreciation. Apportionment can be an arbitrary way of sharing costs.
(b) A single cost driver may not explain the cost behavior of all items in a cost pool. An activity may have two or more cost drivers.
(c) Unless costs are 'driven' by an activity that is measurable in quantitative terms, cost drivers cannot be used. What drives the cost of the annual external audit, for example?
(d) There must be a reason for using a system of ABC. ABC must provide meaningful product costs or extra information that management will use. If management is not going to use ABC information for any practical purpose, a traditional absorption costing system would be simpler to operate and just as good
(e) The cost of implementing and maintaining an ABC system can exceed the benefits of 'improved accuracy' in product costs.
(f) Implementing ABC is often problematic, due to problems with understanding activities and their costs.
(g) ABC is an absorption costing system. Absorption costing has only limited value for management accounting purposes

REVISION QUESTIONS

QUESTION 5.1 STEEL WORLD LTD

Steel World Ltd (SWL) produces three products: Exotile, Y-angle bar and Z-angle bar. Each uses the same resources, but in different proportions as shown in the table of budgeted data for 2018 below:

Product	Exotile	Y-angle bar	Z-angle bar
Budgeted production (units)	3,000	5,000	8,000
Direct labour hours per unit	2	4	3
Machine hours per unit	3	2	3
Number of Batches	50	100	500
Machine set ups per batch	2	3	1
Purchase orders per batch	4	4	6
Material movements per batch	10	5	4

SWL's budgeted production overhead costs for 2018 are Shs 400 million and current practice is to absorb these costs into product costs using an absorption rate based on direct labour hours.

The management of SWL are considering changing to an activity-based method of attributing overhead costs to products and as a result have identified the following cost drivers and related cost pools:

Cost pool	Shs '000'	Cost driver
Machine maintenance	101,050	Machine hours
Machine set ups	70,200	Machine set ups
Purchasing	90,000	Purchase orders
Material handling	60,000	Material movements

The remaining of overhead costs are mainly labour-related and are to be attributed to products on the basis of labour hours.

Required
Advise the management of Steel World Ltd on the production overhead cost attributed to each product unit using;

- ***(a) Traditional absorption costing and***
- ***(b) Activity based costing***

QUESTION 5.2 VET FARM LTD

Vet Farm Ltd are manufacturers and distributors of veterinary drugs. They currently produce three products using the same machinery/ process. Drugs include Swine Fever Vaccine (SFV) for pigs, Foot and Mouth disease Vaccine (FMV) for cattle and New Castle Vaccine (NCV) for poultry.

Vet Farm Ltd pack the drugs in batches; SFV batch contains 30 units sold at Shs 600,000, FMV batch contains 35 units sold at Shs 350,000, and NCV batch contains 50 units sold at Shs 600,000.

The demand for FMV is growing steadily, yet the company has reached maximum capacity, they have been considering dropping one of the vaccines and concentrate on the two most profitable ones.

Their current monthly production figures are as follows:

Products	**SFV**	**FMV**	**NCV**
Units produced	300	700	2,000
Direct labour cost per unit (shs)	1,000	500	250
Direct Materials cost per unit (Shs)	6,000	3,000	6,000
Number of setups	50	100	400
Number of inspections	200	150	300
Number of material movements	10	7	20
Number of orders	10	20	40

The following additional information on monthly costs is available:

	Shs '000'
Material handling costs	5,000
Machine set up costs	3,000
Inspection costs	1,300
Ordering costs	2,100

Required:
Using activity-based costing (ABC), advise on the decision Vet Farm Ltd wants to take

QUESTION 5.3 TWINCO TECHNICAL SERVICES LTD

Twinco Technical Services Ltd (TTSL) are experts at maintaining and repairing different brands of photocopiers. They stock spare parts for the three common brands on the market (Kyocera, Canon and Xerox). They have contracts for maintenance and repairs in case of machine breakdowns. They also serve walk-in clients who are not on contract. Customers are charged different prices per machine depending on the complexity of the work done. Their chief finance officer (CFO) has suggested that they should start charging more accurately and they have decided to implement activity-based costing system in determining each brand's contribution to company profits.

The following information has been extracted from last year's records:

	Kyocera	Canon	Xerox
Average machine maintenance fees per machine (Shs)	300,000	150,000	250,000
Average repair fees per repair (Shs)	50,000	50,000	75,000
Number of machines maintained	200	300	100
Number of repairs	100	200	75
Number of maintenance schedules per machine	6	4	9
Number of unplanned maintenance schedules per machine	3	2	3

Overhead costs:

Activity	Cost driver	Shs '000'
Transport	Number of maintenance schedules	10,000
Cost of spare parts	Number of repairs	15,000
Customer handling costs	Number of machines maintained	27,000
Maintenance costs	Number of maintenance schedules	27,000
Other overheads	Number of machines maintained	30,000

Required:
Determine the profit per machine brand using activity-based costing.

4.3 TARGET COSTING

4.3.1 Introduction

In a competitive market, selling prices must be competitive. In order to sell at a competitive price and make a required amount of profit, the cost of production and sales must be kept at a level that will provide the required profit at the chosen selling price.

Target costing is concerned with designing a product and its production process so that it can be made and sold at a cost that delivers the required profit at the chosen price. It focuses on getting the expected cost of a product down to a target cost amount. Achieving a target cost will usually require some re- designing of the product and the removal of unnecessary costs.

In many markets, new product innovation and the re-designing of existing products is a continual process. Target costing is most effective at the product design stage, rand is less effective for established products that are made in established processes. At the design stage, it is easier and cheaper to make changes that reduce costs.

Here are some examples of decisions made at the design stage which impact on the cost of a product.

- The number of different components in a product, that have to be assembled in the production process
- Whether the components are standard or not: using standard components can reduce costs
- Deciding to exclude design features on the product that do not add any value for the customer
- Using cheaper materials to make the product, where this does not affect product quality
- Simplifying the production process, for example to make it easier and quicker to change over tools.

4.3.2 Key terms

- **Target costing** involves setting a target cost by subtracting a desired profit margin from a target selling price.
- **Target cost** is the cost at which a product must be produced and sold in order to achieve the required amount of profit at the target selling price. When a product is first planned, its estimated cost will often be higher than its target cost. The aim of target costing is then to find ways of closing this target cost gap, and producing and selling the product at the target cost.

4.3.3 Implementing target costs

The following steps can be followed in the implementation of the target costing process.

Step 1 Determine a product specification of which an adequate sales volume is estimated.

Step 2 Decide a target selling price at which the organisation will be able to sell the product successfully and achieve a desired market share.

Step 3 Estimate the required profit, based on required profit margin or return on investment.

Step 4 Calculate: ***Target cost = Target selling price – Target profit.***

Step 5 Prepare an estimated cost for the product, based on the initial design specification and current cost levels.

Step 6 Calculate: ***Target cost gap = Estimated cost – Target cost.***

Step 7 Make efforts to close the gap. This is more likely to be successful if efforts are made to 'design out' costs prior to production, rather than to 'control out' costs after 'live production has started.

It is usual for estimates of target cost to be based not only on a target selling price per unit, but also on the expected volume of sales.

CASE STUDY:

Swedish retailer IKEA dominates the home furniture market in many countries. The "IKEA concept" as defined on the company website www.ikea.com is "based on offering a wide range of well designed functional home furnishing products at prices so low as many people as possible will be able to afford them."

IKEA is widely known for pricing products at 30-50% below the price charged by competitors. Extracts from the website outline how the company has successfully employed a strategy of target pricing:

"While most retailers use design to justify a higher price, IKEA designers work in exactly the opposite way. Instead they use design to secure the lowest possible price. IKEA designers design every IKEA product starting with a functional need and a price. Then they use their vast knowledge of innovative, low-cost manufacturing processes to create functional products, often co-ordinated in style. Then large volumes

are purchased to push prices down even further.

Most IKEA products are also designed to be transported in flat packs and assembled at the customer's

home. This lowers the price by minimising transportation and storage costs. In this way, the IKEA Concept uses design to ensure that IKEA products can be purchased and enjoyed by as many people as possible."

4.3.4 Deriving a target cost

The target cost is calculated by starting with a market-based target selling price and subtracting a desired profit margin. The target cost is simply the target price minus the required profit.

Activity 1 Target Costing

A car manufacturer wants to calculate a target cost for a new car, the price of which will be set at shs17,950,000. The company requires an 8% profit margin on sales.

Required

What is the target cost?

Solution

Profit required = 8% x shs17,950,000 = shs1,436,000

Target cost = shs(17,950,000 – 1,436,000) = shs16,514,000

The car manufacturer will then need to carefully compile an estimated cost for the new car. ABC will help to ensure that costs allocated to the new model are more accurate.

Activity 2: Target costing and the target cost gap

Great Games, a manufacturer of computer games, is in the process of introducing a new game to the market and has undertaken market research to find out about customers' views on the value of the product and also to obtain a comparison with competitors' products. The results of this research have been used to establish a target selling price of shs60,000. This is the price that the company thinks it will have to sell the product to achieve the required sales volume.

Cost estimates have been prepared based on the proposed product specification.

Manufacturing cost	*Shs*
Direct material	32,100
Direct labour	24,030
Direct machinery costs	1,120
Ordering and receiving	230
Quality assurance	4,600
Non-manufacturing costs	
Marketing	8,150
Distribution	3,250
After-sales service	1,300

The target profit margin for the game is 30% of the target selling price.

Required

Calculate the target cost of the new game and the target cost gap.

Solution

	Shs
Target selling price	60,000
Target profit margin (30% of selling price)	18,000
Target cost (60,000 – 18,000)	42,000
Projected cost	45,890

The projected cost exceeds the target cost by shs3,890. This is the target cost gap. Great Games will therefore have to investigate ways to reduce the cost from the current estimated amount down to the target cost.

4.3.5 Closing a target cost gap

The target cost gap is the estimated cost less the target cost. When a product is first manufactured, its currently-attainable cost may be higher than the target cost. Management can then set benchmarks for improvement towards the target cost, by improving production technologies and processes. Various techniques can be employed.

- *Reducing the number of components*
- *Using cheaper staff*
- *Using standard components wherever possible*
- *Acquiring new, more efficient technology*
- *Training staff in more efficient techniques*
- *Cutting out non-value-added activities*
- *Using different materials (identified using activity analysis etc)*

However, as stated earlier, the most effective time to eliminate unnecessary cost and reduce the expected cost to the target cost level is during the product design and development phase, not after 'live' production has begun.

NOTE: When answering a question on closing a target cost gap, you may be expected to refer to the specific circumstances of the business in the question.

4.3.6 Target costing in service industries

Target costing is difficult to use in service industries due to the characteristics and information requirements of service businesses.

Characteristics of services

Unlike manufacturing companies, services are characterised by intangibility, inseparability, variability, perishability and no transfer of ownership.

Examples of service businesses include:

(a) Mass service e.g. the banking sector, transportation (rail, air), mass entertainment
(b) Either / or e.g. fast food, teaching, hotels and holidays, psychotherapy
(c) Personal service e.g. pensions and financial advice, car maintenance

Key Definition

"**Services** are any activity of benefit that one party can offer to another that is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product."

(P Kotler, Social Marketing)

There are five major characteristics of services that distinguish services from products.

(a) **Intangibility**. This refers to the lack of substance which is involved with service delivery. Unlike goods (physical products such as confectionery), there is no substantial material or physical aspects to a service: no taste, feel, visible presence and so on.

(b) **Inseparability/simultaneity**. Many services are created at the same time as they are consumed. (Think of dental treatment.) No service exists until it is actually being experienced or consumed by the person who has bought it.

(c) **Variability/heterogeneity**. Many services face the problem of maintaining consistency in the standard of output. It may be hard to attain precise standardisation of the service offered, but customers expect it (such as with fast food). When services are delivered by humans, it is very difficult to ensure that the same service is provided in exactly the same way every time.

(d) **Perishability**. Services are innately perishable. The services of a beautician, for example, are purchased for a period of time.

(e) **No transfer of ownership**. Services do not result in the transfer of property. The purchase of a service only confers on the customer access to or a right to use a facility.

Services also vary widely in nature. For example, services include banking, transport, parcel delivery, energy supply, entertainment, education, hotels and holidays, car repairs and maintenance, professional services such as law and accountancy, cleaning, security services, and so on. The list is virtually endless.

A feature of many services, however, is that although the labour content may be high, the materials content is often quite low. With products, the material content is higher and the labour element may be lower.

Problems with target costing for services

Some of the characteristics of services make it difficult to use target costing, and identify a target cost for a service having established a target selling price.

A target cost for a product is a cost for an item whose design and make-up is specified in exact detail in a product specification. A target cost is the cost for this detailed specification.

Services are much more difficult to specify exactly. This is due to some of the characteristics of a service.

(a) Intangibility. Some of the features of a service cannot be properly specified because they are intangible. What exactly does a customer receive, for example, when he or she goes to a cinema? When services are provided by a human, the quality of the personal service can be critically important for the customer, but this is difficult or impossible to specify.

When services do not have any material content, it is not possible to reduce costs to a target level by reducing material costs. In comparison, reducing material costs can be an effective approach to target costing for products.

(b) Variability/homogeneity. A service can differ every time it is provided, and a standard service may not exist. For example, repairing a motor car, providing an accountancy service, or driving a delivery truck from London to Paris are never exactly the same each time. When services are variable, it is possible to calculate an estimated average cost, but this is not specific and so not ideal for target costing.

4.4 KAIZEN COSTING

4.4.1 Introduction

Kaizen is a Japanese term for **continuous improvement** in all aspects of an entity's performance at every level.

As its name suggests, it's an ongoing process that strives to reduce costs by making improvements and removing waste. Successful continuous improvement requires full commitment from senior managers, along with effective, well-documented policies and procedures designed to log, examine and develop all new ideas.

Often associated with total quality management, many firms limit Kaizen to improving production.

Kaizen costing is aligned closely with lean manufacturing, whose main aim is to cut waste through continuous improvement. This is achieved by identifying the best resources and most efficient processes to remove waste from production.

4.4.2 Characteristics of Kaizen Costing

- Kaizen involves setting standards and then continually improving these standards to achieve long-term sustainable improvements.
- The focus is on eliminating waste, improving processes and systems and improving productivity.
- Involves all employees and all areas of the business.

Illustration - Kaizen

Many Japanese companies have introduced a Kaizen approach:

- In companies such as Toyota and Canon, a total of 60-70 suggestions per employee are written down and shared every year.
- It is not unusual for over 90% of those suggestions to be implemented.
- In 1999, in one US plant, 7,000 Toyota employees submitted over 75,000 suggestions, of which 99% were implemented.

4.4.3 The concept of continuous improvement

Continuous improvement is the continual examination and improvement of existing processes and is very different from approaches such as business process re-engineering (BPR), which seeks to make radical one-off changes to improve an organisation's operations and processes. The concepts underlying continuous improvement are:

- The organisation should always seek perfection. Since perfection is never achieved, there must always be scope for improving on the current methods.
- The search for perfection should be ingrained into the culture and mindset of all employees. Improvements should be sought all the time.
- Individual improvements identified by the work force will be small rather than far-reaching.

4.4.4 Eliminating waste

Kaizen costing has been developed to support the continued cost reduction of existing components and products. Cost reduction targets are set on a regular, e.g. monthly basis and variance analysis is carried out at the end of each period to compare the target cost reduction with the actual cost.

One of the main ways to reduce costs is through the elimination of the seven main types of waste:

- **Over-production** - produce more than customers have ordered.
- **Inventory** - holding or purchasing unnecessary inventory.
- **Waiting** - production delays/idle time when value is not added to the product.
- **Defective units** - production of a part that is scrapped or requires rework.
- **Motion** - actions of people/equipment that do not add value.
- **Transportation** - poor planning or factory layout results in unnecessary transportation of materials/work-in-progress.
- **Over-processing** - unnecessary steps that do not add value.

EXAM TYPE QUESTION

SD Ltd recently introduced a system of Kaizen costing which has resulted in changes to the methods used to manufacture their timber products. However, previously, there have been significant differences between the actual costs and standard costs of the products manufactured. Some of the directors have suggested that the use of standard costs as a means of monitoring performance is no longer appropriate and that the monthly variance reports being produced by the company are meaningless.

Required:

(i) Explain the principles of Kaizen costing

(ii) Discuss how SD Ltd can use standard costing and variance analysis to prepare meaningful reports when using Kaizen costing.

SOLUTIONS

(i) The principles of Kaizen costing

Kaizen Costing is a system of cost reduction based upon the concept of continuous review of systems and procedures to identify and implement small incremental cost savings.

It is used in the production phase of a product and employees are both encouraged and empowered to recommend changes that they believe will reduce costs without affecting the quality of products or otherwise affect the customer's perception of products

(ii) Discussing how SD Ltd can use standard costing and variance and variance analysis to prepare meaningful reports when using Kaizen costing.

Based on the concept of continuous small improvements to reduce costs then the original standard cost would no longer reflect the target that is achievable.

Consequently the measurement of performance against this target would be of limited usefulness.
In order to prepare meaningful reports SD ltd would need to determine the extent of the variances that have been caused by changes in the method of operations as a result of using Kaizen Costing. These variances

would be reported as planning variances and the remaining cost differences would be reported as operational variances.

Although the managers of SD will have been involved in the Kaizen process it is important that the variances between the targets that the managers believed would now be achievable and the actual results are reported separately. Then the managers can consider whether these variances have arisen due to operational factors or due to over ambitious revised targets. The variance between the original target and the new Kaizen target (the planning variance) measures the extent to which it is believed that Kaizen techniques have reduced SD Ltd's costs

PART E
PRICING DECISIONS, PROFITABILITY ANALYSIS & TRANSFER PRICING

5.0 PRICING DECISIONS

UNIT 5 OVERVIEW:

- Pricing policy and the market
- Price strategies

5.1 PRICING POLICY AND THE MARKET

In the modern world there are many more influences on price than cost (e.g. competitors, product range, quality).

5.1.1 Influences on price

(a) Price Sensitivity
Sensitivity to price levels will vary amongst purchasers. Those that can pass on the cost of purchases will be the least sensitive and will therefore respond more to other elements of perceived value. For example, a business traveller will be more concerned about the level of service in looking for an hotel than price, provided that it fits the corporate budget. In contrast, a family on holiday are likely to be very price sensitive when choosing an overnight stay.

(b) Price Perception
Price perception is the way customers react to prices. For example, customers may react to a price increase by buying more. This could be because they expect further price increases to follow (they are 'stocking up').

(c) Quality
This is an aspect of price perception. In the absence of other information, customers tend to judge quality by price. Thus a price rise may indicate improvements in quality, a price reduction may signal reduced quality.

(d) Intermediaries
If an organisation distributes products or services to the market through independent intermediaries, such intermediaries are likely to deal with a range of suppliers and their aims concern their own profits rather than those of suppliers.

(e) Competitors
In some industries (such as petrol retailing) pricing moves in unison; in others, price changes by one supplier may initiate a price war.

(f) Suppliers
If an organisation's suppliers notice a price rise for the organisation's products, they may seek a rise in the price for their supplies to the organisation.

(g) Inflations
In periods of inflation the organisation may need to change prices to reflect increases in the prices of supplies, labour, rent and so on.

(h) Newness
When a new product is introduced for the first time there are no existing reference points such as customer or competitor behaviour; pricing decisions are most difficult to make in such circumstances. It may be possible to seek alternative reference points, such as the price in another market where the new product has already been launched, or the price set by a competitor.

(i) Incomes
If incomes are rising price may be a less important marketing variable than product quality and convenience of access (distribution). When income levels are falling and/or unemployment levels rising, price will be more important.

(j) Product range
Products are often interrelated, being complements to each other or substitutes for one another. The management of the pricing function is likely to focus on the profit from the whole range rather than the profit on each single product.

For example, a very low price is charged for a loss leader to make consumers buy additional products in the range which carry higher profit margins (e.g. selling razors at very low prices whilst selling the blades for them at a higher profit margin).

(k) Ethics
Ethical consideration may be a further factor, for example whether or not to exploit short-term shortages through higher prices.

5.2 PRICE STRATEGIES

The price to be charged for a product or service is often one of the most important decisions made by business organisations. There are a number of alternative pricing strategies. These include;

(i) Cost-plus pricing
(ii) Marginal cost-plus pricing
(iii) Market Skimming pricing
(iv) Market penetration pricing
(v) Complementary product pricing
(vi) Product line pricing
(vii) Relevant cost pricing

5.3 COST-PLUS PRICING

Full cost-plus pricing is a method of deciding the sales price by adding a percentage mark-up for profit to the full cost of the product.

In practice cost is one of the most important influences on price. Many firms base price on simple cost-plus rules (costs are estimated and then a profit margin is added in order to set the price).

The 'full cost' may be a fully absorbed production cost only, or it may include some absorbed administration, selling and distribution overhead.

A business might have an idea of the percentage profit margin it would like to earn, and so might decide on an average profit mark-up as a general guideline for pricing decisions.

Businesses that carry out a large amount of contract work or jobbing work, for which individual job or contract is different, there are no market prices; and in the absence of a market price, adding a profit mark-up to cost provides a logical way to decide the selling price. The percentage profit mark-up, however, does not have to be rigid and fixed, but can be varied to suit different circumstances.

Activity 1: *Full cost-plus pricing*

PWC Co wants to set its selling price of its new shaving machine. The Accounting department has provided the following associated production costs;

	Per unit Shs	Total Shs
Direct materials	60	
Direct labour (5 hrs @ shs.8 per hr)	40	
Variable manufacturing overheads (machining 3hrs at shs 10 per hour)	30	
Fixed manufacturing overheads		70,000
Variable selling and administration expenses	20	
Fixed selling and administration expenses		60,000

PWC Co has a general policy of marking up unit product costs by 20% on full cost of new products. The absorption rate will be a direct labour rate and budgeted direct labour hours are 10,000 hours. Because of the shortage of available machining capacity, the company will be restricted to 12,000 hours of machine time per period.

Required.
Ascertain the full cost-plus based price.

5.3.1 Cost-plus pricing including opportunity costs and estimation errors

Firms usually ensure that the full cost before markup accommodates all possible costs including opportunity costs and make adjustments of any possible costing errors.

Activity 2:

The management accountant estimated that PWC Co could obtain a minimum contribution of shs.10 per machine hour on producing items other than the new shaving machine. The direct costs estimated are not certain as to material usage rates and direct labour productivity, and it is recognised that the estimates of direct materials and direct labour costs may be subject to an error of ± 15%. Machine time estimates are similarly subject to an error of ± 10%.

Required.
Ascertain the full cost-plus based price including the time opportunity costs and the possible costing errors.

5.3.2 Disadvantages of full cost-plus pricing

There are several disadvantages with cost-plus pricing.

(a) It fails to recognise that since demand may be determining price, there will be a profit-maximising combination of price and demand.

(b) There may be a need to adjust prices to market and demand conditions. When there is an existing market price for the product, that competitors are charging, prices based on 'cost plus' may be uncompetitive.

(c) Budgeted output volume needs to be established. Output volume is a key factor in the overhead absorption rate and so in the calculation of full cost. If there is over-or under-absorption due to incorrect estimates of production capacity, measures of full cost will be too high or too low.

(d) A suitable basis for overhead absorption must be selected, where a business produce more than one product. Some products may be charged with too much overhead, so that the full cost and selling price are too high (at a price that customers may be unwilling to pay); and other products may be charged with too little overhead, so that the selling price is too low.

5.3.3 Advantages of full cost-plus pricing

Full cost plus pricing has some advantages

(a) It is a quick, simple and cheap method of pricing which can be delegated to junior managers.
(b) Since the size of the profit margin can be varied, a decision based on a price in excess of full cost should ensure that a company working at normal capacity will cover all of its fixed costs and make a profit.
(c) When there is no market price for the product, deciding a price by adding a profit margin to cost is a logical approach, which seeks to ensure that the organization makes a profit.

5.4 MARGINAL COST-PLUS PRICING

5.4.1 Introduction

Marginal cost-plus pricing, also called mark-up pricing, involves adding a profit margin to the marginal cost of the product.

Whereas a full cost-plus approach to pricing draws attention to net profit and the net profit margin, a variable cost-plus approach to pricing draws attention to gross profit and the gross profit margin, or contribution.

Activity 3:

A product has the following costs.

	Shs
Direct materials	5
Direct labour	3
Variable overheads	7

Fixed overheads are Shs.10,000 per month. Budgeted sales per month are 400 units to allow the product to break even.

Required.
Determine the profit margin which needs to be added to marginal cost to allow the product to break even.

5.4.2 Advantages of marginal cost-plus pricing

- **Marginal cost pricing has several advantages;**
  (a) It is a simple and easy method to use
  (b) The mark-up percentage can be varied, and so mark-up pricing can be adjusted to reflect demand conditions.
  (c) It draws management attention to contribution, and the effects of higher or lower sales volumes on profit. For example, if a product costs Shs.10 per unit and a mark-up of 15% (shs.15) is added to reach a price of Shs.25 per unit, management should be clearly aware that every additional Shs.1 of sales revenue would add 60 cents to contribution and profit (shs.15 ÷ shs.25 = shs.0.60).
  (d) In practice, mark-up pricing is used in businesses where there is a readily-identifiable basic variable cost. Retail industries are the most obvious example, and it is quite common for the prices of goods in shops to be fixed by adding a mark-up (20% or 33.3%, say) to the purchase cost.

5.4.3 Disadvantages of marginal cost-plus pricing

(a) Although the size of the mark-up can be varied in accordance with demand conditions, it does not ensure that sufficient attention is paid to demand conditions, competitors' prices and profit maximization.
(b) It ignores fixed overheads and sales volumes in the pricing decision, but the sales price must be sufficiently high to ensure that a profit is made after covering fixed costs.

5.5 MARKET SKIMMING PRICE

- **Key term.**

Price skimming involves charging high prices when a new product is first launched on the market, in order to maximize short-term profitability. Initially there is heavy spending on advertising and sales promotion to encourage sales demand. As the product moves into the later stages of its life cycle (growth, maturity and decline) progressively lower prices are charged. The profitable 'cream' is thus skimmed off in stages until sales can be sustained at lower prices.

The aim of market skimming is to gain high unit profits early in the product's life, in the hope of recovering the costs of investment quickly. High unit prices make it more likely that competitors will enter the market than if lower prices were to be charged.

- **A price skimming policy may be appropriate in the cases below.**

(a) The product is new and different, so that customers are prepared to pay high prices so as to be one up on other people who do not own it.
(b) The strength of demand and the sensitivity of demand to price are unknown. It is better from the point of view of marketing to start by charging high prices and then reduce them if the demand for the product turns out to be price elastic than to start by charging low prices and then attempt to raise them substantially if demand appears to be insensitive to higher prices.
(c) High prices in the early stages of a product's life might generate high initial cash flows. A firm with liquidity problems may prefer market-skimming for this reason.

(d) The firm can identify different market segments for the product, each prepared to pay progressively lower prices. It may therefore be possible to continue to sell at higher prices to some market segments when lower prices are charged in others.
(e) Products may have a short life cycle, and so need to recover their development costs and make a profit relatively quickly.

5.6 MARKET PENETRATION PRICING

Key term.
Penetration pricing is a policy of low prices when a product is first launched in order to obtain strong demand for the product as soon as it is launched on the market. Low prices should encourage bigger demand.

A penetration pricing policy may be appropriate in the cases below.

(a) The firm wishes to discourage new entrants into the market.
(b) The firm wishes to shorten the initial period of the product's life cycle in order to enter the growth and maturity stages as quickly as possible.
(c) There are significant economies of scale to be achieved from a high volume of output.
(d) Demand is highly elastic and so would respond well to low prices.

Penetration prices are prices which aim to secure a substantial share in a substantial total market. A firm might therefore deliberately build excess production capacity and set its prices very low. As demand build up the spare capacity will be used up gradually and unit cost will fall; the firm might even reduce prices further as unit costs fall. In this way, early losses will enable the firm to dominate the market and have the lowest costs.

5.7 COMPLEMENTARY PRODUCT PRICING

Key term.
Complementary products are goods that tend to be bought and used together. If an organization makes and sells complementary products, it may wish to decide the selling prices for the products in a single pricing policy decision.

Complementary products are sold separately but are connected and dependent on each other for sales, for example, an electric toothbrush and replacement toothbrush heads. The electric toothbrush may be priced competitively to attract demand but the replacement heads can be relatively expensive.

On the other hand, the decision could be to set low prices for all the complementary products (or high prices for all complementary products) so that the expected sales demand for each is consistent. For example a company selling digital book readers may also sell digital books. The prices of both may be set low in order to win sufficient sales demand for all the products. (This would be a different policy from, say, charging low prices for digital books but a high price for the reader).

A loss leader is when a company sets a very low price for one product intending to make consumers buy other products in the range which carry higher profit margins. Another example is selling razors at very low prices whilst selling the blades for them at a higher profit margin. People will buy many of the high profit items but only

one of the low profit items – yet they are 'locked in' to the former by the latter. This can also be described as captive product pricing.

Loss leaders are common in retailing, where stores may advertise very low prices for selected products hoping that this will attract customers into the store where they will also buy other products that are 'normally' priced.

5.8 PRODUCT LINE PRICING

Key term.

A product line is a group of products that are related to one another. A product line may be a range of branded products, and a consistent pricing policy should be applied to all the products in the range.

A product line is the marketing strategy of offering for sale several related products. A line can comprise related products of various sizes, types, colours, qualities or prices. Demand for and costs of the products are likely to be inter-related. For example a company may manufacture a range of hygiene and skin care products, such as soaps, shower gels, bath oils and so on, under the same brand name. with product line pricing, there will be a consistent pricing policy for all the products in the range.

There is a range of product line pricing strategies.

(a) Set prices proportional to full or marginal cost with the same percentage profit margin for all products. This means that prices are dependent on cost and ignore demand.
(b) Set prices reflecting the demand relationships between the products so that an overall required rate of return is achieved.
(c) Set prices that reflect customer opinion about the quality of the products, and how they compare with similar products of competitor organisations.

5.9 RELEVANT COST PRICING

Special orders may require a relevant cost approach to the calculation of the price. A relevant cost approach is to identify a price at which the organisation will be no better off, but no worse off, of it sells the item at that price. Any price in excess of this minimum price will add to net profit.

A special order is a one-off revenue earning opportunity. These may arise in the following situations.

(a) When a business has a regular source of income but also has some spare capacity, allowing it to take on extra work if demanded. For example a brewery might have a capacity of 500,000 barrels per month but only be producing and selling 300,000 barrels per month. It could therefore consider special orders to use up some of its spare capacity.
(b) When a business has no regular source of income and relies exclusively on its ability to respond to demand. A building firm is a typical example as are many types of sub-contractors. In the service sector, consultants often work on this basis.

The reason for making the distinction is that in the case of (a), a firm would normally attempt to cover its longer-term running costs in its prices for its regular product. Pricing for special orders therefore does not need to

consider unavoidable fixed costs, which will be incurred anyway. This is clearly not the case for a firm in (b)'s position, where special orders are the only source of income for the foreseeable future.

5.9.1 MINIMUM PRICING

The basic approach in both situations is to determine the price at which the firm would break even if it undertook the work, that is the minimum price that it could afford to charge without a reduction in profit. To make a profit on the product or the order, the actual price charged should be higher than the minimum price.

- A minimum price is the minimum price that would have to be charged so as to cover the following two groups of cost.

  (a) The incremental costs of producing and selling the item.
  (b) The opportunity costs of the resources consumed in making and selling the item.

- A minimum price would leave the business no better or worse off than if it did not sell the item.

- Two essential points to understand immediately about a minimum price are as follows.
  (a) It is based on relevant costs, that is the incremental costs plus the opportunity costs of making and selling the product or providing the service.

  (b) It is unlikely that a minimum price would actually be charged, because if it were it would not provide the business with any incremental profit. However, the minimum price for an item shows the following.
    (i) An absolute minimum below which the price should not be set.
    (ii) The incremental profit that would be obtained from any price that is actually charged in excess of the minimum. For example, if the minimum price is Shs.200 and the actual price charged is Shs.240, the incremental profit on the sale would be Shs.40.

If there are no scarce resources, and a company has spare capacity, the minimum price of a product would be an amount which equals the incremental cost of making it. Any price in excess of this minimum would provide an incremental contribution towards profit.

If there are scarce resources and a company makes more than one product, minimum prices would include an allowance for the opportunity cost of using the scarce resources to make and sell the product (instead of using the resources on the next most profitable product).

Where a firm also has to consider its long-term costs in the decision because it has no other way of recovering them it would have to add a proportion of estimated unattributable costs to the price of each order. This could be calculated on a time basis (if the job is expected to take one month, one twelfth of unavoidable costs would be included). However this may lead to inconsistencies if, say, the unavoidable costs are borne in full by one customer in one month, but shared between several customers in another month.

Activity 4:

Roko Uganda Ltd has been asked to quote a price for a one-off contract. The following information is available:

Materials

The contract required 3,000kg of material K, which is a material used regularly by the company in other production. The company has 2,000kg of material K currently in stock which had been purchased last month for a total cost of Shs.19,600. Since then the price per kilogram for material K has increased by 5%.

The contract also requires 200kg of material L. There are 250kg of material L in stock which are not required for normal production. This material originally cost a total of Shs.3,125. If not used on this contract, the stock of material L would be sold for Shs.11 per kg.

Labour

The contract requires 800 hours of skilled labour. Skilled labour is paid Shs.9.50 per hour. There is a shortage of skilled labour and all the available skilled labour is fully employed in the company in the manufacture of product P. The following information relates to product P:

	Shs. Per unit	Shs. Per unit
Selling price		100
Less:		
Skilled labour	38	
Other variable costs	22	
		(60)
		40

Required:

As the management accountant of Roko Uganda Ltd, prepare on a relevant cost basis, the lowest cost estimate that could be used as the basis for a quotation.

6.0 TRANSFER PRICING

UNIT 6 OVERVIEW:

- Definition, and purpose of transfer pricing
- Basic rules of transfer pricing.
- Transfer pricing approaches
- International Aspects of transfer pricing

6.1 Definition

A transfer price is the price at which goods or services are transferred from one **entity B** to another **entity C** under the same control and management of **entity A**.

An entity is an individual unit operating with a certain level of autonomy. Entities in this case can be looked at the following levels;

(i) Departmental level
Here, entities B and C are considered to be Divisions of the same organization A. For Instance; the Raw-materials Division, Manufacturing division and Selling & distribution division are all departments under the same organization.

(ii) Organisational level
Here, entities B and C are considered to be Subsidiaries of the same parent A.

(iii) Multi-national level
Here, entities A and B are considered to be subsidiaries or branches of the same multinational company A having foreign operations.

6.2 Purpose of transfer pricing

To determine the ideal price at which a division within the organization should charge other divisions of the same organisation for goods and services they provide to them.

Transfer prices should be set at a level which ensures that profits for the organisation as a whole are maximised.

6.3 Internal and external sales revenue

Where a subsidiary A makes a component that is used as part (input / raw-material) of a product made by subsidiary B of the same company, and at the same time can also be sold to the external market, including makers of rival products to subsidiary B's product, there will be two sources of revenue for product A. That is to say;

(a) External sales revenue from sales made to other organisations.
(b) Internal sales revenue from sales made to other responsibility centres within the same organisation, valued at the transfer price.

6.4 Challenges with transfer pricing

6.4.1 Maintaining the right level of divisional autonomy

Transfer prices are particularly appropriate for profit centres because of one profit centre does work for another the size of the transfer price will affect the costs of one profit centre and the revenues of another.

However, as we have seen, a danger with profit centre accounting is that the business organisation will divide into a number of self-interested segments, each acting at times against the wishes and interests of other segments. Decisions might be taken by a profit centre manager in the best interests of his own part of the business, but against the best interests of other profit centres and possibly the organisation as a whole.

6.4.2 Ensuring divisional performance is measured fairly

Profit centre managers tend to put their own profit performance above everything else. Since profit centre performance is measured according to the profit they earn, no profit centre will want to do work for another and incur costs without being paid for it. Consequently, profit centre managers are likely to dispute the size of transfer prices with each other, or disagree about whether one profit centre should do work for another or not. Transfer prices affect behaviour and decisions by profit centre managers.

6.4.3 Ensuring corporate profits are maximised

When there are disagreements about how much work should be transferred between divisions, and how many sales the division should make to the external market, there is presumably a profit-maximising level of output and sales for the organisation as a whole. However, unless each profit centre also maximises its own profit at this same level of output, there will be inter-divisional disagreements about output levels and the profit-maximising output will not be achieved.

6.5 THE BEST / OPTIMUM TRANSFER PRICING DECISION

Ideally a transfer price should be set at a level that overcomes the above challenges. The following considerations can be made;

(a) The transfer price should provide an 'artificial' selling price that enables the transferring division to earn a return for its efforts and the receiving division to incur a cost for benefits received.
(b) The transfer price should be set at a level that enables profit centre performance to be measured 'commercially'. This means that the transfer price should be a fair commercial price.
(c) The transfer price, if possible, should encourage profit centre managers to agree on the amount of goods and services to be transferred, which will also be at a level that is consistent with the aims of the organisation as a whole such as maximising company profits.

6.6 BENEFITS / IMPORTANCE OF A TRANSFER PRICING SYSTEM

(i) It can lead to goal congruence by motivating divisional managers to make decisions which improve divisional profit and improve the profit of the organization as a whole.
(ii) It can prevent dysfunctional decision making so that decisions taken by a divisional manager are in the best interests of his own part of business, other divisions and the organization as a whole.
(iii) Transfer prices can be set at a level that enables divisional performance to be measured commercially. A transfer pricing system should therefore report a level of divisional profit that is a reasonable measure of the managerial performance of the division.

(iv) It should ensure that divisional autonomy is not undermined. A well run transfer pricing system helps to ensure that a balance is kept between divisional autonomy to provide incentives and motivation, and centralized authority to ensure that the divisions are all working towards the same target, the benefit of the organization as a whole.

6.7 THE BASIC RULES OF TRANSFER PRICING

6.7.1 Minimum Transfer Price

- The minimum transfer price is the price below which the supplying division will not agree to transfer because of the possibility of incurring a loss during the transfer process.

- The minimum transfer price should therefore be set as the sum of the supplying division's;

> "***MARGINAL COST + OPPORTUNITY COST OF THE ITEM TRANSFERRED"***

6.7.2 Maximum Transfer Price

- The maximum transfer price is the price above which the receiving division will not agree to transfer because of the possibility of incurring excess costs during the transfer process.

- The appropriate transfer price is hence measured as;

> ***"The lowest market price at which the receiving division could purchase the goods or services externally less any internal cost savings in packaging and delivery"***

- The receiving division will aim at buying the item at the cheapest price possible.

Activity 9.1: *Basic rules of transfer pricing*

Division X produces product L at a marginal cost per unit of Shs.100. If a unit is transferred internally to division Y, Shs.25 contribution is foregone on an external sale. The item can be purchased externally for Shs.150.

Required
Using the basic rules in discussed in 7.7 above, determine the minimum and maximum transfer prices

6.8 OPPORTUNITY COST

The opportunity cost included in determining the lower limit will be one of the following.

(a) *The maximum contribution foregone by the supplying division in transferring internally rather than selling goods externally.*
(b) *The contribution foregone by not using the same facilities in the producing division for their next best alternative use.*

If there is no external market for the item being transferred, and no alternative uses for the division's facilities, the transfer price = standard variable cost of production.

If there is an external market for the item being transferred and no alternative, more profitable use for the facilities in that division, the transfer price = the market price.

6.8.1 The transfer price at full and spare capacity

Activity 9.2: *Transfer price at full and spare capacity*

Until recently, Strike Ltd focused exclusively on making soles for work boots and football boots. It sold these rubber soles to boot manufacturers. Last year the company decided to take advantage of its strong reputation by expanding into the business of making football boots. As a consequence of this expansion, the company is now structured as two independent division, the boot Division and the Sole Division.

The Sole Division continues to make rubber soles for both football boots and work boots and sells these soles to other boot manufacturers. The boot division manufactures leather uppers for football boots and attaches these uppers to rubber soles. During its first year the Boot Division purchased its rubber soles from outside suppliers so as not to disrupt the operations of the Sole Division.

Strike management now wants the Sole Division to provide at least some of the soles used by the Boot division. The table shows the contribution margin for each division when the Boot Division purchases from an outside supplier.

	Boot Division Shs		Sole Division Shs.
Selling price of football boot	100	Selling price of sole	28
Variable cost of making boot (not including sole)	45	Variable cost per sole	21
Cost of sole purchased from outside suppliers	25		
Contribution margin per unit	30	Contribution margin per unit	7

Required:
Determine the transfer price given that the Sole Division sold 10,000 soles to the boot Division under the following conditions;

(i) The sole division has no spare capacity; it produces and sells 80,000 soles to outside customers

(ii) The Sole Division has Spare capacity; it produces 80,000 soles of which only 70,000 soles are sold on the open market.

6.9 THE USE OF MARKET PRICE AS A BASIS FOR TRANSFER PRICES

If an external market price exists for transferred goods, profit centre managers will be aware of the price they could obtain or the price they would have to pay for their goods on the external market, and they would inevitably compare this price with the transfer price.

Activity 9.3: *Transferring goods at market value*

A company has two profit centres, A and B. A sells half of its output on the open market and transfers the other half to B. Costs and external revenues in an accounting period are as follows.

	A	B	Total
	Shs.	Shs.	Shs.
External sales	8,000	24,000	32,000
Costs of production	12,000	10,000	22,000
			10,000

Required.
Prepare a profit statement to show the consequence of setting a transfer price at market value

6.9.1 The merits of market value transfer prices

- **Divisional autonomy**

In a decentralized company, divisional managers should have the autonomy to make output, selling and buying decisions which appear to be in the best interest of the division's performance. (If every division optimizes its performance, the company as a whole must inevitably achieve optimal results). Thus a transferor division should be given the freedom to sell output on the open market, rather than to transfer it within the company.

Arm's length transfer prices, which give profit centre mangers the freedom to negotiate prices with other profit centres as though they were independent companies, will tend to result in a market-based transfer price.

- **Corporate profit maximization**

In most cases where the transfer price is at market price, internal transfers should be expected, because the buying division is likely to benefit from a better quality of service, greater flexibility and dependability of supply. Both divisions may benefit from cheaper costs of administration, selling and transport. A market price as the transfer price would therefore result in decisions which would be in the best interests of the company or group as a whole.

- **Divisional performance measurement**

Where a market price exists, but the transfer price is a different amount (say, at standard cost plus), divisional managers will argue about the volume of internal transfers.

For example, if division X is expected to sell output to division Y at a transfer price of Shs.8 per unit when the open market price is Shs.10, its manager will decide to sell all output on the open market. The manager of division Y would resent the loss of his cheap supply from X, and would be reluctant to buy on the open market. A wasteful situation would arise where X sells on the open market at Shs.10, where Y buys at Shs.10, so that administration, selling and distribution costs would have been saved if X had sold directly to Y at Shs.10, the market price.

6.9.2 The disadvantages of market value transfer prices

Market value as a transfer price does have certain disadvantages.

(a) The market price may be a temporary one, induced by adverse economic conditions, or dumping, or the market price might depend on the volume of output supplied to the external market by the profit centre.

(b) A transfer price at market value might, under some circumstances, as a disincentive to use up any spare capacity in the divisions. A price based on incremental cost, in contrast, might provide an incentive to use up the spare resources in order to provide a marginal contribution to profit.

(c) Many products do not have an equivalent market price so that the price of a similar, but not identical, product might have to be chosen. In such circumstances, the option to sell or buy on the open market does not really exist.

(d) There might be an imperfect external market for the transferred item, so that if the transferring division tried to sell more externally, it would have to reduce its selling price.

6.10COST-BASED APPROACHES TO TRANSFER PRICING

Problems arise with the use of cost-based transfer prices because one party or the other is liable to perceive them as unfair.

Cost-based approaches to transfer pricing are often used in practice, because in practice the following conditions are common.

(a) There is no external market for the product that is being transferred.
(b) Alternatively, although there is an external market it is an imperfect one because the market price is affected by such factors as the amount that the company setting the transfer price supplies to it, or because there is only a limited external demand.

In either case there will not be a suitable market price upon which to base the transfer price.

6.10.1 Transfer prices based on full cost

Under this approach, the full cost (including fixed overheads absorbed) incurred by the supplying division in making the 'intermediate' product is charged to the receiving division. The obvious drawback to this is that the division supplying the product makes no profit on its work so is not motivated to supply internally. Also, there are a number of alternative ways in which fixed costs can be accounted for. If a full cost plus approach is used a profit margin is also included in this transfer price. The supplying division will therefore gain some profit at the expense of the buying division.

6.10.2 Transfer price at variable cost

A variable cost approach entails charging the variable cost (which we assume to be the same as the marginal cost) that has been incurred by the supplying division to the receiving division. The problem is that with a transfer price at marginal cost the supplying division does not cover its fixed costs.

6.11 Identifying the optimal transfer price

Here are some guiding rules for identifying the optimal transfer price.

(a) The ideal transfer price should reflect the opportunity cost of sale to the supply division and the opportunity cost to the buying division. Unfortunately, full information about opportunity costs may not be easily obtainable in practice.

(b) Where a perfect external market price exists and unit variable costs and unit selling prices are constant, the opportunity cost of transfer will be external market price or external market price less savings in selling costs.

(c) In the absence of a perfect external market price for the transferred item, but when unit variable costs are constant, and the sales price per unit of the end-product is constant, the ideal transfer price should reflect the opportunity cost of the resources consumed by the supply division to make and supply the item and so should be at standard variable cost + opportunity cost of making the transfer.

(d) When unit variable costs and/or unit selling prices are not constant, there will be a profit-maximising level of output and the ideal transfer price will only be found by sensible negotiation and careful analysis.

   (i) Establish the output and sales quantities that will optimize the profits of the company or group as a whole.

   (ii) Establish the transfer price at which both profit centres would maximise their profits at this company-optimising output level.

There may be a range of prices within which both profit centres can agree on the output level that would maximise their individual profits and the profits of the company as a whole. Any price within the range would then be 'ideal'.

6.12 International Aspects of Transfer Pricing

The objectives of transfer pricing change when a multinational corporation is involved and the goods and services being transferred cross international borders.

6.12.1 Challenges of international transfer pricing to multinational companies

In this context, the objectives of international transfer pricing focus on;

(i) Minimizing taxes,
(ii) Minimising duties,
(iii) Minimising foreign exchange risks,
(iv) Enhancing a company's competitive position in a foreign market and
(v) Improving its relations with foreign governments.

Although domestic objectives such as managerial motivation and divisional autonomy are always important, they often become secondary when international transfers are involved.
Companies will focus instead on charging a transfer price that reduces its total tax bill or that strengthens a foreign subsidiary.

For example;

(i) **Charging a low transfer price** for parts shipped to a foreign subsidiary may reduce customs duty payments as the parts cross international borders, or it may help the subsidiary to compete in foreign markets by keeping the subsidiary's costs low.

(ii) **Charging a high transfer price** may help a multinational corporation draw profits out of a country that has stringent controls on foreign remittances, or it may allow a multinational corporation to shift income from a country that has high income tax rates to a country that has low rates.

Exam type Questions

Activity 9.4:

Wash Co assembles and sells two types of washing machines – the Spin (S) and the Rinse (R). The company has two divisions: the assembly division, and the retail division.

The company's policy is to transfer the machines from the assembly division to the retail division at full cost plus 10%. This has resulted in internal transfer prices, when S and R are being transferred to the retail division, of Shs.220.17 and Shs.241.69 respectively. The retail division currently sells S to the general public for She.320 per machine and R for Shs.260 per machine. Assume it incurs no other costs except for the transfer price.

The retail division's manager is convinced that, if he could obtain R at a lower cost and therefore reduce the external selling price from Shs.260 to Shs.230 per unit, he could significantly increase sales of R, which would be beneficial to both divisions. He has questioned the fact that the overhead costs are allocated to the products on the current basis of labour hours; he thinks it should be done using activity based costing.

You have obtained the following information for the last month from the assembly division:

	Product S	Product R
Production and sales (units)	3,200	5,450
Materials cost	Shs.117	Shs.95
Labour cost (at Shs.12 per hour)	shs.6	Shs.9
Machine hours (per unit)	2	1
Total no. of production runs	30	12
Total no. of purchase orders	82	64
Total no. of deliveries to retail division	64	80
	Shs.	
Overhead costs:		
Machine set-up costs	306,435	
Machine maintenance costs	415,105	
Ordering costs	11,680	
Delivery costs	144,400	
Total	877,620	

Required:

(a) Using activity based costing to allocate the overheads, recalculate the transfer prices for S and R and comment on the view of the retail division manager.

(b) Calculate last month's profit for each division, showing it both for each product and in total, if activity based costing is used.

Activity 9.5:

Bath Co is a company specializing in the manufacture and sale of baths. Each bath consists of a main unit plus a set of bath fitting. The company is split into two divisions A and B. Division A manufactures the bath and Division B manufactures sets of bath fittings. Currently, all of Division A's sales are made externally. Division B, however, sells to Division A as well as to external customers. Both of the divisions are profit centres.

The following data is available for both divisions:

Division A

Current selling price for each bath	Shs.450
Costs per bath:	
Fittings from Division B	Shs.75
Other materials from external suppliers	Shs.200
Labour costs	Shs.45
Annual fixed overheads	Shs.7,440,000
Annual production and sales of bath (units)	80,000
Maximum annual market demand for baths (units)	80,000

Division B

Current external selling price per set of fittings	Shs.80
Current price for sales to Division A	Shs.75
Costs per set of fittings:	
Materials	Shs.5
Labour costs	Shs.15
Annual fixed overheads	Shs.4,400,000
Maximum annual production and sales of sets of fittings (units) (including internal and external sales)	200,000
Maximum annual external demand for sets of fittings (units)	180,000
Maximum annual internal demand for sets of fittings	80,000

The transfer price charged by Division B to Division A was negotiated some years ago between the previous divisional managers, who have now both been replaced by new managers. Head office only allows Division A to purchase its fittings from Division B, although the new manager of division A believes that he could obtain fittings of the same quality and appearance for She.65 per set, if he was give the autonomy to purchase from outside the company. Division B makes no cost savings from sup[plying internally to Division A rather than selling externally.

Required.

(a) Under the current transfer pricing system, prepare a profit statement showing the profit for each of the divisions and for Bath Vo as a whole. Your sales and costs figures should be split into external sales and inter-divisional transfers, where appropriate.

(b) Head Office is considering changing the transfer pricing policy to ensure maximization of company profits without demotivating either of the divisional mangers. Division A will be given autonomy to buy from external suppliers and Division B to supply external customers in priority to supplying to Division A. Calculate the maximum profit that could be earned by Bath Co if transfer pricing is optimized.

PART F
RISK AND UNCERTAIN

7.0
RISK AND UNCERTAINTY

UNIT 7 OVERVIEW:

- Risk and uncertainty
- Allowing for uncertainty
- Probabilities and expected values
- Decision rules
- Decision trees
- The value of information
- Sensitivity analysis
- Simulation models

7.1 RISK AND UNCERTAINTY

An example of a risky situation is one in which we can say that there is a 70% probability that returns from a project will be in excess of Shs.100,000 but a 30% probability that returns will be less than Shs.100,000. If we cannot predict an outcome or assign probabilities, we are faced with an uncertain situation.

Key terms:

Risk involves situations or events which may not occur, but whose probability of occurrence can be calculated statistically and the frequency of their occurrence predicted from past records. Thus insurance deals with risk.

Uncertain events are those whose outcome cannot be predicted with statistical confidence.

In everyday usage, the terms risk and uncertainty are not clearly distinguished. If you are asked for a definition, do not make the mistake of believing that the latter is a more extreme version of the former. It is not a question of degree, it is a question of whether or not sufficient information is available to allow the lack of certainty to be quantified. As a rule, however, the terms are used interchangeably.

7.2 RISK PREFERENCE

People may be risk seekers, risk neutral or risk averse.

Key terms:

A risk seeker is a decision maker who is interested in the best outcomes no matter how small the chance that they may occur.

A decision maker is **risk neutral** if he is connected with that will be the most likely outcome.

A **risk averse** decision maker acts on the assumption that the worst outcome might occur.

This has clear implications for managers and organisations. A risk seeking manager working for an organisation that is characteristically risk averse is likely to make decisions that are not congruent with the goals of the organisation. There may be a role for the management accountant here, who could be instructed to present decision-making information in such a way as to ensure that the manager considers all the possibilities, including the worst.

7.3 ALLOWING FOR UNCERTAINTY

Management accounting directs its attention towards the future and the future is uncertain. For this reason a number of methods of taking uncertainty into consideration have evolved.

7.4 RESEARCH TECHNIQUES TO REDUCE UNCERTAINTY

Market research can be used to reduce uncertainty.

Key term:
Market research is the systematic process of gathering, analyzing and reporting data about markets to investigate, describe, measure, understand or explain a situation or problem facing a company or organisation.

Market research involves tackling problems. The assumption is that these problems can be solved, no matter how complex the issues are, if the researcher follows a line of enquiry in a systematic way, without losing sight of the main objectives. Gathering and analyzing all the facts will ultimately lead to better decision making.

7.4.1 The role of market research

In the last 20 years or so market research has become a much more widespread activity. Organisations in the private sector, the public sector and the not-for-profit sector – rely on research to inform and improve their planning and decision making.

Market research enables organisations to understand the needs and opinions of their customers and other stakeholders. Armed with this knowledge they are able to make better quality decisions and provide better products and better services.

Thus, research influences what is provided and the way it is provided. It reduces uncertainty and monitors performance. A management team which possesses accurate information relating to the marketplace will be in a strong position to make the best decisions in an increasingly competitive world.

Decision-makers need date to reduce uncertainty and risk when planning for the future and to monitor business performance. Market researchers provide the data that helps them to do this.

7.4.2 Types of date collected

Data can be either primary (collected at first hand from a sample of respondents), or secondary (collected from previous surveys, other published facts and opinions, or from experts). Secondary research is also known as desk research, because it can be carried out from one's desk.

More importantly for research practice and analysis, data can be either quantitative or qualitative.

Quantitative data usually deals with numbers and typically provides the decision maker with information about how many customers, competitors e.t.c act in a certain way. Quantitative data can, for example tell the researcher what people need or consume, or where, when and how people buy goods or consumer services.

Qualitative data tells us why consumers think/buy or act the way they do. Qualitative data is used in consumer insight (e.g understanding what makes consumers prefer one brand to another), media awareness (e.g how much of an advertisement is noticed by the public), new product development studies and for many other reasons.

Qualitative research has as its specific purpose the uncovering and understanding of thought and opinion. It is carried out on relatively small samples and unstructured or semi-structured techniques, such as individual in depth interviews and group discussions (also known as focus groups) are used.

7.5 CONSERVATISM

This approach simply involves estimating outcomes in a conservative manner in order to provide a built-in safety factor.

However, the method fails to consider explicitly a range of outcomes and, by concentrating only on conservative figures, may also fail to consider the expected or most likely outcomes.

Conservatism is associated with risk aversion and prudence (in the general sense of the word). In spite of its shortcomings it is probably the most widely used method in practice.

7.6 WORST/MOST LIKELY/BEST OUTCOME ESTIMATES

A more scientific version of conservatism is to measure the most likely outcome from a decision, and the worst and best possible outcomes. This will show the full range of possible outcomes from a decision, and might help managers to reject certain alternatives because the worst possible outcome might involve an unacceptable amount of loss. This requires the preparation of pay-off tables.

7.6.1 Pay-off tables

Pay-off tables identify and record all possible outcomes (or pay-offs) in situations where the action taken affects the outcomes.

Activity 1: *Worst/best possible outcome*

JESA Co is trying to set the sales price for one of its products. Three prices are under consideration, and expected sales volumes and costs are as follows.

Price per unit	Shs.400	Shs.430	Shs.440
Expected sales volume (units)			
Best possible	16,000	14,000	12,500
Most likely	14,000	12,500	12,000
Worst possible	10,000	8,000	6,000

Fixed costs are Shs.2,000,000 and variable costs of sales are Shs.200 per unit.

Required
Advise management of JESA Ltd on which price to be chosen

7.7 EXPECTED VALUE (EV) APPROACH

This technique involves use of probabilities and expected values

Expected values indicate what an outcome is likely to be in the long term with repetition. Fortunately, many business transactions do occur over and over again.

Although the outcome of a decision may not be certain, there is some likelihood that probabilities could be assigned to the various possible outcomes from an analysis of previous experience.

7.7.1 Expected values

Where probabilities are assigned to different outcomes we can evaluate the worth of a decision as the expected value, or weighted average, of these outcomes. The principle is that when there are a number of alternative decisions, each with a range of possible outcomes, the optimum decision will be the one which gives the "**highest Expected Value (EV)**".

Activity 2: *Expected Values (EV)*

You have been approached by a manager who has to choose between mutually exclusive options A and B, with the probable outcomes of each option are as follows.

Option A		option B	
Probability	Profit Shs	Probability	Profit Shs
0.8	5,000	0.1	(2,000)
0.2	6,000	0.2	5,000
		0.6	7,000
		0.1	8,000

Advise the manager on the best option to choose

Activity 3: *Expected Values and pay-off tables*

Monitor Newsagents stocks a weekly lifestyle magazine. The owner buys the magazines for Shs.3,000 each and sells them at the retail price of Shs.5,000 each. At the end of the week unsold magazines are obsolete and have no value. The estimated probability distribution for weekly demand is shown below.

Weekly demand *(in number of magazines)*	Probability
200	0.20
300	0.55
400	0.25
	1.00

Required;

(i) Compute the expected value of demand

(ii) If the owner is to order a fixed quantity of magazines per week, how many should that be? (Assume no seasonal variations in demand.)

Activity 4:
A manager has to choose between mutually exclusive options C and D with the following probable outcomes:

Option C		Option D	
Probability	Cost Shs	Probability	Cost Shs
0.29	15,000	0.03	14,000
0.54	20,000	0.30	17,000
0.17	30,000	0.32	21,000
		0.32	24,000

Required
Given that both options will produce an income of Shs.30,000, determine the option to be chosen

7.7.2 Limitations of expected values

- The preference for B over A on the basis of expected value is marred by the fact that A's worst possible outcome is a profit of Shs.5,000, whereas B might incur a loss of Shs.2,000 (although there is a 70% chance that profits would be Shs.7,000 or more, which would be more than the best profits from option A).

- Since the decision must be made once only between A and B, the expected value of profit (which is merely a weighted average of all possible outcomes) has severe limitations as a decision rule by which to judge preference. The expected value will never actually occur.

- Expected values are used to support a risk-neutral attitude. A risk-neutral decision maker will ignore any variability in the range of possible outcomes and be concerned only with the expected value of outcomes.

- Expected values are more valuable as a guide to decision making where they refer to outcomes which will occur many times over. Examples would include the probability that so many customers per day will buy a can of baked beans, the probability that a customer services assistant will receive so many phone calls per hour, and so on.

Attempt exam type Question 10.20 in the exercises

7.8 DECISION RULES

- The play it safe basis for decision making is referred to as the **maximin basis**. This is short for 'maximise the minimum achievable profit'.

- A basis for making decisions by looking for the best outcome is known as the **maximax** basis, short for 'maximise the maximum achievable profit'.

- The 'opportunity loss' basis for decision making is known as **minimax regret**.

7.8.1 The maximin decision rule

Key term:
The maximin decision rule suggests that a decision maker should select the alternative that offers the least unattractive worst outcome. This would mean choosing the alternative that maximises the minimum profits.

Activity 5:
A businessman is trying to decide which of three mutually exclusive projects to undertake. Each of the projects could lead to varying net profit under three possible scenarios.

		Profits		
		Project		
		D	E	F
Scenarios	I	100	80	60
	II	90	120	85
	III	(20)	10	85

Required
Advise the business man using the maximin decision rule

Criticisms of maximin

(a) It is defensive and conservative, being a safety-first principle of avoiding the worst outcomes without taking into account opportunities for maximizing profits.
(b) It ignores the probability of each different outcome taking place.

7.8.2 Maximax

Key term:
The maximax criterion looks at the best possible results. Maximax means 'maximise the maximum profit'.

Activity 6:

Re-work example 4.5 and advise the business man using the maximax decision rule

Criticism of maximax

(a) It ignores probabilities.
(b) It is over-optimistic

Activity 7
A company is considering which one of three alternative courses of action A, B and C to take. The profit or loss from each choice depends on which one of four economic circumstances I, II, III or IV will apply. The possible profits and losses, in thousands of pounds, are given in the following payoff table. Losses are shown as negative figures.

		Action		
		A	B	C
	I	70	60	70
Circumstances	II	–10	20	–5
	III	80	0	50
	IV	60	100	115

Required:
State which action would be selected using each of the maximax and maximin criteria.

7.8.3 Minimax regret rule

Key term:
The **minimax regret rule** aims to minimize the regret from making the wrong decision. Regret is the opportunity lost through making the wrong decision.

We first consider the extreme to which we might come to regret an action we had chosen.

Regret for any combination of action and circumstances	=	Profit for best action in those circumstances	–	Profit for the action actually chosen in those circumstances

The minimax regret decision rule is that the decision option selected should be the one which minimizes the maximum potential regret for any of the possible outcomes.

Activity 8:

Re-work example 5 and 7 advise accordingly using the minimax decision rule

7.9 CONTRIBUTION TABLES

- Questions requiring application of the decision rules often incorporate a number of variables, each with a range of possible values. For example these variables might be:

  ⇒ *Unit price and associated level of demand*
  ⇒ *Unit variable cost*

- Each variable might have, for example, three possible values.

- Before being asked to use the decision rules, exam questions could ask you to work out contribution for each of the possible outcomes. (Alternatively profit figures could be required if you are given information about fixed costs).

Activity 9: *Contribution tables and the decision rules*
Suppose the budgeted demand for product X will be 11,500units if the price is shs.10; 8,500 units if the price is shs.12 and 5,000 units if the price is shs.14. Variable costs are estimated at shs.4, shs.5, or shs.6 per unit respectively.

Required
Advise on the price to be charged using the three decision rules (i.e. Maximin, maximax and minimax).

7.10 DECISION TREES

7.10.1 Key term:
A decision tree is a pictorial method of showing a sequence of interrelated decisions and their expected outcomes. Decision trees can incorporate both the probabilities of, and values of, expected outcomes, and are used in decision-making.

Exactly how does the use of a decision tree permit a clear and logical approach?

- All the possible choices that can be made are shown as branches on the tree
- All the possible outcomes of each choice are shown as subsidiary branches on the tree.

7.10.2 Constructing a decision tree

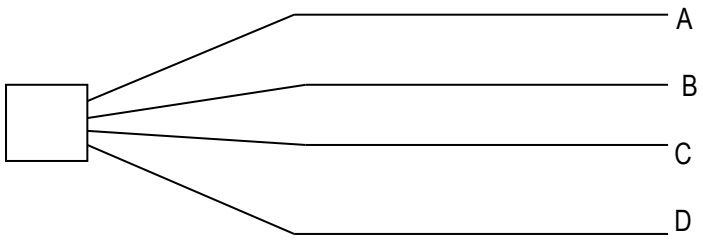
There are two stages in preparing a decision tree.

- Drawing the tree itself to show all the choices and outcomes.
- Putting in the numbers (the probabilities, outcomes values and EVs)

Every decision tree starts from a decision point with the decision options that are currently being considered.

(a) It helps to identify the decision point, and any subsequent decision points in the tree, with a symbol. Here a square shape has been used.
(b) There should be a line, or branch, for each option or alternative.

It is conventional to draw decision trees from left to right, and so a decision tree will start as follows.



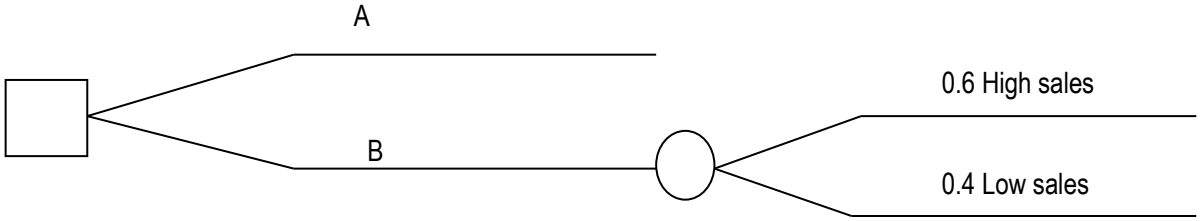
The square is the decision point, and A, B, C and D represent four alternatives from which a choice must be made (such as buy a new machine with cash, hire a machine, continue to use existing machine, raise a loan to buy a machine).

If the outcome from any choice is certain, the branch of the decision tree for that alternative is complete.

If the outcome of a particular choice is uncertain, the various possible outcomes must be shown.

We show the various possible outcomes on a decision tree by inserting an outcome point on the branch of the tree. Each possible outcome is then shown as a subsidiary branch, coming out from the outcome point. The probability of each outcome occurring should be written on to the branch of the tree which represents that outcome.

To distinguish decision points from outcome points, a circle will be used as the symbol for an outcome point.



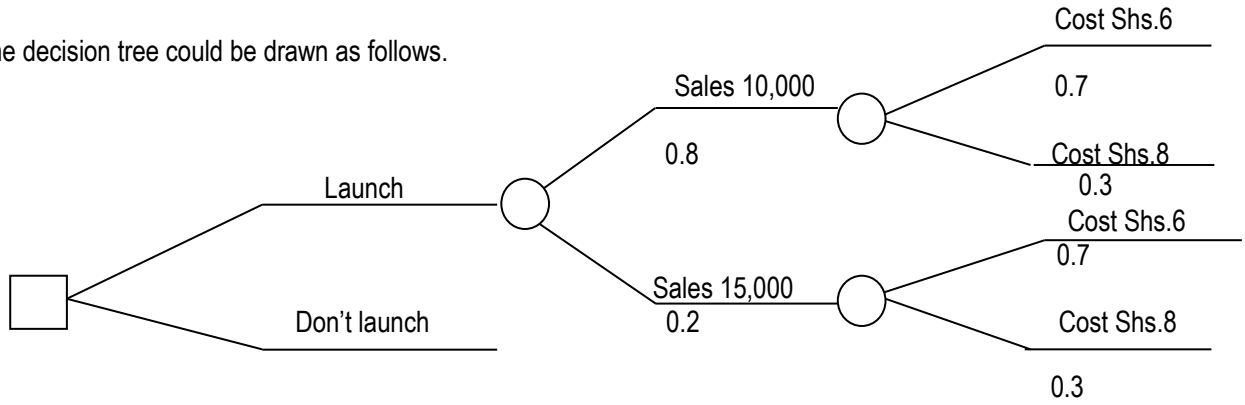
In the example above, there are two choices facing the decision-maker, A and B. the outcome if A is chosen is known with certainty, but if B is chosen, there are two possible outcomes, high sales (0.6 probability) or low sales (0.4 probability).
When several outcomes are possible, it is usually simpler to show two or more stages of outcome points on the decision tree.

Activity 10:

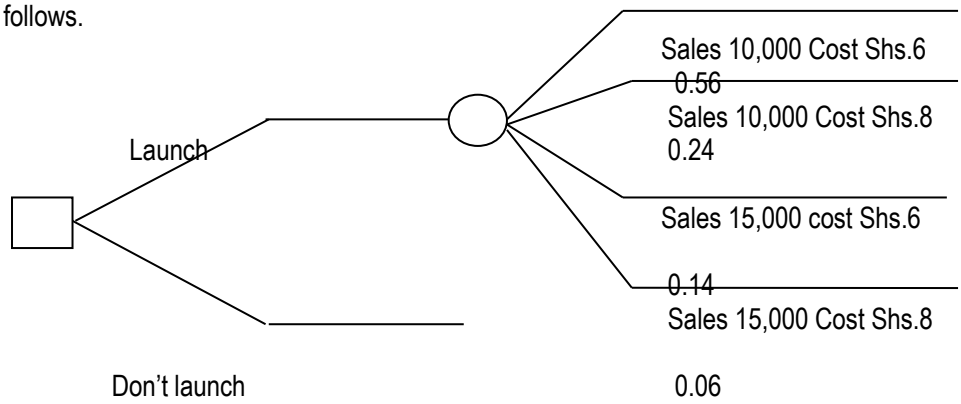
A company can choose to launch a new product XYZ or not. If the product is launched, expected sales and expected unit costs might be as follows

Sales		Unit costs	
Units	Probability	£	Probability
10,000	0.8	6	0.7
15,000	0.2	8	0.3

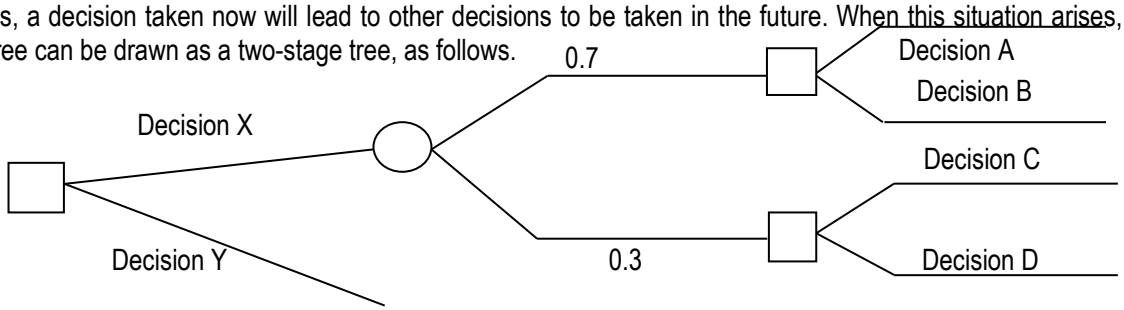
(a) The decision tree could be drawn as follows.



(b) The layout shown above will usually be easier to use than the alternative way of drawing the tree, which is as follows.



Sometimes, a decision taken now will lead to other decisions to be taken in the future. When this situation arises, the decision tree can be drawn as a two-stage tree, as follows.



In this tree, either a choice between A and B or else a choice between C and D will be made, depending on the outcome which occurs after choosing X. The decision tree should be in chronological order from left to right. When there are two-stage decision trees, the first decision in time should be drawn on the left.

Activity 11: *A decision tree*

Beethoven has a new wonder product, the vylin, of which it expects great things. At the moment the company has two courses of action open to it, to test market the product or abandon it.

If the company test markets it, the costs will be Shs.100,000 and the market response could be positive or negative with probabilities of 0.60 and 0.40.

If the response is positive the company could either abandon the product or market it full scale.

If it markets the vylin full scale, the outcome might be low, medium or high demand, and the respective net gains/(losses) would be (200), 200 or 1,000 in units of Shs.1,000 9the result could range from a net loss of Shs.200,000 to a gain of Shs.1,000,000). These outcomes have probabilities of 0.20, 0.50 and 0.30 respectively.

If the result of the test marketing is negative and the company goes ahead and markets the product, estimated losses would be Shs.600,000.

If, at any point, the company abandons the product, there would be a net gain of Shs.50,000 from the sale of scrap. All the financial values have been discounted to the present.

Required:

(a) Draw a decision tree.
(b) Include figures for cost, loss or profit on the appropriate branches of the tree.

7.10.3 Evaluating the decision with a decision tree

Rollback analysis evaluates the EV of each decision option. You have to work from right to left and calculate EVs at each outcome point.

The EV of each decision option can be evaluated, using the decision tree to help with keeping the logic on track. The basic rules are as follows.

(a) We start on the right hand side of the tree and work back towards the left hand side and current decision under consideration. This is sometimes known as the 'rollback' technique or 'rollback analysis'.
(b) Working from right to left, we calculate the EV of revenue, cost contribution or profit at each outcome point on the tree.

In the above example, the right-hand-most outcome point is point E, and the EV is as follows.

	Profit X Shs.'000	Probability P	PX Shs.000
High	1,000	0.3	300
Medium	200	0.5	100
Low	(200)	0.2	(40)
		EV	360

This is the EV of the decision to market the product if the test shows positive response. It may help you to write the EV on the decision tree itself, at the appropriate outcome point (point E).

(a) At decision point C, the choice is as follows.

(i) Market EV = + 360 (the EV at point E)
(ii) Abandon, value = + 50

The choice would be to market the product, and so the EV at decision point C is +360.

(b) At decision point D, the choice is as follows

(i) Market, value = –600
(ii) Abandon, value = +50

The choice would be to abandon, and so the EV at decision point D is +50

The second stage decisions have therefore been made. If the original decision is to test market, the company will market the product if the test shows positive customer response, and will abandon the product if the test results are negative.

The evaluation of the decision tree is completed as follows.

(a) Calculate the EV at outcome point B.

	0.6 x 360	(EV at C)
+	0.4 x 50	(EV at D)
=	216 + 20 = 236	

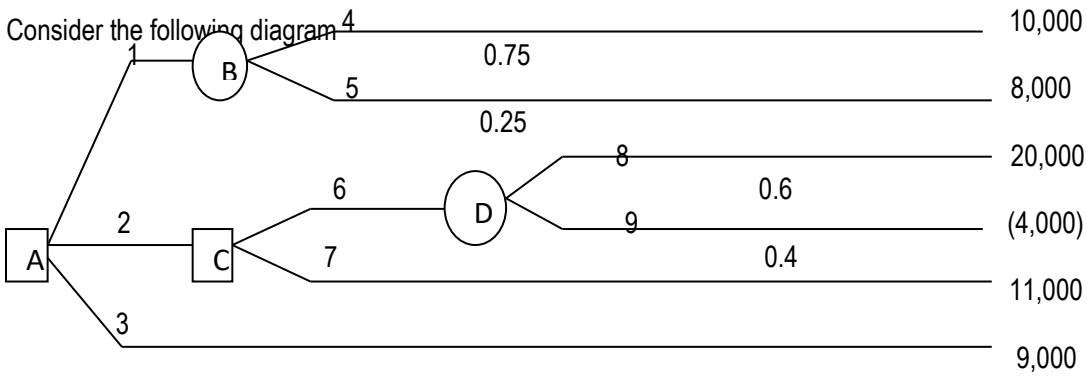
(b) Compare the options at point A, which are as follows.

(i) Test: EV = EV at B minus test marketing cost = 236 – 100 = 136
(ii) Abandon: Value = 50

The choice would be to test market the product, because it has a higher EV of profit.

Activity 12:

Consider the following diagram



If a decision maker wished to maximise the value of the outcome, which options should be selected?

A	Option and option 7	C	Option 1 and option 4
B	Option 3	D	Option 1, option 6 and option 8

7.11 THE VALUE OF INFORMATION

Perfect information is guaranteed to predict the future with 100% accuracy. Imperfect information is better than no information at all but could be wrong in its prediction of the future.

The value of perfect information is the difference between the EV of profit with perfect information and the EV of profit without perfect information.

7.11.1 Key term:
Perfect information removes all doubt and uncertainty from a decision, and enables managers to make decisions with complete confidence that they have selected the optimum course of action.

7.11.2 The value of perfect information

Step 1

If we do not have perfect information and we must choose between two or more decision options, we would select the decision option which offer the highest EV of profit. This option will not be the best decision under all circumstances. There will be some probability that what was really the best option will not have been selected, given the way actual events turn out.

Step 2

With perfect information, the best decision option will always be selected. The profits from the decision will depend on the future circumstances which are predicted by the information nevertheless, the EV of profit with perfect information should be higher than the EV of profit without the information.

Step 3

The value of perfect information is the difference between these two EVs.

Activity 13: The value of perfect information

The management of Ivor Ore must choose whether to go ahead with either of two mutually exclusive projects, A and B. the expected profits are as follows.

	Profit if there is Strong demand	Profit if there is moderate demand	Profit/(loss) if there is weak demand
Option A	Shs.4,000	Shs.1,200	Shs.(1,000)
Option B	Shs.1,500	Shs.1,000	Shs.500
Probability of demand	0.2	0.3	0.5

Required:
(a) Ascertain what the decision would be, based on expected values, if no information about demand were available.
(b) Calculate the value of perfect information about demand.

Activity 14:
WL must decide at what level to market a new product, the Urk. The urk can be sold nationally, within a single sales region (where demand is likely to be relatively strong) or within a single area. The decision is complicated by uncertainty about the general strength of consumer demand for the product, and the following conditional profit table has been constructed

		Weak	Demand moderate	Strong
		Shs	Shs	Shs
Market	nationally(A)	(4,000)	2,000	10,000
	in one region (B)	0	3,500	4,000
	in one area (C)	1,000	1,500	2,000
Probability		0.3	0.5	0.2

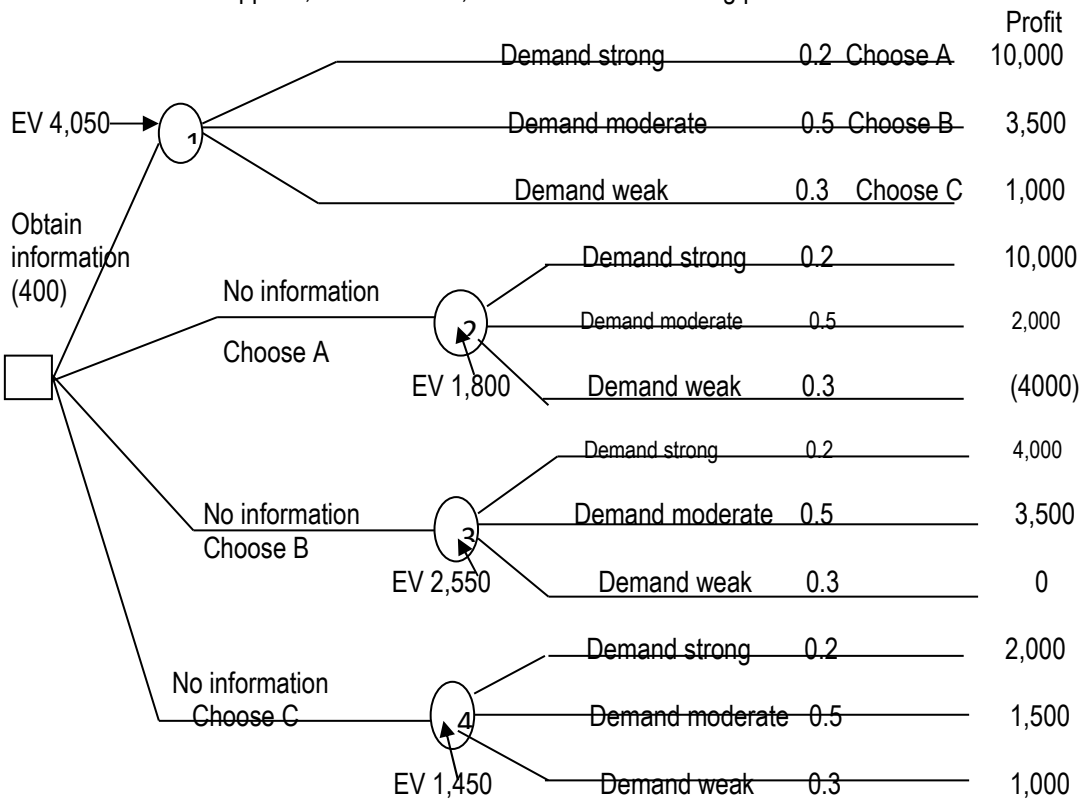
Required:
Option B should be selected, based on EVs of profit. True or false?

Activity 15
Use the information in your answer to the question above (Decision based on EV of profit).

Required:
Calculate the value of perfect information about the state of demand.

7.11.3 Perfect information and decision trees

When the option exists to obtain information, the decision can be shown, like any other decision, in the form of a decision tree, as follows. We will suppose, for illustration, that the cost of obtaining perfect information is Shs.400.



The decision would be to obtain perfect information, since the EV of profit is Shs.4,050 – Shs.400 = Shs.3,650.

You should check carefully that you understand the logic of this decision tree and that you can identify how the EVs at outcome boxes 1, 2, 3 and 4 have been calculated.

7.11.4 The value of imperfect information

There is one serious drawback to the techniques we have just looked at: in practice, useful information is never perfect unless the person providing it is the sole source of the uncertainty. Market research findings or information from pilot tests and so on are likely to be reasonably accurate, but they can still be wrong: they provide imperfect information. It is possible, however, to arrive at an assessment of how much it would be worth paying for such imperfect information, given that we have a rough indication of how right or wrong it is likely to be.

Activity 16

Suppose we are considering the sex and hair colour of the people in a given group or population consisting of 70% men and 30% women. We have established the probabilities of hair colourings as follows.

	Men	Women
Brown	0.60	0.35
Blonde	0.35	0.55
Red	0.05	0.10

This shows, for example, that 5% of men in such a sample have red hair. These probabilities of sex and hair colouring might be referred to as prior probabilities.

Posterior probabilities consider the situation in reverse or retrospect, so that we can ask the question: Given that a person taken at random from the population is brown-haired what is the probability that the person is male (or female0?

The information can be presented in a table. Let's suppose that the population consists of 1,000 people.

	Male	Female	Total
Brown	420 (W3)	105 (W4)	525 (W5)
Blonde	245	165	410
Red	35	30	65
	700 (W1)	300 (W2)	1,000

Workings:

0 1,000 x 70%
1 1,000 – 700
2 700 x 60% (the other two values in the column being calculated in a similar way)
3 300 x 35% (the other two values in the column being calculated in a similar way)
4 420 + 105 (the other two values in the column being calculated in a similar way)

∴ P (Person selected is a male, given that that person is brown-haired) = 420/525 = 0.8

Activity 17: *The value of imperfect information*

Suppose that the small Oil Company (SOC) is trying to decide whether or not to drill on a particular site. The chief engineer has assessed the probability that there will be oil, based on past experience, as 20%, and the probability that there won't be oil as 80%.

It is possible for SOC to hire a firm of international consultants to carry out a complete survey of the site. SOC has used the firm many times before and has estimated that if there really is oil, there is a 95% chance that the report will be favorable, but if there is no oil, there is only a 10% chance that the report will indicate that there is oil.

Required:
Determine whether drilling should occur.

7.12 SENSITIVITY ANALYSIS

Sensitivity analysis can be used in any situation so long as the relationships between the key variables can be established. Typically this involves changing the value of a variable and seeing how the results are affected.

7.12.1 Approaches to sensitivity analysis

Key term:
Sensitivity analysis is a term used to describe any technique whereby decision options are tested for their vulnerability to changes in any 'variable' such as expected sales volume, sales price per unit, material costs, or labour costs.

Here are three useful approaches to sensitivity analysis.
(a) To estimate by how much costs and revenues would need to differ from their estimated values before the decision would change.
(b) To estimate whether a decision would change if estimated costs were X% higher than estimated or estimated revenues y% lower than estimated.
(c) To estimate by how much costs and/or revenues would need to differ from their estimated values before the decision maker would be indifferent between two options.

The essence of the approach therefore is to carry out the calculations with one set of values for the variables and then substitute other possible values for the variables to see how this affects the overall outcome.

Activity 18: *Sensitivity analysis*
Sensitivity has estimated the following sales and profits for a new product which it may launch on to the market.

		Shs	Shs
Sales	(2,000 units)		4,000
Variable costs:	Materials	2,000	
	Labour	1,000	
			3,000
Contribution			1,000
Less incremental fixed costs			800
Profit			200

Required:
Analyse the sensitivity of the project.

7.13 SIMULATION MODELS

Simulation models can be used to deal with decision problems involving a number of uncertain variables. Random numbers are used to assign values to the variables.

One of the chief problems encountered in decision making is the uncertainty of the future. Where only a few factors are involved, probability analysis and expected value calculations can be used to find the most likely outcome of a decision. Often, however, in real life, there are so many uncertain variables that this approach does not give a true impression of possible variations in outcome.

To get an idea of what will happen in real life one possibility is to use a simulation model in which the values and the variables are selected at random. Obviously this is a situation ideally suited to a computer (large volume of data, random number generation).

The term 'simulation' model is often used more specifically to refer to modeling which makes use of random numbers. This is the 'Monte Carlo' method of simulation in the business environment it can, for example, be used to examine inventory, queuing, scheduling and forecasting problems.

Random numbers are allocated to each possible value of the uncertain variable in proportion to the probabilities, so that a probability of 0.1 gets 10% of the total numbers to be assigned. These random numbers are used to assign values of the variables.

Activity 10.19: *Simulation and spreadsheets*

A supermarket sells a product for which the daily demand varies. An analysis of daily demand over a period of about a year shows the following probability distribution.

Demand per day Units	Probability
35	0.10
36	0.20
37	0.25
38	0.30
39	0.08
40	0.07
	1.00

To develop a simulation model in which one of the variables is daily demand, we would assign a group of numbers to each value for daily demand. The probabilities are stated to two decimal places, and so there must be 100 random numbers in total, 00-99 (we use 00-99 rather than 1-100 so that we can use two digit random numbers). Random numbers are assigned in proportion to the probabilities, so that a probability of 0.1 gets 10% of the total numbers to be assigned, that is 10 numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.

The assignments would therefore be as follows.

Demand per day Units	Probability	Numbers assigned
35	0.10	00 – 09
36	0.20	10 – 29
37	0.25	30 – 54
38	0.30	55 – 84
39	0.08	85 – 92
40	0.07	93 – 99

When the simulation model is run, random numbers will be generated to derive values for daily demand. For example, if the model is used to simulate demand over a ten day period, the random numbers generated might be as follows.

19007174604721296802

The model would then assign values to the demand per day as follows.

Day	Random number	Demand units
1	19	36
2	00	35
3	71	38
4	74	38
5	60	38
6	47	37
7	21	36
8	29	36
9	68	38
10	02	35

You might notice that on none of the ten days is the demand 39 or 40 units, because the random numbers generated did not include any value in the range 85 – 99. When a simulation model is used, there must be long enough run to give a good representation of the system and all its potential variations.

7.12.2 Uses of simulation

In the supermarket example above, the supermarket would use the information to minimize inventory holding without risking running out of the product. This will reduce costs but avoid lost sales and profit.

A supermarket can also use this technique to estimate queues with predicted length of waiting time determining the number of staff required.

EXAM TYPE QUESTIONS

QUESTION 10.20

Zedi Limited manufactures concrete pavement making devices and has been selling each at She 16,000 for many years. The company is currently reviewing its pricing policy. The production manager has provided the following information:

The standard variable cost of manufacture is shs.10,000 and an analysis of the cost behaviours for the past 20 months shows the following:

1. An adverse variance of 10% of the standard variable costs has occurred in 10 of the 20 months.
2. Nil variance occurred in six of the 20 months.
3. Favoured variances of 5% occurred in four of the 20 months.

Fixed costs have been shs. 4,000 on average sales of 20,000 units but these costs are expected to rise and the following estimates have been made:

Estimate	Probability	Shs "000"
Optimistic	0.3	82,000
Most likely	0.5	85,000
Pessimistic	0.2	90,000

The marketing manager has estimated two prices and he considers the following information relevant to them:

		Shs 17,000	Shs 18,000
		Sales units	
Estimate	**Probability**	**Shs "000"**	**Shs "000"**
Optimistic	0.2	21,000	19,000
Most likely	0.5	19,000	17,500
Pessimistic	0.3	16,500	15,500

Required:

(a) Advise management based on the information above, whether they should change their selling price and state your recommended price. [10 marks]

(b) Calculate the expected profit at the price recommended and the resulting margin of safety [10 marks]

[Total 20 marks]

Source: CPA(U), November 2013, Question 2

EXAM TYPE QUESTIONS

QUESTION 10.21

A theatre has a seating capacity of 500 people. The management is considering engaging a musician, Maria Sawa and her orchestra, for a one night concert. Maria Sawa will charge a fee of Shs 10 million regardless of the size of the audience.

The management of the theatre have set an entrance fee of Shs 25,000 per person. Based on past experience, attendance of concerts of this nature is expected to be as follows:

Number of attendees	*Probability*
300	50%
400	30%
500	20%

To boost the revenue from the concert, confectionaries have been added to the menu and they are expected to be sold prior and during the concert.

The contribution that these confectionaries would yield is uncertain but it is estimated as follows:

Contributions from confectionary sales	*Probability*
Shs 3,000 per person	30%
Shs 5,000 per person	50%
Shs 4,000 per person	20%

Required:

Using expected values as a basis of your decision, advise the management of the theatre whether it is worthwhile engaging the musician. (10 marks)

Source: CPA(U), November 2011, Question 4

QUESTION 10.22

Katala Ltd can produce a product using either labour intensive or machine intensive operations. Costs of production for each method are as follows:

	Labour Intensive Shs '000'	Machine Intensive Shs '000'
Variable costs per unit	2	3
Fixed costs	9,000	12,400

The marketing manager has informed you that demand for the product and the selling price are uncertain. The following possible outcomes and associated probabilities have been provided by the business analyst.

Demand		Unit Selling Price	
Number of units	Probability	Price (Shs)	Probability
150,000	0.4	2,000	0.3
200,000	0.1	2,300	0.3
250,000	0.3	2,500	0.4
300,000	0.2		

Required:

(a) Develop a probability tree to show the possible profits from labour intensive and machine intensive operations (8 marks)

(b) Determine the following for each production method:

(i) Expected profits. (4 marks)

(ii) Probability of at least breaking even. (4 marks)

(c) Discuss other factors that the management of Katala Ltd should consider before deciding on the production method. (4 marks)

(Total 20 marks)

Source: CPA(U), November 2010, Question 2

EXAM TYPE QUESTIONS

QUESTION 10.23

Moses Muhumuza is a sole proprietor and deals in the purchase of Automatic Teller Machines (ATMs) for rental to banks under operating lease arrangements.
Currently, Muhumuza is experiencing a capital rationing situation and must opt between one of the two profitable different ATM models available. The demand for ATMs is seasonal, specifically, more people use ATMs during holidays (Easter, Idd, and Christmas) seasons, which increases the demand for more ATMs to rent by the banks.
Consequently, Muhumuza expects two possible demand levels – high and low and the estimated probability of event 'High' occurring is 0.6.

The estimated profit for each demand level are as follows:

	Demand level	
	High	**Low**
	Shs million	**Shs million**
Model A	180,000	120,000
Model B	200,000	80,000

Muhumuza is considering employing an independent market research consultant who would be able to provide 100% perfect prediction of the actual demand.

Required:
(a) (i) Calculate the expected profit for Models A and B, and advise him on the **Model** to be bought on the basis of expected value. **(2 marks)**
(ii) With relevant explanations and computations, determine the maximum amount of money Muhumuza should be prepared to pay the consultant for the additional information to enable him obtain 100% perfect predictions of the actual demand instead of taking decisions based on probabilities. **(6 marks)**

(b) Explain the meaning of each of the following decision criteria and advise Muhumuza on which Model should be bought using each decision criteria:

(i) Maximin. **(2 marks)**
(ii) Maximax. **(2 marks)**
(iii) Regret. **(4 marks)**

(c) The independent market research consultant has advised Muhumuza that "it is risky to invest all your money in the ATM business only because it is seasonal. I would advise you to **diversify** and create a **portfolio**."
Required:
Explain with examples, the meaning of each of the underlined words in the consultant's statement above.
(4 marks)

(Total 20 marks)

PART G
MANAGEMENT CONTROL SYSTEMS

8.0
MANAGEMENT CONTROL SYSTEMS

UNIT 8 OVERVIEW:

- Introduction
- The planning and control cycle.
- Planning and control in the performance hierarchy
- Other aspects of budgeting
- Budgetary Systems

8.1 INTRODUCTION

Consider how the activities of planning and control are inter-related.

(a) Plans set targets

(b) Control involves two main processes

(i) Measure actual results against the plan

(ii) Take action to adjust actual performance to achieve the plan or to change the plan altogether

Control is therefore impossible without planning.
The essence of control is the measurement of results and comparing them with the original plan. Any deviation from plan indicates that control action is required to make the results conform more closely with plan.

8.2 THE PLANNING AND CONTROL CYCLE.

The planning and control cycle has **seven** steps;

(a) **Identify objectives**: - Objectives establish the direction in which management of the organization wish it to be heading. They answer the question; where do we want to be?

(b) **Identify potential strategies**: - Once an organization has decided 'where it wants to be', the next step is to identify a range of possible courses of action or strategies that might enable the organization to get there. The organization must therefore carry out an, information-gathering exercise to ensure it has a full understanding of where it is now. This is known as a 'positional edit' or 'strategic analysis' and involves looking both inwards and outwards.

(i) The organization must gather information from all its internal parts to find out what it possesses. What its manufacturing capacity and capability is, what is the state of its technical know-how, how well it is able to market itself, how much cash it has in the bank and so on.

(ii) It must also gather information externally so that it can assess its position in the environment. Just as it has assessed its own strength and weaknesses, it must do likewise for its competitors (threats). Current and potential markets must be analyzed to identify new opportunities. The 'state of the world' must be considered. Is it in recession or is it booming? What is likely to happen in the future?

(c) **Evaluate strategies**: - The strategies must then be evaluated in terms of suitability, feasibility and acceptability. Management should select those strategies that have the greatest potential for achieving the organizations objective.

(d) **Choose alternative course of action**: - The next step in the process is to collect the chosen strategies together and co-ordinate them into long term financial plan. Typically this would show the following;

- Projected cash flows
- Projected long-term profits
- A description of the long-term objectives and strategies in word
- Capital expenditure plans
- Balance sheet forecast

(e) **Implement the long-term plan**: - The long-term plan should then be broken down into smaller parts. It is unlikely that the different parts will fall conveniently into successive time periods. Strategy A may take two and a half years, while strategy B may take 6 months but not start until year three of the plan. It is usual, however, to break down the plan as a whole into equal time periods (usually 1 year). The resulting short-term plan is called a budget.

(f) **Measure actual results and compare with plan**: - Actual results are recorded and analyzed and information about actual results is fed back to management concerned, often in the form of accounting reports. This reported information is feedback.

(g) **Respond to divergences from plan**:- By comparing actual and planned results, management can then do one of three things, depending on how they see the situation;

- They can take control action. By identifying what has gone wrong, and then finding out why, corrective measures can be taken.
- They can decide to do anything. This could be the decision when actual results are going better than planned, or when poor results were caused by something which is unlikely to happen again in the future.
- They can alter the plan or target if actual results are different from the plan or target, and there is nothing that management can do (or nothing, perhaps, that they want to do) to correct the situation.

8.3 PLANNING AND CONTROL IN THE PERFORMANCE HIERARCHY.

Planning and control occurs at all levels of the performance hierarchy to different degrees. The performance hierarchy refers to the system by which performance is measured and controlled at different levels of management within the organization.

Although it implies a 'top down' approach to management, we could describe a cascade of goals, objectives and plans down through the layers of the organization. The plans made at the higher level of the performance hierarchy provide a framework within which the plans at the lower levels must be achieved. The plans at the lower levels are the means by which the plans at the higher levels are achieved.

It could therefore be argued that without the plans allied directly to the vision and corporate objective the operational level and departmental plans have little meaning. Planning could therefore be deemed as more significant at the higher levels of the performance hierarchy than the lower levels.
This is not to say that planning at an operational level is not important. It is just that the nature of planning differs according to the level in the management hierarchy that takes place.

Corporate plans/strategic plans Prepared at a strategic level by senior management	• Focused on overall corporate performance • Environment influence • Set over all plans and targets for units and departments

	• Sometimes qualitative planning (e.g. program to change the culture of the organization)
Tactical plans **Prepared at lower management level ('management control level'), within guidelines set by senior management.**	• Time horizon typically 12 months • Plans for individual departments or activities, within guidelines set by senior management. • Some budgets may be prepared in non-financial terms, but all budgets are converted into money values. • The overall budget is expressed in financial terms, with a budgeted income statement, budgeted end-of-year financial position and budget cash flow forecast. • Provides a link between strategic plans at senior level and operational planning. • Budget targets should be consistent with strategic objectives. • Approved by senior management (board of directors)
Operational plans **Prepared by managers at a fairly junior level, at a practical operational level**	• Based on objectives about 'what' to achieve in operational terms • Specific (e.g. acceptable number of 'rings' before a song is answered) • Operational targets likely to be quantitative • Detailed specifications on targets and standards • Based on 'how' something is achieved • Short time zones • Operational plans should be prepared that enable budget to be achieved

8.4 CONTROL

Consider how the activities of planning and control are inter-related.

(c) Plans set targets

(d) Control involves two main processes

(iii) Measure actual results against the plan

(iv) Take action to adjust actual performance to achieve the plan or to change the plan altogether

Control is therefore impossible without planning.
The essence of control is the measurement of results and comparing them with the original plan. Any deviation from plan indicates that control action is required to make the results conform more closely with plan.

8.4.1 Feed back

Feedback occurs when the results (outputs) of a system are used to control it, by adjusting the input or behavior of the system. Feedback is information produced as output from operations; it is used to compare actual results with planned results for control purposes.

8.4.2 A business organization uses feedback for control.

(a) Negative feedback indicates that results or activities must be brought back on course, as they are deviating from the plan.

(b) Positive feedback results in control action continuing the current course. You would normally assume that positive feedback means that results are going according to plan and that no corrective action is necessary; but it is best to be sure that the control system itself is not picking up the wrong information.
(c) Feed forward control is control based on forecast results; in other words if the forecast is bad, control action is taken well in advance of actual results.

8.4.3 Types of Feedback

There are two types of feedback.

1. Single loop feedback is control, like a thermostat, which regulates the output of a system. For example, if sales targets are not reached, control action will be taken to ensure that targets will be reached soon. The plan or target itself is not changed, even though the resources needed to achieve it might have to be reviewed.

2. Double loop feedback is of a different order. It is information used to change the plan itself. For example, if sales targets are not reached, the company may need to change the plan.

8.4.4 Control of different levels

Budgetary control occurs at the middle management or 'management control' levels of the performance hierarchy.
Control at the middle management or 'management control' level of the performance hierarchy, such as standard costing, and budgetary control has the following features.

- It is exercised by measuring actual performance against planned performance in the budget or similar medium-term plans.
- Actual results are measured and reported to the managers responsible for the performance. There is formal feedback system for reporting, and performance reports may be produced monthly, in form of a budgetary control report or variance report.
- Reports are based mainly on feedback, i.e. performance information produced from within the organization's systems. They don't make any significant use of information obtained externally, from outside the organization
- Comparisons of actual budgeted performance are often expressed in financial terms.

8.5 OTHER ASPECTS OF BUDGET PREPARATION

The following are the key points about preparation;

Point	Detail
Long-term plan	The starting point, this will show what the budget has to achieve (the introduction of new production, the required return and so on) and outline how it is to be done. It will also contain general guidelines on allowable price increases like wage rates. The long term policy needs to be communicated to all managers responsible for preparing budgets so that they are aware of the context within which they are budgeting and how their area of responsibility is expected to contribute.
Limiting factor	This is the factor in the budget that limits the scale of operations. The limiting factor is often sales demand, but may be production capacity, when sale demand is high, or when a key production resource is in short supply. Budgeting cannot proceed, until the budget for the limiting factor has been prepared, since this affects all other budgets.

Budget manual	A budget manual is a guide or instruction document to assist functional managers with preparing their functional budgets. It shows how figures and forecast for the budget should be calculated, and gives other practical information. It is likely to include proformas showing how the information is presented. If budgeting is done with spreadsheets, layouts and computations may be pre-programed, requiring only the entry of the figures. It may include a flow diagram showing how individual budgets are interlinked and specify deadlines by which first drafts must be prepared.
Sales budget	This contains information on the expected volume of sales (based on estimates or market research), the sales mix, and selling prices. The total revenues indicated will be used to compile the cash budget, although this information needs to be adjusted to allow for the expected timing of receipts. The volume of sales indicates the level of production required and the extent of spending on distribution and administration.
Production capacity	The level of sales anticipated is matched against opening inventory and desired closing inventory to establish the level of production. From this can be calculated for materials (again allowing for opening and closing inventory), labour and machine hours. In other words production budgeting is done in terms of physical resources initially and costed afterwards.
Functional budgets	Functional budgets are budgets for the different departments or functions within the organization. Budgets for production-related functions such as purchasing, engineering and inspection and testing, may be best on the budgeted volume of production. Budgets for other areas of the organization, such as distribution and administration may take the anticipated sales level as their point of reference. Vehicle costs, carriage costs, stationery and communication costs, and above all staff costs feature in these budgets. Some budgeted, such as the budget for R & D spending, may be entirely discretionary and set a level that management consider the organization can or should afford.
Discretionary costs	Training and R & D are known as 'discretionary costs' and have special features.
Consolidation and coordination	This can begin once all parts of the organization have submitted their individual budgets. It is most likely that all of the budgets will be in line with each other at the first attempt. Areas of incompatibility must be identified and the budgets modified in consultation with individual managers. Spreadsheets are invaluable at this stage, both for the consolidation itself and to allow changes to be made quickly and accurately.
Cash budget	This can only be prepared at this stage because it needs to take account of all of the plans of the plans of the organization and translate them into expected cash flow. Cash must be available when it is needed to enable the plans to be carried out. Overdraft facilities may need to be negotiated in advance, or some activities may need to be deferred until cash has been collected.
Master budget	The final stage, once all of the necessary modifications have been made, is to prepare a summary of all of the budgets in the form of a master budget, which generally comprises a budgeted income statement, a budgeted balance sheet and a budgeted cash flow statement.

8.5.1 Approaches to Budget Preparation; "Top-down and bottom-up budgeting"

'Top-down' and 'bottom-up' are two different approaches to budget prepare.

(a) With 'top-down budgeting' budget targets are set at senior management level for the organization as a whole and for each major department or activity within the organization. The departmental budget targets are then given to the

departmental mangers, who are required to prepare a budget that conforms to the targets that have been imposed on them from above.

Similarly, when budgets have been set at departmental level, targets are given to managers down the organization hierarchy; these managers are then required to prepare budgets that meet the targets for their area of operation that have been imposed on them.

(b) With bottom-up budgeting, the budgeting process starts at a relatively low level of management. Managers are required to draft a budget for their area of operation. These are submitted to their superior, who combines the lower-level budgets into a combined budget for the department as a whole. Departmental budgets are then submitted to senior management, where they are combined into a coordinated budget for the organization as a whole.

Top-down budgeting takes much less time and planning effort than bottom-up budgeting and senior management can use top-down budgets to impose their views. Bottom-up budgeting is much more time-consuming, and draft budgets may have to be revised many times until they are properly coordinated.
However, bottom-up budgeting has two potential advantages.

(a) It reflects the views and expectations of managers who are closer to operations and so who may have a better understanding of what and what is not achievable.
(b) Bottom-up budgeting is a form of participative budgeting process, which can have behavioural and motivational advantages.

PART H
BUDGETING AND BUDGETARY CONTROL

9.0
INTRODUCTION TO BUDGETING

UNIT 9 OVERVIEW:

- Objectives of Budgeting
- The planning and control cycle.
- Planning and control in the performance hierarchy
- Other aspects of budgeting
- Budgetary Systems

9.1 OBJECTIVE OF BUDGETING SYSTEMS

A budget is a qualified plan of action for a forthcoming accounting period. A budget can be set from the top down (imposed budget) or from the bottom up (participatory budget).

The objectives of a budgetary planning and control system include the following;

- *Ensure the achievement of the organizations objective.*
- *Compel planning*
- *Communicate ideas and plans*
- *Coordinate activities*
- *Provide framework for responsible accounting*
- *Establish a system of control*
- *Motivate employees to improve their performance*

A budgetary planning and control system is essentially a system for ensuring communication, coordination and control within an organization. Communication, coordination and control are generally objectives: more information is provided by an inspection of the specific objectives of a budgetary planning and control system.

Objective	Comment
Ensure the achievement of the organization's objectives	Objectives are set for the organization as a whole, and for individual departments and operations within the organization. Qualified expressions of these objectives are then drawn up as targets to be achieved within the time scale of the budget plan.
Compel planning	This is probably the most important feature of a budgetary planning and control system. Planning forces management to look ahead, to set out detailed plans of achieving the targets for each department, operation and (ideally) each manager and to anticipate problems. It thus prevents management from relying on ad hoc or uncoordinated planning which may be detrimental to the performance of the organization .
Communicate ideas and plans	A formal system is necessary to ensure that each person affected by the plans is aware of what he or she is supposed to be doing. Communication might be one-way, with managers giving orders to subordinates, or there might be a two-way dialogue and exchange of ideas.

Coordinate activities	The activities of different departments or sub-units of the organization need to be coordinated to ensure maximum integration of effort towards common goals. This concept of coordination implies that, for example, that the purchasing department should base its budget on production of requirements and that the production budget should in turn be based on the sales expectations. Although straightforward in concept, coordination is remarkably difficult to achieve, and there is often 'sub-optimality' and conflict between departmental plans in the budget so that the efforts of each department are not fully integrated into a combined plan to achieve the company's best targets.
Provide a framework for responsibility accounting	Budgetary planning and control systems require the mangers of budget centers are made responsible for the achievement of budget targets for the operations under their personal control.
Establish a system of control	A budget yardstick against which actual performance is measured and assessed. Control over actual performance is provided by the comparisons of actual results against the budget plan. Departures from budget can then be investigated and the reasons for the departures can be divided into controllable and uncontrollable factors
Motivate employees to improve their performance	The interest and commitment of employees can be retained via a system of feedback of actual results, which lets them know how well or badly they are performing. The identification of controllable reasons for departures from budget with managers responsible provides an incentive for improving future performance.

9.2 KEY ASPECTS OF BUDGET PREPARATION

The following are the key points about preparation;

Point	Detail
Long-term plan	The starting point, this will show what the budget has to achieve (the introduction of new production, the required return and so on) and outline how it is to be done. It will also contain general guidelines on allowable price increases like wage rates. The long term policy needs to be communicated to all managers responsible for preparing budgets so that they are aware of the context within which they are budgeting and how their area of responsibility is expected to contribute.
Limiting factor	This is the factor in the budget that limits the scale of operations. The limiting factor is often sales demand, but may be production capacity, when sale demand is high, or when a key production resource is in short supply. Budgeting cannot proceed, until the budget for the limiting factor has been prepared, since this affects all other budgets.
Budget manual	A budget manual is a guide or instruction document to assist functional managers with preparing their functional budgets. It shows how figures and forecast for the budget should be calculated, and gives other practical information. It is likely to include proformas showing how the information is presented. If budgeting is done with spreadsheets, layouts and computations may be pre-programed, requiring only the entry of the figures. It may include a flow diagram showing how individual budgets are interlinked and specify deadlines by which first drafts must be prepared.
Sales budget	This contains information on the expected volume of sales (based on estimates or market research), the sales mix, and selling prices. The total revenues indicated will be used to compile the cash budget, although this information needs to be adjusted to allow for the expected timing of receipts.

	The volume of sales indicates the level of production required and the extent of spending on distribution and administration.
Production capacity	The level of sales anticipated is matched against opening inventory and desired closing inventory to establish the level of production. From this can be calculated for materials (again allowing for opening and closing inventory), labour and machine hours. In other words production budgeting is done in terms of physical resources initially and costed afterwards.
Functional budgets	Functional budgets are budgets for the different departments or functions within the organization. Budgets for production-related functions such as purchasing, engineering and inspection and testing, may be best on the budgeted volume of production. Budgets for other areas of the organization, such as distribution and administration may take the anticipated sales level as their point of reference. Vehicle costs, carriage costs, stationery and communication costs, and above all staff costs feature in these budgets. Some budgeted, such as the budget for R & D spending, may be entirely discretionary and set a level that management consider the organization can or should afford.
Discretionary costs	Training and R & D are known as 'discretionary costs' and have special features.
Consolidation and coordination	This can begin once all parts of the organization have submitted their individual budgets. It is most likely that all of the budgets will be in line with each other at the first attempt. Areas of incompatibility must be identified and the budgets modified in consultation with individual managers. Spreadsheets are invaluable at this stage, both for the consolidation itself and to allow changes to be made quickly and accurately.
Cash budget	This can only be prepared at this stage because it needs to take account of all of the plans of the plans of the organization and translate them into expected cash flow. Cash must be available when it is needed to enable the plans to be carried out. Overdraft facilities may need to be negotiated in advance, or some activities may need to be deferred until cash has been collected.
Master budget	The final stage, once all of the necessary modifications have been made, is to prepare a summary of all of the budgets in the form of a master budget, which generally comprises a budgeted income statement, a budgeted balance sheet and a budgeted cash flow statement.

9.2.1 Approaches to Budget Preparation; "Top-down and bottom-up budgeting"

'Top-down' and 'bottom-up' are two different approaches to budget prepare.

(a) With 'top-down budgeting' budget targets are set at senior management level for the organization as a whole and for each major department or activity within the organization. The departmental budget targets are then given to the departmental mangers, who are required to prepare a budget that conforms to the targets that have been imposed on them from above.

Similarly, when budgets have been set at departmental level, targets are given to managers down the organization hierarchy; these managers are then required to prepare budgets that meet the targets for their area of operation that have been imposed on them.

(b) With bottom-up budgeting, the budgeting process starts at a relatively low level of management. Managers are required to draft a budget for their area of operation. These are submitted to their superior, who combines the lower-level budgets into a combined budget for the department as a whole. Departmental budgets are then submitted to senior management, where they are combined into a coordinated budget for the organization as a whole.

Top-down budgeting takes much less time and planning effort than bottom-up budgeting and senior management can use top-down budgets to impose their views. Bottom-up budgeting is much more time-consuming, and draft budgets may have to be revised many times until they are properly coordinated.
However, bottom-up budgeting has two potential advantages.

(a) It reflects the views and expectations of managers who are closer to operations and so who may have a better understanding of what and what is not achievable.
(b) Bottom-up budgeting is a form of participative budgeting process, which can have behavioural and motivational advantages.

9.3 APPROACHES TO BUDGETING

9.3.1 INCREMENTAL BUDGETING

Incremental budgeting is a method of budgeting in which next year's budget is prepared by using the current's year's actual results as a starting point, and making adjustment for expected inflation, sales growth or decline and other known changes.

The main advantage of incremental budgeting is that it is a relatively straightforward way of preparing a budget.
Increment budgeting may also be a reasonable procedure if current operations are as effective, efficient and economical as they can be. It is also appropriate for budgeting for costs such as staff salaries, which may be estimate on the basis of current salaries plus an increment for inflation, provide that no significant changes in the work force are anticipated, and hence administratively fairly easy to prepare.

In general, however, it is **an inefficient form of budgeting** as it **encourages slack** and **wasteful spending** to creep into budgets. Past inefficiencies and perpetuated because cost levels are rarely subjected to close scrutiny.

Advantages of incremental budgets	Disadvantages of incremental budgets
• Considered to be the quickest and easiest method of budgeting •	• Builds in previous problems and inefficiencies
• Suitable for organizations that operate in a stable environment where historic figures are reliable and are not expected to change significantly	• Managers may spend for the sake of spending in order to use up their budget for the year and thus ensure that they get the same (or larger) budget next year
	• Uneconomic activities may be continued. For example, a car manufacturer may continue to make parts in-house when it may be cheaper to outsource.

9.3.2 FIXED AND FLEXIBLE BUDGETS

A fixed budget is a financial plan that does not change throughout the budget period, regardless of any changes from the plan in the actual volume of activity. A flexible budget recognizes cost behaviour and changes as the actual volume of activity changes.

A fixed budget is normally used for planning purposes and is prepared in advance of the beginning of the financial period. A flexible budget is used for control purposes and is normally prepared retrospectively when the actual level of activity in a period is known.

9.3.3 Fixed budgets

A fixed budget is a budget which remains unchanged throughout the budget period, regardless of differences between the actual and the original planned volume of output or sales.
The master budget, which is prepared and approved before the beginning of the budget period, is normally a fixed budget. The term 'fixed' means the following;

(a) The budget is prepared on the basis of an estimated volume of production and an estimated volume of sales, but no plans are made for the event that actual volumes of production and sales may differ from budgeted volumes.

(b) When actual volumes of production and sales during a control period (month or four weeks or quarter) are achieved, the budget is not adjusted or revised (in retrospect) to the new levels of activity.

The major purpose of a fixed budget is for planning. It is prepared at the planning stage, when it used to define the objectives and targets of the organization for the budget period; (Financial year).

9.3.4 Flexible budgets

A flexible budget is a budget which, by recognizing different cost behaviour patterns, is changed as the volume of output and sales changes. It recognizes cost behaviour patterns, such as changes in sales revenue and variable costs as sales volumes change, and step changes in fixed costs as activity levels rise or fall by more than a certain amount.

Flexible budgets may be used in one of two ways.

(a) **At the planning stage**. An organization may prepare flexible budgets at the planning stage for different levels of activity. For example, suppose that a company expects to sell 10,000 units of output during the next year.

A master budget (the fixed) would be prepared on the basis of these expected volumes. However, if the company thinks that output and sales might be as low as 8,000 units or as high as 12,000 units, it may prepare contingency flexible budgets, at volumes of, say 8,000, 9,000, 11,000 and 12,000 units and then assess the possible outcomes.

However, preparing flexible budgets in advance adds to the time and effort required for preparing budget, and this is not common.

(b) **Retrospectively.** At the end of each month (control period) or year, the results that should have been achieved given the actual circumstances (the flexible budget) can be compared with the actual results. As you will notice, flexible budgets are an essential factor in budgetary control.

Whereas fixed budget are prepared in advance for planning purposes, flexible budgets are usually prepared retrospectively, for planning purposes.

9.4 ZERO BASED BUDGETING

The principal behind zero based budgeting (ZBB) is that the budget for each cost center should be made from 'scratch' or zero. Every item of expenditure must be justified in its entirety in order to be included in next year's budget.

ZBB rejects the assumption inherent in incremental budgeting that next year's budget should be based on the current financial year results (or the current year budget), with adjustments for incremental changes such as growth and inflation. It is based on recognition that;

(a) The current year's results may include wasteful spending and inefficiencies.
(b) Budgeted activities should be reviewed and assessed, to establish whether they are still required or whether they should continue at the same level of activity as in the past

The aim of ZBB is to remove unnecessary and wasteful spending from the budget. It can be particularly useful in budgeting for administrative expenses and administrative departments, where there may be a tendency to tolerate unnecessary spending.
Zero based budgeting involves preparing a budget for each cost centre or activity from a zero base. Every item of expenditure has then to be justified in its entirety in order to be included in the next year's budget.
In practice, however, managers do not have to budget from zero, but can start from their current level of expenditure and work downwards, asking what would happen if any particular aspect of current expenditure and current operations were removed from the budget. In this way, every aspect of the budget is examined in terms of its costs and the benefits it provides and selection of better alternatives is encouraged.

9.4.1 Implementing zero based budgeting

There is a three-step approach to ZBB.

- Define items or activities for which costs should be budgeted, and spending decisions should be planned: these are 'decision packages'
- Evaluate and rank the packages in order of priority; eliminate packages whose costs exceed their value.
- Allocate resources to decision packages according to their ranking. Where resources such as money are in short supply, they are allocated to the most valuable activities.

The implementation of ZBB involves a number of steps, but the success of ZBB depends on the application of a questioning attitude by all those involved in the budgeting process. Existing practices, activities and expenditure must be challenged and searching questions about their value should be asked.

- Does the activity need to be carried out?
- What would be the consequences if the activity was not carried out?
- Is the current level of provision sufficient?
- Are there alternative (and cheaper) ways of achieving the same objective?
- How much should the activity cost?
- Is the expenditure worth the benefits achieved?

The basic approach of ZBB has three steps;

Step 1. Define decision packages. Decision packages are activities or items in the budget about which a decision should be made. Should this activity be included in the budget or not? Decisions packages are used to rank activities in order of priority or preference. This ranking can be used to allocate scarce resources in the budget.

Decision packages must be thoroughly documented.

There are two types of decision package.

(a) **Mutually exclusive packages**. These are alternative methods of getting the same job done. The best option among the packages must be selected by comparing costs and benefits and the other packages are then discarded. If there two mutually exclusive decision packages, the preferred package is selected and the other rejected for budgeting purpose.

(b) **Incremental packages.** These divide an aspect of operations into different levels of activity. The 'base' package will contain the minimum amount of work that must be done to carry out the activity and the cost of this minimum level. The other incremental packages identify additional (incremental) work that could be done, at a cost and for what benefits.

Step 2. Evaluate and rank each activity (decision package) on the basis of its benefit to the organization. This can be a lengthy process. Minimum work requirements (those that are essential to get a job done) will be given very high priority and so too will work which must be done to meet legal obligations.
In accounting department these would be minimum requirements to operate the pay role, purchase ledger and sales ledger systems, and to maintain and publish a set of accounts.

Step 3. Allocate resources in the budget according to the funds available and the evaluation and ranking of the competing packages. For example, a car manufacturer may choose to allocate significantly more funds to production processes than service and administration functions, based on the ranking of each activity in step 2.

9.4.2 The advantages and limitations of implementing ZBB

The advantages of zero based budgeting are as follows;

- It is possible to identify and remove inefficient or obsolete operations
- It forces employees to avoid wasteful expenditure
- It can increase motivation of staff by promoting a culture of efficiency
- It responds to changes in a business environment
- ZBB documentation provides an in-depth appraisal of an organization's operations
- It challenges the status quo.
- In summary, ZBB should result in a more efficient allocation of resources.

The major disadvantage of Zero based budgeting is the enormous extra volume of paperwork created and the extra time required to prepare the budget. The assumptions about costs and benefits in each package must be continually updated and new packages developed as soon as new activities emerge. The following problems might also occur;

- Short-term benefits might be emphasized to the detriment of long-term benefits
- It might give the impression that all decisions have to be made in the budget. Management must be able to meet unforeseen opportunities and threats at all times, however, and must not feel restricted from carrying out new ideas simply because they were not approved by a decision package, cost benefit analysis and the ranking process
- It may call for management skills both in constructing decision packages and in the ranking process which the organization does not possess. Managers may have to be trained in ZBB techniques.
- The organization's information systems may not be capable of providing suitable information.
- The ranking process can be difficult. Managers face three common problems.
  - A large number of packages may have to be ranked.
  - It can be difficult to rank packages which appear to be equally vital, for legal or operational reasons.

- It is difficult to rank activities which have qualitative rather than quantitative benefits – such as spending on staff welfare and working conditions.

In summary, perhaps the most serious drawback of ZBB is that it requires a lot of management time and paper work. One way of obtaining benefits of ZBB but of overcoming the draw backs is to apply it selectively on a rolling basis throughout the organization. This year finance, next year marketing, the year after personnel and so on. In this way all activities will be thoroughly scrutinized over a period of time.

9.5 ACTIVITY BASED BUDGETING

At its simplest, activity based budgeting (ABB) is merely the use of activity based costing methods as a basis for preparing budgets.

Activity based budgeting involves defining the activities that underlie the financial figures in each function and using the level of activity to decide how much resource should be allocated, how well it is being managed and to explain variances from budget.

Activity based budgeting differs from traditional budgeting in the way that budgets are prepared for overhead costs. Overhead costs are budgeted on the basis of activities, rather than on departmental basis.

9.5.1 Principles of ABB

With ABB, budgeting for direct costs (direct materials, direct labour) is no different from 'traditional' budgeting. The only difference is the approach to budgeting for overhead costs.

ABB involves defining the key activities that account for overhead spending, and considering the cost of the activity. Budgeted costs will depend on the expected level of activity (volume of the cost driver). A decision is made about the planned level of activity and the resources required sustaining this activity level and the estimated costs is included in the budget.

ABB is therefore based on the following

(a) It is **activities which drive costs** and the aim is to plan and control the causes (drivers) of costs rather than the costs themselves, with the result that in the long-term, costs will be better managed and better understood.
(b) **Not all activities add value**, so activities must be examined and split up according to their ability to add value.
(c) Most departmental activities are driven by demands and decisions **beyond the immediate** control of the manager responsible for the department's budget.
(d) Traditional financial measures of performance are unable to fulfil the objective of **continuous improvement.** Additional measures which focus on drivers of costs, the quality of activities undertaken, the responsiveness to change and so on are needed.

9.5.2 Benefits of ABB

Some writers treat ABB as a complete philosophy in itself and attribute to it all the good features of strategic management accounting, zero base budgeting, total quality management, and other ideas. For example, the following claims have been made.

(a) Different **activity levels** will provide a foundation for the 'base' package and incremental packages of ZBB
(b) It will ensure that the organization's overall strategy and any actual or likely changes in that strategy will be taken into account, because it attempts to manage the business as **the sum of its interrelated parts**.
(c) **Critical success factors** will be identified and performance measures devised to monitor progress towards them. (A critical factor is an activity in which a business must perform well if it is to succeed).
(d) Because concentration is focused on the **whole of an activity,** not just its separate parts, there is more likelihood of **getting it right first time.** For example what is the use of being able to produce goods in time for their dispatch date if the budget provides insufficient resources for the distribution manager who has to **deliver** them?

9.6 ROLLING BUDGETS

Rolling budgets (also called **continuous budgets**) are budgets which are continuously updated throughout a financial year, by adding a further period (say a month or a quarter) and removing the corresponding period that has just ended.

9.6.1 Dynamic conditions

Actual conditions may differ from those anticipated when the budget was up for a number of reasons.

(a) **Organizational changes** may occur
   i. A change in structure, from a functional basis, say, to a process based one.
   ii. New agreements with the work force about flexible working or safety procedures
   iii. The reallocation of responsibilities following, say, the removal of tiers of middle management and the 'empowerment' of workers further down the line.

(b) Action may be needed to **combat an initiative by a competitor**.
(c) **New technology** may be introduced to improve productivity, reduce labour requirements or enhance quality.
(d) **Environmental conditions** may change; there may be a general boom or a recession, an event affecting supply or demand, or a chance in government or government policy.
(e) The level of **inflation** may be higher or lower than that anticipated.
(f) The **level of activities** may be different from the levels planned.

Any of these changes **may make the original budget quite inappropriate**, either in terms of the numbers expected, or the way in which responsibility for achieving them is divided, or both.
There is a risk that in a period of rapid and continual change, budgets cease to be useful as a plan guide for management. To deal with risk, budget may be reviewed and amended regularly.
If management needs to revise their plans regularly, to keep them relevant and realistic, they may decide to introduce a system of **rolling budgets**.

A rolling budget is a budget which is continuously updated by adding a further accounting period (a month or a quarter) to the end of the budget when the corresponding period in the current budget has ended.
As a result, a number of rolling budgets are prepared each year; each rolling budget covers the next 12 month period.

Rolling budgets may be used when the pace of change in the business environment is fast and continual. They represent an attempt to prepare plans which are more **realistic**, particularly with a regard to price levels, by **shortening the period between preparing budgets.**

Instead of preparing a periodic budget annually for the full budget period, new **budgets are prepared every one, two**, **three or four months** (so that there are three, four, six, or even twelve budgets each year).

Each of these budgets would cover for the next twelve months so that the current budget is extended by an extra period as the current period ends; hence the name rolling budget.

9.6.2 The advantages and disadvantages of rolling budgets

Advantages;

(a) They **reduce the element of uncertainty** in budgeting because they concentrate detailed planning and control on the near-term future, where the degree of uncertainty is much smaller.

(b) They force managers to reassess the budget regularly, and to produce budgets which are **up to date** in the light of current events and expectations.
(c) **Planning and control will be based on a recent plan** which is likely to be far more **realistic** than a fixed annual budget made many months ago.
(d) Realistic budgets are likely to have a **better motivational influence** by managers.
(e) There is always **a budget which extends for several months ahead**. For example, if rolling budgets are prepared quarterly there will always be a budget extending for the next 9 to 12 months. This is not the case when fixed annual budgets are used.

Disadvantages;
(a) They involve **more time, effort and money** in budget preparation.
(b) Frequent budgeting may have an **off-putting effect on managers** who doubt the value of preparing one budget after another at regular intervals.
(c) Revisions to the budget might involve revisions to standard costs too, which in turn would involve revisions to stock variations. This could replace a large **administrative effort** from the accounts department every time a rolling budget is prepared.
(d) The benefits of rolling budgets are limited, and so not worth the extra cost, when the rate of change in the business environment is not rapid and continual.

9.7 BEYOND BUDGETING

Beyond budgeting is a budgeting model which proposes that traditional budgeting should be abandoned. **Adaptive management processes** should be used rather than fixed annual budgets.

9.7.1 Criticism of budgeting

There are many problems with budgets and criticism of how they are used in organization.
The Beyond Budgeting Round Table (BBRT), an independent research organization, proposes that budgeting, as most organizations practice it, should be abandoned. Their website (at www.bbrt.org) list the following ten criticism of budgeting as put forward by Hope and Fraser beyond budgeting, 1st edition, Harvard Business School Press, 2003;

(a) **Budgets are time-consuming and expensive.** Even with the support of computer models it is estimated that the budgeting process uses up to 20 to 30 percent of 'senior executives' and financial manager's time.
(b) **Budgets provide poor value to members**. Although surveys have shown that some mangers feel that budgets give them control, a large majority of financial directors wish to reform the budgetary process because they feel that finance staff spend too much time on 'lower value added activities'
(c) **Budgets fail to focus on shareholder value**. Most budgets are set on an incremental basis as an acceptable target agreed between the manager and manager's superior. Managers may be rewarded for achieving their short-term budgets and will not look to the longer term or take risks, for fear of affecting their own short term results.
(d) **Budgets are too rigid and prevent fast response**. Although most organizations do update and revise their budgets at regular intervals as the budget period proceeds the process is often too slow compared with the pace at which the external environment is changing.
(e) **Budgets protect rather than reduce costs**. Once a manager has authorized budget he can spend that amount of resource without further authorization. A 'use it or lose it' mentality often develops so that managers will incur cost unnecessarily. This happens especially towards the end of the budget period in the expectation that managers will not be permitted to carry forward any unused resource into the budget for next period.
(f) **Budgets stifle product and strategy innovation.** The focus on achieving the budget discourages managers from taking risks in case this has adverse effects on their short term performance. Managers do not have the freedom to respond to changing customer needs in a fast changing market because the activity they want is not authorized in their budget.
(g) **Budget focus on sales targets rather than customer satisfaction**. The achievement of short-term sales forecast becomes the focus of most organization. However this does not necessarily result in customer satisfaction.
The customer may be sold something inappropriate to their needs, as in recent years in UK financial services industry. Alternatively if a manger has already met the sales target for a particular period they might try to **delay sales to the next period**, in order to give themselves a head start towards achieving the target for the next period.

Furthermore there is an incentive towards the end of the period, if a manager feels that the sales target is not going to be achieved for the period, to **delay sales until the next period**, and thus again have a head start towards achieving the target for the next period. All of these actions, focusing on sales targets rather than customer satisfaction, will have a detrimental effect on the organization in the longer term

(h) **Budgets are divorced from strategy.** Most organizations monitor the monthly results against the short-term budget for the month. What is needed instead is a system of monitoring the longer-term progress against the organizations strategy.
(i) **Budgets reinforce a dependency culture**. The process of planning and budgeting within a framework devolved from senior management perpetuates a culture of dependency. Traditional budgeting systems, operated on a centralized basis, do not encourage a culture or personal responsibility.
(j) **Budgets lead to unethical behaviour**. For example building slack into the budget in order to create an easier target for achievement.

9.7.2 Beyond Budgeting concepts
9.7.3

Two fundamental concepts underlie the Beyond Budgeting approach.

1. **Use adaptive management processes for making decisions rather than tie decisions making to conformity with a rigid annual budget**. Traditional annual plans tie managers to predetermined actions which are not responsive to current situations. Managers should instead plan on a **more adaptive**, rolling basis but with the focus on cash forecasting rather than purely on cost control. Performance is monitored against world-class benchmarks, competitors and previous performance.

2. **Move towards devolved networks rather than centralized hierarchies**. The emphasis is on encouraging a culture of personal responsibility by delegating decision making and performance accountability to line managers.

9.8 INFORMATION USED IN BUDGET SYSTEMS

Information used in budgeting comes from a wide variety of sources.

Past data may be used as a starting point for the preparation of budgets but other information from a wide variety of sources will also be used. Each function of the organization will be required to estimate revenue and expenditure for the period. For example, marketing, personnel and research and development.

9.8.1 Sales budget information

As we have seen, for many organizations, the principle budget factor is sales volume. The sales budget is therefore often the primary budget from which the majority of the other budgets are derived. Before the sales budget can be prepared a **sales forecast** has to be made. Sales forecasting is complex and difficult and involves the use of information from a variety of sources;

- Past sales patterns
- The economic environment
- Results of market research
- Anticipated advertising
- Competition
- Changing consumer taste
- New legislation
- Pricing policies and discounts offered
- Legislation
- Environment factors
- Distribution

9.8.2 Production budget information

Sources of information for production budget will include

(a) **Labour cost** including idle time, overtime and standard output rates per hour
(b) **Raw material cost** including allowances for losses during production
(c) **Machine hours** including expected idle time and expected output rates per machine hour.

This information will come from the production department and a large part of the traditional work of **cost accounting** involves ascribing costs to the physical information produced.

9.8.3 Changing budgetary systems

An organization wishing to **change** its budgetary practices will face a number of difficulties.
The business environment has become increasingly complex, uncertain and dynamic and organizations need to be able to adapt quickly to changing conditions. It has been argued that traditional budgets are too rigid and prevent fast response to changing conditions.

However, an organization which decides to **change** its type of budget used, or budgetary system, will face a number of **difficulties.**

(a) **Resistance by employees**. Employees will be familiar with the current system and may have built slack so will not easily accept new targets. New control systems that threaten to alter existing power relationships may be thwarted by those affected.
(b) **Loss of control**. Senior management may take time to adapt to the new system and understand the implications of results.
(c) **Costs of implementation**. Any new system or process requires careful implementation which will have cost implications. For example, the procedures of preparing budgets will have to be re-written in a new budget manual. Establishing a system of zero based budgeting, for example, will require the design documentation of a large number of decision packages.
(d) **Training.** In order to prepare and implement budgets under the new system, managers will need to be fully trained. This is time-consuming and expensive.
(e) **Lack of accounting information**. The organization may not have the systems in place to obtain and analyze the necessary information for preparing the new style budget. For example, an organization needs a system a system of activity-based costing if it is to implement activity-based budgeting.

9.9 BUDGETING SYSTEMS AND UNCERTAINTY

Uncertainty can be allowed for in budgeting by means of **flexible budgeting, rolling budgets, probabilistic budgeting and sensitivity analysis.**

Causes of uncertainty in the budget process include;

- **Customers**. They may decide to buy less than forecast, or they may buy more
- **Products/services**. In the modern business environment, organizations need to respond to customers' rapidly changing requirements
- **Inflation** and movements in interest and exchange rates.
- **Volatility** in the **cost of materials**.
- **Competitors**. They may steal some of the organizations expected customers, or some competitors' customers may change their buying allegiance.
- **Employees**. They may not work as hard as was hoped, or they may work harder.
- **Machines**. They may break down unexpectedly.
- There may be **political unrest** (terrorist activity), **social unrest** (public transport strikers) or minor or major **natural disasters** (storms, floods).

Rolling budgets are a way of trying to **reduce the element of uncertainty in the plan**. There are **other planning methods** which try to **analyze the uncertainty** such as **probabilistic budgeting** (where probabilities are assigned to different conditions and **sensitivity analysis**. These methods are suitable when the **degree of uncertainty is quantifiable** from the start of the budget period and actual results are not expected to go outside the range of these expectations.

PART I
STANDARD COSTING & VARIANCE ANALYSIS

10.0 STANDARD COSTING

UNIT 10 OVERVIEW:

- Standard costs defined
- Use of standard costs
- Deriving Standards.
- Types of Standards
- Budgets Vs Standards
- Flexible Budgets
- The Principle of controllability

10.1 STANDARD COSTS

A standard cost is an estimated unit cost built up of standards of each cost element such as standard labour hours, standard material usage and standard resource price.

10.2THE STANDARD COST CARD

This is a statement showing how the standard unit cost is built up.

10.2.1 Typical Standard cost card

The standard cost of product 12345 is set out below on a standard cost card

STANDARD COST CARD
Product: the Splodget No 12345

	Cost	Requirement	Shs	Shs
Direct materials				
A	Shs 2.00 per kg	6 kgs	12	
B	Shs 3.00 per kg	2 kgs	6	
C	Shs 4.00 per kg	1 litre	4	
Others			2	
				24
Direct labour				
Grade 1	Shs 4.00 per hr	3 hours	12	
Grade 2	Shs 5.40 per hr	5 hours	27	
				39
Variable production overheads	Shs 1. 00 per hr	8 hours	8	
Fixed production overheads	Shs 3.00 per hr	8 hours	24	
Standard full cost of production			**95**	

From the above, the standard unit cost of shs. 95/= is made up of standard quantities of of materials at standard prices, standard quantities of labour time at standard rates amounting to shs. 39 and so on.

The standard cost is therefore determined by management's estimates of the following;

- *The expected prices of materials, labour and expenses*
- *Efficiency levels in the use of materials and labour.*
- *Budgeted overhead costs and budgeted volumes of activity.*

10.3THE USES OF STANDARD COSTING

Standard costing has two principle uses.

- To value inventories and cost production for cost accounting purposes. It is an alternative method of valuation methods like FIFO and LIFO.
- To act as a control device by establishing standards (expected costs) and comparing the actual costs with the expected costs, thus highlighting areas of the organization which may be out of control.

It can also be used in the following circumstances;

(a) To assist in setting budgets and evaluating managerial performance.
(b) To enable the principle of 'management by exception' to be practiced. A standard cost, when established, is an average expected unit cost. Because it is only an average, actual results will vary to some extent above and below the average. Only significant differences between actual and standard should be reported.
(c) To provide a prediction of future costs to be used in decision-making situations.
(d) To motivate staff and management by the provision of challenging targets
(e) To provide guidance on possible ways of improving efficiency

10.4 STANDARD COSTING AS A CONTROL TECHNIQUE

Standard costing involves the establishment of predetermined estimates of the costs of products or services, the collection of actual costs and the comparison of the actual costs with the predetermined estimates. The predetermined costs are known as standard costs and the difference between standard and actual costs is known as a variance. The process by which the total difference between standard and actual results is analyzed is known as **variance analysis.**

10.4.1 Importance of a standard costing system in an organisation

(i) Carefully planned standards are an aid to more accurate budgeting.
(ii) Standard costs provide a yardstick against which actual costs can be measured.
(iii) The setting of standards involves determining the best materials and methods which may lead to economies.
(iv) A target of efficiency is set for employees to reach and cost consciousness is stimulated.
(v) Variances can be calculated which enable the principle of management by exception to be operated. Only the variances which exceed acceptable tolerance limits need to be investigated by management with a view of control.
(vi) Standard costing and variance analysis can provide a way of motivation to managers to achieve better performance.

10.5 DERIVING STANDARDS

The responsibility for deriving standard costs should be between managers able to provide the necessary information about levels of expected efficiency, prices and overhead costs.

10.5.1 Setting standards for material costs

Direct materials cost per unit of raw material will be estimated by the purchasing department from their knowledge of the following

- *Purchase contracts already agreed*
- *Pricing discussions with regular suppliers*
- *The forecast movement of prices in the market*
- *The availability of bulk purchase discounts*
- *The quality of material required by the production departments*

The standard cost ought to include an allowance for **bulk purchase discounts**, if these are available on all or some of the purchases, and it may have to be a weighted average price of the differing prices charged for the same product by alternative suppliers.

A decision must also be taken as to how to deal with price **inflation**. Standard costing is more **difficult in times of inflation but it is still worthwhile since.**

- *Usage and efficiency variances will still be meaningful*
- *Inflation is measurable: there is no reason why its effects cannot be removed*
- *Standard cost can be revised, so long as this is not done too frequently.*

10.5.2 Setting standards for labour costs

Direct labour rates per hour will be set by reference to the payroll and to any agreements on pay rises with trade union representatives of the employees. A separate hourly rate or weekly wage will be set for each different labour grade/type of employee and an average hourly rate will be applied for each grade)(even though individual rates of pay may vary according to age and experience). Similar problems to those which arise when setting material standards in times of high inflation can be met when setting labour standards.

10.5.3 Setting standards for material usage and labour efficiency

To estimate the materials required to make each product (material usage) and also the labour hours required (labour efficiency), technical specifications must be prepared for each product by production experts (either in the production department or the work study department).

10.5.4 Setting standards for overheads

When standard costs are fully absorbed costs (standard costs can be used in both marginal and absorption costing systems), the absorption rate of fixed production overheads will be predetermined and based on budgeted fixed production overhead and planned production volume.

Production volume will depend on two factors

(a) **Production capacity** (or '**volume capacity'**) measured perhaps in standard hours of output (a standard hour being the amount of work achievable at standard efficiency levels in an hour), which in turn reflects direct production labour hours.

(b) **Efficiency of working**, by labour or machines, allowing for rest time and contingency allowances.

10.5.5 Setting standards for sales price and margin

The **standard selling price** will depend on a number of factors including the following.

- Anticipated market demand
- Competing products
- Manufacturing costs
- Inflation estimates

The **standard sales margin** is the difference between the standard cost and the standard selling price.

10.5.6 Challenges encountered during setting of Standards

(i) Deciding how to incorporate inflation into planned unit costs.
(ii) Agreeing on a performance standard (attainable or ideal).
(iii) Deciding on the quality of materials to be used (a better quality will cost more but perhaps reduce material wastage).
(iv) Estimating materials prices where seasonal price variations or bulk purchase discounts may be significant.
(v) Finding sufficient time to construct standards as standard setting can be time consuming.
(vi) Incurring the cost of setting up and maintaining a system for establishing standards is a big challenge to many firms.

10.6 TYPES OF STANDARD

There are **four types of standards**: i.e;

(i) **ideal,**
(ii) **attainable,**
(iii) **current** and
(iv) **basic**.

These can have an impact on employee motivation.

How demanding should a standard be? Should the standard represent perfect performance or easily attainable performance? There are four types of standard.

- An **ideal standard** is a standard which can be attained under perfect operating conditions: no wastage, no inefficiencies, no idle time, no breakdowns

- An **attainable standard** is a standard which can be attained if production is carried out efficiently, machines are properly operated and/or materials are properly used. Some allowance is made for wastage and inefficiencies
- A **current standard** is standard based on current working condition (current wastage, current inefficiencies)
- A **basic standard** is a long term standard which remains unchanged over the years and is used to show changes in efficiency or performance over a long period of time.

10.6.1 The different types of standard have a number of advantages and disadvantages.

(a) **Ideal standards** can be seen **as long term targets** but are not very useful for day to day control purposes.
(b) **Ideal standards cannot be achieved**. If such standards are used for budgeting, an allowance will have to be included to make the budget realistic and attainable.
(c) **Attainable standards** can be used for **product costing**. Cost control, inventory valuation, estimating and as a basis for budgeting.
(d) **Current standards** or attainable standards provide the **best basis for budgeting**, because they represent an achievable level of productivity.
(e) Current standards **do not attempt to improve** on current levels of efficiency.
(f) Current standards are useful during **periods when inflation is high**. They can be set on a month by month basis.
(g) **Basic standards** are used to show **changes in efficiency or performance** over a long period of time. They are perhaps the least useful and least common type of standard in use.

10.6.2 The impact on employee behavior of the type of standard set

The type of standard set can have an impact on the behavior of the employees trying to achieve those standards.

Types of standards	Impact
Ideal	Some say that they provide employees with an incentive to be more efficient even though it is highly it is highly unlikely that the standard will be achieved. Others argue that they are likely to have an unfavorable effect on employee motivation because the differences between standards and actual results will always be adverse. The employees may feel that the goals are unattainable and so they will not work so hard.
Attainable	Might be an incentive to work harder as they provide a realistic but challenging target of efficiency.
Current	Will not motivate employees to do anything more than they are currently doing.
Basic	May have an unfavorable impact on the motivation of employees. Over time they will discover that they are easily able to achieve the standards. They may become bored and lose interest in what they are doing if they have nothing to aim for.

10.7 BUDGETS AND STANDARDS COMPARED

Budgets and standards are very similar and interrelated, but there are important differences between them.

10.7.1 Similarities

Budgets and standards are similar in the following ways.

(a) They both involve looking to the future and forecasting what is likely to happen given a certain set of circumstances.
(b) They are both used for control purposes. A budget aids control by setting financial targets or limits for a forthcoming period. Actual achievements or expenditures are then compared with the budgets and action is taken to correct any variances where necessary. A standard also achieves control by comparison of actual results against a predetermined target.
(c) As well as being similar budgets and standards are interrelated. For example, a standard unit production cost can act as the basis for a production cost budget. The unit cost is multiplied by the budgeted activity level to arrive at the budgeted expenditure on production costs.

10.7.2 Differences

A budget is a quantified monetary plan for a future period, which managers will try to achieve. Its major function lies in communicating plans and coordinating activities within an organisation. On the other hand, a standard is a carefully predetermined quantity target which can be achieved in certain conditions.

There are, however, more important differences between budgets and standards.

Budgets	Standards
Gives planned total aggregate costs for a function or cost center	Shows the unit resource usage for a single task, for example the standard labour hours for a single unit of production.
Can be prepared for all functions, even where output cannot be measured	Limited to situations where repetitive actions are performed and output can be measured
Express in money terms	Need not to be expressed in money terms. For example a standard rate of output does not need a financial value put on it.

10.8 FLEXIBLE BUDGETS

10.8.1 Definition

A flexible budget is a budget which, by recognizing different cost behavior patterns, is designed to change as volume of activity changes. Flexible budgets should be used to show what cost and revenues should have been for the actual level of activity.

10.8.2 Preparing Flexible budgets

Step 1: The first step in the preparation of a flexible budget is the determination of cost behavior patterns, which means deciding whether costs are fixed, variable or semi variable.

Step 2: The second step in the preparation of a flexible budget is to calculate the budget cost allowance for each cost item.

Where;

Budget cost allowance = budgeted fixed cost* + (Actual number of units x Budgeted variable cost per unit)**

**nil for variable cost*
***nil for fixed cost*

Semi variable costs therefore need splitting into their fixed and variable components so that the budget cost allowance can be calculated. One method for splitting semi-variable costs is the high/low method.

10.8.3 Flexible budgets and performance management

- Budgetary control involves drawing up budgets for the areas of responsibility for individual managers (for example production managers, purchasing managers and so on) and of regularly comparing actual results against expected results.

- The differences between actual results and expected results are called variances and these are used to provide a guideline for control action by individual managers.

Note that individual managers are held responsible for investigating differences between budgeted and actual results, and are then expected to take corrective action or amend the plan in the light of actual events.

Activity 1: *Preparation of a Flexible budget*

(a) Prepare a budget for 2016 for the direct labour costs and overhead expenses of a production department flexed at the activity levels of 80%, 90% and 100%, using the information listed below.

(i) The direct labour hourly rate is expected to be shs.3,750.

(ii) 100% activity represents 60,000 direct labour hours.

(iii) Variable costs

Indirect labour	shs.750 per direct labour hours
Consumable supplies	shs.375 per direct labour hour
Canteen and other Welfare services	6% of direct and indirect labour costs

(iv) Semi-variable costs are expected to relate to the direct labour hours in the same manner as for the last five years.

Year	**Direct labour hours**	**Semi-variable costs**
		Shs. "000"
2011	64,000	20,800
2012	59,000	19,800
2013	53,000	18,600
2014	49,000	17,800
2015	40,000 (estimate)	16,000 (estimate)

(v) Fixed costs

	Shs.
Depreciation	18,000
Maintenance	10,000
Insurance	4,000
Rates	15,000
Management salaries	25,000

(vi) Inflation is to be ignored.

(b) Calculate the budget cost allowance (i.e. expected expenditure) for 2016 assuming that 57,000 direct labour hours are worked.

Activity 2: *Flexible budgets and performance management*

Suppose that a company manufactures a single product, Z. Budgeted results and actual results for June 20X2 are shown below

	Budget	Actual results
Production and sales (units)	2,000	3,000
	Shs.	Shs.
Sales revenue (a)	20,000	30,000
Direct materials	6,000	8,500
Direct Labour	4,000	4,500
Maintenance	1,000	1,400
Depreciation	2,000	2,200
Rent and rates	1,500	1,600
Other costs	3,600	5,000
Total costs (b)	18,100	23,200
Profit (a) – (b)	1,900	6,800

You have been provided with the following estimates of cost behaviour for the company.

(a) Direct materials, direct labour and maintenance costs are variable.
(b) Rent and rates and depreciation are fixed costs.
(c) Other costs consist of fixed costs of shs.1,600 plus a variable cost of shs.1 per unit made and sold.

Required:
Prepare a budget that will be useful for management control purposes.

Activity 13.3:
The budgeted and actual results of Crunch Co for September were as follows. The company uses a marginal costing system. There were no opening or closing stocks.

		Fixed budget		Actual
Sales and production		1,000		700 units
	Shs.	Shs.	Shs.	
Sales		20,000		14,200
Variable cost of sales				
Direct materials	8,000		5,200	
Direct labour	4,000		3,100	
Variable overhead	2,000		1,500	
		14,000		9,800
Contribution		6,000		4,400
Fixed costs		5,000		5,400
Profit/(loss)		1,000		(1,000)

Required:
Prepare a budget that will be useful for management control purposes.

10.8.4 Factors to consider when preparing flexible budgets

The mechanics of flexible budgeting are, in theory, fairly straightforward but in practice there are a number of points to consider before figures are simply flexed.

(a) Splitting mixed costs is not always straightforward.

(b) Fixed costs may behave in a step-line fashion as activity levels increase/decrease.

(c) Account must be taken of the assumptions upon which the original fixed budget was based. Such assumptions might include the constraint posed by limiting factors, the rate of inflation, judgments about future uncertainty, the demand for the organizations products and so on.

(d) By flexing a budget, a manager is effectively saying If I knew then what I know now, this is the budget I would have set. It is a useful concept but can lead to some concern as managers can become confused and frustrated if faced with continually moving targets.

10.8.5 The need for flexible budgets

We have seen that flexible budgets may be prepared in order to plan for variations in the level of activity above or below the level set in the fixed budget. It has been suggested, however, that since many cost items in modern industry are fixed costs, the value of flexible budgets in planning is dwindling.

(a) In many manufacturing industries, plant costs (depreciation, rent and so on) are a very large proportion of total costs, and these tend to be fixed costs.

(b) Wage costs also tend to be fixed, because employees are generally guaranteed a basic wage for a working week of an agreed number of hours.
(c) With the growth of service industries, labour (wages or fixed salaries) and overheads will account for most of the costs of a business, and direct materials will be a relatively small proportion of total costs.

Flexible budgets are nevertheless necessary, and even if they are not used at the planning stage, they must be used for budgetary control variance analysis.

10.9 THE PRINCIPLE OF CONTROLLABILITY

The principle of controllability is that managers of responsibility centers should only be held accountable for costs over which they have some influence.

10.9.1 Budget centers

Budgetary control is based around a system of budget centres. Each budget centre will have its own budget and a manager will be responsible for managing the budget centre and ensuring that the budget is met.

The selection of budget centers in an organization is therefore a key first step in setting up a control system. What should the budget centers be? What income, expenditure and/or capital employment plans should each budget centre prepare? And how will measures of performance for each budget centre be made?

A well-organized system of control should have the following features.

Feature	Explanation
A hierarchy of budget centers	If the organizations are quite large a hierarchy is needed. Subsidiary companies, departments and work section might be budget centres. Budgets of each section would then be consolidated into a departmental budget, departmental budgets in turn would be consolidated into the subsidiary's budgets in turn would be consolidated into the subsidiary's budgets of each subsidiary would be combined into a master budget for the group as a whole.
Clearly identified responsibilities for achieving budget targets	Individual managers should be made responsible for achieving the budget targets of a particular budget centre.
Responsibilities for revenues, costs and capital employed	Budget centers should be organized so that all the revenues earned by an organization, all the costs it incurs, and all the capital it employs are made the responsibility of someone within the organization an appropriate level of authority in the management hierarchy.

Budgetary control and budget centers are therefore part of the overall system of **responsibility accounting** within an organization.

Responsibility accounting is a system of accounting that segregates revenue and costs into areas of personal responsibility in order to monitor and assess the performance of each part of an organization.

10.9.2 Controllable costs

Controllable costs are items of expenditure which can be directly influenced by a given manager within a given time span.

Care must be taken to distinguish between controllable costs and uncontrollable costs in variance reporting. The controllability principle is that managers of responsibility centers should only be held accountable for costs over which they have some influence. From a motivation point of view this is important because it can be very demoralizing for managers who feel that their performance is being judged on the basis of something over which they have no influence. It is also important from a control point of view in that control reports should ensure that information on costs is reported to the manager who is able to take action to control them.

Responsibility accounting attempts to associate costs, revenues, assets and liabilities with the managers most capable of controlling them. As a system of accounting, it therefore distinguishes between controllable and uncontrollable costs.

Most variable costs within a department are thought to be controllable in the short term because managers can influence the efficiency, with which resources are used, even if they cannot do anything to raise or lower price levels.

A cost which is not controllable by a junior manager might be controllable by a senior manager. For example; there may be high direct labour costs in a department caused by excessive overtime working. The junior manager may feel obliged to continue with the overtime to meet production schedules, but his senior may be able to reduce costs by hiring extra full-time staff, thereby reducing the requirements for overtime.

A cost which is not controllable by a manager in one department may be controllable, by a senior manager. For example, there may be high direct labour costs in a department caused by excessive overtime working. The junior manager may feel obliged to continue with the overtime to meet production schedules, but his senior may be able to reduce costs by hiring extra full –time staff, thereby reducing the requirements for overtime.

A cost which is not controllable by a manager in one department may be controllable by a manager in another department. For example, an increase in material costs may be caused by buying at higher prices than expected (controllable by the purchasing department) or by excessive wastage (controllable by the production department) or by a faulty machine producing rejects (controllable by the maintenance department).

Some costs are non- controllable, such as increases in expenditure items due to inflation. Other costs are controllable, but in the long term rather than the short term. For example, production costs might be reduced by the introduction of new machinery and technology, but in the short term, management must attempt to do the best they can with the resources and machinery at their disposal.

10.9.3 The controllability of fixed costs.

It is often assumed that all fixed costs are non-controllable in the short run .This is not so.

(a) Committed fixed costs are those costs arising from the possession of plant, equipment, buildings and an administration department to support the long-term needs of the business. These costs (depreciation, rent, administration salaries)are largely non-controllable in the short term because they have been committed by longer term decisions affecting longer term needs. When a company decides to cut production drastically, the long-term committed fixed costs will be reduced, but only after redundancy terms have been settled and assets sold.

(b) Discretionary fixed costs, such as advertising and research and development costs, are incurred as a result of a top management decision, but could be raised or lowered at fairly short notice(irrespective of the actual volume of production and sales).

10.9.4 Controllability and apportioned costs.

Managers should only be held accountable for costs over which they have some influence. This may seem quite straightforward in theory, but it is not always so easy in practice to distinguish controllable from uncontrollable costs. Apportioned overhead costs provide a good example. Suppose that a manager of a production department in a manufacturing company is made responsible for the costs of his department. These costs include directly attributable overhead items such as the costs of indirect labour employed and indirect materials consumed in the department.

The department's overhead costs also include an apportionment of costs from other cost centers, such as rent and rates for the building it shares with other departments and a share of the costs of the maintenance department.

Should the production manager be held accountable for any of these apportioned costs?

(a) Managers should not be held accountable for costs over which they have no control. In this example, apportioned rent and rates costs would be controllable by the production department manager.

(b) Managers should be held accountable for costs over which they have some influence. In this example, it is the responsibility of the maintenance department manager to keep maintenance costs within budget. But their costs will be partly variable and partly fixed, and the variable cost element will depend on the volume of demand for their services. If the production departments staff treat their equipment badly we might expect higher repair costs, and the production department manager should therefore be made accountable for the repair costs that his department makes the maintenance department incur on its behalf.

(c) Charging the production department with some of the costs of the maintenance department prevents the production department from viewing the maintenance services as free services. Over-use would be discouraged and the production manager is more likely to question the activities of the maintenance department possibly resulting in a reduction in maintenance costs or the provision of more efficient maintained services.

10.9.5 Controllability and dual responsibility

Quite often a particular cost might be the responsibility of two or more managers. For example, raw materials costs might be the responsibility of the purchasing manager (prices) and the production manager (usage).A reporting system must allocate responsibility appropriately. The purchasing manager must be responsible for any increase in raw materials prices whereas the production manager should be responsible for any increase in raw materials usage.

11.0 VARIANCE ANALYSIS

UNIT 11 OVERVIEW

- Basic variances
- The reasons for variances
- Operating statements
- Investigating variances
- Materials mix and yield variances
- Sales mix and quantity variances

11.1 VARIANCE – *Definition*

A variance is the difference between an actual result and an expected result.

11.2 VARIANCE ANALYSIS – *Definition*

Variance analysis is the process by which the total difference between standard and actual results is analysed.

11.2.1 Adverse (S) Vs Favourable (F) variance

When actual results are better than expected results, we have ***a favourable variance (F)***. If actual results are worse than expected results, we have ***an adverse variance (A)***.

11.3 BASIC VARIANCES

Basic variances are dividend into 5 major categories, i.e;

(i) Sales Variances
(ii) Materials Variances
(iii) Labour Variances
(iv) Variable overhead variance
(v) Fixed overhead variances

11.3.1 SALES VARIANCES

- **The selling price variance** measures the effect on expected profit of a selling price difference to the standard selling price. It is calculated as the difference between what the sales revenue should have been for the actual quantity sold, and what it was.

- **The sales volume variance** measures the increase or decrease in expected profit as a result of the sales volume being higher or lower than budgeted. It is calculated as the difference between the budgeted sales volume and the actual sales volume multiplied by the standard profit per unit.

- **Sales mix variance** and Quantity variances are defined later in this unit

11.3.2 MATERIALS VARIANCES

- **The material total variance** is the difference between what the output actually cost and what it should have cost, in terms of material. It can be divided into the following two sub-variances.
- **The material price variance** is the difference between what the material did costs and what it should have cost.
- **The material usage variance** is the difference between the standard cost of the material that should have been used and the standard cost of the material that was used.
- **Materials mix** and **yield variances** are discussed later in this unit.

11.3.3 LABOUR VARIANCES

- **The labour total variance** is the difference between what the output should have cost and what it did cost, in terms of labour. It can be divided into two sub-variances.
- **The labour rate variance** is the difference between what the labour did cost and what it should have cost.
- **The labour efficiency variance** is the difference between the standard cost of the hours that should have been worked and the standard cost of the hours that were worked.

11.3.4 VARIABLE OVERHEAD VARIANCES

- **The variable production overhead total variance** is the difference between what the output should have cost and what it did cost, in terms of variable production overhead. It can be divided into two sub-variances.
- **The variable production overhead expenditure** variance is the difference between the amount of variable production overhead that should have been incurred in the actual hours actively worked, and the actual amount of variable production overhead incurred.
- **The variable production overhead efficiency variance** is the difference between the standard cost of the hours that should have been worked for the number of units actually produced, and the standard cost of the actual number of hours worked.

11.3.5 FIXED OVERHEAD VARIANCES

- **Fixed production overhead total variance** is the difference between fixed production overhead incurred and fixed production overhead absorbed. In other words, it is the under-or over-absorbed fixed production overhead.
- **Fixed production overhead expenditure variance** is the difference between the budgeted fixed production overhead expenditure and actual fixed production overhead expenditure.
- **Fixed production overhead volume variance** is the difference between actual and budgeted production/volume multiplied by the standard absorption rate per unit.
- **Fixed production overhead volume efficiency variance** is the difference between the number of hours that actual production should have taken, and the number of hours actually taken (that is, worked) multiplied by the standard absorption rate per hour.

- **Fixed production overhead volume capacity variance** is the difference between budgeted hours of work and the actual hours worked, multiplied by the standard absorption rate per hour.

Activity 1: *Basic Variances*

A company produces and sells one product only, the thing, the standard cost for one unit being as follows.

	Shs.
Direct material A – 10 kilograms at shs.20 per kg	200
Direct material B – 5 litres at shs.6 per litre	30
Direct wages – 5 hours at shs.6 per hour	30
Fixed production overhead	50
Total standard cost	310

The fixed overhead included in the standard cost is based on an expected monthly output of 900 units. Fixed production overhead is absorbed on the basis of direct labour hours.

During April the actual results were as follows.

Production	800 units
Material A	7,800kg used, costing shs.159,900
Material B	4,300 litres used, costing shs.23,650
Direct wages	4,200 hours worked for shs.24,150

Fixed production overhead shs.47,000.

Required:

(a) Calculate price and usage variances for each material.

(b) Calculate labour rate and efficiency variances.

(c) Calculate fixed production overhead expenditure and volume variances and then subdivide the volume variance.

11.4 THE REASONS FOR VARIANCES

- The table below presents a summary of the above basic variances and possible reasons for the respective variances.
- For exam purposes, candidates are advised to review the information provided and use their individual imagination to suggest possible reasons for the variances.

Variance	Favourable	Adverse	Calculation
Material price	Unforeseen discounts received Greater care in purchasing Change in material standard	Price increase Careless purchasing Change in material standard	Price Shs. Based on actual purchases What should it have cost? X What did it cost? (X) **X**
Material usage	Material used of higher quality than standard More effective use made of material Errors in allocating material to jobs	Defective material Excessive waste Theft Stricter quality control Errors in allocating material to jobs	Usage Kgs Based on actual production What should have been used? X What was used? (X) X Difference valued at standard cost per kg. **X**
Labour rate	Use of workers at a rate of pay lower than standard	Wage rate increase	Rate Shs. Based on actual hours paid What should it have cost? X What did it cost? (X) X
Idle time	Possible if idle time has been built into the budget	Machine breakdown Non-availability of material Illness or injury to worker	Idle time Hrs Hours worked X Hours paid (X) Difference valued at X Standard rate per hour
Labour efficiency	Output produced more quickly than expected, because of work motivation, better quality of equipment or materials, better learning rate Errors in allocating time to jobs	Lost time in excess of standard allowed Output lower than standard set because of lack of training, sub-standard material etc Errors in allocating time to jobs	Efficiency Hrs Based on actual production How long should it have taken? X How long did it take? (X) X Difference valued at standard rate per hour **X**
** **Overhead expenditure**	Savings in costs incurred More economical use of services	Increase in cost of services Excessive use of services Change in type of services used	Based on actual hours worked Shs. What should it have cost? X What did it cost? (X) **X**
Overhead volume	Production or level of activity greater than budgeted	Production or level of activity less than budgeted	Units Budgeted units X Actual units (X) X Difference valued at **X** OAR per unit

Fixed overhead capacity	Production or level of activity greater than budgeted	Production or level of activity less than budgeted	Budgeted hrs worked Actual hrs worked Difference valued at OAR per hour	Hrs X (X) X **X**
Selling price	Unplanned price increase	Unplanned price reduction	For the quantity sold What revenue should have been Generated Actual revenue	Shs. X (X) **X**
Sales volume	Additional demand	Unexpected fall in demand Production difficulties	Budgeted sales Actual sales Difference valued at standard profit per unit	Units X (X) X **X**

11.5 OPERATING STATEMENTS

- An operating statement is a regular report for management which compares actual costs and revenues with budgeted figures and shows variances.

- There are several ways in which an operating statement may be presented. Perhaps the most common format is one which reconciles budgeted profit to actual profit. Sales variances are reported first, and the total of the budgeted profit and the two sales variances results in a figure for actual sales minus the standard cost of sales. The cost variances are then reported, and an actual profit calculated.

11.5.1 Profoma operating Statement (*Absorption Costing System*)

	Favourable (F) Shs	**Adverse (A) Shs**	**Total Shs**
Budgeted profit			**XX**
Sales variance:			
Sales price variance	XX	XX	
Sales volume variance	XX	XX	XX
Actual sales minus the standard cost of sales			**XX**
COST VARIANCES:			
Materials variances	XX	XX	
Labour Variances	XX	XX	
Variable overhead variances	XX	XX	
Fixed overhead variances	XX	XX	
	XX	XX	XX
Actual profit for the period			**XX**

Activity 2: *Operating Statement*

A company manufactures one product, and the entire product is sold as soon as it is produced. There are no opening or closing inventories and work in progress is negligible. The company operates a standard costing system and analysis of variances is made every month. The standard cost card for the product, a widget, is as follows.

STANDARD COST CARD WIDGET

		Shs.
Direct materials	0.5 kilos at shs.4 per kilo	2.00
Direct wages	2 hours at shs.2.00 per hour	4.00
Variable overheads	2 hours at shs.0.30 per hour	0.60
Fixed overhead	2 hours at shs.3.70 per hour	7.40
Standard cost		14.00
Standard profit		6.00
Standard selling price		20.00

Budgeted output for January was 5,100 units. Actual results for January were as follows.
Production of 4,850 units was sold for shs.95,600
Materials consumed in production amounted to 2,300 kilos at a total cost of shs.9,800.
Labour hours paid for amounted to 8,500 hours at a cost of shs.16,800.
Actual operating hours amounted to 8,000 hours.
Variable overheads amounted to shs.2,600.
Fixed overheads amounted to shs.42,300.

Required:
Calculate all variances and prepare an operating statement for January.

11.5.2 Operating statements in a marginal cost environment

- There are two main differences between the variances calculated in an absorption costing system and the variances calculated in a marginal costing system. In a marginal costing system the only fixed overhead variance is an expenditure variance and the sales volume variance is valued at standard contribution margin, not standard profit margin.

Activity 3:

Returning to the question above, now assume that the company operates a marginal costing system.

Required:
Recalculate any variances necessary and produce an operating statement.

11.5.3 Profoma operating Statement (*Marginal Costing System*)

	Favourable (F) Shs	Adverse (A) Shs	Total Shs
Budgeted profit			XX
Add: Bugeted fixed production costs			XX
Budgeted contribution			**XX**
Sales variance:			
Sales price variance	XX	XX	
Sales volume variance	XX	XX	XX
Actual sales minus the standard variable cost of sales			**XX**
COST VARIANCES:			
Materials variances	XX	XX	
Labour Variances	XX	XX	
Variable overhead variances	XX	XX	
	XX	XX	XX
Actual contribution			**XX**
Budgeted fixed production overhead expenditure variance	XX	XX	
Actual fixed production overhead	XX	XX	
			XX
Actual Profit			**XX**

11.6 INVESTIGATING VARIANCES

11.6.1 The decision whether or not to investigate.

Before management decide whether or not to investigate the reasons for the occurrence of a particular variance, there are a number of factors which should be considered in assessing the significance of the variance. These include;

(i) **Materiality**. Because a standard cost is really only an average expected cost, small variations between actual and standard are bound to occur and are unlikely to be significant. Obtaining an 'explanation' of the reasons why they occurred is likely to be time consuming and irritating for the manager concerned. For such variations further investigation is not worthwhile since such variances are not controllable.

(ii) **Controllability**. Only controllable variances should be investigated. Uncontrollable variances call for a change in plan, not an investigation into the past.

(iii) **The type of standard being used**. The efficiency variance reported in any control period, whether for materials or labour, will depend on the efficiency level set. If, for example, an ideal standard is used, variances will always be adverse. Similarly, if basic standards are used, variances are likely to be favourable.

(iv) **Variance trend**. Although small variations in a single period are unlikely to be significant, small variations that occur consistently may need more attention. The trend provides an indication of whether the variance is fluctuating within acceptable control limits or becoming out of control.

(v) **Interdependence between variances**. One variance might be inter-related with another, and much of it might have occurred only because the other variance occurred too. When two variances are interdependent (interrelated) one will usually be adverse and the other favourable. For example, an adverse selling price variance might be counterbalanced by a favourable sales volume variance.

(vi) **Costs of investigation**. The costs of an investigation should be weighed against the benefits of correcting the cause of a variance.

11.6.2 Variance investigation models

The rule-of thumb and statistical significance variance investigation models and/or statistical control charts can be used to determine whether a variance should be investigated.

(a) **The rule of thumb model**. This involves deciding a limit and if the size of a variance is within the limit, it should be considered immaterial. Only if it exceeds the limit is it considered materially significant, and worthy of investigation.

(b) **Statistical significance model**. Historical data is used to calculate both a standard as an expected average and the expected standard deviation around this average when the process is under control. By assuming that variances that occur are normally distributed around this average, a variance will be investigated if it is more than a distance from the expected average that the estimated normal distribution suggests is likely if the process is in control.

(c) **Statistical control charts**. By marking variances and control limits on a control chart, investigation is signaled not only when a particular variance exceeds the control limit but also when the trend of variances shows a progressively worsening movement in actual results (even though the variance in any single control period has not yet overstepped the control limit).

11.7 MATERIALS MIX AND YIELD VARIANCES

The materials usage variance can be subdivided into a materials mix variance and a materials yield variance when more than one material is used in the product.
Manufacturing processes often require that a number of different materials are combined to make a unit of finished product. When a product requires two or more raw materials in its make-up, it is often possible to sub-analyse the materials usage variance into a materials mix and a materials yield variance.
Adding a greater proportion of one material (therefore a smaller proportion of a different materials) might make the materials mix cheaper or more expensive. For example the standard mix of materials for a product might consist of the following.

	Shs.
(2/3) 2 Kg of material A at shs.1.000 per kg	2.00
(1/3) 1 kg of material B at shs.0.50 per kg	0.50
	2.50

It may be possible to change the mix so that one kilogram of material A is used and two kilograms of material B. The new mix would be cheaper.

	Shs.
(1/3) 1 kg of material A	1
(2/3) 2 kg of material B	1
	2

By changing the proportions in the mix, the efficiency of the combined material usage may change. In our example, in making the proportions of A and B cheaper, at 1:2, the product may now require more than three kilograms of input for its manufacture, and the new materials requirement per unit of product might be 3.6 kilograms.

	Shs.
(1/3) 1.2 kg of material A at shs.1.00 per kg	1.20
(2/3) 2.4 kg of material B at shs.0.50 per kg	1.20
	2.40

In establishing a materials usage standard, management may therefore have to balance the cost of a particular mix of materials with the efficiency of the yield of the mix. Once the standard has been established it may be possible for management to exercise control over the materials used in production by calculating and reviewing mix and yield variances.

11.7.1 Key terms:

- **A mix variance** occurs when the materials are not mixed or blended in standard proportions and it is a measure of whether the actual mix is cheaper or more expensive than the standard mix.

- **A yield variance arises** because there is a difference between what the input should have been for the output achieved and the actual input.

11.7.2 Calculating the variances

The mix variance is calculated as the difference between the actual total quantity used in the standard mix and the actual quantities used in the actual mix, valued at standard costs.

The yield variance is calculated as the difference between the standard input for what was actually output, and the actual total quantity input (in the standard mix), valued at standard costs.

11.7.3 When to calculate the mix and yield variance

A mix variance and yield variance are only appropriate in the following situations.

(a) Where proportions of materials in a mix are changeable and controllable.
(b) Where the usage variance of individual materials is of limited value because of the variability of the mix, and a combined yield variance for all the materials together is more helpful for control.

It would be totally inappropriate to calculate a mix variance where the materials in the 'mix' are discrete items. A chair, for example, might consist of wood, covering material, stuffing and glue. These materials are separate components, and it would not be possible to think in terms of controlling the proportions of each material in the final product. The usage of each material must be controlled separately.

Activity 4:
A company manufactures a chemical, Dynamite, using two compounds Flash and Bang. The standard materials usage and cost of one unit of Dynamite are as follows.

		Shs.
Flash	5 kg at Shs.2 per kg	10
Bang	10kg at shs.3 per kg	30
		40

In a particular period, 80 units of Dynamite were produced from 500 kg of Flash and 730kg of Bang.

Required:
Calculate the materials usage, mix and yield variances.

Activity 5:
The standard materials cost of product D456 is as follows.

		Shs.
Material X	3kg at shs.2.00 per kg	6
Material Y	5kg at shs.3.60 per kg	18
		24

During period 2, 2,000kgs of material X (costing shs.4,1000) and 2,400kgs of material Y (costing shs.9,600) were used to produce 500 units of D456.

Required: Calculate the following variances.
(a) Price variances
(b) Mix variances
(c) Yield variances – in total and for each individual material

With all variance calculations, it is vital that you do not simply learn formulae. You must have a thorough understanding of what your calculations are showing. This is especially true of the variances covered in this in this unit.

Activity 6: *Losses, mix and yield*

Coope and Sorcerer Co make product T42 in a continuous process, for which standard and actual quantities in month 10 were as follows.

	Quantity Kg	Standard price per Kg (shs)	Value shs.	Quantity kg	Actual Price per Kg (shs)	Std cost of actual usage per Kg (Shs.)
Material P	40,000	2.50	100,000	34,000	2.50	85,000
Material Q	20,000	4.00	80,000	22,000	4.00	88,000
	60,000		180,000	56,000		173,000

Losses occur at an even rate during the processing operation and are expected to be 10% of materials input. Actual output during the month was 53,000Kgs.

Required:
Calculate total usage, mix and yield variances

11.8 The issues involved in changing the mix

The materials mix variance indicates the cost of a change in the mix of materials and the yield variance indicates the productivity of the manufacturing process. A change in the mix can have wider implications for example, rising raw material prices may cause pressure to change the mix of materials. Even if the yield is not affected by the change in the mix, the quality of the final product may change. This can have an adverse effect on sales if customers do not accept the change in quality. The production manager's performance may be measured by mix and yield variances but these performance measures may fail to indicate problems with falling quality and the impact on other areas of the business. Quality targets may also be needed.

11.9 Alternative methods of controlling production processes

In a modern manufacturing environment with an emphasis on quality management, using mix and yield variances for control purposes may not be possible or may be inadequate. Other control methods could be more useful.

- *Rates of wastage*
- *Average cost of input calculations*
- *Percentage of deliveries on time*
- *Customer satisfaction ratings*
- *Yield percentage calculations or output to input conversion rates*

11.10SALES MIX AND QUANTITY VARIANCES

The sales volume variance can also be analysed further into a sales mix variance and a sales quantity variance.

11.10.1 Sales mix and quantity variances

- If a company sells more than one product, it is possible to analyse the overall sales volume variance into a sales mix variance and a sales quantity variance.
- The sales mix variance occurs when the proportions of the various products sold are different from those in the budget.
- The sales quantity variance shows the difference in contribution/profit because of a change in sales volume from the budgeted volume of sales.

11.10.2 When to calculate the mix and quantity variances

A sales mix variance and a sales quantity variance are only meaningful where management can control the proportions of the products sold.

In particular, sales mix variances are only of use if there is some kind of link between the products in question.

(a) Complementary products, such as pancake mix and lemon juice
(b) Substitute products, such as branded and own-label goods.
(c) Same products, different sizes.
(d) Products produced within a limiting factor environment

11.10.3 The units method of calculation

The sales mix variance is calculated as the difference between the actual quantity sold in the standard mix and the actual quantity sold in the actual mix, valued at standard margin per unit. The sales quantity variance is calculated as the difference between the actual sales volume in the budgeted proportions and the budgeted sales volumes, multiplied by the standard margin.

Activity 7: *Sales mix and quantity variances*

Just Desserts Limited makes and sells two products. Chocolate Crunch and Strawberry Sundae. The budgeted sales and profit are as follows.

	Sales Units	Revenue shs.	Costs Shs.	Profits Shs.	Profit per unit Shs.
Chocolate crunch	400	8,000	6,000	2,000	5
Strawberry sundae	300	12,000	11,100	900	3
				2,900	

Actual sales were 280 units of Chocolate Crunch and 630 units of Strawberry Sundae. The company management is able to control the relative sales of each product through the allocation of sales effort, advertising and sales promotion expenses.

Required.
Calculate the sales volume variance, the sales mix variance and the sales quantity variance.

PART J
DIVISIONAL PERFORMANCE EVALUATION

12.0 DIVISIONAL PERFORMANCE EVALUATION

UNIT 12 OVERVIEW

- Introduction to Divisionism and performance measurement
- Performance measures
- Financial Performance Indicators
- Non-financial performance indicators

12.0 ORGANISATIONAL STRUCTURE AND DECENTRALISATION

12.1 DECENTRALISATION

This refers to the delegation of authority to make decisions. Decentralisation requires the creation of autonomous business units or divisions such as **cost centres**, **profit centres**, **revenue centres** and **investment centres**.

12.1.1 KEY TERMS

(a) Investment centre
An investment centre is part of the business organisation headed by managers charged with the responsibility of making investment decisions as well as decisions affecting costs and revenues.

(b) Profit Centre:-
This is part of the business for which both costs incurred and the revenue earned are identified. Common in organisations with divisional structure where each division is treated as a profit centre.

(c) Revenue Centre:-
This is part of the organisation that earns sales revenue. It's similar to a cost centre but only accountable for revenues and not costs.

(d) Cost Centre:-
This is a collective place for costs before they are analysed further.

12.2 DIVISIONALISM

This refers to the splitting of an organisation into divisions with each division allocated a manager who is responsible for the performance of the division. A division may be a cost centre, a profit centre or an investment centre or strategic business unit.

12.2.1 Advantages of divisionalism

(a) Divisionalisation can improve the quality of decisions made because divisional managers (those taking the decisions) know local conditions and are able to make more informed judgements.

Moreover, with the personal incentive to improve the division's performance, they ought to take decisions in the division's best interests.

(b) Decisions should be taken more quickly because information does not have to pass along the chain of command to and from top management. Decisions can be made on the spot by those who are familiar with the product lines and production processes and who are able to react to changes in local conditions quickly and efficiently.

(c) The authority to act to improve performance should motivate divisional managers.

(d) Divisional organisation frees top management from detailed involvement in day-to-day operations and allows them to devote more time to strategic planning.

(e) Divisions provide valuable training grounds for future members of top management by giving them experience of managerial skills in a less complex environment than that faced by top management.

(f) In a large business organisation, the central head office will not have the management resources or skills to direct operations closely enough itself. Some authority must be delegated to local operational managers.

12.2.2 Disadvantages of divisionalism

(a) A danger with divisional accounting is that the business organisation will divide into a number of self-interested segments, each acting at times against the wishes and interests of other segments. Decisions might be taken by a divisional manager in the best interests of his own part of the business, but against the best interest of other divisions and possibly against the interests of the organisation as a whole.

A task of head office is therefore to try to prevent dysfunctional decision making by individual divisional managers. To do this, head office must reserve some power and authority for itself so that divisional managers cannot be allowed to make entirely independent decisions. A balance ought to be kept between decentralisation of authority to provide incentives and motivation, and retaining centralised authority to ensure that the organisation's divisions are all working towards the same target, the benefit of the organisation as a whole (in other words, retaining goal congruence among the organisation's separate divisions).

(b) It is claimed that the costs of activities that are common to all divisions such as running the accounting department may be greater for a divisionalised structure than for a centralized structure.

(c) Top management, by delegating decision making to divisional managers, may lose control since they are not aware of what is going on in the organisation as a whole. (With a good system of performance evaluation and appropriate control information, however, top management should be able to control operations just as effectively.)

12.3 RESPONSIBILITY ACCOUNTING

Responsibility accounting is the term used to describe decentralisation of authority, with the performance of the decentralised units measured in terms of accounting results.

With a system of responsibility accounting there are five types of **responsibility centre: cost centre; revenue centre; profit centre; contribution centre; investment centre**.

Type of responsibility centre	Manager has control over …	Principal performance measures
Cost centre	Controllable costs	Variance analysis Efficiency measures
Profit centre	Controllable costs Sales prices (including transfer prices)	Profit
Revenue centre	Revenues only	Revenues
Contribution centre	As for profit centre except that expenditure is reported on a marginal cost basis	Contribution
Investment centre	Controllable costs Sales prices (including transfer prices) Output volumes Investment in non-current assets and working capital	Return on investment Residual income Other financial ratios

12.4 PERFORMANCE MANAGEMENT

Performance measurement aims to establish how well something or somebody is doing in relation to a plan.

Performance measurement is a vital part of the planning and control process. The purpose of performance measurement is to assess actual performance in relation to a plan or target, which may be short-term or long-term.

12.5 PERFORMANCE MEASURES

These are dimensions used to measure performance. Performance measures are divided into two types;

- Financial Performance Measures
- Non-financial Performance Measures

12.5.1 Financial Performance Measures

Financial measures are typically measures relating to **revenues**, **costs**, **profits**, **return on capital**, **asset values** or **cash flows**. In assessing performance using financial performance measures, actual performance is often measured against a financial plan, such as a budget.

12.5.2 Non-financial Performance Measures

Non-financial measures may relate to a number of different aspects of performance, such as:

- *Product or service quality*
- *Reliability*
- *Speed of performance*
- *Risk*
- *Flexibility*
- *Customer attitudes*
- *Innovation*
- *Capability*
- *Pollution*

Non-financial aspects of performance are often a good indicator of future financial performance. Strong financial performance is not achievable over the long term unless non- financial performance is sufficiently strong to sustain the business.

Some performance measurements combine financial and non-financial aspects of performance, especially performance that relates to the efficiency of resource utilisation or capacity utilisation.

12.5.3 Factors that influence the design of a Performance Measurement system of an organisation

(a) **Measurement needs resources** – people, equipment and time to collect and analyse information. The costs and benefits of providing resources to produce a performance indicator must be carefully weighed up.

(b) **Performance must be measured in relation to something**, otherwise measurement is meaningless. Overall performance should be measured against the objectives of the organisation and the plans that result from those objectives. If the organisation has no clear objectives, the first step in performance measurement is to set them. The second is to identify the factors that are critical to the success of those objectives.

(c) **Measures must be relevant**. This means finding out what the organisation does and how it does it so that measures reflect what actually occurs.

(d) **Short and long-term achievement should be measured**. Short-term targets can be valuable, but exclusive use of them may direct the organisation away from opportunities that will mean success for the business in the long-term.

(e) **Measures should be fair**. They should only include factors which managers can control by their decisions, and for which they can be held responsible. Measuring controllable costs, revenues and assets may prove controversial however.

(f) **A variety of measures should be used**. Managers may be able to find ways to distort a single measure, but should not be able to affect a variety of measures. The balanced scorecard (Section provides a method of measuring performance from a number of perspectives.

(g) **Realistic estimates may be required for measures to be employed**. These include estimates of financial items whose value is not certain, such as the cost of capital, and estimates of the impact of non-financial items.

12.5.4 Quantitative and Qualitative performance measures

Quantitative information is information that is expressed in numbers and by measurements. Qualitative information is not numerical, and may relate to issues such as customer loyalty, employee morale and capability. Qualitative information can sometimes be converted into quantitative values through tools such as ranking scales. For example 1 = Good, 2 = Average,
3 = Poor.

(a) An example of a **quantitative performance measure** is: 1,000 units were produced in 50 hours at a cost of shs1,500 per unit.

(b) An example of a **qualitative performance measure** is 'Market research indicates very strong and positive consumer response to the new product.'

Qualitative measures are by nature **subjective** and **judgmental** but they can still be useful. They are especially valuable when they are derived from several **different sources**, as the likelihood of an unreliable judgement is reduced.

Consider the statement.

'Seven out of ten customers think our service is very reliable.'

This is a **quantitative measure** of customer satisfaction (7 out of 10), as well as a **qualitative measure** of the perceived performance of the service (very reliable).

12.6 FINANCIAL PERFORMANCE INDICATORS

Financial performance indicators analyse return on capital, profitability, liquidity and financial risk, often in relation to a plan or budget, or in relation to performance in preceding time periods.

Financial indicators (or **monetary** measures) include:

- Profit (both gross profit and net profit)
- Revenue
- Costs
- Cash flows
- Debt and gearing

The two most common ways of using financial measures to assess performance are:

- Comparing actual results with the **budget** or another financial plan
- Comparing performance in the most recent time period with performance in a **corresponding previous time period** (or analysing a **trend over time**)

Financial measures may be presented as ratios, such as gross profit margin (gross profit/sales), and return on capital employed (net profit/capital employed).

Monetary amounts have meaning only **only in relation to something else**. Financial results should be compared against a **benchmark** such as:

- Budgeted **sales**, **costs** and **profits**
- **Standards** in a standard costing system
- The **trend** over time (last year/this year, say)
- The results of **other parts of the business**
- The results of **other businesses**
- **Future potential** (for example the performance of a new business may be judged in terms of nearness to breaking even).

12.7 CATEGORIES OF FINANCIAL PERFORMANCE INDICATORS

- Broadly speaking, basic financial performance indicators can be grouped into 5 categories
  - **(a)** ***Profitability and return***
  - **(b)** ***Long-term solvency and stability***
  - **(c)** ***Short-term solvency and liquidity***
  - **(d)** ***Efficiency (turnover ratios)***
  - **(e)** ***Investment centre performance ratios***

12.7.1 PROFITABILITY AND RETURN ON CAPITAL

(a) Return of Capital employed (ROCE)

- The most important profitability ratio is therefore return on capital employed (ROCE), which states the profit as a percentage of the amount of capital employed

$$ROCE = \frac{Profit\ before\ interest\ and\ taxation}{Total\ assets\ less\ current\ liabilities} \times 100\%$$

- Capital employed = Shareholders' equity plus non-current liabilities
  (or total assets less current liabilities)

(b) Asset turnover

Asset turnover is the measure of how well the assets of a business are being used to generate sales. This is measured as below;

$$Asset\ turnover\ = \frac{Sales}{Capital\ employed}$$

(c) Profit Margin

This is the ration of profit before Interest and taxation and sales for the period. i.e.;

$$Profit\ margin\ = \frac{PBIT}{Sales}$$

12.7.2 LONG-TERM SOLVENCY (DEBT AND GEARING RATIOS)

- There are 3 ratios that are particularly worth looking at;
  a) Debt Ratio
  b) **Gearing ratio and**
  c) **Interest cover**

i. Gearing ratio

- Gearing is concerned with a company's long time capital structure.
- The capital gearing ratio is a measure of the proportion of a company's capital that is debt. It is measured as follows;

$$Gearing = \frac{Interest\ bearing\ debt}{Shareholders'equity + interest\ bearing\ debt} \times 100\%$$

- ❑ As with the debt ratio, there is no absolute limit to what a gearing ratio ought to be. A company with a gearing ratio of more than 50% is said to be high-geared (whereas low gearing means ratio of less than 50%).

ii. Interest cover

The Interest cover ratio shows whether a company is earning enough profits before interest and tax to pay its interest costs comfortably, or whether its interest costs are high in relation to the size of its profits, so that a fall in PBIT would then have a significant effect on profits available for shareholders.

$$Interest\ cover = \frac{Profit\ before\ interest\ and\ tax}{Interest\ charges}$$

12.7.3 LIQUIDITY RATIOS

- **Liquidity** is the amount of cash a company can put its hands on quickly to settle its debts (and possibly to meet other unforeseen demands for cash payments too).

- Liquid funds consist of;
  - *Cash*
  - *Short-term investments for which there is a ready market*
  - *Fixed term deposits with a bank or other financial institution, for example, a six month high-interest deposit with a bank*
  - *Trade receivables (because they will pay what they owe within a reasonable short period of time)*
  - *Bills of exchange receivable (because like ordinary trade receivable, these represent amounts of cash due to be received within a relatively short period of time)*

- There are 2 major types of liquidity ratios that can be calculated; i.e.;
  a. ***Current ratio***
  b. ***Quick ratio***

iii. Current Ratio

- The standard test of liquidity is the current ratio. It can be obtained from the statement of financial position.

$$Current\ ratio = \frac{Current\ Assets}{Current\ Liabilities}$$

iv. Quick Ratio

- Some companies are not able to convert all their current assets (especially inventories) quickly. In this case, the quick ratio is computed to give an indication of the entity's liquid position.

$$Quick\ ratio = \frac{Current\ Assets - Inventory}{Current\ Liabilities}$$

12.7.4 EFFICIENCY RATIOS

Three major ratios are calculated in regard to the entity's level of efficiency; i.e.;
(a) Accounts receivables collection period
(b) Inventory turnover period
(c) Accounts payables payment period

v. Accounts receivables collection period

This ratio measures the average length of time it takes the company's customers to pay what they owe. The ratio is calculated as follows;

$$\frac{Trade\ receivables}{Sales} \times 365\ days$$

vi. Inventory turnover period

This ratio measures the average number of days that items of inventory are held for. The ratio is computed as follows;

$$\frac{Inventory}{Cost\ of\ Sales} \times 365\ days$$

vii. Accounts payables payment period

This ratio helps in assessing a company's liquidity. An increase in the payment period is often a sign of lack of long-term finance or poor management of current assets, resulting in the use of extended credit from suppliers, increased bank overdraft and so on.

The ratio is computed as follows;

$$\frac{Trade\ accounts\ payable}{Purchases} \times 365\ days$$

12.8 INVESTMENT CENTRE PERFORMANCE MEASUREMENT RATIOS

The performance of an investment centre is usually monitored using either or both of;

(a) Return on investment (ROI) *and*
(b) Residual income (RI).
(c) Economic Value Added (EVA)

12.8.1 RETURN ON INVESTMENT (ROI)

Return on investment (ROI) shows how much profit has been made in relation to the amount of capital invested. ROI is also known as the return on capital employed (ROCE), and is calculated as;

$$= \frac{Profit\ before\ interest\ and\ tax}{Capital\ Employed} \times 100\%$$

15.8.1.1 Controllable and Traceable profit

Depending on the evaluation needed, the profit figure used in the determination of return on investment is divided into 2, i.e. controllable and traceable profit

- **Managerial divisional performance evaluation**
  This is performance evaluation that appraises or shows the performance of the divisional manager individually. It evaluates the fruits of his/her managerial decisions.
  Here, ROI is determined using the controllable profit.

- **Economic divisional performance evaluation**
  This is performance evaluation that appraises or shows the performance of the division as a whole. It evaluates the fruits of the decisions taken at both divisional and top management in respect of the division. Here, ROI is determined using the traceable profit.

Activity 1: Pearl Africa Bank (PAB)

Pearl Africa Bank (PAB) operates three branches in Masaka, Entebbe and Kasese. PAB's financial information for the year ended 31 March 2018 is given below:

Statement of profit or loss:

	Masaka Shs '000'	Entebbe Shs '000'	Kasese Shs '000'	Total Shs '000'
Revenue	45,500	67,250	80,450	193,200
Direct costs	(26,355)	(40,234)	(58,531)	(125,120)
Other direct overheads	(2,650)	(6,540)	(5,280)	(14,470)
Contribution	16,495	20,476	16,639	53,610
Operating overheads	(13,764)	(20,586)	(10,890)	(45,240)
Operating profit/ (loss)	2,731	(110)	5,749	8,370

Statement of financial position:

	Masaka Shs '000'	Entebbe Shs '000'	Kasese Shs '000'	Total Shs '000'
Noncurrent assets (cost)	50,000	75,000	100,000	225,000
Accumulated depreciation	(28,450)	(37,825)	(65,355)	(131,630)
Current assets	15,250	10,235	40,540	66,025
Total assets				159,395
Current liabilities	5,550	3,450	9,206	18,206
Paid up share capital				75,000
Retained earnings				16,189
12% debenture				50,000
Total capital and liabilities				159,375

Additional information:

1. Branch managers have some authority over the acquisition of capital assets. However acquisition of long-term borrowings is under top management control.
2. PAB depreciates its assets at 10% on cost per annum. For the year ended 31 March 2018, depreciation expenses were allocated on basis of 50% to branch managers' decisions and 50% to top management's decisions.
3. The debenture of Shs 50,000,000 is payable within 10 years at coupon rate of 12%.
4. Interest expense of Shs 6,000,000 and depreciation expenses have been included in the operating overheads. Interest expense was distributed to branches in the ratio of 1:1:1.
5. Also operating overheads include Shs 5,500,000 for income tax of which 50% was charged to Masaka branch and another 50% to Kasese branch.
6. PAB's target return on capital employed (ROCE) is 25%.

Required:

Appraise the managerial performance of branch managers using Return on Investment (ROI).

12.8.2 RESIDUAL INCOME (RI)

An alternative way of measuring the performance of an investment centre, instead of using ROI, is residual income (RI).

KEY DEFINITION:

Residual income is a **measure of the centre's profits after deducting a notional or imputed interest cost**.

(a) The centre's profit is **after deducting depreciation** on capital equipment.
(b) The imputed cost of capital might be the organisation's cost of borrowing or its weighted average cost of capital.

Activity 2: JAMBO Ltd

Jambo Ltd was established in 2004 as a distributor of locally manufactured drinks and confectionaries. In 2009, they started manufacturing carbonated soda drinks. This product grew exponentially in the first five years with sales doubling every year until 2015 when sales started dropping. In 2016, they carried out research and found out that there was an increasing preference for organic natural fruit juice and fresh mineral water, whose demand was greatly increasing, due to general awareness of their health benefits. In 2016, the board of directors unanimously agreed to start two additional production lines, one for mineral water, and another one for fruit juice from locally grown fruits. Equipment was purchased, and production started on 1 January 2017. Because these production processes were slightly different, the board agreed to hire different managers for each of these sections.

Previously, all staff and management were earning fixed salaries, but in order to encourage innovation, efficiency and competitiveness, the company, then agreed to change the reward system. Managers were to be paid a basic salary plus a bonus based on residual income generated by their respective sections. In the board meeting of November 2016, the following bonus policy was approved, and it was to be effective at the commencement of the 2017 financial year. The bonus policy requires that each section manager should make a residual income of not less than Shs 500,000,000. A uniform monthly bonus was set at 2% of the excess of the residual income above Shs 500,000,000.

However, the monthly bonus should not exceed Shs 5,000,000. The basic pay for each section manager was set at Shs 3,000,000 per month. The following information was generated from the actual performance of 2017:

Particulars	Soda	Fruit Juice	Mineral Water
	Shs '000'	Shs '000'	Shs '000'
Sales	13,575,060	14,364,020	15,108,500
Variable costs	(6,022,230)	(8,935,040)	(6,524,105)
Finance costs	(167, 000)	(167,000)	(167,000)
Depreciation	(157,545)	(120,000)	(95,000)
Bad debts	(6,787,530)	(4,364,020)	(5,108,500)
Other operating costs	(3,512,500)	(3,020,000)	(3,095,000)
Net profit (loss)	(3,071,745)	(2,242,040)	118,895
Investments	800,000	1,200,000	950,000

Additional information:

1. Other operating costs include central management operating costs of Shs1,500,000,000 allocated to each section on an equal basis.
2. Central management has the authority to borrow for the company and even acquire non-current assets.
3. Section managers have full control over the recovery of the debts.
4. The company's current cost of capital is 20%.

Required:
Determine the annual gross salary for each of the section managers for 2018 based on 2017 financial results.

The advantages and weaknesses of RI compared with ROI

- **The advantages of using RI**
  (a) Residual income will **increase** when investments earning above the cost of capital are undertaken and investments earning below the cost of capital are eliminated.
  (b) Residual income is **more flexible** since a different cost of capital can be applied to investments with **different risk** characteristics.

The **weakness** of RI is that it **does not facilitate comparisons** between investment centres nor **does it relate the size of a centre's income to the size of the investment**.

12.8.3 ECONOMIC VALUE ADDED (EVA)

1. Key Definition

EVA is an internal management performance measure that compares net operating profit to total cost of capital.

2. Computation of EVA

EVA is calculated as follows;

	Shs
Net operating profit after tax (NOPAT)	XX
Less: Capital Charge	(XX)
EVA	XX

Where;

Capital Charge = (NET ASSETS) x (WACC)
WACC = Weighted average cost of capital

3. Difference between EVA and RI

The key differences between EVA and RI are;
(a) The profit figures are calculated differently. EVA is based on 'economic profit' which is derived by making a series of adjustments to accounting profit.
(b) The notional capital charges in EVA use different bases for net assets compared to those used in RI. The replacement cost of net assets is usually used in the calculation of EVA.

Although the logic behind EVA is similar to that of RI (in other words, subtracting an imputed interest charge from the profit earned by a company or division), the calculation of EVA is different to RI because the net assets used

as the basis of the imputed interest charge are usually valued at their replacement cost and are increased by any costs that have been capitalized. .

There are also differences in the way that NOPAT is calculated, compared with the profit figure that is used for RI.

There are three main reasons for adjusting accounting profits to derive NOPAT.

(b) Costs which would normally be treated as expenses in the financial statements, but which are considered within an EVA calculation as investments building for the future, are added back to derive a figure for 'economic profit'. These costs are included instead as assets in the figure for net assets employed; in other words, they are deemed to be investments for the future. Costs treated in this way include such items as research and development expenditure, and advertising costs.

(c) Cash accounting versus accruals. Investors are primarily interested in cash flows, so accounting adjustments for non-cash items, such as allowances for doubtful debts, are eliminated.

(d) Investors, who are interested in maximising their wealth, will be interested in the continuing performance of the company. Therefore one-off, unusual items of profit or expenditure should be ignored.

Another point to note about the calculation of NOPAT, which is the same as the calculation of the profit figure for RI, is that interest is excluded from NOPAT because interest costs are taken into account in the capital charge.

However, note that because NOPAT is after tax, any adjustments to add back interest charges must also adjust the tax figure to include the tax benefit of the interest.

1.1 Accounting Adjustments

Types of item	Comment
1. Value-building expenditure	Expenditure on marketing and promotions, research and development, and staff training which will generate value for the business in future periods should be capitalised. If any such expenditure has been charged as an expense in the income statement, it should be added back to profit, and also added to capital employed in the year in which the expenses were incurred. .
2. Depreciation	The charge for depreciation in the income statement should be added back to profit, and a charge for economic depreciation made instead. The value of non-current assets (and therefore capital employed) should also be adjusted to reflect the revised charge. Economic depreciation reflects the true change in value of assets during the period. However, if no detail is given about economic depreciation in a question scenario, then you should assume that accounting depreciation is a reasonable approximation for it, and therefore you should not make any change to the depreciation figure.
3. Provisions	Provisions, allowances for doubtful debts, inventory write-downs, and deferred tax provisions are deemed to represent over-prudence on the part of the financial accountant, and lead to the true value of capital employed being understated. Therefore they should all be added back to capital employed. Any movements in provisions recognised as income or expenses in the income statement also need to be removed from NOPAT.

4. Non-cash expenses	All non-cash items (eg goodwill) are treated with suspicion, on the basis that if the costs were 'real', cash would have been paid for them. Any non-cash expenses should be added back to profits, and to capital employed.
5. Operating leases	Operating leases should be capitalised and added to capital employed. Otherwise, the inconsistency in treatment between operating and finance leases means that firms can take advantage of operating leases to reduce the capital employed figure, and in doing so increase EVA. In effect, EVA treats all leases as finance leases. Any operating lease charges in the income statement should be added back and removed from NOPAT. In principle, depreciation should then be charged on the assets acquired under finance leases. However, remember that accounting depreciation is replaced with economic depreciation when calculating EVA.

However, note that no additional adjustments are made to the tax charge in relation to the tax on other adjustments made when calculating NOPAT (e.g. adding back value-building expenditure to profit).

Activity 3: KATOKI MOBILE NETWORK (KMN)

Katoki Mobile Network (KMN) is a registered telecom company operating in most parts of Uganda. It deals in mobile money, selling of air time, and phones under different divisions. Divisions are treated as investment centers and are headed by managers who have autonomy to make investment decisions.

Return on investment (ROI) is used to measure divisional performance and the target for the financial year ended 30 June 2016 was 20%, above which managers would earn a bonus payment of 5% of their controllable profit.

At the end of year management meeting, it was decided that in the financial year ending 30 June 2019, head office costs are to be included in the determination of divisional performance, stressing that if divisions were independent, they would incur the costs of those services provided by head office and the bonus calculated on the net profit. It was resolved that Economic Value Added (EVA ™) be used to measure divisional performance instead of ROI, due to its weaknesses. The bonus policy was reviewed such that a manager receives 15% of EVA ™.

In the same meeting, mobile money manager presented his request to procure more sophisticated software arguing that it will improve on customer service to increase sales by Shs 5 million per month. The machine will cost Shs 50 million with a useful life of 5 years with no residual value. The manager hopes to secure a bank loan at an interest rate of 30% per annum due to the current inflation.

Division's variable costs carry 30% of its sales and no changes are expected in fixed operating costs.
KMN's cost of capital is 15% and 20% of head office costs relate to bad debts.
Corporation tax rate is 30%.

The following operating results relate to each division for the year ended 30 June 2018:

Extracts from statement of profit or loss:

Division	Air time	Mobile money	Phones
	Shs '000'	Shs '000'	Shs '000'
Sales	580,000	550,000	670,000
Variable costs	(230,000)	(180,000)	(340,000)
Contribution	350,000	370,000	330,000
Distribution	(15,000)	(10,000)	(25,000)
Marketing	(21,000)	(25,000)	(28,000)
Divisional overheads	(12,000)	(9,000)	(13,000)
Interest	(18,000)	(21,000)	(24,000)
Depreciation	(5,000)	(1,000)	(9,500)
Attributable head office costs	(45,000)	(45,000)	(45,000)
Net profit	234,000	259,000	185,500

Extracts from statement of financial position

	Air time	Mobile money	Phones
	Shs '000'	Shs '000'	Shs '000'
Noncurrent assets (NBV)	885,000	980,500	1,095,500
Inventory	17,500	10,500	20,000
Receivables	9,000	5,000	11,500
Bank	14,500	-	21,000
Payables	12,000	6,000	90,000
Bank overdraft	-	25,000	-

KMN paid corporation tax for year ended 30 June 2018 of Shs 204 million and it was distributed to air time, mobile money and phone divisions in proportions of 35%, 38% and 27% respectively.

Required:

(a) Using the operating results for the year ended 30 June, 2018, advise management on whether the change of the divisional performance measurement is appropriate.

(b) Assess the annual net effect of the proposed investment on EVA ™ of Mobile Money division.

12.9 NON-FINANCIAL PERFORMANCE INDICATORS

There has been a growing emphasis on NFPIs for a number of reasons.

(a) **Concentration on too few variables**. If performance measurement systems focus entirely on those items which can be expressed in monetary terms, managers will concentrate on only those variables and ignore other important variables that cannot be expressed in monetary terms.

(b) **Lack of information on quality.** Traditional responsibility accounting systems fail to provide information on the quality or importance of operations.

(c) **Changes in cost structures.** Modern technology requires massive investment and product life cycles have got shorter. A greater proportion of costs are sunk and a large proportion of costs are planned, engineered or

designed into a product/service before production/delivery. At the time the product/service is produced/delivered, it is therefore too late to control costs.

(d) **Changes in competitive environment.** Financial measures do not convey the full picture of a company's performance, especially in a modern business environment.

(e) **Changes in manufacturing environment**. New manufacturing techniques and technologies focus on minimising throughput times, inventory levels and set-up times. But managers can reduce the costs for which they are responsible by increasing inventory levels through maximising output. If a performance measurement system focuses principally on costs, managers may concentrate on cost reduction and ignore other important strategic manufacturing goals.

(f) **NFPIs are a better indicator of future prospects**. Financial performance indicators tend to focus on the short term. They can give a positive impression of what is happening now but problems may be looming. For example, falling quality will ultimately damage profitability.

Unlike traditional variance reports, NFPIs can be provided **quickly** for managers, per shift, daily or even hourly as required. They are likely to be easy to calculate, and easier for non-financial managers to **understand** and therefore to **use effectively**.

12.9.1 NFPIs that should be measured by an entity

As a general guide, NFPIs may be measurements of the following aspects of performance.

(a) **Quality** of production: wastage rates or percentage of rejects in production
(b) **Speed** or **efficiency**, such as output per hour; average time taken per unit of activity
(c) **Delivery**: average time between taking an order and delivery to the customer
(d) **Reliability**: percentage of calls answered within a given target time; number of equipment failures or amount of 'down time'
(e) **Customer satisfaction**: number of complaints
(f) **Innovation**: number of new products developed and launched on to the market

With non-financial indicators, **anything can be measured and compared** if it is **meaningful** to do so. The measures should be **tailored** to the circumstances of the business.

12.9.2 The balanced scorecard

The **balanced scorecard** approach to performance measurement focuses on four different perspectives of performance, and uses both financial and non-financial indicators to set performance targets and monitor performance. Although business performance may be measured by a single financial performance indicator such as ROI, profit, or cost variances, it is often more suitable to use multiple measures of performance where each measure reflects a **different aspect of achievement**. Where multiple measures are used, several may be **nonfinancial.**

An important argument in favour of measuring non-financial performance is that current and future financial performance depend largely on non-financial aspects of performance. If an organisation uses a performance measurement system for monitoring its performance, it seems appropriate that the measurement system should be formally structured, so that:

- all relevant aspects of performance are measured
- targets are set for all key aspects of performance
- actual performance is measured against targets, rather than compared with performance in
- previous years
- performance targets are consistent with each other.

Perhaps the most widely-used structured approach to performance targeting and measurement is the **'balanced scorecard'.**

A balanced scorecard is a performance measurement system in which:

(a) Objectives and targets are set for **four different aspects or perspectives of performance**:
- a financial perspective;
- customer perspective;
- internal perspective; and
- innovation and learning perspective.

All four perspectives are important for the long-term success of the organisation. Three of these perspectives are non-financial in nature.

(b) There should be a small number of **targets for each of the four perspectives**.

(c) The **different targets for the four perspectives should be consistent with each other**: the four perspectives are sometimes in conflict with each other and it is necessary to establish an acceptable balance between the different perspectives and targets. (Hence, a 'balanced' scorecard.)

(d) **Actual performance is measured regularly and compared with the targets for all of the perspectives**.

(e) Differences between the target and actual performance are investigated, and where appropriate measures are taken to improve performance.

Cost Estimation and Regression Analysis

13.0
COST ESTIMATION AND REGRESSION ANALYSIS

UNIT 13 OVERVIEW:

1. **General principles and application to estimating cost functions**:
   (a) Regression equation
   (b) Multi regression analysis
   (c) Cost functions
   (d) Factors to be considered when using past data to estimate cost functions
   (e) Steps involved in estimating cost functions

2. **Cost estimation methods and their application:**
   (a) Engineering method
   (b) Inspection of accounts method
   (c) Graphical including scatter graph method
   (d) High-low method
   (e) Least squares method

3. **Test of reliability:**
   (a) The coefficient of determination
   (b) Standard error of the estimate
   (c) Standard error of the coefficient

4. **Learning curve theory:**
   (a) The learning curve effect and its applications
   (b) The experience curve and its applications

1. GENERAL PRINCIPLES AND APPLICATION TO ESTIMATING COST FUNCTIONS:

1.1 Cost Functions

Cost function is an equation that can be linear or curve-linear representing a relationship between an independent variable and dependent variable within the total cost figure.

The Cost function is generally represented as;

TC = FC + VC

Where;
TC = Total cost
FC = Fixed costs
VC = Variable costs

1.2 Steps involved in cost estimation

The following brief steps can be used in the estimation of the cost function;

Step 1: **Selection of the dependent variable**:
This is based on the purpose of the cost function. In most cases, the objective of a cost function is to facilitate the future cost estimation and forecasting.

Step 2. **Selection of potential cost drivers**:
These are bases on which costs allocated to an activity such as direct labour hours, direct machine hours etc

Step 3. **Collect data on the dependent variable and cost drivers**:
Appropriate and adequate methods of data collection must be used to obtain acceptable data for deriving cost functions and in case of any changes data should be adjusted.

Step 4. **Plot the observations on a graph**:
This helps to show the relationship between dependent variable and cost driver to establish whether a linear cost function can estimate cost behavior. It highlights abnormal behaviours which should be investigated before reaching a conclusion.

Step 5. **Estimate the cost function**:
This can be found using engineering method, inspection of the accounts method, high-low method, least squares method and graphical method.

Step 6. **Test the reliability of the cost function**:
This should be done to see whether the function is plausible and it confirms or rejects the beliefs derived from the collected and analyzed data.

2. COST ESTIMATION METHODS AND THEIR APPLICATION

Firms use various methods to estimate costs. The commonly used methods include;

(i) Engineering method
(ii) Inspection of Accounts Methods
(iii) Least squares method
(iv) Graphical including scatter graph method
(v) High-low method

2.1 Engineering method

The Engineering Cost Estimating method builds the overall cost estimate by summing detailed estimates done at lower levels of the Work Breakdown Structure (WBS). It's a technique where the system being costed is broken down into lower-level components (such as parts or assemblies), each of which is costed separately for direct labor, direct material, and other costs. Engineering estimates for direct labor hours may be based on analyses of engineering drawings and contractor or industry-wide standards.

Engineering estimates for direct material may be based on discrete raw material and purchase part requirements. The remaining elements of cost (such as quality control or various overhead charges) may be factored from the direct labor and material costs. The various discrete cost estimates are aggregated by simple algebraic equations (hence the common name "bottoms-up" estimate). The use of engineering estimates requires extensive knowledge of a system's (and its components') characteristics, and lots of detailed data.

Because of the high level of detail, each step of the work flow should be identified, measured, and tracked, and the results for each outcome should be summed to make the point estimate.

- **Advantages of the Engineering Cost Estimating method**

(i) The estimator's ability to determine exactly what the estimate includes and whether anything was overlooked,
(ii) Its unique application to the specific program and manufacturer,
(iii) That it gives good insight into major cost contributors, and
(iv) Easy transfer of results to other programs.

- **Disadvantages of the Engineering Cost Estimating method**

(i) It can be expensive to implement and it is time consuming
(ii) It is not flexible enough to answer what-if questions
(iii) New estimates must be built for each alternative
(iv) The product specification must be well known and stable
(v) All product and process changes must be reflected in the estimate

2.2 Inspection of accounts method

Inspection of Accounts (also known as the account analysis method) is a cost accounting method for estimating the different costs associated with producing a product.

When a firm is determining how much it costs to make a product, the management accountant will divide the costs into three categories: variable, fixed, and mixed; where **Variable costs** are the costs that increase as more products are produced like materials, **Fixed costs** are the costs that remain the same no matter how many products are produced like rent and **Mixed costs** are exactly what they sound like—a variety of fixed and variable costs that can't be separated.

The purpose of the inspection of accounts method is to estimate the costs of producing a product relating these three categories together using linear algebra. This method takes experience and knowledge of the company's processes and production.

Activity 1

Classic House Construction Limited (CHCL) is an emerging company in the construction sector. It was established in 2016 with the aim of reaping profits in the booming real estate business in Uganda. CHCL, whose reporting date is 31 December, deals in building classic residential houses for its clients the majority of whom are the working class. The company is located in Kampala.

At the beginning of 2018, CHCL received an order to construct 30 houses from Kampala District Widows Association (KDWA), a local NGO, for 30 widows. It has also received an additional 50 unconfirmed orders within the central region.

In the 2018 opening year management meeting, the Managing Director hinted on the likelihood of failing to meet clients' demands due to cash flow problems. He thus tasked the accountant, CPA Jane Muloya to develop a cost model, for cost estimation, to ease decision making. The current pricing policy for CHCL is full cost plus a 5% profit. CHCL completed and handed over 10 houses to customers in 2017 and its cost data is as follows:

	Shs "000"	Shs"000"
Direct Materials:		
Bricks	60,000	
Sand	20,000	
Stone aggregates	7,800	
Iron sheets	55,000	
Cement	90,000	
Other direct materials	50,000	282,800
Direct Labour:		
Foreman's allowances	15,000	
Builders' allowances	50,000	
Porters' allowances	25,000	
Site engineers' allowances	25,000	115,000
Other direct costs:		
Wear and Tear	75,000	
Repairs and maintenance	50,000	125,000
Operating Costs:		
Staff salaries and wages	300,000	
Administration costs	53,500	
Marketing costs	10,000	
Depreciation	15,000	378,500
Taxation	12,555	
Interest	57,500	70,055

CHCL signed the contract with KDWA at the beginning of March 2018 to construct and hand over 30 houses within two years with expected end date of 28 February 2020. The contract price per house was agreed at Shs 78 million. It was also agreed that CHCL would suffer a fine of Shs 5 million per house in case of contract termination, but that it would earn a bonus of Shs 5 million per house if all houses were completed and handed over by 30 November 2019.

After a thorough trend analysis, the accountant developed a model for estimating costs. Accordingly she expects staff salaries and wages, administration costs and marketing costs to increase by 10% per annum while depreciation, taxation and interest to increase by 20% per annum with effect from 1 January 2018. She has assured management that CHCL will complete 17 houses in 2018 and 13 houses in 2019 and that the official hand over of the houses will be done by 30 November, 2019.

CHCL expects to complete 3 more houses in 2018 and 12 houses in 2019 for other customers at a price of Shs 89 million per house. However, this will lead to additional costs as follows:

	2018 Shs"000"	2019 Shs"000"
Staff salaries and wages	21,000	86,000
Administration costs	10,565	43,000
Depreciation	5,000	21,000

Required:

(a) **Using the inspection of accounts method:**
   (i) Estimate the total construction costs and profits for the years ending 31 December 2018 and 2019.
   (ii) Advise the management of CHCL whether they should adopt the accountant's estimates.

(b) Assuming that the order of 50 houses has been confirmed and that construction will be completed in 2020; basing on total costs for 2017, 2018 and 2019, use the high-low method to determine CHCL's cost function and use it to estimate the amount of money required to complete the 50 houses.

2.3 Least-squares method

Least-squares regression is a statistical technique that may be used to estimate a linear total cost function for a mixed cost, based on past cost data. The cost function may then be used to predict the total cost at a given level of activity such as number of units produced or labor/machine hours used.

Least-squares regression mathematically calculates a line of best fit to a set of data pairs i.e. a series of activity levels and corresponding total-cost at each activity level. The calculation involves minimizing the sum of squares of the vertical distances between the data points and the cost function. The name least-squares regression also reflects this proposition, that the ideal fitting of the regression line is achieved by minimizing the sum of squares of the distances between the straight line and all the data points on the graph.

Assuming that the cost varies along y-axis and activity levels along x-axis, the required cost line may be represented in the form of following equation:

$$y = a + bx$$

In the above equation, a is the y-intercept of the line and it equals the approximate fixed cost at any level of activity. Whereas b is the slope of the line and it equals the average variable cost per unit of activity.

By using mathematical techniques the following formulas to calculate a and b may be derived:

$$Unit\ variable\ cost\ (b) = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x^2)}$$

$$Total\ fixed\ Cost\ (a) = \frac{\sum y - b(\sum x)}{n}$$

Where,
n is number of pairs of units–total-cost used in the calculation;
Σy is the sum of total costs of all data pairs;
Σx is the sum of units of all data pairs;
Σxy is the sum of the products of cost and units of all data pairs; and
Σx2 is the sum of squares of units of all data pairs.

Activity 16.2 – MDC JUNE 2014 **Question 5**

2.4 High-low Method

This method is used to identify the fixed and variable elements of costs that are **semi –variable**. This method follows a few simple 5 steps; i.e.

Step 1 Review records of costs in previous periods

- Select the period with the **highest** activity level
- Select the period with the **lowest** activity level

Step 2 If inflation makes it difficult to compare costs, adjust by indexing up or down.

Step 3 Determine the following

- Total costs at high activity level
- Total costs at low activity level
- Total units at high activity level
- Total units at low activity level

Step 4 Calculate the following

Total cost at high activity level – Total cost at low activity level
Total units at high activity level – total units at low activity level
= Variables costs per unit (v)

Step 5 The fixed costs can be determined as follows;

= Total costs at high activity level – (total units at high activity level x variable costs per unit)

Activity 16.3:

A department in a large organization wishes to develop a method of predicating its total costs in period. The following data have been recorded.

MONTH	Activity level (X)	Costs
	units	Shs
JANUARY	16,00	28,200
FEBRUARY	2,300	29,600
MARCH	1,900	28,800
APRIL	1,800	28,600
MAY	1,500	28,000
JUNE	1,700	28,400

Required
Determine the cost equation of the above enterprise using the High-low method

16.1 The usefulness of the high – low method

The high –low method is a simple and easy to use method of estimating fixed and variables costs. However, there are a number of problems with it.

(a) The method **ignores** all costs information apart from at the highest and lowest of activity and these may not be **representative** of costs at all of activity.
(b) **Inaccurate** cost estimates may be produced as results of the assumption of a constant relationship between costs and volume of activity.
(c) Estimates are based on **historical** information and conditions may have changed.

2.5 Graphical Method (including scatter graph)

One of the main tasks of management decision and business investigation is the analysis of the interrelations of the variables being investigated.

As frequently done in business administration, the interrelationships can be obtained by studying how one variable **x** changes with respect to another variable, **y**.

For example, as a manager of a company you may want to know how total costs are affected by an increase in output or how increase in sales has affected the increase in advertising costs.
The relationship between total sales and advertising costs will help the manager to make analysis about the movement of such a relation (i.e. whether the movement is positive or negative). By plotting the two variables on a straight line graph we can obtain the nature of the relationship and which one variable can be deduced from another and vice versa.

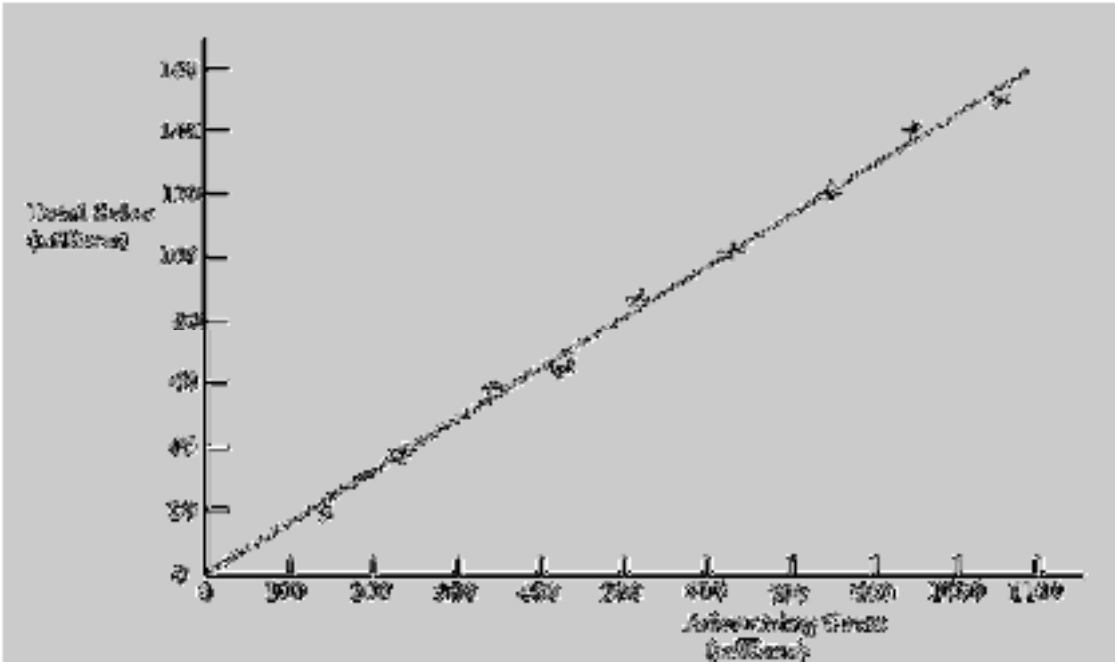


Fig. 17.1above is an example of the graph of sales versus advertising costs.

It can be seen that the points lie almost on a straight line. By eye one can very easily draw a straight line that very nearly passes through all the points.

However one should note that there are cases where the relationship may not be clearly marked so that the relationship sought can only be approximated. Such cases are most likely to occur in instances where the variables concerned may be height and weight of N individuals from the N pairs of observations. One may be in need to determine the mathematical form of the relationship existing between the two variables. In this case the use of a scatter diagram becomes essential.

17.2: The Scatter diagram

Ten adults have their weight taken and their height measured. The results obtained are shown in Table 17.1 below.

Table 17.1: weight and heights of 10 adults

Adult	Weight (kg)	Height (ft.)
A	60	5.1
B	61	5.3
C	62	5.2
D	63	5.5
E	64	5.6
F	65	5.6
G	66	6
H	67	5.7
I	68	6.2
J	69	6.2

From such data one may want to ask – How does the height of an individual vary with his weight? One way to answer this question is to plot the above data in graphical form. By using coordinate paper and using suitable intervals we can plot on the y axis the height of the individuals and on the x axis their weight. The points are then marked off with say crosses as shown in Fig.13.2 below. The resulting figure is called *scatter diagram*.

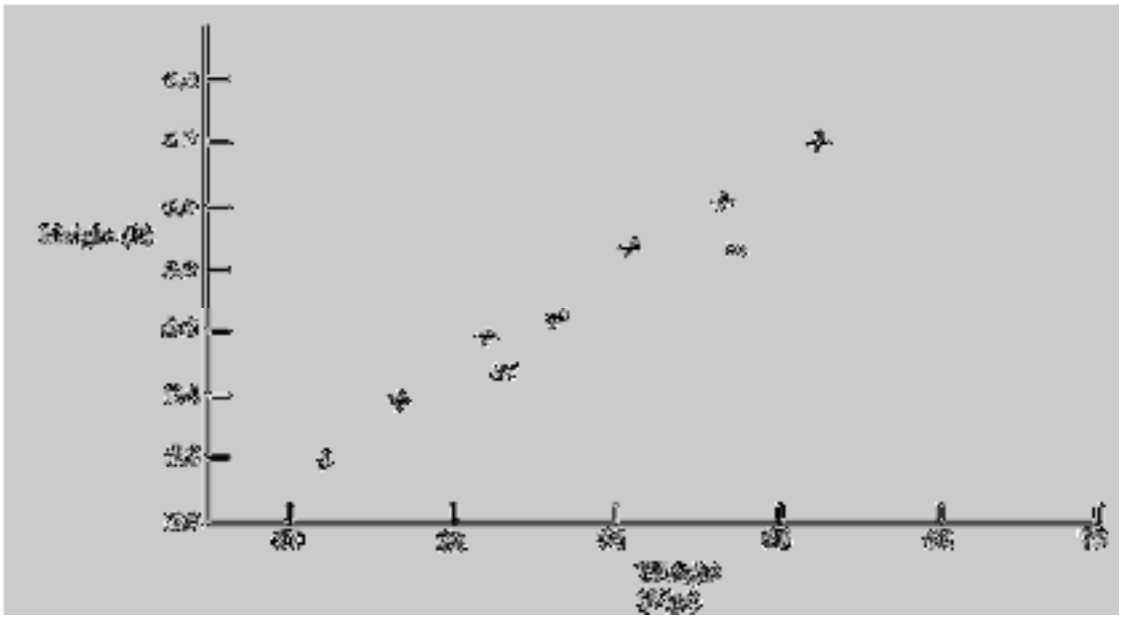


FIG.17.2 *Scatter diagram for table 17.1*

As we can see from the scatter diagram above the points show that there is an obvious linear relationship between the weight of an individual and his height. However, if one were to fit by freehand drawing to the set of points, then different lines could easily be obtained by different people. Hence in order to be consistent we should devise a mathematical technique by which line fitting to such data produces a line of "best" fit reproducible by everyone.

17.3 Curves of Regression

Under normal circumstances a relation between two variables has one of the variables being independent and the other being dependent. In a formula connecting two variables the subject is taken to be dependent variable, and when represented graphically, the independent variable is usually plotted along the "x-axis". However in most *bivariate* distributions the same relation exists although either variable can be taken to be *dependent* or *independent*. This normally depends on what questions are being asked about the distribution in consideration.

Consider a bivariate distribution (x_1, y_1), (x_2, y_2), e.t.c. One may seek to find the formula for a curve which expresses x in terms of y or y in terms of x. In general these two formulae will not be the same. They can only be identical under the special circumstances when all pairs of the distributions are all identical. That is, the curve passes exactly through all the points. Therefore in practice we have two formulae.

In general terms, the equation which expresses y in terms of x is given by

$$y = a_1 + b_1x + c_1x^2 + \ldots \quad (17.1)$$

The one which expresses x in terms of y is given by

$$x = a_2 + b_2x + c_2x^2 + \ldots \quad (17.2)$$

Equation (17.1) is called the *equation of regression of y on x*. Equation (17.2) is called equation of regression of x on y. We call the resulting *curves of regression*. In the cases dealt with here, we are interested in linear relationships between two pairs of distributions. Hence strictly speaking we are interested in the *equation of regression of y on x* given by

$$y = m_1x + c_1 \quad (17.3)$$

And the equation of regression of x on y given by

$$x = m_2y + c_2 \quad (17.4)$$

Equations (17.3) and (17.4) are just special cases of equations (17.1) and (17.2) respectively.

Fig.17.3 *Below shows a line "best" fit drawn by eye*.

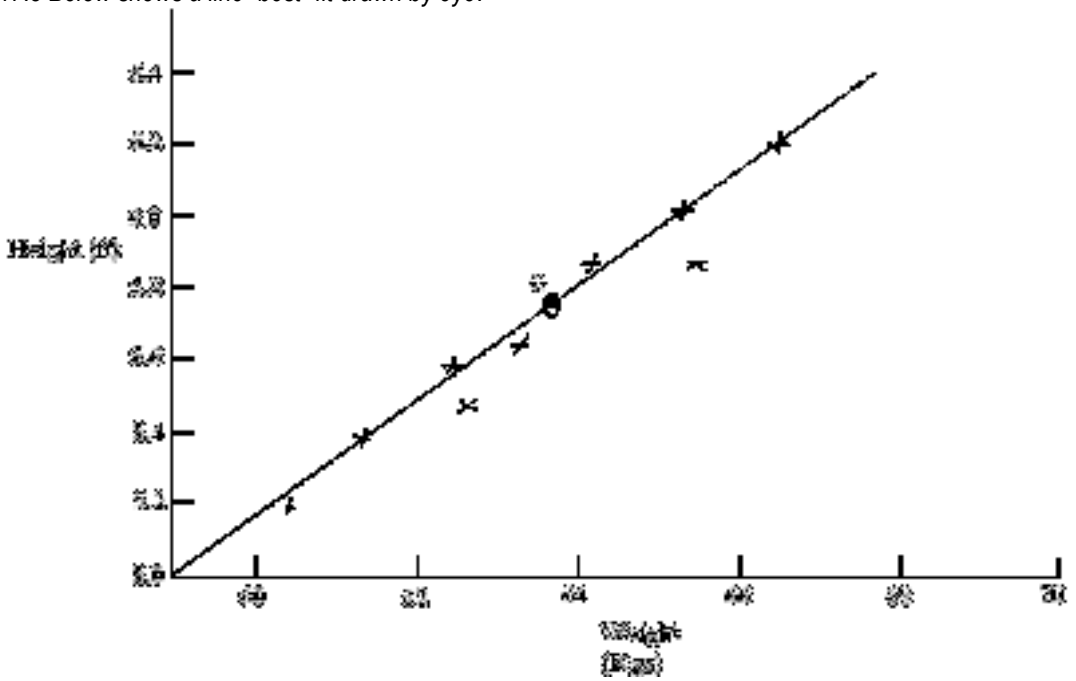


FIG. 17.3 *Line of best fit for the scatter diagram Fig.17.2*

The procedure for drawing a line of best fit is as follows: Find the mean centre, **G** of the estimated line of regression. This is the point G($\bar{x}$, $\bar{y}$), where$\bar{x}$ is the mean of the *x* values and $\bar{y}$ is the mean of the *y* values. Using a ruler, the line of regression is drawn to fit the plotted points as closely as possible while passing through **G**. The equation of the estimated line of regression can be obtained easily by first calculating its gradient (slope), *m*. Obtain this by using the co-ordinates of two points on the line which are far enough apart and then substitute the value of the gradient into the equation.

$$y - \bar{y} = m(x - \bar{x}) \quad (17.5)$$

where $\bar{x}$ and $\bar{y}$ are as defined above.

Using this procedure the line of best fit of Fig.13.3 is found to be (depending on the person who draws the line)

$y = 0.125x - 2.42$

As we said above we must have a mathematical technique by which everyone should be able to reproduce a line of best fit. We shall now study this technique of how to obtain a line of best fit by calculation and then compare this equation with the one obtained by estimation.

17.4 Calculation of Regression Lines

Table 17.2 Calculation of regression lines

x	y	x^2	y^2	xy
60	5.1	3600	26.01	306.0
61	5.3	3721	28.09	323.3
62	5.2	3844	27.04	322.4
63	5.5	3969	30.25	346.5
64	5.6	4096	31.36	358.4
65	5.6	4225	31.36	364.0
66	6.0	4356	36.00	396.0
67	5.7	4489	32.49	381.9
68	6.2	4624	38.44	421.6
69	6.2	4761	38.44	427.8
∑ x = 645	**∑ y = 56.4**	**∑x² = 41685**	**∑y² = 319.48**	**∑xy = 3647.9**

In order to calculate a regression line we need a table with columns for x, y, x^2, xy as shown below. Consider the example of ten adults above. Consider the foregoing table.

$\bar{x} = \frac{645}{10} = 64.50$ *and* $\bar{y} = \frac{56.4}{10} = 5.64$

The gradient of the regression line of y on x is calculated from the equation

$$m_1 = \frac{\sum(xy) - n.\bar{x}.\bar{y}}{\sum x^2 - n.\bar{x}^2} \quad (17.6)$$

The gradient of the regression line of x on y is calculated from the equation

$$m_2 = \frac{\sum(xy) - n.\bar{x}.\bar{y}}{\sum y^2 - n.\bar{y}^2} \quad (17.7)$$

From the table above we have

$$m_1 = \frac{\sum(xy) - n.\bar{x}.\bar{y}}{\sum(x)^2 - n.\bar{x}^2} = \frac{3647.9 - 10 \times 64.5 \times 5.64}{41685.0 - 10 \times 64.5 \times 64.5}$$

$$= \frac{3647.9 - 3637.8}{41685.0 - 41602.5} = \frac{10.1}{82.5} = \mathbf{0.122}$$

Substituting for m_1 in equation (13.5) i.e. $\boldsymbol{y - \bar{y} = m(x - \bar{x})}$ we have

y – 5.64 = 0.122(x – 64.5)

y- 5.64 = 0.122x – 7.87

y = 0.122x – 2.23

Comparing with the estimated regression line one can see that the difference is very small. Hence the estimated regression line was quite accurate.

Example 17.2
The following table shows the number of units of a good produced and the total costs incurred.

Units	100	200	300	400	500	600	700
Total Cost Shs	40,000	45,00	50,000	65,000	70,000	70,000	80,000

Required

(i) *Calculate the regression line for Y on X.*
(ii) *Assuming **250** units were produced, compute the total costs incurred.*

SOLUTION

Determine the dependent variable, Y and which the independent variable X
For cost estimation, the values of the activities are the values of X and related costs are the values for Y.

X	Y	XY	X^2
100	40,000	4,000,000	10,000
200	45,000	9,000,000	40,000
300	50,000	15,000,000	90,000
400	65,000	26,000,000	160,000
500	70,000	35,000,000	250,000
600	70,000	42,000,000	360,000
700	80,000	56,000,000	490,000
2,800	**420,000**	**187,000,000**	**1,400,000**

Solution

From the general equation of the regression line ;$y - \bar{y} = m_1(x - \bar{x})$ ….*regression of y on x.*

$$\bar{x} = \frac{2{,}800}{7} = \mathbf{400}\ and \bar{y} = \frac{420{,}000}{7} = \mathbf{60{,}000}$$

$$m_1 = \frac{\sum(xy) - n.\bar{x}.\bar{y}}{\sum(x)^2 - n.\bar{x}^2}$$

$$m_1 = \frac{187{,}000{,}000 - 7 \times 400 \times 60{,}000}{1{,}400{,}000 - 7 \times (400)^2} = \frac{19{,}000{,}000}{280{,}000} = \mathbf{67.86}$$

Substituting in the general equation of regression lines,

Y – 60,000 = 67.86 (x – 400)
Y – 60,000 = 67.86X – 27,144
Y = 67.86X – 27,144+60,000
Y = 67.86X + 32,856

(iii) If 250 units were produced then;
In this case, x = 250.

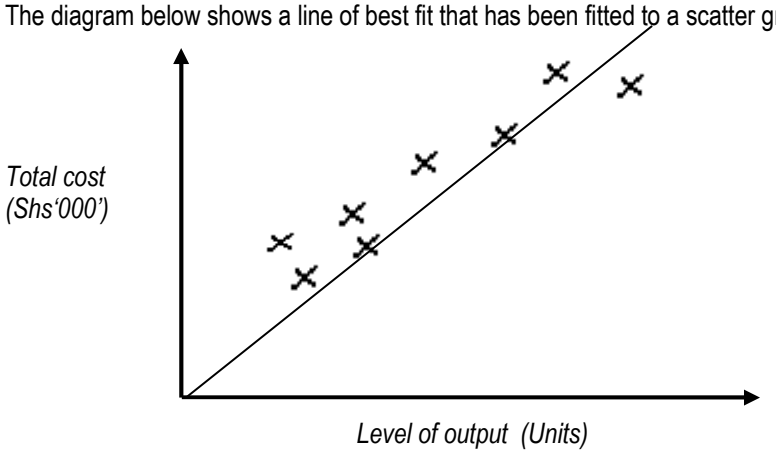
Therefore, substituting in the equation of regression, we shall have;

Y = (67.86 × 250) – 32,856
Y = 49,821
Thus the total cost were; **Shs. 49821.**

17.5: Application of line of best fit

A scatter graph can be used to make an estimate of fixed and variable costs by drawing a line of best fit through the band of points on a scatter graph, which best represents all the plotted points.

The diagram below shows a line of best fit that has been fitted to a scatter graph by 'eye' or judgment.



(a) Estimating fixed and variable costs using line of best fit

The amount of fixed costs can be found by looking at the point where the graph intercepts the Y-axis. In other words, look at total costs when activity (level of output) is zero. These must all be fixed costs.
To calculate variable costs, take any other point on your line of best fit and use these figures and your calculation of fixed costs to estimate variable cost per unit.

Example 17.3
In the previous diagram.
When X= 0, Y= 2000, therefore fixed costs are = Shs. 2000/-
Take point **P** on the line,
X = 5, Y = 6000Shs.
Total costs (TC) = 6000 Shs

TC = FC + VC (17.8)
VC = TC – FC
VC = 6000 -2000 = 4000Shs
Activity = 5 units
VC per unit = $\frac{4000}{5}$ = **800Shs**

3.1 THE LEARNING CURVE THEORY

Learning curve theory may be useful for forecasting production time and labour costs in certain circumstances, although the method has many limitations.

Whenever an individual starts a job which is **fairly repetitive** in nature and provided that his speed of working is not dictated to him by the speed of machinery (as it would be on a production line), he is likely to be become, more **confident and knowledgeable** about the work as he gains experience, to become efficient, and to do **more quickly.**

Eventually, however, when he has acquired enough experience, there will be nothing more for him to learn and **so the learning process will stop.**

Learning curve theory applies to situations where the work forces as a whole improve in efficiency with experience. The learning effect or learning curve describes the speeding up of a job with repeated performance.

16.1.1 Where does learning curve theory apply?

Labour time should be expected to get shorter, with experience, in the production of items which exhibit any or all of the following features**.**

- Made largely by **labour effort** (rather than by **highly mechanized** process)
- Brand **new** or relatively **short lived** (learning process does not continue indefinitely)
- **Complex** and made in **small quantities** for **special orders**

16.1.2 The three approaches to learning curve problem

There are three that can be used to address learning curve scenarios.

- **Method 1**. The tabular approach
- **Method 2**. The graphical approach
- **Method 3** .The algebraic approach

Method 1 – The tabular approach: Cumulative average time and the learning rate.

The **tabular approach** is only effective in scenarios where output is doubling.
Under this approach, a table is set up to show levels of output, cumulative average time required per unit and incremental time for additional units. The **cumulative average time per unit** produced is assumed to **decrease** by a **constant percentage** every time **total output** of product **doubles.**

For instance, when an 80% learning affect occurs, the cumulative average time required per unit of output is reduced to 80% of the previous cumulative average time when output is doubled.

(a) By **cumulative average time**, we mean the average time per units produced so far, back to and including the first unit made.

(b) The **doubling** of output is an important feature of the learning curve measurement.

Activity 16.2:

JFK Motors is planning to introduce its newly developed saloon car. The first unit of output of the new saloon car requires 100 hours. An 80% learning curve applies.

Required
Demonstrate using relevant computations how the production times will change assuming that output is doubled.

Activity 16.3: GRAPHICAL METHOD

Using information obtained in 10.3 above, sketch the learning curve on an appropriate scale to how the behavior of the learning curve as production times are changed.

NOTE: The graphical approach is best in scenarios where output is not doubling.

Activity 16.4:

Toyota Uganda has designed a new type of Passenger Bus, for which the cost of the first passenger bus t be produced has been estimated as follows;

	Shs
Materials	5,000
Labour (800hrs @ shs5 per hour)	4,000
Overhead (150% of labour cost)	6,000
	15,000
Profit mark-up (20%)	3,000
Sales price	18,000

The firm plans to sell all the passenger buses manufactured at full cost plus 20%. An 80% learning curve is expected to apply to the production work. The management accountant has been asked to provide cost information so that decisions can be made on what price to charge.

Required

(a) Determine the separate cost of the second passenger bus

(b) Toyota Uganda has received two separate orders from KCCA and UMEME, compute the cost per unit for the 3rd and 4th passenger buses that the firm will charge for the 2 orders received.

Method 3 – The algebraic approach

The formula for the learning curve is $Y = aX^b$

Where;
Y is the cumulative average time per unit to produce x units
X is the cumulative number of units
a is the time taken for the first unit of output
b is the index of learning (log LR / log 2)
LR is the learning rates as a decimal

The above formula can also be used to calculate the labour cost per unit. The labour times are calculated using the curve formula and then converted to cost. *In that case therefore **Y** = cumulative average cost per unit of the product and consequently, **a** = cost for the first unit of output.*

Activity 16.5:

ABC Co manufactures product **X** to which an 80% learning curve applies. Production information for the month of March 2015 indicates that 230 units of product **X** have been produced to date. The firm has budgeted to produce 55units for the month of April 2015. The cost of the very first unit of product **X** in January 2015 was Shs. 120.

Required
Using the algebraic method, compute the budgeted total labour cost for the month of April 2015

Activity 16.6:

A company needs to calculate a new standard cost for one of its products. When the product was introduced, the standard variable cost of the first unit was as follows;

		Cost per unit Shs
Direct materisl	10kg @ shs.3 per Kg	30
Direct labour	10 hours @ shs.9 per hour	90
Varaible overhead	10 hours @ shs.5 per hour	50
		170

During the following year, a 90% learning curve was observed. The cumulative production at the end of the third quarter was 50 units and the budgeted production for the fourth quarter is 10 units.

Required
(a) Compute the standard cost per unit for the fourth quarter assuming that the 90% learning curve still applies.
(b) What is the standard cost per unit for the fourth quarter assuming the learning curve has reached a steady state i.e. peak efficiency was reached after the 50th unit was produced?

16.1.3 The practical application of learning curve theory.

The following costs are affected by the learning curve

(a) Direct labour time and costs
(b) Variable overhead costs , if they vary with direct labour hours worked
(c) **Material costs** are usually **unaffected** by learning among the workforce, although it is conceivable that material handling might improve, and so wastage costs be reduced.
(d) **Fixed overhead expenditure** should be **unaffected** by the learning curve (although in an organization that uses absorption costing , if fewer hours are worked in producing a unit of output, and the factory operates at full capacity, the fixed overheads recovered or absorbed per unit in the cost of output will decline as more units are made.

16.1.4 The relevance of learning curve effects in management accounting

- **Learning curve theory can use to:**

(a) Calculate the marginal (incremental) costs of making extra units of a product.

(b) Quote selling prices for a contract, where prices are calculated at cost plus a percentage mark – up for profit. An awareness of the learning curve can make all the difference between winning contracts and losing them, or between making profits and selling at a loss- making prices.
(c) Prepare realistic production budget and more efficient production schedules.
(d) Prepare realistic standard costs for costs for control purposes

- **Considerations to bear in mind include:**

(a) Sales projections, advertising expenditure and delivery date commitments. Identifying a learning curve effect should allow an organization to plan its adverting and delivery schedules to coincide with expected production schedules. Production capacity and sales projections.
(b) Budgeting with standard costs. Companies that use standard costing for much of their production output cannot apply standard times to output where a learning effect is taking place. This problem can be overcome in practice by:

- Establishing **standard times** for output , once the learning effect has worn off or become insignificant , and
- Introducing a' **launch cost budget'** for the duration of learning period.
- **Budgetary control.** When learning is still taking place ,it would be unreasonable to compare actual times with the standard time that ought eventually to be achieved when the learning effect wears off .**Allowance should be made** accordingly when interpreting labour efficiency variances
- **Cash budgets .**Since the learning effect reduces unit variables costs as more units are produced , it should be allowed for in cash flow projections
- **Working scheduling and overtime decisions.** To take full advantage of the learning effect, idle production time should be avoided and work scheduling / overtime decisions should pay regard to the expected learning effect.
- **Pay.** Where the workforce is paid a productivity bonus, the time needed to learn a new production process should be allowed for in calculating the bonus for the bonus for a period.
- **Recruiting new labour**. When a company plans to take on new labour to help to help with increasing production, the learning curve assumption will have to be reviewed.
- **Market share.** The significance of the learning curve is that increasing its share of the market, a company can benefit from shop – floor, and technological 'learning to achieve economies of scale.

Limitations of learning curve theory

a) The learning it assumes stable conditions at work which will enable learning to take place. This is not always practicable, for example because of turnover labour.
b) It must also assume a certain degree of motivation amongst employees.
c) Breaks between repeating production of an item must not be too long, or workers will ' forget ' and the learning process will have to begin all over again.
d) It might be difficult to obtain accurate data to decide what the learning curve is.
e) Workers might not agree to a gradual reduction in production times per unit.
f) Production techniques might change, or production design alterations might be made, so that it takes a long time for a 'standard 'production method to emerge, to which a learning effect will apply.

PART L
PLANNING AND CONTROL OF INVENTORY

14.0
PLANNING AND CONTROL OF INVENTORY

UNIT 14 OVERVIEW

- Stock Control
- Stock Control Levels
- Re-order Quantity Problem
- EOQ Assumptions
- Inventory Costs
- EOQ and Discounts

14.1 STOCK CONTROL - *Introduction*

- The major goal of stock control is to discover and maintain the optimum level of investment in all types of stocks from raw materials and supplies to finished goods. Thus limits must be imposed in controlling inventory levels because there are two danger points that management usually wants to avoid.

  The first danger is that of inadequate stocks, disrupts production and may lose sales. The second danger, excessive stocks introduces unnecessary **carrying costs** and **obsolescence** risks between the two danger points.

- The **stocks** held in any organization can generally be classified under four main headings:
  - *Raw Materials*
  - *Work in progress*
  - *Spare parts/consumables*
  - *Finished goods*

- **Stock control** covers the following functions:
  - *The ordering of stock*
  - *The purchase of stock*
  - *The receipt of goods into store*
  - *Storage*
  - *The issue of stock and maintenance of stock at the most appropriate level.*

14.2 STOCK CONTROL LEVELS

14.2.1 Reasons for Holding Stocks

- To ensure sufficient goods are available to meet expected demand.
- To provide a buffer between processes.
- To meet any future shortages.
- To take advantage of bulk purchase e.g. discounts
- To absorb seasonal fluctuation and any variation in usage and demand.
- To allow production processes to flow smoothly and efficiently.
- As a necessary part of the production process.
- As a deliberate investment policy, especially in times of inflation or possible shortages.

14.3 THE ORDER QUANTITY PROBLEM

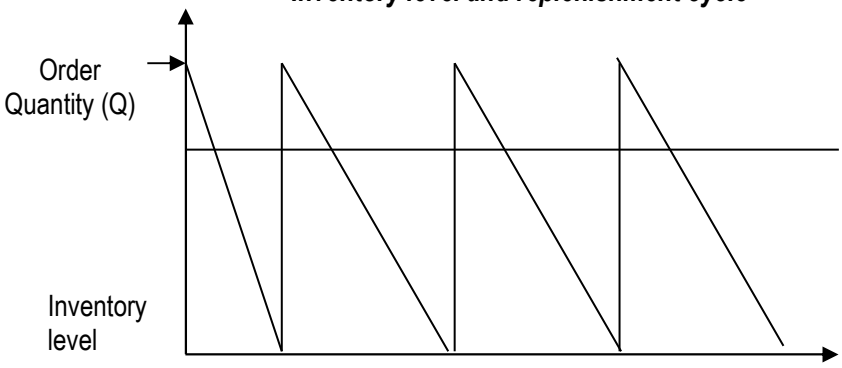
The order quantity problem involves determining;
(i) the optimal order size for an inventory item given its expected usage,
(ii) carrying costs and
(iii) ordering costs.

The economic order quantity (EOQ) model attempts to determine the order size that will minimise total inventory costs. It assumes that

Total inventory Costs = Total carrying costs + Total ordering costs

Assuming that inventory is allowed to fall to zero and then it is immediately replenished, the average inventory becomes Q/2, where Q is inventory order size in units

Inventory level and replenishment cycle



Average Inventory =

Order quantity = Q
2 2

If the average inventory is Q/2 and the carrying cost per unit is C, then **carrying costs** become

Total carrying costs = (average inventory) (Carrying cost per unit) = (Q/2) C

Where Q = The inventory order size in units
C = Carrying cost per unit.

The **ordering costs** incurred are equal to the ordering costs per order times the number of orders. If we assume total demand over the planning period is S and we order in lot sizes of Q, then Q/S represents the number of orders over the planning period.

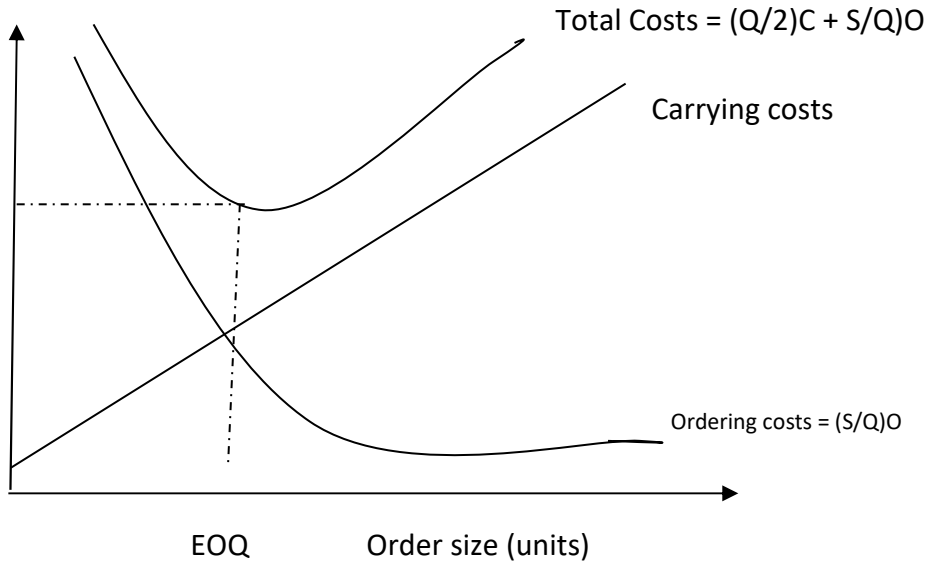
If the ordering cost per order is O), then,

Total ordering costs = (Number of orders) (ordering cost per order)
= (S/Q) O

where S = Total demand in units over the planning period
O = Ordering cost per order

Thus total cost = (Q/2)C + (S/Q)O

Graphically this equation is illustrated as follows



What we are looking for is the order size Q, that provides the minimum total costs. By manipulating the equation for total costs, we find that the optimal value of Q – that is the economic order quantity (EOQ) is

$$Q = \sqrt{\frac{2SO}{C}}$$

14.4 EOQ ASSUMPTIONS

The major weaknesses of the EOQ model are associated with several of its assumptions inspite of which the model tends to yield quite good results. Where its assumptions have been dramatically violated, the EOQ model can generally be easily modified to accommodate the situation. The model's assumptions are as follows:

1. **Constant or uniform demand**. Although the EOQ model assumes constant demand, demand may vary from day to day. If demand is stochastic – that is not known in advance – the model must be modified through the inclusion of a **safety stock**.

2. **Constant unit price**. The inclusion of variable prices resulting from quantity discounts can be handled quite easily through a modification of the original EOQ model, redefining total costs and solving for the optimum order quantity.

3. **Constant carrying costs**. Unit carrying costs may vary substantially as the size of the inventory rises, perhaps decreasing because of economies of scale or storage efficiency or increasing as storage space runs out and new warehouses have to be rented. This situation can be handled through a modification in original model similar to the one used for variable unit price.

4. **Constant ordering costs**. While this assumption is generally valid, its violation can be accommodated by modifying the original EOQ model in a manner similar to the one used for variable unit price.

5. **Instantaneous delivery**. If delivery is not instantaneous, which is generally the case; the original EOQ model must be modified through the inclusion of safety stocks.

6. **Independent orders**. If multiple orders result in cost savings by reducing paper work and transportation cost, the original EOQ model must be further modified. While this modification is somewhat complicated, special EOQ models have been developed to deal with it.

14.5 HOLDING COSTS/CARRYING COSTS

Holding costs will be incurred if stocks are high i.e.:

- Costs of storage and store operations
- Interest charges
- Insurance costs
- Risk of obsolescence
- Deterioration

14.6 COSTS OF OBTAINING STOCKS

These are sometimes called ordering or procurement which are associated with low stocks.

(a) Clerical and administrative costs
(b) Transport costs
(c) Production run costs (where stocks are produced internally)

14.7 STOCK-OUT COSTS

Causes of stock out costs:

- Lost contribution from lost sales
- Loss of future sales due to disgruntled customer
- Loss of customer goodwill
- Cost of production stoppages
- Labour frustrations over stoppages
- Extra costs of urgent, small quantity, replenishment orders.

14.8 OBJECTIVE OF STOCK CONTROL

To minimize:

- Holding costs
- Ordering costs
- Stock out costs

14.9 STOCK CONTROL LEVELS

(a) **Reorder level** = maximum usage x maximum lead time
Maximum lead-time is the time between placing an order with a supplier and the stock becoming available for use.

(b) **Minimum level** = Reorder level – (average usage x average lead time)
This is a warning level to management of potential stock out.

(c) **Maximum level** = Reorder level + Reorder quantity – (minimum usage x minimum lead time)

(d) **Reorder Quantity** – this is the quantity of stock which is to be ordered when stock reaches the reorder level. If it is set so as to minimize the total costs associated with holding and ordering stocks, then it is known as the **economic order quantity (EOQ)**

(e) **Average Stock** – the formula for the average stock level assumes that stock levels fluctuate evenly between the minimum (or safety) stock level and the highest possible stock level (the amount of stock immediately after an order is received, i.e. safety stock + reorder quantity
Average Stock = Safety stock + ½ Reorder Quantity

14.10 ECONOMIC ORDER QUANTITY (EOQ)

The economic order theory assumes that the average stock is equal to one half of the re-order quantity. Holding costs tend to increase with the level of stock and so could be reduced by ordering smaller amounts from suppliers each time. Ordering costs tend to increase if smaller orders are placed, because a large number of orders would then be needed for a given annual demand. The EOQ is therefore found at the point where holding costs equal ordering costs.

$$\sqrt{\frac{2C_oD}{Ch}}$$

Where
Ch *= Cost of holding one unit of stock for one period*
C_o *= Cost of ordering a consignment from a supplier*
D *= Demand during the time period*

Number of Orders = Annual demand ÷ Order Quantity
Annual Holding Cost = Average Stock x Holding Costs per unit
Annual Order Cost = Numbering of orders x Cost per order

Example 17.1

Suppose a company purchases a raw material at a cost of shs16 per unit. The annual demand for the raw material is 25,000 units. The holding cost per unit is shs6.40 and the costs of placing an order is shs32.

Required
Calculate the EOQ

14.11BULK DISCOUNTS

The solution obtained using the simple EOQ formula may need to be modified if bulk discounts (quantity discounts) are available.

To decide mathematically whether it would be worthwhile taking a discount and ordering larger quantities it is necessary to minimize the total of the following:

- Total material costs
- Ordering costs
- Stock holding cots

Example 17.2

A local gift shop is attempting to determine how many sets of wine glasses to order. The store feels it will approximately need 800 sets in the next year at a price of shs18.00 per set. The wholesale price that the store pays per set is shs12.00. Costs of carrying one set of wine glasses are estimated at shs1.50 per year while ordering costs are estimated at shs25.00.

(a) What is the economic order quantity for the sets of wine glasses?

(b) What are the annual inventory costs for the firm if it orders in this quantity? (assume constant demand and instantaneous delivery and thus no safety stock is carried)

Example 17.3 *Bulk Discounts*

The annual demand for an item of stock is 45 units. The item costs shs200 a unit to purchase. The holding cost for one unit for one year is 15% of the unit cost and ordering cost are shs300 an order.

The supplier offers a 3% discount for orders of 60 units or more, and a discount of 5% for orders of 90 units or more.

Required.
Calculate the cost minimising order size.

14.12 OTHER SYSTEMS OF STORES CONTROL AND REORDERING

(a) Under the **order cycling method**, quantities on hand of each stores item are reviewed periodically (every 1, 2 or 3 months). For low cost items, a technique called the 90-60-30 day technique can be used, so that when stocks fall to 60 days supply, a fresh order is placed for a 30 day supply so as to boost stocks to 90 days supply.

(b) **The two-bin system of stores control** (or visual method of control) is one whereby each stores item is kept in two storage bins. When the first bin is emptied an order must be placed for re-supply, the second bin will contain sufficient supplies to last until the fresh delivery is received. It is not based on any objective criteria.

(c) Material items may be classified as **expensive or inexpensive** or in a middle cost range.
   i. Expensive and medium cost materials are subject to careful stores control procedures to minimize costs.
   ii. Inexpensive materials can be stored in large quantities.
   This approach is called ABC method whereby materials are classified A, B or C according to their expense group

A = Expensive materials
B = Medium cost materials
C = Inexpensive materials

(d) A similar selective approach to stores control is the Pareto (80/20) distribution is based on the finding that in many stores, 80% of the value of stores is accounted for by only 20% of the stores items, and stocks of these more expensive items should be controlled more closely.

PART M
LINEAR PROGRAMMING

15.0
LINEAR PROGRAMMING

UNIT 15 OVERVIEW:

- Limiting factors
- Limiting factor analysis – make or buy decisions and scarce resources
- The principles of linear programming
- The graphical method
- Using simultaneous equations
- Slack and surplus
- Shadow prices

15.1 Limiting factors

All companies are limited in their capacity, either for producing goods or providing services. There is always one resource that is most restrictive (the limiting factor).

Key term:

A limiting factor is any factor that is in scarce supply and that stops the organisation from expending its activities further, that is, it limits the organisation's activities.

- An organisation might be faced with just one limiting factor (other than maximum sales demand) but there might also be several scarce resources, with two or more of them putting an effective limit on the level of activity that can be achieved.

- Examples of limiting factors include sales demand and production constraints.

  - **Labour**. The limit may be either in terms of total quantity of particular skills

  - **Materials**. There may be insufficient available materials to produce enough units to satisfy sales demand.

  - **Manufacturing capacity**. There may not be sufficient machine capacity for the production required to meet sales demand.

- It is assumed in limiting factor analysis that management would make a product mix decision or service mix decision based on the option that would maximise profit and that profit is maximised when contribution is maximised (given no change in fixed cost expenditure incurred). In other words, marginal costing ideas are applied.

  - Contribution will be maximised by earning the biggest possible contribution per unit of limiting factor. For example if grade A labour is the limiting factor, contribution will be maximised by earning the biggest contribution per hour of grade A labour worked.

- The limiting factor decision therefore involves the determination of the contribution earned per unit of limiting factor by each different product.
- If the sales demand is limited, the profit-maximising decision will be to produce the top ranked product(s) up to the sales demand limit.

- In limiting factor decisions, we generally assume that fixed costs are the same whatever product or service mix is selected, so that the only relevant costs are variable costs.

- When there is just one limiting factor, the technique for establishing the contribution-maximising product mix or service mix is to rank the products or services in order of contribution-earning ability per unit of limiting factor.

Activity 1: *Limiting factor decision*

Sausage makes two products, the Mash and the Sauce. Unit variable costs are as follows.

	Mash Shs	Sauce Shs
Direct materials	1	3
Director labour (Shs.3 per hour)	6	3
Variable overhead	1	1
	8	**7**

The sales price per unit is Shs.14 per Mash and Shs.11 per Sauce. During July the available direct labour is limited to 8,000 hours. Sales demand in July is expected to be as follows.

Mash	3,000 units
Sauce	5,000 units

Required:

Determine the production budget that will maximise profit, assuming that fixed costs per month are Shs.20,000 and that there is no opening inventory of finished goods or work in progress.

15.2 Two potentially limiting factors

You may be asked to deal with situations where two limiting factors are potentially limiting (and there rae also product/service demand limitation). The approach in these situations is to find out which factor (if any) prevents the business from fulfilling maximum demand.

Activity 2: *Two potentially limiting factors*

Lucky manufactures and sells three products X, Y and Z for which budgeted sales demand, unit selling prices and unit variable costs are as follows.

		X		Y		Z	
Budgeted sales demand		550 units		500 units		400 units	
		Shs	Shs	Shs	Shs	Shs	Shs
Unit sales price			16		18		14
Variable costs:	Materials	8		6		2	
	Labour	4		6		9	
			12		12		11
Unit contribution			4		6		3

The organisation has existing inventory of 250 units of X and 200 units of Z, which it is quite willing to use up to meet sales demand. All three products use the same direct materials and the same type of direct labour. In the next year, the available supply of materials will be restricted to Shs.4,800 (at cost) and the available supply of labour to Shs.6,600 (at cost).

Required:

Determine what product mix and sales mix would maximise the organisation's profits in the next year.

15.3 LIMITING FACTOR ANALYSIS – MAKE OR BUY DECISIONS AND SCARCE RESOURCES

In a situation where a company must sub-contract work to make up a shortfall in its own in-house capabilities, its total costs will be minimized if those units bought have the lowest extra variable cost of buying per unit of scarce resource saved by buying.

15.3.1 Combining internal and external production

An organisation might want to do more things than it has the resources for, and so its alternatives would be as follows.

(a) Make the best use of the available resources and ignore the opportunities to buy help from outside
(b) Combine internal resources with buying externally so as to do more and increase profitability.

Buying help from outside is justifiable if it adds to profits. A further decision is then required on how to split the work between internal and external effort. What parts of the work should be given to suppliers or sub-contractors so as to maximise profitability?

In a situation where a company must sub-contract work to make up a shortfall in its own in-house capabilities, its total costs will be minimized if those units bought have the lowest extra variable cost of buying per unit of scarce resource saved by buying.

Activity 3: *Make or buy decisions with scarce resources*

MM manufactures three components S, A and T using the same machines for each. The budget for the next year calls for the production and assembly of 4,000 of each component. The variable production cost per unit of the final product is as follows.

	Machine hours	Variable cost Shs
1 unit of S	3	20
1 unit of A	2	36
1 unit of T	4	24
Assembly		20
		100

Only 24,000 hours of machine time will be available during the year, and a sub-contractor has quoted the following unit prices for supplying components: S shs.29; A shs.40; T shs.34

Required:

Advise MM

15.4 THE PRINCIPLES OF LINEAR PROGRAMMING

Linear programming is a technique for solving problems of profit maximization or cost minimization and resource allocation. If a scenario contains two or more limiting factors, linear programming must be applied.

A typical business problem is to decide how a company should divide up its production among the various types of product it manufactures in order to obtain the maximum possible profit. A business cannot simply aim to produce as much as possible because there will be limitations or constraints within which the production must operate. Such constraints could be one or more of the following.

a) Limited quantities of raw materials available
b) A fixed number of labour hours per week for each type of worker
c) Limited machine hours

Moreover, since the profits generated by different products vary, it may be better not to produce any of a less profitable line, but to concentrate all resources on producing the more profitable ones. On the other hand limitations in market demand could mean that some of the products produced may not be sold.

15.5 THE GRAPHICAL METHOD

Linear programming at least at this fairly simple level, is a technique that can be carried out in a fairly handle turning manner once you have got the basic ideas sorted out. The steps involved are as follows.

(i) Define variables
(ii) Establish constraints
(iii) Construct objective function
(iv) Graph constraints
(v) Establish feasible region
(vi) Determine optimal solution

Activity 4:

WX Co manufactures two products, A and B. both products pass through two production departments, mixing and shaping. The organisation's objective is to maximise contribution to fixed costs.

Product A is sold for shs.1.50 whereas product B is priced at shs.2.00. There is unlimited demand for product A but demand for B is limited to 13,000 units per annum. The machine hours available in each department are restricted to 2,400 per annum. Other relevant data are as follows.

Machine hours required	Mixing Hrs	Shaping Hrs
Product A	0.06	0.04
Product B	0.08	0.12

Variable cost per unit	Shs
Product A	1.30
Product B	1.70

What are the constraints in the situation facing WX Co?

15.5.1 Formulating the problem using the graphical method: steps 1 – 3

Let's formulate WX's problem.

Step 1: Define variables

What are the quantities that WX can vary? Obviously not the number of machine hours or the demand for product B. the only things which it can vary are the number of units of each type of product produced. It is those numbers which the company has to determine in such a way as to obtain the maximum possible profit. Our variables (which are usually products being produced) will therefore be as follows.

Let x = number of units of product A produced
Let y = number of units of product B produced

Step 2: Establish constraints

The value of the objective function (the maximum contribution achievable from producing products A and B) is limited by the constraints facing WX, however. To incorporate this into the problem we need to translate the constraints into inequalities involving the variables defined in Step 1. An inequality is an equation taking the form 'greater than or equal to' or 'less than or equal to'.

(a) Consider the mixing department machine hours constraint.

(i) Each unit of product A requires 0.06 hours of machine time. Producing five units therefore requires 5 x 0.06 hours of machine time and, more generally, producing x units will require 0.06x hours.
(ii) Likewise producing y units of product B will require 0.08y hours.
(iii) The total machine hours needed in the mixing department to make x units of product A and y units of product B is 0.06x + 0.08y.
(iv) We know that this cannot be greater than 2,400 hours and so we arrive at the following inequality.
$0.06x + 0.08y \leq 2{,}400$

Qn: How can the constraint facing the shaping department be written as an inequality?

(b) The final inequality is easier to obtain. The number of units of product B produced and sold is y but this has to be less than or equal to 13,000. Our inequality is therefore as follows.
$y \leq 13{,}000$.

(c) We also need to add non-negativity constraints ($x \geq 0$, $y \geq 0$) since negative numbers of products cannot be produced. (Linear programming is simply a mathematical tool and so there is nothing in this method which guarantees that the answer will 'make sense'. An unprofitable product may produce an answer which is negative. This is mathematically correct but nonsense in operational terms. Always remember to include the non-negativity constraints. The examiner will not appreciate 'impossible' solutions).

Step 3: Construct objective function

We now need to introduce the question of contribution or profit. We know that the contribution on each type of product is as follows.

			Shs. Per unit
Product A	Shs. (1.50 – 1.30)	=	0.20
Product B	Shs. (2.00 – 1.70)	=	0.30

The objective of the company is to maximise contribution and so the objective function to be maximised is as follows.
Contribution (C) = 0.2x + 0.3y

The problem has now been reduced to the following four inequalities and one equation.

Maximise contribution (C) = 0.2x + 0.3y, subject to the following constraints.

$$\begin{aligned} 0.06x + 0.08y &\leq 2{,}400 \\ 0.04x + 0.12y &\leq 2{,}400 \\ y &\leq 13{,}000 \\ x,y &\geq 0 \end{aligned}$$

15.6 Steps 4 and 5 – graphing the problem and establishing the feasible region

Step 4 of the linear programming model is to represent the constraints as straight lines on a graph.

A graphical solution is only possible when there are two variables in the problem. One variable is represented by the x axis of the graph and one by the y axis. Since non-negative values are not usually allowed, the graph shows only zero and positive values of x and y.

Revision of graphing a straight line

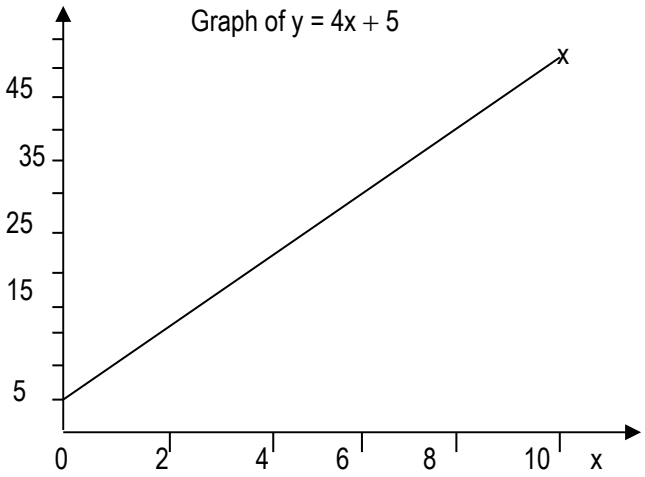
- To begin with, we must have a linear relationship between two measurements. For example, y = 4x + 5
- **Note:**
  (1) To recognize a linear relationship the equation must only have 'x' not 'x' to the power of anything, such as x^2.
  (2) A straight line has two characteristics:
    (i) A slope or gradient – which measures the 'steepness' of the line
    (ii) A point at which it cuts the y axis – this is called the intercept:
  y = (slope x X) + intercept. For example, y = 4x + 5
- Therefore, the gradient is 4 and the point at which the line cuts the y axis is 5.
- To draw a straight line graph we only need to know two points that can then be joined.

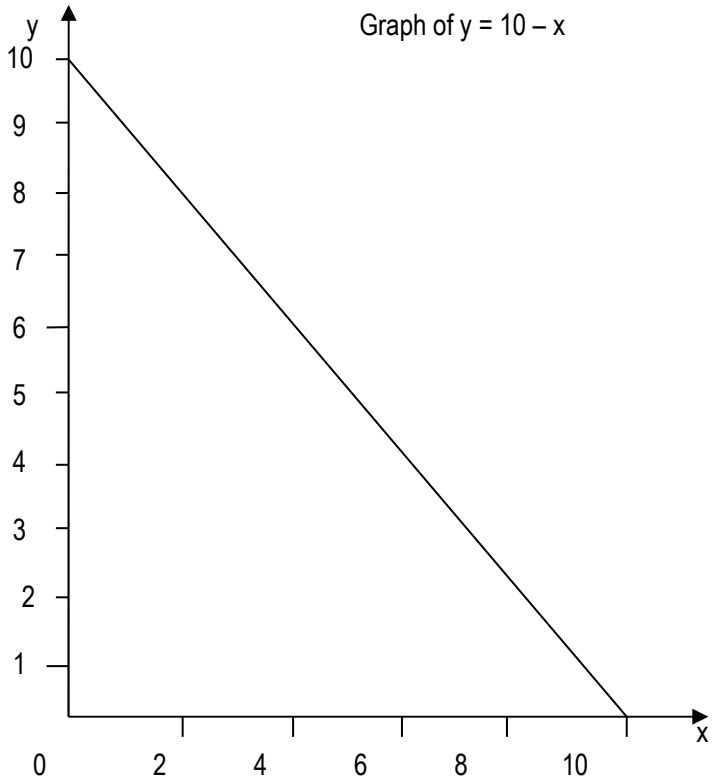
- Consider the following two equations:

(i) $y = 4x + 5$
(ii) $y = 10 - x$

- In order to draw the graphs of these equations it is necessary to decide on two values for x and then calculate the corresponding values for y. Let us use x = 0 and 10.
  (i) (x = 0, y = 5) and (x = 10, y = 45)
  (ii) (x = 0, y = 10) and (x = 10, y = 0)

- So to draw equation (i), we plot the points (0,5) and (10,45) and join them up.
- Similarly, to draw equation (ii), we plot the points (0, 10) and (10, 0) and join them up.

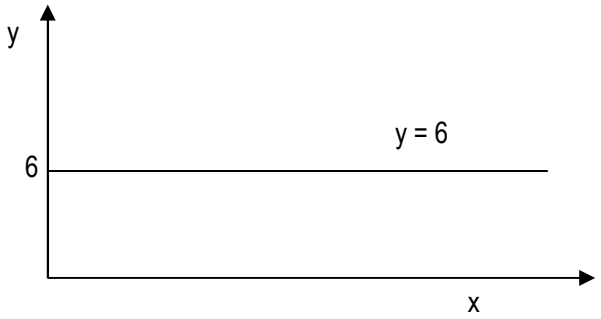




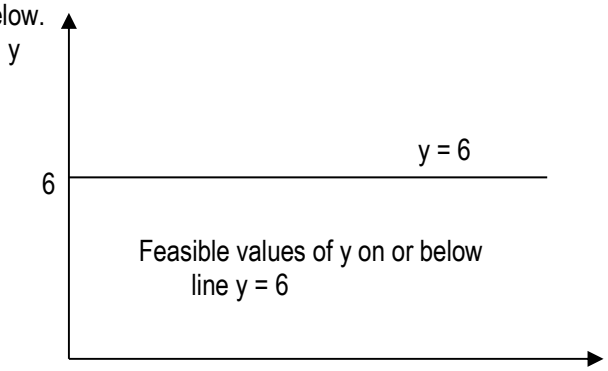
15.6.1 Graphing equations and constraints

We will return to the scenario facing WX Co. For now, let us focus on the main principles involved in graphing equations and constraints.

A linear equation with one or two variables is shown as a straight line on a graph. Thus y = 6 would be shown as follows.



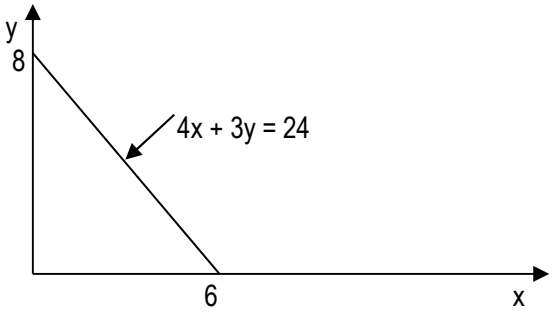
If the problem included a constraint that y could not exceed 6, the inequality $y \leq 6$ would be represented by the shaded area of the graph below.



The equation 4x +3y = 24 is also a straight line on a graph. To draw any straight line, we need only to plot two points and join them up. The easiest points to plot are the following.

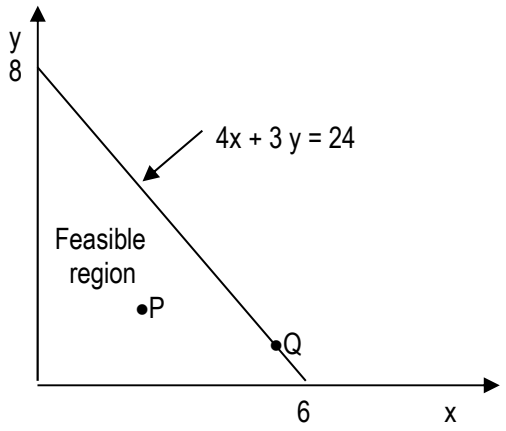
- x = 0 (in this example, if x = 0, 3y = 24, y = 8)
- y = 0 (in this example, if y = 0, 4x = 24, x = 6)

By plotting the points, (0, 8) and (6, 0) on a graph, and joining them up, we have the line for 4x + 3y = 24.



Any combination of values for x and y on the line satisfies the equation. Thus at a point where x = 3 and y = 4, 4x + 3y = 24. Similarly, at a point where x = 4.5 and y = 2, 4x + 3y = 24.

If we had a constraint $4x + 3y \leq 24$, any combined value of x and y within the shaded area below (on or below the line) would satisfy the constraint.



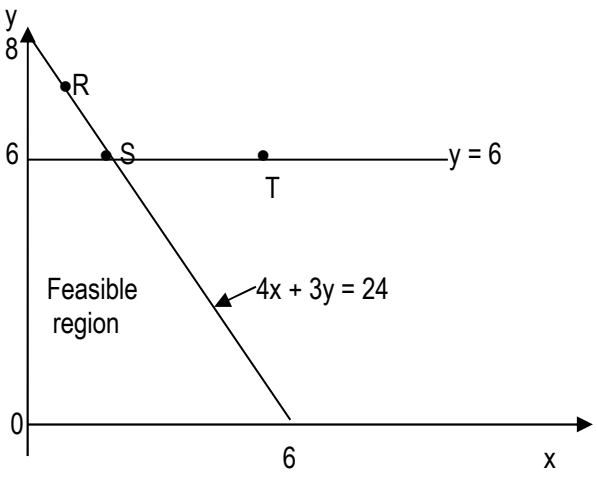
Consider point P which has coordinates of (2, 2). Here $4x + 3y = 14$,which is less than 24; and at point Q where x = 51/2, y = 2/3, $4x + 3y = 24$. Both P and Q lie within the feasible region or feasible area.

15.6.2 Establishing the feasible region

Key term:

A feasible region is the area contained within all of the constraint lines shown on a graphical depiction of a linear programming problem. All feasible combinations of output are contained within or located on the boundaries of the feasible region.

When there are several constraints, the feasible region of combinations of values of x and y must be an area where all the inequalities are satisfied. Thus, if $y \leq 6$ and $4x + 3y \leq 24$ the feasible region would be the shaded area in the following graph.

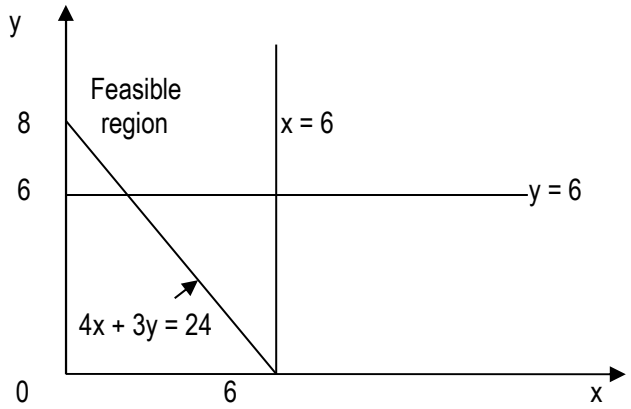


(a) Point R (x = 0.75, y = 7) is not in the feasible region because although it satisfies the inequality $4x + 3y \leq 24$, it does not satisfy $y \leq 6$.

(b) Point T (x = 5, y = 6) is not in the feasible region, because although it satisfies the inequality $y \leq 6$, it does not satisfy $4x + 3y \leq 24$.

(c) Point S (x = 1.5, y = 6) satisfies both inequalities and lies just on the boundary of the feasible region since y = 6 exactly, and 4x + 3y = 24. Point S is thus at the intersection of the two lines.

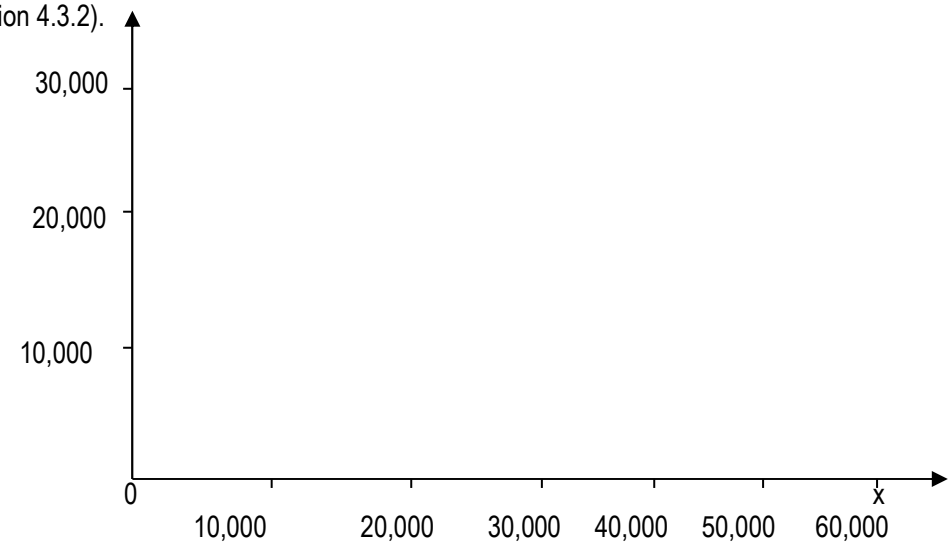
Similarly, if $y \geq 6$ and $4x + 3y \geq 24$ but x is ≤ 6, the feasible region would be the shaded area in the graph below.



Let's return to scenario facing WX Co.

Activity 18.5:

Draw the feasible region which arises from the constraints facing WX on the graph below (the constraints are listed in section 4.3.2).



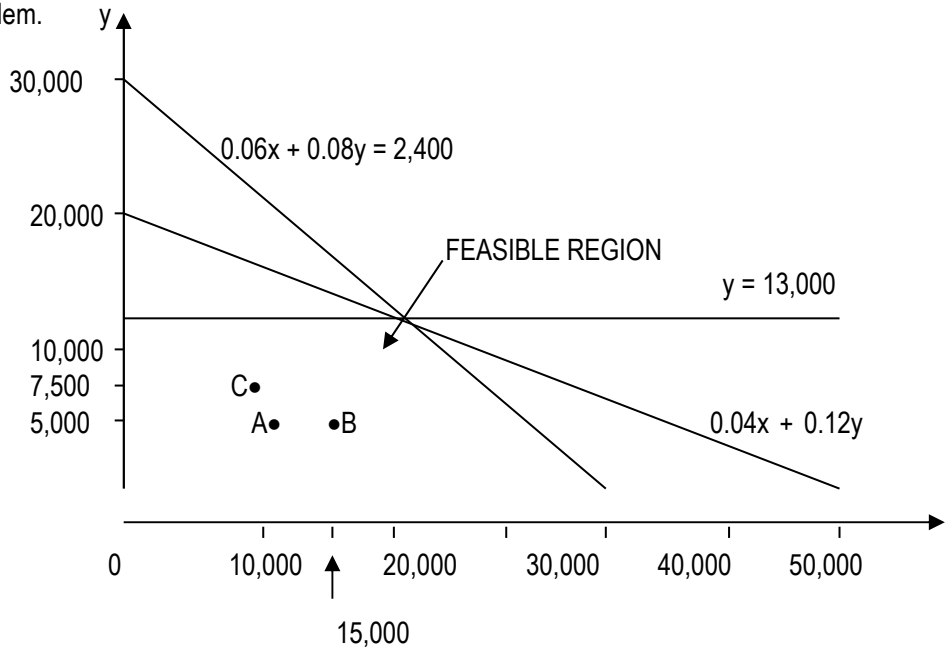
15.7 Step 6 – finding the optimum allocation of resources

The optimum solution can be found by 'sliding the iso-contribution line out'.

Having found the feasible region (which includes all the possible solutions to the problem) we need to find which of these possible solutions is 'best' or optimal in the sense that it yields the maximum possible contribution.

Look at the feasible region of the problem faced by WX (see the answer to the question above). Even in such a simple problem as this, there are a great many possible solution points within the feasible region. Even to write them all down would be a time consuming process and also an unnecessary one, as we shall see.

Here is the graph of WX's problem.



= 2,400

60,000 x

(a) Consider point A at which 10,000 units of product A and 5,000 units of product B are being manufactured. This will yield a contribution of (10,000 x Shs.0.20) + (5,000 x Shs.0.30) = Shs.3,500.

(b) We would clearly get more contribution at point B, where the same number of units of product B are being produced but where the number of units of product A has increased by 5,000.

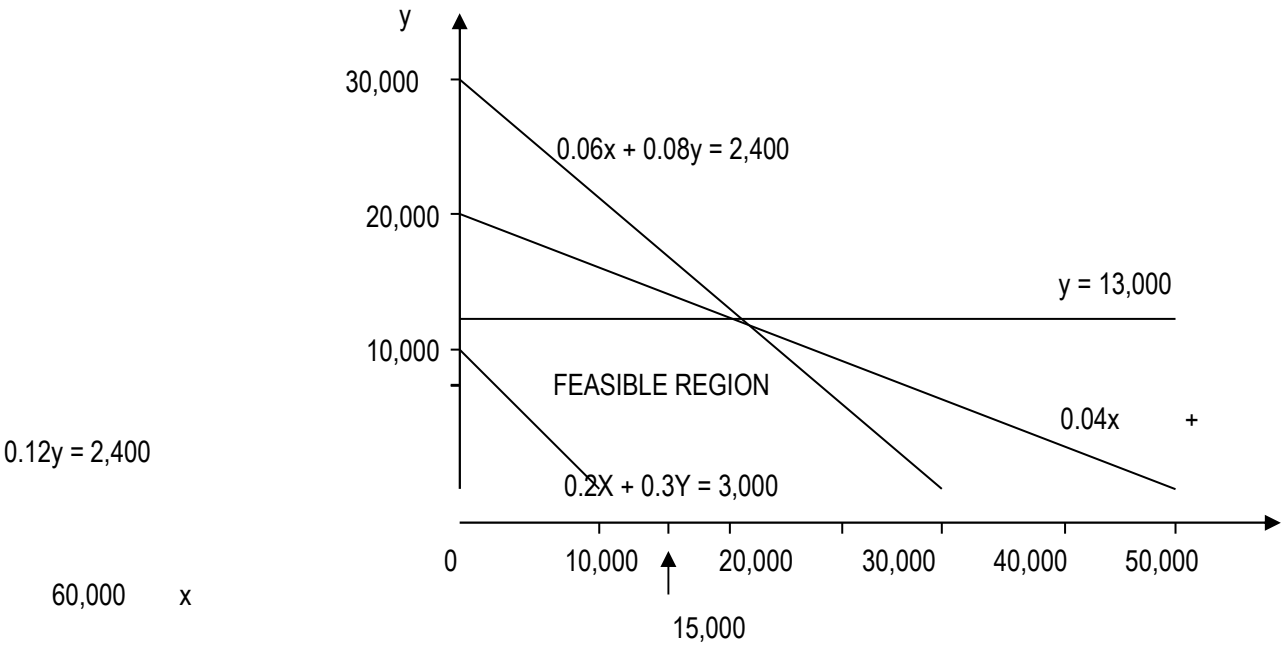
(c) We would also get more contribution at point C where the number of units of product A is the same but 2,500 more units of product B are being produced.

This argument suggests that the 'best' solution is going to be at a point on the edge of the feasible region rather than in the middle of it.

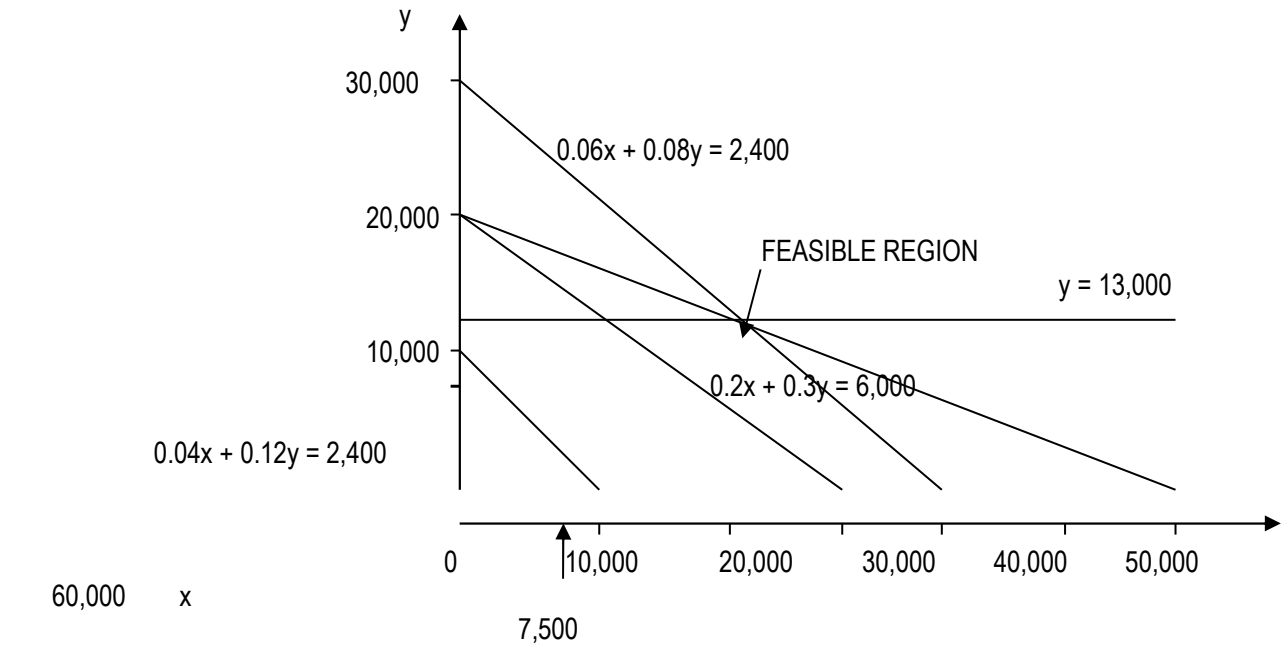
This still leaves us with quite a few points to look at but there is a way in which we can narrow down still further the likely points at which the best solution will be found. Suppose that WX wishes to earn contribution of Shs.3,000. The company could sell the following combinations of the two products.

(a) 15,000 units of A, no B.
(b) No. A, 10,000 units of B.
(c) A suitable mix of the two, such as 7,500 A and 5,000 B.

The possible combinations required to earn contribution of Shs.3,000 could be shown by the straight line 0.2x + 0.3y = 3,000.



Likewise for profits of Shs.6,000 and Shs.1,500, lines of 0.2x + 0.3y = 6,000 and 0.2x + 0.3y = 1,500 could be drawn showing the combination of the two products which would achieve contribution of Shs.6,000 or Shs.1,500.



The contribution lines are all parallel. (They are called iso-contribution lines, 'iso' meaning equal). A similar line drawn for any other total contribution would also be parallel to the three lines shown here. Bigger contribution is shown by lines further from the origin (0.2x + 0.3y = 1,500). As WX tries to increase possible contribution, we need to 'slide' any contribution line outwards from the origin, while always keeping it parallel to the other contribution lines.

As we do this there will come a point at which, if we were to move the contribution line out any further, it would cease to lie in the feasible region. Greater contribution could not be achieved, because of the constraints. In our example concerning WX this will happen, as you should test for yourself, where the contribution line just passes through the intersection of 0.06x + 0.08y = 2,400 and 0.04x + 0.12y = 2,400 (at coordinates (24,000, 12,000)).

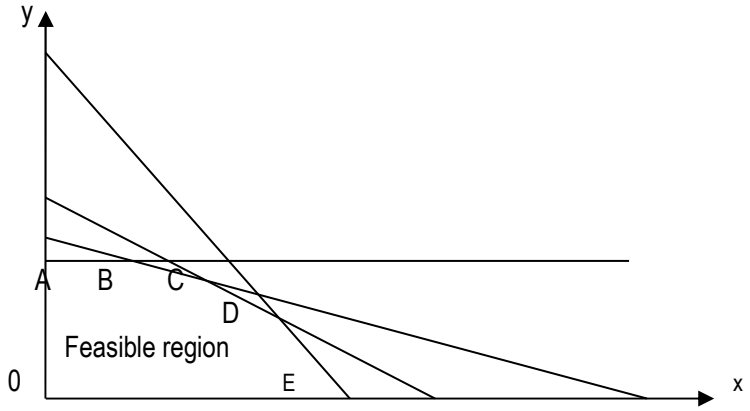
The point (24,000, 12,000) will therefore give us the optimal allocation of resources (to produce 24,000 units of A and 12,000 units of B).

15.8 Using simultaneous equations

The optimal solution can also be found using simultaneous equations.

You might think that a lot of time could be saved if we started by solving the simultaneous equations in a linear programing problem and did not bother to draw the graph.

Certainly, this procedure may give the right answer, but in general, it is not recommended until you have shown graphically which constraints are effective in determining the optimal solution. (In particular, if a question requires 'the graphical method', you must draw a graph). To illustrate this point, consider the following graph.



No figures have been given on the graph but the feasible region is OABCDE. When solving this problem, we would know that the optimum solution would be at one of the corners of the feasible area. We need to work out the profit at each of the corners of the feasible area and pick the one where the profit is greatest.

One the optimum point has been determined graphically, simultaneous equations can be applied to find the exact values of x and y at this point.

Instead of a 'sliding the contribution line out' approach, simultaneous equations can be used to determine the optimal allocation of resources, as shown in the following example.

Activity 18.6: Using simultaneous equations

The six-step process for WX Co is summarized below. Let's focus on step 6 to illustrate how simultaneous equations can be used to establish the contribution-maximising product mix.

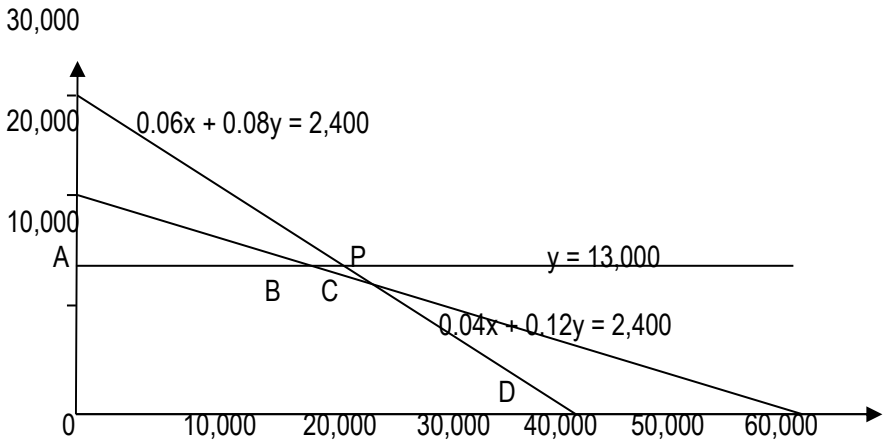
Step 1: Define variables
x = number of units of production A produced
y = number of units of product B produced

Step 2: Establish constraints
The constraints are as follows.

$0.06x + 0.08y \leq 2{,}400$ (mixing department)
$0.04x + 0.12y \leq 2{,}400$ (shaping department)
$y \leq 13{,}000$ (demand for product B)
$x, y \geq 0$ (non-negativity)

Step 3: Construct objective function
Product A yields a contribution of Shs.0.20 per unit Shs.(1.50 – 1.30)
Product B yields a contribution of Shs.0.30 per unit Shs.(2.00 – 1.70)
Therefore the objective is to maximise contribution (C) = 0.2x + 0.3y subject to the constraints

Step 4: Graph problem



Step 5: Establish feasible region
The combinations of x and y that satisfy all three constraints are represented by the area OABCD

Step 6: Determine optimal solution

Which combination will maximise contribution? Obviously, the more units of x and y, the bigger the contribution will be, and the optimal solution will be at point B, C or D. It will not be at A, since at A, y = 13,000 and x = 0, whereas B, y = 13,000 (the same) and x is greater than zero.

Using simultaneous equations to calculate the value of x and y at each of points B, C and D, and then working out total contribution at each point from this, we can establish the contribution-maximising product mix.

Point B

y = 13,000 (1)

0.04x + 0.12y = 2,400 (2)

Substitute (1) into (2): 0.04x + (0.12 x 13,000) = 2,400

0.04x + 1,560 = 2,400

0.04x = 2,400 – 1,560

0.04x = 840

x = 840/0.04

x = 21,000

Total contribution = (21,000 x Shs.0.20) + (13,000 x Shs.0.30) = Shs.8,100

Point C

0.06x + 0.08y	=	2,400 (1)
0.04x + 0.12y	=	2,400 (2)
0.12x + 0.16y	=	4,800 (3) ((1) x 2)
0.12x + 0.36y	=	7,200 (4) ((2) x 3)
0.2y	=	2,400 ((4) – (3))
y	=	12,000 (6)
0.06x + 960	=	(substitute y in (1))
x	=	24,000

Total contribution = (24,000 x Shs.0.20) + (12,000 x Shs.0.3) = Shs.8400

Point D

Total contribution = 40,000 x Shs.0.20 = Shs.8,000

Comparing B, C and D, we can see that contribution is maximised at C, by making 24,000 units of product A and 12,000 units of product B, to earn a contribution of Shs.8,400.

15.9 Slack and surplus

Slack occurs when maximum availability of a resource is not used. Surplus occurs when more than a minimum requirement is used.

Key term

Slack occurs when maximum availability of a resource is not used.

If, at the optimal solution, the resource used equals the resource available there is no spare capacity of a resource and so there is no slack.

If a resource which has a maximum availability is not binding at the optimal solution, there will be slack.

For example, a machine shop makes boxes (B) and tins (T). Contribution per box is Shs.5 and per tin is Shs.7. A box requires 3 hours of machine processing time, 16kg of raw materials and 6 labour hours. A tin requires 10 hours of machine processing time, 4kg of raw materials and 6 labour hours. In a given month, 330 hours of machine processing time are available, 400kg of raw material and 240 labour hours. The manufacturing technology used means that at least 12 tins must be made every month. The constraints are:

$$3B + 10T \leq 330$$
$$16B + 4T \leq 400$$
$$6B + 6T \leq 240$$
$$T \geq 12$$

The optimal solution is found to be to manufacture 10 boxes and 30 tins.

If we substitute these values into the inequalities representing the constraints, we can determine whether the constraints are binding or whether there is slack.

Machine time: (3 x 10) + (10 x 30) = 330 = availability
Constraint is binding

Raw materials: (16 x 10) + (4 x 30) = 280 < 400
There is slack of 120kg of raw materials

Labour: (6 x 10) + (6 x 30) = 240 = availability
Constraint is binding

If a minimum quantity of a resource must be used and, at the optimal solution, more than that quantity is used, there is a surplus on the minimum requirement. This is shown here in the production of tins where the optimum production is 30 tins but $T \geq 12$. There is therefore a surplus of 18 tins over the minimum production requirement.

You can see from this that slack is associated with $\leq$ constraints and surplus with $\geq$ constraints. Machine time and labour are binding constraints so they have been used to their full capacity. It can be argued that if more machine time and labour could be obtained, more boxes and tins could be produced and contribution increased.

15.10 SHADOW PRICES

The shadow price or dual price of a limiting factor is the increase in value which would be created by having one additional unit of the limiting factor at the original cost.

Key term:

The shadow price is the increase in contribution created by the availability of an extra unit of a limited resource at its original cost.

Activity 16.7:

Mukwano industries produces two products P and Q, where P requires 4 hours of labour and Q requires 6 hours of labour. Both products P and Q consume 1kg of materials. Product P requires 4 hours of processing while product Q requires 2 hours of processing. In any given week, only 100 hours of processing, 180 labour hours and 40kgs of materials are available. Product P generates a profit of Shs. 3,000 per unit while Q generates a profit of Shs. 4,000 per unit.
Because of a trade agreement, sales of P are limited to a weekly maximum of 20 units and to honour an agreement with an old established customer at least 10units of Q must be sold per week

Required;

(i) Formulate the objective function for the above company.
(ii) Formulate the constraints to the above function.
(iii) Determine the weekly production that maximizes profits and calculate the profit at this level.
(iv) Determine the degree of utilization for each constraint at the profit maximisation level

Solution

(i) *The objective function*

$$3{,}000P + 4{,}000Q$$

(ii) *Constraints to the objective function*

These will be obtained easily by rearranging the given information in the table as shown below;

PRODUCTS	Labour (hrs)	Materials (Kgs)	Processing (hrs)
P	4	1	4
Q	6	1	2
Available per week	180	40	100

Inequalities;

$Labour\ constraint$: $4P + 6Q \leq 180$
$Raw - materials\ constraint$: $P + Q \leq 40$
$Processing\ constraint$: $4P + 2Q \leq 100$
$P - Production\ constraint$: $P \leq 20$
$Q - sales\ constraint$: $Q \leq 10$

Plotting;- Coordinates

- Labour constraint: $\boldsymbol{4P + 6Q = 180}$

When P = 0, Q = 30 and when Q = 0, P = 45
hence the coordinates to be plotted are **(0,30)** and **(45,0)**

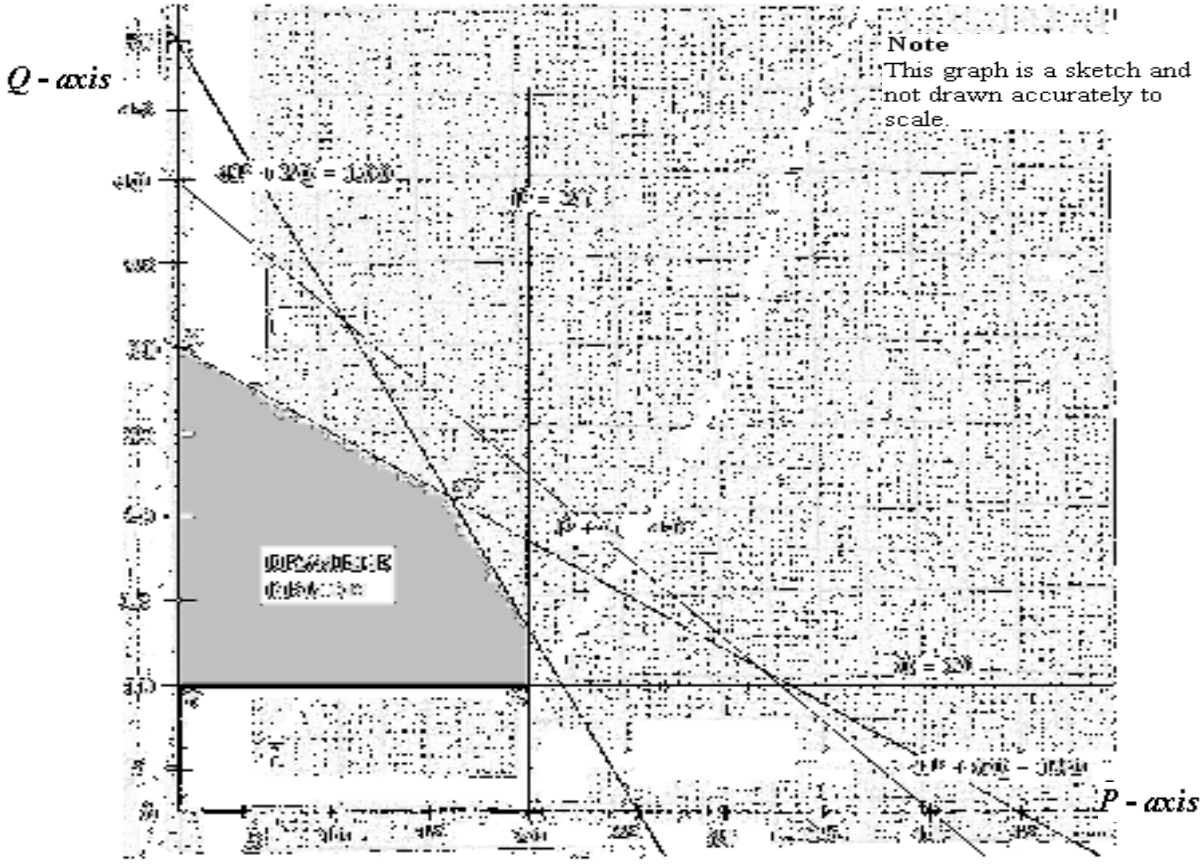
- Materials constraint: $\boldsymbol{P + Q = 40}$

When P = 0, Q = 40 and when Q = 0, P = 40
hence the coordinates to be plotted are **(0,40)** and **(40,0)**

- Processing constraint: $\boldsymbol{4P + 2Q = 100}$

When P = 0, Q = 50 and when Q = 0, P = 25
hence the coordinates to be plotted are **(0,50)** and **(25,0)**

- P - Production constrain is the line $\boldsymbol{P = 20}$
- Q- sales constrain is the line $\boldsymbol{Q = 10}$



(iii) *Weekly production that maximises profit*

Vertex points include; X(0,30), Y(0,10), Z(20,10) and W(15,20)
We substitute these in the objective function to establish the pair that gives the greatest profit margin (profit maximizing basket); i.e;

Point X: 3,000(0) + 4,000(30) = Shs. 120,000
Point Y: 3,000(0) + 4,000(10) = Shs. 40,000
Point Z: 3,000(20) + 4,000(10) = Shs. 100,000
Point W: 3,000(15) + 4,000(20) = Shs. 125,000*** *Profit maximizing pair*

Therefore the production that maximises profit will comprise of 15 units of P and 20 units of Q.

Profit maximised = **Shs. 125,000/=**

(iv) *Utilization levels for each constraint*

Here, we shall insert the values P = 15 units and Q = 20 units in each of the equation of constraints. i.e;

$Labour\ constraint\colon\quad 4(15) + 6(20) = 180\ \ Full\ utilisation, no\ spare$

$Raw - materials\ constraint\colon\quad 15 + 20 = 35\ \ Utilisation\ 5kgs\ below\ maximum$

$Processing\ constraint\colon\quad 4(15) + 2(20) = 100\ Full\ utilisation, no\ spare$

$P - Production\ constraint$: $P = 15, production\ 5\ units\ below\ maximum$

$Q - sales\ constraint$: $Q = 10$, $sales\ 10\ units\ above\ maximum$

24.8: Shadow and dual prices

Equations without spare capacity are known as "binding equations" and represent constraints that are at full capacity whereby shortage of such resource will halt further production.

Dual prices arise from the amount of increase (or decrease) in contribution (or profit) that would arise if one or more (or less) of a unit of a scare resource was availed.

The shadow price of binding constraint provides valuable guidance because it indicates to management the extra contribution they would gain from increasing by one unit the amount of the scarce resource.

Note:-
Only resources at full capacity utilization are used to compute dual prices.

Activity 16.8:

Rework Activity 16.7 and determine;

(i) *Shadow price per processing hour*
(ii) *Shadow price per labour hour*
(iii) *Amount of overtime pay for a person working an extra 20 hours assuming the current labour cost is Shs. 8,000 per hour*

Solution

In activity 16.7, labour and processing hours are at full capacity; these therefore form the binding constraints for this particular example.
We shall hence follow to compute the shadow / dual prices as follows;

(i) *Shadow price per Processing hour*

We assume 1 more processing hour is available (leaving the labour hours constant at 180), then compute the resulting difference in contribution; i.e;

Processing hours: 4P + 2Q = 101 (i.e. Original 100 + 1) ……..(i)
Labour hours: 4P + 6Q = 180 (Unchanged) ……..(ii)

By solving equations (i) and (ii) Simultaneously new values of P and Q are obtained.

Hence **P= 15.375** and **Q = 19.75**

By substituting in the objective function we obtain;

3(15.375) + 4(19.75) = Shs. 125,125
Original contribution = Shs. 125,000
Difference **Shs. 125/=**

Thus 1 extra machine hour has resulted in a extra increase in contribution of Shs. 125/- which is the shadow price per processing hour.

(ii) Shadow price per Labour hour

We assume 1 more labour hour is available (leaving the processing hours constant at 100), then compute the resulting difference in contribution; i.e;

Processing hours: 4P + 2Q = 100
Labour hours: 4P + 6Q = 181

where **P= 14.875** and **Q = 20.25**

By substituting in the objective function we obtain;

3(14.875) + 4(20.625) = Shs. 125,625
Original contribution = Shs. 125,000
Difference **Shs. 625/=**

Therefore shadow price per labour hour = **Shs. 625/-.**

The above implies that management would be prepared to pay up to Shs. 625/- per hour in order to gain more labour hours.

(iii) Overtime pay = (8,000 + 625) × 20 hours

= Shs. 8,625 × 20 hours

= **Shs. 172,500/=**

15.11 THE SIMPLEX METHOD

15.11.1 Introduction

The simplex method is another linear programming mathematical technique that is used to maximize or minimize a quantity by choosing appropriate values for variables involved.

The simplex method unlike the graphical method can be used to solve both equations having only two variables and those with three or more variables.

The main feature that charaterises the simplex method is the procedure converting inequalities (less-than or equal-to) into equality equations which involves the introduction of "*Slack Variables*" in each of the inequality equation.
The slack variable in this case represents the spare capacity or what we may call the unused units.

15.11.2 Standard Maximisation Problem

As noted before, a standard maximization problem is a linear programming problem for which the objective function is to be maximized and all the constraints are "less-than or equal-to" inequalities.

A typical example of a standard maximisation problem is *profit maximisation*.

Main steps followed in the simplex method-Standard maximisation

Step 1:- The first step of the simplex method requires that you express the linear programming into a standardized format.

Step 2:- The second step requires that each inequality (in constraints) be converted into an equation by adding a *slack variable*.

Step 3:- At this stage, formulate an *augmented matrix* of the system of linear equations and use it to set up the *initial tableau*.

Step 4- Select the *pivot column* in the initial tableau. This is the column with the "*highest contribution*" in the objective function row.
Divide the positive numbers in the pivot column with the corresponding elements in the solution quantity column.
Step 5- Select the *pivot row*. This is the row with the *smallest non-negative* quotient resulting from step 4 above.
Identify the *pivot number* which is the number that appears in *both* the pivot column and the pivot row.

Step 6:- Calculate the new values for the pivot row by dividing every number in the row by the pivot number.

Step 7:- Replace the slack variable in the pivot row with the basic variable ***x*** in the pivot column. Use row operations to make all numbers in the pivot column equal to 0 except for the pivot number which remains as **1**.

Example

Footsteps Furniture Company produces chairs and tables. Each table takes four hours of labour from the carpentry department and two hours of labour from the finishing department.
Each chair requires three hours of carpentry and one hour of finishing. During the current week, 240 hours of carpentry time are available and 100 hours of finishing time. Each table produced gives a profit of Shs. 70 and each chair a profit of Shs. 50.

Required;
Determine the number of chairs and tables to be produced in a week in order to maximize profits

Solution:
We first choose the variables to use;
Let ***x*** represent tables and ***y*** chairs that are produced in the week.
The information is then summarized as follows;

	Tables	Chairs	Constraints	
Number produced per week	x	y	Cannot be negative	$x \geq 0$, $y \geq 0$
carpentry	4 h/table	3 h/chair	Maximum of 240 hours for the week	$4x+3y \leq 240$
finishing	2 h/table	1 h/chair	Maximum of 100 hours for the week	$2x+y \leq 100$

The total profit for the week is given by the objective function as P = 70x + 50y.

Step 1:- Rearranging the system of inequalities;

Carpentry hrs constraint: $4x + 3y \leq 240$
Finishing hrs constraint: $2x + y \leq 100$
Objective function: $70x + 5y = P$

Step 2:- Convert inequalities to equations by adding slack variables i.e;
$4x + 3y + 1a + 0b = 240$
$2x + y + 0a + 1b = 100$

As unused hours result in no profit, the slack variables can be included in the objective function with zero coefficients.
$P = 70x + 5y + 0a + 0b$

The problem can now be considered as solving a system of 3 linear equations involving the 5 variables x, y, a, b and P where a and b are slack variables with variable P having the maximum value.

Step 3:- The system of equations can be written in matrix form or a 3 x 5 *augmented* matrix i.e;

$$\begin{pmatrix} 4 & 3 & 1 & 0 & 0 \\ 2 & 1 & 0 & 1 & 0 \\ 70 & 50 & 0 & 0 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \\ a \\ b \end{pmatrix} = \begin{pmatrix} 240 \\ 100 \\ 0 \end{pmatrix} \; or \; \left[\begin{array}{ccccc|c} 4 & 3 & 1 & 0 & 0 & 240 \\ 2 & 1 & 0 & 1 & 0 & 100 \\ 70 & 50 & 0 & 0 & 1 & 0 \end{array}\right]$$

In simplex method, the *augmented* matrix is referred to as the "*tableau*".

The initial tableau is;

Solution Variables	x	y	A	b	Solution Quantity	
a	4	3	1	0	240	240÷4 = 60
b	2	1	0	1	100	100÷2 = 50
	70	50	0	0	0	

Step 4:- Column 1 forms the pivot column at this stage since it contains 70 which is the highest contribution in the objective function row.

Step 5:- The pivot row is row 2 since 50 is the smallest non-negative result when elements in the solution quantity are divided by the corresponding elements in the pivot column.

Step 6:- Calculate the new values for the pivot row by dividing every number in the row with the corresponding elements in the pivot column i.e; $R_2 / 2$.

Solution Variables	x	y	A	b	Solution Quantity
a	4	3	1	0	240
b	1	$\frac{1}{2}$	0	$\frac{1}{2}$	50
	70	50	0	0	0

Step 7:- Replace the slack variable **b** (in the pivot row) with the basic variable ***x*** in the pivot column. Use row operations to make all numbers in the pivot column 0 except for the pivot number which remains as 1. i.e; $(R_1 - 4R_2)$ and $R_3 - 70R_2$.

Solution Variables	x	y	A	b	Solution Quantity
a	0	1	1	-2	40
x	1	$\frac{1}{2}$	0	$\frac{1}{2}$	50
	0	15	0	-35	-3,500

Now repeat the steps until there are no positive contributions in the objective function row.

Additional Steps;

- Set up a new tableau by selecting the next pivot column. Y should replace slack variable **a** in the solution variable column. All other steps are followed. Hence we have the next initial tableau as;

Solution Variables	x	y	A	b	Solution quantity	
a	0	1	1	-2	40	40÷1 = 40
x	1	$\frac{1}{2}$	0	$\frac{1}{2}$	50	50÷½ = 100
	0	15	0	-35	-3,500	

- Calculate new values for the pivot row. As the pivot number is already 1, there is no need to calculate new values for the pivot row.

- Use row operations to make all numbers in the pivot column equal to 0 except for the pivot number. i.e. $R_2 - \frac{1}{2}R_1$ and $R_3 - 15R_1$

Solution Variables	x	y	A	b	Solution quantity
y	0	1	1	-2	40
x	1	0	$-\frac{1}{2}$	$\frac{3}{2}$	30
Row 3	0	0	-15	-5	-4,100

Since there are no positive contributions in the objective function column, the optimum solution has been reached.

Therefore, maximum profit of Shs. 4,100 occurs when 30 tables and 40 chairs are made. There are no unused hours.

The values of Row 3 for the slack variables are of great importance. These are the valuations of resources and are known as *shadow prices*.

a* = *-15 means that for every extra carpentry labour hour available, Shs. 15 extra overall contribution would be gained.
b* = *-5 means that for every extra finishing labour hour availed, the overall contribution would increase by Shs. 5.

REVISION QUESTIONS

QUESTION 18.1 BAHINGA POULTRY FARM (BPF)

Bihanga Poultry Farm (BPF) is a leading farm in poultry farming located in Bushenyi district. BPF specialized in rearing broilers and layers of Netherlands origin. BPF director is a retired accountant and has always strived to utilize resources optimally for profit maximization. On monthly basis, BPF sells an average of 10,000 broilers at Shs 8,000 each and 30,000 trays of eggs at Shs 6,500 each.

The supplier of maize bran charges Shs 500 per kg but can only deliver 210,000 kg in a month. Each broiler requires 9 kg of maize bran while producing one tray of eggs requires 5.5 kg.

Within 1 month; BPF uses 30,000 labour hours at Shs 1,000 per hour, each broiler requires 0.6 hours of labour, while producing one tray of eggs requires 0.75 labour hours.

During the month, the supplier of 'other ingredients' charges Shs 800 per kg but can only deliver 105,000 kg, each broiler requires 1.75 kg of 'other ingredients' while producing one tray of eggs requires 2.75 kg.

Required:

(a) Calculate the monthly contribution per broiler and tray of eggs (3 marks)
(b) Formulate a linear programming model that maximises monthly contribution for BPF. (5 marks)
(c) Using Simplex method, determine the maximum monthly contribution for BPF and interpret your result. (8 marks)
(d) Using sensitivity analysis, determine the range over which opportunity costs apply to maize bran constraint. (4 marks)

(Total 20 marks)

QUESTION 18.2 BRIGHT LIMBA

Bright Limba is a retired civil servant that has three wholesale business centre in the municipalities of Kabale (K), Gulu (G) and Fort Portal (F). He trades in maize grain, irish potatoes and groundnuts which are supplied to various customers. The following linear programming (LP) model was developed using his business data to establish the optimal number of customers per business center.

Maximize profits (Z) 15K + 20G + 14F (in million shillings)

Subject to the constraints:
Maize grain 5K + 6G + 4F ≤ 210 (in thousand sacks)
Irish potatoes 10K + 8G + 5F ≤ 200 (in thousand sacks)
G-nuts 4K + 2G + 5F ≤ 170 (in thousand sacks)
Non-negativity K, G, F ≥ 0

The following final simplex tableau was derived from the above LP model:

Where,

- S_1, S_2, and S_3 are slack variables to the constraints of maize grain, Irish potatoes and g-nuts respectively.
- K, G, and F are number of customers in the municipalities of Kabale, Gulu and Fort Portal respectively.

Required:

(a) Interpret the final tableau above. *(8 marks)*

(b) Advise Bright Limba, the effect of an additional sack of groundnuts on business profitability. *(4 marks)*

(c) Discuss uses of linear programming to business enterprises. *(8 marks)*

(Total 20 marks)

QUESTION 18.3 LANA RETIREMENT BENEFIT SCHEME (LRBS)

PART N
COST MANAGEMENT AND STRATEGIC MANAGEMENT ACCOUNTING

16.0
COST MANAGEMENT AND STRATEGIC MANAGEMENT ACCOUNTING

UNIT 17 OVERVIEW

- Activity based costing systems (ABC)
- Life cycle accounting
- Activity based management (ABM)
- Target costing
- Just-in-time systems (JIT)
- Strategic Management accounting system
- Value added system
- Customer profitability analysis
- Thorough put accounting
- Total quality management and accounts
- Back flash Accounting

New management accounting approaches have been adopted and these include;

1. Activity based costing systems (ABC)
2. Life cycle accounting
3. Activity based management (ABM)
4. Target costing
5. Just-in-time systems (JIT)
6. Strategic Management accounting system
7. Value added system
8. Customer profitability analysis
9. Thorough put accounting
10. Total quality management and accounts
11. Back flash Accounting

17.1 ACTIVITY BASED MANAGEMENT (ABM)

This is a discipline that focuses on the effective and efficient management of activities as the route to continuously improving value received by customer and firm profit. ABM utilizes information gathered through Activity based costing ABC and hence, uses it to describe management operations.

ABM focuses in managing activities rather than resources. It determines what drives the activity of the organization and how these activities can be improved to increase profitability. ABM follows similar stages used in ABC except that the last one (4th) is not considered.

It eliminates the tendency of management to manage work force instead of managing workload. Many companies tried to solve overhead cost problems by focusing on a number of employees, and on cutting head count (retrenchment) to reduce costs. These actions have never proved effective in the long run. ABM instead resorts at management of workload or activities that consume resources and cause costs (i.e. relate employee to activities).

ABM puts much attention on activities that influence results instead of concentrating in evaluating and monitoring the results of the firm. Examples of value added activities include activities that cover the production process, production of orders, vetting of suppliers, pricing, improving quality of the product etc.

Non-value added activities are those that do not add value to product in the eyes of its customers. Such activities should completely be completely eliminated by ABM. Examples include support activities, wait activities, inspection activities, more activities etc. ABM tries to address the problem by continuously reducing non-value added activities through the process of value analysis.

Benefits: ABC & ABM

- Improve the effectiveness and efficiency of the internal processes in the organization
- Elimination of non-value added activities
- Improving specific operations by managing activities that cause measured costs
- Increasing the value the customer received from consuming goods or services
- Increasing and sustaining organizational profitability

17.2 JUST IN TIME SYSTEMS

a) J.I.T. manufacturing

Just in time manufacturing has been defined as a 'work flow' organization technique to allow rapid, high quality, flexible production while minimizing stock levels and waste (Kaplan & Newton 1998). It is basically concerned with reducing production costs and production delays. In practice this means producing components only when they are needed and in quantity that is needed.

- The main aim of JIT manufacturing system is to produce the required items at the precise time they are needed
- The second aim is to eliminate waste in the production process.
  Waste is defined here as any activity performed within a manufacturing company that does not add value to the product e.g. Raw materials handling, unnecessary clerical and accounts procedures, inspection of raw materials/product, queue and delays in the shop floor.

JIT manufacturing attempts to eliminate the above at every stage of the manufacturing process by;

- Elimination of raw materials by suppliers delivering direct to the shop-floor just in time
- Elimination of scrap and re-work by putting much emphasis on total quality controls of design of the process and the materials
- Elimination of finished goods inventories by reducing lead times, so that all products are made to order

- Elimination of material handling costs by re-designing of shop floor so that goods move direct between adjacent work stations

Other aims of JIT include;

- Zero inventory
- Short set-ups
- Lead time reduction
- Zero defects-(materials)
- 100% on time deliveries

JIT production is based on 'Pull' manufacturing system as opposed to 'Push' manufacturing environment
The pull manufacturing system is where parts/components move through the production system based on end unit demand and focus is on maintaining a constant flow of components rather than batches of work in progress (WIP). Wit pull manufacturing systems, work does not commence until specifically requested by next process.

In the push manufacturing system, machines are grouped into work stations/centers based on the similarity of their functional capabilities. Each manufactured product has a design routing and the proceeding process supplies parts to the subsequent process without any consideration being given to whether the next process is ready to work on the parts or not. The system does not consider whether there is demand at the end of the process. Push manufacturing systems are synonymous with Just In Case (JIC) systems where goods are produced to be stored.

b) JIT purchasing

This is where materials are immediately requisitioned from the supplier when needed. The purpose of JIT purchasing is to buy goods/raw materials so that delivery immediately precedes their use. The aim here is to reduce stock levels to a minimum. The reliability of supplies is very important and therefore, the company must build up close working relationships with their suppliers. This is usually achieved by doing business with fewer suppliers and placing long term purchasing orders so that suppliers have assured sales and can plan to meet the demand. By dealing with reduced number of suppliers it enables a firm to reduce purchasing costs. The general benefits of JIT are;

- Substantial savings in space
- Large quantity discounts
- Reduced ordering costs because of the granted blanket long-term orders
- Greater customer satisfaction results from higher quality deliveries and greater product variety

17.3 TARGET COSTING

This is a method of determining the appropriate cost of product that first ascertains the selling price of a product. Target costing systems requires the company first to establish what customers can afford to pay for the product it intends to produce.
The company then works backwards to determine the cost of the product. It is a market based cost that is calculated using sales price necessary to capture a pre-determined market share.

It can also be defined as a product cost estimate derived from competitive market price used to reduce cost through continuous improvement and replacement of technologies and processes. The aim of target costing is not to find what a new product does cost but what it should cost, it aims at establishing how much a company can spend to manufacture or purchase a product in order to achieve an acceptable profit level based on the following formula;

Market price-profit=target cost
Market research establishes the performance requirements and target-selling price required to gain the desired market. The essential idea is that where a price of a product is determined by a market place, costs have to be reduced to enable the product to be sold at that price. The cost reduction approach known as value analysis is used to help the business achieve the target costs.

17.4 BACKFLUSH ACCOUNTING

It is defined as cost accounting system which focuses on the output of an organization and then works backwards to assign costs to stock and cost to sales. This is a simpler cost accounting system designed to reduce or eliminate detailed accounting entries applied in traditional costing system.

Instead of detailed tracking of material movement through stores and production, a back flush system focuses on the output (i.e. finished goods) and then works backwards to attribute costs between costs of goods sold and finished goods inventory with no separate account for work in progress (WIP). The system records the transaction at termination of the production and sales cycle. Traditional costing systems use sequential tracking i.e. costing methods are synchronized with physical sequences of purchases and production.
Back flush eliminates WIP account. Other reasons for justification are as follows.

- To remove incentive for managers to produce for inventory
- To increase the focus of managers on plant-wide goal rather than on individual sub unit cost goals

Difficulties of back flush costing include;

- It does not strictly adhere to generally accepted principles of external reporting
- Absence of audit trials leads to critics
- It does not pinpoint the use of resources at each step of the production process
- It is suitable for only JIT production system with virtually no direct material inventory and minimum WIP inventories. It is less feasible otherwise.

In conclusion, back flush aims at streamlining and simplifying costs accounting and focuses on the output and then attributes costs to inventories and cost of sales.
CASE: By adopting back-flush accounting Packard Ltd reduced the number of cost accounting entries from 100,000 per period to fewer than 10,000 (Kenny 2000)

17.5 STRATEGIC MANAGEMENT ACCOUNTING

This was developed to address the weakness of convectional management accounting because of being historical, inward looking, focused on financial data, not responsive to market changes and failure to monitor the company's performance in the market place.
According to Kaplan et al. (1998), strategic management accounting is "the provision and analysis of financial information on the firms product markets, competitors' costs and cost structures, and monitoring of the enterprises strategies besides those of its competitors in the market over a number of periods
This simply means that, strategic management accounting;

- Determines the product characteristic and cost
- Determines and monitors the firm's strategies and cost structure
- Determines and monitors competitor strategies and cost structure and;
- Responds strategically to achieve specific goals

By monitoring movements in market share, an organization can gauge whether it is gaining or losing position in the market place.

Strategic management accounting further focuses on providing information on the market prospects of existing products, their position in the product life cycle and the portfolio of products. Strategic management accounting therefor involves;

- Use of external information relevant to the firms' products markets.
- Use of external information on competitors' strategies, cost structures and internal business processes
- Evaluating reporting and monitoring the firm's strategies, internal business process and performance in the market place
- Reporting on key success factors –costs, quality, time reduction and continuous improvement and innovation
- Production of more accurate, relevant and reliable information which is generated internally and externally to aid in effective implementation of chosen strategies.

17.6 TOTAL QUALITY MANAGEMENT

It is a technique in which management develops policies and practices to ensure that the firm's products and services exceed customers' expectations. The approach includes increased product functionality, reliability, durability and serviceability.
Only those companies that are able to develop new products quickly, and supply them at a consistently high level of quality and on time, will command position of leadership in the market (Kaplan & Norton 1999).

TQM, therefore, have been adopted by many firms and is used as a term to describe a situation where all business functions are involved in a process of continuous quality improvement. Quality concerns affect management accounting practices in different ways

First, the implementation of total quality management untimely must influence all aspects company's functional activities including the accounting process. For instance, for an accounting dept, excellence in performance may be measured on the basis of the number of times reports are generated and delivered on schedule.
Secondly, management accounting practices may be affected by quality concerns in the situation where quality priorities are tied to enhancing the products and services, which a company is in business of providing to customers. In such a case, quality control criteria are at times established through specific measures such as proportions of deliveries made on time, the number of standard products, the amount of re-works and, the number of gravity customer complaints. However, successful monitoring of quality depends on the availability and ability to capture the necessary data and more importantly on recognizing and establishing relevant monitoring information.

More innovative quality monitoring strategies that are organizationally defined are thought to be desirable. For instance, one measure of achieving quality improvement is the reduction of quality inspection. This means that an organization must strike the right mis between installing information systems for reporting on various dimensions of quality and relying on individual workers to monitor quality without requiring an extra system.

Quality costs
In order to maintain high levels of quality, some costs must be incurred and these can be classified under;

Prevention costs: These are expenditures that are incurred to ensure that unsatisfactory products are not produced. This is done by preventing the use or production of defective and non-conforming parts.
Prevention costs cover costs invested in machinery, technology and educational programs designed to reduce the number of defective products during production. Examples may include but not limited to customer survey costs, field trials, quality education and training costs, and investments in improved production equipment.

Appraisal cost: these are costs incurred to ensure that materials and products meet quality conformance standards. These include costs of monitoring and inspecting products in terms of specified standard before the products are released to customers. Examples include;

- Inspection and tests costs
- Product quality audit costs
- Test equipment expense
- Process control monitoring etc.

Failure costs: these are costs that are required to evaluate, dispose off, and either correct or replace defective products. There are two categories;

- Internal failure costs-costs associated with materials and products that fail to meet quality standards. These are discovered before the product is delivered to a customer e.g. re-work costs, net cost of scrap, and disposal of defective products.
- External failure costs- costs incurred when inferior products are delivered to customers. These include;
    - Complaint investigation and handling cost
    - Warranty claims
    - Cost of lost sales
    - Product recalls
    - Costs arising from a damaged company reputation.

17.7 LIFE CYCLE ACCOUNTING

It is the management technique used to identify and monitor the costs of a product throughout its life cycle. The life cycle consists of all steps from product design and purchase of raw materials to delivery, and service of the finished product.
The steps include research and development, product design, manufacturing, marketing and sales and service. Traditional focus has been centered on the third step of manufacturing. But now management accountants manage the full cycle of costs for the product. This is really the expanded focus of costing.