Faculty of Commerce,
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Strategic Management Accounting (**BSA 3210**)

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TOPIC TWO: COST BEHAVIOR AND PROFIT ANALYSIS

MUBS: To enable the future of our clients through creation and provision of knowledge

TOPIC 2: Cost behavior and profit analysis

Subtopic	Learning Outcomes
• Cost Behavior	Explains how costs behave in response to changes in business activity levels.
• Cost Structure	Identifies the components of cost structure and their implications for decision-making.
• Evaluating Sources of Cost Structures	Analyzed different cost structures and assess their impact on financial performance.
• Estimating Cost Behavior (Scatter graph, Least Squares, Regression Analysis)	Applies various methods to estimate cost behavior and make accurate cost predictions.
• Learning Curve	Explain the concept of the learning curve and how it affects cost efficiency over time.
• Confidence Intervals	Construct and interpret confidence intervals in cost estimation and financial analysis.
• Test Reliability	Assess the reliability of cost estimation models using statistical tools.
• Cost Control & Cost Reduction	Develop strategies for effective cost control and cost reduction to enhance profitability.

Basic Cost Terminology

1. **Cost** : A **cost** is the monetary value of resources used to produce goods or services. It is a sacrificed resource to achieve a specific objective, a firm incurs a cost when it uses a resource for some purpose.

- **For Example**, A phone appliance manufacturing company incurs costs for **materials** (e.g., sheet metal, bolts, LCD screens), **labor** (e.g., assembly workers, technicians), and **other expenses** (e.g., factory rent, machine maintenance, marketing, and distribution).

2. Actual Cost : A Cost That Has Occurred

3. Budgeted Cost :A Predicted Cost

4. Cost Object: Cost object is any product, service, customer, activity, or organizational unit to which costs are assigned.

Key Words

- **Cost behavior** refers to how a cost changes in relation to changes in the activity level of a business, such as whether a cost is fixed (stays the same regardless of activity) or variable (fluctuates with activity)
- **Cost structure** describes the mix of fixed and variable costs a company has.
- **Cost estimation techniques** are methods used to predict future costs based on historical data and activity levels, including the high-low method, scattergraph method, and regression analysis.

Behavioural analysis: Volume-based Cost Classification

- **Based on the behavioral patterns**, Costs can be classified into the following categories:

(i) Fixed Costs

(ii) Variable Costs

(iii) Semi-variable Costs

Fixed Costs:

- Fixed costs are those which remain fixed in total amount with increases or decreases in volume of output or productive activity for a particular period of time, e.g. managerial remuneration, rent of building, insurance of building, plant etc.
- Fixed costs remain the same from one period to another except when they are deliberately changed, e.g. increments granted to staff. The incidence of fixed overhead on unit cost decreases as production increases and vice versa.
- Fixed costs are stated to be uncontrollable in the sense that they are not influenced by managerial action.
- However, it should be noted that an expenditure is fixed within a specified limit relating to time or activity.
- In a hypothetical organization, no expenditure remains unchanged for all time. Therefore, it is true to state that “fixed cost is fixed within specified limits relating to time and activity.

Key Assumptions of Fixed Costs

- **Fixed in Total** – Fixed costs remain constant in total amount over a specific period, regardless of production volume.
- **Varies Per Unit** – The per-unit fixed cost decreases as production increases and vice versa.
- **Time-Bound Stability** – Fixed costs remain unchanged for a defined time period but may change due to external factors like inflation or strategic decisions.
- **Not Directly Controllable** – Fixed costs are generally not influenced by short-term managerial actions.
- **Essential for Capacity Maintenance** – Fixed costs are necessary to maintain the operational capacity of the business, such as rent, salaries, and insurance.
- **Stepwise Changes Possible** – Fixed costs may change in steps when production reaches a new threshold, requiring additional capacity or resources.

Variable Costs:

- Variable costs are those costs which vary in total in direct proportion to the volume of output.
- Direct materials is a true or proportionately VC because the total cost of direct material used during a period will vary in direct proportion to the level of production activity.
- For instance, if the output increases by 5%, the variable expenses also increase by 5%.
- Correspondingly, on a decline of the output it will also decline proportionately.
- Examples are indirect material and indirect labour. Variable costs changes in total but its incidence on unit cost remains constant.

Key Assumptions of Variable Costs

- **Directly Proportional to Output** – Variable costs change in direct proportion to production or sales volume.
- **Constant Per Unit** – The cost per unit of a variable cost remains constant regardless of production levels.
- **Short-Term Controllability** – Managers can influence variable costs in the short term by adjusting production levels.
- **No Fixed Commitment** – Unlike fixed costs, variable costs do not incur if there is no production activity.
- **Linear Behavior Assumption** – It is assumed that variable costs increase or decrease in a straight-line manner with production, although in reality, they may exhibit economies of scale or bulk discount effects.
- Examples Include – Direct materials, direct labor, sales commissions, and utility costs directly tied to production.

Examples of Variable Costs

1. **Merchandising companies** – cost of goods sold.
2. **Manufacturing companies** – direct materials, direct labor and variable overhead direct labor, and variable overhead.
3. **Merchandising and manufacturing companies** – commissions, shipping costs, and clerical costs, such as invoicing.
4. **Service companies** – supplies, travel, and clerical.

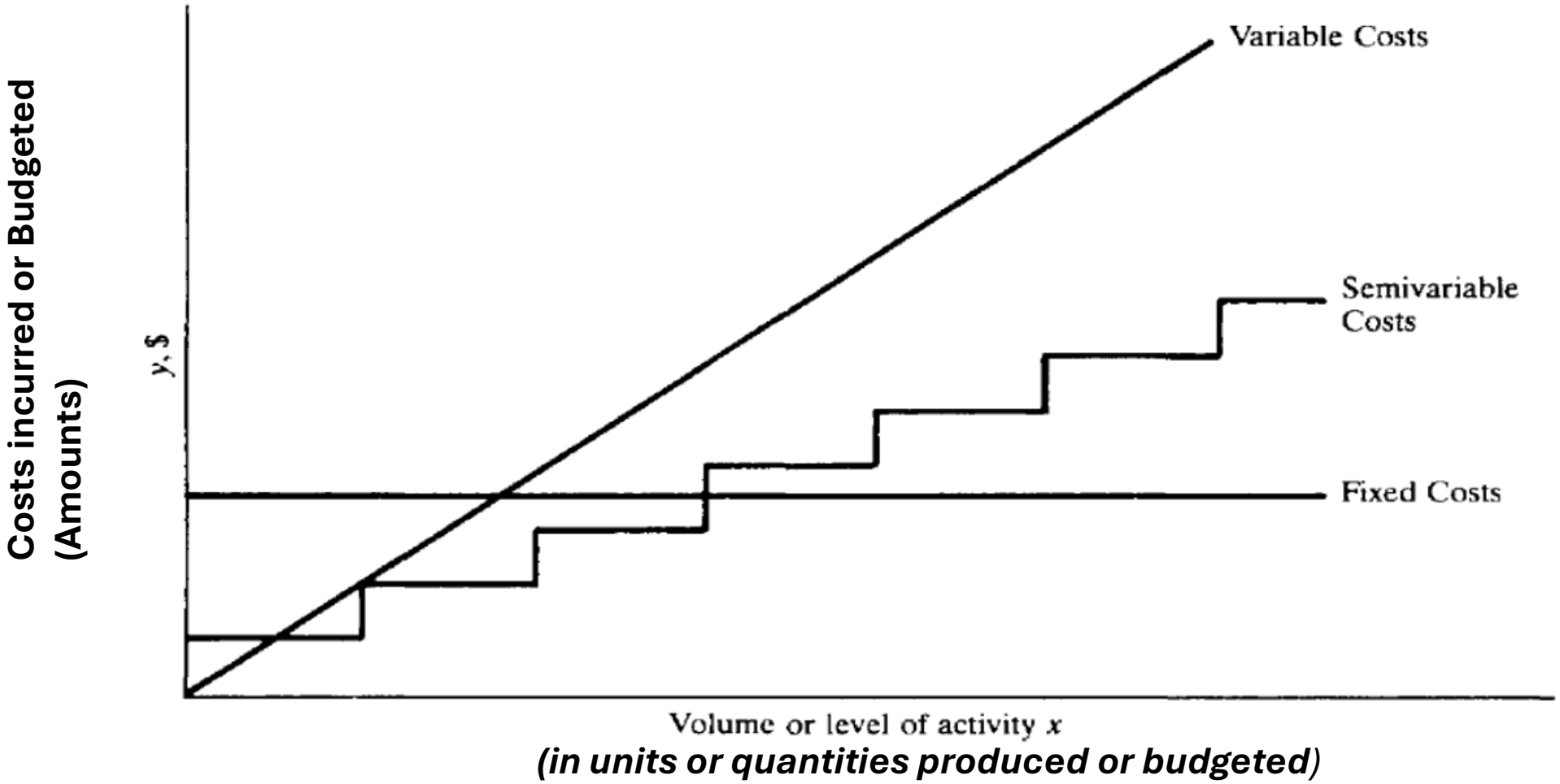
Mixed Costs / Semi-variable Costs/ Step Costs

- They contain a fixed and a variable cost element. They are partly fixed and partly variable
- They remain same up to a certain level of output and after crossing that level, they start increasing.
- Total mixed costs are positive (like fixed costs) when activity is zero, and they increase linearly (like total variable costs) as activity increases.
- Examples are depreciation, telephone charges, repair and maintenance of buildings, machines and equipment etc.
- For example, supervisor's salary is treated as fixed but if a decision is taken to operate a second shift, additional supervisor may have to be appointed which results into increase in the salary of the supervisor. This indicates that it is a semi-variable overheads. Similarly, maintenance expenditure, for reinsurance are also semi-variable overheads.
- The cost of electric power is an example of a mixed cost.
- Some electricity is required to provide basic lighting, while an increasing amount of electricity is required to production served increases.

Key Assumptions of Mixed (Semi-Variable) Costs

- **Combination of Fixed and Variable Components** – Mixed costs include both a fixed portion (which does not change with activity) and a variable portion (which changes with activity levels).
- **Fixed Cost Component Exists Even at Zero Activity** – The fixed portion remains constant regardless of production, such as base salaries or equipment rental fees.
- **Variable Component Changes with Output** – The variable portion increases or decreases with changes in production or sales volume, such as overtime pay or utility costs based on usage.
- **Not Fully Controllable in the Short Term** – The fixed portion is often contractual and cannot be easily adjusted, while the variable portion can be managed based on operational decisions.
- **Stepwise or Non-Linear Behavior Possible** – The variable portion may not always increase proportionally; it can exhibit stepwise changes due to factors like bulk pricing or tiered utility rates.
- **Examples Include** – Electricity bills with a base charge plus usage fees, delivery costs with a fixed base charge and mileage-based variable fees, and machine maintenance costs with a fixed service fee plus additional costs based on usage.

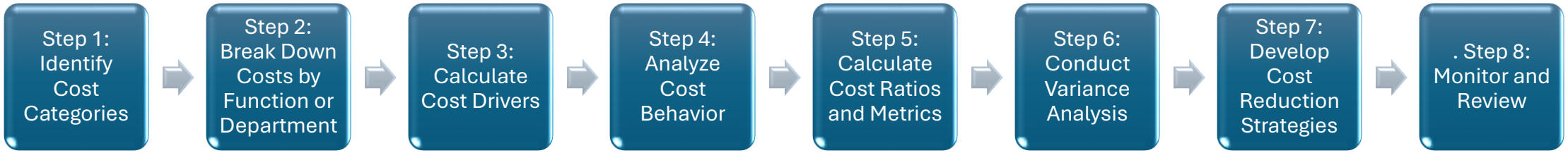
Graphical Presentation of the FC, VC and Mixed costs:



Sources of cost structures

- Evaluating sources of cost structures involves analyzing the different components that make up a company's overall expenses, identifying where costs originate within the business operations, and assessing the relative proportion of fixed and variable costs to understand their impact on profitability and strategic decision-making.

Steps for evaluating the Cost Structures



Analyzing Cost Structures: A Step-by-Step Guide

Steps	Activity
Step 1: Identify Cost Categories	***Analyzing cost structures is to categorize expenses into meaningful categories. Common cost categories include: Fixed Costs, VC and mixed costs***
Step 2: Break Down Costs by Function or Department	✓ to gain an understanding of where expenses are incurred. This allows businesses to pinpoint areas of high spending and identify opportunities for cost reduction
	✓ Production: Costs related to manufacturing or producing goods, such as materials, labor, and equipment. - commissions, and promotional expenses. -
	✓ Sales and Marketing: Costs associated with promoting and selling products or services, such as advertising, sales
	✓ Administration: Costs related to general overhead and administrative functions, such as salaries, rent, utilities, and office supplies.
	✓ - Research and Development: Costs associated with product development, innovation, and research activities, such as R&D salaries, prototyping, and testing
Step 3: Calculate Cost Drivers	***Identify the key drivers that influence each cost category to understand what factors contribute most significantly to overall costs.***
	✓ For example: - For manufacturing costs, cost drivers may include production volume, machine hours, or material usage. -
	✓ For sales and marketing costs, cost drivers may include sales volume, customer acquisition, or advertising spend.
	✓ - For administrative costs, cost drivers may include headcount, office space, or IT infrastructure
Step 4: Analyze Cost Behavior	***Behavior Determine how costs behave in relation to changes in business activity or volume. Classify costs as either:***
	✓ - Fixed Costs: Costs that remain constant regardless of changes in activity levels

Steps	Activity
Step 5: Calculate Cost Ratios and Metrics	***Calculate key cost ratios and metrics to assess the efficiency and effectiveness of cost structures. Common metrics include: - Gross Margin: Gross profit divided by total revenue***,
	✓ measuring the percentage of revenue retained after subtracting the cost of goods sold. - Operating Margin: Operating income divided by total revenue,
	✓ Contribution Margin: Revenue minus variable costs, measuring the amount available to cover fixed costs and contribute to profit
	✓ Cost-to-Sales Ratio: Total operating expenses divided by total sales revenue, measuring the percentage of revenue consumed by operating expenses
	✓ Break-Even Point: The level of sales at which total revenue equals total costs
	✓ the minimum level of sales needed to cover costs and achieve profitability
Step 6: Conduct Variance Analysis	***Analysis Compare actual costs to budgeted or historical costs to identify variances and deviations from expectations***
	✓ Analyze the reasons behind significant variances and take corrective action as needed
	✓ Variances may be due to changes in market conditions, unexpected expenses, inefficiencies, or inaccuracies in budgeting
Step 7: Develop Cost Reduction Strategies	***Based on the insights gained from cost analysis, develop targeted cost reduction strategies to improve efficiency and profitability***
	• Focus on areas with the greatest potential for cost savings, such as renegotiating supplier contracts
	• optimizing production processes, reducing waste, or reallocating resources to higher-value activities.
	• Prioritize initiatives that align with business goals and deliver the most significant impact on the bottom line
Step 8: Monitor and Review	***Regularly Cost analysis is an ongoing process that requires regular monitoring and review to ensure effectiveness and relevance over time.***
	✓ Establish a cadence for reviewing cost structures, tracking performance metrics, and adjusting strategies as needed in response to changing market conditions or business priorities
	✓ By maintaining a proactive approach to cost analysis, businesses can continuously optimize cost structures and drive sustainable growth and profitability

Methods of segregating semi-variable costs into fixed and variable costs

Four common approaches are used to estimate fixed and variable costs:

- **Account analysis**
- High-low method
- Scattergraph method
- Regression analysis

A. Graphical Presentation Method

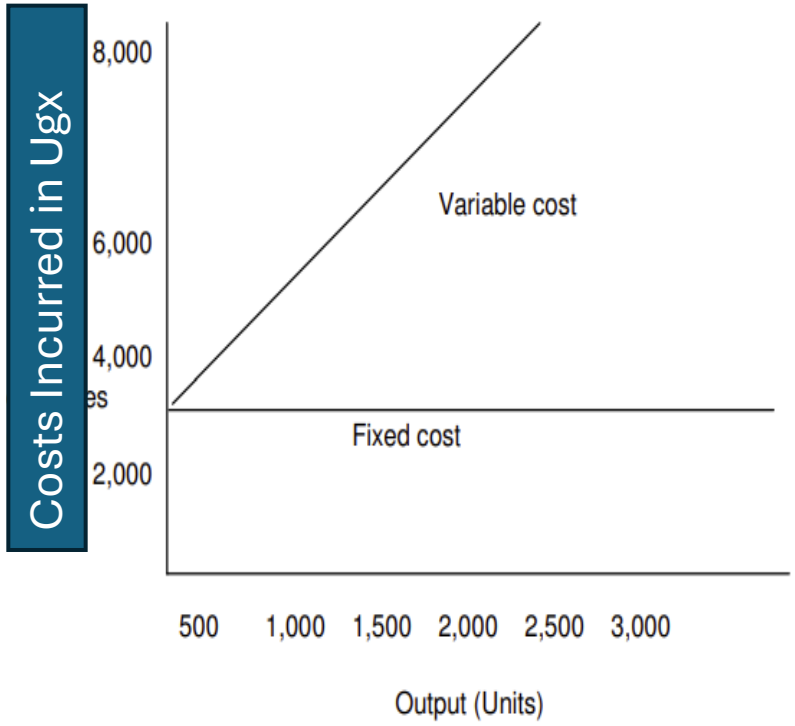
- Under this method, a good number of observations in respect of the total costs at different levels of activity or output are plotted on a graph with the output on the X-axis and their corresponding costs on the Y-axis.
- Then by judgment a line of ‘best fit’ which passes through all or most of the points is drawn.
- The point at which the cost line touches the Y-axis is taken to be the fixed element of cost. From this point a line parallel to X-axis is drawn to represent fixed cost line. The variable cost, at any level of output, is derived by deducting this fixed cost element from the total cost.

Example 1: Graphical Method

Use the following information to Plot the graph for the 'line of best fit'

Months	Output in Units produced	Costs Incurred (Ugx)
April	1,500	6,000
May	1,800	6,600
June	2100	7200
July	2820	8640
August	2220	7440

Solution: Cost behavioral analysis Graph showing the line of the best fit



B. Regression Analysis: Least square method:

- In this method ‘line of best fit’ is drawn for a number of observations with the help of statistical method. This method uses the linear equation y=mx+c, where ;

✓‘m’ represents the variable element of cost per unit,

✓‘c’ represents the total fixed cost,

✓‘y’ represents the total cost

✓ ‘x’ represents the volume of output.

The relationship between fixed and variable costs explained.

Least square method

- **Calculate the Mean**
- $Mean = \frac{1{,}500+1{,}800+2100+2820+2220}{5}$
- $\text{Mean} = \frac{10{,}440}{5} = 2{,}088$ Units
- **Calculate deviations from the mean for each number**
- **For 1,500-2,088 = -588**
- **For 1,800 -2088= -288**
- **For 2,100-2088 = 12**
- **For 2,820-2088= 732**
- **For 2,220-2088= 132**

Least square method

Months	Output in Units produced (X)	Deviation of output from the mean (X)	X Squared (X2)	Costs Incured (Ugx) Y	Deviation of costs (Y) from the mean	XY
April	1,500	-588	345,744	6,000	-1,176	691,488
May	1,800	-288	82,944	6,600	-576	165,888
June	2100	12	144	7200	24	288
July	2820	732	535,824	8640	1,464	1,071,648
August	2220	132	17,424	7440	264	34,848
Totals in 5 months	10,440		982,080	35,880		1,964,160
Means	**2088**		**ΣX2 = 982,080**	**7,176**		**ΣXY =1,964,160**

Least square method

- **ΣX2 = 982,080**
- **ΣXY =1,964,160**
- $\frac{\Sigma XY}{\Sigma X\text{^}2} = \frac{1{,}964{,}160}{982{,}2080} =$ **=Ugx 2**
- Fixed costs = Mean Costs –(Mean output*Variable costs per unit)
- Ugx **7,176 –(2088*Ugx 2)**
- **=7,176-4,176 = Ugx 3000**
- **Y =MX+C**
- **Y=2X+3000 Where**
- **Y =total costs, X= Number of Units**

C. High and low points method:

The **high-low method** is a cost estimation technique used to separate a mixed cost into its fixed and variable components.

- ✓ It uses only the highest and the lowest activity (or volume) data points from a set of observations to estimate how much of the total cost changes with activity (variable cost) and how much remains constant (fixed cost).

Key Steps to Separate Variable and Fixed Costs Using the High-Low Method

Step 1: Identify the month or batches with High and Low Activity Levels with and associated costs

Step 2: Determine the Change in Cost and Change in Activity

Step 3: Calculate the Variable Cost per Unit

Step 4: Compute the Fixed Cost

Step 5: Formulate the Cost Equation

PRACTICE QUESTIONS
Separating semi-variable costs into fixed and variable elements

Example One: Suppose the total monthly production costs of a company have been measured at Ugx 78,000 when out put was 4,800 units and Ugx 81,600 when out put was 5,700 units.

Calculate the fixed costs per month and the variable costs per unit.

- **Example 3:** An **Electric Pressure Cooker (EPC)** has variable cost elements based on the number of hours used for cooking. The following cost data has been recorded:
- When cooking hours were 22,000, the total cost was **UGX 57,600** per month.
- When cooking hours were 20,600, the total cost was **UGX 54,800** per month.
- **Required:**
- Using the High-Low Method, estimate:
    i. The variable cost per cooking hour
    ii. The fixed cost per month

C. High and low points method:

Question One: Use the following information to Plot the graph for the 'line of best fit', estimate the Variable costs per unit and the total fixed cost.

Months	Output in Units produced	Costs Incurred (Ugx)
April	1,500	6,000
May	1,800	6,600
June	2100	7200
July	2820	8640
August	2220	7440

Practice Question Two:

Use the following data to estimate the cost formula (y=mx+b format).

i. to calculate the company's estimated variable cost per package and fixed costs using the least squares regression method, Highlow method and the Graphical method to separate costs from fixed and variable costs

Batch	Units Produced	Total Cost	
1	680	UGX	29,800
2	820	UGX	34,000
3	570	UGX	27,500
4	660	UGX	29,000
5	750	UGX	31,900

Practice Question Three:

The following information relates to Buddy's Shipping company for Jan to June 2022.

Months	Number of Packages Shipped	Shipping Cost (Ugx)
January	100	1,200
February	120	1,300
March	125	1,350
April	130	1,500
May	110	1,400
June	90	1,100

Required:

a) Using the high-low method, estimate the cost formula (y=mx+b format).

i. Using your answer from part a) above, to calculate the company's estimated variable cost per package and fixed costs.

a) Using the scatter graph method, estimate the cost formula.

b) Using the least squares regression method, estimate the cost formula.

c) Are there any factors other than the number of packages shipped that may contribute to a variation in shipping cost?

More to cover

- Learning Curve
- Confidence Intervals
- Test Reliability
- Cost Control & Cost Reduction

Cost Behavior and Profit Analysis in Strategic Management Accounting; Learning Curve

- The learning curve concept in cost behavior refers to the reduction in per-unit production costs as workers become more proficient at performing tasks. It is based on the principle that with experience, labor efficiency improves, leading to reduced labor time and cost per unit.
- **Key Aspects:**
- Applicable in manufacturing and service industries.
- The rate of cost reduction varies by industry and complexity of tasks.
- Used in pricing decisions, budgeting, and forecasting.

Learning Curve

- If you practice something you will get better at it and it will take less time to do
- Less time = Less cost
- - Hours per unit decrease by a constant percentage
- every time cumulative output is doubled.
- - If the improvement is 30% the learning rate is:
- 100% - 30% = 70% - The learning rate
- - Experience curve includes other costs such as administration, marketing and distribution

Learning Curves and Budgeting

- - Average costs are more important than costs of individual units.
- If costs fall as production volumes increase, then this has to be built into cost estimates.
- If cost plus pricing used starts failing to take cost reductions into account then it can make prices uncompetitive.
- **Conditions needed for the Learning Curve**

- Motivated Workforce
- Consistency in workforce
- No breaks in production
- Early stage of production
- Complex task
- Repetitive task
- Large manual element

Factors that can limit its use in practice

- Learning curve theory depends on a high content of labour in the production process, otherwise learning's cannot be achieved.
- High staff turnover will also reduce the learning effect as new staff have to begin at the bottom of the learning curve.
- Modern technology has replaced people with machines so there is reduced opportunities for learning.
- Staff need to be happy with good morale as learning curve will not work on a go slow.
- There needs to be constant production as the learning effect is lost if there is a break in production.

READ MORE: Learning Curves Theory, Models, and Applications By Mohamad Y. Jaber

2. Understanding Confidence Intervals

- Statistics help one to view reported data through a more sophisticated lens.
- By looking more deeply into what statistics are being reported in the news, what the population of interest is, how the sample was drawn from the po ulation, what the sample size is, and how large is the margin of error.
- Statisticians have control of certain elements of their study, while some elements are beyond their control.
- They can determine their sampling procedure. They can, to some degree, determine the level of confidence they want to report.
- However, the conventions of 99%, 95%, and 90% are pretty rigid.
- However, they have control over deciding the size of their sample. The relationship between the width of a confidence interval and the sample size is relatively straightforward. The bigger the margin of error, thewider the interval.
- The bigger the sample size, the smaller the margin of error. So, holding every thing else the same, as the sample size increases the margin of error and the width of the confidence interval decrease. The intervals are tighter with bigger samples.

2. Confidence Intervals

- Confidence intervals (CIs) provide a range of values within which a population parameter (e.g., mean cost) is expected to fall, given a certain level of confidence (e.g., 95%).
- The first step is choosing the level of confidence.
- If we want to be absolutely 100% confident that our range (lower and upper values) contain the true value, then all we would have to do is specify ridiculously extreme values.
- Confidence intervals are typically calculated at the 99%, 95%, or 90%level of confidence.
- if a statistical report includes a confidence interval, but does not specify the level, you can bet it is the 95% confidence level.
- If a distribution is normal, then roughly 95% of all the data is within two standard deviations of the mean
- **Key Aspects:**
- Used in cost estimation and risk assessment.
- Helps in financial forecasting and decision-making.
- A wider interval indicates greater uncertainty.
- **Some examples** include estimating presidential approval ratings, unemployment levels, customer satisfaction levels, and tax compliance levels.

2. Confidence Intervals

- Consider an example of the percentage of voters who planned on voting for Obama in the US presidential election. The agency chose a sample size of 1300, such a small fraction of the larger population. You may ask yourself why they did not increase their sample size to try to capture more potential voters. After all, larger samples lead to more precise intervals. The answer is that sampling is costly and so businesses would prefer to minimize their expenditures on sampling given that they meet certain objectives. Those objectives have to do with the margin of error. As you look more carefully at news reports with your developing statistician's eye, you may notice that the margin of error for most studies is 3% or less. A 3%marginoferrorfor the 95%confidenceinterval has developed into a sort of norm for the maximum allowable margin of error.

3. Test Reliability

- Test reliability measures the consistency of a method or model in cost analysis. A reliable test produces stable and repeatable results under consistent conditions.
- **Key Aspects:**
- In cost behavior analysis, reliable cost estimates reduce financial risks.
- Includes inter-rater reliability, test-retest reliability, and internal consistency.
- Essential for variance analysis and performance measurement.
- **Practice Question:**

Explain how a firm can improve the reliability of its cost estimation models in strategic decision-making.

1. Use historical data to validate models.
2. Perform sensitivity analysis to assess variations.
3. Incorporate expert reviews to refine assumptions.
4. Regularly update models to reflect current trends.

Cost control and cost Reduction

- One of the major concern of the enterprise is to maximize the profit, which is possible only through decreasing the cost of production.
- For this purpose, two efficient tools are used by the management, i.e. cost control and cost reduction.
- **Cost Control** is a technique which provides the necessary information to the management that actual costs are aligned with the budgeted costs or not.
- **Cost Reduction** is a technique used to save the unit cost of the product without compromising its quality.
- While cost control, regulates the action to keep the cost elements within the set limits, cost reduction refers to the actual permanent reduction in the unit cost.

4. Cost Control & Cost Reduction

- Cost control and cost reduction are strategic techniques used to manage expenses and improve profitability.
- **Cost Control**:
  - ✓ Focuses on maintaining costs within predetermined budgets.
  - ✓ Techniques include standard costing, variance analysis, and budgetary control.
- **Cost Reduction:**
  - ✓ Aims at permanently lowering costs without compromising quality.
  - ✓ Methods include process optimization, value engineering, and waste minimization.

Practice Question:

A manufacturing firm seeks to reduce its production costs by 10% without affecting quality. Discuss three strategic cost reduction techniques that the firm can apply.

1. ***Process Optimization:*** *Improve workflow efficiency through automation and lean manufacturing.*
2. ***Supplier Negotiation:*** *Secure bulk purchase discounts and better pricing terms.*
3. ***Energy Efficiency:*** *Invest in energy-saving equipment to lower operational costs.*

Comparison; Key Differences Between Cost Control and Cost Reduction

Basis for Comparison	Cost Control	Cost Reduction
• **Meaning**	• A technique used for maintaining the costs as per the set standards	• A technique used to economize the unit cost without lowering the quality of the product.
• **Savings in**	• Total Cost	• Cost Per Unit
• **Retention of Quality**	• Not Guaranteed	• Guaranteed
• **Nature**	• Temporary	• Permanent
• **Emphasis on**	• Past and Present Cost	• Present and Future Cost
• **Ends when**	• The pre-determined target is achieved.	• No end
• **Type of Function**	• Preventive	• Corrective