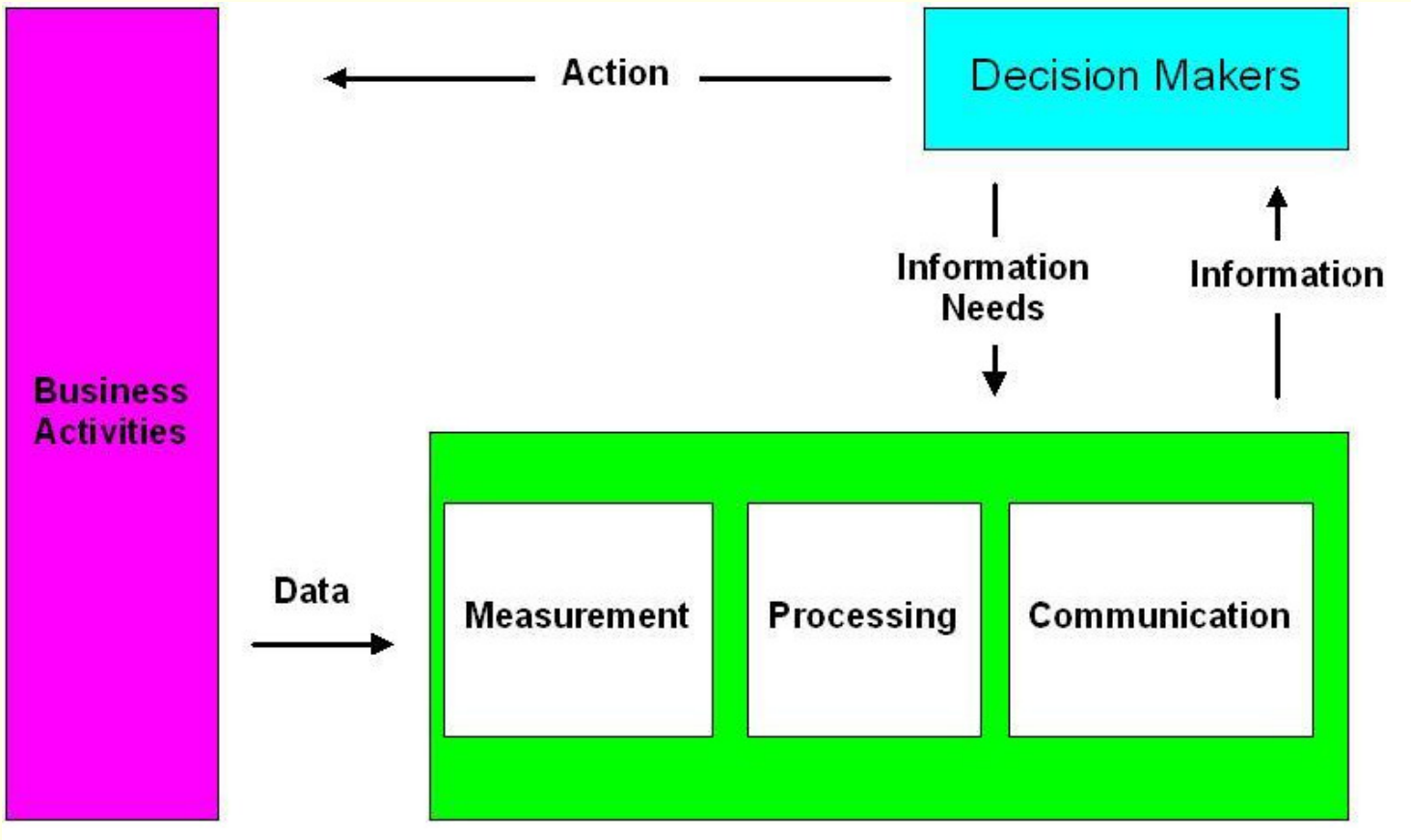
- Accounting Systems take economic events and transactions, and process the data into information that is helpful to managers and other users



- Accounting is a link between business activities and decision makers

- Management Accounting measures, analyzes and reports financial and nonfinancial information that that helps managers make decisions to fulfill the goals of an organization.

- Managers use management accounting information to
  - choose, communicate and implement strategy
  - coordinate product design, production and marketing decisions
  - evaluate performance

	Management Accounting	Financial Accounting
Purpose of Information	Help managers make decisions to fulfill an organization's goals	Communicate financial position to investors, creditors, etc.
Primary Users	Managers of the organization	External Users
Focus and Emphasis	Future-oriented	Past-oriented
Rules	Internal measures and reports do not have to follow GAAP	must be in accordance with GAAP and be certified by external, independent auditors
Time span and Type of Reports	Variable, with financial and nonfinancial reports on products, departments, territories and strategies	Annual and quarterly financial reports primarily on the company as a whole
Behavioral Implications	Designed to influence the behavior of managers and other employees	Primarily reports economic events but also influences behavior

Objective

A common understanding of the meaning of cost concepts and terms

- Cost: sacrificed resource to achieve a specific objective. It is measured as the monetary amount that must be paid to acquire goods and services.
  - Actual Cost: a cost that has occurred
  - Budgeted Cost: a predicted cost
- Cost Object: anything for which a cost is desired
  - Product: BMW X5
  - Service: Telephone Hotline providing assistance to customers
  - Project: R&D project
  - Activity: Setting up machines in production line

A cost system determines the cost of a cost object in two stages:

1. Cost Accumulation: the collection of cost data in an organized manner by means of an accounting system
2. Cost Assignment: a general term that includes assigning accumulated costs to a cost object. This includes:
   - Tracing accumulated costs with a direct relationship to the cost object
   - Allocating accumulated costs with an indirect relationship to a cost object

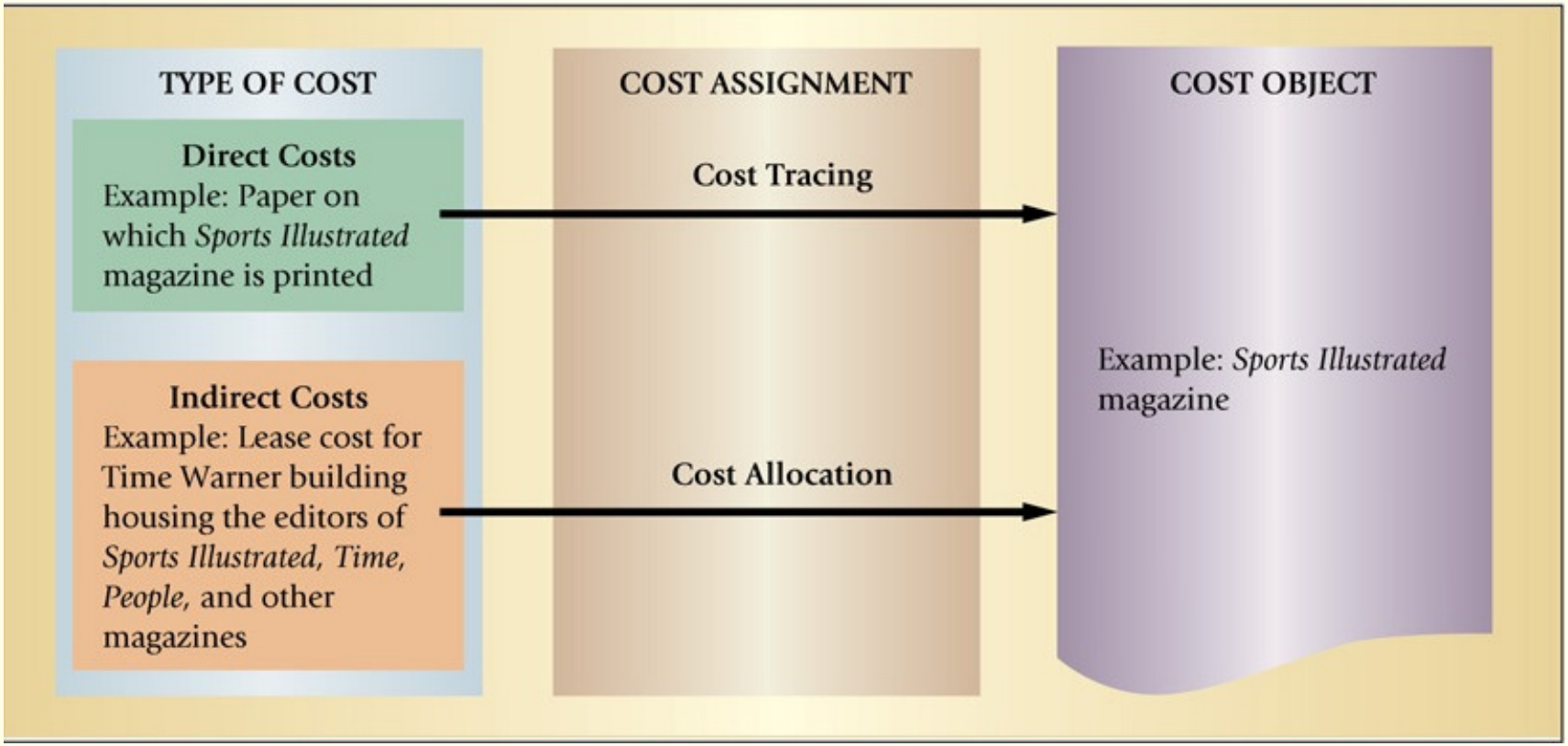
- Purposes of cost assignment
  - Decisions about department efficiency
  - Pricing decisions and analyzing profitability
  - Allocation of resources

- Direct Costs can be conveniently and economically traced (tracked) to a cost object
  - Cost tracing: Assignment of direct costs to a particular cost object
- Indirect Costs cannot be conveniently or economically traced (tracked) to a cost object. Instead of being traced, these costs are allocated to a cost object in a rational and systematic manner
  - Cost Allocation: Assignment of indirect costs to a particular cost object
- Inaccuracy will mislead managers in decision making
  - Direct costs preferred
- Factors that affect cost classification:
  - The materiality of the cost
  - Available information gathering technology
  - Design of operations

- Cost Examples
  - Direct Costs: Parts, Assembly line wages
  - Indirect Costs: Electricity, Rent, Property taxes
- A specific cost may be both a direct cost of one cost object, and indirect cost of another cost object
  - The classification depends on the choice of the cost object
  - The salary of an assembly department supervisor
    - If cost object is Assembly Department: is a direct cost
    - If cost object is one of the products produced in that department: is an indirect cost

Objective

Examine different ways to assign costs to cost objects


TYPE OF COST
Direct Costs
Example: Paper on which Sports Illustrated magazine is printed
Indirect Costs
Example: Lease cost for Time Warner building housing the editors of Sports Illustrated, Time, People, and other magazines
COST ASSIGNMENT
Cost Tracing
Cost Allocation
COST OBJECT
Example: Sports Illustrated magazine

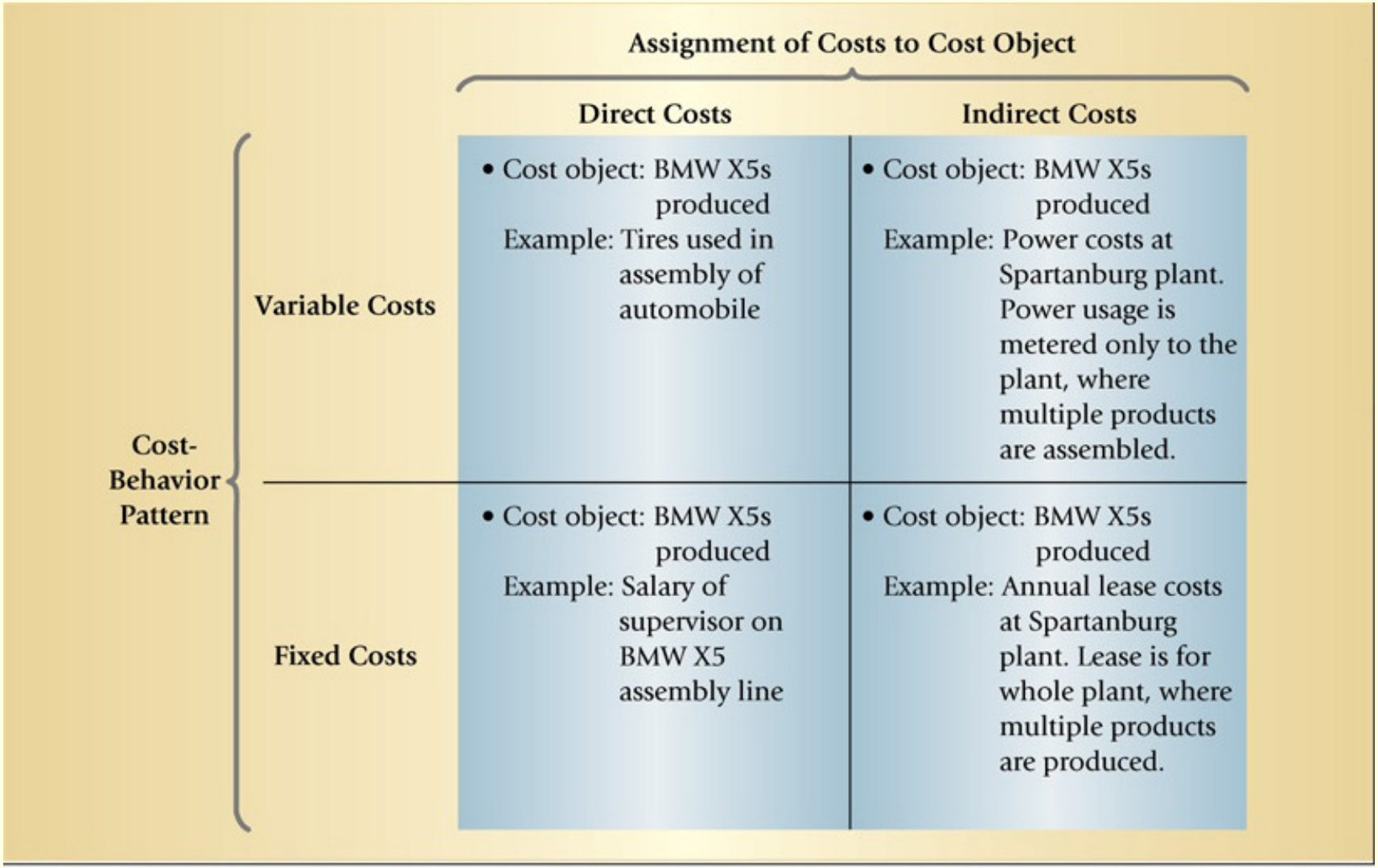
- Variable Costs change in total in proportion to changes in the related level of activity or volume
  - constant on a per-unit basis: If a product takes 5 pounds of materials each, it stays the same per unit regardless of whether one, ten, or a thousand units are produced
- Fixed Costs remain unchanged in total regardless of changes in the related level of activity or volume
  - change inversely with the level of production: As more units are produced, the same fixed cost is spread over more and more units, reducing the cost per unit
- Costs are fixed or variable only with respect to a specific activity and for a given time period
  - Registration and licence fee of a rental car fleet:
    - For a particular car: is a fixed cost
    - For all of the fleet: is a variable cost (wrt. ♯ of cars)

	Total Dollars	Cost per Unit
Variable Costs	Change in proportion with output (More Output = More cost)	Unchanged in relation to output
Fixed Costs	Unchanged in relation to output	change inversely with output

Example:

- Total cost of Steering Wheels used for X5s is a variable cost
- A total cost of $2,000,000 of supervision cost for X5 production line is a fixed cost

- Cost Driver: a variable that causally affects costs over a given time span
  - Variable costs: level of activity or volume whose change causes proportionate changes in costs
  - Fixed Costs: no cost driver
- Relevant Range: the band of normal activity level (or volume) in which there is a specific relationship between the level of activity (or volume) and a given cost
  - For example, fixed costs are fixed only within the relevant range
  - Outside the relevant range, variable costs may not change proportionately with changes in the related level of activity or volume


Assignment of Costs to Cost Object
Direct Costs
Indirect Costs
Cost-Behavior Pattern
Variable Costs
• Cost object: BMW X5s produced
Example: Tires used in assembly of automobile
• Cost object: BMW X5s produced
Example: Power costs at Spartanburg plant. Power usage is metered only to the plant, where multiple products are assembled.
Fixed Costs
• Cost object: BMW X5s produced
Example: Salary of supervisor on BMW X5 assembly line
• Cost object: BMW X5s produced
Example: Annual lease costs at Spartanburg plant. Lease is for whole plant, where multiple products are produced.

Unit Cost

Dividing the amount of total costs by the related number of units, ex. autos assembled, packages delivered...

Remark

Unit costs should be used cautiously. Since unit costs change with a different level of output or volume, it may be more prudent to base decisions on a total dollar basis. Assume we produce 500,000 units.

Units Produced	Variable Cost per Unit	Total Variable Costs	Total Fixed Costs	Total Costs	Unit Cost
100,000	$60	$6,000,000	$10,000,000	$16,000,000	$160.00
200,000	$60	$12,000,000	$10,000,000	$22,000,000	$110.00
500,000	$60	$30,000,000	$10,000,000	$40,000,000	$80.00
800,000	$60	$48,000,000	$10,000,000	$58,000,000	$72.50
1,000,000	$60	$60,000,000	$10,000,000	$70,000,000	$70.00

- Different Types of Firms
  - Manufacturing-sector companies: create and sell their own products
  - Merchandizing-sector companies: product resellers
  - Service-sector companies: provide services (intangible products)
- Types of Inventories
  - Manufacturing-sector companies:
    - Direct Materials: resources in stock and available for use
    - Work-in-Process: products started but not yet completed
    - Finished Goods: products completed and ready for sale
  - Merchandizing-sector companies:
    - Merchandising Inventory
  - Service-sector companies
    - None

1. Direct Material Costs: Acquisition costs of all materials that eventually become part of the cost object and can be traced to the cost object

2. Direct Manufacturing Labor Costs: The compensation of all manufacturing labor that can be traced to the cost object

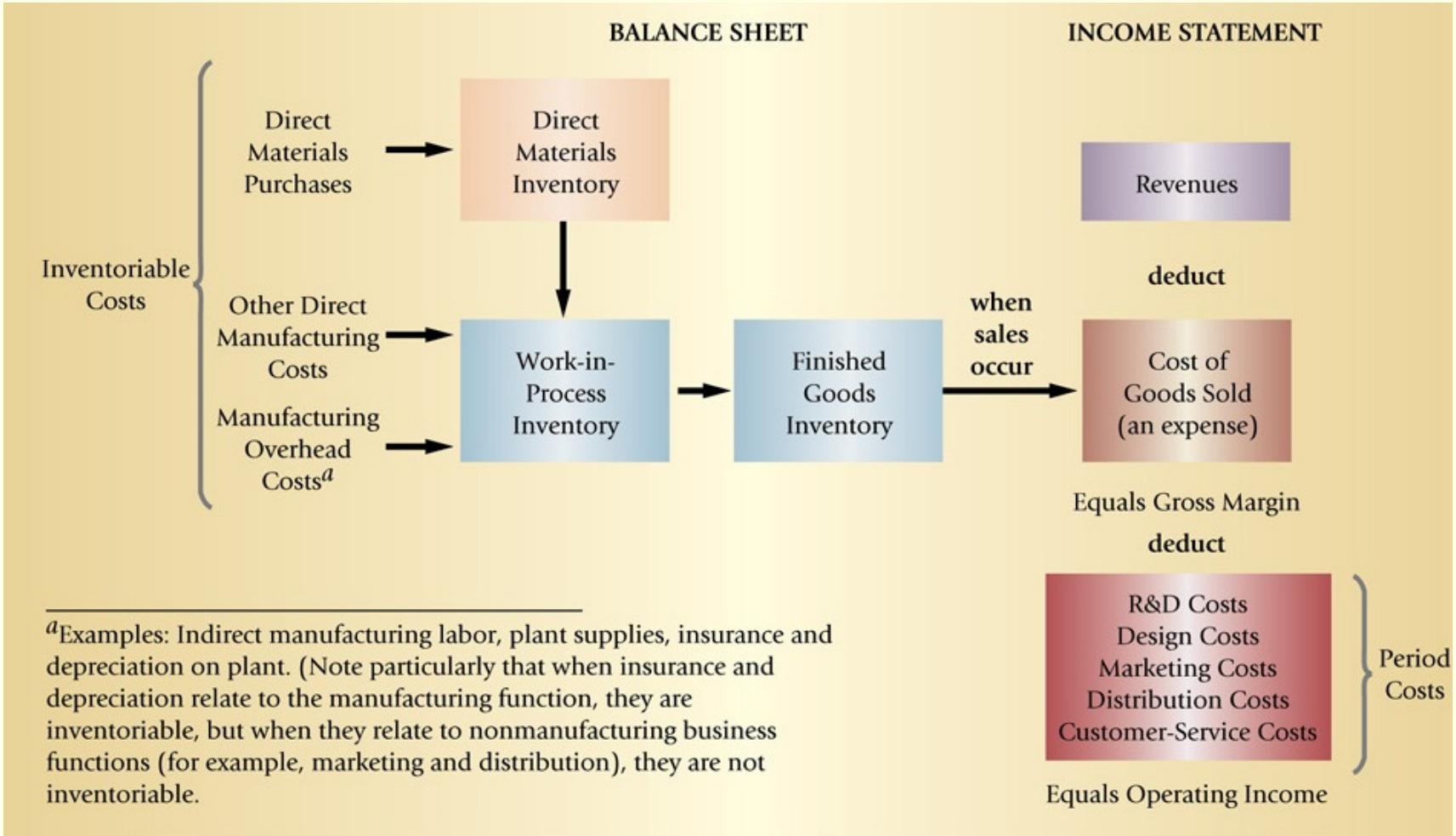
3. Indirect Manufacturing Costs: all manufacturing costs related to the cost object but cannot be traced to the cost object
   - Also known as manufacturing overhead costs
   - Examples: Electric power, supplies, indirect materials, maintenance labor, plant rent and insurance, plant depreciation

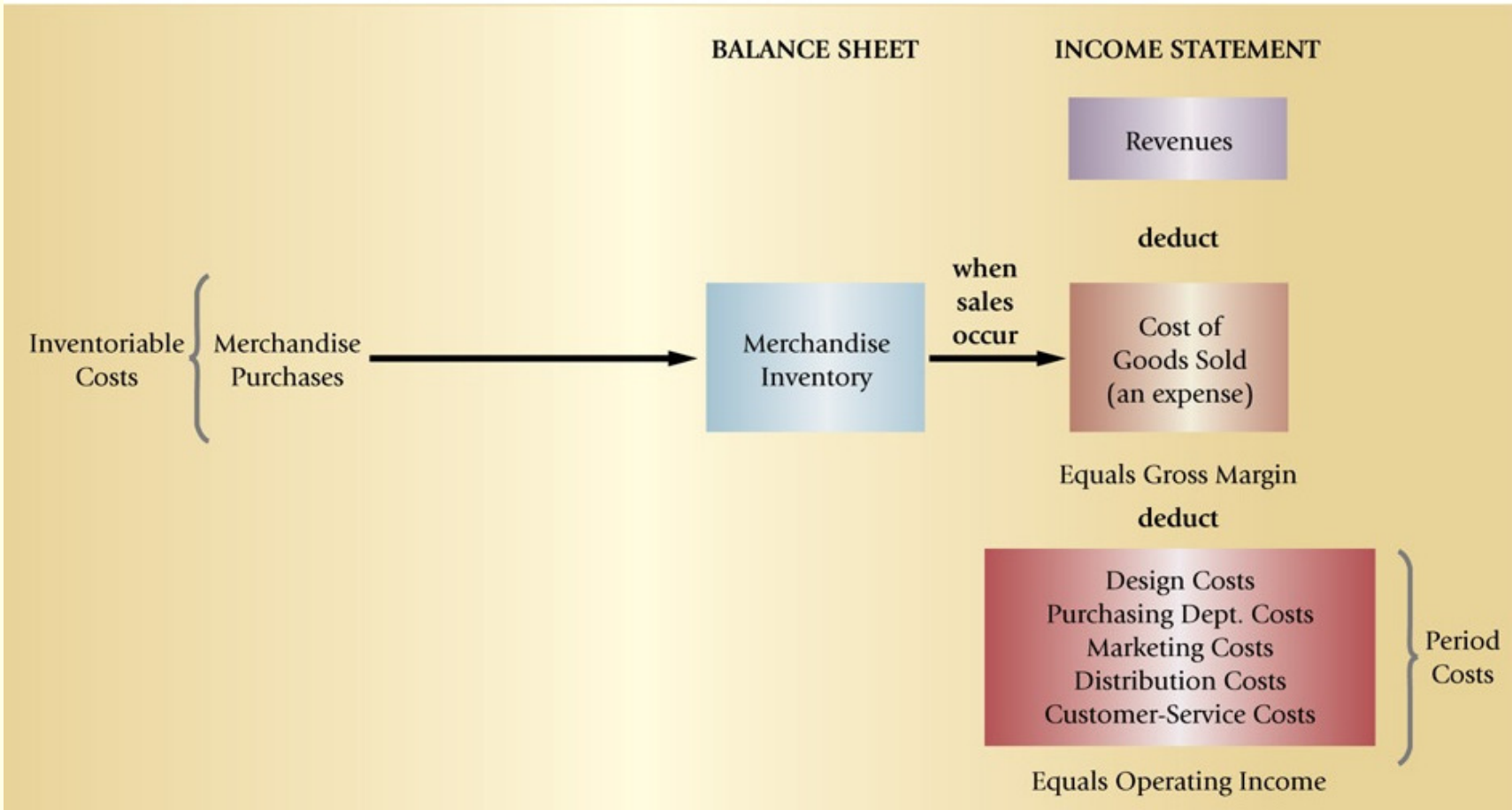
- Inventoriable Costs: All costs that are regarded as assets when they are incurred and become cost of goods sold when the product is sold.
  - All manufacturing costs are inventoriable
  - Finished goods can be sold during a different period than the period they were manufactured
  - The rule is
    - inventorying manufacturing costs during the period when they were manufactured (in direct materials, WIP, FGs Inventory)
    - expensing them during the period they were sold
- Period Costs: have no future benefit and are expensed as incurred
  - All costs in the income statement other than the cost of goods sold
  - Examples: Distribution costs, labor costs of sales personnel, marketing costs

Revenues		$200,000
Cost of goods sold:		
Beginning finished goods	$ 20,000	
Cost of goods manufactured	100,000	
Cost of goods available for sale	$120,000	
Ending finished goods	15,000	
Cost of goods sold		105,000
Gross margin		$ 95,000
Total operating costs		70,000
Operating Income		$ 25,000

- Cost of Goods Sold = Beginning FG Inventory + Cost of Goods Manufactured - Ending FG Inventory
- Cost of goods manufactured refers to the cost of goods brought to completion, whether they were started before or during the current accounting period.
- Cost of Goods Manufactured = Beginning WIP inventory + Manufacturing Costs - Ending WIP inventory

Direct materials:		
Beginning inventory	$10,000	
Purchases of direct materials	64,000	
Cost of direct materials available for use	$74,000	
Ending inventory	6,000	
Direct materials used		$ 68,000
Direct manufacturing labor		12,000
Manufacturing overhead costs:		
Indirect manufacturing labor	$ 6,000	
Depreciation	5,000	
Miscellaneous	11,000	
Total manufacturing overhead costs		22,000
Manufacturing costs incurred		$102,000
Beginning WIP inventory		8,000
Total manufacturing costs to account for		$110,000
Ending WIP inventory		10,000
Cost of goods manufactured		$100,000


BALANCE SHEET
INCOME STATEMENT
Direct Materials Purchases
Direct Materials Inventory
Revenues
Inventoriable Costs
deduct
Other Direct Manufacturing Costs
Work-in-Process Inventory
Finished Goods Inventory
when sales occur
Cost of Goods Sold (an expense)
Manufacturing Overhead Costs[a]
Equals Gross Margin
deduct
R&D Costs
Design Costs
Marketing Costs
Distribution Costs
Customer-Service Costs
Period Costs
Equals Operating Income
[a]Examples: Indirect manufacturing labor, plant supplies, insurance and depreciation on plant. (Note particularly that when insurance and depreciation relate to the manufacturing function, they are inventoriable, but when they relate to nonmanufacturing business functions (for example, marketing and distribution), they are not inventoriable.

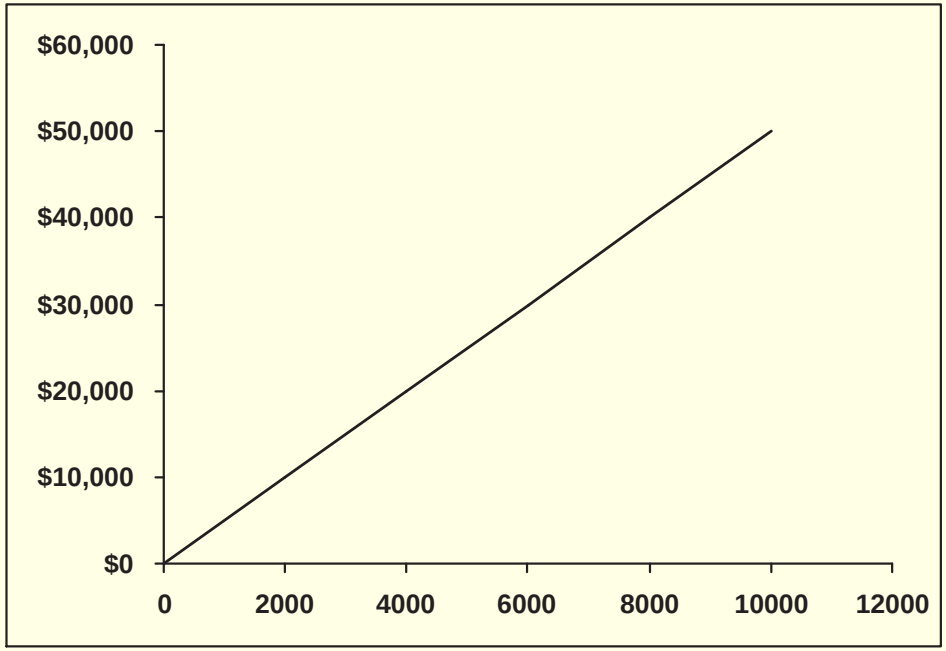

BALANCE SHEET
INCOME STATEMENT
Revenues
deduct
Inventoriable Costs
Merchandise Purchases
Merchandise Inventory
when sales occur
Cost of Goods Sold (an expense)
Equals Gross Margin
deduct
Design Costs
Purchasing Dept. Costs
Marketing Costs
Distribution Costs
Customer-Service Costs
Period Costs
Equals Operating Income

- Objective: Determining cost-behavior patterns, that is, how costs change in relation to changes in activity levels etc.
- Cost Function: Mathematical representation of how a cost changes with changes in the level of an activity relating to that cost
- Cost Function Assumptions:
  1. Variations in the level of a single activity (the cost driver) explain the variations in the related total costs
  2. Cost behavior is approximated by a linear cost function within the relevant range
     - Graphically, the total cost versus the level of a single activity related to that cost is a straight line within the relevant rage

       x-axis: the level of activity

       y-axis: the amount of total costs dependent on the level of activity

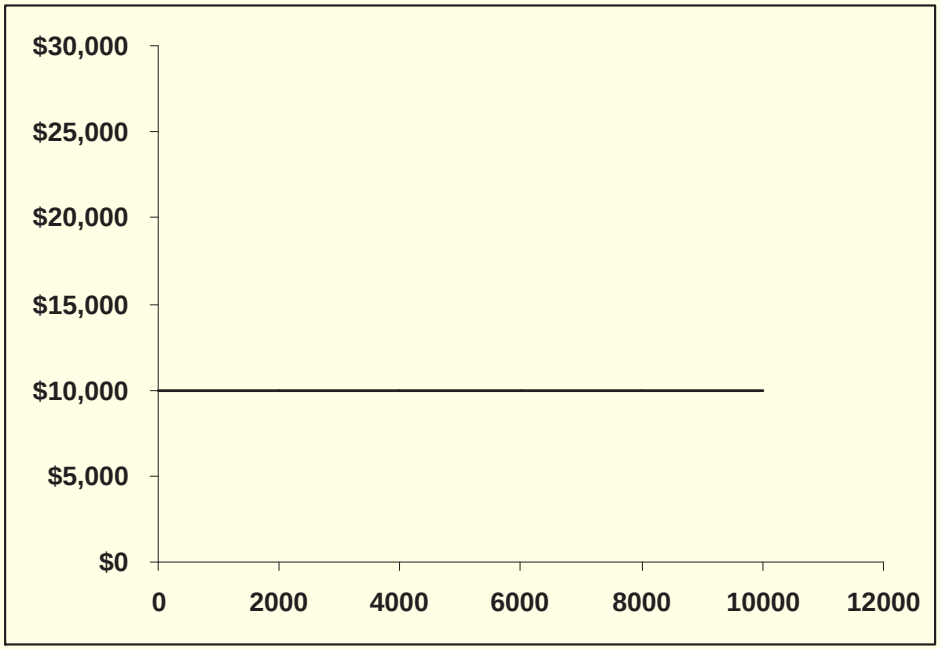
- Costs that change in total in relation to some chosen activity or output



$$y = 5X$$

Slope coefficient: the amount by which total cost changes when a one-unit change occurs in the level of activity within the relevant range

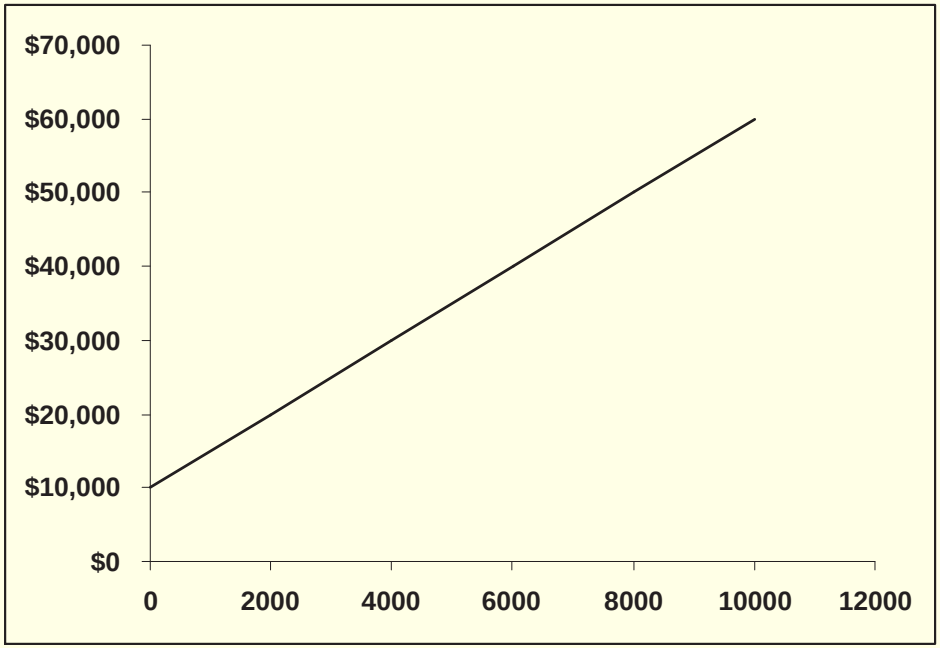
- Costs that do not change in total in relation to some chosen activity or output within the relevant range



$$y = 10,000$$

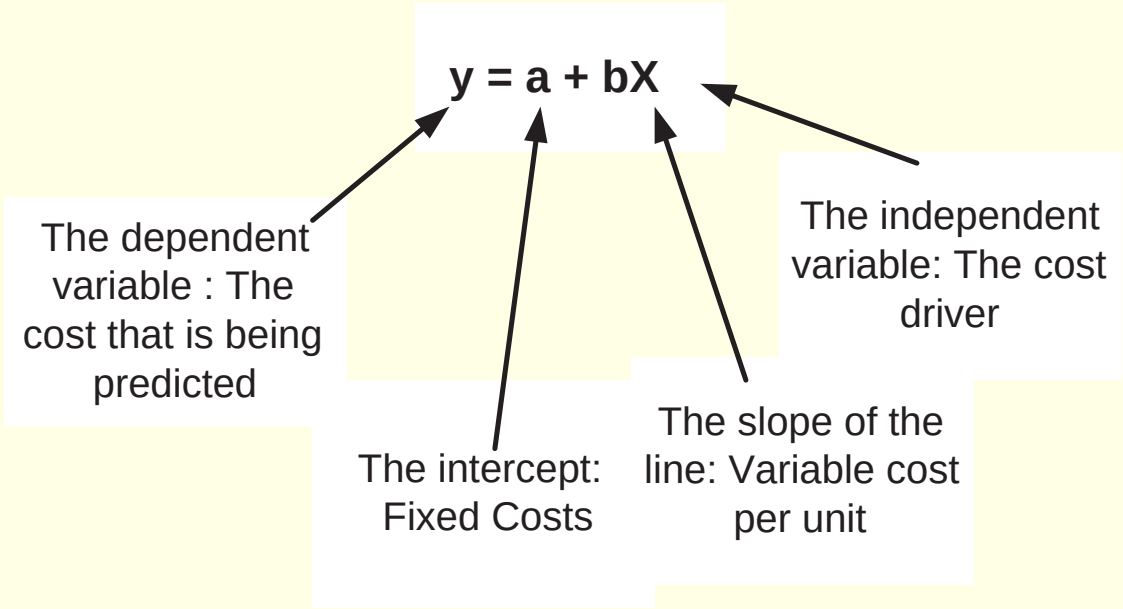
The slope coefficient is zero. The cost function is characterized by the fixed cost (constant, intercept).

- Costs that have both fixed and variable components; also called semivariable costs



$$y = 10,000 + 5X$$

Total cost increases as the level of activity increases; however, not in proportion.



Criteria for Classifying Variable and Fixed Components of a Cost

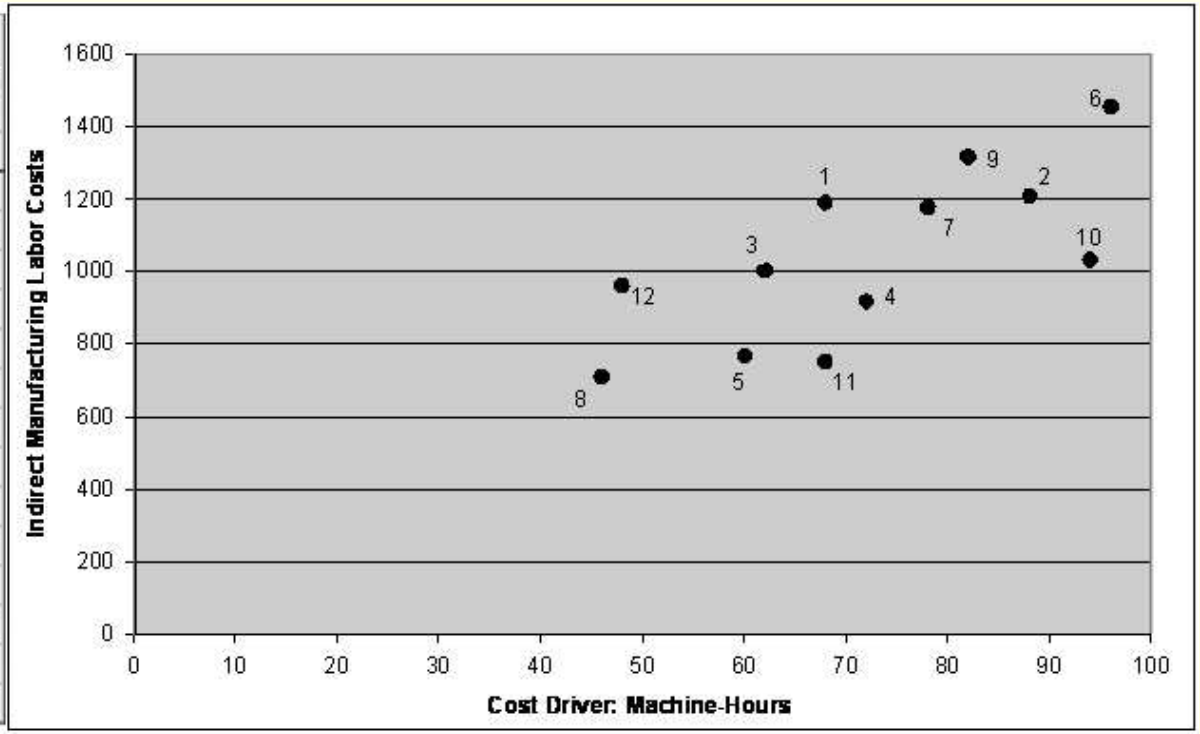
- Choice of Cost Object: different objects may result in different classification of the same cost
- Time Horizon: the longer the period, the more likely the cost will be variable
- Relevant Range: behavior is predictable only within this band of activity

- The most important issue in estimating a cost function is determining whether a cause-and-effect relationship exists between the level of an activity and the costs related to that level of activity
- A cause-and-effect relationship might arise as a result of:
  - A physical relationship between the level of activity and costs
  - A contractual agreement
  - Knowledge of operations
- Note: a high correlation (connection) between activities and costs does not necessarily mean causality
  - Only a cause-and-effect relationship establishes the relationship between the level of an activity and its cost

- Work-Measurement Method
  - Estimates cost functions by analyzing the relationship between inputs and outputs in physical terms
  - Includes time-and-motion studies
  - Very thorough and detailed, but also costly and time consuming
  - Physical relationships may be difficult to specify
- Conference Method
  - Estimates cost functions on the basis of analysis and opinions about costs and their drivers gathered from various departments of a company
  - Pools expert knowledge
  - Can be developed quickly
  - Reliance on opinions still makes this method subjective
  - Accuracy depends on the care and skills of the people

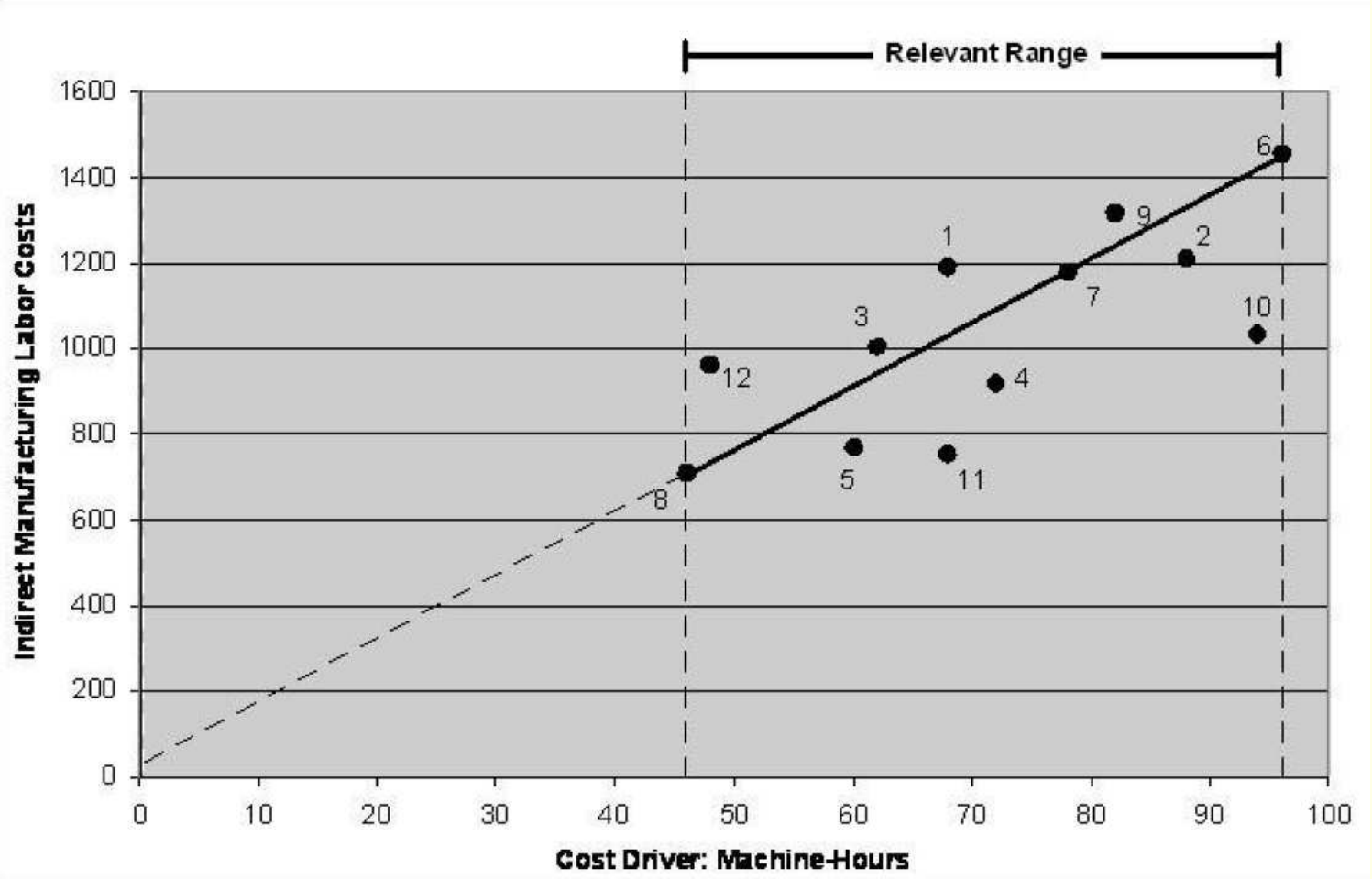
- Account Analysis Method
  - Estimates cost functions by classifying various cost accounts as variable, fixed, or mixed with respect to the identified level of activity
  - Reasonably accurate, cost-effective, and easy to use, but is subjective
- Quantitative Analysis
  - Uses a formal mathematical method to fit cost functions to past data observations
  - Advantage: results are objective
  - Steps of Quantitative Analysis
    1. Choose the dependent variable (the cost to be predicted)
    2. Identify the independent variable or cost driver
    3. Collect data on the dependent variable and the cost driver
    4. Plot the data
    5. Estimate the cost function using High-Low Method or Regression

Week	Cost Driver: Machine-Hours (X)	Indirect Manufacturing Labor Costs (Y)
1	68	$1,190
2	88	1,211
3	62	1,004
4	72	917
5	60	770
6	96	1,456
7	78	1,180
8	46	710
9	82	1,316
10	94	1,032
11	68	752
12	48	963
Total	862	$12,501



- High-Low Method
  - Simplest method of quantitative analysis
  - Uses only the highest and lowest observed values of the cost driver
  - $y = a + bX$
    1. Calculate variable cost per unit of activity (slope coefficient, b)
    2. Calculate Fixed Costs, a
    3. Write the linear equation, $y = a + bX$
- For the example;
  - Highest value of cost driver (Week 6): $X = 96$, $y = 1,456$
  - Lowest value of cost driver (Week 8): $X = 46$, $y = 710$
  - $b = 14.92 \qquad a = 23.68$
  - $y = 23.68 + 14.92X$

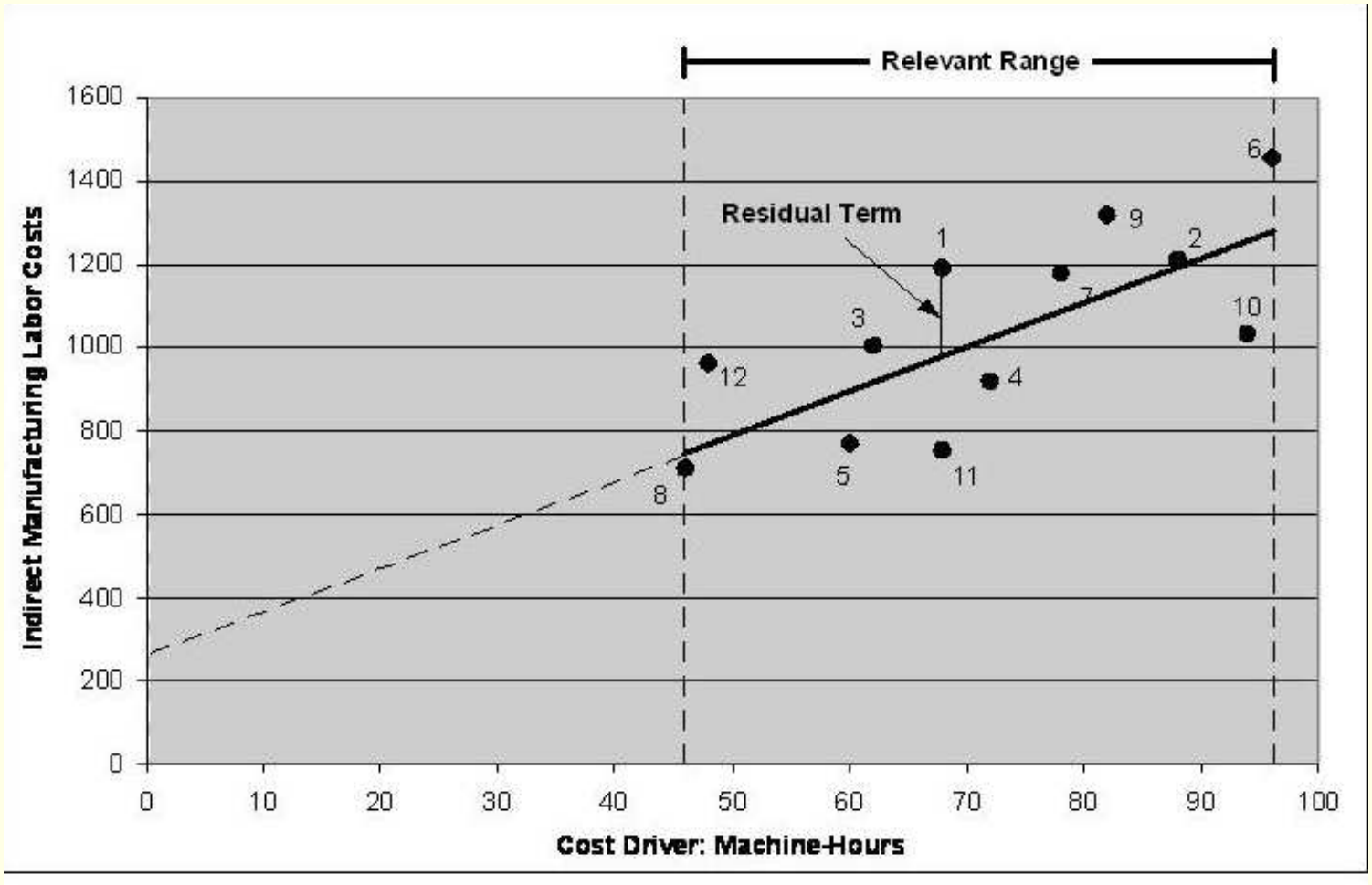
- High-Low Method (continued)



Regression Analysis

- Regression analysis is a statistical method that measures the average amount of change in the dependent variable associated with a unit change in one or more independent variables (cost drivers)
- More accurate than the High-Low method because the regression equation estimates costs using information from *all* observations; the High-Low method uses only *two observations*
- Simple Regression estimates the relationship between the dependent variable and *one* independent variable
- Multiple Regression estimates the relationship between the dependent variable and *two or more* independent variables
- Goodness of Fit indicates the strength of the relationship between the cost driver and costs
- Residual Term measures the distance between actual cost and estimated cost for each observation

Regression Analysis (continued)



- $y = 300.98 + 10.31X$

- Economies of Scale
- Quantity Discounts
- Step Cost Functions: resources increase in ‘lot-sizes’, not individual units
- Learning Curves: labor hours consumed decrease as workers learn their jobs and become better at them
- Experience Curve: broader application of learning curve that includes downstream activities including marketing and distribution

- Cumulative Average-Time Learning Model: *cumulative average time per unit* declines by a constant percentage each time the cumulative quantity of units produced doubles

- Incremental Unit-Time Learning Model: *incremental time needed to produce the last unit* declines by a constant percentage each time the cumulative quantity of units produced doubles

- The mathematical relationship underlying the learning models: $Y = aX^b$ where

  Y = Cumulative average time per unit, or time taken to produce the last unit

  X = Cumulative number of units produced

  a = time required to produce the first unit

  $b = \frac{\ln(\text{learning-curve \% in decimal form})}{\ln 2}$

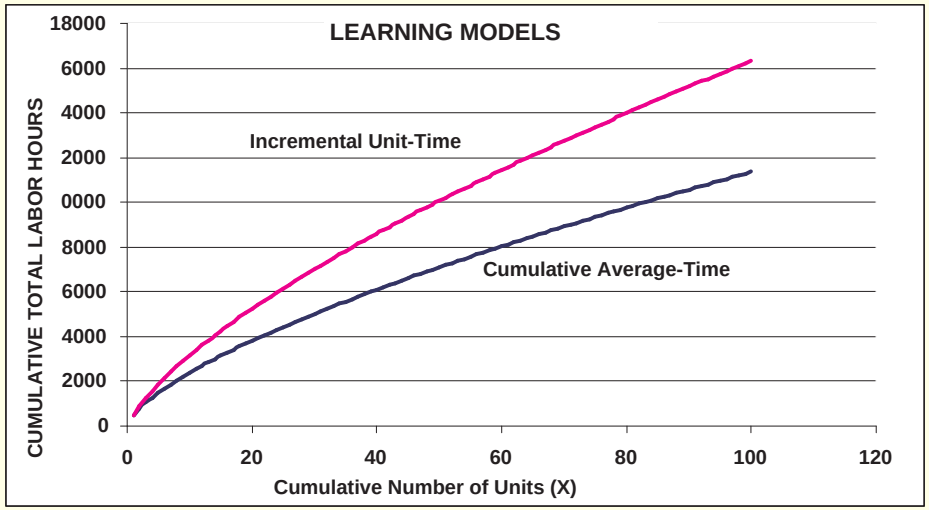
Assume that the first unit is produced using 500 labor hours, and the company uses a 80% learning model. Then, $b = \ln(0.8)/\ln 2 = -0.3219$

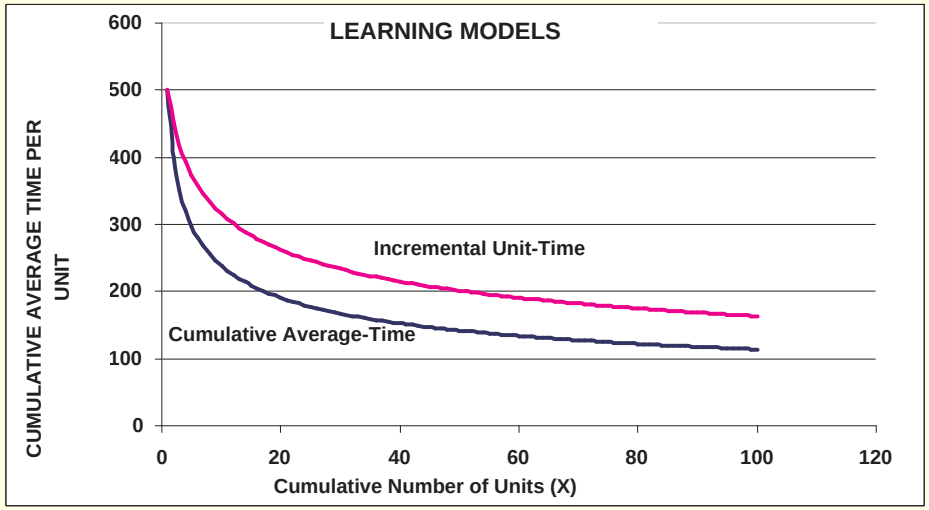
- Cumulative Average-Time Learning Model

Cumulative Number of Units	Cumulative Average Unit Time	Cumulative Total Time	Individual Unit Time
1	500	500	500
2	400 (500×0.8)	800	300
3	351.05 ($500\times 3^{-0.3219}$)	1,053.2	253.16
4	320 (400×0.8)	1,280	226.84

- Incremental Unit-Time Learning Model

Cumulative Number of Units	Incremental Unit Time	Cumulative Total Time	Cumulative Average Unit Time
1	500	500	500
2	400 (500×0.8)	900	450
3	351.05 ($500\times 3^{-0.3219}$)	1,251.05	417.02
4	320 (400×0.8)	1,571.05	392.76


LEARNING MODELS
CUMULATIVE TOTAL LABOR HOURS
18000
6000
4000
2000
0000
8000
6000
4000
2000
0
Incremental Unit-Time
Cumulative Average-Time
0
20
40
60
80
100
120
Cumulative Number of Units (X)


LEARNING MODELS
CUMULATIVE AVERAGE TIME PER UNIT
600
500
400
300
200
100
0
Incremental Unit-Time
Cumulative Average-Time
0
20
40
60
80
100
120
Cumulative Number of Units (X)