I. **Cost Behavior Patterns (Cost Drivers)**
    A. Overview of Cost Accounting Terms and Definitions
        1. The importance of communication in decision making cannot be overstated. It is essential to understand the language of business. The more frequently used terms are defined and categorized below
            a. **TIME-ORIENTED COSTS:** these are costs that bear a specific relationship to periods of time.
                i.   *Historical* cost: The actual exchange price that was paid at the time of acquisition.
                ii. *Sunk cost:* A past cost that is irrelevant to a current economic decision.
                iii. *Estimated cast:* A future cost that can be reasonably ascertained at present.
                iv. *Standard cost:* A predetermination of what costs should be under projected conditions. Often referred to as "engineered cost"
                v.   *Period cost:* An expenditure that relates to a time rather than to an activity index.
            b. **TRACEABILITY-ORIENTED COSTS** these costs are distinguished by our ability to trace them to activity areas.
                i.   *Direct cost:* A cost that *is* internal to a given cost center
                ii. *Indirect cost:* A cost that benefits more than one cost center
                iii. *Product cost:* A cost that can be traced to a given product center
                iv. *Prime Cost:* Direct materials (DM) and direct labor (DL) attributable to a given product center
                v.   *Joint cost:* The common cost of facilities or services employed in the output of two or more simultaneous products of major commercial significance
                vi. *By-product cost:* The cost associated with marketing a secondary product. A byproduct does not carry part of the basic production costs as does a joint product
            c. **CONTROL-ORIENTED COSTS:** these terms are distinguished by our ability to control costs.
                i.   *Controllable cost:* A direct cost for which one person has complete responsibility. *Noncontrollable cost:* A cost for which one person does not have complete responsibility
                ii. *Opportunity cost:* The cost of an alternative, often restricted in definition to the next best alternative
                iii. *Differential* or *marginal cost:* The cost of adding one additional unit of effort. More broadly defined as the difference between costs at two activity levels.
                iv. *Imputed cost:* The subjective and arbitrary determination of cost in the absence of factual data.
                v.   *Postponable cost:* A cost that can be delayed without serious injury to the enterprise
                vi. *Out-of-pocket cost:* That portion of total cost which is represented by the physical outlay of cash
            d. **BEHAVIORALLY-ORIENTED COSTS:** these costs are recognized by the degree of responsiveness to activity indexes.
                i.   *Fixed cost:* A cost which has no recognized activity index or fails to respond to one; fixed in total cost over the relevant range of measurement but vary on a per unit basis
                ii. *Variable cost:* A cost that changes in direct proportion to an activity index; Variable cost are fixed on a per unit basis but vary in total cost amount.
                iii. *Semi-variable cost:* A cost that changes with respect to an activity index, but not in direct proportion

> These cost categories are not mutually exclusive, but they place the terms into a meaningful classification.

    B. **A Closer look at specific classifications**
        1. **TIME-ORIENTED COSTS**: These costs have a strong relationship to time rather than to activity indices. For example, a salary is paid somewhat irrespective of what a person produces in one time period versus another; the same amount of rent is paid each month whether or not a facility is used. <u>Time-oriented costs are generally Fixed Costs</u>.

<div align="center">Examples of Time Oriented Costs</div>

> Rent
> Property tax
> Property insurance premiums
> Depreciation, other than the units-of-production method
> *period* costs (or revenues) should be assigned to the time periods to which they belong. If we pay first and last month's rent, for example, that portion belonging to the last month is considered prepaid rent until we reach the time period to which it belongs, at which time it becomes rent expense. This convention is adhered to even though we recognize that some present period costs may give rise to future revenues.

2. **HISTORICAL COST**
   a. *Historical cost* is the amount actually paid for an item. Financial accounting records are maintained on an historical cost basis. The alternatives to historical cost are:
      i. *Replacement cost:* What it would cost at the present time to replace an asset
      ii. *Earning power cost:* Cost based on the earnings of an asset discounted to its present value
      iii. *Current market value:* What we could sell an asset for at the present time in the open market
   b. While historical cost underlies financial accounting as it is practiced in the United States, in cost accounting we have more freedom to experiment with other cost bases, as cost accounting data is only utilized internally. Note that for management decision making, historical cost may not be the hest guide to value, and so other valuation techniques are often utilized.

3. **SUNK COST**
   a. A *sunk cost* is an historical cost, but in addition it is a cost which does not have relevance (it is not a *future differential cost)* to a current economic decision. For example, in selling a house, what was paid for it originally may be of some interest to the seller, but has no bearing on what the property is worth. The house could have been purchased originally in excess of its value. The fact that the first buyer made a mistake does not mean that his error can be passed on to the second buyer. Or the property could have been purchased for much less than its market value, in which case the first buyer is unlikely to share his profits with the second buyer. <u>The concept of sunk costs is critical to capital budgeting decisions, as we point out in Handout 11.</u>

4. **ESTIMATED AND STANDARD COSTS**
   a. Most modern business activity is based on what products *should cost* rather than on what they *do cost.* It is generally necessary to price a product before actual costs are known. To the extent that pricing relies on cost data, we have to use estimated rather than actual costs for this purpose. For example, the cost of making a particular model automobile is based on this computation:

      $$\frac{\text{Total Costs of Production}}{\text{Number of Autos Produced}} = \text{Cost per Automobile}$$

      Note that the above data is not available until the end of the business year, but it is necessary that we be able to estimate the cost the automobile at the beginning of the year. We use estimated (standard) costs for this purpose. Likewise, a school budget is based on the estimated cost of educating a certain number of students a year. The rates that a hospital charges are based on estimates of patient load and intensity of care needed. Insurance premiums are based on an estimate of the number of claims. In fact, all major organizations operate on the basis of estimated costs.

      The difference between estimated and standard costs turns upon the degree of precision used. *Standard costs* are carefully structured costs, using engineering estimates which break operations down into minute tasks, e.g., how long it should take to produce a certain part on a machine lathe, or the average time needed to install the steering assembly onto an automobile chassis on an assembly line.

5. **TRACEABILITY-ORIENTED COSTS**
   a. <u>COST or PRODUCT CENTERS</u> A *cost center* is a unit of the organization to which costs are assigned and within which they are aggregated.
      i. Cost centers are like systems—we have one within another.
      ii. At the highest level the whole organization is a cost center. if it has two divisions, they are each cost centers, and there are many cost centers at lower levels, right down to specific jobs or products
      iii. In short, a cost center is any unit of activity (Enterprise, Division, Department, Labor etc.) for which it is useful to gather cost information.
   b. DIRECT AND INDIRECT COSTS
      i. *Direct costs* are directly traceable 100% to *one* cost center. For example, DM and DL are both directly traceable to specific manufacturing areas
      ii. *Indirect costs* are those costs that are not directly traceable to specific cost or product centers. Indirect costs are sometimes referred to as **overhead** costs. For example, the cost of the accounting department, janitorial services or security are not directly traceable to specific cost centers and are subsequently shared by the cost centers they benefit.

c. PRODUCT AND PRIME COSTS
   i.   *Prime costs* are direct material (DM) and direct labor (DL) costs that can be traced to a specific product or job.
   ii. *Production overhead* are those other that cannot be traced directly to a product or cost cente

d. JOINT PRODUCT COSTS
   i.   *Joint costs* are direct costs that are shared by cost centers. Joint costs are normally allocated by to products in the ratio of dollar volume of sales.
      1. Once again, each product may have its direct costs, so we are referring only to the common costs of production when we speak of joint costs.
      2. For Example, suppose there are five products, where the joint costs total $100,000. This sum, as stated above, is apportioned among the five products in the ratio of their sales volume

Example of the Allocation of Joint Costs

		Sales Volume	Sales Ratio	Joint Cost Allocation
Product A	$	300,000	.30	$ 30,000
Product B		150,000	.15	15,000
Product C		100,000	.10	10,000
Product D		250,000	.25	25,000
Product E		200,000	.20	20,000
Total	$	1 000 000	1.00	$ 100 000

e. BY-PRODUCT COSTS
   i.   By products are produced as an offshoot of the production process.
   ii. There is no specific intention to produce a by-product.
   iii. For example, saw dust and wood chips are a by-product of a lumber mill that are used to create plywood, inexpensive cabinets and other items.
   iv. A by-product is charged only with the direct costs of preparing it for market(including direct selling and administrative expenses directly attributable to its sales).
   v.   In time some by-products may become major products (gasoline was once a byproduct of kerosene) and *vice versa,* but no general rule has been developed to determine when a by-product should bear its share of general overhead.

6. **CONTROL-ORIENTED COSTS**
   a. CONTROLLABLE VERSUS NON-CONTROLLABLE Costs
      i.   A *controllable cost* is a direct cost for which one person has complete responsibility. A *responsibility accounting system* is where this type of control climate is in effect
      ii. A *non-controllable cost* is a cost for which one person does not have complete responsibility. It may be direct or indirect. There may be costs within a cost center over which no one person in the cost center has complete responsibility, such as rental of space which is negotiated on a central basis.
      iii. A *responsibility accounting system* calls for the separation of costs for which one person is responsible from those over which he has little or no control. Obviously, evaluation of executive performance is influenced most by the ability to manage controllable costs.
   b. OTHER CONTROL-ORIENTED COSTS:
      i.   *Differential costs* (marginal) are the costs that change between two activity points. This concept is allied to variable costs which we discuss in below
      ii. *Imputed costs* are costs assigned to an object through subjective analysis. For example, a piece of equipment may have been donated to a firm, but in order to value its contribution to the organization it is helpful to impute a value. Imputed costs underlie much of the simulation currently applied to business operations, where arbitrary values are assigned and function as variables which can be tested under different assumed operating conditions.
      iii. *Postponable costs* (or *discretionary costs)* are those costs that can be delayed without adversely affecting operations. It separates things that it "would be nice to have" from things that are "really needed."
      iv. *Out-of-pocket* refers to the specific cash outlay involved in a transaction. If you make a $300 down payment on a $3,000 automobile, the $300 is out-of-pocket.

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7. **BEHAVIORALLY-ORIENTED COSTS**
     a. *Cost behavior* refers to the degree of responsiveness to an activity. To illustrate this concept consider depreciation of a vehicle. If we use the straight-line method, the same amount of depreciation will be charged each period without regard to the number of miles we drive the truck. If we use the units-of-production method, however, the depreciation charge is a direct function of mileage. In the former case we have a non-responsive cost, while in the latter case we have a fully responsive cost.
     b. <u>Fixed Costs</u>: do not respond at all to a change in an activity index (they are constant in total and vary on per unit basis).
     c. <u>Variable Costs</u>: change in direct proportion to a change in an activity index (they are constant on a per unit basis by vary by level of activity).
     d. Semi-Variable Costs: change in relation to an activity index, but not in direct proportion.

C. **ACTIVITY INDICES**
     1. Although there are many activity indices, each organization has a *macro-activity index.* This macro-index relates to the principal *production function* of an organization. Every organization has a production function—it is a descriptive of the real purpose of an organization. It is only by comparing resources consumed against the macro-index that we are able to make efficiency judgments on organizations.
     2. If we look at the total fixed, variable, and semi-variable costs of an organization, the macro-index becomes the scale of the *X* axis. Dollars is uniformly the scale of the Y axis

MICRO-INDICES AS SURROGATES OF MACRO-INDEX
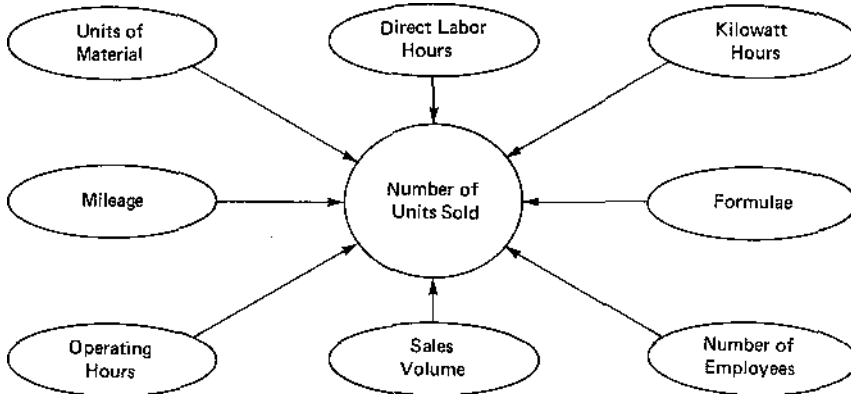
C. **TWO ASSUMPTIONS OF BEHAVIORAL COSTS**
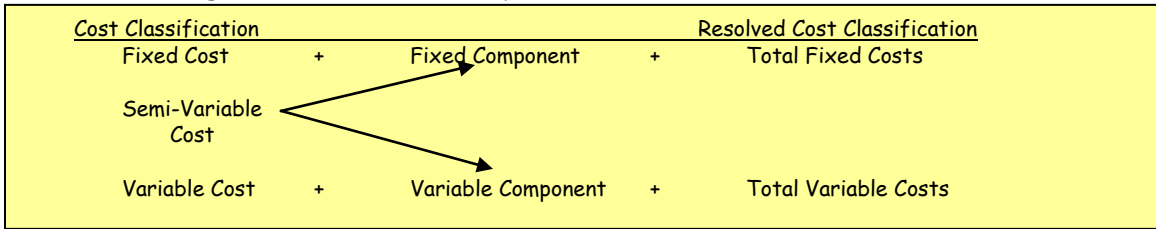   1. The ability to separate costs in terms of behavior rests upon two important assumptions
         a. A time period of one year
         b. A normal macro-activity range (referred to as the" **relevant range"** of operations)
     2. <u>Fixed costs</u> are only assumed to be over the relevant range.
         a. Obviously fixed costs will not remain constant if we drop to zero activity or if we exceed the *normal capacity* of organization (in this case, additional fixed costs need to be incurred to handle the overload)
     3. It is important to note at this point that we can work around this restriction by recognizing series of ranges, as will be explained in Handout 8. This process is referred to as ***flexible budgeting.***

II. **Using Cost Behavior Patterns to Estimate Costs**
   A. **DECOMPOSING SEMI-VARIABLE COSTS**
     1. Fixed and variable costs are linear by definition, while semi-variable costs are curvilinear. Because it is useful to work with linear relationships, it would be useful to convert semi-variable costs into fixed and variable cost components.
         a. Each semi-variable cost consists of a fixed and a variable component. There are three methods for separating the fixed and variable parts of a semi-variable cost
             i. High and Low Point
             ii. Scattergraph
             iii. Regression Analysis

Resolving the Problem Caused by the Curvilinear Nature of Semi-Variable Costs

Cost Classification			Resolved Cost Classification
Fixed Cost	+	Fixed Component	+ Total Fixed Costs
Semi-Variable Cost			
Variable Cost	+	Variable Component	+ Total Variable Costs

2. To illustrate these procedures, it is necessary to have both activity and cost data. Inspection of the data presented below makes it clear that the Fringe Benefit Costs are semi-variable because if they were fixed, the dollar amounts would be the same regardless of changes in volume and if they were variable, the dollar amounts would vary in direct proportion to changes in volume. Neither of these conditions describe the data.

Month	DL Hours	Fringe-Benefit Costs
1	700	$ 750
2	800	840
3	900	930
4	1,000	1,015
5	1,100	1,090
6	1,200	1,170
7	1,350	1,205
8	1,250	1,200
9	1,150	1,130
10	950	970
11	850	900
12	750	800
Total	12,000	$ 12,000

HIGH AND LOW POINT METHOD

1. Select the *highest activity* point with its corresponding dollar amount, which incidentally need not be the highest dollar figure
2. Select the *lowest activity* point with its corresponding dollar amount, *which* in turn need not be the lowest dollar figure
3. Find the difference in activity and in dollars
4. Divide the difference in activity into the difference in dollars to get the variable rate
5. Multiply high and low activity points by the variable rate and subtract the product from the respective dollar amounts in I and 2 above
6. The remainder in each instance is *fixed* cost. It should be the same amount for the high and low levels of activity

Step	Hours	Cost
1.	1,350	$ 1,205
2.	700	750
3.	650	$ 455
4.	$455/650=	$0.70

Step	High Activity	Low Activity
Cost Data	$ 1,205	$ 750
5. Variable Cost Component:		
High (0.70x1,350) =	(945)	
Low (0.70 x 700) =		(490)
6. Fixed Cost Component:	$ 260	$ 260

Fixed cost should be the same value for both the High and Low mentod

A graph of the high and low points method would show fixed costs as intersecting the Y axis at $260.

### GRAPH OF HIGH AND LOW POINTS METHOD
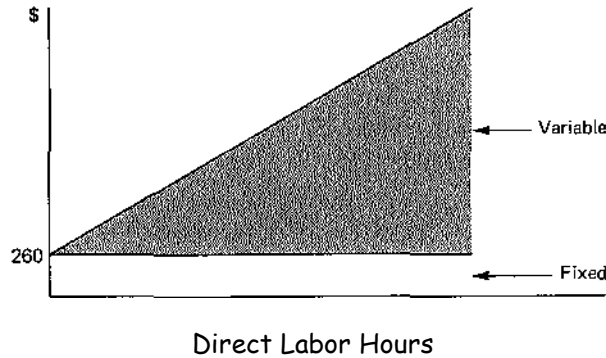
The advantage of the high and low points method lies in its simplicity in calculations. Its disadvantage is that it draws a regression line on the basis of only two data points and assumes that the other points lie on a straight line between the high and low points.

SCATTERGRAPH METHOD: The scattergraph method employs a graphic solution. It requires that we plot the coordinates of each set of activity-cost data. The specific steps of the scattergraph method are enumerated as follows:
1.   Draw a graph to scale, with the axes extending beyond the highest activity and cost points.
2.   Plot the coordinates of each set of data, which may be marked M_1, M_2, ... for each period for purposes of identification.
3.   Visually draw a regression line that appears to represent the thrust of the data
4.   The fixed cost level is determined where the regression line intersects the Y axis.
5.   The variable cost rate is determined conventionally as follows:
   a.   Take the dollar amount at the high activity point.
   b.   Subtract fixed costs obtained in Step 4 .
   c.   The remainder is variable cost at the high activity point.
   d.   Divide variable cost by the high activity figure to get the variable cost rate.

The scattergraph method is applied to our fringe-benefit account as depicted below:

THE SCATTEBGRAPH
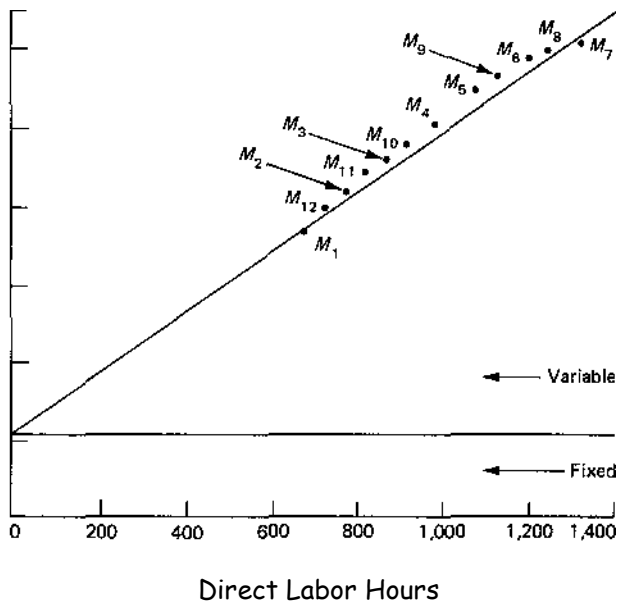
Supporting Computations:
Compute the variable cost rate (as in Step 5):
a.   Cost corresponding with high activity level ..... $ 1,205
b.   Fixed cost per graph   230
c.   Variable cost .... $ 975
d.   Variable cost rate = %975/1,350 hrs = $.72 per direct labor hour
In drawing the regression line, it is *not* necessary to have an equal number of points above and below the line. The objective, as stated before, is to draw a line that represents the thrust of the coordinates.
The scattergraph does take into account all of the data. Its disadvantage lies in one's ability to draw an accurate line of regression.

<u>LINEAR REGRESSION METHOD (LEAST SQUARES) METHOD</u>: Linear Regression (least squares) computes the weight or value of each coordinate in arriving at the line of regression. The formula for this type of solution involves a pair of simultaneous linear equations:

(1) $\sum XY = a\sum X + b\sum Y^2$
(2) $\sum Y = na + b\sum X$

X = activity data
Y = cost data
n = number of periods
a = fixed cost
b = variable cost rate

The fringe-benefit data is arrayed as follows:

(n) Months	(X) Activity Data	(n Cost Data	(XY)	(X-)
1	700 hours	$ 750	525,000	490,000
2	800	840	672,000	640,000
3	900	930	837,000	810,000
4	1,000	1,015	1,015,000	1,000,000
5	1,100	1,090	1,199,000	1,210,000
6	1,200	1,170	1,404.000	1,440,000
7	1,350	1,205	1,626,750	1,822,500
8	1,250	1,200	1,500,000	1,562,500
9	1,150	1,130	1,299,500	1,322,500
10	950	970	921,500	902,500
11	850	900	765,000	722,500
12	750	800	600,000	562,500
	$\sum X$ 12,000	$\sum Y$ 12,000	$\sum XY$ 12,3 64,750	$\sum X^2$ 12,485,000

Substitute the above values in equations (1) and (2)

12,364,750 = 12,000a + 12,485,000b
12,000 = 12a + 12,000b

To eliminate (a):   Repeat (1)   12,364,750 =   12,000a   +   12,485,000b
                    Multiply (2) by −1,000   <u>-12,000,000 =   -12.000a   -   12,000,000b</u>
                                             364,750   =   -0-   485,000b

Solve for b (variable cost rate):   b   =   <u>364,750</u>   =   .752 or 75.2% variable
                                               485,000

Solve for (a) (Fixed Cost):   Substitute .752 for (b) in equation (2)
                                  12,000 =   12a +   12,000(.752)
                                           =   12a +   9,024
                                 2,976   =   12a
                                         a   = $248

Linear regression by means of least squares gives us a more accurate solution to the problem. Fortunately, its primary disadvantage (the amount of manual computation involved) can easily be overcome with the use of calculators or computers.

In separating the fixed and variable portions of semi-variable costs, we can compute each account independently by means of its own activity index or we can group all semi-variable accounts together and regress the total cost data on the basis of the best or most frequent index. In this latter instance the macro-activity index is usually the best one to use.

To download a template for regression visit http://www.business-spreadsheets.com/regfor_om.htm