AC 202 Management Accounting

- *Cost Behavior: Analysis and Use*
- *Absorption Costing and Variable Costing*

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Cost Behavior: Analysis and Use

- Managers must understand how costs behave
- When managers are able to predict cost behavior, they can estimate the amount of costs that are expected to be incurred at different levels of activity and they can use cost data to make decisions

Variable Cost Behavior

- ***Total variable costs*** vary in direct proportion to the level of activity. For example, the more units produced, the higher the total variable cost. ***The unit variable cost*** is the same at every level of activity. Total variable cost is zero if no units are produced.
- Examples of variable costs include:
  - Materials and parts to manufacture products
  - Hourly employee labor (wages) to produce or assemble products or to provide services to customers
  - Some selling expenses, such as commissions and delivery costs of shipping products to customers

Fixed Cost Behavior

- ***Total fixed cost*** remains constant regardless of changes in the level of activity. ***Fixed costs per unit*** changes when a cost driver changes.
- Some example of fixed costs are:
  - Rent
  - Insurance
  - Wages & salaries for employees, such as supervisors and janitors
  - Advertising and marketing costs
  - Depreciation on equipment and buildings

Assumptions

- To estimate cost behavior, the following must be assumed:
  - The number of units produced is equal to the number of units sold. In other words, there is no change in inventory levels.
  - Changes in total costs can be explained by changes in the level of a single activity (*the cost driver*)
  - The level of activity (sales and production) occurs within the relevant range.

The Relevant Range

- A relevant range is a range of activity within which a particular cost behavior holds true. It is the normal range of production or sales that can be expected for a particular product or company.
- For example, retail store may have normal monthly revenues ranging from *$450,000 to $580,000*. The costs that are identified as fixed, such as salesperson salaries, are expected to remain the same throughout the entire relevant range. If sales were to increase to $650,000, the company would likely acquire additional salesperson, thereby increasing its fixed costs. Conversely, if sales drop to $320,000, the company would likely lay off a salesperson to reduce total fixed costs.

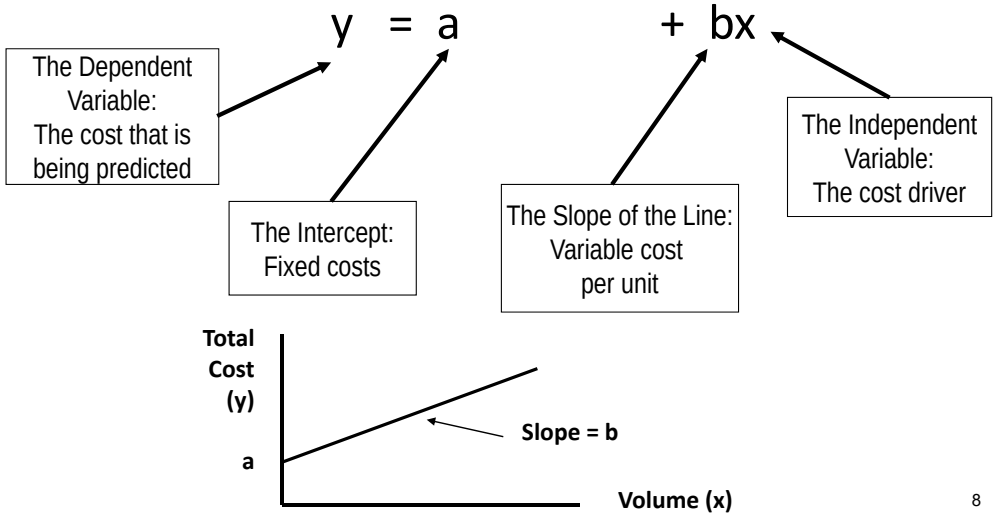
The Relevant Range

- Managers expect that within the relevant range, fixed costs will remain the same in total, and variable costs will increase proportionately in total as activity levels increase.
  - Costs behave in a *linear* manner (graphically, the total cost versus the level of a single activity related to that cost is a straight line)
- Above or below the relevant range, forecasts of cost behavior may not be linear and predictions of future costs will be less accurate.

The Linear Cost Function

A mathematical representation describing how costs change with changes in the level of an activity

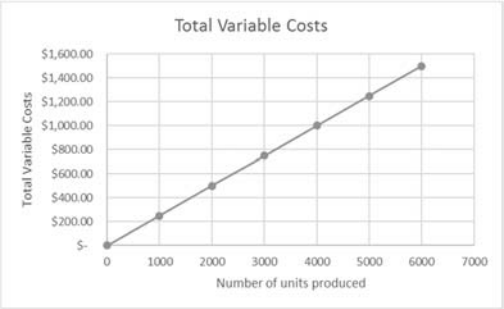
Total Costs = Fixed Costs + Variable Costs



Example: Variable Cost Behavior

- Assume that Beach Co. produces beach buckets at a variable production cost of $0.25 each.

Units	Costs
0	$ 0
1000	$ 250.00
2000	$ 500.00
3000	$ 750.00
4000	$ 1,000.00
5000	$ 1,250.00
6000	$ 1,500.00



- As the number of units produced increases, the total cost increases. However, the unit variable cost is the same at every level of activity.

Variable Cost Function: $y = a + bx$

- The mathematical function of this line is shown as:

$y = \$0.25x$

The slope of the cost function is $0.25

where Y is the total cost and x represents the "activity"

- In this case, the activity is the number of buckets produced & sold.

Example: Fixed Cost Behavior

- Assume that Beach Co. incurs a monthly rental cost on its retail store totaling $200, regardless of the number of buckets the company produces and sells.

- The total monthly rent cost is not dependent upon the number of buckets sold. However, unit fixed costs vary inversely when more or fewer units are produced and sold.

Fixed Cost Function: $y = a + bx$

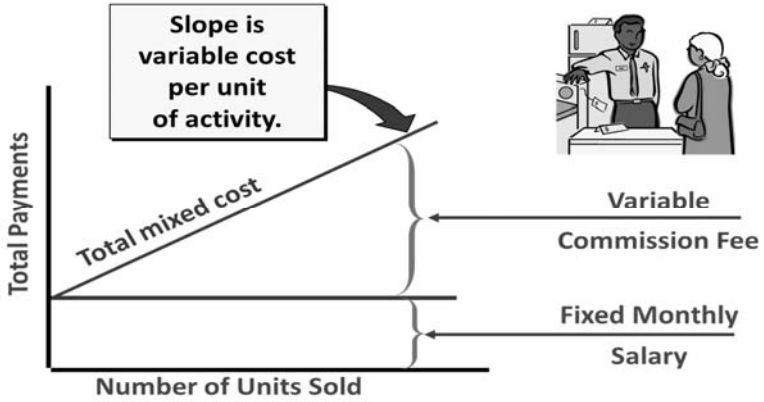
- The math function for this cost is:

y = $200

$200 is called a constant or intercept.
The slope of the cost function is zero.

Mixed Cost Behavior

- *Mixed costs,* often called semi-variable costs, contain *a fixed portion* that is incurred even when facility is unused, and *a variable portion* that increases with usage.



Mixed Cost Function: $y = a + bx$

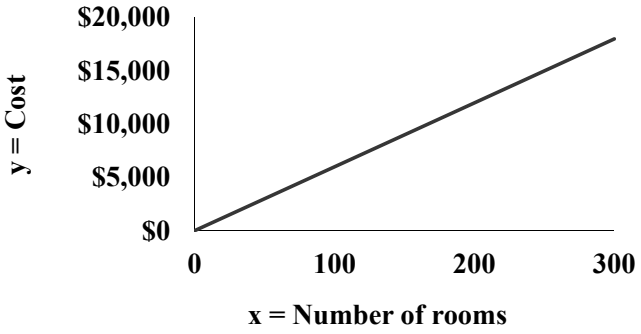
- Assume that Beach Co. incurs a basic monthly cell phone fee totaling $450. In addition, the cell phone contract requires an additional $15 cost for each gigabyte of data used beyond the allotted 4 gigabytes.
- The math function for data usage cost is:

$y = \$450 + \$15x$
The slope of the cost function is $15

- where Y is the total cost and X is the additional gigabytes of data used above 4 gigabytes.
- Managers must break down all mixed costs into fixed and variable portions.

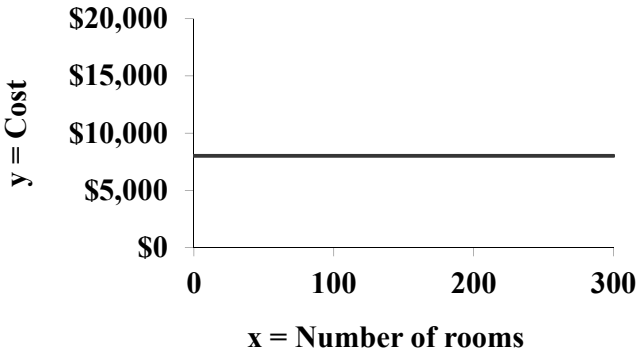
Example: Cost Function

Regent Hotel offers an airline 3 alternative cost structures to accommodate its crew overnight:
1) $60 per night per room usage
$y =$ _____
The slope of the cost function is $60.



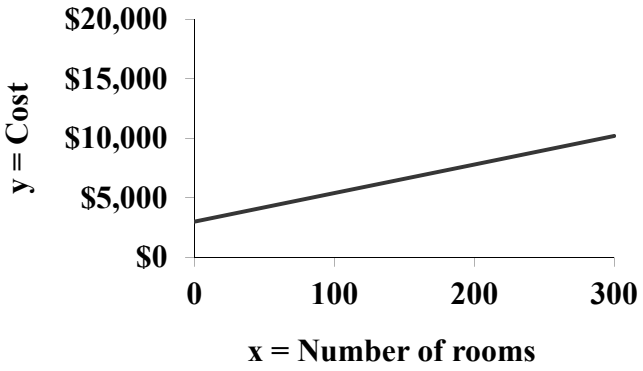
Example: Cost Function

2) $8,000 per month
y = _____
$8,000 is called a constant or intercept.
The slope of the cost function is zero.



Example: Cost Function

3) $3,000 per month plus $24 per room
This is an example of a mixed cost.
$y =$ _____
The slope of the cost function is 24.



Cost Estimation

- Cost estimation methods are necessary only for costs that are identified as mixed costs. There is no need to apply an estimation method to break a cost into fixed and variable portions if you have already determined it is solely fixed or solely variable.
- *Cost estimation* is the attempt to measure a past cost relationship between costs and the level of an activity.
- Past cost-behavior functions can help managers make more accurate *cost predictions*.

Criteria for Classifying Variable and Fixed Components of a Cost

❶ *Choice of Cost Object* – different objects may result in different classification of the same cost, i.e.,
- If the *number of taxis owned* by a taxi company is the cost object, annual taxi registration and license fees would be variable costs.
- If *miles driven during a year* on a particular taxi is the cost object, registration and license fees for that taxi are fixed costs.

❷ *Relevant Range* – behavior is predictable only within this band of activity

Cost Estimation Approaches

❶ Engineering Approach
❷ Account Analysis Approach
❸ Scatter Diagram Approach
❹ Quantitative Analysis Approach
- 4.1 High-Low Method
- 4.2 Regression Analysis

❶ *Engineering Approach*

- This approach classifies costs based upon an industrial engineer's evaluation of production methods, and material, labor and overhead requirements.
- Estimates cost functions by analyzing the relationship between inputs and outputs in physical terms
- Includes time-and-motion studies, i.e.,
  - 1 unit of product requires 1 DLH @ $50 per hour
  - The result is an estimated cost function relating DL costs to units of product produced
- Very thorough and detailed, but also costly and time consuming
  - Physical relationships between inputs and outputs are difficult to specify for some individual cost items, i.e., R&D, advertising.

❷ *Account Analysis Approach*

- Managers use judgment and experience to estimate cost functions by classifying cost accounts in the ledger as variable, fixed, or mixed with respect to the identified activity
- It is reasonably accurate, cost-effective, and easy to use, but is subjective (experience & judgment)

Account Analysis Example

Avis & Co. sells software programs. The company sold 1,000 programs with total sales $390,000

Costs	Amount	VC	FC
Cost of goods sold	$130,000		
Manager's salary	$40,000		
Secretary's salary	$29,000		
Rent expense	$20,000		
Commissions	12% of sales		

Account Analysis Example

- Total fixed costs

  = $40,000 + $29,000 + $20,000

  = $89,000

- Total variable costs

  = $130,000 + (12% x $390,000)

  = $130,000 + $46,800 = $175,800

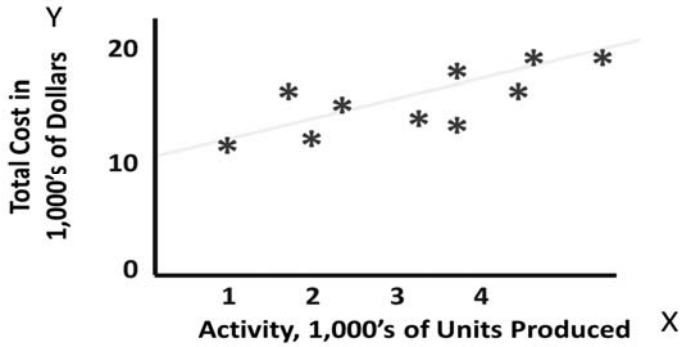
- Variable cost per unit sold

  = $176,900 ÷ 1,000 units = $176.80

$$Y = \$89{,}000 + \$176.8\,X$$

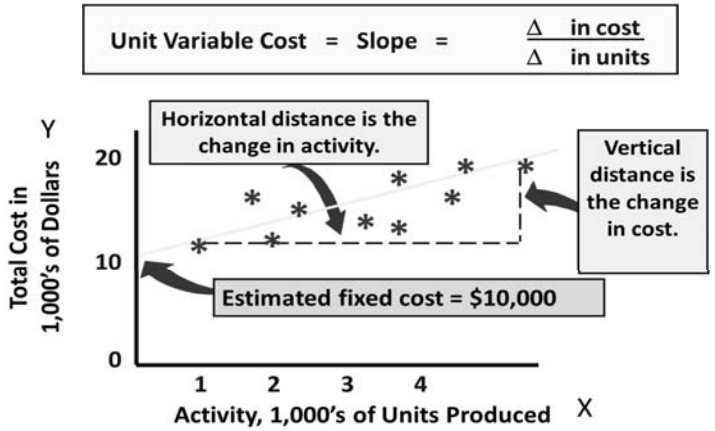
❸ Scatter Diagram Approach

- It provides a visual picture of the total costs at different activity levels.
- *Step 1*: Draw a graph with the total cost on the y-axis and the activity (units) on the x-axis. Plot the total costs for each activity point.
- *Step 2*: Draw a straight line through the data points.



❸ Scatter Diagram Approach

- *Step 3*: Determine variable cost per unit by identifying the slope
- *Step 4*: Identify where the line crosses the y-axis. This is the total fixed cost amount
- *Step 5*: Write a cost function: y = a + bx



❹ Quantitative Analysis Approach

- Uses a formal mathematical method to fit cost functions to past data observations
  - 4.1 High-Low Method
  - 4.2 Regression Analysis
- Advantage: results are objective. No judgment is needed.

4.1 High-Low Method

- Simplest method of quantitative analysis
- Uses only the highest and lowest activity levels of a data set
- Steps in the High-Low Method
  - ❶ Choose the data points pertaining to the highest and lowest activity levels and calculate variable cost per unit of activity

$$\text{Unit Variable Cost} = \frac{\{\text{Cost associated with highest activity level} - \text{Cost associated with lowest activity level}\}}{\text{Highest activity level} - \text{Lowest activity level}}$$

4.1 High-Low Method

	Month	Machine Hours*	Electricity Costs
	August	31,000	$64,000
Lowest MHs →	September	**30,000**	**$64,200**
	October	47,000	$73,500
	November	52,000	$79,000
Highest MHs →	December	**55,000**	**$80,450**

*Focus on the highest & lowest cost drivers.

What is the variable cost per MH?
($80,450 – $64,200) ÷ (55,000 – 30,000)
$16,250 ÷ 25,000 = $0.65

4.1 High-Low Method

❷ Calculate Total Fixed Costs

Total Cost from either the highest or lowest activity level
– (Variable Cost per unit of activity X Activity associated with above total cost)
Fixed Costs

❸ Summarize by writing a linear equation

Y = Fixed costs + (Variable cost per unit of Activity * Activity)

Y = a + b X

4.1 High-Low Method

Or

What is the fixed cost?
$80,450 = Fixed cost + (55,000 × $0.65)
Fixed cost = $80,450 – $35,750 = $44,700

$64,200 = Fixed cost + (30,000 × $0.65)
Fixed cost = $64,200 – $19,500 = $44,700

$y = a + bx$
y = $44,700 + ($0.65 × MH)

4.2 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
- It is 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

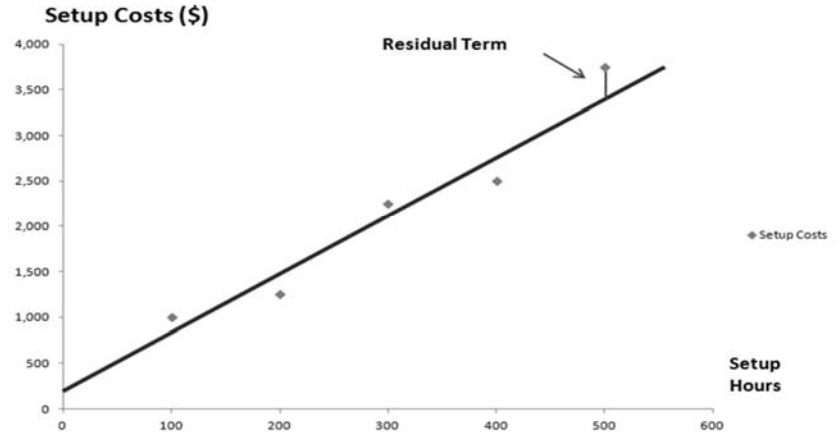
Simple Regression Example

- Software can be used to fit a regression line through the data points.

Month	Setup Costs	Setup Hours
Jan	1,000	100
Feb	1,250	200
Mar	2,250	300
Apr	2,500	400
May	3,750	500

Simple Regression Example

Linear regression calculates an equation that minimizes the distance between the fitted line and all of the data points.



Residual Term – measures the distance between actual cost and estimated cost for each observation

Simple Regression Example

Regression Statistics	
Multiple R	0.971751264
R Square	**0.944300518**
Adjusted R Square	0.925734024
Standard Error	299.3047499
Observations	5

The results give rise to the following equation:
Setup costs = $125 + ($6.75 x Setup hours)

ANOVA

	df	SS	MS	F	Significance F
Regression	1	4556250	4556250	50.86046512	0.005675231
Residual	3	268750	89583.33333		
Total	4	4825000			

	Coefficients	Standard Error	t Stat	P-value
Intercept	**125**	313.91347	0.398198905	0.717129011
Setup Hours	**6.75**	0.946484724	7.131652341	0.005675231

Simple Regression Example

- R^2 → *Goodness of Fit* – indicates the degree of association between the cost driver and costs
- R^2 = *.944*, or *94.4 percent of the variation in setup costs is explained by the number of setup hours variable*
- In general, the higher the R^2, the better the model fits your data.
- *P-value of cost driver* shows the level of statistical significance. If the reported P-value is less than the specified degree of confidence (for example, 0.05), the independent variable is a significant explanatory variable.

Multiple Regression Example

Month	Utilities Cost ($)	Summer	MH
Jan	1,740	0	1,340
Feb	1,636	0	1,298
Mar	1,788	0	1,376
Apr	1,770	0	1,405
May	2,390	1	1,500
Jun	2,304	1	1,432
Jul	2,250	1	1,322
Aug	2,284	1	1,416
Sep	2,260	1	1,370
Oct	1,991	0	1,580
Nov	1,840	0	1,460
Dec	1,867	0	1,455

Multiple Regression Example

Regression Statistics					
Multiple R	0.9957				
R Square	**0.9914**				
Adjusted R Square	0.9895				
Standard Error	27.5753				
Observations	12.0000				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	788538.4219	394269.2109	518.5040	0.0000
Residual	9	6843.5781	760.3976		
Total	11	795382.0000			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	
Intercept	**291.5792**	148.2778	1.9664	0.0808	
Summer	**501.8800**	16.1696	31.0385	0.0000	
MH	**1.0683**	0.1044	10.2291	0.0000	

Multiple Regression Example

- The results gives rise to the following equation:

Utilities cost = $291.58 + $1.068 (Machine hours) + ($501.88 × Summer)

- R^2 = *.991*, or *99.1 percent of the variation in utilities cost is explained by the machine hours and summer variables.*
- Based on P-value (< 0.05), the machine hours and summer variables are significant explanatory variables.

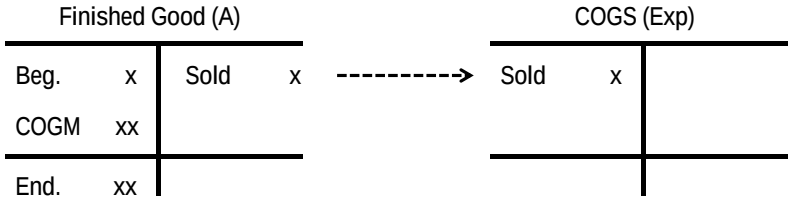
Criteria to Evaluate and Choose Cost Drivers

In evaluating a cost driver look for:

- *Goodness of fit (R^2)*
  - How many % of the change in the dependent variable can be explained by the change in the independent variable?
- *Significance of the Independent Variable (P-value)*
  - Are the relationships between the dependent and independent variables strong or weak?
- *Economic Plausibility*
  - Does it make sense that the cost driver would explain changes in the cost?

Cost Classification: By Function

- *Inventoriable costs or product costs*
  - All costs of a product that are regarded as an *asset* (reported in the statement of financial position) when incurred (all manufacturing costs & costs of net purchases) and then become cost of goods sold (reported in the income statement) when product sold.



- *Period costs*
  - All nonmanufacturing costs in the income statement other than cost of goods sold, i.e. selling costs, general and administrative costs. Period costs are recorded as *expenses* of the accounting period in which they are incurred.

Inventory-Costing Methods

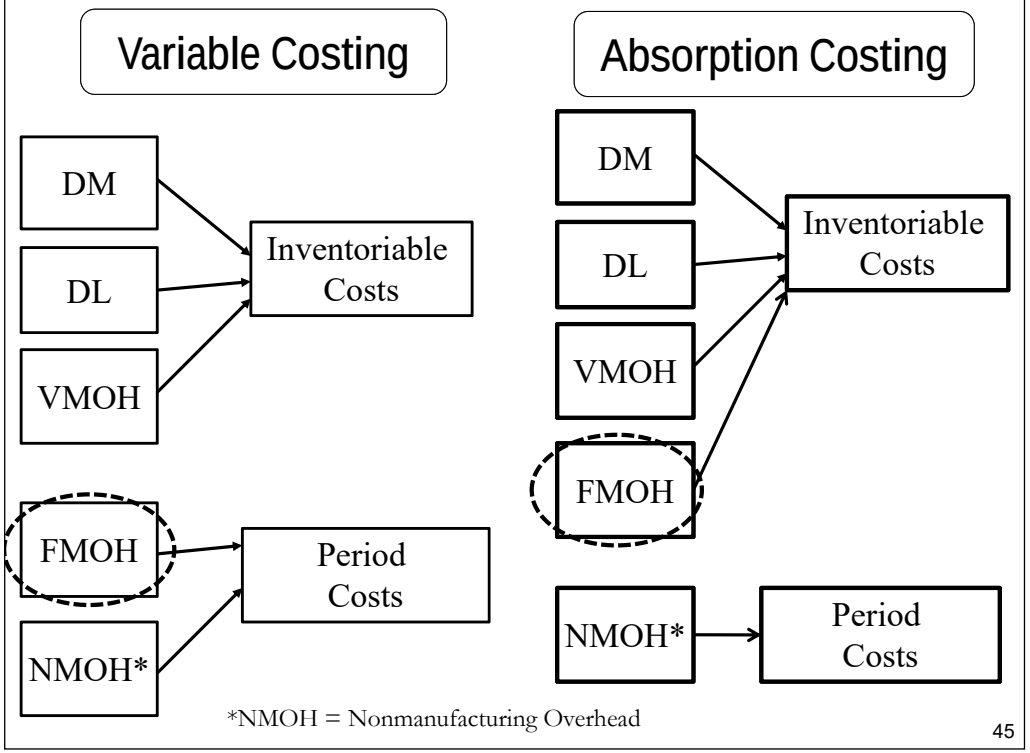
- Inventory costing choices:
  - Absorption costing
    - Generally Accepted Accounting Principles (GAAP) requires absorption costing for inventory
  - Variable costing
- The difference between variable costing and absorption costing is based on the treatment of *fixed manufacturing overhead*

Absorption Costing

- **Absorption (Full) costing** includes all variable and fixed *manufacturing costs* as inventoriable costs
- Inventoriable costs:
  - Direct material (DM)
  - Direct labor (DL)
  - Variable manufacturing overhead (VMOH)
  - *Fixed manufacturing overhead (FMOH)*
- Period costs:
  - Nonmanufacturing costs (i.e., selling and administrative expenses)

Variable Costing

- **Variable costing** (or direct costing) includes all *variable manufacturing costs* as inventoriable costs; all fixed manufacturing costs are treated as costs of the period in which they are incurred
- *Inventoriable costs*
  - Direct material (DM)
  - Direct labor (DL)
  - Variable manufacturing overhead (VMOH)
- *Period costs* (expense in period incurred):
  - *Fixed manufacturing overhead (FMOH)*
  - Nonmanufacturing costs (i.e., selling and administrative expenses)



Income Statement Formats

Absorption Costing Gross Margin Format (Financial Accounting)	Variable Costing Contribution Margin Format (Management Accounting)
❖ Revenues	❖ Revenues
❖ Less: Cost of Goods Sold	❖ Less: Variable Costs
❖ Gross Margin	❖ Contribution Margin
❖ Less: Period Costs	❖ Less: Fixed Costs
❖ Operating Income	❖ Operating Income
Product costs vs. Period costs	Variable costs vs. Fixed costs

Comparing Income Statements

The following data pertain to Davenport Fixtures:

Budgeted sales price per unit = $71.00

Budgeted variable manufacturing costs per unit:

DM:	$ 4.00
DL:	$21.00
VMOH:	$24.00

Budgeted FMOH	= $54,000
Normal (planned) capacity	= 12,000 units
FMOH rate ($54,000 ÷ 12,000)	= $4.50 per unit

Comparing Income Statements

MOH is applied based on number of units produced.

Budgeted nonmanufacturing costs:

- Fixed selling & administrative expenses
  = $30,000 per year
- Variable selling & administrative expenses
  = $2.00 per unit sold

Assume that at the end of the 1st, 2nd and 3rd periods, actual costs were the same as budgeted costs.

Comparing Income Statements

Actual units produced & sold were as followed:

	Year 1	Year 2	Year 3
Beginning inventory	-0-	-0-	4,000
Produced	12,000	12,000	12,000
Sold	12,000	8,000	13,000
Ending inventory	-0-	4,000	3,000

Variable Costing Income Statement

Inventoriable costs = DM + DL + VMOH

What are revenues for year 1?

What is the cost of goods sold for Year 1?

Variable Costing Income Statement

Year 1

Revenues (12,000 × $71)		$852,000
Variable COGS (12,000 × $49)	588,000	
Variable S&A expenses (12,000 × $2)	24,000	
Total variable costs		(612,000)
Contribution margin		240,000
Fixed MOH	54,000	
Fixed S&A expenses	30,000	
Total fixed costs		(84,000)
Operating income		$ 156,000

Variable Costing Income Statement

Year 2

Revenues (8,000 × $71)		$568,000
Variable COGS (8,000 × $49)	392,000	
Variable S&A expenses (8,000 × $2)	16,000	
Total variable Costs		(408,000)
Contribution margin		160,000
Fixed MOH	54,000	
Fixed S&A expenses	30,000	
Total fixed costs		(84,000)
Operating income		$ 76,000

Variable Costing Income Statement

Year 3

Revenues (13,000 × $71)		$923,000
Variable COGS (13,000 × $49)	637,000	
Variable S&A expenses (13,000 × $2)	26,000	
Total variable Costs		(663,000)
Contribution margin		260,000
Fixed MOH	54,000	
Fixed S&A expenses	30,000	
Total fixed costs		(84,000)
Operating income		$176,000

Variable Costing Income Statement

	Year 1	Year 2	Year 3	*Combined*
Revenues	$852,000	$568,000	$923,000	*$2,343,000*
VCOGS	588,000	392,000	637,000	*1,617,000*
V S&A	24,000	16,000	26,000	*66,000*
Total variable costs	612,000	408,000	663,000	*1,683,000*
Net contribution margin	240,000	160,000	260,000	*660,000*
FMOH	54,000	54,000	54,000	*162,000*
F S&A	30,000	30,000	30,000	*90,000*
Total fixed costs	84,000	84,000	84,000	*252,000*
Operating income	156,000	$ 76,000	$176,000	*$408,000*

Absorption Costing Income Statement (DM + DL + VMOH + FMOH)

What are revenues for year 1?

What is the cost of goods sold for Year 1?

Absorption Costing Income Statements

Year 1

Revenues (12,000 × $71)		$852,000
COGS (12,000 × $53.5)		642,000
Gross margin		210,000
Nonmanufacturing costs:		
Variable S&A expenses (12,000 × $2)	24,000	
Fixed S&A expenses	30,000	(54,000)
Operating income		$ 156,000

Absorption Costing Income Statements

Year 2

Revenues (8,000 × $71)		$568,000
COGS (8,000 × $53.5)		428,000
Gross margin		140,000
Nonmanufacturing costs:		
Variable S&A expenses (8,000 × $2)	16,000	
Fixed S&A expenses	30,000	(46,000)
Operating income		$ 94,000

Absorption Costing Income Statements

Year 3

Revenues (13,000 × $71)		$923,000
COGS (13,000 × $53.5)		695,500
Gross margin		227,500
Nonmanufacturing costs:		
Variable S&A expenses (13,000 × $2)	26,000	
Fixed S&A expenses	30,000	(56,000)
Operating income		$171,500

Absorption Costing Income Statements

	Year 1	Year 2	Year 3	Combined
Revenues	$852,000	$568,000	$923,000	$2,343,000
COGS	(642,000)	(428,000)	(695,500)	(1,765,500)
Gross margin	210,000	140,000	227,500	577,500
Variable S&A	(24,000)	(16,000)	(26,000)	(66,000)
Fixed S&A	(30,000)	(30,000)	(30,000)	(90,000)
Operating income	$156,000	$ 94,000	$171,500	$421,500

Comparison of Variable and Absorption Costing

Variable costing operating income Year 1: $156,000

Absorption costing operating income Year 1: $156,000

AC operating income = VC operating income

Production = sales in Year 1

Comparison of Variable and Absorption Costing

❖ The difference between variable costing and absorption costing is based on *the treatment of fixed manufacturing overhead*

FMOH = $54,000

VC
Expense = $54,000

AC
Asset = $54,000

COGS = 12,000 x $4.5
= $54,000

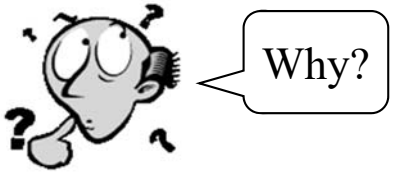
So expenses are the same under VC & AC, operating incomes then are the same

Comparison of Variable and Absorption Costing

Variable costing operating income Year 2: $76,000

Absorption costing operating income Year 2: $94,000

Absorption costing operating income is $18,000 higher.



Production > sales in Year 2

Comparison of Variable and Absorption Costing

FMOH = $54,000

VC
Expense = $54,000

AC
Asset = $54,000

COGS = 8,000 x $4.5
= $36,000

Asset = $18,000

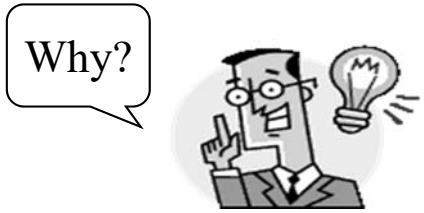
So expense under VC is higher, OI then is lower

Comparison of Variable and Absorption Costing

Variable costing operating income Year 3: *$176,000*

Absorption costing operating income Year 3: *$171,500*

Variable costing operating income is *$4,500* higher.



Production < sales in Year 3

Comparison of Variable and Absorption Costing

FMOH = $54,000

VC
Expense = $54,000

AC
Asset = $54,000

COGS = 13,000 x $4.5
= $58,500

So expense under AC is higher by $4,500, OI then is lower

Comparison of Variable and Absorption Costing

Variable costing combined net income:	$408,000
Absorption costing combined net income:	$421,500
Absorption costing is higher by	$13,500

Total production > Total sales

Comparison of Variable and Absorption Costing

FMOH = $54,000 x 3 years = $162,000

VC
Expense = $162,000

AC
Asset = $162,000

COGS = 33,000 x $4.5
= $148,500

Asset = $13,500

So expense under VC is higher, OI then is lower

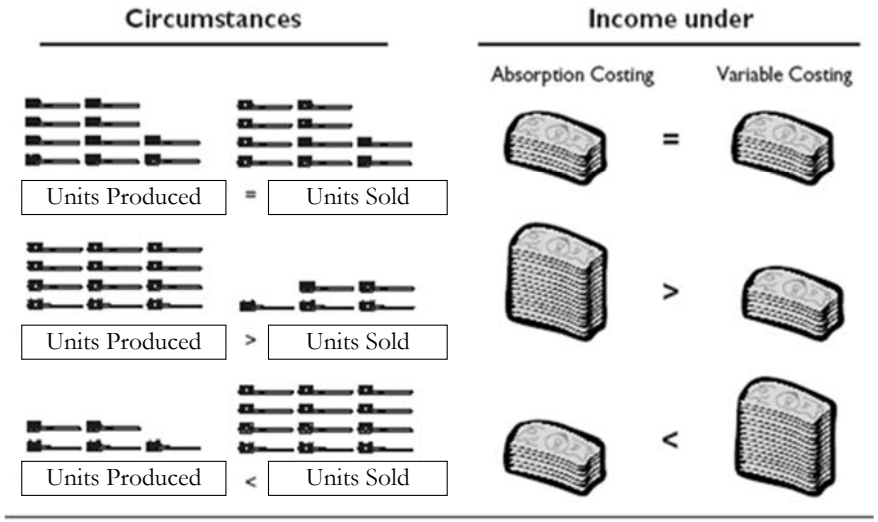
Comparison of Variable and Absorption Costing

3,000 units in ending inventory:	
VC: 3,000 units × $49	= $147,000
AC: 3,000 units × $53.5	= $160,500
Difference	= $ 13,500

3,000 units x $4.5

Comparison of Variable & Absorption Costing

- Variable costing *does not defer* fixed manufacturing overhead to the future - i.e., *they are not inventoried*



Decision-Making Concerns

- Generally Accepted Accounting Principles (GAAP)
  - Must be followed for external reporting
  - Requires *absorption costing* for inventory
  - Does *not* differentiate between fixed and variable costs
- Absorption costing can provide *undesirable incentives* for managers to manipulate income by producing too many units even if there is no customer demand for the additional production → lower cost per unit → higher income
- Thus, variable costing is used for *internal decision making*