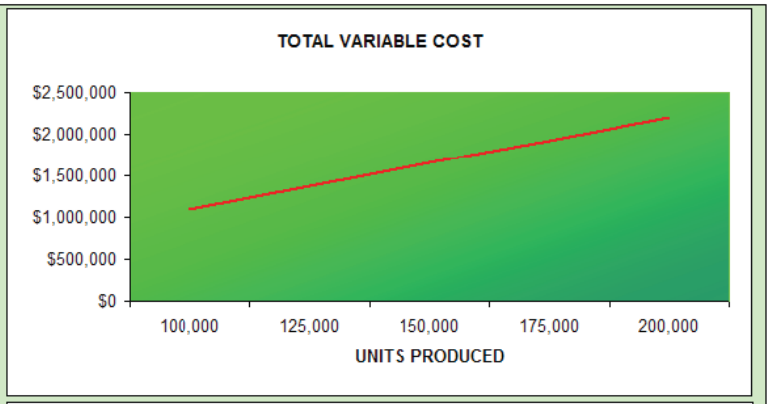
Variable Costs and Fixed Costs

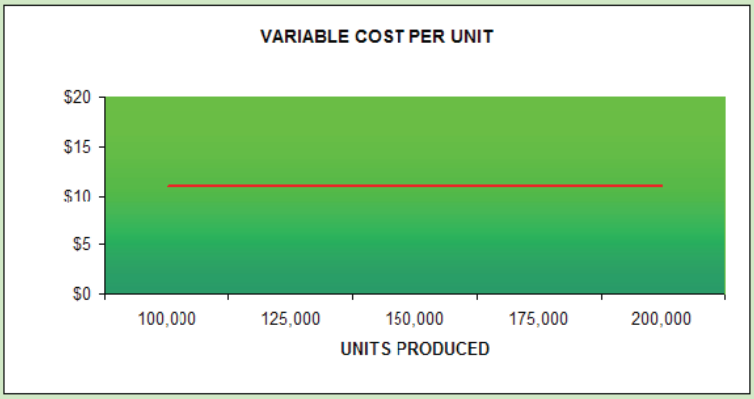
6.2 Variable Costs

Variable costs will vary in direct proportion to changes in the level of an activity. For example, direct material, direct labor, sales commissions, fuel cost for a trucking company, and so on, may be expected to increase with each additional unit of output.

Assume that GoSound produces portable digital music players. Each unit produced requires a printed circuit board (PCB) that costs $11. Below is a spreadsheet that reveals rising PCB costs with increases in unit production. For example, $1,650,000 is spent when 150,000 units are produced (150,000 X $11 = $1,650,000). The data are plotted on the graphs. The top graph reveals that total variable cost increases in a linear fashion as total production rises. The slope of the line is constant. Of course, when plotted on a "per unit" basis (the bottom graph), the variable cost is constant at $11 per unit. Increases in volume do not change the per unit cost. In summary, every additional unit produced brings another incremental unit of variable cost.

Units	PCB	PCB per unit (PCB/UNITS)
100,000	$1,100,000	$11
125,000	$1,375,000	$11
150,000	$1,650,000	$11
175,000	$1,925,000	$11
200,000	$2,200,000	$11



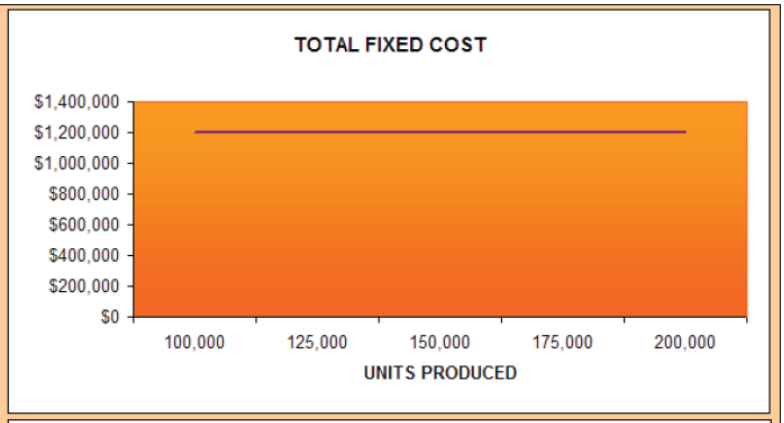


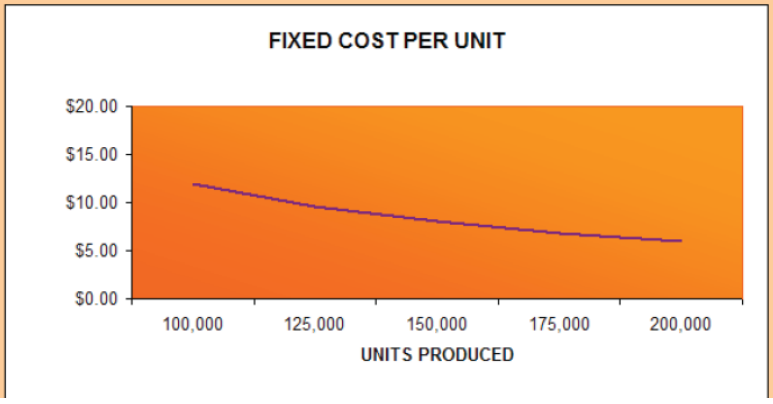
The activity base is the item or event that causes the incurrence of a variable cost. It is easy to think of the activity base in terms of units produced, but it can be more than that. Activity can relate to labor hours worked, units sold, customers processed, or other such "cost drivers." For instance, a dentist uses a new pair of disposable gloves for each patient seen, no matter how many teeth are being filled. Therefore, disposable gloves are variable and key on patient count. But, the material used for fillings is a variable that is tied to the number of decayed teeth that are repaired. Some patients have none, some have one, and others have many. So, each variable cost must be considered independently and with careful attention to what activity drives the cost.

6.3 Fixed Costs

The opposite of variable costs are fixed costs. Fixed costs do not fluctuate with changes in the level of activity. Assume that GoSound leases the manufacturing facility where the portable digital music players are assembled. Assume that rent is $1,200,000 no matter the level of production. The rent is said to be a "fixed" cost, because total rent will not change as output rises and falls. The following spreadsheet reveals the factory rent incurred at different levels of production and the resulting "per unit" rent amount. Observe that the fixed cost per unit will decline with increases in production. This attribute of fixed costs is important to consider in assessing the scalability of a business proposition. There are numerous types of fixed costs. Examples include administrative salaries, rents, property taxes, security, networking infrastructure support, and so forth.

Units	Factory Rent	Rent per unit (RENT/UNITS)
100,000	$1,200,000	$12.00
125,000	$1,200,000	$9.60
150,000	$1,200,000	$8.00
175,000	$1,200,000	$6.86
200,000	$1,200,000	$6.00





8. Break-Even and Target Income

CVP analysis is imperative for management. It is used to build an understanding of the relationship between costs, business volume, and profitability. The analysis focuses on the interplay of pricing, volume, variable and fixed costs, and product mix. This analysis will drive decisions about what products to offer, how to price them, and how to manage an organization's cost structure. CVP is at the heart of techniques that are useful for calculating the break-even point, volume levels necessary to achieve targeted income levels, and similar computations. The starting point for these calculations is to consider the contribution margin.

8.1 Contribution Margin

The contribution margin is revenues minus variable expenses. Do not confuse the contribution margin with gross profit as discussed in the previous chapter (revenues minus cost of sales). Gross profit would be calculated after deducting all manufacturing costs associated with sold units, whether fixed or variable. Instead, the contribution margin is a conceptual number reflecting the amount available from each sale, after deducting all variable costs associated with the units sold. Some of these variable costs are product costs, and some are selling and administrative in nature. The contribution margin is generally a number calculated for internal use and analysis; it does not ordinarily become a part of the externally reported data set.

8.2 Contribution Margin: Aggregated, per Unit, or Ratio?

When speaking of the contribution margin, one might be referring to aggregated data, per unit data, or ratios. This point is illustrated below for Leyland Sports, a manufacturer of score board signs. The production cost is $500 per sign, and Leyland pays its sales representatives $300 per sign sold. Thus, variable costs are $800 per sign. Each sign sells for $2,000. Leyland's contribution margin is $1,200 ($2,000 - ($500 + $300)) per sign. In addition, assume that Leyland incurs $1,200,000 of fixed costs, regardless of the level of activity. Below is a schedule with contribution margin information, assuming 1,000 units are produced and sold:

	Total	Per Unit	Ratio
Sales (1,000 X $2,000)	$2,000,000	$2,000	100%
Variable costs (1,000 X $800)	800,000	800	40%
Contribution margin	$1,200,000	$1,200	60%
Fixed costs	1,200,000		
Net income	-		

What would happen if Leyland sold 2,000 units?

	Total	Per Unit	Ratio
Sales (2,000 X $2,000)	$4,000,000	$2,000	100%
Variable costs (2,000 X $800)	1,600,000	800	40%
Contribution margin	$2,400,000	$1,200	60%
Fixed costs	1,200,000		
Net income	$1,200,000		

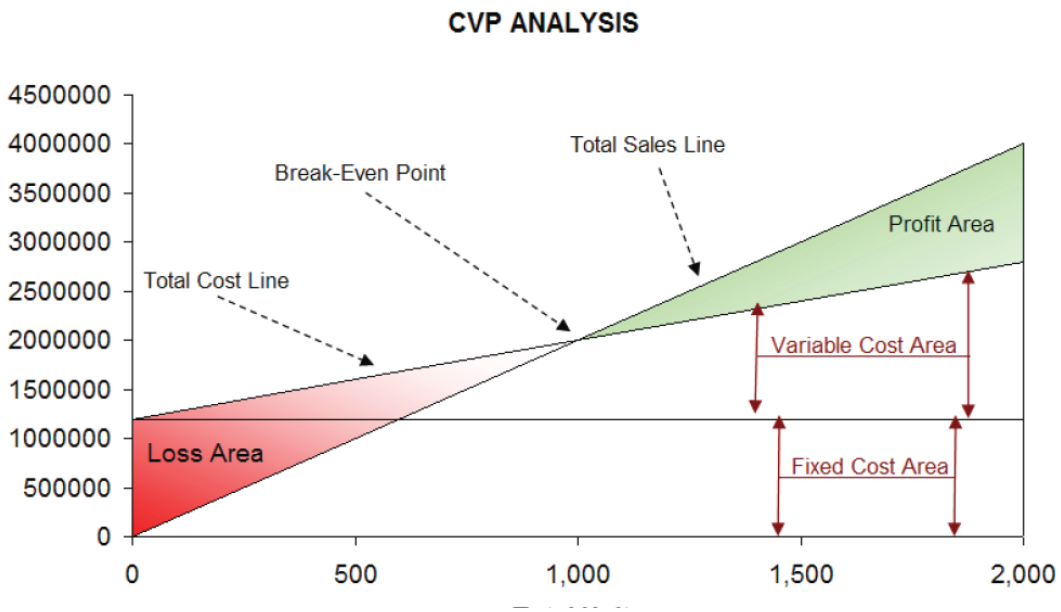
What would happen if Leyland sold only 500 units?

	Total	Per Unit	Ratio
Sales (500 X $2,000)	$1,000,000	$2,000	100%
Variable costs (500 X $800)	400,000	800	40%
Contribution margin	$ 600,000	$1,200	60%
Fixed costs	1,200,000		
Net income	$ (600,000)		

Notice that changes in volume only impact certain amounts within the "total column." Volume changes did not impact fixed costs, or change the per unit or ratio calculations. By reviewing the data on the previous page, also note that 1,000 units achieved breakeven net income. At 2,000 units, Leyland managed to achieve a $1,200,000 net income. Conversely, 500 units resulted in a $600,000 loss.

8.3 Graphic Presentation

Leyland's management would probably find the following chart very handy. Dollars are represented on the vertical axis and units on the horizontal:



Be sure to examine this chart, taking note of the following items: The total sales line starts at "0" and rises $2,000 for each additional unit. The total cost line starts at $1,200,000 (reflecting the fixed cost), and rises $800 for each additional unit (reflecting the addition of variable cost). "Break-even" results where sales equal total costs. At any given point, the width of the loss area (in red) or profit area (in green) is the difference between sales and total costs.

8.4 Break-Even Calculations

As they say, a picture is worth a thousand words, and that is certainly true for the CVP graphic just presented. However, everyone is not an artist, and you may find it more precise to do a little algebra to calculate the break-even point. Consider that:

Break-even results when:
Sales = Total Variable Costs + Total Fixed Costs

For Leyland, the math turns out this way:

(Units X $2,000) = (Units X $800) + $1,200,000

Solving:

Step a: (Units X $2,000) = (Units X $800) + $1,200,000
Step b: (Units X $1,200) = $1,200,000
Step c: Units = 1,000

Now, it is possible to "jump to step b" above by dividing the fixed costs by the contribution margin per unit. Thus, a break-even short cut is:

Break-Even Point in Units = Total Fixed Costs / Contribution Margin Per Unit
1,000 Units = $1,200,000 / $1,200

Sometimes, you may want to know the break-even point in dollars of sales (rather than units). This approach is especially useful for companies with more than one product, where those products all have a similar contribution margin ratio:

Break-Even Point in Sales = Total Fixed Costs / Contribution Margin Ratio
$2,000,000 = $1,200,000 / 0.60

8.5 Target Income Calculations

Breaking even is not a bad thing, but hardly a satisfactory outcome for most businesses. Instead, a manager may be more interested in learning the necessary sales level to achieve a targeted profit. The approach to solving this problem is to treat the "target income" like an added increment of fixed costs. In other words, the margin must cover the fixed costs and the desired profit:

Target Income results when:

Sales = Total Variable Costs + Total Fixed Costs + Target Income

Assume Leyland wants to know the level of sales to reach a $600,000 income:

(Units X $2,000) = (Units X $800) + $1,200,000 + $600,000

Solving:

Step a: (Units X $2,000) = (Units X $800) + $1,200,000 + $600,000
Step b: (Units X $1,200) = $1,800,000
Step c: Units = 1,500

Again, it is possible to "jump to step b" by dividing the fixed costs and target income by the per unit contribution margin:

Units to Achieve a Target Income
=
(Total Fixed Costs + Target Income) / Contribution Margin Per Unit
1,500 Units = $1,800,000 / $1,200

If you want to know the dollar level of sales to achieve a target net income:

Sales to Achieve a Target Income
=
(Total Fixed Costs + Target Income) / Contribution Margin Ratio
$3,000,000 = $1,800,000 / 0.60