



# Break-Even Analysis

Break-even analysis is the examination of the relationship between costs, volume and profits. In addition to determining the break-even sales level for a firm, it can be used to answer all sorts of other important questions such as:

- 1 If costs go up 10%, will profits go down 10%?
- 2 If sales go up 10%, will profits go up 10%?
- 3 How far can sales go down before I start to lose money?
- 4 How much more in sales do I have to have in order to double my profits?

In other words, all kinds of questions regarding the relationship between costs, volume and profit can be answered by using this very important tool.

Break-even analysis is an easy four step process:

## STEP 1: Divide Costs Into Two Groups – Fixed And Variable

### VARIABLE COSTS ARE THOSE THAT ARE CAUSED BY SALES.

Examples include:

- Commissions
- Direct Labor
- Raw Materials
- Freight
- Bad Debts

Certain types of costs will be fixed for some businesses and variable for others. Fuel costs for a trucking firm would be variable, while fixed for a service firm, as an example.

### FIXED COSTS ARE THOSE THAT ARE NOT VARIABLE.

Examples include:

- Maintenance
- Office Expense
- Rent
- Utilities
- Insurance
- Travel & Entertainment
- Depreciation
- Legal & Accounting
- Interest
- Dues & Subscriptions
- Donations
- Advertising

Please note that some of these costs may have a variable nature to them. Utilities and telephone expense may go up as sales volume goes up, however, it may not be meaningful to try and separate out the variable portion of these expenses. Bank borrowing often goes up as sales go up and therefore interest would go up, but interest is still always classified as a fixed cost. The rule that if you are uncertain about whether a cost is fixed or variable, **put it into fixed**. This will increase the break-even sales level and be a more conservative estimate. Please also note that some of these costs are controllable and some are uncontrollable. That is not the determining factor as to whether or not a cost is fixed.

Finally, note that advertising is a fixed cost. Funds for advertising are budgeted at the beginning of the year and do not vary as sales go up or down. The key test for variable costs is whether they are **caused** by sales. Advertising causes sales, not the other way around.

Differentiating between fixed and variable costs is the only difficult step in a break-even analysis, but do not take more time with this step than is warranted. This

analysis is not intended to be scientifically precise down to the last dollar, since things are constantly changing. If you are uncertain about how to classify a certain cost, put it in the fixed category. This will give you a higher, more conservative break-even sales level.

## STEP 2: Determine the Variable Cost Percentage

Once you have determined the fixed and variable cost totals for the period you are analyzing, the second step in break-even analysis is to relate the total variable costs to sales. This is done by dividing the total variable costs by sales in order to derive the **variable cost percentage**.

$$\text{Variable Cost Percentage} = \text{Variable Costs} \div \text{Sales}$$

## STEP 3: Determine the Contribution Margin Ratio

The **contribution margin ratio** (CMR) is calculated by subtracting the **variable cost percentage** from 100%.

$$\text{CMR} = 100.0\% - \text{Variable Cost \%}$$

## STEP 4: Calculate the Break-Even Sales Level

The fourth and final step in the break-even analysis is to divide the **contribution margin ratio** into the **fixed cost total**. This calculation will yield the sales level required to break-even.

$$\text{Break-Even Sales Level} = \text{Fixed Costs} \div \text{Contribution Margin Ratio}$$

### SALES LEVEL NECESSARY FOR PROFIT

Once the above initial analysis has been completed, it is easy to use this tool to determine the sales level necessary to make a certain profit. This is done by use of the following formula:

$$\text{Sales Level (with profit)} = (\text{Fixed Costs} + \text{Profit}) \div \text{Contribution Margin Ratio}$$

### BREAK-EVEN UNITS

If a company sells a relatively homogeneous product (automobiles, boats, mobile homes, etc.), it is possible to determine how many **units** are required to break-even. The formula for this is:

$$\text{Break-Even Units} = \text{Fixed Costs} \div (\text{Price/Unit} - \text{Variable Cost/Unit})$$

## SPECTRUM MANUFACTURING COMPANY EXAMPLE

### STEP 1: DIVIDE COST INTO TWO GROUPS – FIXED AND VARIABLE

A careful review of the Income Statement for year 5 produces the following:

FIXED COSTS		VARIABLE COSTS	
Owner's Salary	\$ 50,000	Cost of Goods Sold	\$ 4,920,000
Other Salaries	508,000	Commissions	350,000
Salary Related Expense	135,000	Bad Debts	18,000
Advertising	67,000	Salary Related Expense	85,000 <sup>15</sup>
Business Tax and Licenses	73,000	<b>TOTAL</b>	<b>\$ 5,373,000</b>
Depreciation	183,000		
Insurance	105,000		
Legal and Accounting	24,000		
Maintenance and Repairs	65,000		
Office Expense	23,000		
Telephone and Utilities	158,000		
Travel and Entertainment	52,000		
Vehicle Expense	64,000		
Other Administrative Expense	80,000		
Interest	129,000		
<b>TOTAL</b>	<b>\$ 1,716,000</b>		

### STEP 2: DETERMINE THE VARIABLE COST PERCENTAGE

$$\begin{aligned}\text{Variable Cost Percentage} &= \text{Variable Costs} \div \text{Sales} \\ 75.7\% &= \$5,373,000 \div \$7,100,000\end{aligned}$$

### STEP 3: DETERMINE THE CONTRIBUTION MARGIN RATIO

$$\begin{aligned}\text{CMR} &= 100\% - \text{VC}\% \\ 24.3\% &= 100\% - 75.7\%\end{aligned}$$

### STEP 4: CALCULATE THE BREAK-EVEN SALES LEVEL

$$\begin{aligned}\text{Break-Even Sales Level} &= \text{Fixed Costs} \div \text{CMR} \\ \$7,062,000 &= \$1,716,000 \div 0.243\end{aligned}$$

At \$7,100,000 in sales, Spectrum is operating very close to the break-even level in year 5. With a profit before tax of only \$11,000, this was already fairly apparent. Several very important questions can now be answered about the operations of this firm.

**QUESTION 1: WHAT WOULD HAPPEN TO BREAK-EVEN SALES IF MANAGEMENT DECIDED TO HIRE AN OFFICE MANAGER AT \$30,000 PER YEAR?**

Prior Fixed Costs	\$1,716,000
Plus	30,000
<b>New Fixed Costs</b>	<b>\$1,746,000</b>

$$\$1,746,000 \div 0.243 = \$7,185,000$$

New Break-Even Sales	\$7,185,000
Old Break-Even Sales	(7,062,000)
<b>Increase</b>	<b>\$123,000</b>

The above calculation indicates that sales will have to increase \$123,000 *just to break-even*, if fixed costs increase only \$30,000.

**QUESTION 2: WHAT SALES WOULD BE NECESSARY TO MAKE A NET PROFIT OF \$50,000?**

$$\text{Sales Level} = (\text{Fixed Costs} + \text{Profit}) \div \text{Contribution Margin Ratio}$$

$$\$7,267,500 = (\$1,716,000 + \$50,000) \div 0.243$$

This calculation illustrates that sales would have to increase to \$7,267,500 in order to generate a net profit of \$50,000. We can easily check this by the following calculations:

Sales	\$7,267,500	100%
Variable Costs	- 5,501,500	75.7%
Contribution Margin	\$1,766,000	24.3%
Fixed Costs	- 1,716,000	
<b>Profit Before Tax</b>	<b>\$50,000</b>	

In other words, an increase in sales of just 2.4% would produce an increase in profit before tax of over 350%!

**QUESTION 3: WHAT WOULD HAPPEN TO THE BREAK-EVEN LEVEL IF MANAGEMENT COULD CUT FIXED COSTS BY 5%?**

$$\$1,716,000 \times 0.95 = \$1,630,200$$

$$\$1,630,200 = \$6,708,600 \div 0.243$$

Old Break-Even Sales	\$7,062,000
New Break-Even Sales	-(6,708,600)
<b>Decrease</b>	<b>\$353,400</b>

In this case, we see that a reduction of \$85,800 in fixed costs created a reduction of \$353,400 in the break-even sales level.

Again, we can check this easily:

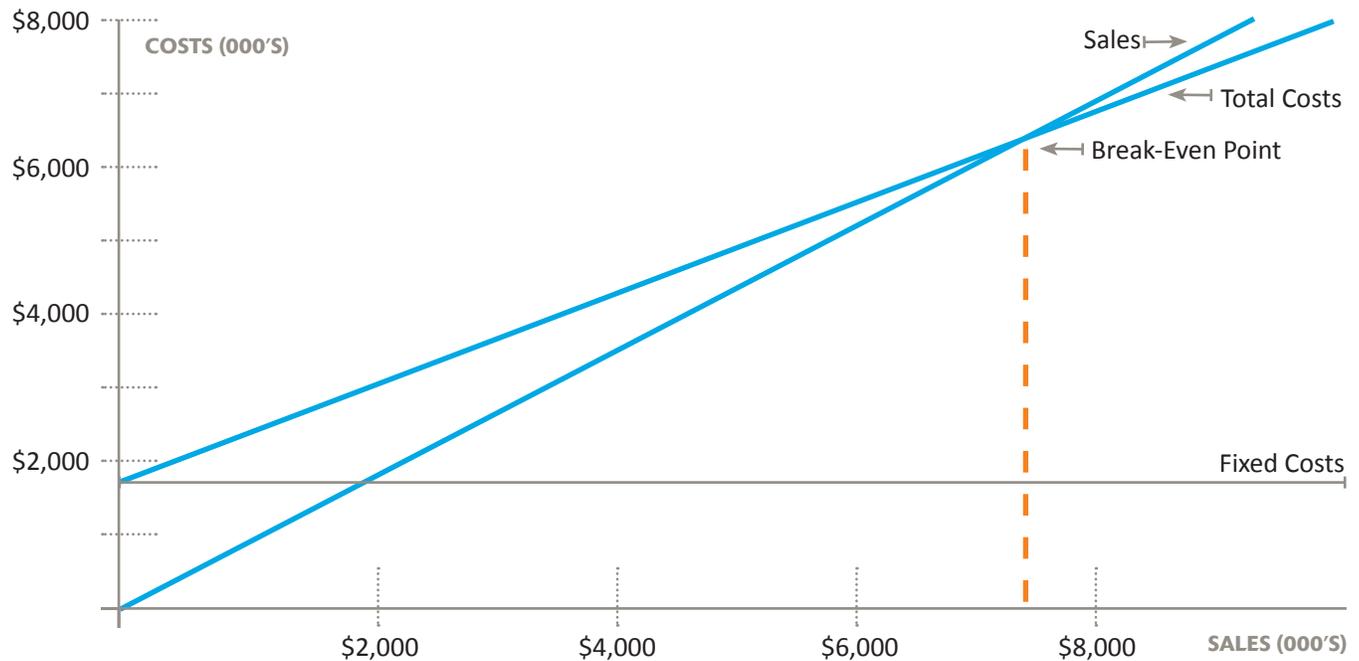
Sales	\$6,708,600	100%
Variable Costs	5,078,400	75.7%
Contribution Margin	\$1,630,200	24.3%
Fixed Costs	1,630,200	
<b>Net Profit</b>	<b>\$0</b>	

There are many similar types of analyses that you can perform with this very useful financial tool once you know how costs relate to sales within a business.

## A Graphic Approach

Once you have determined your fixed and variable costs, you can graph them to get a clearer view of their relationship to sales and profit.

THE FOLLOWING WOULD BE SUCH A GRAPH FOR SPECTRUM MANUFACTURING COMPANY:



The horizontal line represents fixed costs and is drawn in at the \$1,716,000 level. The variable cost line is drawn according to the relationship between sales (on the bottom axis) and costs (on the left axis). Previously, we determined that for every \$1.00 of sales there is about \$0.76 in variable costs. Using these figures we can draw a line representing this relationship. It starts at the level of the fixed cost line because any variable costs would be over and above the fixed costs already existing. The sales line is drawn on a dollar for dollar basis (over \$1.00, up \$1.00) starting at the zero point. This completes the graph.

## SUMMARY

Calculating the level of sales necessary to break-even is a very important exercise so that management can determine how the company is doing in this regard. Sustained operation at less than the break-even level must be accompanied by a reduction in fixed costs in order to avoid losing money. If this trend is caught soon enough, losses can either be avoided or minimized. The fact is that in most cases it is possible to avoid ever losing money. Losses are simply a result of a failure to cut fixed costs when necessary.

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<sup>15</sup>The amount related to commissions.