**Module 2 - Background**

**COST-VOLUME-PROFIT ANALYSIS**

**Modular Learning Objectives**

Keep the following objectives in mind as you work through the material in this module:

* Define of cost-volume-profit.
* Understand the relationship between variable costing and cost-volume-profit analysis.
* Apply and analyze break-even.
* Compute break-even in units.
* Compute break-even in sales.
* Analyze target profit.

**Required Reading**

Variable and fixed costs were introduced in the prior module. Now it is time to examine cost behavior in more detail by familiarizing yourself with the following while keeping the above six objectives in mind. Click on the three arrows to explore each topic in more detail.

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**Cost-volume-profit (CVP) analysis**

Companies use cost-volume-profit (CVP) analysis (also called break-even analysis) to determine what affects changes in their selling prices, costs, and/or volume will have on profits in the short run. A careful and accurate cost-volume-profit (CVP) analysis requires knowledge of costs and their fixed or variable behavior as volume changes.

A cost-volume-profit chart is a graph that shows the relationships among sales, costs, volume, and profit. Look at illustration below. The illustration shows a cost-volume-profit chart for Video Productions, a company that produces DVDs. Each DVD sells for $20. The variable cost per DVD is $12, and the fixed costs per month are $ 40,000.

**Cost-Volume-Profit Chart**

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The total cost line represents the fixed costs of $40,000 plus $12 per unit. Thus, if Video Productions produces and sells 6,000 DVDs, the company’s total costs are $112,000, made up of $40,000 fixed costs and $ 72,000 total variable costs ($ 72,000 = $ 12 per unit X 6,000 units produced and sold).

The total revenue line shows how revenues increase as volume increases. Total revenue is $ 120,000 for sales of 6,000 tapes ($20 per unit X 6,000 units sold). In the chart, we demonstrate the effect of volume on revenue, costs, and net income, for a particular price, variable cost per unit, and fixed cost per period.

At each volume, one can estimate the company’s profit or loss. For example, at a volume of 6,000 units, the profit is $8,000. We can find the net income either by constructing an income statement or using the profit equation. The contribution margin income statement gives the following results for a volume of 6,000 units:

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| Video Productions |
| Contribution Margin Income Statement |
| Revenue | $120,000 |
| Less: variable costs | 72,000 |
| Contribution margin | $ 48,000 |
| Less: Fixed costs | 40,000 |
| Net income | $ 8,000 |

The contribution margin is the amount by which revenue exceeds the variable costs of producing that revenue. We can calculate it on a per unit or total sales volume basis. On a per unit basis, the contribution margin for Video Productions is $8 (the selling price of $20 minus the variable cost per unit of $ 12).

**Contribution Margin = Sales – Variable Cost**

The contribution margin indicates the amount of money remaining after the company covers its variable costs. This remainder contributes to the coverage of fixed costs and to net income. In Video Production’s income statement, the $ 48,000 contribution margin covers the $ 40,000 fixed costs and leaves $ 8,000 in net income.

You can also calculate a contribution margin ratio by using the following formula:

**Contribution Margin RATIO = Sales – Variable Cost**

Profit equation The profit equation is just like the income statement, except it presents the analysis in a slightly different form. According to the profit equation:

**Net income = Revenue – Total variable costs – Fixed costs**

**For Video Productions, the profit equation looks like this:**

**Net income = $ 120,000 − $ 72,000 − $ 40,000**

**Net income = $ 8,000**

The CVP chart above shows cost data for Video Productions in a relevant range of output from 500 to 10,000 units. Recall the relevant range is the range of production or sales volume over which the basic cost behavior assumptions hold true. For volumes outside these ranges, costs behave differently and alter the assumed relationships. For example, if Video Productions produced and sold more than 10,000 units per month, it might be necessary to increase plant capacity (thus incurring additional fixed costs) or to work extra shifts (thus incurring overtime charges and other inefficiencies). In either case, the assumed cost relationships would no longer be valid.

The following video reviews the contribution margin (variable costing) income statement and its components to prepare for the computation of break-even.

https://www.youtube.com/watch?time\_continue=4&v=fyAEVKCSjcI

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A company breaks even for a given period when sales revenue and costs charged to that period are equal. Thus, the break-even point is that level of operations at which a company realizes no net income or loss.

A company may express a break-even point in dollars of sales revenue or number of units produced or sold. No matter how a company expresses its break-even point, it is still the point of zero income or loss. To illustrate the calculation of a break-even point, watch the following video. <https://www.youtube.com/watch?time_continue=9&v=94lrvPlG9P4>

Let us compute break-even for Video Productions.

Fixed costs = $40,000

Contribution margin per unit = $20 selling price less $12 variable expenses = $8

Break-even in units: $40,000 / 8 = 5,000 units

Break-even in sales: $40,000 / ($8/$20) = $100,000

Let us test the above computations by creating a contribution margin income statement. The revised income statement below shows that Video Productions break even at $100,000 in sales. Another way to define break-even is to say it is the point where the total contribution margin equals fixed costs.

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| Video Productions |
| Contribution Margin Income Statement |
| Revenue | $100,000 |
| Less: variable costs | 60,000 |
| Contribution margin | $40,000 |
| Less: Fixed costs | 40,000 |
| Net income | 0 |

**Margin of safety = Current sales – Break even sales**

Margin of safety = $ 120,000 – $ 100,000 = $ 20,000

Sometimes people express the margin of safety as a percentage, called the margin of safety rate or just margin of safety percentage. The **margin of safety rate** is equal to

**(current sales- break-even sales) / current sales.**

Using the data just presented, we compute the margin of safety rate is $20,000 / 120,000 = 16.67 %

This means that sales volume could drop by 16.67 percent before the company would incur a loss.

Although you are likely to use cost-volume-profit analysis for a single product, you will more frequently use it in multi-product situations. The easiest way to use cost-volume-profit analysis for a multi-product company is to use dollars of sales as the volume measure. For CVP purposes, a multi- product company must assume a given product mix. Product mix refers to the proportion of the company's total sales attributable to each type of product sold.

What about starting a coffee shop? The video highlights the use of break-even for such an endeavor. <https://www.youtube.com/watch?v=i7uhmGVsbUg>

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You can also use this same type of analysis to determine how many sales units or sales dollars you would need to make a specific profit (very helpful!). The good news is you have already learned the basic formula, we are just changing it slightly. The formulas we will need are:

**Units at Target Profit =**

(Fixed Costs + Target Income)/Contribution Margin per unit

**Sales Dollars for Target Profit =**

(Fixed Costs + Target Income)/Contribution Margin RATIO

These look familiar (or they should!). These are the same formulas we used for break-even analysis but this time we have added target income. If you think about it, it is the same formula because at break-even our target income is zero. <https://www.youtube.com/watch?time_continue=7&v=4U60Ya5ysMU>

Let’s look at another example. The management of a major airline wishes to know how many seats must be sold on Flight 529 to make $8,000 in profit. To solve this problem, management must identify and separate costs into fixed and variable categories.
The fixed costs of Flight 529 are the same regardless of the number of seats filled. Fixed costs include the fuel required to fly the plane and crew (with no passengers) to its destination; depreciation on the plane used on the flight; and salaries of required crewmembers, gate attendants, and maintenance and refueling personnel. Fixed costs are $12,000.

The variable costs vary directly with the number of passengers. Variable costs include snacks and beverages provided to passengers, baggage handling costs, and the cost of the additional fuel required to fly the plane with passengers to its destination. Management would express each variable cost on a per passenger basis. Variable costs are $25 per passenger.

Tickets are sold for $125 each. The contribution margin is $100 ($125 sales – $25 variable) and the contribution margin ratio is 80% ($100 contribution margin /$125 sales). We can calculate the units and sales dollar required to make $8,000 in profit by:\

**Units at Target Profit =**

Fixed Costs + Target Income = 12,000 + 8,000 = $20,000 = 200 tickets

The sales dollars required could be calculated as break even units of 200 tickets x $125 sales price per ticket = $25,000 or by using the following formula:

**Sales Dollars for Target Profit =**

(Fixed Costs + Target Income) / Contribution Margin RATIO

or $20,000 / .8 = $25,000

Management can also use its knowledge of cost-volume-profit relationships to determine whether to increase sales promotion costs in an effort to increase sales volume or to accept an order at a lower-than-usual price. In general, the careful study of cost behavior helps management plan future courses of action.

**Check Your Understanding**

Check your understanding to make sure that you have a good grasp of the background material. If you are not comfortable with the concepts, review some of the material again or go to the optional resource for more examples.

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| *https://tlc.trident.edu/content/enforced/102026-X_FUTURE_ACC201-MOD/images/quiz%20icon.png?_&d2lSessionVal=WuCKTJULfhyk2oLhEfhAZmoxv&ou=107901* | Click on the quiz icon for an ungraded, 20-question true-or-false self-study quiz to check your progress. If you are not satisfied with the score, review some of the material again. For more in-depth information, review materials listed under optional reading at the bottom of this page. |

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| **Final Thoughts**Cost-Volume-Profit (CVP) analysis is a computational method that analyzes the effect of sales and product costs on the operating income of a business. Specifically, it assesses the effect of changes in variable costs, fixed costs and selling price on operating income. Break-even analysis (with or without a target profit) is a common CVP approach. Another definition of break-even is where the total contribution margin equals total costs. A contribution margin income statement shows zero income at break-even.Several assumptions underlie CVP analysis:* All cost can be categorized as variable or fixed.
* Sales price per unit, variable cost per unit, and total fixed cost are constant.
* Mixed costs must be split into their fixed and variable component by an estimation process.
* Understanding the behavior of costs makes cost-volume-profit analysis possible.
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**Optional Reading**

For further detail refer to Dr. Walther’s accounting text and videos.

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| *https://tlc.trident.edu/content/enforced/102026-X_FUTURE_ACC201-MOD/images/principles%20of%20accounting%20icon.png?_&d2lSessionVal=WuCKTJULfhyk2oLhEfhAZmoxv&ou=107901* | Walther, L. (2017). Chapter 18: [*Cost-Volume-Profit and Business Scalability*](http://www.principlesofaccounting.com/chapter-18/).<http://www.principlesofaccounting.com/chapter-18/> |