

CVP Analysis

Uses of the Contribution Format

The contribution income statement format is used as an internal planning and decision making tool. This approach is useful for:

1. Cost-volume-profit analysis
2. Budgeting
3. Segmented reporting of profit data
4. Special decisions such as pricing and make-or-buy analysis

The Contribution Format

Comparison of the Contribution Income Statement with the Traditional Income Statement

Traditional Approach (costs organized by function)		Contribution Approach (costs organized by behavior)	
Sales	\$ 100,000	Sales	\$ 100,000
Less cost of goods sold	70,000	Less variable expenses	60,000
Gross margin	<u>\$ 30,000</u>	Contribution margin	<u>\$ 40,000</u>
Less operating expenses	20,000	Less fixed expenses	30,000
Net operating income	<u><u>\$ 10,000</u></u>	Net operating income	<u><u>\$ 10,000</u></u>

Used primarily for
external reporting.

Used primarily by
management.

The Contribution Format

	<u>Total</u>	<u>Unit</u>
Sales Revenue	\$ 100,000	\$ 50
Less: Variable costs	60,000	30
Contribution margin	\$ 40,000	\$ 20
Less: Fixed costs	30,000	
Net operating income	\$ 10,000	

The contribution margin format emphasizes cost behavior. Contribution margin covers fixed costs and provides for income.

COST-VOLUME-PROFIT ANALYSIS

<u>%</u>	<u>I/S</u>	_____ Bike	_____ Bikes	_____ Bikes
	Sales			
	Variable Costs			
	Contribution Margin			
	Fixed Costs			
	Net Income			
<u>%</u>	<u>I/S</u>	_____ Bikes	_____ Bikes	_____ Bikes
	Sales			
	Variable Costs			
	Contribution Margin			
	Fixed Costs			
	Net Income			

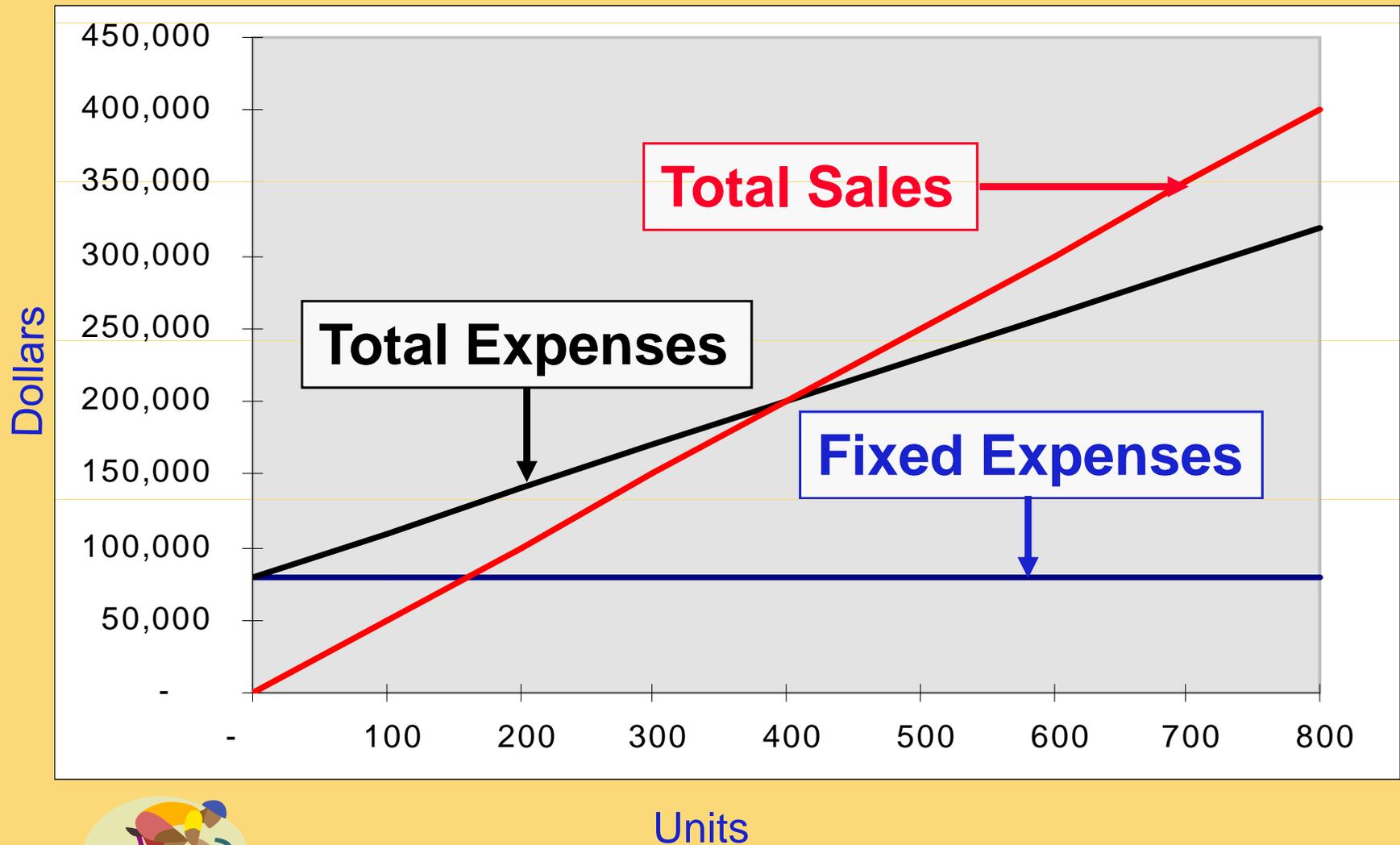
CVP Relationships in Graphic Form



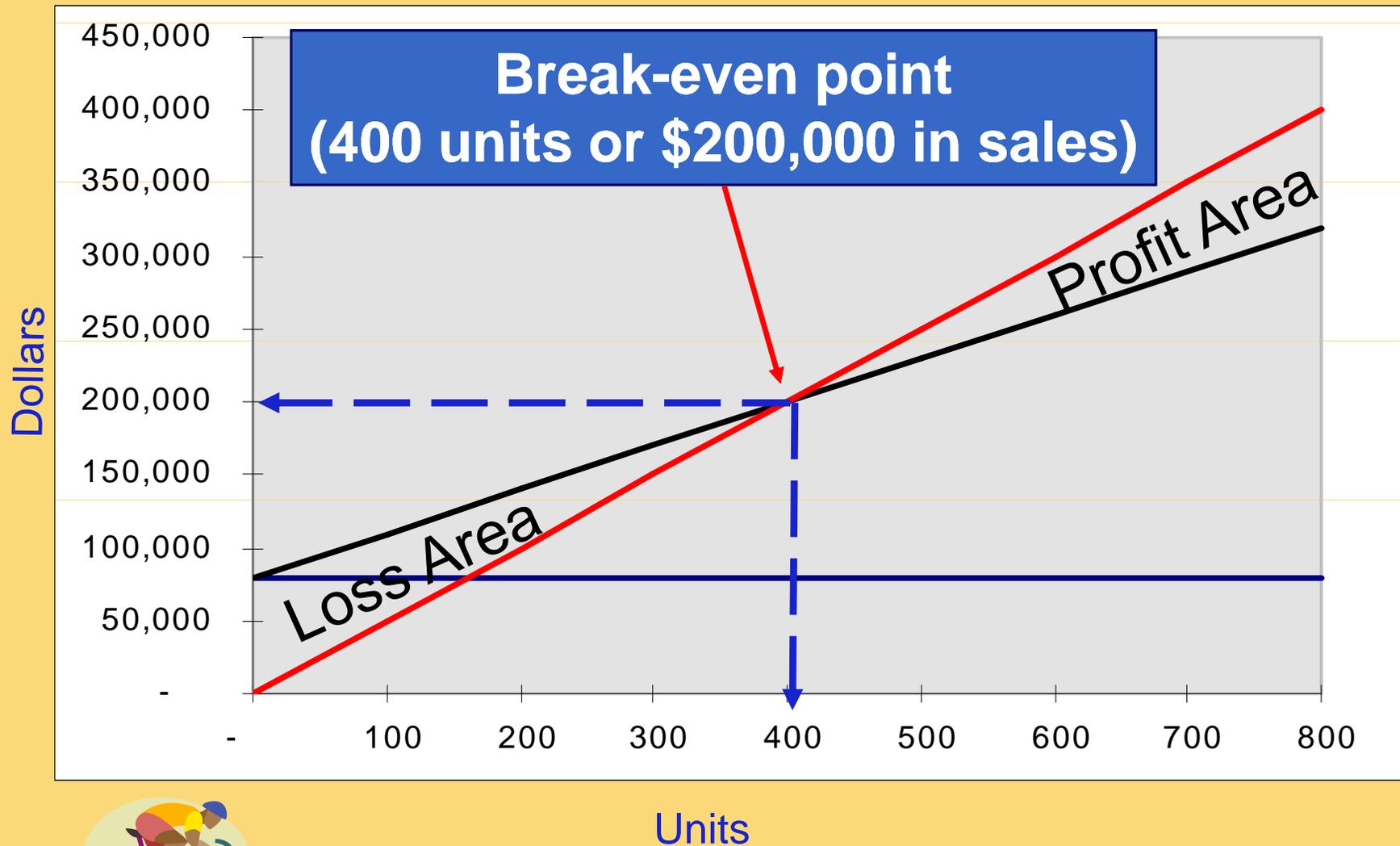
The relationship among revenue, cost, profit and volume can be expressed graphically by preparing a CVP graph. Racing developed contribution margin income statements at 300, 400, and 500 units sold. We will use this information to prepare the CVP graph.

	Income 300 units	Income 400 units	Income 500 units
Sales	\$ 150,000	\$ 200,000	\$ 250,000
Less: variable expenses	90,000	120,000	150,000
Contribution margin	\$ 60,000	\$ 80,000	\$ 100,000
Less: fixed expenses	80,000	80,000	80,000
Net operating income	\$ (20,000)	\$ -	\$ 20,000

CVP Graph



CVP Graph



Contribution Margin Ratio

The contribution margin **ratio** is:

$$\text{CM Ratio} = \frac{\text{Total CM}}{\text{Total sales}}$$

For Racing Bicycle Company the ratio is:

$$\frac{\$80,000}{\$200,000} = 40\%$$

Each \$1.00 increase in sales results in a total contribution margin increase of 40¢.



Contribution Margin Ratio

Or, in terms of **units**, the contribution margin **ratio** is:

$$\text{CM Ratio} = \frac{\text{Unit CM}}{\text{Unit selling price}}$$

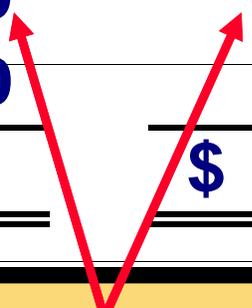
For Racing Bicycle Company the ratio is:

$$\frac{\$200}{\$500} = 40\%$$



Contribution Margin Ratio

	<u>400 Bikes</u>	<u>500 Bikes</u>
Sales	\$ 200,000	\$ 250,000
Less: variable expenses	120,000	150,000
Contribution margin	80,000	100,000
Less: fixed expenses	80,000	80,000
Net operating income	\$ -	\$ 20,000



A \$50,000 increase in sales revenue results in a \$20,000 increase in CM.
($\$50,000 \times 40\% = \$20,000$)

Break-Even Analysis

Here is the information from Racing Bicycle Company:

	<u>Total</u>	<u>Per Unit</u>	<u>Percent</u>
Sales (500 bikes)	\$ 250,000	\$ 500	100%
Less: variable expenses	150,000	300	60%
Contribution margin	\$ 100,000	\$ 200	40%
Less: fixed expenses	80,000		
Net operating income	\$ 20,000		



Contribution Margin Method

The contribution margin method has two key equations.

$$\text{Break-even point in units sold} = \frac{\text{Fixed expenses}}{\text{CM per unit}}$$

$$\text{Break-even point in total sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$



Contribution Margin Method

Let's use the contribution margin method to calculate the break-even point in total sales dollars at Racing.

$$\text{Break-even point in total sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$\frac{\$80,000}{40\%} = \$200,000 \text{ break-even sales}$$



Target Profit Analysis

Suppose Racing Bicycle Company wants to know how many bikes must be sold to earn a profit of \$100,000.



The Contribution Margin Approach

The contribution margin method can be used to determine that 900 bikes must be sold to earn the target profit of \$100,000.

$$\text{Unit sales to attain the target profit} = \frac{\text{Fixed expenses} + \text{Target profit}}{\text{CM per unit}}$$

$$\frac{\$80,000 + \$100,000}{\$200/\text{bike}} = 900 \text{ bikes}$$



The Margin of Safety



The margin of safety is the excess of budgeted (or actual) sales over the break-even volume of sales.

Margin of safety = Total sales - Break-even sales

Let's look at Racing Bicycle Company and determine the margin of safety.



The Margin of Safety

If we assume that Racing Bicycle Company has actual sales of \$250,000, given that we have already determined the break-even sales to be \$200,000, the margin of safety is \$50,000 as shown.

	Break-even sales 400 units	Actual sales 500 units
Sales	\$ 200,000	\$ 250,000
Less: variable expenses	120,000	150,000
Contribution margin	80,000	100,000
Less: fixed expenses	80,000	80,000
Net operating income	\$ -	\$ 20,000

The Margin of Safety

The margin of safety can be expressed as
20% of sales.
($\$50,000 \div \$250,000$)

	Break-even sales 400 units	Actual sales 500 units
Sales	\$ 200,000	\$ 250,000
Less: variable expenses	120,000	150,000
Contribution margin	80,000	100,000
Less: fixed expenses	80,000	80,000
Net operating income	\$ -	\$ 20,000

The Margin of Safety

The margin of safety can be expressed in terms of the number of units sold. The margin of safety at Racing is \$50,000, and each bike sells for \$500.

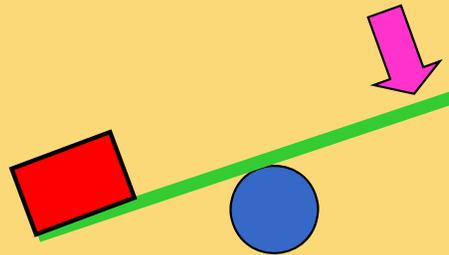
$$\text{Margin of Safety in units} = \frac{\$50,000}{\$500} = 100 \text{ bikes}$$



Operating Leverage

A measure of how sensitive net operating income is to percentage changes in sales.

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}$$



Operating Leverage

At Racing, the degree of operating leverage is 5.

	Actual sales
	500 Bikes
Sales	\$ 250,000
Less: variable expenses	150,000
Contribution margin	100,000
Less: fixed expenses	80,000
Net income	\$ 20,000

$$\frac{\$100,000}{\$20,000} = 5$$

Operating Leverage

With an operating leverage of 5, if Racing increases its sales by 10%, net operating income would increase by 50%.

Percent increase in sales		10%
Degree of operating leverage	x	5
Percent increase in profits		50%

Here's the verification!



Operating Leverage

	Actual sales (500)	Increased sales (550)
Sales	\$ 250,000	\$ 275,000
Less variable expenses	150,000	165,000
Contribution margin	100,000	110,000
Less fixed expenses	80,000	80,000
Net operating income	\$ 20,000	\$ 30,000

**10% increase in sales from
\$250,000 to \$275,000 . . .**

**. . . results in a 50% increase in
income from \$20,000 to \$30,000.**

The Concept of Sales Mix

- Sales mix is the relative proportion in which a company's products are sold.
- Different products have different selling prices, cost structures, and contribution margins.

Let's assume Racing Bicycle Company sells bikes and carts and that the sales mix between the two products remains the same.



Multi-product break-even analysis

Racing Bicycle Co. provides the following information:

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	AB	C	D	E	F	G	H
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

	Bicycles		Carts		Total	
Sales	\$ 250,000	100%	\$ 300,000	100%	\$ 550,000	100.0%
Variable expenses	150,000	60%	135,000	45%	285,000	51.8%
Contribution margin	<u>\$ 100,000</u>	<u>40%</u>	<u>\$ 165,000</u>	<u>55%</u>	<u>265,000</u>	<u>48.2%</u>
Fixed expenses					170,000	
Net operating income					<u>\$ 95,000</u>	
Sales mix	\$ 250,000	45%	\$ 300,000	55%	\$ 550,000	100%

$$\frac{\$265,000}{\$550,000} = 48.2\% \text{ (rounded)}$$

Multi-product break-even analysis

$$\begin{aligned}
 \text{Break-even sales} &= \frac{\text{Fixed expenses}}{\text{CM Ratio}} \\
 &= \frac{\$170,000}{48.2\%} \\
 &= \mathbf{\$352,697}
 \end{aligned}$$

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AB	C	D	E	F	G	H	I
1							
2		Bicycles		Carts		Total	
3	Sales	\$ 158,714	100%	\$ 193,983	100%	\$ 352,697	100.0%
4	Variable expenses	95,228	60%	87,292	45%	182,521	51.8%
5	Contribution margin	\$ 63,486	40%	\$ 106,691	55%	170,176	48.2%
6	Fixed expenses					170,000	
7	Net operating income					\$ 176	
8							
9	Sales mix	\$ 158,714	45%	\$ 193,983	55%	\$ 352,697	100%

Rounding error →

Key Assumptions of CVP Analysis

- ① Selling price is constant.
- ② Costs are linear.
- ③ In multiproduct companies, the sales mix is constant.
- ④ In manufacturing companies, inventories do not change (units produced = units sold).

