



B.Com Honours

Semester V

Calicut University

Management Accounting

Course Code: COM5CJ302 • Module 4 Notes

Module IV: Cost-Volume-Profit (CVP) Analysis & Marginal Costing

Curricular Scope & Foundational Framework

Cost-Volume-Profit (CVP) Analysis and **Marginal Costing** represent the ultimate analytical engine of managerial economics and managerial accounting. Traditional absorption costing, which treats all manufacturing costs (fixed and variable) as product costs, fails to provide operational guidance when executive leadership faces crucial short-term choices: pricing special export orders, fixing selling prices during an economic recession, making or buying sub-assemblies, optimizing scarce factory bottlenecks, or deciding whether to operate or shut down a plant. This module provides an exhaustive examination of cost behavior, the **Contribution** paradigm, the **Profit-Volume (P/V) Ratio**, mathematical determination of **Break-Even Points** and **Margin of Safety**, construction of **Break-Even Charts**, and rigorous algorithmic frameworks for strategic managerial decision-making.

1. Concept, Meaning, and Philosophy of Marginal Costing (Unit 13)

Marginal Costing is not a distinct system of cost ascertainment (like job costing, process costing, or operating costing), but rather a specialized **technique of cost analysis and presentation** designed to guide managerial planning and decision engineering.

Definition: CIMA (London)

"Marginal Costing is the ascertainment of marginal costs and of the effect on profit of changes in volume or type of output by differentiating between fixed costs and variable costs."

Concept of Marginal Cost

Economically, **Marginal Cost** is the cost of producing one additional unit of product. In accounting terminology, because fixed overheads remain constant within the relevant range of capacity, the marginal cost of a product is exactly equal to its **aggregate variable cost** (Prime Cost + Variable Production Overheads).

Classification of Costs According to Behavior

The entire structure of Marginal Costing is erected upon the segregation of all business costs into two fundamental behavioral components:

- **Fixed Costs (Period Costs):** Costs that remain unchanged in total amount across a given period and within a relevant range of operational activity, regardless of fluctuations in production volume (e.g., factory rent, executive salaries, municipal property taxes, straight-line depreciation).
Key Characteristic: Total fixed cost remains constant, but **fixed cost per unit decreases as output expands**.
- **Variable Costs (Product Costs):** Costs that vary in direct proportion to changes in the volume of production or sales (e.g., direct raw materials, direct labor wages, direct power, variable selling

commissions).

Key Characteristic: Total variable cost increases linearly with output, but **variable cost per unit remains strictly constant**.

- **Semi-Variable / Mixed Costs:** Costs that possess both a fixed core and a variable activity component (e.g., electricity bills with fixed meter rent plus per-unit usage charges, factory maintenance, telephone expenses).

Segregation Techniques: (i) High-Low Method, (ii) Comparison Method, (iii) Method of Least Squares (Linear Regression), (iv) Analytical Method.

HIGH-LOW SEGREGATION ALGORITHM FOR SEMI-VARIABLE COSTS

Mathematical
Segregation

$$\text{Variable Cost per Unit (v)} = (\text{Cost at Highest Activity} - \text{Cost at Lowest Activity}) \div (\text{Highest Output Units} - \text{Lowest Output Units})$$
$$\text{Total Fixed Cost (F)} = \text{Total Cost at Highest Activity} - (\text{Highest Output Units} \times v)$$

2. Marginal Costing vs. Absorption Costing: Fundamental Differences

The dispute between Absorption Costing (Full Costing) and Marginal Costing (Direct Costing) lies at the heart of managerial finance:

Dimension	Absorption Costing (Traditional)	Marginal Costing (Modern)
1. Treatment of Fixed Costs	Fixed factory overheads are treated as product costs and absorbed into inventory units.	Fixed overheads are treated as period costs and charged off directly against contribution in P&L.
2. Inventory Valuation	Inventories (WIP and Finished Goods) are valued at Total Production Cost (Prime Cost + Fixed & Variable Overheads).	Inventories are valued strictly at Marginal Production Cost (Prime Cost + Variable Overheads only).
3. Under / Over Absorption	Results in under-absorption or over-absorption of overheads due to volume variances.	No under/over absorption of fixed costs because fixed costs are not unitized.
4. Impact of Production Shifts	Profits can be artificially inflated by increasing production without selling (capitalizing fixed costs in closing stock).	Profit is a direct function of sales volume alone. Increasing unsold production cannot inflate profit.
5. Decision-Making Utility	Can mislead management in pricing, outsourcing, and product-mix decisions due to arbitrary overhead apportionment.	Provides clear incremental cash flows via Contribution , enabling sound managerial decisions.

Profit Reconciliation Between Absorption and Marginal Costing

When opening and closing inventory volumes differ:

Profit as per Absorption Costing = Profit as per Marginal Costing + (Fixed Overhead in Closing Stock – Fixed Overhead in Opening Stock)

- If **Production > Sales**: Closing stock exceeds opening stock → *Absorption Profit is Higher.*
- If **Production < Sales**: Opening stock exceeds closing stock → *Marginal Profit is Higher.*
- If **Production = Sales**: Closing stock equals opening stock → *Both profits are Identical.*

3. The Contribution Concept and Marginal Cost Equation (Unit 14)

"**Contribution**" (or Gross Margin) is the fundamental economic surplus generated by sales revenue over variable costs. It is termed "contribution" because it contributes first toward the recovery of unavoidable fixed overheads, and once fixed costs are fully recovered, every additional rupee of contribution translates rupee-for-rupee into net operating profit.

THE FUNDAMENTAL MARGINAL COST EQUATION

The Master Equation

$$\text{Sales} - \text{Variable Cost} = \text{Contribution} = \text{Fixed Cost} \pm \text{Profit / Loss}$$
$$S - V = C = F + P$$

Operational Relationships:

- **Contribution (Total) = Sales Revenue – Total Variable Costs**
- **Contribution per Unit (c) = Selling Price per unit (s) – Variable Cost per unit (v)**
- **Profit = Contribution – Fixed Cost**
- **Fixed Cost = Contribution – Profit**

4. Profit-Volume (P/V) Ratio (Unit 14)

The **Profit-Volume (P/V) Ratio** (also known as the **Contribution Margin Ratio**) expresses the proportion of sales revenue available to cover fixed expenses and yield a profit. It is the single most important profitability indicator in marginal costing:

FORMULAS FOR PROFIT-VOLUME (P/V) RATIO

Efficiency Benchmark

$$\begin{aligned} \text{P/V Ratio} &= (\text{Contribution} \div \text{Sales}) \times 100 = [(s - v) \div s] \times 100 \\ \text{P/V Ratio} &= (\text{Change in Profit or Contribution} \div \text{Change in Sales}) \times 100 \\ \text{P/V Ratio} &= 100\% - \text{Variable Cost Ratio} \end{aligned}$$

Managerial Strategic Significance:

- **Product Profitability:** Indicates which products or lines generate the highest cash surplus per rupee of sales.
- **Sensitivity:** High P/V ratio means a small change in sales volume generates a massive change in net profit.
- **Methods to Improve P/V Ratio:** (1) Increase selling price per unit, (2) Reduce variable costs through lean sourcing/automation, (3) Discontinue low-margin products, (4) Shift sales mix toward high-margin offerings.

5. Break-Even Analysis and Margin of Safety (Unit 15)

Break-Even Analysis is the mathematical determination of the operational volume where total revenue exactly equals total costs, yielding zero profit and zero loss:

MATHEMATICAL FORMULAS FOR BREAK-EVEN POINT (BEP)

Solvency Point

$$\begin{aligned} \text{BEP (in Units)} &= \text{Total Fixed Costs} \div \text{Contribution per Unit} = F \div (s - v) \\ \text{BEP (in Sales Rupees)} &= \text{Total Fixed Costs} \div \text{P/V Ratio} = F \div [(s - v) \div s] \end{aligned}$$

Advanced Break-Even Formulations:

- **Sales for Desired Profit (Units)** = (Fixed Cost + Target Profit) $\div$ Contribution per Unit
- **Sales for Desired Profit (₹)** = (Fixed Cost + Target Profit) $\div$ P/V Ratio
- **Sales for Desired Profit After Tax (₹)** = [Fixed Cost + {Target PAT $\div$ (1 - t)}] $\div$ P/V Ratio
- **Cash Break-Even Point (Units)** = Cash Fixed Costs $\div$ Contribution per Unit (excludes non-cash fixed costs like depreciation and amortization).
- **Composite / Multi-Product BEP (₹)** = Total Combined Fixed Costs $\div$ Overall Weighted Average P/V Ratio

Concept and Managerial Significance of Margin of Safety (MOS)

The **Margin of Safety (MOS)** represents the operational cushion or safety buffer by which actual or budgeted sales exceed the break-even sales volume. It indicates the maximum amount by which sales can contract before the company begins incurring operating losses:

MARGIN OF SAFETY (MOS) FORMULAS

Risk Cushion

$$\text{Margin of Safety (₹)} = \text{Actual Sales} - \text{Break-Even Sales}$$

$$\text{Margin of Safety (Units)} = \text{Actual Units} - \text{Break-Even Units}$$

$$\text{Margin of Safety Ratio (\%)} = \left[\frac{(\text{Actual Sales} - \text{Break-Even Sales})}{\text{Actual Sales}} \right] \times 100$$

$$\text{Margin of Safety (₹)} = \text{Profit} \div \text{P/V Ratio} \Leftrightarrow \text{Profit} = \text{Margin of Safety} \times \text{P/V Ratio}$$

Managerial Interpretation: A high Margin of Safety indicates robust economic health, resilient cash flows, and substantial protection against recessions. A low Margin of Safety signals high business risk, where even a minor decline in sales volume triggers cash losses.

6. Construction and Graphical Interpretation of Break-Even Charts (Unit 16)

A **Break-Even Chart** is a graphical visualization of the cost-volume-profit relationships at different activity levels.

1. Traditional Chart

Plot Units on X-axis and Costs/Revenues on Y-axis. Draw a horizontal Fixed Cost line. Plot Total Cost starting from the fixed cost intercept. Draw Total Sales Revenue from the origin (0,0). The intersection is the **Break-Even Point**.

2. Contribution Chart

Draw Variable Cost line first from origin. Draw Total Cost line parallel to variable cost line at the height of fixed costs. The vertical gap between sales line and variable cost line highlights **Total Contribution**.

3. Profit-Volume Graph

Plots Net Profit/Loss directly against Sales Volume on a single line. The line originates below zero at negative fixed costs, cutting the horizontal axis at the **Break-Even Point**.

The Angle of Incidence and Its Managerial Diagnosis

The **Angle of Incidence** is the angle formed between the Total Sales line and the Total Cost line at the Break-Even Point. It visually represents the rate of profit generation once fixed overheads are recovered:

1. **Large Angle of Incidence + High Margin of Safety:** The business operates under highly favorable conditions, possessing low variable costs and generating rapid profits as volume expands.
2. **Small Angle of Incidence + High Margin of Safety:** Low profit velocity; variable costs consume a heavy portion of revenue.
3. **Large Angle of Incidence + Low Margin of Safety:** Heavy fixed costs, high operating gearing; highly

sensitive to slight sales downturns.

4. **Small Angle of Incidence + Low Margin of Safety:** The worst commercial scenario: low profitability, weak cushion, acute vulnerability.

7. Marginal Costing in Managerial Decision-Making (Unit 17)

Because fixed costs are sunk or committed in the short term, managerial decisions must be evaluated based on their **incremental / marginal cash flows**. The six classic decision engineering scenarios include:

1. Fixation of Selling Prices & Recession Pricing

Under normal market conditions, prices must cover total cost plus a profit. However, during market recessions, off-seasons, trade depressions, or when entering competitive new markets, an enterprise may accept prices **below total cost provided the price exceeds marginal cost**:

- Selling Price > Marginal Cost → Generates a positive contribution to offset fixed costs, minimizing total corporate loss.
- Selling Price = Marginal Cost → Covers out-of-pocket costs; maintains plant operational capability and labor force intact.
- Selling Price < Marginal Cost → Strictly unacceptable (causes direct cash loss per unit).

2. Exploring New Markets & Accepting Special Export Orders

When an enterprise has spare or unutilized production capacity, management can evaluate foreign export offers at prices lower than domestic market prices without affecting domestic margins, provided:

- The export price exceeds the marginal cost of production plus any special export shipping overheads.
- Domestic sales and domestic price structures remain completely unaffected and insulated.
- The transaction complies with international trade laws and anti-dumping regulations.

3. Make or Buy Decisions (Outsourcing)

When deciding whether to manufacture a component part internally or purchase it from an external specialized supplier:

The Make or Buy Decision Rule

- Relevant Cost of Making = Direct Material + Direct Labor + Variable Overheads + Incremental Specific Fixed Costs.
- General Allocated Fixed Costs are completely IRRELEVANT (they persist whether the component is made or bought).
- If Supplier's Quoted Price > Marginal Cost of Making → **MAKE** the component internally.
- If Supplier's Quoted Price < Marginal Cost of Making → **BUY** the component externally.
- Qualitative Factors: Supplier reliability, quality consistency, technological secrecy, risk of supplier price monopoly.

4. Key Factor / Limiting Factor Optimization

A **Key Factor** (or Limiting / Principal Budget Factor) is any factor of production in scarce or restricted supply (e.g., shortage of raw materials, labor strike, restricted machine hours, import quotas) that prevents the enterprise from producing unlimited volume.

KEY FACTOR OPTIMIZATION DECISION ALGORITHM

Linear Profit Maximization

$$\text{Profitability Index} = \text{Contribution per Unit} \div \text{Key Factor Requirement per Unit}$$

Decision Protocol:

1. Calculate Contribution per unit for each competing product (\$s - v\$).
2. Compute the **Contribution per unit of Key Factor** (e.g., Contribution per kg of material, or Contribution per machine hour).
3. **Rank products** in descending order of Contribution per unit of Key Factor (Rank 1, 2, 3...).
4. Allocate the scarce resource strictly according to rank to fulfill demand, maximizing total enterprise profit.

5. Product Mix Decisions & Dropping an Unprofitable Line

When financial statements show that an individual department or product line is reporting a net loss under absorption costing, management often contemplates discontinuing it.

The Golden Marginal Costing Rule: A product line should **NEVER be dropped** merely because it reports an accounting net loss, so long as it yields a **positive contribution!** If a product generating ₹1,00,000

contribution is discontinued, its allocated fixed costs (e.g., ₹1,50,000) cannot be eliminated; they will fall entirely onto the remaining products, worsening total corporate profit by exactly ₹1,00,000!

6. Operate or Shutdown Point

When demand collapses drastically during economic crises, an enterprise may be forced to choose between continuing operations at a loss or shutting down operations temporarily.

- **Unavoidable Fixed Costs (Sunk Costs):** Costs that must be incurred even if the factory is completely shut down (factory watchmen, property taxes, insurance, building rent, minimum maintenance).
- **Avoidable Fixed Costs:** Costs that can be completely eliminated if operations are shut down (supervisor wages, machinery power, lighting).

SHUTDOWN POINT FORMULATION

Plant Preservation

$$\text{Shutdown Point (Units)} = \text{Avoidable Fixed Costs} \div \text{Contribution per Unit}$$

$$\text{Shutdown Point (₹)} = \text{Avoidable Fixed Costs} \div \text{P/V Ratio}$$

Decision Threshold:

- If **Actual Expected Sales > Shutdown Point: CONTINUE operations** (loss incurred by operating is less than the fixed loss of shutting down).
- If **Actual Expected Sales < Shutdown Point: SHUT DOWN operations temporarily** (loss of operating exceeds the unavoidable fixed loss).

8. Comprehensive Practical Workout Problems

Master Case Study 1: Multi-Year CVP Mechanics & Target Profit Analysis

Problem: The comparative operational data of Apex Motors Ltd. for two consecutive financial years are presented below:

Period	Sales Revenue (₹)	Profit / Loss (₹)
Year 2022-23	12,00,000	80,000 (Profit)
Year 2023-24	18,00,000	2,00,000 (Profit)

Required: Compute: (1) P/V Ratio, (2) Total Fixed Costs, (3) Break-Even Point in Rupees, (4) Profit when Sales are ₹25,00,000, (5) Sales required to earn a Net Profit of ₹3,50,000, and (6) Margin of Safety for Year 2023-24.

1. Profit-Volume (P/V) Ratio:

$$\bullet \text{ Change in Sales} = ₹18,00,000 - ₹12,00,000 = ₹6,00,000$$

$$\bullet \text{ Change in Profit} = ₹2,00,000 - ₹80,000 = ₹1,20,000$$

$$\bullet \text{ P/V Ratio} = (\text{Change in Profit} \div \text{Change in Sales}) \times 100 = (₹1,20,000 \div ₹6,00,000) \times 100 = 20\%$$

2. Total Fixed Costs:

$$\bullet \text{ For 2022-23: Contribution} = \text{Sales} \times \text{P/V Ratio} = ₹12,00,000 \times 20\% = ₹2,40,000$$

$$\bullet \text{ Fixed Cost} = \text{Contribution} - \text{Profit} = ₹2,40,000 - ₹80,000 = ₹1,60,000$$

3. Break-Even Point (in Sales Value):

$$\bullet \text{ BEP (₹)} = \text{Fixed Cost} \div \text{P/V Ratio} = ₹1,60,000 \div 0.20 = ₹8,00,000$$

4. Profit at Sales of ₹25,00,000:

$$\bullet \text{ Contribution} = ₹25,00,000 \times 20\% = ₹5,00,000$$

$$\bullet \text{ Profit} = \text{Contribution} - \text{Fixed Cost} = ₹5,00,000 - ₹1,60,000 = ₹3,40,000$$

5. Sales Required to Earn Target Profit of ₹3,50,000:

$$\bullet \text{ Required Sales} = (\text{Fixed Cost} + \text{Desired Profit}) \div \text{P/V Ratio} = (₹1,60,000 + ₹3,50,000) \div 0.20$$

$$\bullet \text{ Required Sales} = ₹5,10,000 \div 0.20 = ₹25,50,000$$

6. Margin of Safety for Year 2023-24:

$$\bullet \text{ MOS (₹)} = \text{Actual Sales} - \text{BEP Sales} = ₹18,00,000 - ₹8,00,000 = ₹10,00,000$$

$$\bullet \text{ MOS Ratio} = (₹10,00,000 \div ₹18,00,000) \times 100 = 55.56\%$$

- Verification: Profit = MOS × P/V Ratio = ₹10,00,000 × 20% = ₹2,00,000
[Matches given profit!]

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Master Case Study 2: Key Factor (Raw Material Bottleneck) Product Optimization

Problem: Precision Tools Ltd. manufactures three industrial products: Alpha, Beta, and Gamma. The cost structure per unit is given below:

Particulars	Alpha (₹)	Beta (₹)	Gamma (₹)
Selling Price per unit	100	120	150
Direct Raw Material (@ ₹10 per kg)	30 (3 kg)	50 (5 kg)	40 (4 kg)
Direct Labor Wages (@ ₹15 per hour)	30 (2 hrs)	15 (1 hr)	45 (3 hrs)
Variable Production Overheads	10	15	20
Total Variable Cost per unit	70	80	105
Monthly Market Demand (Units)	2,000	1,500	1,000

Total available raw material for the upcoming month is restricted to **12,000 kg** due to import quota sanctions. Total monthly fixed overheads are ₹60,000. Determine the **optimal product mix** and the **maximum profit**.

Step 1: Compute Contribution per Unit & Contribution per kg of Raw Material

• Alpha: Contribution = ₹100 - ₹70 = ₹30 per unit. Raw Material = 3 kg.
Contribution/kg = ₹30 ÷ 3 = **₹10.00 / kg** → **RANK II**

• Beta: Contribution = ₹120 - ₹80 = ₹40 per unit. Raw Material = 5 kg.
Contribution/kg = ₹40 ÷ 5 = **₹8.00 / kg** → **RANK III**

• Gamma: Contribution = ₹150 - ₹105 = ₹45 per unit. Raw Material = 4 kg.
Contribution/kg = ₹45 ÷ 4 = **₹11.25 / kg** → **RANK I**

Step 2: Optimal Allocation of 12,000 kg Scarce Material

• **Rank I (Gamma):** Produce full demand of 1,000 units × 4 kg = **4,000 kg allocated**. (Balance = 12,000 - 4,000 = 8,000 kg).

• **Rank II (Alpha):** Produce full demand of 2,000 units × 3 kg = **6,000 kg allocated**. (Balance = 8,000 - 6,000 = 2,000 kg).

• **Rank III (Beta):** Remaining material = 2,000 kg. Beta requires 5 kg/unit.
Units produced = 2,000 ÷ 5 = **400 units**. (Demand of 1,100 units left unfulfilled).

Step 3: Maximum Total Corporate Profit Computation:

- Contribution from Gamma (1,000 units × ₹45) = ₹45,000
- Contribution from Alpha (2,000 units × ₹30) = ₹60,000
- Contribution from Beta (400 units × ₹40) = ₹16,000
- **Total Maximum Contribution = ₹1,21,000**

- Less: Total Monthly Fixed Overheads = ₹60,000
- Maximum Net Profit Achievable = ₹1,21,000 - ₹60,000 = ₹61,000

9. Master Summary Reference Matrix: Key CVP Formulas

CVP Concept	Standard Equation	Managerial Application
Contribution	Sales – Variable Cost = Fixed Cost + Profit	Evaluates marginal surplus per unit.
P/V Ratio	$(\text{Contribution} \div \text{Sales}) \times 100$	Measures rate of profit generation.
Break-Even Units	$\text{Fixed Cost} \div \text{Contribution per Unit}$	Zero-profit production volume.
Break-Even Value	$\text{Fixed Cost} \div \text{P/V Ratio}$	Zero-profit sales turnover.
Margin of Safety	$\text{Actual Sales} - \text{Break-Even Sales} = \text{Profit} \div \text{P/V Ratio}$	Cushion against economic downturn.
Key Factor Ratio	$\text{Contribution per Unit} \div \text{Key Factor per Unit}$	Product prioritization during bottlenecks.
Shutdown Point	$\text{Avoidable Fixed Costs} \div \text{P/V Ratio}$	Minimum sales to warrant keeping plant open.

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