Math Clinic (Pre-MBA)

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Lecture Notes & Guided Practice

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Preface

These questions support the Math Clinic for incoming MBA students. The goal is to refresh essential quantitative skills used in operations, economics, finance, and data-driven decision-making.

Each chapter follows a consistent pattern:

- short theory written for quick recall,
- worked examples with commentary,
- practice questions (with solutions)[See recording].

How to use these notes. Try the practice problems before watching the video with the solutions. If you get stuck, identify exactly which line you cannot justify; then use the solution as a model for writing your own reasoning clearly.

Contents

Chapter 1

1.1 Cost–Volume–Profit Analysis and Managerial Decision Making

Cost–volume–profit (CVP) analysis is a fundamental decision–making framework in managerial accounting. It examines how changes in sales volume, selling prices, variable costs, and fixed costs affect operating income. Managers use CVP analysis to evaluate pricing strategies, cost structures, and profit planning decisions.

1.2 Assumptions Underlying CVP Analysis

CVP analysis relies on several simplifying assumptions: selling price per unit and variable cost per unit remain constant; total fixed costs do not change within the relevant range; all costs can be classified as fixed or variable; and production equals sales.

Decision implication: These assumptions make CVP analysis most useful for short–term decisions within a stable operating environment. Managers must exercise caution when applying CVP results to long–term or high–uncertainty decisions.

1.3 Contribution Margin and Profit Planning

The contribution margin represents the portion of sales revenue available to cover fixed costs and generate profit. It is defined as sales revenue minus variable costs.

On a per–unit basis, contribution margin equals selling price per unit minus variable cost per unit. The contribution margin ratio expresses this amount as a percentage of sales revenue.

Decision relevance: Contribution margin is central to decisions involving pricing, product mix, outsourcing, and cost control. It is more useful than gross margin because it explicitly distinguishes between variable and fixed costs.

1.4 Breakeven Analysis within CVP

Breakeven analysis determines the level of sales at which total revenue equals total costs, resulting in zero operating income. It represents only one point on the broader CVP relationship between sales volume and profit.

Decision relevance: Managers rarely aim to merely break even. CVP analysis allows evaluation of target profits, margins of safety, and the financial impact of strategic decisions.

1.5 Sensitivity Analysis in CVP

Sensitivity analysis examines how changes in key assumptions—such as selling price, variable cost, or fixed cost—affect profit outcomes.

The widespread use of electronic spreadsheets has made sensitivity analysis an essential managerial tool, enabling rapid scenario evaluation and what–if analysis.

Decision relevance: Sensitivity analysis helps managers understand risk and identify which variables have the greatest impact on profitability.

1.6 Operating Leverage and Cost Structure Decisions

Operating leverage measures the extent to which fixed costs are used in an organization. A higher degree of operating leverage increases the sensitivity of operating income to changes in sales volume.

Decision relevance: Managers must balance higher potential profits against higher risk when choosing between fixed and variable cost structures, such as automation versus outsourcing.

1.7 Limitations of CVP Analysis

Although CVP analysis is a powerful planning tool, it is based on simplifying assumptions that may not hold over long periods. All costs can change given sufficient time, and real–world conditions often involve uncertainty and non–linear relationships.

Decision implication: CVP analysis should be used as an initial screening tool and complemented with more advanced analytical techniques for strategic decisions.

Chapter 2

Applied Problems

1. Orchid Components Ltd. sold 200,000 units of its product for $30 per unit last year. The variable cost per unit is $25 and total annual fixed costs are $800,000.

   (a) Calculate (a) the total contribution margin and (b) the operating income.

   (b) Orchid's current process is labour intensive. The operations manager, Leah Baptiste, proposes investing in new manufacturing equipment. This would increase annual fixed costs to $2,400,000, but reduce variable cost to $16 per unit. Orchid expects to sell the same number of units next year at the same selling price. Explain how accepting this proposal would affect your answers in part (1).

   (c) Should Orchid accept the proposal? Explain briefly.

2. Fill in the missing amounts for each independent case.

Case	**Revenues**	**Variable Costs**	**Fixed Costs**	**Total Costs**	**Operating Income**	**CM %**
a	_____	$500	_____	$800	$1,200	____
b	$2,000	_____	$300	_____	$200	____
c	$1,000	$700	_____	$1,000	_____	____
d	$1,500	_____	$300	_____	_____	40%

3. IslandLink Travel Services specializes in flights between Toronto and *Trinidad*. It books passengers on Northern Skies Air. IslandLink's fixed costs are $22,000 per month. Northern Skies Air charges passengers $1,000 per round-trip ticket.

   Calculate the number of tickets IslandLink must sell each month to (a) break even and (b) earn a target operating income of $10,000 per month in each of the following independent cases.

   (a) IslandLink's variable costs are $35 per ticket. Northern Skies Air pays IslandLink an 8% commission on the ticket price.

   (b) IslandLink's variable costs are $29 per ticket. Northern Skies Air pays IslandLink an 8% commission on the ticket price.

   (c) IslandLink's variable costs are $29 per ticket. Northern Skies Air pays IslandLink a $48 fixed commission per ticket. Comment on the results.

   (d) IslandLink's variable costs are $29 per ticket. It receives a $48 commission per ticket from Northern Skies Air. It also charges its customers a delivery fee of $5 per ticket. Comment on the results.

4. Coastal Crullers operates six doughnut outlets in and around Port of Spain. The following corporate budget data are provided for next year:

Revenues	$10,000,000
Fixed costs	$1,800,000
Variable costs	$8,000,000

Variable costs change with respect to the number of doughnuts sold.

Compute the budgeted operating income for each of the following deviations from the original budget data. (Consider each case independently.)

(a) A 10% increase in contribution margin, holding revenues constant

(b) A 10% decrease in contribution margin, holding revenues constant

(c) A 5% increase in fixed costs

(d) A 5% decrease in fixed costs

(e) An 8% increase in units sold

(f) An 8% decrease in units sold

(g) A 10% increase in fixed costs and a 10% increase in units sold

(h) A 5% increase in fixed costs and a 5% decrease in variable costs

5. HarbourWrite Ltd. manufactures and sells pens. Currently, 5,000,000 units are sold per year at $0.50 per unit. Fixed costs are $900,000 per year. Variable costs are $0.30 per unit.

   Consider each case separately.

   (a) (1) What is the current annual operating income?
   (2) What is the present breakeven point *in revenues*?

   (b) Compute the new operating income if variable cost increases by $0.04 per unit.

   (c) Compute the new operating income if fixed costs increase by 10% and units sold increase by 10%.

   (d) Compute the new operating income if fixed costs decrease by 20%, selling price decreases by 20%, variable cost per unit decreases by 10%, and units sold increase by 40%.

   (e) Compute the new breakeven point *in units* if fixed costs increase by 10%.

   (f) Compute the new breakeven point *in units* if selling price increases by 10% and fixed costs increase by $20,000.

6. The *GreenHaven Trust (GHT)* is an environmentally focused organization that buys land with the goal of preserving natural habitats. GHT receives private contributions and does not receive any regular government funding.

   Fixed annual operating costs are $1,000,000. Variable costs (including purchase of land, environmental impact reports, and title search) average $3,000 per acre. In 2009, GHT expects to receive contributions of $19,000,000. All contributions in excess of operating costs will be used to purchase land.

   (a) How many acres will GHT be able to purchase in 2009?

   (b) GHT is considering participating in a new government program that will provide $1,000 per acre to subsidize the purchase of environmentally sensitive land. If GHT participates, it estimates it will lose $5,000,000 in contributions from supporters who feel accepting government money is not consistent with GHT's mission. If GHT participates in the program, how many acres will it be able to buy in 2009? On financial considerations alone, should GHT take the $1,000 per acre subsidy?

   (c) GHT is worried that contributions may drop by more than $5,000,000 if it takes the government subsidy. By how much can contributions decrease for GHT to be able to buy the *same* amount of land if it takes the government subsidy or rejects it?