Course: Cost & Management Accounting II
Chapter 1: Cost-Volume-Profit (CVP) Analysis

- ✓ Most basic planning tool
- ✓ Examines the behavior of total revenues, total cost and operating income as change occur in the output level, selling price, variable cost per unit or fixed cost.
- ✓ CVP answers what-if questions

1. CVP Assumptions an Terminology

1. Changes in the level of revenues and costs arise only because of changes in the number of product (or service) units produced or sold.
2. Total costs can be divided into fixed and variable components with respect to the level of out put
3. When graphed, the behavior of total revenues and total costs is linear in relation to output units within the relevant range.
4. The unit selling price, unit variable cost and fixed costs are constant
5. The analysis either covers single product or assumes that the sales mix where multiple products are sold will remain constant as the level of total units sold changes
6. All revenues and costs can be added and compared without taking into account the time value of money.

Example 1: essentials of CVP Analysis
Mary Frost plans to sell Do-All Software. Mary can purchase this software from whole wholesaler at $120 per package with the privilege of returning all unsold units and receiving a full $120 refund per package. The units (package) will be sell at $200 each. She has already paid $2,000 to Computer conventions Inc. for the booth rental for two day convention. Assume there are no any other costs.

Required

a) If Mary sells 5 packages in the business fair what will be the revenues, variable costs, fixed cost and the operating income
b) If Mary sells 40 packages in the business fair what will be the revenues, variable costs, fixed cost and the operating income

2. The Concept of Contribution Margin

- ✓ The only numbers that change from selling different quantities of packages are **total revenues** and **total variable costs**
- ✓ The difference between total revenues minus total variable cost is **contribution margin.**
- ✓ It represents amounts of revenues minus variable costs that contribute to recovering fixed costs.
- ✓ When fixed costs are fully recovered contribution margin contributes to operating income.
- ✓ Contribution margin per unit is the difference between selling price and variable cost per unit

Example 2: Concept of Contribution Margin

If Mary sells the below number of software packages:

a. 0 package
b) 1 package
c) 5 packages
d) 25 packages
e) 40 packages

Required

a) Calculate total revenues, total variable cost, total contribution margin and total operating income for each case (prepare contribution income statement)
b) Calculate the contribution margin per unit?
c) Calculate total contribution margin if 100 packages are sold?
d) Calculate contribution margin percentage (CM ratio)?
e) By applying CM ratio what will be the contribution margin if revenues of $5000 are generated.

Note: Contribution margin ratio is the contribution margin per unit divided by selling price per unit in other words it is the percentage of contribution in revenues.

3. The Breakeven Point

- ✓ The breakeven point is the quantity of output where total revenues equal total costs- that is where operating income is zero.
- ✓ There are three methods to determine the breakeven point: the equation method, the contribution method and the graph method.

Note: *the breakeven point is where total contribution margin equal fixed costs*

What the abbreviations mean in breakeven point

USP= Unit selling price
UVC=Unit variable cost
UCM=Unit contribution margin (USP-UVC)
CM%=Contribution margin percentage (UCM/USP)
FC=Fixed costs
Q= Quantity of output units sold (and Manufactured)
OI=Operating Income
TOI=Target Operating Income
TNI=Target net income

3.1The equation method:

- ✓ Under the equation method, the income statement can be expressed using the preceding terminology in the form of the following equation.

Revenues-variable costs-fixed costs= operating income

(USP X Q)-(UVC X Q)-FC=OI	Formula 1

Example 3 : Breakeven point: the equation method
Assume Mary charges a unit selling price of $200 and the unit variable cost is $120 and that fixed costs are $2, 0000.
Required

a) Calculate quantity of units Mary required to breakeven
b) Calculate dollar revenues Mary requires to breakeven

3.2 The contribution Margin Method

- ✓ The contribution margin method simply uses the concept of contribution margin to rework the equation method.

When the equation method is reworked the formula is

Q=FC/UCM	**Formula 2**

Breakeven # of units= fixed costs/ unit contribution margin

Example 4: breakeven point: the contribution margin method

By using the information in example three above

a) Calculate quantity of units to breakeven under contribution margin method
b) Calculate revenues to break even under the contribution margin method

3.3 The Graph Method

- ✓ In the graph method we plot a line for total cost and a line for total revenues. Their point of intersection is the breakeven point.

Example 5: The Breakeven point: Graph method

By referring in example 2 above construct a graph for total cost and total revenue (Cost-Volume Graph) and determine the breakeven point.

Example 6: Target Operating Income

Assume Mary charges a unit selling price of $200 and the unit variable cost is $120 and that fixed costs are $2, 000.

Required

a) By using equation method, how many units must be sold to earn an operating income of $1,200
b) Calculate the revenue in dollars to earn an operating income of $1,200
c) By using profit volume graph determine units to be sold to earn operating income of $1,200
d) By using the profit volume graph determine revenue to earn an operating income of $1,200

Example 7: Target Net Income and Income Taxes

Assume Mary charges a unit selling price of $200 and the unit variable cost is $120 and that fixed costs are $2, 000.

Required

a) Mary is interested in number of units of software packages she must sell to earn a net income of $1,200. Assuming an income tax rate of 40%. (use equation method)
b) Calculate the revenue that can earn a target net income of $1,200 (use equation method)
c) Calculate units to be sold by marry to reach the target net income of $1,200 (use contribution margin method.
d) Calculate revenue to reach the target net income of $1,200

Example 8: Decision to Advertise or Not to Advertise

Mary can sells without advertisement 40 packages each month with a contribution margin of $80 and fixed cost of $2,000. Mary is thinking about advertisement which will cost a fixed cost of $500. If Mary advertises her product features she may sell 45 packages.

Required
Should Mary Advertise her product or Not

Example 9: Decision to Reduce Selling price or Not

Having decided not to advertise, Mary is contemplating whether to reduce the selling price of the her product to $175 (current price is $200). At this price she thinks sales will be 50 units. At this quantity the software wholesaler will sell packages to Mary at $115 instead of $120.

Required
Should Mary reduce the selling price

4. Sensitivity Analysis and Uncertainty

Before choosing among alternatives managers frequently undertake sensitivity analysis. Sensitivity analysis is What-if technique that managers use to examine how a result will change if the original predicted data are not achieved or if an underlying assumption changes. Spreadsheets are of great tool for making sensitivity analysis

Below is an example of spread sheet used for sensitivity analysis of revenues required at $200 selling price to earn an operating income of .

FIXED COST	UVC	$0	$1,000	$1,500	$2,000
$2,000	$100	$4,000	$6,000	$7,000	$8,000
$2,000	$120	$5,000	$7,500	$8,750	$10,000
$2,000	$140	$6,667	$10,000	$11,667	$13,300
$2,500	$100	$5,000	$7,000	$8,000	$9,000
$2,500	$120	$6,250	$8,750	$10,000	$11,250
$2,500	$140	$8,333	$11,667	$13,333	$15,000
$3,000	$100	$6,000	$8,000	$9,000	$10,000
$3,000	$120	$7,500	$10,000	$11,250	$12,500
$3,000	$140	$10,000	$13,333	$15,000	$16,667

- ✓ An aspect of sensitivity analysis is **margin of safety** which is the amount of budgeted revenues over and above the breakeven point. Expressed in units, margin of safety is sales quantity minus breakeven quantity.

Alternative fixed-Cost/Variable-Cost Structures

CVP-based sensitivity analysis highlights the risks and returns that an existing cost structure holds for an organization.

Example 10: Alternative fixed cost/ variable cost structures
Mary paid $2,000 booth rental fees. Suppose however, computer conventions offers Mary three rental alternatives.
Option 1: $2,000 fixed fee
Option 2: $800 fixed fee plus 15% of convention revenues
Option 3:25% of convention revenues with no fixed fee
Mary anticipates selling 40 packages. She is interested in how her choice rental agreement will affect the income she earns and the risks she faces.
Required

a) Calculate the operating income at all options
b) Show in PV graph all of the three options
c) What will happen if the number of units to be sold falls to 20 units?
d) Indicate the risks associated with each option

Effects of Time Horizons

A critical assumption of CVP analysis is that costs can be classified as either variable or fixed. This classification is affected by the time period being considered for the decision. The shorter the time horizon, the higher the percentage of total costs we may view as fixed.

Example 11: effects of time horizon
Daallo Airlines will depart from its gate in 60 minutes and there are 20 empty seats. A potential passenger arrives bearing a transferrable ticket from a competing airline.
Required
What is the variable costs(such as one more meal) would be negligible
Will there be any variable cost if Daallo Airlines to include another city in its routes

Effects of Sales Mix on Income
Sales mix is the relative combination of quantities of products (or services) that constitute total units sales.

Example 12: Sales Mix

Mary is now budgeting for the next convention; she planned to sell software products- Do All and Superword- and the budgets are like the following.

	Do-All	Superword	Total
Units Sold	60	40	100
Revenues $200 and $100	$12,000	$4,000	$16,000
Variable costs $120 and $70 p.u	$7,200	$2,800	$10,000
UCM $80 and $30	$4800	$1,200	$6,000
Fixed Costs			$4,500
Operating Income			$1,500

Required

a) Calculate the breakeven point by considering sales mix ratio of the two products
b) Calculate the weighted average contribution margin per units for the two products taken together?
c) Calculate the breakeven point by using this formula of: BEP=FC/Weighted average Contribution margin per unit?
d) How much of the calculated breakeven point units belong to Do-All software and Superword Software.?
e) Calculate weighted average contribution margin percentage?
f) Calculate the breakeven point revenue?

CVP Analysis in Service and Nonprofit Organizations

CVP can be applied readily to decisions by manufacturing, service and nonprofit organizations. The key to applying CVP Analysis in service and non-profit organizations is measuring their output. Here is a measure of various service and non-profit organizations.

Industry	**Measure of Output**
Airlines	Passenger-miles
Hotel	Room nights occupied
Hospitals	patient days
University	Student credit hours

Example 13: CVP Analysis in NFPs

Doses of Hope Foundation with a budget appropriation (revenue) for the year 2014 of $900,000. This non-profit agency's major purpose is to assist handicapped people who are seeking employment. On average, the agency supplements each person's income by $5,000 annually. The agency's fixed costs are $270,000. It has no other costs.

Required

a) The agency manager wants to know how many people could be assisted in 2014
b) Suppose that the manager is concerned that the total budget appropriation will be reduced by 15%. The manager wants to know how many handicapped people could be assisted. Assume the same amount of monetary assistance per person.

c) Discuss the percentage drop in budget and the percentage drop in assistance service provision