MODULE 2: COST-VOLUME-PROFIT ANALYSIS
Chapters 3, 4, & 5

Learning Objectives:		Topic*	Ch & Time
2.1	Identify the activities in the three operating processes.	M	Ch 3 pp.66-86 5 hours
2.2	Identify and explain variable costs, fixed costs, and mixed costs.	M	
2.3	Use high-low analysis to determine variable costs, fixed costs, and mixed costs.	M	
2.4	Calculate break-even point and perform cost-volume-profit (CVP) analysis.	M	Ch 4 pp.103-117 6 hours
2.5	Apply sensitivity analysis to CVP analysis.	M	
2.6	Determine selling price using sensitivity analysis and CVP analysis.	M	
2.7	Describe the process of determining selling prices and demonstrate how various strategies are used to determine selling price.	M	
2.8	Describe the differences among product and non-product costs.	M	
2.9	Identify and explain product costs: direct/indirect materials, direct/indirect labor, manufacturing overhead.	M	
2.10	Analyze accept-or-reject and make-or-buy decisions.	M	
2.11	Describe the process of determining selling prices and demonstrate how various strategies are used to determine selling price.	M	Ch 5 pp.131-137 2 hours

** F: Financial Accounting; M: Managerial Accounting; A: Financial Statement Analysis*

Module 2 Total Hours = 13

NOTES:

MODULE 2 | CHS 3,4,5

Chapter 3 - Operating Processes: Planning and Control

LEARNING OBJECTIVE 2.1: Identify the activities in the three operating processes.

Revenue Process – activities that involve customers *(money in)*

Expenditure Process – activities that involve suppliers *(money out)*

Conversion Process – activities of the production process *(manufacturing)*

LEARNING OBJECTIVE 2.2: Identify and explain variable costs, fixed costs, and mixed costs.

Predicting cost and revenue behaviors:

Activities cause costs/revenue to occur, hence the term **cost driver.** Some activity is driving the costs/revenue. *Cost/revenue does not cause activity to change.*

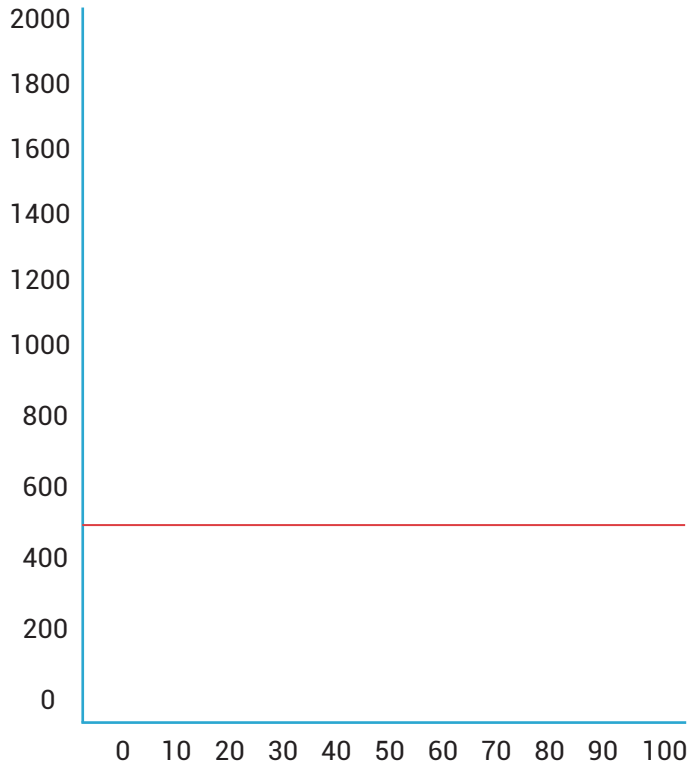
Determine the span of operating activity considered normal for the business. We call this the **relevant range**.

Prairie Plants example:

Prairie Plants sells and delivers potted plants. A number of costs they will incur are not related to the number of plants they sell. For example, the rent on the place of business or the manager's salary is independent of the activity of selling plants. These are **fixed costs.**

If rent is $500 per month, what does this look like on a graph?

Activity level	Cost $
0	500
10	500
20	500
30	500
40	500
50	500
60	500
70	500
80	500
90	500
100	500



Fixed costs do not change in total when activity changes:
Produce 40 units: Total cost = **$500**
Produce 100 units: Total cost = **$500**

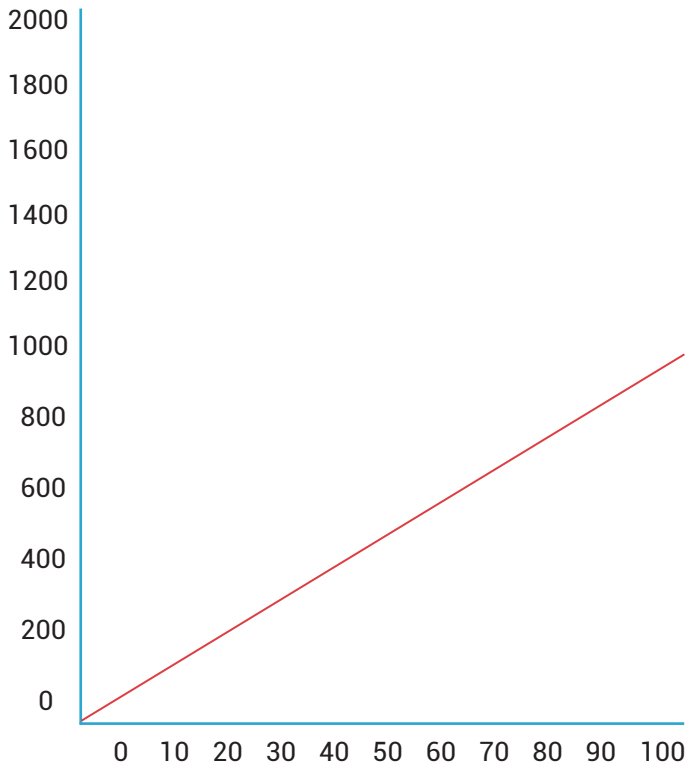
Fixed cost per unit of activity does change:
Produce 40 units: Cost per unit = $500/40 units = **$500/40 = $12.50 per unit**
Produce 100 units: Cost per unit = $500/100 units = **$500/100 = $5.00 per unit**

As activity increases, fixed cost per unit decreases.

The actual cost to purchase the ceramic pots that are used for each plant will relate directly to the number of plants sold. This is a **variable cost**.

If ceramic pots are $10 each, what does this look like on a graph?

Activity level	Cost $
0	0
10	100
20	200
30	300
40	400
50	500
60	600
70	700
80	800
90	900
100	1000

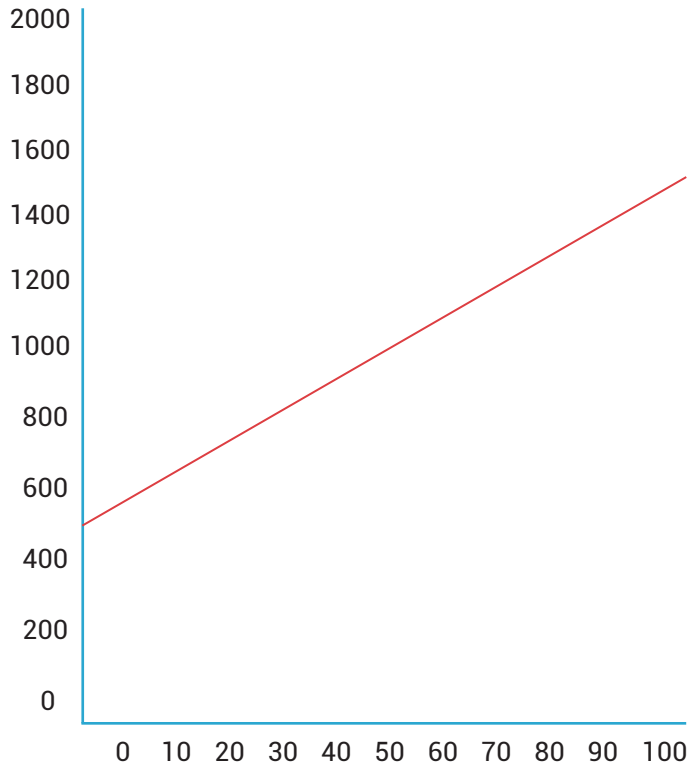


Variable costs change in total in direct proportion with changes in activity:
Produce 40 units: **$10 x 40 units = $400 total**
Produce 100 units: **$10 x 100 units = $1,000 total**

Variable cost per unit does not change:
Produce 40 units: **$400/40 = $10 per unit**
Produce 100 units: **$1,000/100 = $10 per unit**

The cost of the delivery van will have mixed components. There is regular maintenance and payment of property tax on the van regardless of how many miles are driven to make deliveries. However, as the van is driven more with more delivery activity, additional maintenance may be needed. This is a mixed cost. If regular maintenance and property taxes are $500 and additional cost per plant delivered is $10, what does this look like on a graph?

Activity level	Cost $
0	500
10	600
20	700
30	800
40	900
50	1000
60	1100
70	1200
80	1300
90	1400
100	1500



Mixed costs in total vary with changes in activity, but not proportionately:
Produce 40 units: **$10 x 40 + $500 = $900 Total**
Produce 100 units: **$10 x 100 + $500 = $1,500 Total**

Mixed costs per unit decreases because of the fixed cost but not as quickly as if it were entirely fixed:
Produce 40 units: **$900/40 = $22.50 per unit**
Produce 100 units: **$1500/100 = $15 per unit**

LEARNING OBJECTIVE 2.3: Use high-low analysis to determine variable costs, fixed costs, and mixed costs.

Since we know Prairie Plants incurs fixed, variable, and mixed costs, we need a method to predict future costs that recognizes multiple cost behavior patterns.

High/low method:

Use past data about costs (revenues) and the associated drivers to determine a total cost formula which then is used to predict costs in the future.

Cost Formula:
total cost = fixed cost + (variable cost x activity level)

First, find months with highest and lowest levels of activity. This difference represents the **relevant range** (span of operating activity considered normal for the company)

Second, must determine the total costs of these two months.

Key point is that the high and low points are based on activity since we assume that activity changes cause cost (or revenue) changes.

$$\frac{\text{high cost} - \text{low cost}}{\text{high activity} - \text{low activity}} = \text{slope (variable cost)}$$

Next, use the variable cost in the cost formula to determine fixed cost. When trying to determine fixed cost, use low cost as total cost and low activity as activity level.

low cost = fixed cost + (variable cost x *low activity*)

Now, given any level of activity you can estimate the total cost at that level.

Prairie Plants collected data over seven months about total cost and number of plants delivered.

Given this what would the relevant range be?

Month	Plants delivered	Cost
1	20	$690
2	10	650
3	50	998
4	30	808
5	70	1,310
6	40	920
7	60	1,110

Find the cost equation:

$1,310 – $650
70 – 10 = $11.00 variable cost

$650 = FC + (10*$11); FC = $540
$650TC = $540FC + $110VC

**VC and FC determined here will be used later in breakeven analysis*

What would the total cost be if they were to sell 38 plants?

TC = $540 + (38*$11)
TC = $958

What about if they sold 99 plants?

cannot calculate: out of relevant range

Averett Company incurred the following shipping costs during the past six months. Use the high/low method to determine the expected cost of shipping 1,000 items in one month.

Month	Total Items Shipped	Total Shipping Cost
1	850	$2520
2	900	$2625
3	1,100	$3150
4	1,200	$3290
5	750	$2187.50
6	1,150	$3220

Variable cost:

$$\frac{\$3,290.00 - \$2,187.50}{1,200 - 750} = \$2.45 \text{ VC}$$

Fixed cost:

$2,187.50 = FC + ($2.45 * 750)
FC = $350

Total cost:

TC = $350 + ($2.45 * 1,000)
TC = $350 + $2,450
TC = $2,800

Bogard is estimating costs for the last half of the year based on activity during the first half of the year. The result from January through June are as follows:

Month	Units	Production Cost
January	3500	$68,040
February	6200	$98,160
March	4600	$83,760
April	12500	$154,680
May	8100	$114,960
June	9800	$146,520

a. Determine total variable cost per unit made.

$154,680 - $68,040 = $9.63 VC
12,500 - 3,500

b. Determine total fixed cost per month.

$68,040 = FC + ($9.63 x 3,500)
FC = $34,335

c. What is the cost estimation equation?

Total Cost = $34,335 + ($9.63 x units produced)

d. Estimate the total cost if 11,000 units are made during July.

TC = $34,335 + ($9.63 x 11,000)
TC = $140,265

e. What are the high and low points chosen based on units?

Because "units" represents the activity – the cause of the cost

Chapter 4 – Short-Term Decision Making

LEARNING OBJECTIVE 2.4: Calculate break-even point and perform cost-volume-profit (CVP) analysis.

See textbook p. 105 for breakeven graph

See www.investopedia.com for break-even analysis video.

Cost-Volume-Profit Analysis:
Use past data about costs (revenues) and the associated drivers to determine a total cost formula which then is used to predict costs in the future.

How costs and profits respond to changes in volume of goods/services provided to customers. Is used as a planning tool for pricing and production decisions.

total revenue – total cost = profit
total revenue = selling price per unit x number of units sold
total cost = (variable cost per unit x number of units produced) + fixed cost

(SP x Q*) - (VC x Q) - FC = P
(SP – VC) x Q – FC = P
CM* x Q – FC = P
CM x Q = FC + P
Q = (FC + P)/CM

*Q = defines unit quantity
*SP - VC = contribution margin (CM)

Therefore, a quicker way is to calculate using the contribution margin approach:
(FC + P)/CM = Q

Use of the contribution margin income statement makes prediction much easier:

Revenue	SP * Q	TR
Less Variable Costs	VC * Q	TVC
Contribution Margin	CM * Q	TCM
Less Fixed Costs		FC
Net Income (before taxes)		Profit

Breakeven point:

The point where total costs equals total revenue. (no profit, no loss) Any sales volume above breakeven results in profit. Contribution margin approach to solving breakeven is as follows:

FC/CM = ***breakeven point in units***

To breakeven, you must sell enough units to generate enough contribution margin to cover fixed costs.

contribution margin ratio *= CM per unit/SP per unit*

using CM ratio will give you the breakeven point ***in sales dollars rather than units***

FC/CM% = ***breakeven point in sales dollars***

Back to Prairie Plants:

Month	Plants delivered	Cost
1	20	$690
2	10	650
3	50	998
4	30	808
5	70	1,310
6	40	920
7	60	1,110

Assuming Prairie Plants above sells each plant for $20.
** you will use the VC and FC determined earlier.*

Breakeven analysis:

What is their breakeven point in units?

$20SP - $11VC = $9CM
$540FC/$9CM = 60 plants to breakeven

What is their breakeven point in sales dollars?

$9CM/$20SP = .45CM%
$540FC/.45CM%
$1,200 in sales dollars to breakeven

OR… 60 plants x $20SP = $1,200 sales dollars

Determining Target Profit Level:

Business does not plan to breakeven, it is merely a minimum production level below which a loss would occur. Instead, business wants to earn a profit. Here is the equation not considering tax:

FC + Target Profit/CM = Q

Now, taxes being considered business will have a profit target stated in after tax terms. If you know the after tax profit, the easiest approach is to convert this back into a before tax profit then use the result in the equation we already know shown above.

After tax profit / (1 – tax rate) = Before tax profit

How about earning a profit?:

Assume Prairie Plants wishes to make a profit before tax of $1,000 how many plants do they need to sell?

($540 FC + $1,000 Target Profit)/$9 CM = 171.11 plants, round to 172 plants

What about taxes?:

Assume Prairie Plants wants to have a $1,000 after tax profit. Assume a 15% tax rate. What will they need in before tax profit?

ATP/ (1- tax %) = BTP
$1,000/ (1-15%) = $1,176.47 BTP

How many plants must they sell to meet the $1,000 after tax profit?

($540 FC + $1,176.47 BTP)/ $9 CM = 190.72 plants or round to 191

How many dollars in sales must they have to meet the $1,000 after tax profit goal?

($540 FC + $1,176.47 BTP)/ .45 CM% = $3,814.38 in sales dollars

OR… 191 plants x $20SP = $3,820

Individually complete E4.6, page 122, to practice CVP analysis:

Ellsworth Company distributes insect repellent. Each can of repellent sells for $4.00. The variable cost per can of repellent is $0.65. The fixed selling and distribution costs are $80,000. The after-tax target profit level is $15,000. Longpre Co. is subject to an income tax rate of 20 percent.

A. What is the breakeven point in units?

$80,000 FC/$3.35 CM = 23,880.597 rounded to 23,881 cans to breakeven

B. What is the breakeven point in dollars?

CM% = $3.35/$4.00 = 83.75%

$80,000/0.8375 = $95,552.39 Sales dollars to breakeven

C. To achieve the profit goal, what must the before-tax profit be?

$15,000 ATP/(1 – 0.20) = $18,750 BTP

D. How many units must be sold to achieve the profit goal after taxes?

($80,000 FC + $18,750 BTP)/$3.35 CM = 29,477.6119 rounded to 29,478 cans

Watch an episode of *Shark Tank* to discuss product margins, breakeven and scaling up production.

LEARNING OBJECTIVE 2.5: Apply sensitivity analysis to CVP analysis.

LEARNING OBJECTIVE 2.6: Determine selling price using sensitivity analysis and CVP analysis.

Sensitivity Analysis

How changes in the variables of CVP cause changes in breakeven

Change FC :	If change FC will change BE but not CM		
	FC/CM	FC ↑	then BE ↑
Change VC:	SP	FC/CM ↓	then BE ↑
	↑ VC		
	↓ CM		
Change SP	SP ↑	CM ↑	then BE ↓
Change in tax	% Tax% ↓↑	No change in CM or BE (past BE calculation)	

However, will change the number of units needed to reach the after tax profit.

Relevant Variable Analysis

A relevant variable is a cost or revenue that will occur in the future and that differs among the alternatives considered.

- Sunk costs never relevant
- Opportunity costs always relevant

LEARNING OBJECTIVE 2.7: Describe the process of determining selling prices and demonstrate how various strategies are used to determine selling price.

Monopolistic vs. Pure competition
Monopoly vs. Oligopoly
Penetration pricing vs. Predatory pricing
Skimming pricing vs. Price gouging
Life-cycle pricing vs. Target pricing

LEARNING OBJECTIVE 2.8: Describe the differences among product and non-product costs.

Product (manufacturing) costs: direct materials, direct labor, manufacturing overhead
Non Product costs: selling and administrative expenses

LEARNING OBJECTIVE 2.9: Identify and explain product costs: direct/indirect materials, direct/indirect labor, manufacturing overhead.

Direct Materials

The traceable costs incurred to purchase and receive direct materials.

iPods	Plastic cases, components, processors
Publishing company	Paper, ink, book covers, etc.
Automobile manufacturer	Tires, automobile metal parts, etc.
Computer manufacturer	Hard drives, monitors, etc.
Keebler chocolate chip cookies	Chocolate chips, flour, sugar

Direct Labor

Labor costs of employees who actually manufacture the product. The Keebler Elves' wages would be included in this classification.

Manufacturing Overhead

All product costs other than direct material and direct labor, including indirect materials (see below), indirect labor (employees whose services support manufacturing such as factory janitors and supervisors), factory utilities, factory rent, factory depreciation

*Indirect materials examples:

iPods	Glue
Publishing company	Glue, printing press lubricants, etc.
Automobile manufacturer	Factory light bulbs, drill bits etc.
Computer manufacturer	Assembly line lubricants, screwdrivers, polishers, etc.
Keebler chocolate chip cookies	Cooking spray

*These indirect materials would be credited out of the asset "Supplies" when placed in production.

LEARNING OBJECTIVE 2.10: Analyze accept-or-reject and make-or-buy decisions.

Accept-or-Reject Decisions

Operating decision rule: Accept a special order if the relevant profit is positive and reject if the relevant profit is negative.

Make-or-Buy Decisions

Operating decision rule: Make a product internally if the relevant cost of making the item is less than the relevant cost of buying the item externally. Buy item externally if the relevant cost of buying the item is less than the relevant cost of making the item.

Be sure to discuss qualitative factors such as: impacts to employees, customer perception, reputation, quality, etc.

Accept or Reject Decision

Chavez Co. produces and sells duffel bags that are priced at $60 each. Chavez has received a request for a special order for 500 duffel bags at a price of $48 each. The current unit cost to produce a bag is $32 (direct material, $20; direct labor, $8; and unit-related overhead, $4). Chavez Co. has the capacity to produce the special order; however, one additional production run will be required costing $2,000. Should the order be accepted? Why or why not.

Selling price	**$ 48**
Less unit costs ($20 + $8 + $4)	**(32)**
Contribution margin per unit $	**16**
x Quantity	**500**
Total contribution margin	**$8,000**
Less batch cost	**(2,000)**
Profit on order	**$6,000**

Chavez Co. should accept the special order because the relevant profit is positive.

Make or Buy Decision

Whitney, Inc. manufactures a unique hand lotion formulated for extremely dry weather. It also makes the containers the lotion is sold in. Production costs for the 15,000 containers needed annually are as follow:

Direct materials	$35,000
Direct labor	15,000
Unit-related overhead	5,000
Product-sustaining overhead	6,000
Allocated facility-sustaining overhead	14,000

A supplier has offered to provide all 15,000 containers at a price of $4.50 per container. If Whitney, Inc. accepts the offer, it will rent the released space for an annual rental fee of $12,000. Should Whitney, Inc. make or buy the containers?

Make:		**Buy:**
Direct materials	**$35,000**	**15,000 x $4.50 = $67,500**
Direct labor	**15,000**	
Unit-related overhead	**5,000**	
Product sustaining OH	**6,000**	
Total	**$61,000**	
Opportunity cost	**12,000**	
Relevant cost to make	**$73,000**	

Whitney, Inc. should buy the containers.

Chapter 5 – Strategic Planning Regarding Operating Processes

LEARNING OBJECTIVE 2.11: Describe the process of determining selling prices and demonstrate how various strategies are used to determine selling price.

Watch *Stossel in the Classroom* on price gouging
https://www.youtube.com/watch?v=R6ojYtKazgQ