#3

BREAK-EVEN ANALYSIS

Proving the Price is Right

AICPA

CPA... Imagine the possibilities!

Learning Activity

Break-even analysis: *Students play the role of business owners and are responsible for managing expenses to determine their business' profits.*

Learning Objectives

1. Understand the meaning of variable costs and fixed costs, and their relationship to production volume.
2. Calculate contribution margins and break-even points.
3. Determine how break-even points are affected by fixed and variable costs.

Assessment

Students will: (1) calculate variable and fixed costs, (2) calculate contribution margins and break-even points, (3) calculate the number of units a business will need to sell to earn a profit, and (4) identify the cost and determine the amount of the cost that must be reduced in order to increase profits.

Academic Standard

"Students represent and analyze mathematical situations and structures using algebraic symbols." (NCTM)

"Students use algebraic operations and mathematical procedures to analyze and solve business problems." (NBEA)

Business Skill

Management Consulting: Break-even analysis is a forecasting tool used to calculate the number of units that a business must sell in order to generate sufficient revenue to cover expenses. CPAs use break-even analysis to provide advice and insight on how to improve business performance.

Procedure

Distribute a copy of the Topic Overview to your students and discuss any terms or concepts they are unfamiliar with.

Explain the "break-even point" to your students while providing definitions of fixed and variable costs. For instance:

Total Fixed Costs *(i.e., rent)* ***do not vary*** *(remain constant), regardless of the number of units produced, but* ***fixed costs per unit do vary*** *inversely per unit based on the number of units produced:*

Fixed Cost per unit = Total Fixed Cost / # of units produced

Variable Costs *(i.e., cost of hamburger patties and hot dog buns)* ***do not vary*** *(remain constant) per unit, regardless of the total number of units produced, but* ***total variable costs do vary*** *in direct proportion to the number of units produced:*

Total Variable Costs = Variable Cost per unit * # units produced

Explain the concept of contribution margin using the following formula and emphasize that each sale first contributes to "covering" or paying fixed costs and, once enough units are sold to cover them—i.e., the break-even point—the contribution margin represents the business' profit per unit. As such, for each unit sold beyond the break-even point, the following formula represents profit:

Contribution Margin = Sales price per unit – Variable cost per unit

Distribute copies of Activity #3 to the class. Note that the **Activity consists of three competitions.**

For each competition:
Divide your class into two teams and place the two "Game Cards" face down on a desk. Have a student from each team select one card at random and take the Game Card back to their team. Each team will represent the owner of the business displayed on the Game Card selected.

Conduct Round 1 of the Game and score the results. Explain that in the business world people are paid to interpret and analyze information, and provide insight and advice as to how to improve business performance, as opposed to just "crunching" the numbers.

Conduct Round 2 of the Game, which gives the team with the low score from Round 1 a chance to analyze its business and make improvements which will win the Game.

Overview

Certified Public Accountants (CPAs) provide insight into bottom-line business performance through the use of math-based analytical and forecasting tools. One such tool is **break-even analysis.** A business is said to **"break-even"** when its **revenue** (sales in terms of dollars) exactly equals its **expenses.** The importance of the break-even "point" lies in the fact that until the break-even point is reached, a company will incur a loss. Thus, it can be said that a business will start to earn a profit only when sales (in units) exceed the break-even point. In addition, once the break-even point is determined, businesses can then analyze their expenses to determine those that can be reduced and by what amount in order to prevent losses and increase profits.

Break-even analysis uses the following basic equation to determine the break-even point:

Revenue – Expenses = 0, or Dollar Sales – Dollar Expenses = 0

Note that "zero" represents the "break-even" point because at that point revenues **equal** expenses, thus neither a profit nor a loss exists. Total revenue, expressed in dollar terms, is calculated by multiplying the **sales price** (or revenue) per unit by the **total number of units sold.** The total number of units that must be sold in order to "break even" is the "unknown" – the variable represented by "x."

Expenses are separated into two categories, **fixed expenses** and **variable expenses. Fixed expenses** are costs that a business incurs, such as rent and insurance, that *are not* directly related to the volume of production. That is, total fixed expenses remain the same regardless of the number of units the business produces. Note, however, that fixed expenses PER UNIT will vary according to the number of units produced.

Variable expenses, such as materials and labor, are those costs that are directly related to the volume of production. Total variable expenses, therefore, vary according to the number of units produced. That is, total variable expenses will increase as the number of units produced increases and conversely decrease as units produced decreases. As such, total variable expenses, expressed in dollar terms, are calculated by multiplying the variable cost per unit by the total number of units sold, which is the variable "x." (Note that variable costs per unit remain constant; that is, variable costs per unit do not vary.)

To expand upon the basic equation, total revenue is equal to total units sold (variable "x") multiplied by the sales price per unit. Total variable expenses are equal to total units sold (variable "x") multiplied by the variable cost per unit. Therefore, the break-even equation now reads:

(Sales price per unit * x) less (Variable costs per unit * x) less Total fixed costs equals Zero

Or

$$X = \frac{\textit{Total fixed costs}}{\textit{Sales price per unit} - \textit{Variable costs per unit}}$$

*Where x represents the number of units that must be sold to break-even, (Sales price per unit * x) represents total revenue, and (Variable cost per unit * x) represents total variable expenses*

In addition, the sales price per unit less the variable cost per unit is often referred to as the profit per unit but is actually the **contribution margin.** Until the break-even point is reached, the "profit" per unit contributes to paying the fixed costs, thus the term **contribution margin.** In order to determine the number of units that must be sold to earn a desired profit, substitute the desired profit figure for "zero" in the equation. For example:

(Sales price per unit * x) less (Variable cost per unit * x) less Total fixed costs equals Desired profit

"Revenue follows expenses" is an accounting concept that means expenses are incurred first, before revenue can be recognized and cash inflow realized. This is true of any business. In addition, note that the price of an item, the "revenue" factor, can be established only after the total cost of that item, the expense factor, is determined. This is also true of any business.

Activities

ROUND – 1

First, use the data on your team's card to analyze your business' financial position, and enter the results in your team's column below. Do the same for your competition and enter their results in the appropriate column.

Remember, the equation for the break-even point is:

(Sales Price per unit * X) – (Variable Costs per Unit * X) – Total Fixed Costs = 0, where X is the number of units that must be sold to break-even.

Then, assign points to your business and your competition based on the following scoring model:

	Business Data	Higher Figure	Lower Figure
1	Sales price per unit	1 point	0 points
2	Variable cost per unit	0 points	1 point
3	Total fixed costs	0 points	1 point
4	Contribution margin	1 point	0 points
5	Break-even point	0 points	1 point
6	Number of units to be sold to earn $10,000	0 points	1 point

*If your business and the competition have the **same figure** for any of the business data,* **assign 1 point to BOTH** *your team and the competition.*

Business Score Card

	Business Data	Your Team	Points	The Competition	Points
1	Sales price per unit				
2	Variable cost per unit				
3	Total fixed costs				
4	Contribution margin				
5	Break-even point				
6	Number of units to be sold to earn $10,000				
	Round 1 Points				
7	Explanation…				
8	Calculation…				
	Round 2 Points				
	TOTAL POINTS				

ROUND – 2

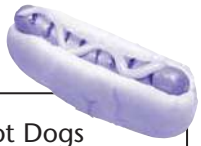
The team with the **LOW SCORE** will now get a chance to analyze their business' financial position and improve their point total. **See questions #7 and #8 below.**

For each correct answer, assign your team 2 points. If the team with the lower score from Round 1 fails to answer a question correctly, the opposing team will be given the opportunity to answer.

At the conclusion of Round 2, total your points and your competitor's points from both rounds. The team with the higher point total is the winner!

Bob's Burgers	
Sales price per burger	$2.75
Cost Per Burger	
Hamburger patty	$.80
Bun	.32
2 pickles	.19
Ketchup & mustard (packets)	.14
Monthly Business Expenses	
Rent	$1,250
Manager's salary	975
Utilities	175
Advertising	80
Maintenance	120

VS



Harriet's Hot Dogs	
Sales price per hot dog	$2.75
Cost Per Hot Dog	
Hot dog	$.24
Bun	.11
Sauerkraut	.08
Ketchup & mustard (packets)	.07
Monthly Business Expenses	
Rent	$2,125
Manager's salary	1,375
Utilities	375
Advertising	275
Maintenance	350

Bob's Burgers vs. Harriet's Hot Dogs

7 **Explain** to Bob why he must sell more burgers than Harriet has to sell hot dogs to earn a profit of $10,000, despite the fact that he (Bob) sells his burgers for the same price that Harriet sells her hot dogs.

8 **Calculate** the dollar amount of Bob's variable expenses that must be reduced so that Bob can earn $10,000 by selling the same number of burgers that Harriet sells hot dogs to earn $10,000.

Duke's Dairy Store	
Sales price per milkshake	$2.25
Cost Per Milkshake	
Milk	$.47
Ice Cream	.73
Flavoring	.15
Monthly Business Expenses	
Rent	$1,800
Manager's salary	1,050
Utilities	400
Insurance	350

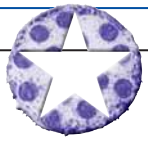
VS

Queen's Coffee Shop	
Sales price per cup of coffee	$1.25
Cost Per Cup of Coffee	
Milk or cream	$.05
Flavored coffee	.18
Sugar	.02
Monthly Business Expenses	
Rent	$1,800
Manager's salary	1,050
Utilities	400
Insurance	350

Duke's Dairy Store vs. Queen's Coffee Shop

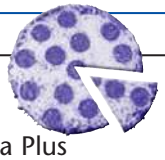
7 **Explain** to Duke why he must sell more milkshakes than Queen must sell cups of coffee in order to break-even, despite the fact that Duke charges more for a milkshake than Queen charges for a cup of coffee.

8 **Calculate** the dollar amount of Duke's variable costs that must be reduced so that Duke can earn $10,000 by selling the same number of milkshakes that Queen sells cups of coffee to earn $10,000.



Star Pizzeria	
Sales price per pizza	$8.00
Cost Per Pizza	
Dough	$.45
Sauce	.94
Mozzarella	.21
Monthly Business Expenses	
Rent	$1,650
Manager's salary	1,200
Utilities	825
Insurance	325

VS



Uptown Pizza Plus	
Sales price per pizza	$8.00
Cost Per Pizza	
Dough	$.45
Sauce	.94
Mozzarella	.21
Monthly Business Expenses	
Rent	$1,025
Manager's salary	1,100
Utilities	800
Insurance	275

Star Pizzeria vs. Uptown Pizza

7 **Explain** to Star why they must sell more pizzas than Uptown in order to break-even, despite the fact that they both sell pizzas for the same price and the ingredients cost each the same amount.

8 **Calculate** the dollar amount of Star's fixed costs that must be reduced so that Star can break-even by selling the same number of pizzas that Uptown sells to break-even.

ROUND-1: Bob's Burgers vs. Harriet's Hot Dogs

	Business Data	Bob's Burger	Points	Harriet's Hot Dogs	Points
1	Sales price per unit	$2.75	1	$2.75	1
2	Variable cost per unit	$1.45	0	$.50	1
3	Total fixed costs	$2,600	1	$4,500	0
4	Contribution margin	$1.30	0	$2.25	1
5	Break-even point	2,000 burgers	1	2,000 burgers	1
6	Number of units to be sold to earn $10,000	9,693 burgers	0	6,445 hot dogs	1
	Round 1 Points		**3**		**5**

PART-2:

7 Bob's variable costs are greater than Harriet's: $1.45 vs. $.50. Therefore, Harriet's contribution margin per unit is greater ($2.25 vs. $1.30).

8 Bob must reduce his variable costs by $.66 to $.79.

Bob's Team earns 2 points for each correct answer and can therefore win the game!

ROUND-1: Duke's Dairy Store vs. Queen's Coffee Shop

	Business Data	Duke's Dairy	Points	Queen's Coffee	Points
1	Sales price per unit	$2.25	1	$1.25	0
2	Variable cost per unit	$1.35	0	$.25	1
3	Total fixed costs	$3,600	1	$3,600	1
4	Contribution margin	$.90	0	$1.00	1
5	Break-even point	4,000 shakes	0	3,600 cups	1
6	Number of units to be sold to earn $10,000	15,112 shakes	0	13,600 cups	1
	Round 1 Points		**2**		**5**

ROUND-2:

7 Duke's variable costs are greater than Queen's: $1.35 vs. $.25. Therefore, Queen's contribution margin per unit is greater ($1.00 vs. $.90).

8 Duke must reduce his variable costs by $.10 to $1.25.

Duke's Team earns 2 points for each correct answer and can therefore win the game!

ROUND-1: Star Pizzeria vs. Uptown Pizza

	Business Data	Star Pizzeria	Points	Uptown Pizza	Points
1	Sales price per unit	$8.00	1	$8.00	1
2	Variable cost per unit	$1.60	1	$1.60	1
3	Total fixed costs	$4,000	0	$3,200	1
4	Contribution margin	$6.40	1	$6.40	1
5	Break-even point	625 pizzas	0	500 pizzas	1
6	Number of units to be sold to earn $10,000	2,188 pizzas	0	2,063 pizzas	1
	Round 1 Points		**3**		**6**

ROUND-2:

7 Star's fixed costs are greater than Uptown's: $4,000 vs. $3,200.

8 Reduce fixed expenses $800, from $4,000 to $3,200.

Star's Team earns 2 points for each correct answer and can therefore win the game!