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Cost Behavior and Cost Estimation

Unit Summaries

Unit 2.1 – Cost Behavior Patterns

This unit examines four cost behavior types – variable, fixed, mixed, and step.

Unit 2.2 – Cost Estimation

This unit focuses on using knowledge of cost behaviors to develop cost functions and estimate total costs. The high-low method and the EXCEL functions for regression are illustrated as means for analyzing mixed costs.

Unit 2.3 – Contribution Margin Analysis

The contribution margin and the contribution format income statement are introduced.

Continuing Case Recap

This is the first chapter in the text that uses the running case. In this chapter students are introduced to Universal Sports Exchange, one of C&C Sports' customers.

Motivating the Chapter with The Business Decision and Context

Martin Keck, Universal Sports' vice president of sales, wonders why a 10% decrease in sales volume did not result in a 10% decrease in net income. The 10% decrease in sales volume also resulted in a larger than expected ending inventory of baseball jerseys. Martin needs to know how to predict the changes in income when sales volume changes.

Assignment Classification by Learning Objective

Learning Objective	Exercises	Problems	Cases
1. Identify basic cost behavior patterns and explain how changes in activity level affect total cost and unit cost. (Unit 2.1)	1, 2, 3, 4, 5, 6, 7	19, 24	27, 29
2. Estimate a cost equation from a set of cost data and predict future total cost from that equation. (Unit 2.2)	8, 9, 10, 11, 12	20, 21, 22, 23, 25	28
3. Prepare a contribution format income statement. (Unit 2.3)	13, 14, 15, 16, 17, 18	24, 26	28

Assignment Characteristics

Item	Description	L. O.	Difficulty Level	Minutes to Complete	Bloom's Taxonomy	AACSB	AICPA FN	AICPA PC	IMA	Ethics Coverage
	EXERCISES									
2-1	Identify cost behaviors	1	M	12	C	AN	R	C	CM	
2-2	Identify cost behaviors	1	D	15	C	AN	R	C	CM	
2-3	Identify cost behaviors	1	M	12	AP	AN	M	PS	CM	
2-4	Identify cost behaviors	1	M	15-20	AP, C	AN	M	PS	CM	
2-5	Identify cost behaviors	1	M	10	AP, AN	AN	M	PS	CM	
2-6	Explain use of fixed costs in calculating unit cost	1	D	5-7	AN	AN	M	PS	CM	
2-7	Understand the effect of changes in volume on costs	1	D	8	AP, AN	AN	M	PS	CM	
2-8	Use a scattergraph to estimate a cost function	2	M	15-20	AP, AN	AN	M	PS	CM	
2-9	Use the high-low method to estimate a cost function	2	M	20	AP, AN	AN	M	PS	CM	
2-10	Use the high-low method to estimate a cost function	2	M	12	AP, AN	AN	M	PS	CM	
2-11	Develop cost functions	2	D	20	AP	AN	M	PS	CM	
2-12	Develop cost function and estimate total cost	2	D	10-15	AP	AN	M	PS	CM	
2-13	Prepare a contribution format income statement	3	M	10-15	AP	AN	M	PS	CM	
2-14	Find missing amounts in a contribution format income statement	3	E	10-15	AN	AN	M	PS	CM	
2-15	Prepare a contribution format income statement	3	D	10-15	AP	AN	M	PS	CM	
2-16	Prepare a contribution format income statement	3	M	15	AP	AN	M	PS	CM	
2-17	Prepare a contribution format income statement	3	E	20-25	AP	AN	M	PS	CM	
2-18	Interpret contribution format income statement	3	M	10	AP, AN	AN	M	PS	CM	
	PROBLEMS									
2-19	Identify cost behavior using unit cost information	1	E	20-25	AP	AN	M	PS	CM	

Item	Description	L. O.	Difficulty Level	Minutes to Complete	Bloom's Taxonomy	AACSB	AICPA FN	AICPA PC	IMA	Ethics Coverage
2-20	Develop cost function using scattergraph and high-low method, estimate total cost	2	M	20-25	AP, AN	AN	M	PS	CM	
2-21	Develop cost function using high-low method, estimate total cost	2	D	15-20	AP, AN	AN	M	PS	CM	
2-22	Develop cost function using high-low method, identify cost outliers	2	M	20-25	AP, AN	AN	M	PS	CM	
2-23	Develop and evaluate cost function using high-low method	2	D	30-35	AP, AN	AN	M	PS	CM	
2-24	Identify cost behavior, prepare contribution format income statement	1, 3	D	20-25	AP	AN	M	PS	CM	
2-25	Prepare a contribution format income statement, estimate total cost	2, 3	D	20	AP	AN	M	PS	CM	
2-26	Prepare a contribution format income statement, evaluate changes in cost behavior	3	D	20-25	AP	AN	M	PS	CM, DA	
	C&C CONTINUING CASE									
2-27	Identify cost behavior	1	E	5-7	C	AN	M	PS	CM	
2-28	Determine operating profit equation, prepare contribution format income statement	2, 3	M	10	AP, AN	AN	M	PS	CM	
	CASES									
2-29	Identify cost behavior, estimate total cost	1	D	20-25	AP	AN	M	PS	CM	
2-30	Evaluate ethical issues		M	10-15	AN	AN, E	R	C	BA	✔

Difficulty: E = Easy, M = Moderate, D = Difficult
Bloom: K = Knowledge, C = Comprehension, AP = Application, AN = Analysis, S = Synthesis, E = Evaluation
AACSB: A = Analytic, C = Communication, E = Ethics
AICPA FN: DM = Decision modeling, RA = Risk Analysis, M = Measurement, R = Reporting, RS = Research, T = Technology
AICPA PC: C = Communication, I = Interaction, L = Leadership, P = Professional demeanor, PM = Project Management, PS = Problem Solving and Decision Making, T = Technology
IMA: BA = Business applications, BP = Budget Preparation, CM = Cost Management, DA = Decision Analysis, PM = Performance Measurement, R = Reporting, SP = Strategic Planning

Chapter Summary

Unit 2.1

LO 1 ***Identify basic cost behavior patterns and explain how changes in activity level affect total cost and unit cost.***

The two basic cost behavior patterns are variable and fixed. Costs that are a combination of these two basic patterns are referred to as mixed. The following table shows how these costs change with changes in activity:

	AS ACTIVITY INCREASES		AS ACTIVITY DECREASES	
Cost Behavior	**Total Cost**	**Cost per Unit**	**Total Cost**	**Cost per unit**
Variable	increases	remains constant	decreases	remains constant
Fixed	remains constant	decreases	remains constant	increases
Mixed	increases	decreases	decreases	increases

Unit 2.2

LO 2 ***Estimate a cost equation from a set of cost data and predict future total cost from that equation.***

Total cost can be expressed in the form $y = mx + b$, where y is the total cost, m is the variable cost per unit, x is the number of units, and b is the total fixed cost. Given a set of costs and activity levels, you can estimate a cost equation using one of the following methods: scattergraph, high-low, or regression.

Unit 2.3

LO 3 ***Prepare a contribution format income statement.***

A contribution format income statement is an income statement that categorizes expenses by their behavior. It follows the structure:

	Sales Revenue
-	Variable expenses
=	Contribution margin
-	Fixed expenses
=	Operating income

Besides showing total sales revenue and expenses, the contribution format statement should also show per unit amounts for sales revenue, variable expenses, and contribution margin.

Related Reading

James Fantus, "Understanding Cost Behavior in the Lab: The Key to Financial Success," *Medical Laboratory Observer,* July 1997.

This article discusses fixed and variable costs in a medical laboratory setting. It can provide the basis for discussing cost behavior in a service setting. Available online at http://www.thefreelibrary.com/Understanding+cost+behavior+in+the+lab%3A+the+key+to+financial+success.-a021145718.

Douglas MacMillan, "Turning Smartphones Into Cash Registers," *Bloomburg Businessweek*, February 14 – February 20, 2011, 44-45.

This article provides information about the costs incurred to use Square, a mobile payment system that plugs into smartphones. The cost information in the article provides an example of a mixed cost, with a fixed monthly base charge and a variable charge per transaction. One interesting twist on this mixed cost is that

there are two variable components – one based on the number of transactions and one based on the sales revenue.

Alex Colon, **"**New Ipad 4G Data Plans: AT&T Vs. Verizon," *PCMag.com*, March 15, 2012, http://www.pcmag.com/article2/0,2817,2401618,00.asp

The data plans discussed in this article provide a good example of a step-variable cost.

Additional Cases

Susan P. Convery and Amy M. Swaney, "Analyzing Business Issues – With EXCEL: The Case of Superior Log Cabins, Inc.," *Issues in Accounting Education,* February 2012, 141-156.

This case provides an opportunity to practice cost estimation using scattergraphs, the high-low method, and regression. It also provides the opportunity to practice and improve EXCEL skills. The assignment contains several components, some of which have not been covered at this point in the text, so you will need to provide revised instructions to students about which components to complete.

Shane S. Dikolli and Karen L. Sedatole, "Delta's New Song: A Case on Cost Estimation in the Airline Industry," *Issues in Accounting Education,* August 2004, 345-358.

This case provides an opportunity for students to make and test hypotheses about cost drivers and cost behavior. Using quarterly operating data from Delta Airlines, students are asked to identify possible cost drivers for salary costs and to establish a salary cost formula using high-low, single regression and multiple regression. The data, which covers 1993 – 2002, may appear a bit old, but the exercise does not depend on the newness of the data. The case also offers limited data for the first years of Jet Blue Airlines' operations, allowing a comparison of the cost functions of two airlines with different operating strategies. If you have an alumnus with experience in the airline industry, the case offers an excellent chance for team teaching.

L. Melissa Waters and Teresa M. Pergola, "An Instructional Case: Cost Concepts and Managerial Analysis," *Issues in Accounting Education*, November 2009, 531-538.

This case illustrates basis cost concepts using a library setting. Students must identify cost drivers, identify the relevant range of activity, identify can classify costs by behavior, and calculate unit cost. One of the case requirements does require knowledge of cost traceability, which is not covered in the text until Chapter 3. However, the case can be used at this point by omitting that requirement.

Critical Thinking Exercises

Read Anton Troianovski and Thomas Gryta, "Verizon Overhauls Wireless Plans," *The Wall Street Journal,* June 13, 2012 (available online at http://online.wsj.com/article/SB10001424052702303901504577462241394886300.html) or Roger Yu, "Verizon Wireless Overhauls Service Plans With New Options," June 12, 2012 (available online at http://usatoday30.usatoday.com/tech/news/story/2012-06-12/verizon-data-service-plans/55542720/1).

Questions

- Verizon's previous tiered pricing plans charges customers based on the number of minutes talked and the data volume consumed. For instance, a customer would pay $40 for 450 minutes of air talk time and $50 for 1 GB of data access, for a total monthly fee of $90. How would a consumer on this plan classify the cost in terms of its behavior?
  As long as the customer did not exceed the contracted air time and data access, the consumer would classify this plan as a fixed cost of $90 per month.

- Under the new pricing plan, Verizon will offer a low-usage plan for $40. While the plan provides 700 minutes of air talk time, texts are billed at $0.25 each. How would a consumer on this plan classify the cost in terms of its behavior?

This plan would be a mixed cost to the consumer. The cost function would be: ($0.25 × number of texts) + $40.

- Another option under the new pricing plan charges smart phone users $40 for unlimited voice and text access plus an amount based on the volume of data access. The data plan is available at six levels, ranging from $50 for 1 GB to $100 for 10GB. How would a consumer on this plan classify the cost in terms of its behavior?
  This voice component of the plan would be a fixed cost to the consumer while the data plan would be a step variable cost.

Read Quentin Fottrell, Ryanair Aims to Bank off Rivals' Pains, *The Wall Street Journal*, February 1, 2010. (available online at http://online.wsj.com/article/SB10001424052748704722304575038351927396866.html)

Visit http://www.ryanair.com/en/news/passenger-figures and find the number of passengers that flew on Ryanair in October 2009, November 2009, and December 2009.

Questions

- The headlines on each of the monthly passenger reports states that traffic has grown during the month. What period is the company using for that comparison?
  Ryanair is comparing each month to that month in the previous year, 2008. Passenger traffic actually fell from October 2009 to December 2009.

- What costs do you think the reduced passenger volume would affect?
  The reduced passenger volume would affect all variable costs that are driven by passenger volume. This could include costs related to items such as baggage handling and on-board food and beverages.

- The article mentions a 37% decrease in fuel costs. Based on the passenger data, does fuel appear to be a variable cost driven by passenger volume?
  Since fuel costs have decreased while passenger volume has decreased, it might be a variable cost that is driven by passenger volume.

- What other non-volume related factor could account for the 37% drop in fuel costs?
  If the price Ryanair paid for a gallon of jet fuel decreased during that period, the fuel cost would be reduced, even without a reduction in the number of passengers. Looking at historical jet fuel prices at http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EER_EPJK_PF4_RGC_DPG&f=D this appears to be a reasonable explanation for at least part of the fuel cost savings.

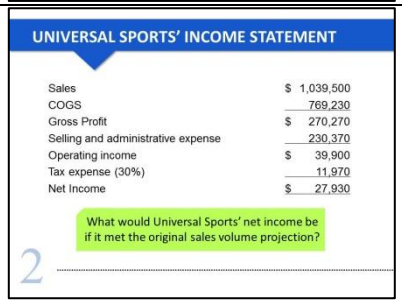
Read "Hot or Not," *CFO Magazine*, June 2009, 16. (available online at http://cfo.com/article.cfm/13720112.)

Questions

- The "Keep It Up" graphic shows costs that companies believe are important to maintain in difficult financial times. Would managers at the companies surveyed consider these costs to be committed or discretionary?
  These costs would be considered to be committed, since the managers are not willing to reduce the level of spending. They apparently believe that cutting these costs would be detrimental to the companies' long term success.

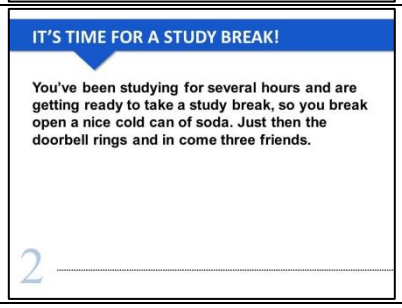
- Why do you think more managers consider information technology expenditures to be committed than those who consider travel expenditures to be committed?
  Information technology tools gather data and provide information to support managerial decision making, and making good managerial decisions is critical if the company is going to survive in the long run. Business travel probably does not have as great an effect on long run success. In fact, investments in technology may allow business to be conducted using technology tools rather than requiring travel expenditures for a face-to-face meeting.

PowerPoint Slide Notes

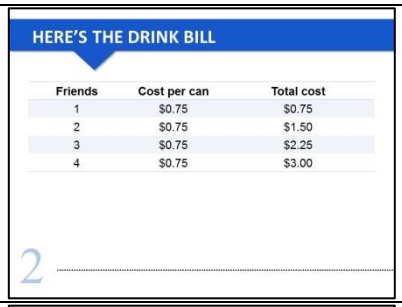


The Business Decision and Context is based on Universal Sports Exchange's (a C&C customer) vice president of sales wondering what net income would have been if the company had reached its planned jersey sales. Ask students to use this income statement to come up with an answer for Universal. After getting some answers, point out that some of the costs won't change. For example, selling more jerseys wouldn't increase the company's utility bill. Set the stage by telling students they will learn how to identify which costs will change with additional sales volume and how to prepare a different income statement to help answer this type of question.

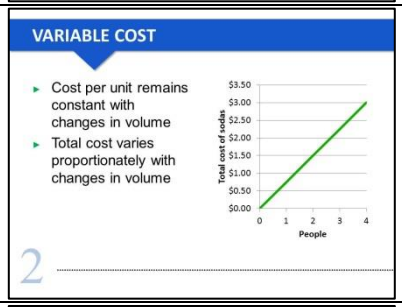
Inform students that there are four general types of cost behavior that will be studied in Chapter 2.



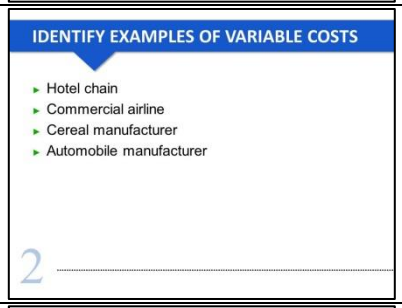
Use this and the following slides of familiar scenarios to illustrate cost behaviors.



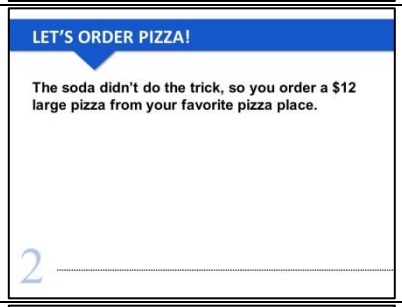
Point out that each can of soda costs $0.75 and that doesn't change as more friends show up.



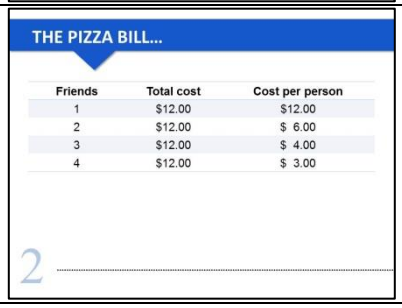
Define variable cost. Point out that the graph shows the same information as the table in the previous slide. Review the concept of the slope of a line and how the slope of the cost line is the cost per unit.



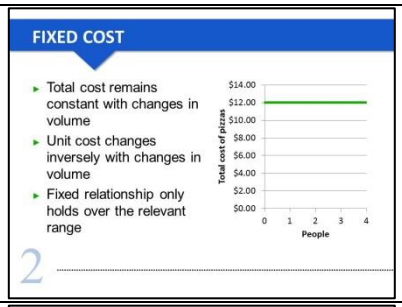
Ask students to identify variable costs for each of these industries. The hotel chain is a good example to use to talk about activity drivers. For instance, the cost of laundry is driven by the number of guests registered. However, the cost of maid service is driven by the number of rooms rented. A room with four people will require more laundry than a room with one person. However, each of the rooms will require approximately the same amount of cleaning.



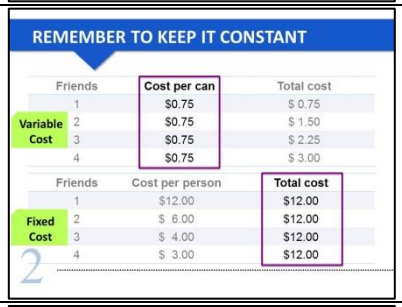
Continue the study break example.



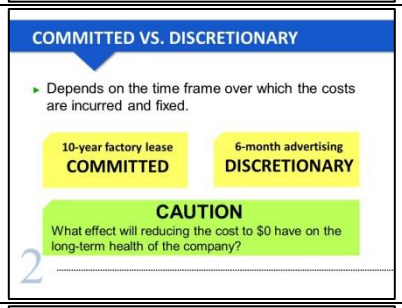
Point out that one pizza was ordered, and the cost of the pizza will not change as more friends drop in.



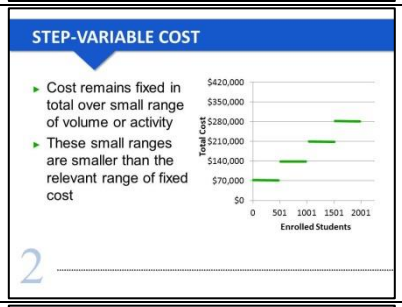
Define fixed cost. Point out that the graph illustrates the data from the table in the previous slide. Discuss the concept of relevant range.



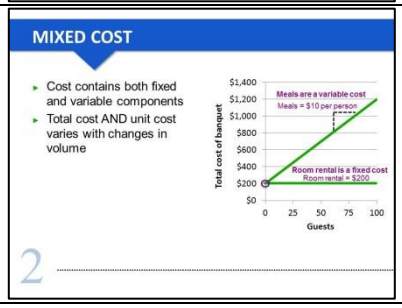
Emphasize that if students will always work with the "constant" form of the costs, they will be less likely to adjust costs incorrectly for changes in volume or activity. For variable costs, this is the cost per unit; for fixed costs, it is the total cost.



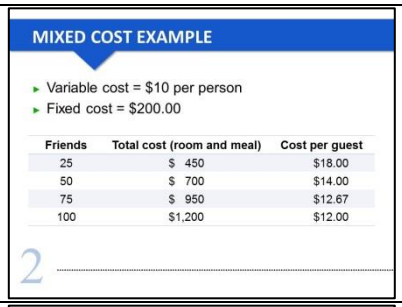
Discuss the concepts of committed and discretionary costs. Relate the concepts to students' lives by using apartment rent and movie tickets to illustrate committed and discretionary costs, respectively.



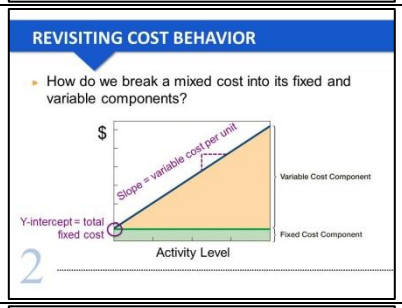
Discuss step-variable costs. This illustration assumes an academic support person for online courses is paid $70,000 per year and can handle 500 students. Make sure students understand that while step variable costs appear fixed, they steps are relatively small compared to the relevant range over which fixed costs are fixed.



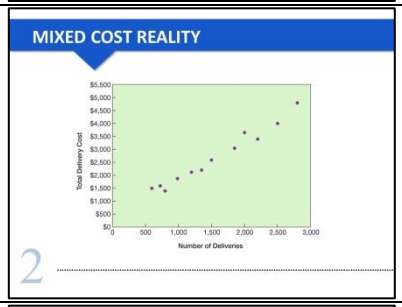
Discuss mixed costs and present the definition. The graph shows the total cost a banquet that requires a $200 charge for the room and then a $10 per person charge for food.



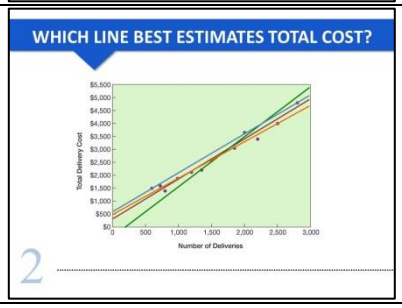
Using the same pizza example, point out how total cost increases and cost per person decreases as more people are added to the pizza party.



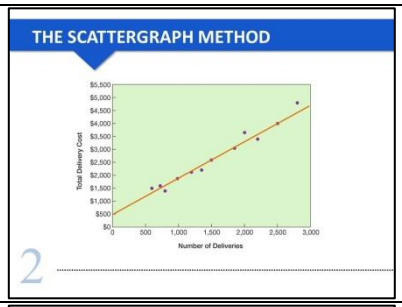
This graph illustrates the fixed and variable components of a mixed cost. Point out the line intercepts the y-axis at the level of the fixed component of the mixed cost and that the slope of the total cost line represents the variable cost per unit.



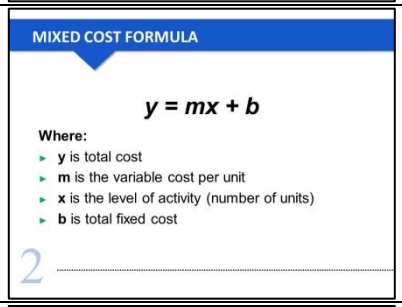
This is a scattergraph of the delivery cost example in the textbook. Ask students how they would use this data to find the fixed and variable delivery cost. Then show the next slide.



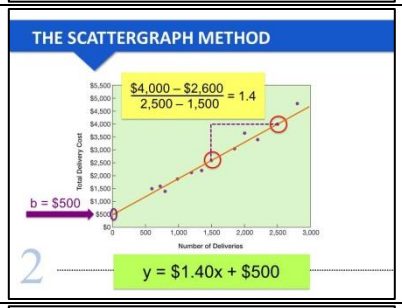
Discuss the pros and cons of each of these possible lines drawn through the delivery cost data points. Ask students which is the best line and what makes that line the best.



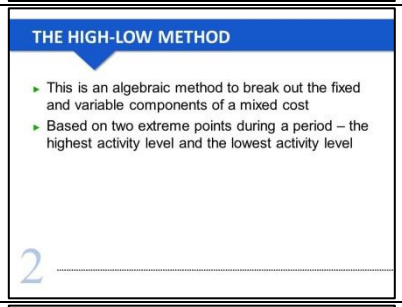
This shows one potential total cost line that could be used to define the cost function. Once again, point out the y-intercept and the slope of the line.



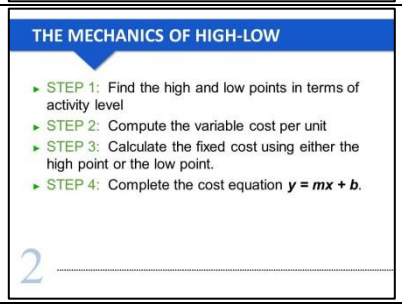
This is the basic linear cost function definition. Remind students that this is the same line equation they learned in high school algebra.



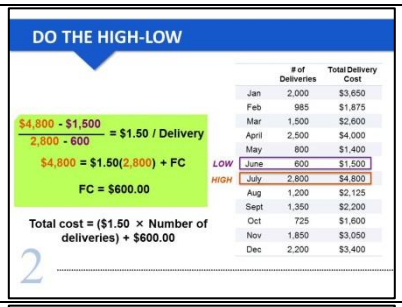
Point out the steps for developing the equation of a line. 1. Select two points from the data. 2. Draw the line through the two points. 3. Find the y-intercept. 4. Calculate the slope of the line using the two points. 5. Write the equation of the line. Have students compute the equation of the line before you reveal the answer.



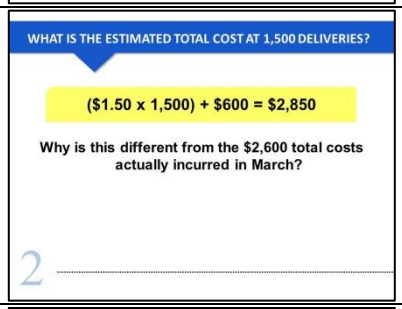
Discuss the usefulness of the high-low method as a quick way to estimate the fixed and variable components of a mixed cost. Point out that the change in the total cost is a result of a change in volume (the cost per unit or slope of the cost line).



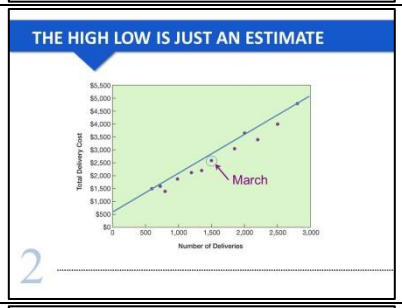
Verbally walk students through the steps of the high-low calculation. Many students will stop after step 2, so remind students that they are not done until they complete the last step to calculate fixed costs.



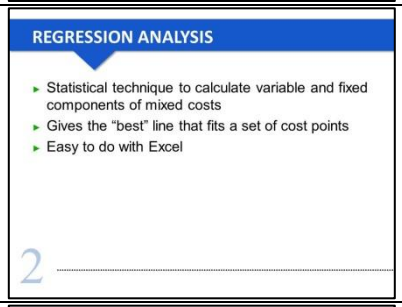
Have students identify the high and low points in this data set. Remind them that the high and low points are based on activity level, not total cost. Once students have tried the problem, walk through the calculations with them.



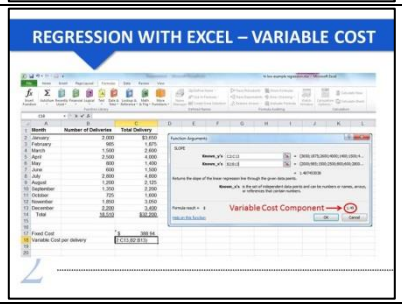
Have students calculate the estimated cost, then work through the calculation with them. Ask why their answer differs from the actual cost when 1,500 deliveries were made.



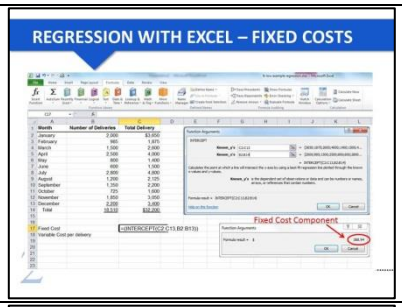
Tie back to the calculation from the previous slide and point out the actual March data point. Emphasize that the high-low method of cost estimation is just that – an estimate. Point out how many actual points fail to fall on the high-low line. But remind students that this doesn't mean it isn't a good tool to use.



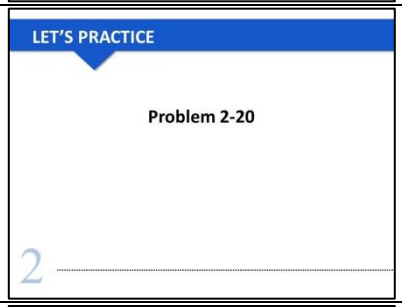
If students have completed a statistics course, they should be familiar with regression. Talk about using regression to determine the intercept (total fixed cost) and slope (variable cost per unit) of a set of cost data points. You may want to create a spreadsheet with the delivery data points and show the students how to use a spreadsheet program such as Excel to compute the regression analysis.



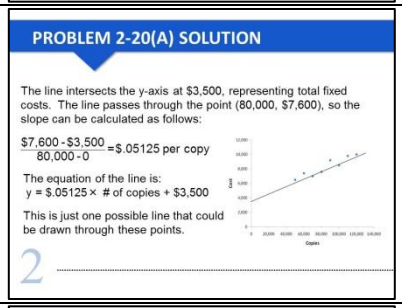
This slide shows how to calculate the variable cost per unit using EXCEL's SLOPE function.



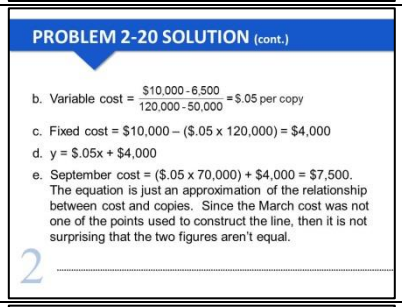
This slide shows how to calculate the variable cost per unit using EXCEL's INTERCEPT function.

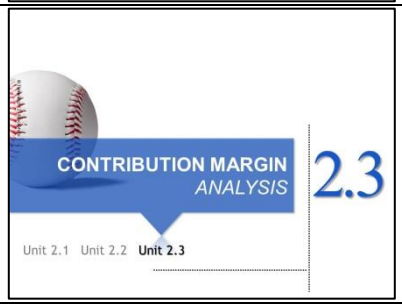


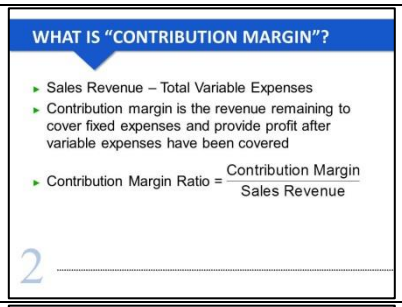
Have students work Problem 2-16 or work it as a class.



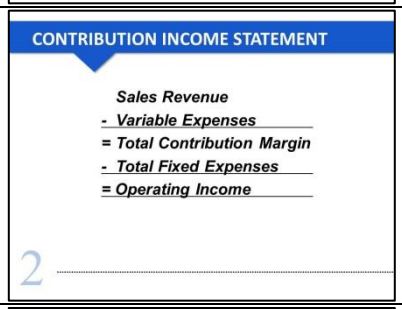
Answers for part A will differ depending on what line the student draws through the data points.



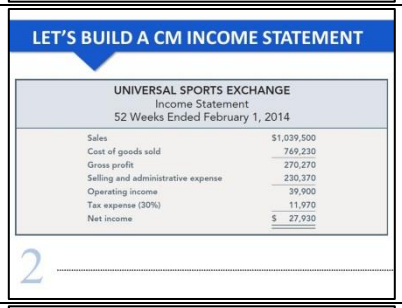




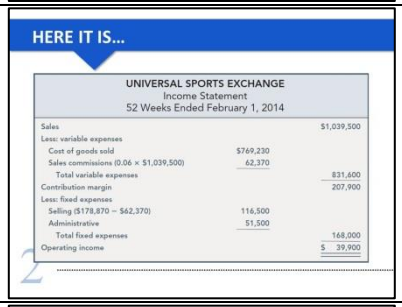
Define contribution margin and point out how it differs from the term gross margin that the students are familiar with.



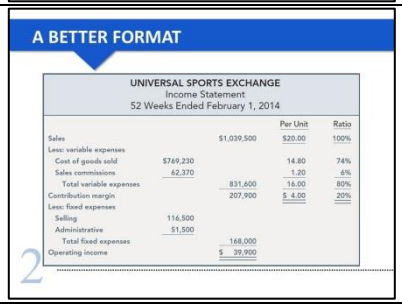
Walk through the contribution margin income statement. Point out that expenses are classified by behavior rather than function. Illustrate how a mixed cost will appear in both variable and fixed sections of the income statement. Emphasize that operating income will not change when recasting a functional income statement into a contribution format income statement. Expenses are not changing, they are just being rearranged.



Have students recast Universal Sports Exchange's income statement (Exhibit 2-9) into a contribution format income statement using Exhibit 2-9 and the information on page 66.



Work through Universal's contribution format income statement.



Emphasize that including the per unit amounts for sales, variable expenses, and contribution margin, along with their percentages, will create a more useful income statement to support decision making efforts.