Questions & Solutions

Cost Accounting

A Managerial Emphasis

15th Edition

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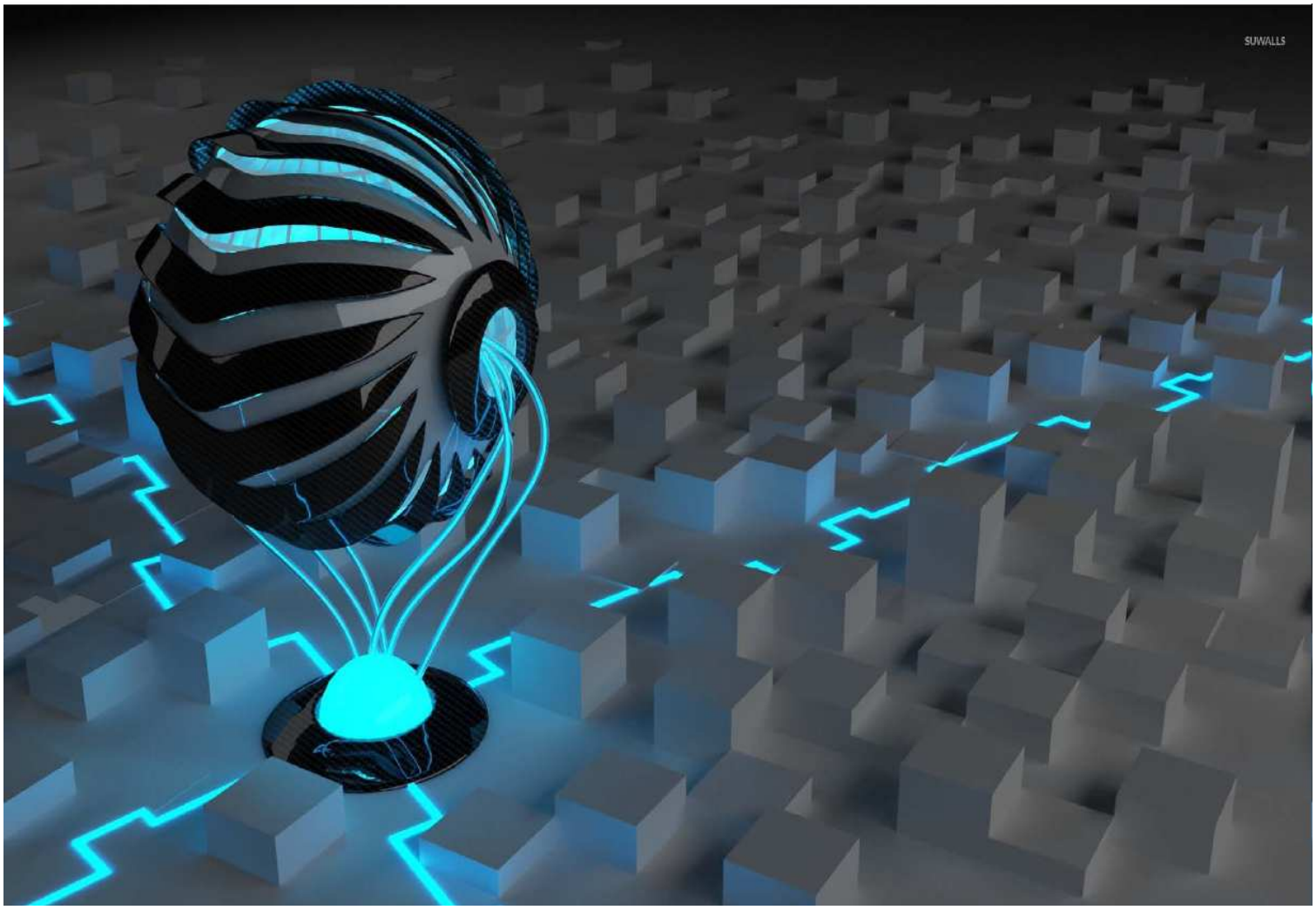
Chapter - 3

Cost–Volume–Profit Analysis




QUESTIONS

Note: To underscore the basic CVP relationships, the assignment material ignores income taxes unless stated otherwise.

Questions

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3-1 Define cost–volume–profit analysis.
3-2 Describe the assumptions underlying CVP analysis.
3-3 Distinguish between operating income and net income.
3-4 Define contribution margin, contribution margin per unit, and contribution margin percentage.
3-5 Describe three methods that managers can use to express CVP relationships.
3-6 Why is it more accurate to describe the subject matter of this chapter as CVP analysis rather than as breakeven analysis?
3-7 "CVP analysis is both simple and simplistic. If you want realistic analysis to underpin your decisions, look beyond CVP analysis." Do you agree? Explain.
3-8 How does an increase in the income tax rate affect the breakeven point?
3-9 Describe sensitivity analysis. How has the advent of the electronic spreadsheet affected the use of sensitivity analysis?
3-10 Give an example of how a manager can decrease variable costs while increasing fixed costs.
3-11 Give an example of how a manager can increase variable costs while decreasing fixed costs.
3-12 What is operating leverage? How is knowing the degree of operating leverage helpful to managers?
3-13 "There is no such thing as a fixed cost. All costs can be 'unfixed' given sufficient time." Do you agree? What is the implication of your answer for CVP analysis?
3-14 How can a company with multiple products compute its breakeven point?
3-15 "In CVP analysis, gross margin is a less-useful concept than contribution margin." Do you agree? Explain briefly.

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Exercises

3-16 CVP computations. Fill in the blanks for each of the following independent cases.

Case	Revenues	Variable Costs	Fixed Costs	Total Costs	Operating Income	Contribution Margin Percentage
a.		$800		$1,200	$1,000	
b.	$2,400		$400		$ 700	
c.	$ 900	$500		$ 900		
d.	$1,800		$400			50%

3-17 CVP computations. Garrett Manufacturing sold 410,000 units of its product for $68 per unit in 2014. Variable cost per unit is $60, and total fixed costs are $1,640,000.

Required

1. Calculate (a) contribution margin and (b) operating income.
2. Garrett's current manufacturing process is labor intensive. Kate Schoenen, Garrett's production manager, has proposed investing in state-of-the-art manufacturing equipment, which will increase the annual fixed costs to $5,330,000. The variable costs are expected to decrease to $54 per unit. Garrett expects to maintain the same sales volume and selling price next year. How would acceptance of Schoenen's proposal affect your answers to (a) and (b) in requirement 1?
3. Should Garrett accept Schoenen's proposal? Explain.

3-18 CVP analysis, changing revenues and costs. Brilliant Travel Agency specializes in flights between Toronto and Jamaica. It books passengers on Ontario Air. Brilliant's fixed costs are $36,000 per month. Ontario Air charges passengers $1,300 per round-trip ticket.

Calculate the number of tickets Brilliant must sell each month to (a) break even and (b) make a target operating income of $12,000 per month in each of the following independent cases.

Required

1. Brilliant's variable costs are $34 per ticket. Ontario Air pays Brilliant 10% commission on ticket price.
2. Brilliant's variable costs are $30 per ticket. Ontario Air pays Brilliant 10% commission on ticket price.
3. Brilliant's variable costs are $30 per ticket. Ontario Air pays $46 fixed commission per ticket to Brilliant. Comment on the results.
4. Brilliant's variable costs are $30 per ticket. It receives $46 commission per ticket from Ontario Air. It charges its customers a delivery fee of $8 per ticket. Comment on the results.

3-19 CVP exercises. The Incredible Donut owns and operates six doughnut outlets in and around Kansas City. You are given the following corporate budget data for next year:

Revenues	$10,400,000
Fixed costs	$ 2,100,000
Variable costs	$ 7,900,000

Variable costs change based on 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.)

Required

1. An 11% increase in contribution margin, holding revenues constant
2. An 11% decrease in contribution margin, holding revenues constant
3. A 4% increase in fixed costs
4. A 4% decrease in fixed costs
5. A 7% increase in units sold
6. A 7% decrease in units sold
7. An 11% increase in fixed costs and a 11% increase in units sold
8. A 4% increase in fixed costs and a 4% decrease in variable costs
9. Which of these alternatives yields the highest budgeted operating income? Explain why this is the case.

3-20 CVP exercises. The Doral Company 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:

Required

1. **a.** What is the current annual operating income?
   b. What is the present breakeven point in revenues?

Compute the new operating income for each of the following changes:

2. A $0.04 per unit increase in variable costs
3. A 10% increase in fixed costs and a 10% increase in units sold
4. A 20% decrease in fixed costs, a 20% decrease in selling price, a 10% decrease in variable cost per unit, and a 40% increase in units sold

Compute the new breakeven point in units for each of the following changes:

5. A 10% increase in fixed costs
6. A 10% increase in selling price and a $20,000 increase in fixed costs

3-21 CVP analysis, income taxes. Brooke Motors is a small car dealership. On average, it sells a car for $27,000, which it purchases from the manufacturer for $23,000. Each month, Brooke Motors pays $48,200 in rent and utilities and $68,000 for salespeople's salaries. In addition to their salaries, salespeople are paid a commission of $600 for each car they sell. Brooke Motors also spends $13,000 each month for local advertisements. Its tax rate is 40%.

Required

1. How many cars must Brooke Motors sell each month to break even?
2. Brooke Motors has a target monthly net income of $51,000. What is its target monthly operating income? How many cars must be sold each month to reach the target monthly net income of $51,000?

3-22 CVP analysis, income taxes. The Swift Meal has two restaurants that are open 24 hours a day. Fixed costs for the two restaurants together total $456,000 per year. Service varies from a cup of coffee to full meals. The average sales check per customer is $9.50. The average cost of food and other variable costs for each customer is $3.80. The income tax rate is 30%. Target net income is $159,600.

Required

1. Compute the revenues needed to earn the target net income.
2. How many customers are needed to break even? To earn net income of $159,600?
3. Compute net income if the number of customers is 145,000.

3-23 CVP analysis, sensitivity analysis. Tuff Kids Jeans Co. sells blue jeans wholesale to major retailers across the country. Each pair of jeans has a selling price of $30 with $21 in variable costs of goods sold. The company has fixed manufacturing costs of $1,200,000 and fixed marketing costs of $300,000. Sales commissions are paid to the wholesale sales reps at 5% of revenues. The company has an income tax rate of 25%.

Required

1. How many jeans must Tuff Kids sell in order to break even?
2. How many jeans must the company sell in order to reach:
   a. a target operating income of $450,000?
   b. a net income of $450,000?
3. How many jeans would TuffKids have to sell to earn the net income in part 2b if (consider each requirement independently).
   a. The contribution margin per unit increases by 10%
   b. The selling price is increased to $32.50
   c. The company outsources manufacturing to an overseas company increasing variable costs per unit by $2.00 and saving 60% of fixed manufacturing costs.

3-24 CVP analysis, margin of safety. Suppose Lattin Corp.'s breakeven point is revenues of $1,500,000. Fixed costs are $720,000.

Required

1. Compute the contribution margin percentage.
2. Compute the selling price if variable costs are $13 per unit.
3. Suppose 90,000 units are sold. Compute the margin of safety in units and dollars.
4. What does this tell you about the risk of Lattin making a loss? What are the most likely reasons for this risk to increase?

3-25 Operating leverage. Carmel Rugs is holding a 2-week carpet sale at Jean's Club, a local warehouse store. Carmel Rugs plans to sell carpets for $1,000 each. The company will purchase the carpets from a local distributor for $400 each, with the privilege of returning any unsold units for a full refund. Jean's Club has offered Carmel Rugs two payment alternatives for the use of space.

- Option 1: A fixed payment of $17,400 for the sale period
- Option 2: 20% of total revenues earned during the sale period

Assume Carmel Rugs will incur no other costs.

Required

1. Calculate the breakeven point in units for (a) option 1 and (b) option 2.
2. At what level of revenues will Carmel Rugs earn the same operating income under either option?
   a. For what range of unit sales will Carmel Rugs prefer option 1?
   b. For what range of unit sales will Carmel Rugs prefer option 2?
3. Calculate the degree of operating leverage at sales of 87 units for the two rental options.
4. Briefly explain and interpret your answer to requirement 3.

3-26 CVP analysis, international cost structure differences. Plush Decor, Inc., is considering three possible countries for the sole manufacturing site of its newest area rug: Italy, Spain, and Singapore. All area rugs are to be sold to retail outlets in the United States for $200 per unit. These retail outlets add their own markup when selling to final customers. Fixed costs and variable cost per unit (area rug) differ in the three countries.

Country	Sales Price to Retail Outlets	Annual Fixed Costs	Variable Manufacturing Cost per Area Rug	Variable Marketing & Distribution Cost per Area Rug
Italy	$200.00	$ 6,386,000	$70.00	$27.00
Spain	200.00	5,043,000	61.00	16.00
Singapore	200.00	12,240,000	84.00	14.00

Required

1. Compute the breakeven point for Plush Decor, Inc., in each country in (a) units sold and (b) revenues.
2. If Plush Decor, Inc., plans to produce and sell 80,000 rugs in 2014, what is the budgeted operating income for each of the three manufacturing locations? Comment on the results.

3-27 Sales mix, new and upgrade customers. Chartz 1-2-3 is a top-selling electronic spreadsheet product. Chartz is about to release version 5.0. It divides its customers into two groups: new customers and upgrade customers (those who previously purchased Chartz 1-2-3 4.0 or earlier versions). Although the same physical product is provided to each customer group, sizable differences exist in selling prices and variable marketing costs:

	New Customers		Upgrade Customers	
Selling price		$195		$115
Variable costs				
Manufacturing	$15		$15	
Marketing	50	65	20	35
Contribution margin		$130		$ 80

The fixed costs of Chartz 1-2-3 5.0 are $16,500,000. The planned sales mix in units is 60% new customers and 40% upgrade customers.

Required

1. What is the Chartz 1-2-3 5.0 breakeven point in units, assuming that the planned 60%/40% sales mix is attained?
2. If the sales mix is attained, what is the operating income when 170,000 total units are sold?
3. Show how the breakeven point in units changes with the following customer mixes:
   a. New 40% and upgrade 60%
   b. New 80% and upgrade 20%
   c. Comment on the results.

3-28 Sales mix, three products. The Janowski Company has three product lines of mugs—A, B, and C—with contribution margins of $5, $4, and $3, respectively. The president foresees sales of 168,000 units in the coming period, consisting of 24,000 units of A, 96,000 units of B, and 48,000 units of C. The company's fixed costs for the period are $405,000.

Required

1. What is the company's breakeven point in units, assuming that the given sales mix is maintained?
2. If the sales mix is maintained, what is the total contribution margin when 168,000 units are sold? What is the operating income?
3. What would operating income be if the company sold 24,000 units of A, 48,000 units of B, and 96,000 units of C? What is the new breakeven point in units if these relationships persist in the next period?
4. Comparing the breakeven points in requirements 1 and 3, is it always better for a company to choose the sales mix that yields the lower breakeven point? Explain.

3-29 CVP, not-for-profit. Genesee Music Society is a not-for-profit organization that brings guest artists to the community's greater metropolitan area. The music society just bought a small concert hall in the center of town to house its performances. The lease payments on the concert hall are expected to be $4,000 per month. The organization pays its guest performers $1,800 per concert and anticipates corresponding ticket sales to be $4,500 per concert. The music society also incurs costs of approximately $1,000 per concert for marketing and advertising. The organization pays its artistic director $33,000 per year and expects to receive $30,000 in donations in addition to its ticket sales.

Required

1. If the Genesee Music Society just breaks even, how many concerts does it hold?
2. In addition to the organization's artistic director, the music society would like to hire a marketing director for $25,500 per year. What is the breakeven point? The music society anticipates that the addition of a marketing director would allow the organization to increase the number of concerts to 41 per year. What is the music society's operating income/(loss) if it hires the new marketing director?
3. The music society expects to receive a grant that would provide the organization with an additional $17,000 toward the payment of the marketing director's salary. What is the breakeven point if the music society hires the marketing director and receives the grant?

3-30 Contribution margin, decision making. McCarthy Men's Clothing's revenues and cost data for 2014 are as follows:

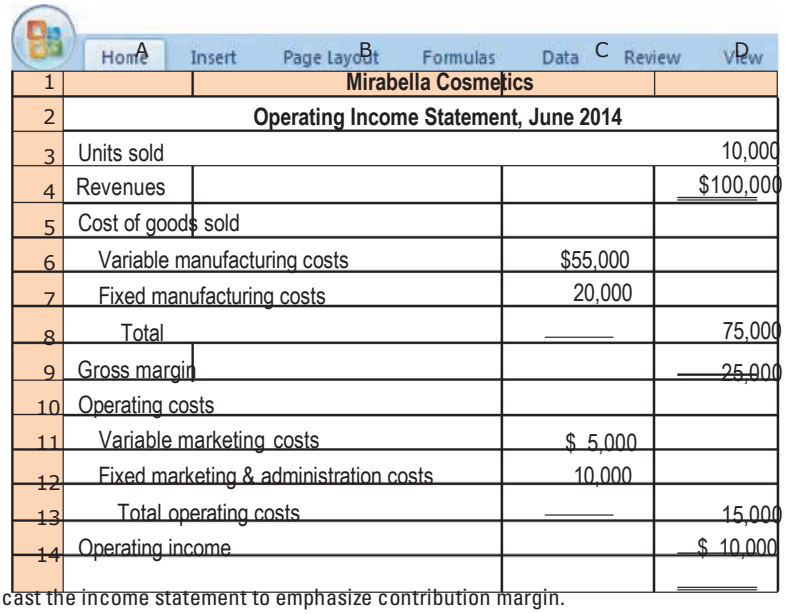
Revenues		$500,000
Cost of goods sold		250,000
Gross margin		250,000
Operating costs:		
Salaries fixed	$160,000	
Sales commissions (11% of sales)	55,000	
Depreciation of equipment and fixtures	15,000	
Store rent ($4,000 per month)	48,000	
Other operating costs	40,000	318,000
Operating income (loss)		$ (68,000)

Mr. McCarthy, the owner of the store, is unhappy with the operating results. An analysis of other operating costs reveals that it includes $35,000 variable costs, which vary with sales volume, and $5,000 (fixed) costs.

Required

1. Compute the contribution margin of McCarthy Men's Clothing.
2. Compute the contribution margin percentage.
3. Mr. McCarthy estimates that he can increase units sold, and hence revenues by 20% by incurring additional advertising costs of $12,000. Calculate the impact of the additional advertising costs on operating income.
4. What other actions can Mr. McCarthy take to improve operating income?

3-31 Contribution margin, gross margin, and margin of safety. Mirabella Cosmetics manufactures and sells a face cream to small ethnic stores in the greater New York area. It presents the monthly operating income statement shown here to George Lopez, a potential investor in the business. Help Mr. Lopez understand Mirabella's cost structure.



	A	B	C	D
1	Mirabella Cosmetics			
2	Operating Income Statement, June 2014			
3	Units sold			10,000
4	Revenues			$100,000
5	Cost of goods sold			
6	Variable manufacturing costs		$55,000	
7	Fixed manufacturing costs		20,000	
8	Total			75,000
9	Gross margin			25,000
10	Operating costs			
11	Variable marketing costs		$ 5,000	
12	Fixed marketing & administration costs		10,000	
13	Total operating costs			15,000
14	Operating income			$ 10,000

Required

1. Recast the income statement to emphasize contribution margin.
2. Calculate the contribution margin percentage and breakeven point in units and revenues for June 2014.
3. What is the margin of safety (in units) for June 2014?
4. If sales in June were only 8,000 units and Mirabella's tax rate is 30%, calculate its net income.

3-32 Uncertainty and expected costs. Hillmart Corp., an international retail giant, is considering implementing a new business-to-business (B2B) information system for processing merchandise orders. The current system costs Hillmart $1,000,000 per month and $45 per order. Hillmart has two options, a partially automated B2B and a fully automated B2B system. The partially automated B2B system will have a fixed cost of $5,000,000 per month and a variable cost of $35 per order. The fully automated B2B system has a fixed cost of $11,000,000 per month and $20 per order.

Based on data from the past two years, Hillmart has determined the following distribution on monthly orders:

Monthly Number of Orders	Probability
300,000	0.15
400,000	0.20
500,000	0.40
600,000	0.15
700,000	0.10

Required

1. Prepare a table showing the cost of each plan for each quantity of monthly orders.
2. What is the expected cost of each plan?
3. In addition to the information systems costs, what other factors should Hillmart consider before deciding to implement a new B2B system?

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Problems

3-33 CVP analysis, service firm. Lifetime Escapes generates average revenue of $7,500 per person on its 5-day package tours to wildlife parks in Kenya. The variable costs per person are as follows:

Airfare	$1,600
Hotel accommodations	3,100
Meals	600
Ground transportation	300
Park tickets and other costs	700
Total	$6,300

Annual fixed costs total $570,000.

Required

1. Calculate the number of package tours that must be sold to break even.
2. Calculate the revenue needed to earn a target operating income of $102,000.

3. If fixed costs increase by $19,000, what decrease in variable cost per person must be achieved to maintain the breakeven point calculated in requirement 1?
4. The general manager at Lifetime Escapes proposes to increase the price of the package tour to $8,200 to decrease the breakeven point in units. Using information in the original problem, calculate the new breakeven point in units. What factors should the general manager consider before deciding to increase the price of the package tour?

3-34 CVP, target operating income, service firm. KinderKids provides daycare for children Mondays through Fridays. Its monthly variable costs per child are as follows:

Lunch and snacks	$100
Educational supplies	30
Other supplies (paper products, toiletries, etc.)	20
Total	$150

Monthly fixed costs consist of the following:

Rent	$1,500
Utilities	150
Insurance	200
Salaries	1,700
Miscellaneous	450
Total	$4,000

KinderKids charges each parent $400 per child per month.

Required

1. Calculate the breakeven point.
2. KinderKids' target operating income is $5,000 per month. Compute the number of children who must be enrolled to achieve the target operating income.
3. KinderKids lost its lease and had to move to another building. Monthly rent for the new building is $2,200. At the suggestion of parents, KinderKids plans to take children on field trips. Monthly costs of the field trips are $1,100. By how much should KinderKids increase fees per child to meet the target operating income of $5,000 per month, assuming the same number of children as in requirement 2?

3-35 CVP analysis, margin of safety. (CMA, adapted) Arvin Tax Preparation Services has total budgeted revenues for 2014 of $618,000, based on an average price of $206 per tax return prepared. The company would like to achieve a margin of safety percentage of at least 45%. The company's current fixed costs are $327,600, and variable costs average $24 per customer. (Consider each of the following separately).

Required

1. Calculate Arvin's breakeven point and margin of safety in units.
2. Which of the following changes would help Arvin achieve its desired margin of safety?
   a. Average revenue per customer increases to $224.
   b. Planned number of tax returns prepared increases by 15%
   c. Arvin purchases new tax software that results in a 5% increase to fixed costs but e-files all tax returns, which reduces mailing costs an average $2 per customer.

3-36 CVP analysis, income taxes. (CMA, adapted) J.T.Brooks and Company, a manufacturer of quality handmade walnut bowls, has had a steady growth in sales for the past 5 years. However, increased competition has led Mr. Brooks, the president, to believe that an aggressive marketing campaign will be necessary next year to maintain the company's present growth. To prepare for next year's marketing campaign, the company's controller has prepared and presented Mr. Brooks with the following data for the current year, 2014:

Variable cost (per bowl)	
Direct materials	$ 3.00
Direct manufacturing labor	8.00
Variable overhead (manufacturing, marketing, distribution, and customer service)	7.50
Total variable cost per bowl	$ 18.50
Fixed costs	
Manufacturing	$ 20,000
Marketing, distribution, and customer service	194,500
Total fixed costs	$214,500
Selling price	$ 35.00
Expected sales, 22,000 units	$770,000
Income tax rate	40%

Required

1. What is the projected net income for 2014?
2. What is the breakeven point in units for 2014?
3. Mr. Brooks has set the revenue target for 2015 at a level of $875,000 (or 25,000 bowls). He believes an additional marketing cost of $16,500 for advertising in 2015, with all other costs remaining constant, will be necessary to attain the revenue target. What is the net income for 2015 if the additional $16,500 is spent and the revenue target is met?
4. What is the breakeven point in revenues for 2015 if the additional $16,500 is spent for advertising?
5. If the additional $16,500 is spent, what are the required 2015 revenues for 2015 net income to equal 2014 net income?
6. At a sales level of 25,000 units, what maximum amount can be spent on advertising if a 2015 net income of $108,450 is desired?

3-37 CVP, sensitivity analysis. The Derby Shoe Company produces its famous shoe, the Divine Loafer that sells for $70 per pair. Operating income for 2013 is as follows:

Sales revenue ($70 per pair)	$350,000
Variable cost ($30 per pair)	150,000
Contribution margin	200,000
Fixed cost	100,000
Operating income	$100,000

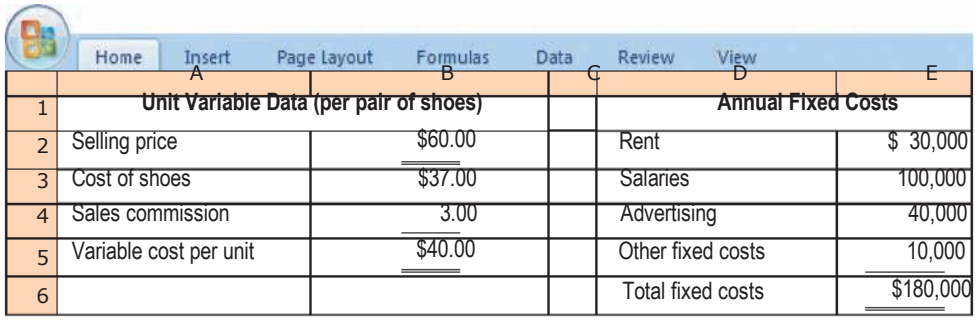
Derby Shoe Company would like to increase its profitability over the next year by at least 25%. To do so, the company is considering the following options:

Required

1. Replace a portion of its variable labor with an automated machining process. This would result in a 20% decrease in variable cost per unit but a 15% increase in fixed costs. Sales would remain the same.
2. Spend $25,000 on a new advertising campaign, which would increase sales by 10%.
3. Increase both selling price by $10 per unit and variable costs by $8 per unit by using a higher-quality leather material in the production of its shoes. The higher-priced shoe would cause demand to drop by approximately 20%.
4. Add a second manufacturing facility that would double Derby's fixed costs but would increase sales by 60%.

Evaluate each of the alternatives considered by Derby Shoes. Do any of the options meet or exceed Derby's targeted increase in income of 25%? What should Derby do?

3-38 CVP analysis, shoe stores. The HighStep Shoe Company operates a chain of shoe stores that sell 10 different styles of inexpensive men's shoes with identical unit costs and selling prices. A unit is defined as a pair of shoes. Each store has a store manager who is paid a fixed salary. Individual salespeople receive a fixed salary and a sales commission. HighStep is considering opening another store that is expected to have the revenue and cost relationships shown here.



	A	B	C	D	E
1	**Unit Variable Data (per pair of shoes)**			**Annual Fixed Costs**	
2	Selling price	$60.00		Rent	$ 30,000
3	Cost of shoes	$37.00		Salaries	100,000
4	Sales commission	3.00		Advertising	40,000
5	Variable cost per unit	$40.00		Other fixed costs	10,000
6				Total fixed costs	$180,000

Consider each question independently:

Required

1. What is the annual breakeven point in (a) units sold and (b) revenues?
2. If 8,000 units are sold, what will be the store's operating income (loss)?

3. If sales commissions are discontinued and fixed salaries are raised by a total of $15,500, what would be the annual breakeven point in (a) units sold and (b) revenues?
4. Refer to the original data. If, in addition to his fixed salary, the store manager is paid a commission of $2.00 per unit sold, what would be the annual breakeven point in (a) units sold and (b) revenues?
5. Refer to the original data. If, in addition to his fixed salary, the store manager is paid a commission of $2.00 *per unit in excess of the breakeven point*, what would be the store's operating income if 12,000 units were sold?

3-39 CVP analysis, shoe stores (continuation of 3-38). Refer to requirement 3 of Problem 3-38. In this problem, assume the role of the owner of HighStep.

Required

1. As owner, which sales compensation plan would you choose if forecasted annual sales of the new store were at least 10,000 units? What do you think of the motivational aspect of your chosen compensation plan?
2. Suppose the target operating income is $69,000. How many units must be sold to reach the target operating income under (a) the original salary-plus-commissions plan and (b) the higher-fixed-salaries-only plan? Which method would you prefer? Explain briefly.
3. You open the new store on January 1, 2014, with the original salary-plus-commission compensation plan in place. Because you expect the cost of the shoes to rise due to inflation, you place a firm bulk order for 11,000 shoes and lock in the $37 price per unit. But toward the end of the year, only 9,500 shoes are sold, and you authorize a markdown of the remaining inventory to $50 per unit. Finally, all units are sold. Salespeople, as usual, get paid a commission of 5% of revenues. What is the annual operating income for the store?

3-40 Alternate cost structures, uncertainty, and sensitivity analysis. Deckle Printing Company currently leases its only copy machine for $1,200 a month. The company is considering replacing this leasing agreement with a new contract that is entirely commission based. Under the new agreement, Deckle would pay a commission for its printing at a rate of $20 for every 500 pages printed. The company currently charges $0.15 per page to its customers. The paper used in printing costs the company $0.04 per page and other variable costs, including hourly labor amounting to $0.05 per page.

Required

1. What is the company's breakeven point under the current leasing agreement? What is it under the new commission-based agreement?
2. For what range of sales levels will Deckle prefer (a) the fixed lease agreement (b) the commission agreement?
3. Do this question only if you have covered the chapter appendix in your class. Deckle estimates that the company is equally likely to sell 20,000, 30,000, 40,000, 50,000, or 60,000 pages of print. Using information from the original problem, prepare a table that shows the expected profit at each sales level under the fixed leasing agreement and under the commission-based agreement. What is the expected value of each agreement? Which agreement should Deckle choose?

3-41 CVP, alternative cost structures. SuperShades operates a kiosk at the local mall, selling sunglasses for $20 each. SuperShades currently pays $800 a month to rent the space and pays two full-time employees to each work 160 hours a month at $10 per hour. The store shares a manager with a neighboring mall and pays 50% of the manager's annual salary of $40,000 and benefits equal to 20% of salary. The wholesale cost of the sunglasses to the company is $5 a pair.

Required

1. How many sunglasses does SuperShades need to sell each month to break even?
2. If SuperShades wants to earn an operating income of $4,500 per month, how many sunglasses does the store need to sell?
3. If the store's hourly employees agreed to a 15% sales-commission-only pay structure, instead of their hourly pay, how many sunglasses would SuperShades need to sell to earn an operating income of $4,500?
4. Assume SuperShades pays its employees hourly under the original pay structure, but is able to pay the mall 8% of its monthly revenue instead of monthly rent. At what sales levels would SuperShades prefer to pay a fixed amount of monthly rent, and at what sales levels would it prefer to pay 8% of its monthly revenue as rent?

3-42 CVP analysis, income taxes, sensitivity. (CMA, adapted) Carlisle Engine Company manufactures and sells diesel engines for use in small farming equipment. For its 2014 budget, Carlisle Engine Company estimates the following:

Selling price	$ 4,000
Variable cost per engine	$ 1,000
Annual fixed costs	$4,800,000
Net income	$1,200,000
Income tax rate	20%

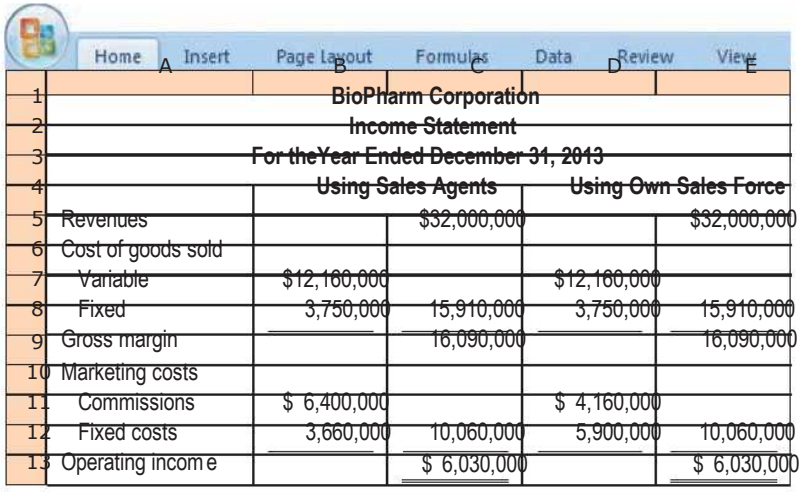
The first-quarter income statement, as of March 31, reported that sales were not meeting expectations. During the first quarter, only 400 units had been sold at the current price of $4,000. The income statement showed that variable and fixed costs were as planned, which meant that the 2014 annual net income projection would not be met unless management took action. A management committee was formed and presented the following mutually exclusive alternatives to the president:

a. Reduce the selling price by 15%. The sales organization forecasts that at this significantly reduced price, 2,100 units can be sold during the remainder of the year. Total fixed costs and variable cost per unit will stay as budgeted.
b. Lower variable cost per unit by $300 through the use of less-expensive direct materials. The selling price will also be reduced by $400, and sales of 1,750 units are expected for the remainder of the year.
c. Reduce fixed costs by 10% and lower the selling price by 30%. Variable cost per unit will be unchanged. Sales of 2,200 units are expected for the remainder of the year.

Required

1. If no changes are made to the selling price or cost structure, determine the number of units that Carlisle Engine Company must sell (a) to break even and (b) to achieve its net income objective.
2. Determine which alternative Carlisle Engine should select to achieve its net income objective. Show your calculations.

3-43 Choosing between compensation plans, operating leverage. (CMA, adapted) BioPharm Corporation manufactures pharmaceutical products that are sold through a network of external sales agents. The agents are paid a commission of 20% of revenues. BioPharm is considering replacing the sales agents with its own salespeople, who would be paid a commission of 13% of revenues and total salaries of $2,240,000. The income statement for the year ending December 31, 2013, under the two scenarios is shown here.



	A	B	C	D	E
1	BioPharm Corporation				
2	Income Statement				
3	For the Year Ended December 31, 2013				
4		Using Sales Agents		Using Own Sales Force	
5	Revenues		$32,000,000		$32,000,000
6	Cost of goods sold				
7	Variable	$12,160,000		$12,160,000	
8	Fixed	3,750,000	15,910,000	3,750,000	15,910,000
9	Gross margin		16,090,000		16,090,000
10	Marketing costs				
11	Commissions	$ 6,400,000		$ 4,160,000	
12	Fixed costs	3,660,000	10,060,000	5,900,000	10,060,000
13	Operating income		$ 6,030,000		$ 6,030,000

Required

1. Calculate BioPharm's 2013 contribution margin percentage, breakeven revenues, and degree of operating leverage under the two scenarios.
2. Describe the advantages and disadvantages of each type of sales alternative.
3. In 2014, BioPharm uses its own salespeople, who demand a 16% commission. If all other cost-behavior patterns are unchanged, how much revenue must the salespeople generate in order to earn the same operating income as in 2013?

3-44 Sales mix, three products. The Ronowski Company has three product lines of belts—A, B, and C—with contribution margins of $3, $2, and $1, respectively. The president foresees sales of 200,000 units in the coming period, consisting of 20,000 units of A, 100,000 units of B, and 80,000 units of C. The company's fixed costs for the period are $255,000.

Required

1. What is the company's breakeven point in units, assuming that the given sales mix is maintained?
2. If the sales mix is maintained, what is the total contribution margin when 200,000 units are sold? What is the operating income?
3. What would operating income be if 20,000 units of A, 80,000 units of B, and 100,000 units of C were sold? What is the new breakeven point in units if these relationships persist in the next period?

3-45 Multiproduct CVP and decision making. Crystal Clear Products produces two types of water filters. One attaches to the faucet and cleans all water that passes through the faucet. The other is a pitcher-cum-filter that only purifies water meant for drinking.

The unit that attaches to the faucet is sold for $100 and has variable costs of $35.
The pitcher-cum-filter sells for $120 and has variable costs of $30.

Crystal Clear sells two faucet models for every three pitchers sold. Fixed costs equal $1,200,000.

Required

1. What is the breakeven point in unit sales and dollars for each type of filter at the current sales mix?
2. Crystal Clear is considering buying new production equipment. The new equipment will increase fixed cost by $208,000 per year and will decrease the variable cost of the faucet and the pitcher units by $5 and $10, respectively. Assuming the same sales mix, how many of each type of filter does Crystal Clear need to sell to break even?
3. Assuming the same sales mix, at what total sales level would Crystal Clear be indifferent between using the old equipment and buying the new production equipment? If total sales are expected to be 24,000 units, should Crystal Clear buy the new production equipment?

3-46 Sales mix, two products. The Stackpole Company retails two products: a standard and a deluxe version of a luggage carrier. The budgeted income statement for next period is as follows:

	Standard Carrier	Deluxe Carrier	Total
Units sold	187,500	62,500	250,000
Revenues at $28 and $50 per unit	$5,250,800	$3,125,000	$8,375,000
Variable costs at $18 and $30 per unit	3,375,000	1,875,000	5,250,000
Contribution margins at $10 and $20 per unit	$1,875,000	$1,250,000	3,125,000
Fixed costs			2,250,000
Operating income			$ 875,000

Required

1. Compute the breakeven point in units, assuming that the company achieves its planned sales mix.
2. Compute the breakeven point in units (a) if only standard carriers are sold and (b) if only deluxe carriers are sold.
3. Suppose 250,000 units are sold but only 50,000 of them are deluxe. Compute the operating income. Compute the breakeven point in units. Compare your answer with the answer to requirement 1. What is the major lesson of this problem?

3-47 Gross margin and contribution margin. The Museum of America is preparing for its annual appreciation dinner for contributing members. Last year, 525 members attended the dinner. Tickets for the dinner were $24 per attendee. The profit report for last year's dinner follows.

Ticket sales	$12,600
Cost of dinner	15,300
Gross margin	(2,700)
Invitations and paperwork	2,500
Profit (loss)	$(5,200)

This year the dinner committee does not want to lose money on the dinner. To help achieve its goal, the committee analyzed last year's costs. Of the $15,300 cost of the dinner, $9,000 were fixed costs and $6,300 were variable costs. Of the $2,500 cost of invitations and paperwork, $1,975 were fixed and $525 were variable.

Required

1. Prepare last year's profit report using the contribution margin format.
2. The committee is considering expanding this year's dinner invitation list to include volunteer members (in addition to contributing members). If the committee expands the dinner invitation list, it expects attendance to double. Calculate the effect this will have on the profitability of the dinner assuming fixed costs will be the same as last year.

3-48 Ethics, CVP analysis. Kirk Corporation produces a molded plastic casing, LX201, for desktop computers. Summary data from its 2013 income statement are as follows:

Revenues	$4,000,000
Variable costs	2,400,000
Fixed costs	1,728,000
Operating income	$ (128,000)

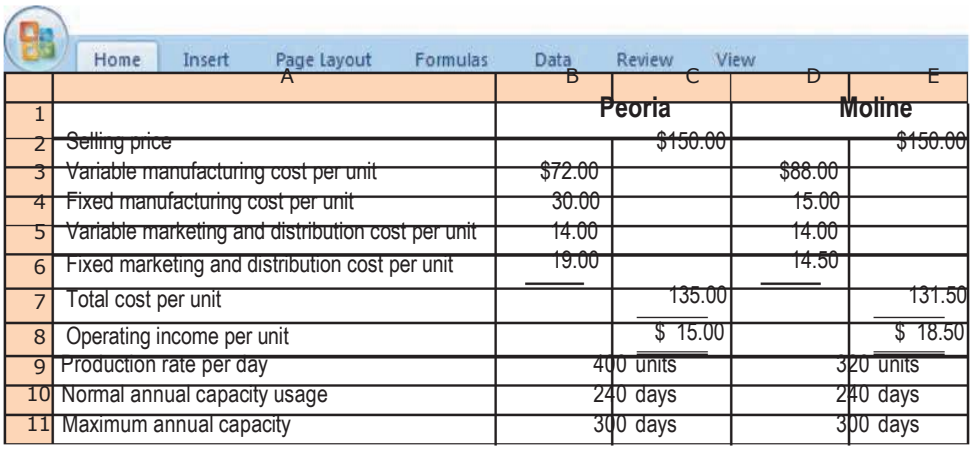
Bridgett Hewitt, Kirk's president, is very concerned about Kirk Corporation's poor profitability. She asks Julian Buckner, production manager, and Seth Madden, controller, to see if there are ways to reduce costs.

After 2 weeks, Julian returns with a proposal to reduce variable costs to 52% of revenues by reducing the costs Kirk currently incurs for safe disposal of wasted plastic. Seth is concerned that this would expose the company to potential environmental liabilities. He tells Julian, "We would need to estimate some of these potential environmental costs and include them in our analysis." "You can't do that," Julian replies. "We are not violating any laws. There is some possibility that we may have to incur environmental costs in the future, but if we bring it up now, this proposal will not go through because our senior management always assumes these costs to be larger than they turn out to be. The market is very tough, and we are in danger of shutting down the company and costing all of us our jobs. The only reason our competitors are making money is because they are doing exactly what I am proposing."

Required

1. Calculate Kirk Corporation's breakeven revenues for 2013.
2. Calculate Kirk Corporation's breakeven revenues if variable costs are 52% of revenues.
3. Calculate Kirk Corporation's operating income for 2013 if variable costs had been 52% of revenues.
4. Given Julian Buckner's comments, what should Seth Madden do?

3-49 Deciding where to produce. (CMA, adapted) Portal Corporation produces the same power generator in two Illinois plants, a new plant in Peoria and an older plant in Moline. The following data are available for the two plants.



	A	B	C	D	E
1		Peoria		Moline	
2	Selling price		$150.00		$150.00
3	Variable manufacturing cost per unit	$72.00		$88.00	
4	Fixed manufacturing cost per unit	30.00		15.00	
5	Variable marketing and distribution cost per unit	14.00		14.00	
6	Fixed marketing and distribution cost per unit	19.00		14.50	
7	Total cost per unit		135.00		131.50
8	Operating income per unit		$ 15.00		$ 18.50
9	Production rate per day	400 units		320 units	
10	Normal annual capacity usage	240 days		240 days	
11	Maximum annual capacity	300 days		300 days	

All fixed costs per unit are calculated based on a normal capacity usage consisting of 240 working days. When the number of working days exceeds 240, overtime charges raise the variable manufacturing costs of additional units by $3.00 per unit in Peoria and $8.00 per unit in Moline.

Portal Corporation is expected to produce and sell 192,000 power generators during the coming year. Wanting to take advantage of the higher operating income per unit at Moline, the company's production manager has decided to manufacture 96,000 units at each plant, resulting in a plan in which Moline operates at maximum capacity (320 units per day $\times$ 300 days) and Peoria operates at its normal volume (400 units per day $\times$ 240 days).

Required

1. Calculate the breakeven point in units for the Peoria plant and for the Moline plant.
2. Calculate the operating income that would result from the production manager's plan to produce 96,000 units at each plant.
3. Determine how the production of 192,000 units should be allocated between the Peoria and Moline plants to maximize operating income for Portal Corporation. Show your calculations.

SOLUTIONS

CHAPTER 3
COST–VOLUME–PROFIT ANALYSIS

NOTATION USED IN CHAPTER 3 SOLUTIONS

SP: Selling price
VCU: Variable cost per unit
CMU: Contribution margin per unit
FC: Fixed costs
TOI: Target operating income

3-1 Cost-volume-profit (CVP) analysis examines the behavior of total revenues, total costs, and operating income as changes occur in the units sold, selling price, variable cost per unit, or fixed costs of a product.

3-2 The assumptions underlying the CVP analysis outlined in Chapter 3 are

1. Changes in the level of revenues and costs arise only because of changes in the number of product (or service) units sold.
2. Total costs can be separated into a fixed component that does not vary with the units sold and a variable component that changes with respect to the units sold.
3. When represented graphically, the behaviors of total revenues and total costs are linear (represented as a straight line) in relation to units sold within a relevant range and time period.
4. The selling price, variable cost per unit, and fixed costs are known and constant.

3-3 Operating income is total revenues from operations for the accounting period minus cost of goods sold and operating costs (excluding income taxes):

$$\text{Operating income} = \text{Total revenues from operations} - \text{Costs of goods sold and operating costs (excluding income taxes)}$$

Net income is operating income plus nonoperating revenues (such as interest revenue) minus nonoperating costs (such as interest cost) minus income taxes. Chapter 3 assumes nonoperating revenues and nonoperating costs are zero. Thus, Chapter 3 computes net income as:

$$\text{Net income} = \text{Operating income} - \text{Income taxes}$$

3-4 Contribution margin is the difference between total revenues and total variable costs. Contribution margin per unit is the difference between selling price and variable cost per unit. Contribution-margin percentage is the contribution margin per unit divided by selling price.

3-5 Three methods to express CVP relationships are the equation method, the contribution margin method, and the graph method. The first two methods are most useful for analyzing operating income at a few specific levels of sales. The graph method is useful for visualizing the effect of sales on operating income over a wide range of quantities sold.

3-6 Breakeven analysis denotes the study of the breakeven point, which is often only an incidental part of the relationship between cost, volume, and profit. Cost-volume-profit relationship is a more comprehensive term than breakeven analysis.

3-7 CVP certainly is simple, with its assumption of output as the only revenue and cost driver, and linear revenue and cost relationships. Whether these assumptions make it simplistic depends on the decision context. In some cases, these assumptions may be sufficiently accurate for CVP to provide useful insights. The examples in Chapter 3 (the software package context in the text and the travel agency example in the Problem for Self-Study) illustrate how CVP can provide such insights. In more complex cases, the basic ideas of simple CVP analysis can be expanded.

3-8 An increase in the income tax rate does not affect the breakeven point. Operating income at the breakeven point is zero, and no income taxes are paid at this point.

3-9 Sensitivity analysis is a "what-if" technique that managers use to examine how an outcome will change if the original predicted data are not achieved or if an underlying assumption changes. The advent of the electronic spreadsheet has greatly increased the ability to explore the effect of alternative assumptions at minimal cost. CVP is one of the most widely used software applications in the management accounting area.

3-10 Examples include:

Manufacturing—substituting a robotic machine for hourly wage workers

Marketing—changing a sales force compensation plan from a percent of sales dollars to a fixed salary

Customer service—hiring a subcontractor to do customer repair visits on an annual retainer basis rather than a per-visit basis

3-11 Examples include:

Manufacturing—subcontracting a component to a supplier on a per-unit basis to avoid purchasing a machine with a high fixed depreciation cost

Marketing—changing a sales compensation plan from a fixed salary to percent of sales dollars basis

Customer service—hiring a subcontractor to do customer service on a per-visit basis rather than an annual retainer basis

3-12 Operating leverage describes the effects that fixed costs have on changes in operating income as changes occur in units sold, and hence, in contribution margin. Knowing the degree of operating leverage at a given level of sales helps managers calculate the effect of fluctuations in sales on operating incomes.

3-13 CVP analysis is always conducted for a specified time horizon. One extreme is a very short-time horizon. For example, some vacation cruises offer deep price discounts for people who offer to take any cruise on a day's notice. One day prior to a cruise, most costs are fixed. The other extreme is several years. Here, a much higher percentage of total costs typically is variable.

CVP itself is not made any less relevant when the time horizon lengthens. What happens is that many items classified as fixed in the short run may become variable costs with a longer time horizon.

3-14 A company with multiple products can compute a breakeven point by assuming there is a constant sales mix of products at different levels of total revenue.

3-15 Yes, gross margin calculations emphasize the distinction between manufacturing and nonmanufacturing costs (gross margins are calculated after subtracting variable and fixed manufacturing costs). Contribution margin calculations emphasize the distinction between fixed and variable costs. Hence, contribution margin is a more useful concept than gross margin in CVP analysis.

3-16 (10 min.) **CVP computations.**

	Revenues	Variable Costs	Fixed Costs	Total Costs	Operating Income	Contribution Margin	Contribution Margin %
a.	**$2,200**	$ 800	**$400**	$1,200	$1,000	**$1,400**	**63.64%**
b.	2,400	**1,300**	400	**1,700**	700	**1,100**	**45.83%**
c.	900	500	**400**	900	**0**	**400**	**44.44%**
d.	1,800	**900**	400	**1,300**	**500**	**900**	50.00%

3-17 (10–15 min.) **CVP computations.**

1a.	Sales ($68 per unit × 410,000 units)	$27,880,000
	Variable costs ($60 per unit × 410,000 units)	24,600,000
	Contribution margin	$ 3,280,000
1b.	Contribution margin (from above)	$3,280,000
	Fixed costs	1,640,000
	Operating income	$1,640,000
2a.	Sales (from above)	$27,880,000
	Variable costs ($54 per unit × 410,000 units)	22,140,000
	Contribution margin	$ 5,740,000
2b.	Contribution margin	$5,740,000
	Fixed costs	5,330,000
	Operating income	$ 410,000

3. Operating income is expected to decrease by $1,230,000 ($1,640,000 − $410,000) if Ms. Schoenen's proposal is accepted.

The management would consider other factors before making the final decision. It is likely that product quality would improve as a result of using state of the art equipment. Due to increased automation, probably many workers will have to be laid off. Garrett's management will have to consider the impact of such an action on employee morale. In addition, the proposal increases the company's fixed costs dramatically. This will increase the company's operating leverage and risk.

3-18 (35–40 min.) **CVP analysis, changing revenues and costs.**

1a. SP = 10% × $1,300 = $130 per ticket
VCU = $34 per ticket
CMU = $130 – $34 = $96 per ticket
FC = $36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$96 \text{ per ticket}}$$

= 375 tickets

1b. $$Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$96 \text{ per ticket}}$$

$$= \frac{\$48,000}{\$96 \text{ per ticket}}$$

= 500 tickets

2a. SP = $130 per ticket
VCU = $30 per ticket
CMU = $130 – $30 = $100 per ticket
FC = $36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$100 \text{ per ticket}}$$

= 360 tickets

2b. $$Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$100 \text{ per ticket}}$$

$$= \frac{\$48,000}{\$100 \text{ per ticket}}$$

= 480 tickets

3a. SP = $46 per ticket
VCU = $30 per ticket
CMU = $46 – $30 = $16 per ticket
FC = $36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$16 \text{ per ticket}}$$

= 2,250 tickets

3b. $Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$16 \text{ per ticket}}$

$= \frac{\$48,000}{\$16 \text{ per ticket}}$

$= 3,000$ tickets

The reduced commission sizably increases the breakeven point and the number of tickets required to yield a target operating income of $12,000:

	10% Commission (Requirement 2)	**Fixed Commission of $60**
Breakeven point	360	2,250
Attain OI of $12,000	480	3,000

4a. The $8 delivery fee can be treated as either an extra source of revenue (as done below) or as a cost offset. Either approach increases CMU $8:

SP = $54 ($46 + $8) per ticket
VCU = $30 per ticket
CMU = $54 – $30 = $24 per ticket
FC = $36,000 a month

$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$24 \text{ per ticket}}$

$= 1,500$ tickets

4b. $Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$24 \text{ per ticket}}$

$= \frac{\$48,000}{\$24 \text{ per ticket}}$

$= 2,000$ tickets

The $8 delivery fee results in a higher contribution margin, which reduces both the breakeven point and the tickets sold to attain operating income of $12,000.

3-19 (20 min.) **CVP exercises.**

	Revenues	Variable Costs	Contribution Margin	Fixed Costs	Budgeted Operating Income
Orig.	~~$10,400,000[G]~~	~~$7,900,000[G]~~	~~$2,500,000~~	~~$2,100,000[G]~~	~~$400,000~~
1.	10,400,000	7,625,000	2,775,000[a]	2,100,000	675,000
2.	10,400,000	8,175,000	2,225,000[b]	2,100,000	125,000
3.	10,400,000	7,900,000	2,500,000	2,184,000[c]	316,000
4.	10,400,000	7,900,000	2,500,000	2,016,000[d]	484,000
5.	11,128,000[e]	8,453,000[f]	2,675,000	2,100,000	575,000
6.	9,672,000[g]	7,347,000[h]	2,325,000	2,100,000	225,000
7.	11,544,000[i]	8,769,000[j]	2,775,000	2,331,000[k]	444,000
8.	10,400,000	7,584,000[l]	2,816,000	2,184,000[m]	632,000

[G]stands for given.

[a]$2,500,000 × 1.11; [b]$2,500,000 × 0.89; [c]$2,100,000 × 1.04; [d]$2,100,000 × 0.96; [e]$10,400,000 × 1.07; [f]$7,900,000 × 1.07; [g]$10,400,000 × 0.93; [h]$7,900,000 × 0.93; [i]$10,400,000 × 1.11; [j]$7,900,000 × 1.11; [k]$2,100,000 × 1.11; [l]$7,900,000 × 0.96; [m]$2,100,000 × 1.04

9. Alternative 1, a 11% increase in contribution margin holding revenues constant, yields the highest budgeted operating income because it has the highest increase in contribution margin without increasing fixed costs.

3-20 (20 min.) **CVP exercises.**

1a. [Units sold (Selling price – Variable costs)] – Fixed costs = Operating income
[5,000,000 ($0.50 – $0.30)] – $900,000 = $100,000

1b. Fixed costs ÷ Contribution margin per unit = Breakeven units
$900,000 ÷ [($0.50 – $0.30)] = 4,500,000 units
Breakeven units × Selling price = Breakeven revenues
4,500,000 units × $0.50 per unit = $2,250,000

or,

$$\text{Contribution margin ratio} = \frac{\text{Selling price} - \text{Variable costs}}{\text{Selling price}}$$

$$= \frac{\$0.50 - \$0.30}{\$0.50} = 0.40$$

Fixed costs ÷ Contribution margin ratio = Breakeven revenues
$900,000 ÷ 0.40 = $2,250,000

2. 5,000,000 ($0.50 – $0.34) – $900,000 = $ (100,000)

3. [5,000,000 (1.1) ($0.50 – $0.30)] – [$900,000 (1.1)] = $ 110,000

4. [5,000,000 (1.4) ($0.40 – $0.27)] – [$900,000 (0.8)] = $ 190,000

5. $900,000 (1.1) ÷ ($0.50 – $0.30) = 4,950,000 units

6. ($900,000 + $20,000) ÷ ($0.55 – $0.30) = 3,680,000 units

3-21 (10 min.) **CVP analysis, income taxes.**

1. Monthly fixed costs = $48,200 + $68,000 + $13,000 = $129,200
   Contribution margin per unit = $27,000 – $23,000 – $600 = $ 3,400
   Breakeven units per month = $\frac{\text{Monthly fixed costs}}{\text{Contribution margin per unit}} = \frac{\$129,200}{\$3,400 \text{ per car}} =$ 38 cars

2. Tax rate 40%
   Target net income $51,000
   Target operating income = $\frac{\text{Target net income}}{1 - \text{tax rate}} = \frac{\$51,000}{(1-0.40)} = \frac{\$51,000}{0.60} =$ $85,000

Quantity of output units required to be sold = $\frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$129,200 + \$85,000}{\$3,400} = 63$ cars

3-22 (20–25 min.) **CVP analysis, income taxes.**

1. Variable cost percentage is $3.80 ÷ $9.50 = 40%

Let R = Revenues needed to obtain target net income

$$R - 0.40R - \$456,000 = \frac{\$159,600}{1-0.30}$$
$$0.60R = \$456,000 + \$228,000$$
$$R = \$684,000 \div 0.60$$
$$R = \$1,140,000$$

or, Target revenues = $\frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin percentage}}$

Target revenues = $\frac{\text{Fixed costs} + \frac{\text{Target net income}}{1-\text{Tax rate}}}{\text{Contribution margin percentage}} = \frac{\$456,000 + \frac{\$159,600}{1-0.30}}{0.60} = \$1,140,000$

Proof:		
	Revenues	$1,140,000
	Variable costs (at 40%)	456,000
	Contribution margin	684,000
	Fixed costs	456,000
	Operating income	228,000
	Income taxes (at 30%)	68,400
	Net income	$ 159,600

2.a. Customers needed to break even:

Contribution margin per customer = \$9.50 – \$3.80 = \$5.70

Breakeven number of customers = Fixed costs ÷ Contribution margin per customer

= \$456,000 ÷ \$5.70 per customer

= 80,000 customers

2.b. Customers needed to earn net income of \$159,600:

Total revenues ÷ Sales check per customer

\$1,140,000 ÷ \$9.50 = 120,000 customers

3. Using the shortcut approach:

$$\text{Change in net income} = \begin{pmatrix}\text{Change in}\\ \text{number of}\\ \text{customers}\end{pmatrix} \times \begin{pmatrix}\text{Unit}\\ \text{contribution}\\ \text{margin}\end{pmatrix} \times (1 - \text{Tax rate})$$

$$= (145{,}000 - 120{,}000) \times \$5.70 \times (1 - 0.30)$$

$$= \$142{,}500 \times 0.7 = \$99{,}750$$

$$\text{New net income} = \$99{,}750 + \$159{,}600 = \$259{,}350$$

Alternatively, with 145,000 customers,

Operating income = Number of customers × Selling price per customer – Number of customers × Variable cost per customer – Fixed costs

= 145,000 × \$9.50 – 145,000 × \$3.80 – \$456,000 = \$370,500

Net income = Operating income × (1 – Tax rate) = \$370,500 × 0.70 = \$259,350

The alternative approach is:

Revenues, 145,000 × \$9.50	\$1,377,500
Variable costs at 40%	551,000
Contribution margin	826,500
Fixed costs	456,000
Operating income	370,500
Income tax at 30%	111,150
Net income	\$ 259,350

3-23 CVP analysis, sensitivity analysis.

1. CMU = \$30−\$21−(0.05 × \$30) = \$7.50

$$Q = \frac{FC}{CMU} = \frac{\$1{,}500{,}000}{\$7.50 \text{ per pair}}$$

= 200,000 pairs

Note: No income taxes are paid at the breakeven point because operating income is \$0.

2a. $Q = \frac{FC + TOI}{CMU} = \frac{\$1,500,000 + \$450,000}{\$7.50 \text{ per pair}}$

$= \frac{\$1,950,000}{\$7.50 \text{ per pair}}$

$= 260,000$ pairs

2b. Target operating income $= \frac{\text{Target net income}}{1 - \text{tax rate}} = \frac{\$450,000}{(1 - 0.25)} = \frac{\$450,000}{0.75} = \$600,000$

Quantity of output units required to be sold $= \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$1,500,000 + \$600,000}{\$7.50}$

$= 280,000$ pairs

3a. Contribution margin per unit increases by 10%
Contribution margin per unit = $\$7.50 \times 1.10 = \$8.25$

Quantity of output units required to be sold $= \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$1,500,000 + \$600,000}{\$8.25}$

$= 254,545$ pairs (rounded)

The net income target in units decreases from 280,000 pairs in requirement 2b to 254,545 pairs.

3b. Increasing the selling price to $32.50
Contribution margin per unit = $\$32.50 - \$21 - (0.05 \times \$32.50) = \$9.875$

Quantity of output units required to be sold $= \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$1,500,000 + \$600,000}{\$9.875}$

$= 212,658$ pairs (rounded)

The net income target in units decreases from 280,000 pairs in requirement 2b to 212,658 pairs.

3c. Increase variable costs by $2.50 per unit and decrease fixed manufacturing costs by 50%.

Contribution margin per unit = $\$30 - \$23$ ($\$21 + \$2$) $- (0.05 \times \$30) = \$5.50$
Fixed manufacturing costs = $(1 - 0.6) \times \$1,200,000 = \$480,000$
Fixed marketing costs = $300,000
Total fixed costs = $\$480,000 + \$300,000 = \$780,000$

Quantity of output units required to be sold $= \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$780,000 + \$600,000}{\$5.50}$

$= 250,909$ pairs (rounded)

The net income target in units decreases from 280,000 pairs in requirement 2b to 250,909 pairs.

3-24 (10 min.) **CVP analysis, margin of safety.**

1. Breakeven point revenues $= \dfrac{\text{Fixed costs}}{\text{Contribution margin percentage}}$

Contribution margin percentage $= \dfrac{\$720{,}000}{\$1{,}500{,}000} = 0.48$ or 48%

2. Contribution margin percentage $= \dfrac{\text{Selling price} - \text{Variable cost per unit}}{\text{Selling price}}$

$$0.48 = \frac{SP - \$13}{SP}$$
$$0.48\,SP = SP - \$13$$
$$0.52\,SP = \$13$$
$$SP = \$25$$

3. Breakeven sales in units = Revenues ÷ Selling price = $1,500,000 ÷ $25 = 60,000 units
   Margin of safety in units = Sales in units – Breakeven sales in units
   = 90,000 – 60,000 = 30,000 units

Revenues, 90,000 units × $25	$2,250,000
Breakeven revenues	1,500,000
Margin of safety	$ 750,000

4. The risk of making a loss is low. Sales would need to decrease by 30,000 units ÷ 90,000 units = 33.33% before Lattin Corp. will make a loss. The most likely reasons for this risk to increase competition, weakness in the economy, or bad management.

3-25 (25 min.) **Operating leverage.**

1a. Let Q denote the quantity of carpets sold

Breakeven point under Option 1

$$\$1{,}000Q - \$400Q = \$17{,}400$$
$$\$600Q = \$17{,}400$$
$$Q = \$17{,}400 \div \$600 = 29 \text{ carpets}$$

1b. Breakeven point under Option 2

$$\$1{,}000Q - \$400Q - (0.20 \times \$1{,}000Q) = 0$$
$$400Q = 0$$
$$Q = 0$$

2. Operating income under Option 1 = $600Q – $17,400
   Operating income under Option 2 = $400Q

Find Q such that $600Q – $17,400 = $400Q

$$\$200Q = \$17{,}400$$
$$Q = \$17{,}400 \div \$200 = 87 \text{ carpets}$$

Revenues = $1,000 × 87 carpets = $87,000

For Q = 87 carpets, operating income under both Option 1 ($600 × 87 – $17,400) and Option 2 ($400 × 87) = $34,800

For Q > 87, say, 88 carpets,

Option 1 gives operating income	= ($600 × 88) – $17,400	= $35,400
Option 2 gives operating income	= $400 × 88	= $35,200

So Color Rugs will prefer Option 1.

For Q < 87, say, 86 carpets,

Option 1 gives operating income	= ($600 × 86) – $17,000	= $34,200
Option 2 gives operating income	= $400 × 86	= $34,400

So Color Rugs will prefer Option 2.

3. Degree of operating leverage $= \dfrac{\text{Contribution margin}}{\text{Operating income}}$

$= \dfrac{\text{Contribution margin per unit} \times \text{Quantity of carpets sold}}{\text{Operating income}}$

Under Option 1, contribution margin per unit = $1,000 – $400 = $600, so

Degree of operating leverage $= \dfrac{\$600 \times 87}{\$34,800} = 1.5$

Under Option 2, contribution margin per unit = $1,000 – $400 – 0.20 × $1,000 = $400, so

Degree of operating leverage $= \dfrac{\$400 \times 87}{\$34,800} = 1.0$

4. The calculations in requirement 3 indicate that when sales are 87 units, a percentage change in sales and contribution margin will result in 1.5 times that percentage change in operating income for Option 1, but the same percentage change in operating income for Option 2 (because there are no fixed costs in Option 2). The degree of operating leverage at a given level of sales helps managers calculate the effect of fluctuations in sales on operating incomes.

3-26 (15 min.) **CVP analysis, international cost structure differences.**

Country	Sales Price to Retail Outlets	Annual Fixed Costs	Variable Manufacturing Cost per Rug	Variable Marketing and Distribution Cost per Rug	Contribution Margin Per Rug (5) = (1) – (3)	Breakeven Units	Breakeven Revenues	Operating Income for Budgeted Sales of 80,000 Rugs
	(1)	(2)	(3)	(4)	– (4)	(6) = (2) ÷ (5)	(6) × (1)	(7) = [80,000 × (5)]–(2)
Italy	$200.00	$ 6,386,000	$70.00	$27.00	$103.00	62,000	$12,400,000	$ 1,854,000
Spain	$200.00	5,043,000	61.00	16.00	123.00	41,000	8,200,000	4,797,000
Singapore	$200.00	12,240,000	84.00	14.00	102.00	120,000	24,000,000	(4,080,000)

Spain has the lowest breakeven point because it has both the lowest fixed costs ($5,043,000) and the lowest variable cost per unit ($77.00). Hence, for a given selling price, Spain will always have a higher operating income (or a lower operating loss) than Italy or Singapore.

The Singapore breakeven point is 120,000 units. Hence, with sales of only 80,000 units, it has an operating loss of $4,080,000.

3-27 (30 min.) **Sales mix, new and upgrade customers.**

1.

	New Customers	Upgrade Customers
SP	$195	$115
VCU	65	35
CMU	130	80

The 60%/40% sales mix implies that, in each bundle, 3 units are sold to new customers and 2 units are sold to upgrade customers.

Contribution margin of the bundle = 3 × $130 + 2 × $80 = $390 + $160 = $550

Breakeven point in bundles = $\frac{\$16,500,000}{\$550}$ = 30,000 bundles

Breakeven point in units is:

Sales to new customers:	30,000 bundles × 3 units per bundle	90,000 units
Sales to upgrade customers:	30,000 bundles × 2 units per bundle	60,000 units
Total number of units to breakeven (rounded)		150,000 units

Alternatively,

Let S = Number of units sold to upgrade customers

1.5S = Number of units sold to new customers

Revenues – Variable costs – Fixed costs = Operating income

[$195 (1.5$S$) + 115S$] – [$65 (1.5S) + 35S$] – $16,500,000 = OI

407.5S$ – 132.5S$ – $16,500,000 = OI

Breakeven point is 150,000 units when OI = $0 because

275S$ = $16,500,000

S = 60,000 units sold to upgrade customers

1.5S = 90,000 units sold to new customers

BEP = 150,000 units

Check

Revenues ($195 × 90,000) + ($115 × 60,000)	$24,450,000
Variable costs ($65 × 90,000) + ($35 × 60,000)	7,950,000
Contribution margin	16,500,000
Fixed costs	16,500,000
Operating income	$ 0

2. When 168,000 units are sold, mix is:

Units sold to new customers (60% × 170,000)	102,000
Units sold to upgrade customers (40% × 170,000)	68,000
Revenues ($195 × 102,000) + ($115 × 68,000)	$27,710,000
Variable costs ($65 × 102,000) + ($35 × 68,000)	9,010,000
Contribution margin	18,700,000
Fixed costs	16,500,000
Operating income	$ 2,200,000

3a. At New 40%/Upgrade 60% mix, each bundle contains 2 units sold to new customers and 3 units sold to upgrade customers.

Contribution margin of the bundle = 2 × $130 + 3 × $80 = $260 + $240 = $500

Breakeven point in bundles = $\frac{\$16,500,000}{\$500}$ = 33,000 bundles

Breakeven point in units is:

Sales to new customers:	33,000 bundles × 2 unit per bundle	66,000 units
Sales to upgrade customers:	33,000 bundles × 3 unit per bundle	99,000 units
Total number of units to breakeven		165,000 units

Alternatively,
Let S = Number of units sold to new customers
then 1.5S = Number of units sold to upgrade customers

[195S$ + $115 (1.5$S$)] – [$65S + $35 (1.5$S$)] – $16,500,000 = OI

367.5S – 117.5S	=	$16,500,000
250S	=	$16,500,000
S	=	66,000 units sold to new customers
1.5S	=	99,000 units sold to upgrade customers
BEP	=	165,000 units

Check

Revenues ($195 × 66,000) + ($115 × 99,000)	$24,255,000
Variable costs ($65 × 66,000) + ($35 × 99,000)	7,755,000
Contribution margin	16,500,000
Fixed costs	16,500,000
Operating income	$ 0

3b. At New 80%/ Upgrade 20% mix, each bundle contains 4 units sold to new customers and 1 unit sold to upgrade customers.

Contribution margin of the bundle = 4 × $130 + 1 × $80 = $520 + $80 = $600

Breakeven point in bundles = $\frac{\$16,500,000}{\$600}$ = 27,500 bundles

Breakeven point in units is:

Sales to new customers:	27,500 bundles × 4 units per bundle	110,000 units
Sales to upgrade customers:	27,500 bundles × 1 unit per bundle	27,500 units
Total number of units to breakeven		137,500 units

Alternatively,

Let S = Number of units sold to upgrade customers
then $4S$ = Number of units sold to new customers

$[\$195 (4S) + \$115S] – [\$65 (4S) + \$35S] – \$16,500,000 = OI$

$895S – 295S = \$16,500,000$
$600S = \$16,500,000$
$S = 27,500$ units sold to upgrade customers
$4S = 110,000$ units sold to new customers
137,500 units

Check

Revenues ($195 × 110,000) + ($115 × 27,500)	$24,612,500
Variable costs ($65 × 110,000) + ($35 × 27,500)	8,112,000
Contribution margin	16,500,000
Fixed costs	16,500,000
Operating income	$ 0

3c. As Chartz increases its percentage of new customers, which have a higher contribution margin per unit than upgrade customers, the number of units required to break even decreases:

	New Customers	Upgrade Customers	Breakeven Point
~~Requirement 3(a)~~	~~40%~~	~~60%~~	~~165,000~~
Requirement 1	60	40	150,000
Requirement 3(b)	80	20	137,500

3-28 (15–25 min.) **Sales mix, three products.**

1. Sales of A, B, and C are in ratio 24,000 : 96,000 : 48,000. So for every 1 unit of A, 4 (96,000 ÷ 24,000) units of B are sold, and 2 (48,000 ÷ 24,000) units of C are sold.

Contribution margin of the bundle = 1 × \$5+ 4 × \$4 + 2 × \$3 = \$5 + \$16 + \$6 = \$27

Breakeven point in bundles = $\frac{\$405,000}{\$27}$ = 15,000 bundles

Breakeven point in units is:

Product A:	15,000 bundles × 1 unit per bundle	15,000 units
Product B:	15,000 bundles × 4 units per bundle	60,000 units
Product C:	15,000 bundles × 2 units per bundle	30,000 units
Total number of units to breakeven		105,000 units

Alternatively,

Let Q = Number of units of A to break even
4Q = Number of units of B to break even
4Q = Number of units of C to break even

Contribution margin – Fixed costs = Zero operating income

\$5Q + \$4(4Q) + \$3(2Q) – \$405,000	=	0
\$27Q	=	\$405,000
Q	=	15,000 (\$405,000 ÷ \$27) units of A
4Q	=	60,000 units of B
2Q	=	30,000 units of C
Total	=	105,000 units

2. Contribution margin:

A: 24,000 × \$5	\$120,000	
B: 96,000 × \$4	384,000	
C: 48,000 × \$3	144,000	
Contribution margin		\$648,000
Fixed costs		405,000
Operating income		\$243,000

3. Contribution margin

A: 24,000 × $5	$120,000	
B: 48,000 × $4	192,000	
C: 96,000 × $3	288,000	
Contribution margin		$600,000
Fixed costs		405,000
Operating income		$195,000

Sales of A, B, and C are in ratio 24,000 : 48,000 : 96,000. So for every 1 unit of A, 2 (48,000 ÷ 24,000) units of B and 4 (96,000 ÷ 24,000) units of C are sold.

Contribution margin of the bundle = 1 × $5 + 2 × $4 + 4 × $3 = $5 + $8 + $12 = $25

Breakeven point in bundles = $\frac{\$405,000}{\$25}$ = 16,200 bundles

Breakeven point in units is:

Product A:	16,200 bundles × 1 unit per bundle	16,200 units
Product B:	16,200 bundles × 2 units per bundle	32,400 units
Product C:	16,200 bundles × 4 units per bundle	64,800 units
Total number of units to breakeven		113,400 units

Alternatively,

Let Q = Number of units of A to break even
2Q = Number of units of B to break even
4Q = Number of units of C to break even

Contribution margin – Fixed costs = Breakeven point

$$\$5Q + \$4(2Q) + \$3(4Q) - \$405,000 = 0$$
$$\$25Q = \$405,000$$
$$Q = 16,200 \ (\$405,000 \div \$25) \text{ units of A}$$
$$4Q = 32,400 \text{ units of B}$$
$$5Q = 64,800 \text{ units of C}$$
$$\text{Total} = 113,400 \text{ units}$$

Breakeven point increases because the new mix contains less of the higher contribution margin per unit, product B, and more of the lower contribution margin per unit, product C.

4. No, it is not always better to choose the sales mix with the lowest breakeven point because this calculation ignores the demand for the various products. The company should look to and sell as much of each of the three products as it can to maximize operating income even if this means that this sales mix results in a higher breakeven point.

3-29 CVP, Not for profit

1.	Ticket sales per concert		$ 4,500
	Variable costs per concert:		
	Guest performers	$ 1,800	
	Marketing and advertising	1,000	
	Total variable costs per concert		2,800
	Contribution margin per concert		$ 1,700
	Fixed costs		
	Salaries	$33,000	
	Lease payments ($4,000 × 12)	48,000	
	Total fixed costs		$81,000
	Less donations		30,000
	Net fixed costs		$51,000

$$\text{Breakeven point in units} = \frac{\text{Net fixed costs}}{\text{Contribution margin per concert}} = \frac{\$51,000}{\$1,700} = 30 \text{ concerts}$$

Check

Donations		$ 30,000
Revenue ($4,500 × 30)		135,000
Total revenue		165,000
Less variable costs		
Guest performers ($1,800 × 30)	$54,000	
Marketing and advertising ($1,000 × 30)	30,000	
Total variable costs		84,000
Less fixed costs		
Salaries	$33,000	
Mortgage payments	48,000	
Total fixed costs		81,000
Operating income		$ 0

2.	Ticket sales per concert		$ 4,500
	Variable costs per concert:		
	Guest performers	$1,800	
	Marketing and advertising	1,000	
	Total variable costs per concert		2,800
	Contribution margin per concert		$ 1,700
	Fixed costs		
	Salaries ($33,000 + $25,500)	$58,500	
	Lease payments ($4,000 × 12)	48,000	
	Total fixed costs		$106,500
	Less donations		30,000
	Net fixed costs		$ 76,500

$$\text{Breakeven point in units} = \frac{\text{Net fixed costs}}{\text{Contribution margin per concert}} = \frac{\$76,500}{\$1,700} = 45 \text{ concerts}$$

Check

Donations		$ 30,000
Revenue ($4,500 × 45)		202,500
Total revenue		232,500
Less variable costs		
Guest performers ($1,800 × 45)	$81,000	
Marketing and advertising ($1,000 × 45)	45,000	
Total variable costs		126,000
Less fixed costs		
Salaries	$58,500	
Lease payments	48,000	
Total fixed costs		106,500
Operating income		$ 0

Operating Income if 41 concerts are held

Donations		$ 30,000
Revenue ($4,500 × 41)		184,500
Total revenue		214,500
Less variable costs		
Guest performers ($1,800 × 41)	$73,800	
Marketing and advertising ($1,000 × 41)	41,000	
Total variable costs		114,800
Less fixed costs		
Salaries	$58,500	
Lease payments	48,000	
Total fixed costs		106,500
Operating income (loss)		$ (6,800)

The Music Society would not be able to afford the new marketing director if the number of concerts were to increase to only 41 events. The addition of the new marketing director would require the Music Society to hold at least 45 concerts in order to breakeven. If only 41 concerts were held, the organization would lose $6,800 annually. The Music Society could look for other contributions to support the new marketing director's salary or perhaps increase the number of attendees per concert if the number of concerts could not be increased beyond 41.

3.

Ticket sales per concert		$ 4,500
Variable costs per concert:		
Guest performers	$ 1,800	
Marketing and advertising	1,000	
Total variable costs per concert		2,800
Contribution margin per concert		$ 1,700

Fixed costs		
Salaries ($33,000 + $25,500)	$58,500	
Lease payments ($4,000 × 12)	48,000	
Total fixed costs		$106,500
Deduct donations		47,000
Net fixed costs		$ 59,500

$$\text{Breakeven point in units} = \frac{\text{Net fixed costs}}{\text{Contribution margin per concert}} = \frac{\$59,500}{\$1,700} = 35 \text{ concerts}$$

Check

Donations		$ 47,000
Revenue ($4,500 × 35)		157,500
Total revenue		204,500
Less variable costs		
Guest performers ($1,800 × 35)	$63,000	
Marketing and advertising ($1,000 × 35)	35,000	
Total variable costs		98,000
Less fixed costs		
Salaries	$58,500	
Mortgage payments	48,000	
Total fixed costs		106,500
Operating income		$ 0

3-30 (15 min.) **Contribution margin, decision making.**

1.	Revenues		$500,000
	Deduct variable costs:		
	Cost of goods sold	$250,000	
	Sales commissions	55,000	
	Other operating costs	35,000	340,000
	Contribution margin		$160,000

2. Contribution margin percentage = $\frac{\$160,000}{\$500,000} = 32\%$

3. Incremental revenue (20% × $500,000) = $100,000

Incremental contribution margin (32% × $100,000)	$32,000
Incremental fixed costs (advertising)	12,000
Incremental operating income	$20,000

If Mr. Lurvey spends $12,000 more on advertising, the operating income will increase by $20,000, decreasing the operating loss from $68,000 to an operating loss of $48,000.

Proof (Optional):

Revenues (120% × $500,000)			$600,000
Cost of goods sold (50% of sales)			300,000
Gross margin			300,000
Operating costs:			
Salaries and wages		$160,000	
Sales commissions (11% of sales)		66,000	
Depreciation of equipment and fixtures		15,000	
Store rent		48,000	
Advertising		12,000	
Other operating costs:			
Variable	$\left(\frac{\$35,000}{\$500,000} \times \$600,000\right)$	42,000	
Fixed		5,000	348,000
Operating income			$ (48,000)

4. To improve operating income, Mr. Wharton must find ways to decrease variable costs, decrease fixed costs, or increase selling prices.

3-31 (20 min.) **Contribution margin, gross margin and margin of safety.**

1.

Mirabella Cosmetics
Operating Income Statement, June 2014

Units sold		10,000
Revenues		$100,000
Variable costs		
Variable manufacturing costs	$ 55,000	
Variable marketing costs	5,000	
Total variable costs		60,000
Contribution margin		40,000
Fixed costs		
Fixed manufacturing costs	$ 20,000	
Fixed marketing & administration costs	10,000	
Total fixed costs		30,000
Operating income		$ 10,000

2.

$$\text{Contribution margin per unit} = \frac{\$40{,}000}{10{,}000 \text{ units}} = \$4 \text{ per unit}$$

$$\text{Breakeven quantity} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}} = \frac{\$30{,}000}{\$4 \text{ per unit}} = 7{,}500 \text{ units}$$

$$\text{Selling price} = \frac{\text{Revenues}}{\text{Units sold}} = \frac{\$100{,}000}{10{,}000 \text{ units}} = \$10 \text{ per unit}$$

Breakeven revenues = 7,500 units × $10 per unit = $75,000

Alternatively,

$$\text{Contribution margin percentage} = \frac{\text{Contribution margin}}{\text{Revenues}} = \frac{\$40{,}000}{\$100{,}000} = 40\%$$

$$\text{Breakeven revenues} = \frac{\text{Fixed costs}}{\text{Contribution margin percentage}} = \frac{\$30{,}000}{0.40} = \$75{,}000$$

3. Margin of safety (in units) = Units sold – Breakeven quantity
= 10,000 units – 7,500 units = 2,500 units

4.

Units sold	8,000
Revenues (Units sold × Selling price = 8,000 × $10)	$80,000
Contribution margin (Revenues ×CM percentage = $80,000 ×40%)	$32,000
Fixed costs	30,000
Operating income	2,000
Taxes (30% × $2,000)	600
Net income	$ 1,400

3-32 (30 min.) **Uncertainty and expected costs.**

1. **Monthly Number of Orders**	**Cost of Current System**
300,000	$1,000,000 + $45(300,000) = $14,500,000
400,000	$1,000,000 + $45(400,000) = $19,000,000
500,000	$1,000,000 + $45(500,000) = $23,500,000
600,000	$1,000,000 + $45(600,000) = $28,000,000
700,000	$1,000,000 + $45(700,000) = $32,500,000

Monthly Number of Orders	**Cost of Partially Automated System**
300,000	$5,000,000 + $35(300,000) = $15,500,000
400,000	$5,000,000 + $35(400,000) = $19,000,000
500,000	$5,000,000 + $35 (500,000) = $22,500,000
600,000	$5,000,000 + $35 (600,000) = $26,000,000
700,000	$5,000,000 + $35 (700,000) = $29,500,000

Monthly Number of Orders	**Cost of Fully Automated System**
300,000	$11,000,000 + $20(300,000) = $17,000,000
400,000	$11,000,000 + $20(400,000) = $19,000,000
500,000	$11,000,000 + $20(500,000) = $21,000,000
600,000	$11,000,000 + $20(600,000) = $23,000,000
700,000	$11,000,000 + $20(700,000) = $25,000,000

2. Current System Expected Cost:

$14,500,000 × 0.15	=	$ 2,175,000
19,000,000 × 0.20	=	3,800,000
23,500,000 × 0.40	=	9,400,000
28,000,000 × 0.15	=	4,200,000
32,500,000 × 0.10	=	3,250,000
		$22,825,000

Partially Automated System Expected Cost:

$15,500,000 × 0.15	=	$ 2,325,000
19,000,000 × 0.20	=	3,800,000
22,500,000 × 0.40	=	9,000,000
26,000,000 × 0.15	=	3,900,000
29,500,000 × 0.10	=	2,950,000
		$21,975,000

Fully Automated System Expected Cost:

$17,000,000 × 0.15	=	$ 2,550,000
19,000,000 × 0.20	=	3,800,000
21,000,000 × 0.40	=	8,400,000
23,000,000 × 0.15	=	3,450,000
25,000,000 × 0.10	=	2,500,000
		$20,700,000

3. Hillmart should consider the impact of the different systems on its relationship with suppliers. The interface with Hillmart's system may require that suppliers also update their systems. This could cause some suppliers to raise the cost of their merchandise. It could force other suppliers to drop out of Hillmart's supply chain because the cost of the system change would be prohibitive. Hillmart may also want to consider other factors such as the reliability of different systems and the effect on employee morale if employees have to be laid off as it automates its systems.

3-33 (15–20 min.) **CVP analysis, service firm**.

1.

Revenue per package	$7,500
Variable cost per package	6,300
Contribution margin per package	$1,200

Breakeven (packages) = Fixed costs ÷ Contribution margin per package

$$= \frac{\$570,000}{\$1,200 \text{ per package}} = 475 \text{ tour packages}$$

2. Contribution margin ratio = $\frac{\text{Contribution margin per package}}{\text{Selling price}} = \frac{\$1,200}{\$7,500} = 16\%$

Revenue to achieve target income = (Fixed costs + target OI) ÷ Contribution margin ratio

$$= \frac{\$570,000 + \$102,000}{0.16} = \$4,200,000, \text{ or}$$

Number of tour packages to earn $102,000 operating income $= \frac{\$570,000 + \$102,000}{\$1,200} = 560$ tour packages

Revenues to earn $102,000 OI = 560 tour packages × $7,500 = $4,200,000.

3. Fixed costs = $570,000 + $19,000 = $589,000

$$\text{Breakeven (packages)} = \frac{\text{Fixed costs}}{\text{Contribution margin per package}}$$

$$\text{Contribution margin per package} = \frac{\text{Fixed costs}}{\text{Breakeven (packages)}}$$

$$= \frac{\$589,000}{475 \text{ tour packages}} = \$1,240 \text{ per tour package}$$

Desired variable cost per tour package = $7,500 – $1,240 = $6,260

Because the current variable cost per unit is $6,300, the unit variable cost will need to be reduced by $40 ($6,300– $6,260) to achieve the breakeven point calculated in requirement 1.

Alternate Method: If fixed cost increases by $19,000, then total variable costs must be reduced by $19,000 to keep the breakeven point of 475 tour packages.

Therefore, the variable cost per unit reduction = $19,000 ÷ 475 = $40 per tour package.

4. Contribution margin per package = $8,200 − $6,300 = $1,900

Breakeven (packages) = Fixed costs ÷ Contribution margin per package
= $570,000 ÷ $1,900 per tour package = 300 tour packages

Breakeven point in dollars = $8,200 per package × 300 tour packages = $2,460,000
The key question for the general manager is: Can Lifetime Escapes sell enough packages at $8,200 per package to earn more total operating income than when selling packages at $7,500. Lowering the breakeven point per se is not the objective.

3-34 (30 min.) **CVP, target operating income, service firm.**

1.

Revenue per child	$400
Variable costs per child	150
Contribution margin per child	$250

$$\text{Breakeven quantity} = \frac{\text{Fixed costs}}{\text{Contribution margin per child}}$$

$$= \frac{\$4,000}{\$250} = 16 \text{ children}$$

2. $$\text{Target quantity} = \frac{\text{Fixed costs} + \text{Target operating income}}{\text{Contribution margin per child}}$$

$$= \frac{\$4,000 + \$5,000}{\$250} = 36 \text{ children}$$

3.

Increase in rent ($2,200 – $1,500)	$ 700
Field trips	1,100
Total increase in fixed costs	$1,800
Divide by the number of children enrolled	÷ 36
Increase in fee per child	$ 50

Therefore, the fee per child will increase from $400 to $450.

Alternatively,

$$\text{New contribution margin per child} = \frac{\$4,000 + \$1,800 + \$5,000}{36} = \$300$$

New fee per child = Variable costs per child + New contribution margin per child
= $150 + $300 = $450

3-35 CVP analysis, margin of safety.

1.

Selling price	$206
Variable costs per unit:	24
Contribution margin per unit (CMU)	$182

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$327,600}{\$182} = 1,800 \text{ returns (units)}$$

Margin of safety (units) = 3,000* – 1,800 = 1,200 units

*$618,000 budgeted revenue÷$206 = 3,000 units
Breakeven revenues = $206 × 1,800 = $370,800
Margin of safety percentage = ($618,000−$370,800) ÷ $618,000= 40%

2a. Increase selling price to $224

Selling price	$224
Variable costs per unit:	24
Contribution margin per unit (CMU)	$200

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$327,600}{\$200} = 1,638 \text{ returns (units)}$$

Breakeven revenues = $224 × 1,638 units = $366,912

Margin of safety percentage = ($618,000 − $366,912) ÷ $618,000 = 40.62%
This change will not help Arvin achieve its desired margin of safety of 45%.

2b.

Selling price	$206
Variable costs per unit:	24
Contribution margin per unit (CMU)	$182

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$327,600}{\$182} = 1,800 \text{ returns (units)}$$

Breakeven revenues = $206 × 1,800 = $370,800

Budgeted revenues = $618,000 × 1.15 = $710,700
Margin of safety percentage = ($710,700 − $370,800) ÷ $710,700 = 47.8%
This change will help Arvin achieve its desired margin of safety of 45%.

2c.

Selling price	$206
Variable costs per unit $24 – $2):	22
Contribution margin per unit (CMU)	$184

Fixed costs = $327,600 × 1.05 = $343,980

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$343,980}{\$184} = 1,870 \text{ returns/units (rounded up)}$$

Breakeven revenues = $206 × 1,870 units = $385,220
Margin of safety percentage = ($618,000− $385,220) ÷ $618,000= 37.7%
This change will not help Arvin achieve its desired margin of safety of 45%.

Options 2a and 2b improve the margin of safety, but only option 2b exceeds the company's desired margin of safety. Option 2c actually lowers the company's margin of safety.

3-36 (30–40 min.) **CVP analysis, income taxes.**

1. Revenues – Variable costs – Fixed costs $= \frac{\text{Target net income}}{1 - \text{Tax rate}}$

Let X = Net income for 2014

$$22{,}000(\$35.00) - 22{,}000(\$18.50) - \$214{,}500 = \frac{X}{1 - 0.40}$$

$$\$770{,}000 - \$407{,}000 - \$214{,}500 = \frac{X}{0.60}$$

$$\$462{,}000 - \$244{,}200 - \$128{,}700 = X$$

$$X = \$89{,}100$$

Alternatively,

Operating income = Revenues – Variable costs – Fixed costs
= \$770,000 – \$407,000 – \$214,500 = \$148,500
Income taxes = 0.40 × \$148,500 = \$59,400
Net income = Operating income – Income taxes
= \$148,500 – \$59,400 = \$89,100

2. Let Q = Number of units to break even
\$35.00Q – \$18.50Q – \$214,500 = 0
Q = \$214,500 ÷ \$16.50 = 13,000 units

3. Let X = Net income for 2015

$$25{,}000(\$35.00) - 25{,}000(\$18.50) - (\$214{,}500 + \$16{,}500) = \frac{X}{1 - 0.40}$$

$$\$875{,}000 - \$462{,}500 - \$231{,}000 = \frac{X}{0.60}$$

$$\$181{,}500 = \frac{X}{0.60}$$

$$X = \$108{,}900$$

4. Let Q = Number of units to break even with new fixed costs of \$146,250

\$35.00Q – \$18.50Q – \$231,000 = 0
Q = \$231,000 ÷ \$16.50 = 14,000 units
Breakeven revenues = 14,000 × \$35.00 = \$490,000

5. Let S = Required sales units to equal 2011 net income

$$\$35.00S - \$18.50S - \$231{,}000 = \frac{\$89{,}100}{0.60}$$

\$16.50S = \$379,500
S = 23,000 units
Revenues = 23,000 units × \$35 = \$805,000

6. Let A = Amount spent for advertising in 2012

$$\$875{,}000 - \$462{,}500 - (\$214{,}500 + A) = \frac{\$108{,}450}{0.60}$$

$$\$875{,}000 - \$462{,}500 - \$214{,}500 - A = \$180{,}750$$

$$\$875{,}000 - \$857{,}750 = A$$

$$A = \$17{,}250$$

3-37 (25 min.) **CVP, sensitivity analysis**.

Contribution margin per pair of shoes = $70 – $30 = $40
Fixed costs = $100,000
Units sold = Total sales ÷ Selling price = $350,000 ÷ $70 per pair = 5,000 pairs of shoes

1. Variable costs decrease by 20%; Fixed costs increase by 15%

Sales revenues 5,000 × $70	$350,000
Variable costs 5,000 × $30 × (1 – 0.20)	120,000
Contribution margin	230,000
Fixed costs $100,000 × 1.15	115,000
Operating income	$115,000

2. Increase advertising (fixed costs) by $30,000; Increase sales 20%

Sales revenues 5,000 × 1.10 × $70.00	$385,000
Variable costs 5,000 × 1.10 × $30.00	165,000
Contribution margin	220,000
Fixed costs ($100,000 + $25,000)	125,000
Operating income	$ 95,000

3. Increase selling price by $10.00; Sales decrease 20%; Variable costs increase by $8

Sales revenues 5,000 × 0.80 × ($70 + $10)	$320,000
Variable costs 5,000 × 0.80 × ($30 + $8)	152,000
Contribution margin	168,000
Fixed costs	100,000
Operating income	$ 68,000

4. Double fixed costs; Increase sales by 60%

Sales revenues 5,000 × 1.60 × $70	$560,000
Variable costs 5,000 × 1.60 × $30	240,000
Contribution margin	320,000
Fixed costs $100,000 × 2	200,000
Operating income	$120,000

Alternative 4 yields the highest operating income. Choosing alternative 4 will give Derby a 20% increase in operating income [($120,000 – $100,000)/$100,000 = 20%], which is less than the company's 25% targeted increase. Alternative 1also generates more operating income for Derby, but it too does not meet Derby's target of 25% increase in operating income. Alternatives 2 and 3 actually result in lower operating income than under Derby's current cost structure. There is no reason, however, for Derby to think of these alternatives as being mutually exclusive. For example, Derby can combine actions 1 and 4, automate the machining process and decrease variable costs by 20% while increasing fixed costs by 15%. This will result in a 38% increase in operating income as follows:

Sales revenue 5,000 × 1.60 × $70	$560,000
Variable costs 5,000 × 1.60 × $30 × (1 – 0.20)	192,000
Contribution margin	368,000
Fixed costs $200,000 × 1.15	230,000
Operating income	$138,000

The point of this problem is that managers always need to consider broader rather than narrower alternatives to meet ambitious or stretch goals.

3-38 (20–30 min.) **CVP analysis, shoe stores.**

1. CMU (SP – VCU = $60 – $40)	$ 20.00
a. Breakeven units (FC ÷ CMU = $180,000 ÷ $20 per unit)	9,000
b. Breakeven revenues (Breakeven units × SP = 9,000 units × $60 per unit)	$540,000
2. Pairs sold	8,000
Revenues, 8,000 × $60	$480,000
Total cost of shoes, 8,000 × $37	296,000
Total sales commissions, 8,000 × $3	24,000
Total variable costs	320,000
Contribution margin	160,000
Fixed costs	180,000
Operating income (loss)	$ (20,000)
3. Unit variable data (per pair of shoes)	
Selling price	$ 60.00
Cost of shoes	37.00
Sales commissions	0
Variable cost per unit	$ 37.00
Annual fixed costs	
Rent	$ 30,000
Salaries, $100,000 + $15,500	115,500
Advertising	40,000
Other fixed costs	10,000
Total fixed costs	$ 195,500
CMU, $60 – $37	$ 23
a. Breakeven units, $195,500 ÷ $23 per unit	8,500
b. Breakeven revenues, 8,500 units × $60 per unit	$510,000

4. Unit variable data (per pair of shoes)

Selling price	$ 60.00
Cost of shoes	37.00
Sales commissions	5.00
Variable cost per unit	$ 42.00
Total fixed costs	$180,000

CMU, $60 – $42	$ 18.00
a. Break even units = $180,000 ÷ $18 per unit	10,000
b. Break even revenues = 10,000 units ×$60 per unit	$600,000

5. Pairs sold

Pairs sold	12,000
Revenues (12,000 pairs × $60 per pair)	$720,000
Total cost of shoes (12,000 pairs × $37 per pair)	444,000
Sales commissions on first 9,000 pairs (9,000 pairs × $3 per pair)	27,000
Sales commissions on additional 3,000 pairs [3,000 pairs × ($3 + $2 per pair)]	15,000
Total variable costs	486,000
Contribution margin	234,000
Fixed costs	180,000
Operating income	$ 54,000

Alternative approach:

Breakeven point in units = 9,000 pairs
Store manager receives commission of $2 on 3,000 (12,000 – 9,000) pairs.
Contribution margin per pair beyond breakeven point of 9,000 pairs =
$18 ($60 – $40 – $2) per pair.
Operating income = 3,000 pairs ×$18 contribution margin per pair = $54,000.

3-39 (30 min.) **CVP analysis, shoe stores (continuation of 3-38).**

1. For an expected volume of 10,000 pairs, the owner would be inclined to choose the higher-fixed-salaries-only plan because income would be higher by $14,500 compared to the salary-plus-commission plan.

. Operating income for salary plan = $23 × 10,000 – $195,500 = $34,500
Operating income under commission pan = $20 × 10,000 – $180,000 = $20,000

But it is likely that sales volume itself is determined by the nature of the compensation plan. The salary-plus-commission plan provides a greater motivation to the salespeople, and it may well be that for the same amount of money paid to salespeople, the salary-plus-commission plan generates a higher volume of sales than the fixed-salary plan.

2. Let TQ = Target number of units

For the salary-only plan,

$60TQ – $37TQ – $195,500	= $69,000
$23TQ	= $264,500
TQ	= $264,500 ÷ $23
TQ	= 11,500 units

For the salary-plus-commission plan,

$60TQ – $40TQ – $180,000	= $69,000
$20TQ	= $249,000
TQ	= $249,000 ÷ $20.00
TQ	= 12,450 units

The decision regarding the salary plan depends heavily on predictions of demand. For instance, the salary plan offers the same operating income at 11,500 units as the commission plan offers at 12,450 units.

3.

HighStep Shoe Company
Operating Income Statement, 2014

Revenues (9,500 pairs ×$60) + (1,500 pairs ×$50)	$645,000
Cost of shoes, 11,000 pairs × $37	407,000
Commissions = Revenues ×5% = $645,000 × 0.05	32,250
Contribution margin	205,750
Fixed costs	180,000
Operating income	$ 25,750

3-40 (40 min.) **Alternative cost structures, uncertainty, and sensitivity analysis.**

1. Contribution margin per page assuming current fixed leasing agreement = \$0.15 – \$0.04 – \$0.05 = \$0.06 per page

   Fixed costs = \$1,200

   $$\text{Breakeven point} = \frac{\text{Fixed costs}}{\text{Contribution margin per page}} = \frac{\$1,200}{\$0.06 \text{ per page}} = 20,000 \text{ pages}$$

   Contribution margin per page assuming \$20 per 500 page commission agreement = \$0.15 – \$0.04[a] – \$0.04 – \$.05 = \$0.02 per page

   Fixed costs = \$0

   $$\text{Breakeven point} = \frac{\text{Fixed costs}}{\text{Contribution margin per page}} = \frac{\$0}{\$0.02 \text{ per page}} = 0 \text{ pages}$$

   (i.e., Deckle makes a profit no matter how few pages it sells)

   [a]\$20 ÷ 500 pages = \$0.04 per page

2. Let x denote the number of pages Deckle must sell for it to be indifferent between the fixed leasing agreement and commission based agreement.

   To calculate x we solve the following equation.

   $\$0.15x - \$0.04x - \$0.05x - \$1,200 = \$0.15x - \$0.04x - \$0.04x - \$.05x$
   $\$0.06x - \$1,200 = \$0.02x$
   $\$0.04x = \$1,200$
   $x = \$1,200 \div \$0.04 = 30,000$ pages

   For sales between 0 to 30,000 pages, Deckle prefers the commission-based agreement because in this range, $\$0.02x > \$0.06x - \$1,200$. For sales greater than 30,000 pages, Deckle prefers the fixed leasing agreement because in this range, $\$0.06x - \$1,200 > \$.02x$.

3. Fixed leasing agreement

Pages Sold (1)	Revenue (2)	Variable Costs (3)	Fixed Costs (4)	Operating Income (Loss) (5) = (2) – (3) – (4)	Probability (6)	Expected Operating Income (7)=(5)×(6)
20,000	20,000× $.15=$ 3,000	20,000× $.09=$1,800	$1,200	$ 0	0.20	$ 0
30,000	30,000× $.15=$ 4,500	30,000× $.09=$2,700	$1,200	$ 600	0.20	120
40,000	40,000× $.15=$ 6,000	40,000× $.09=$3,600	$1,200	$1,200	0.20	240
40,000	50,000× $.15=$ 7,500	50,000× $.09=$4,500	$1,200	$1,800	0.20	360
60,000	60,000× $.15=$ 9,000	60,000× $.09=$5,400	$1,200	$2,400	0.20	480
Expected value of fixed leasing agreement						$1,200

Commission-based leasing agreement:

Pages Sold (1)	Revenue (2)	Variable Costs (3)	Operating Income (4) = (2) –(3)	Probability (5)	Expected Operating Income (6)=(4) × (5)
20,000	20,000 × $.15=$ 3,000	20,000× $.13=$2,600	$400	0.20	$ 80
30,000	30,000 × $.15=$ 4,500	30,000× $.13=$3,900	$600	0.20	120
40,000	40,000 × $.15=$ 6,000	40,000× $.13=$5,200	$800	0.20	160
50,000	50,000 × $.15=$ 7,500	50,000× $.13=$6,500	$1,000	0.20	200
60,000	60,000 × $.15=$ 9,000	60,000× $.13=$7,800	$1,200	0.20	240
Expected value of commission based agreement					$800

Deckle should choose the fixed cost leasing agreement because the expected value is higher than under the commission-based leasing agreement. The range of sales is high enough to make the fixed leasing agreement more attractive.

3-41 (20-30 min.) **CVP, alternative cost structures.**

1. Variable cost per unit = $5
   Contribution margin per unit = Selling price – Variable cost per unit
   = $20 – $5 = $15

   Fixed Costs:

Manager's salary ($40,000 × 1.20 × 0.5) ÷12	$2,000 per month
Rent	800 per month
Hourly employee wages (2 × 160 hours × $10)	3,200 per month
Total fixed costs	$6,000 per month

   Breakeven point = Fixed costs ÷ Contribution margin per unit
   = $6,000 ÷ $15 = 400 sunglasses (per month)

2. $$\text{Target number of sunglasses} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}}$$

$$= \frac{\$6{,}000 + \$4{,}500}{\$15} = 700 \text{ sunglasses}$$

3. Contribution margin per unit = Selling price – Variable cost per computer
   = $20 – 0.15 × $20 – $5 = $12
   Fixed costs = Manager's salary + Rent = $2,000 + $800 = $2,800

$$\text{Target number of sunglasses} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}}$$

$$= \frac{\$2{,}800 + \$4{,}500}{\$12} = 609 \text{ sunglasses(rounded up)}$$

4. Let x be the number of sunglasses for which SuperShades is indifferent between paying a monthly rental fee for the retail space and paying an 8% commission on sales. SuperShades will be indifferent when the operating income under the two alternatives are equal.

$$\$20x - \$5x - \$6{,}000 = \$20x - \$5x - \$20(0.08)x - \$5{,}200$$
$$\$15x - \$6{,}000 = \$13.40x - \$5{,}200$$
$$\$1.60x = \$800$$
$$x = 500 \text{ sunglasses}$$

For sales between 0 and 500 sunglasses, SuperShades prefers to pay the 8% commission because in this range, $\$13.40x - \$5{,}200 > \$15x - \$6{,}000$. For sales greater than 500 sunglasses, the company prefers to pay the monthly fixed rent of $800 because $\$15x - \$6{,}000 > \$13.40x - \$5{,}200$.

3-42 (30 min.) **CVP analysis, income taxes, sensitivity.**

1a.To breakeven, Carlisle Engine Company must sell 1,200 units. This amount represents the point where revenues equal total costs.

Let Q denote the quantity of engines sold.

Revenue	=	Variable costs + Fixed costs
$4,000Q	=	$1000Q + $4,800,000
$3,000Q	=	$4,800,000
Q	=	1,600 units

Breakeven can also be calculated using contribution margin per unit.

Contribution margin per unit = Selling price – Variable cost per unit = $4,000 – $1,000 = $3,000

Breakeven = Fixed Costs ÷ Contribution margin per unit
= $4,800,000 ÷ $3,000
= 1,600 units

1b. To achieve its net income objective, Carlisle Engine Company must sell 2,100 units. This amount represents the point where revenues equal total costs plus the corresponding operating income objective to achieve net income of $1,200,000.

Revenue = Variable costs + Fixed costs + [Net income ÷ (1 – Tax rate)]
$4,000Q = $1,000Q + $4,800,000 + [$1,200,000 ÷ (1 – 0.20)]
$4,000Q = $1,000Q + $4,800,000 + $1,500,000
Q = 2,100 units

2. None of the alternatives will help Carlisle Engineering achieve its net income objective of $1,200,000. Alternative b, where variable costs are reduced by $300 and selling price is reduced by $400 resulting in 1,750 additional units being sold through the end of the year, yields the highest net income of $1,180,000. Carlisle's managers should examine how to modify Alternative b to further increase net income. For example, could variable costs be decreased by more than $300 per unit or selling prices decreased by less than $400? Calculations for the three alternatives are shown below.

Alternative a

Revenues	=	($4,000 × 400) + ($3,400[a] × 2,100) = $8,740,000
Variable costs	=	$1,000 × 2,500[b] = $2,500,000
Operating income	=	$8,740,000– $2,500,000 – $4,800,000 = $1,440,000
Net income	=	$1,440,000 × (1 – 0.20) = $1,152,000

[a]$4,000 – ($4,000 × 0.15) ; [b]400 units + 2,100 units.

Alternative b

Revenues = ($4,000 × 400) + ($3,600[a] × 1,750) = $7,900,000

Variable costs = ($1,000 × 400) + (700[b] × 1,750) = $1,625,000

Operating income = $7,900,000 – $1,625,000 – $4,800,000 = $1,475,000

Net income = $1,475,000 × (1 – 0.20) = $1,180,000

[a]$4,000 – 400 ; [b]$1,000 – $300.

Alternative c

Revenues = ($4,000 × 400) + ($2,800[a] × 2,200) = $7,760,000

Variable costs = $1,000 × 2,600[b] = $2,600,000

Operating income = $7,760,000– $2,600,000 – $4,320,000[c] = 840,000

Net income = $840,000 × (1 – 0.20) = $672,000

[a]$4,000 – ($4,000× 0.30); [b]400 units + 2,200nits; [c]$4,800,000 – ($4,800,000 × 0.10)

3-43 (30 min.) **Choosing between compensation plans, operating leverage.**

1. We can recast BioPharm's income statement to emphasize contribution margin, and then use it to compute the required CVP parameters.

BioPharm Corporation

Income Statement for the Year Ended December 31, 2014

	Using Sales Agents		**Using Own Sales Force**	
Revenues		$32,000,000		$32,000,000
Variable Costs				
Cost of goods sold—variable	$12,160,000		$12,160,000	
Marketing commissions	6,400,000	18,560,000	4,160,000	16,320,000
Contribution margin		13,440,000		15,680,000
Fixed Costs				
Cost of goods sold—fixed	3,750,000		3,750,000	
Marketing—fixed	3,660,000	7,410,000	5,900,000	9,650,000
Operating income		$ 6,030,000		$ 6,030,000
Contribution margin percentage ($13,440,000 ÷ $32,000,000; $15,680,000 ÷ $32,000,000)		42%		49%
Breakeven revenues ($7,410,000 ÷ 0.42; $9,650,000 ÷ 0.49)		$17,642,857		$19,693,878
Degree of operating leverage ($13,440,000 ÷ $6,030,000; $15,680.000 ÷ $6,030,000)		2.23		2.60

2. The calculations indicate that at sales of $32,000,000, a percentage change in sales and contribution margin will result in 2.23 times that percentage change in operating income if BioPharm continues to use sales agents and 2.60 times that percentage change in operating income if BioPharm employs its own sales staff. The higher contribution margin per dollar of sales and higher fixed costs gives BioPharm more operating leverage, that is, greater benefits (increases in operating income) if revenues increase but greater risks (decreases in operating income) if revenues decrease. BioPharm also needs to consider the skill levels and incentives under the two alternatives. Sales agents have more incentive compensation and, hence, may be more motivated to increase sales. On the other hand, BioPharm's own sales force may be more knowledgeable and skilled in selling the company's products. That is, the sales volume itself will be affected by who sells and by the nature of the compensation plan.

3. Variable costs of marketing = 16% of Revenues
Fixed marketing costs = $5,900,000

$$\text{Operating income} = \text{Revenues} - \text{Variable manuf. costs} - \text{Fixed manuf. costs} - \text{Variable marketing costs} - \text{Fixed marketing costs}$$

Denote the revenues required to earn $6,030,000 of operating income by R, then

$$R - 0.38R - \$3{,}750{,}000 - 0.16R - \$5{,}900{,}000 = \$6{,}030{,}000$$
$$R - 0.38R - 0.16R = \$6{,}030{,}000 + \$3{,}750{,}000 + \$5{,}900{,}000$$
$$0.46R = \$15{,}680{,}000$$
$$R = \$15{,}680{,}000 \div 0.46 = \$34{,}086{,}957$$

3-44 (15–25 min.) **Sales mix, three products.**

1. Sales of A, B, and C are in ratio 20,000 : 100,000 : 80,000. So for every 1 unit of A, 5 (100,000 ÷ 20,000) units of B are sold, and 4 (80,000 ÷ 20,000) units of C are sold.

Contribution margin of the bundle = 1 × $3 + 5 × $2 + 4 × $1 = $3 + $10 + $4 = $17

Breakeven point in bundles = $\frac{\$255{,}000}{\$17}$ = 15,000 bundles

Breakeven point in units is:

Product A:	15,000 bundles × 1 unit per bundle	15,000 units
Product B:	15,000 bundles × 5 units per bundle	75,000 units
Product C:	15,000 bundles × 4 units per bundle	60,000 units
Total number of units to breakeven		150,000 units

Alternatively,
Let Q = Number of units of A to break even
5Q = Number of units of B to break even
4Q = Number of units of C to break even

Contribution margin – Fixed costs = Zero operating income

$$\$3Q + \$2(5Q) + \$1(4Q) - \$255{,}000 = 0$$
$$\$17Q = \$255{,}000$$
$$Q = 15{,}000\ (\$255{,}000 \div \$17) \text{ units of A}$$
$$5Q = 75{,}000 \text{ units of B}$$
$$4Q = 60{,}000 \text{ units of C}$$
$$\text{Total} = 150{,}000 \text{ units}$$

2. Contribution margin:

A: 20,000 × $3	$ 60,000	
B: 100,000 × $2	200,000	
C: 80,000 × $1	80,000	
Contribution margin		$340,000
Fixed costs		255,000
Operating income		$ 85,000

3. Contribution margin

A: 20,000 × $3	$ 60,000	
B: 80,000 × $2	160,000	
C: 100,000 × $1	100,000	
Contribution margin		$320,000
Fixed costs		255,000
Operating income		$ 65,000

Sales of A, B, and C are in ratio 20,000 : 80,000 : 100,000. So for every 1 unit of A, 4 (80,000 ÷ 20,000) units of B and 5 (100,000 ÷ 20,000) units of C are sold.

Contribution margin of the bundle = 1 × $3 + 4 × $2 + 5 × $1 = $3 + $8 + $5 = $16

Breakeven point in bundles = $\frac{\$255,000}{\$16}$ = 15,938 bundles (rounded up)

Breakeven point in units is:

Product A:	15,938 bundles × 1 unit per bundle	15,938 units
Product B:	15,938 bundles × 4 units per bundle	63,752 units
Product C:	15,938 bundles × 5 units per bundle	79,690 units
Total number of units to breakeven		159,380 units

Alternatively,

Let Q = Number of units of A to break even
4Q = Number of units of B to break even
5Q = Number of units of C to break even

Contribution margin – Fixed costs = Breakeven point

$$\$3Q + \$2(4Q) + \$1(5Q) - \$255,000 = 0$$
$$\$16Q = \$255,000$$
$$Q = 15,938 \text{ (\$255,000 ÷ \$16) units of A (rounded up)}$$
$$4Q = 63,752 \text{ units of B}$$
$$5Q = 79,690 \text{ units of C}$$
$$\text{Total} = 159,380 \text{ units}$$

Breakeven point increases because the new mix contains less of the higher contribution margin per unit, product B, and more of the lower contribution margin per unit, product C.

3-45 (40 min.) **Multi-product CVP and decision making.**

1. Faucet filter:

Selling price	$100
Variable cost per unit	35
Contribution margin per unit	$ 65

Pitcher-cum-filter:

Selling price	$120
Variable cost per unit	30
Contribution margin per unit	$ 90

Each bundle contains two faucet models and three pitcher models.

So contribution margin of a bundle = $2 \times \$65 + 3 \times \$90 = \$400$

$$\text{Breakeven point in bundles} = \frac{\text{Fixed costs}}{\text{Contribution margin per bundle}} = \frac{\$1,200,000}{\$400} = 3,000 \text{ bundles}$$

Breakeven point in units of faucet models and pitcher models is:

Faucet models: 3,000 bundles $\times$2 units per bundle	= 6,000 units
Pitcher models: 3,000 bundles $\times$3 units per bundle	= 9,000 units
Total number of units to breakeven	15,000 units

Breakeven point in dollars for faucet models and pitcher models is:

Faucet models: 6,000 units $\times$ $100 per unit	= $ 600,000
Pitcher models: 9,000 units $\times$ $120 per unit	= 1,080,000
Breakeven revenues	$1,680,000

Alternatively, weighted average contribution margin per unit $= \frac{(2 \times \$65) + (3 \times \$90)}{5} = \$80$

Breakeven point $= \frac{\$1,200,000}{\$80} = 15,000$ units

Faucet filter: $\frac{2}{5} \times 15,000$ units $= 6,000$ units

Pitcher-cum-filter: $\frac{3}{5} \times 15,000$ units $= 9,000$ units

Breakeven point in dollars

Faucet filter: 6,000 units $\times$ $100 per unit = $600,000

Pitcher-cum-filter: 9,000 units $\times$ $120 per unit = $1,080,000

2. Faucet filter:

Selling price	$100
Variable cost per unit	30
Contribution margin per unit	$ 70

Pitcher-cum-filter:

Selling price	$120
Variable cost per unit	20

Contribution margin per unit $100

Each bundle contains two faucet models and three pitcher models.

So contribution margin of a bundle = $2 \times \$70 + 3 \times \$100 = \$440$

$$\text{Breakeven point in bundles} = \frac{\text{Fixed costs}}{\text{Contribution margin per bundle}} = \frac{\$1,200,000 + \$208,000}{\$440} = 3,200 \text{ bundles}$$

Breakeven point in units of faucet models and pitcher models is:

Faucet models: 3,200 bundles × 2 units per bundle =	6,400 units
Pitcher models: 3,200 bundles × 3 units per bundle =	9,600 units
Total number of units to breakeven	16,000 units

Breakeven point in dollars for faucet models and pitcher models is:

Faucet models: 6,400 bundles × $100 per unit =	$ 640,000
Pitcher models: 9,600 bundles × $120 per unit =	1,152,000
Breakeven revenues	$1,792,000

Alternatively, weighted average contribution margin per unit $= \frac{(2 \times \$70) + (3 \times \$100)}{5} = \$88$

Breakeven point $= \frac{\$1,200,000 + \$208,000}{\$88} = 16,000$ units

Faucet filter: $\frac{2}{5} \times 16,000$ units $= 6,400$ units

Pitcher-cum-filter: $\frac{3}{5} \times 16,000$ units $= 9,600$ units

Breakeven point in dollars:
Faucet filter: 6,400 units × $100 per unit = $640,000
Pitcher-cum-filter: 9,600 units × $120 per unit = $1,152,000

3. Let x be the number of bundles for Crystal Clear Products to be indifferent between the old and new production equipment.

Operating income using old equipment = $\$400x - \$1,200,000$

Operating income using new equipment = $\$440x - \$1,200,000 - \$208,000$

At point of indifference:
$\$400x - \$1,200,000 = \$440x - \$1,408,000$
$\$440x - \$400x = \$1,408,000 - \$1,200,000$
$\$40x = \$208,000$
$x = \$208,000 \div \$40 = 5,200$ bundles

Faucet models = 5,200 bundles × 2 units per bundle = 10,400 units
Pitcher models = 5,200 bundles × 3 units per bundle = 15,600 units
Total number of units 26,000 units

Let x be the number of bundles,

When total sales are less than 26,000 units (5,200 bundles), $\$400x - \$1{,}200{,}000 > \$440x - \$1{,}408{,}000$, so Crystal Clear Products is better off with the old equipment.

When total sales are greater than 26,000 units (5,200 bundles), $\$440x - \$1{,}408{,}000 > \$400x - \$1{,}200{,}000$, so Crystal Clear Products is better off buying the new equipment.

At total sales of 24,000 units (4,800 bundles), Crystal Clear Products should keep the old production equipment.

Check
$\$400 \times 4{,}800 - \$1{,}200{,}000 = \$720{,}000$ is greater than $\$440 \times 4{,}800 - \$1{,}408{,}000 = \$704{,}000$.

3-46 (20–25 min.) **Sales mix, two products.**

1. Sales of standard and deluxe carriers are in the ratio of 187,500 : 62,500. So for every 1 unit of deluxe, 3 (187,500 ÷ 62,500) units of standard are sold.

Contribution margin of the bundle = 3 × \$10 + 1 × \$20 = \$30 + \$20 = \$50

Breakeven point in bundles = $\frac{\$2{,}250{,}000}{\$50}$ = 45,000 bundles

Breakeven point in units is:

Standard carrier:	45,000 bundles × 3 units per bundle	135,000 units
Deluxe carrier:	45,000 bundles × 1 unit per bundle	45,000 units
Total number of units to breakeven		180,000 units

Alternatively,
Let Q = Number of units of Deluxe carrier to break even
3Q = Number of units of Standard carrier to break even

Revenues – Variable costs – Fixed costs = Zero operating income

$$\begin{aligned} \$28(3Q) + \$50Q - \$18(3Q) - \$30Q - \$2{,}250{,}000 &= 0 \\ \$84Q + \$50Q - \$54Q - \$30Q &= \$2{,}250{,}000 \\ \$50Q &= \$2{,}250{,}000 \\ Q &= 45{,}000 \text{ units of Deluxe} \\ 3Q &= 135{,}000 \text{ units of Standard} \end{aligned}$$

The breakeven point is 135,000 Standard units plus 45,000 Deluxe units, a total of 180,000 units.

2a. Unit contribution margins are: Standard: \$28 – \$18 = \$10; Deluxe: \$50 – \$30 = \$20
If only Standard carriers were sold, the breakeven point would be:
\$2,250,000 ÷ \$10 = 225,000 units.

2b. If only Deluxe carriers were sold, the breakeven point would be:
\$2,250,000 ÷ \$20 = 112,500 units

3. Operating income = Contribution margin of Standard + Contribution margin of Deluxe - Fixed costs
= 200,000(\$10) + 50,000(\$20) – \$2,250,000
= \$2,000,000 + \$1,000,000 – \$2,250,000
= \$750,000

Sales of standard and deluxe carriers are in the ratio of 200,000 : 50,000. So for every 1 unit of deluxe, 4 (200,000 ÷ 50,000) units of standard are sold.

Contribution margin of the bundle = $4 \times \$10 + 1 \times \$20 = \$40 + \$20 = \$60$

Breakeven point in bundles = $\frac{\$2,250,000}{\$60}$ = 37,500 bundles

Breakeven point in units is:

Standard carrier:	37,500 bundles × 4 units per bundle	150,000 units
Deluxe carrier:	37,500 bundles × 1 unit per bundle	37,500 units
Total number of units to breakeven		187,500 units

Alternatively,
Let Q = Number of units of Deluxe product to break even
4Q = Number of units of Standard product to break even

$$\begin{aligned} \$28(4Q) + \$50Q – \$18(4Q) – \$30Q – \$2,250,000 &= 0 \\ \$112Q + \$50Q – \$72Q – \$30Q &= \$2,250,000 \\ \$60Q &= \$2,250,000 \\ Q &= 37,500 \text{ units of Deluxe} \\ 4Q &= 150,000 \text{ units of Standard} \end{aligned}$$

The breakeven point is 150,000 Standard +37,500 Deluxe, a total of 187,500 units.

The major lesson of this problem is that changes in the sales mix change breakeven points and operating incomes. In this example, the budgeted and actual total sales in number of units were identical, but the proportion of the product having the higher contribution margin declined. Operating income suffered, falling from \$875,000 to \$750,000. Moreover, the breakeven point rose from 180,000 to 187,500 units.

3-47 (20 min.) **Gross margin and contribution margin**.

1.

Ticket sales ($24 × 525 attendees)		$12,600
Variable cost of dinner ($12[a] ×525 attendees)	$6,300	
Variable invitations and paperwork ($1[b] ×525)	525	6,825
Contribution margin		5,775
Fixed cost of dinner	9,000	
Fixed cost of invitations and paperwork	1,975	10,975
Operating profit (loss)		$ (5,200)

[a] $6,300/525 attendees = $12/attendee
[b] $525/525 attendees = $1/attendee

2.

Ticket sales ($24 × 1,050 attendees)		$25,200
Variable cost of dinner ($12 × 1,050 attendees)	$12,600	
Variable invitations and paperwork ($1 × 1,050)	1,050	13,650
Contribution margin		11,550
Fixed cost of dinner	9,000	
Fixed cost of invitations and paperwork	1,975	10,975
Operating profit (loss)		$ 575

3-48 (30 min.) **Ethics, CVP analysis.**

1. Contribution margin percentage $= \dfrac{\text{Revenues} - \text{Variable costs}}{\text{Revenues}}$

$= \dfrac{\$4,000,000 - \$2,400,000}{\$4,000,000}$

$= \dfrac{\$1,600,000}{\$4,000,000} = 40\%$

Breakeven revenues $= \dfrac{\text{Fixed costs}}{\text{Contribution margin percentage}}$

$= \dfrac{\$1,728,000}{0.40} = \$4,320,000$

2. If variable costs are 52% of revenues, contribution margin percentage equals 48% (100% – 52%)

Breakeven revenues $= \dfrac{\text{Fixed costs}}{\text{Contribution margin percentage}}$

$= \dfrac{\$1,728,000}{0.48} = \$3,600,000$

3.

Revenues	$4,000,000
Variable costs (0.52 × $4,000,000)	2,080,000
Fixed costs	1,728,000
Operating income	$ 192,000

4. Incorrect reporting of environmental costs with the goal of continuing operations is unethical. In assessing the situation, the specific "Standards of Ethical Conduct for Management Accountants" (described in Exhibit 1-7) that the management accountant should consider are listed below.

Competence
Clear reports using relevant and reliable information should be prepared. Preparing reports on the basis of incorrect environmental costs to make the company's performance look better than it is violates competence standards. It is unethical for Madden not to report environmental costs to make the plant's performance look good.

Integrity
The management accountant has a responsibility to avoid actual or apparent conflicts of interest and advise all appropriate parties of any potential conflict. Madden may be tempted to report lower environmental costs to please Buckner and Hewitt and save the jobs of his colleagues. This action, however, violates the responsibility for integrity. The Standards of Ethical Conduct require the management accountant to communicate favorable as well as unfavorable information.

Credibility
The management accountant's Standards of Ethical Conduct require that information should be fairly and objectively communicated and that all relevant information should be disclosed. From a management accountant's standpoint, underreporting environmental costs to make performance look good would violate the standard of objectivity.

Madden should indicate to Buckner that estimates of environmental costs and liabilities should be included in the analysis. If Buckner still insists on modifying the numbers and reporting lower environmental costs, Madden should raise the matter with one of Buckner's superiors. If after taking all these steps, there is continued pressure to understate environmental costs, Madden should consider resigning from the company and not engage in unethical behavior.

3-49 (35 min.) **Deciding where to produce.**

	Peoria		Moline	
Selling price		$150.00		$150.00
Variable cost per unit				
Manufacturing	$72.00		$88.00	
Marketing and distribution	14.00	86.00	14.00	102.00
Contribution margin per unit (CMU)		64.00		48.00
Fixed costs per unit				
Manufacturing	30.00		15.00	
Marketing and distribution	19.00	49.00	14.50	29.50
Operating income per unit		$ 15.00		$ 18.50
CMU of normal production (as shown above)		$64		$48
CMU of overtime production ($64 – $3; $48 – $8)		61		40

1.				
Annual fixed costs = Fixed cost per unit × Daily production rate × Normal annual capacity ($49 × 400 units × 240 days; $29.50 × 320 units × 240 days)	$4,704,000		$2,265,600	
Breakeven volume = FC ÷ CMU of normal production ($4,704,000 ÷ $64; $2,265,600 ÷ 48)	73,500	units	47,200	units
2.				
Units produced and sold	96,000		96,000	
Normal annual volume (units) (400 × 240; 320 × 240)	96,000		76,800	
Units over normal volume (needing overtime)	0		19,200	
CM from normal production units (normal annual volume × CMU normal production) (96,000 × $64; 76,800 × 48)	$6,144,000		$3,686,400	
CM from overtime production units (0; 19,200 × $40)	0		768,000	
Total contribution margin	6,144,000		4,454,400	
Total fixed costs	4,704,000		2,265,600	
Operating income	$1,440,000		$2,188,800	
Total operating income		$3,628,800		

3. The optimal production plan is to produce 120,000 units at the Peoria plant and 72,000 units at the Moline plant. The full capacity of the Peoria plant, 120,000 units (400 units × 300 days), should be used because the contribution from these units is higher at all levels of production than is the contribution from units produced at the Moline plant.

Contribution margin per plant:	
Peoria, 96,000 × $64	$ 6,144,000
Peoria 24,000 × ($64 – $3)	1,464,000
Moline, 72,000 × $48	3,456,000
Total contribution margin	11,064,000
Deduct total fixed costs	6,969,600
Operating income	$ 4,094,400

The contribution margin is higher when 120,000 units are produced at the Peoria plant and 72,000 units at the Moline plant. As a result, operating income will also be higher in this case because total fixed costs for the division remain unchanged regardless of the quantity produced at each plant.