**Cost-Volume-Profit Assumptions**

Now that you have seen how CVP analysis works, think about the following assumptions we made during the analysis:

1. Changes in the levels of revenues and costs arise only because of changes in the number of product (or service) units sold. The number of units sold is the only revenue driver and the only cost driver. Just as a cost driver is any factor that affects costs, a revenue driver is a variable, such as volume, that causally affects revenues.

2. Total costs can be separated into two components: a fixed component that does not vary with units sold and a variable component that changes with respect to units sold.

3. When represented graphically, the behaviors of total revenues and total costs are linear (meaning they can be represented as a straight line) in relation to units sold within a relevant range (and time period).

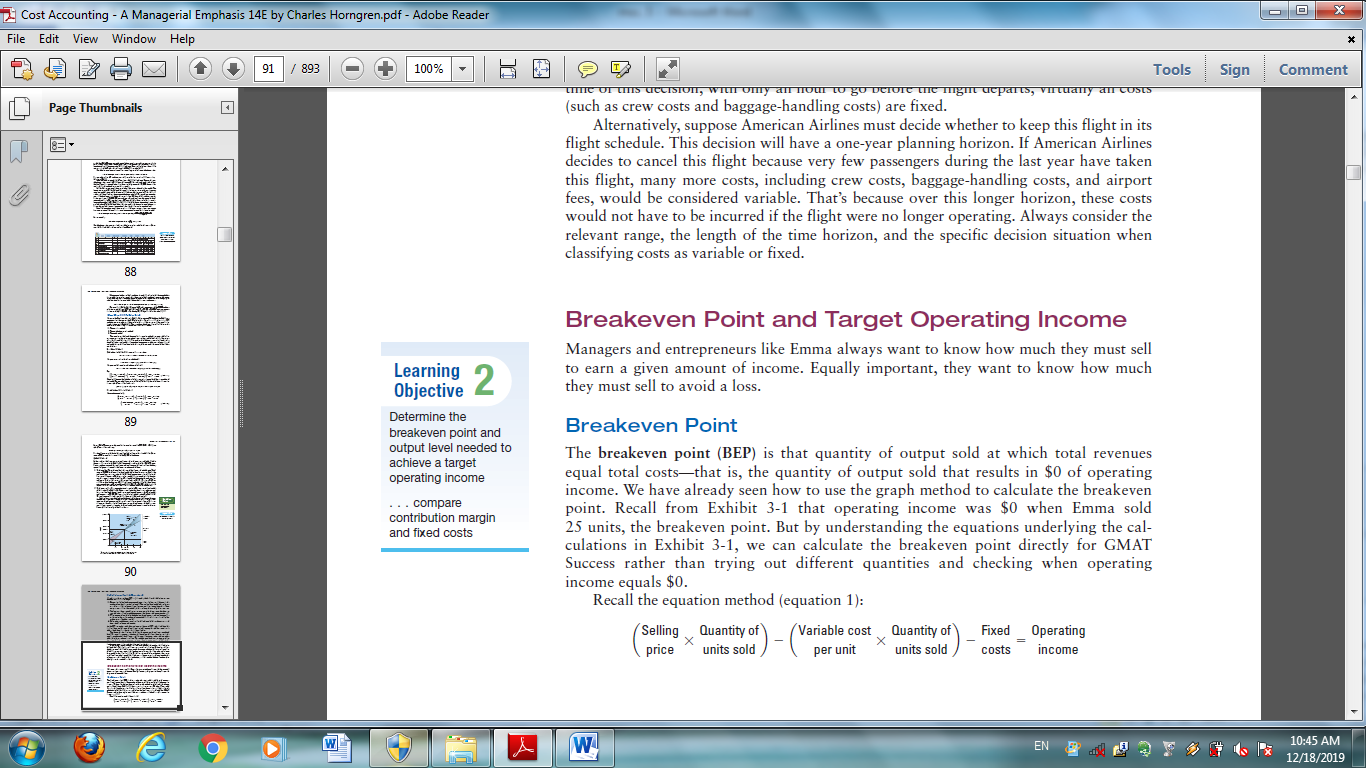
4. Selling price, variable cost per unit, and total fixed costs (within a relevant range and time period) are known and constant.

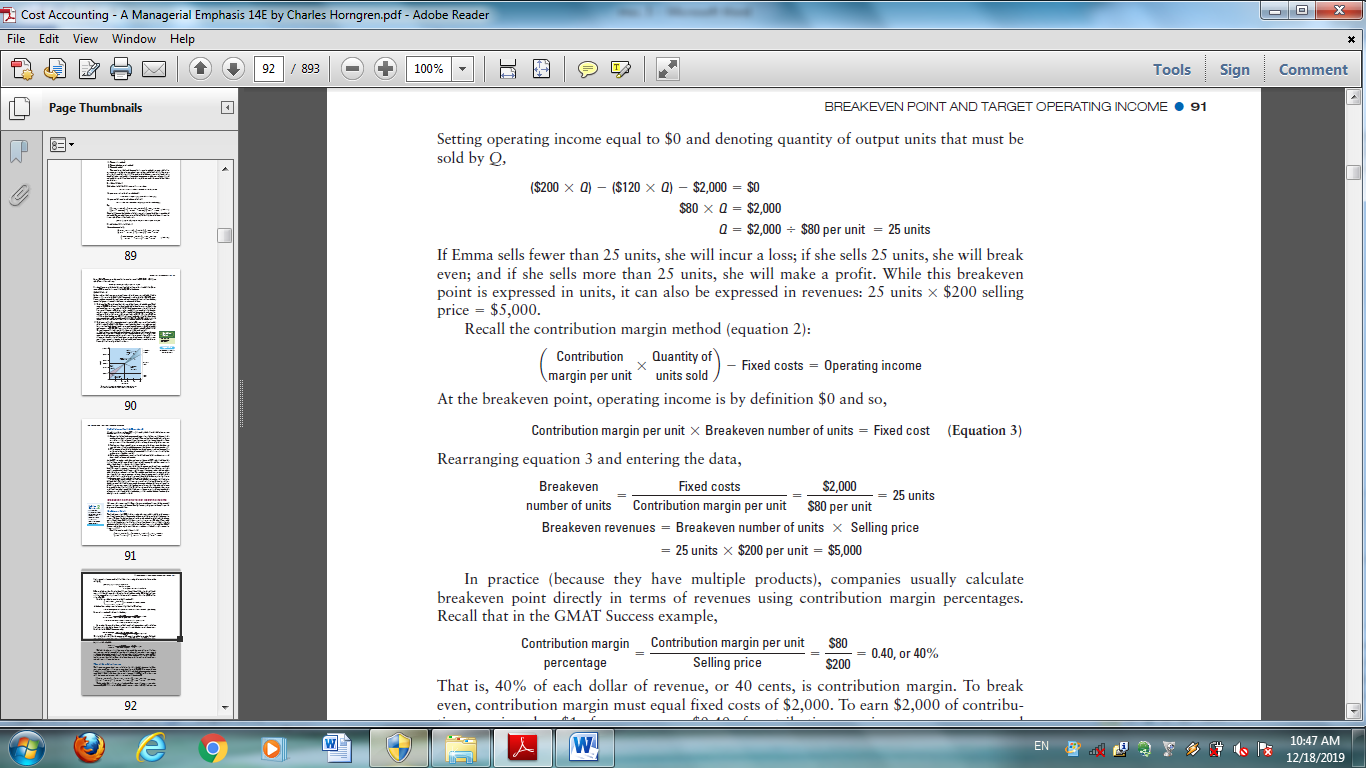
As the CVP assumptions make clear, an important feature of CVP analysis is distinguishing fixed from variable costs. Always keep in mind, however, that whether a cost is variable or fixed depends on the time period for a decision. The shorter the time horizon, the higher the percentage of total costs considered fixed. For example, suppose an American Airlines plane will depart from its gate in the next hour and currently has 20 seats unsold. A potential passenger arrives with a transferable ticket from a competing airline. The variable costs (such as one more meal) to American of placing one more passenger in an otherwise empty seat is negligible At the time of this decision, with only an hour to go before the flight departs, virtually all costs (such as crew costs and baggage-handling costs) are fixed. Alternatively, suppose American Airlines must decide whether to keep this flight in its flight schedule. This decision will have a one-year planning horizon. If American Airlines decides to cancel this flight because very few passengers during the last year have taken this flight, many more costs, including crew costs, baggage-handling costs, and airport fees, would be considered variable. That’s because over this longer horizon, these costs would not have to be incurred if the flight were no longer operating. Always consider the relevant range, the length of the time horizon, and the specific decision situation when classifying costs as variable or fixed.

**Breakeven Point and Target Operating Income**

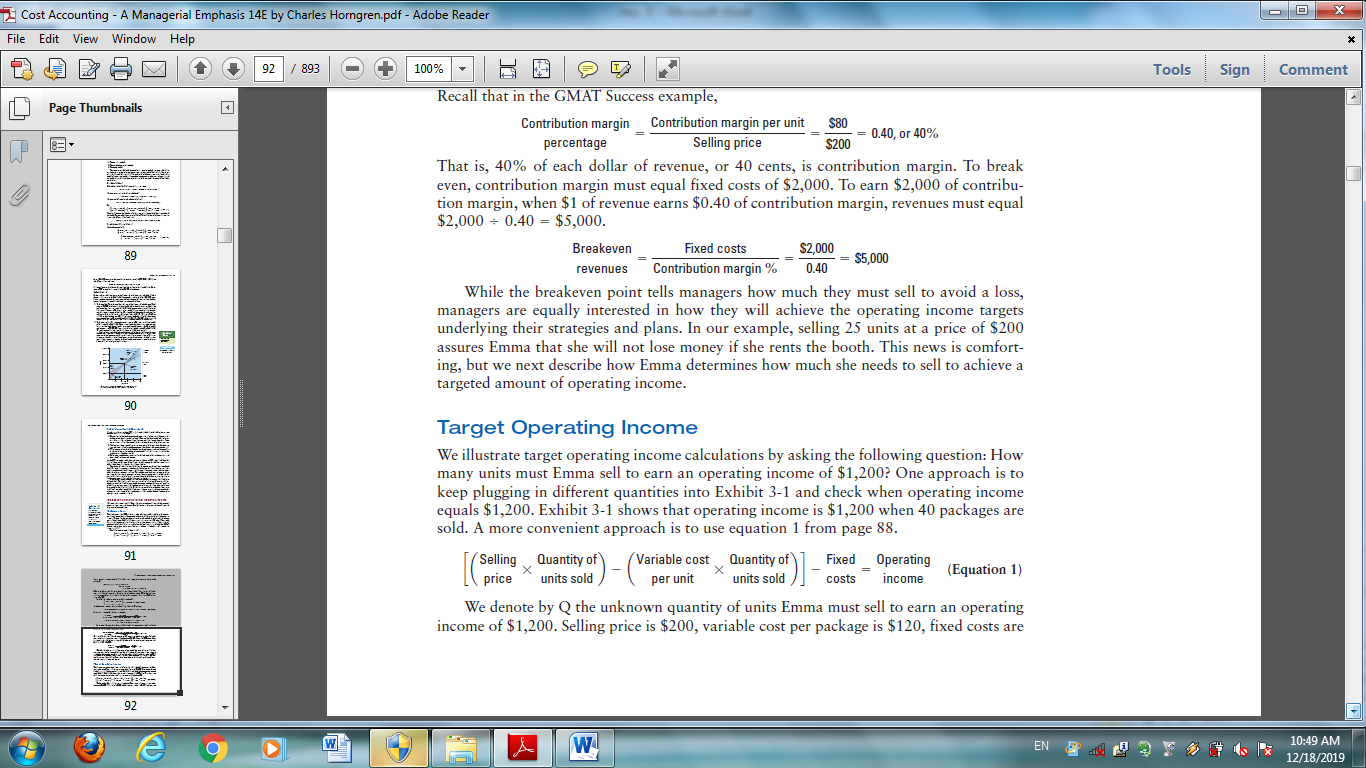
Managers and entrepreneurs like Emma always want to know how much they must sell to earn a given amount of income. Equally important, they want to know how much they must sell to avoid a loss. Breakeven Point

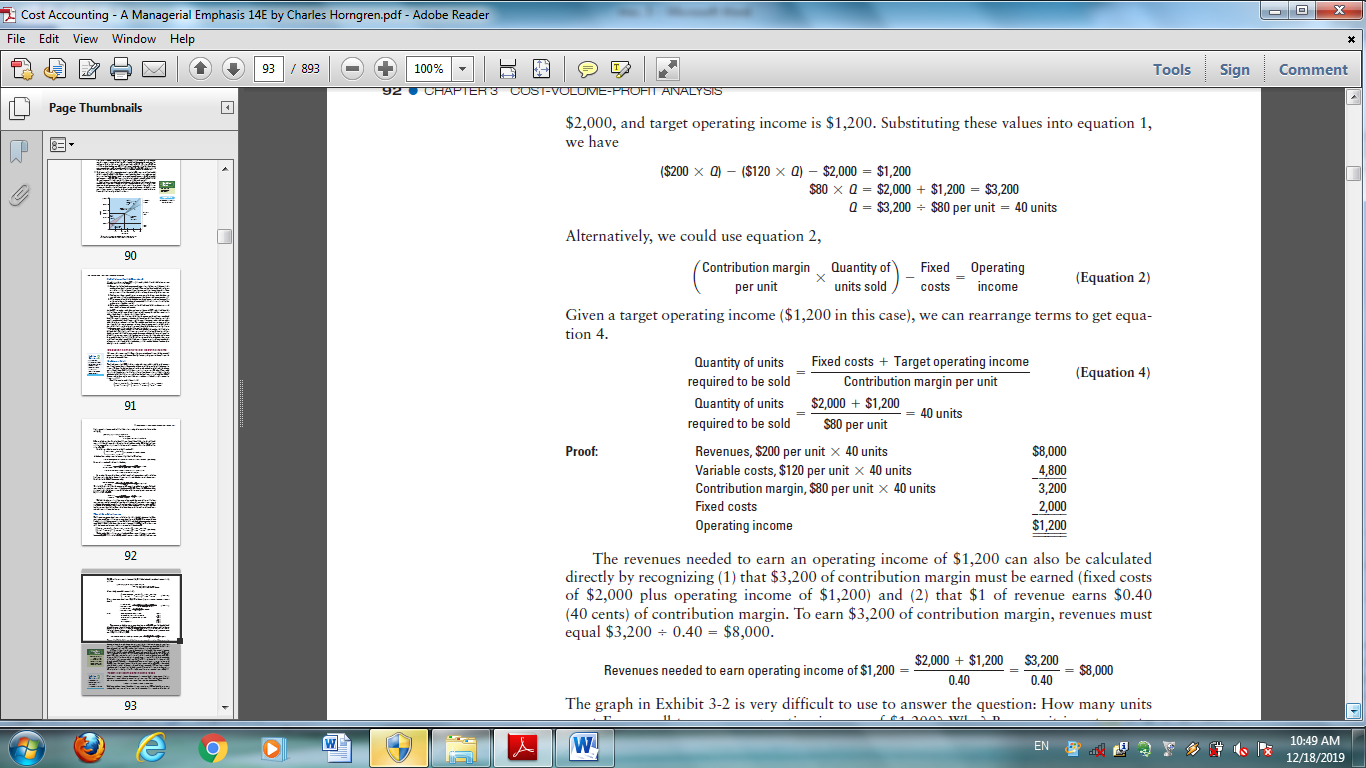
The breakeven point (BEP) is that quantity of output sold at which total revenues equal total costs—that is, the quantity of output sold that results in $0 of operating income. We have already seen how to use the graph method to calculate the breakeven point. Recall from Exhibit 3-1 that operating income was $0 when Emma sold 25 units, the breakeven point. But by understanding the equations underlying the calculations in Exhibit 3-1, we can calculate the breakeven point directly for GMAT Success rather than trying out different quantities and checking when operating income equals $0. Recall the equation method (equation 1):











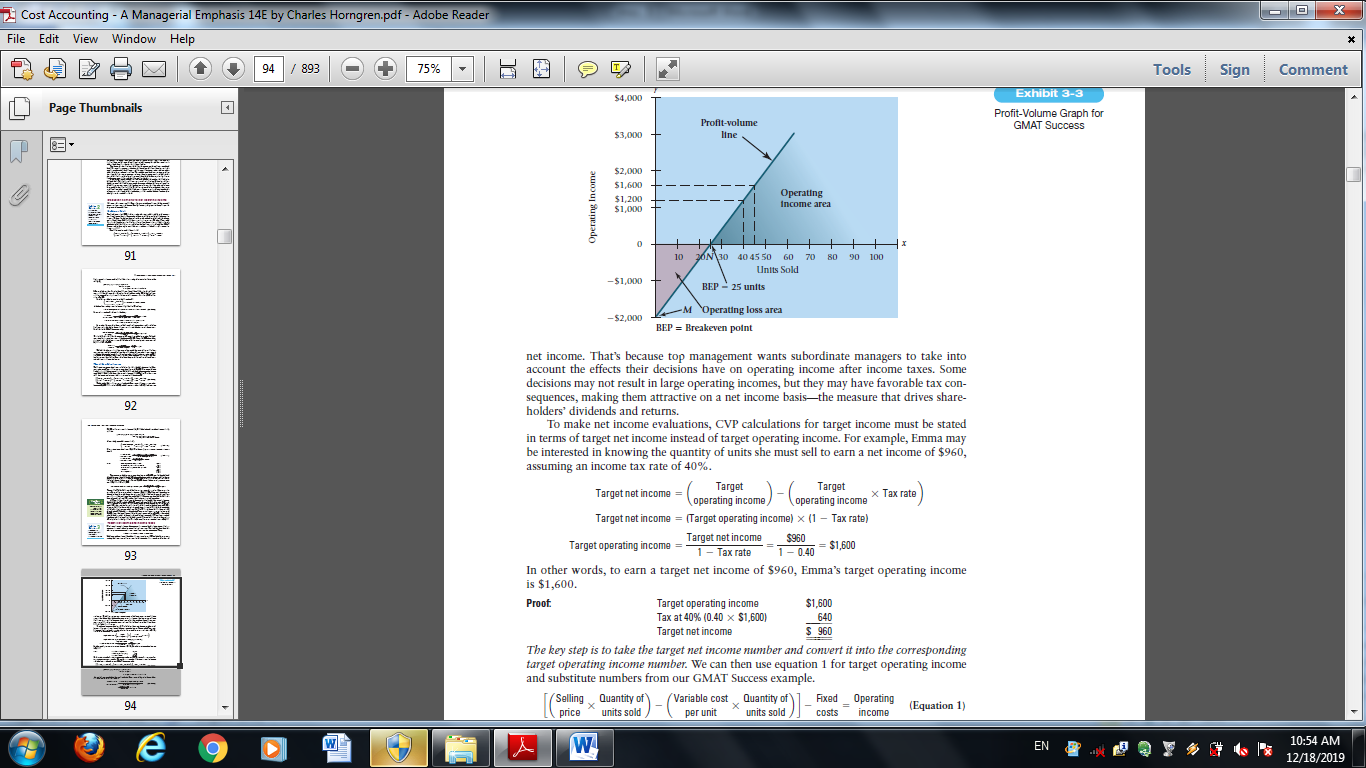
The graph in Exhibit 3-2 is very difficult to use to answer the question: How many units must Emma sell to earn an operating income of $1,200? Why? Because it is not easy to determine from the graph the precise point at which the difference between the total revenues line and the total costs line equals $1,200. However, recasting Exhibit 3-2 in the form of a profit-volume (PV) graph makes it easier to answer this question. A PV graph shows how changes in the quantity of units sold affect operating income. Exhibit 3-3 is the PV graph for GMAT Success (fixed costs, $2,000; selling price, $200; and variable cost per unit, $120). The PV line can be drawn using two points. One convenient point (M) is the operating loss at 0 units sold, which is equal to the fixed costs of $2,000, shown at –$2,000 on the vertical axis. A second convenient point (N) is the breakeven point, which is 25 units in our example (see p. 91). The PV line is the straight line from point M through point N. To find the number of units Emma must sell to earn an operating income of $1,200, draw a horizontal line parallel to the x-axis corresponding to $1,200 on the vertical axis (that’s the y-axis). At the point where this line intersects the PV line, draw a vertical line down to the horizontal axis (that’s the x-axis). The vertical line intersects the x-axis at 40 units, indicating that by selling 40 units Emma will earn an operating income of $1,200.

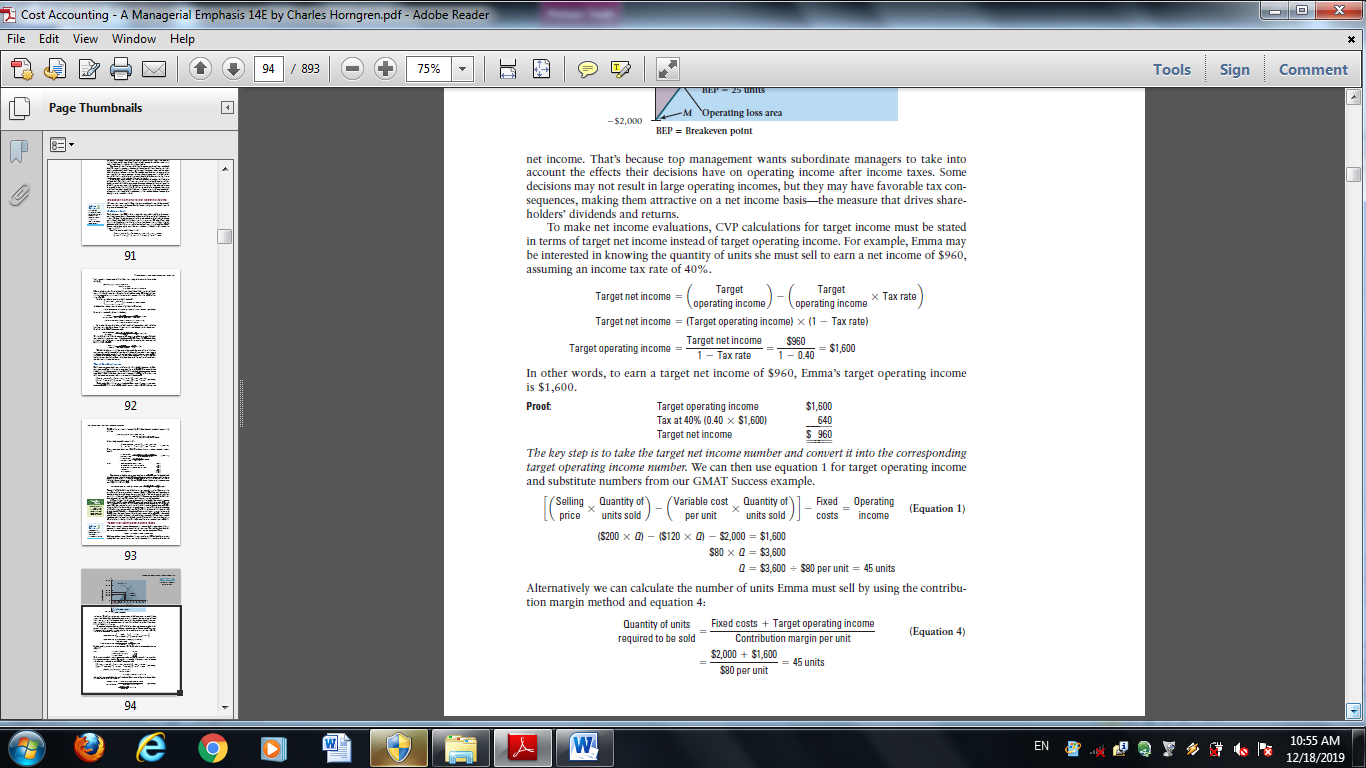
**Target Net Income and Income Taxes**

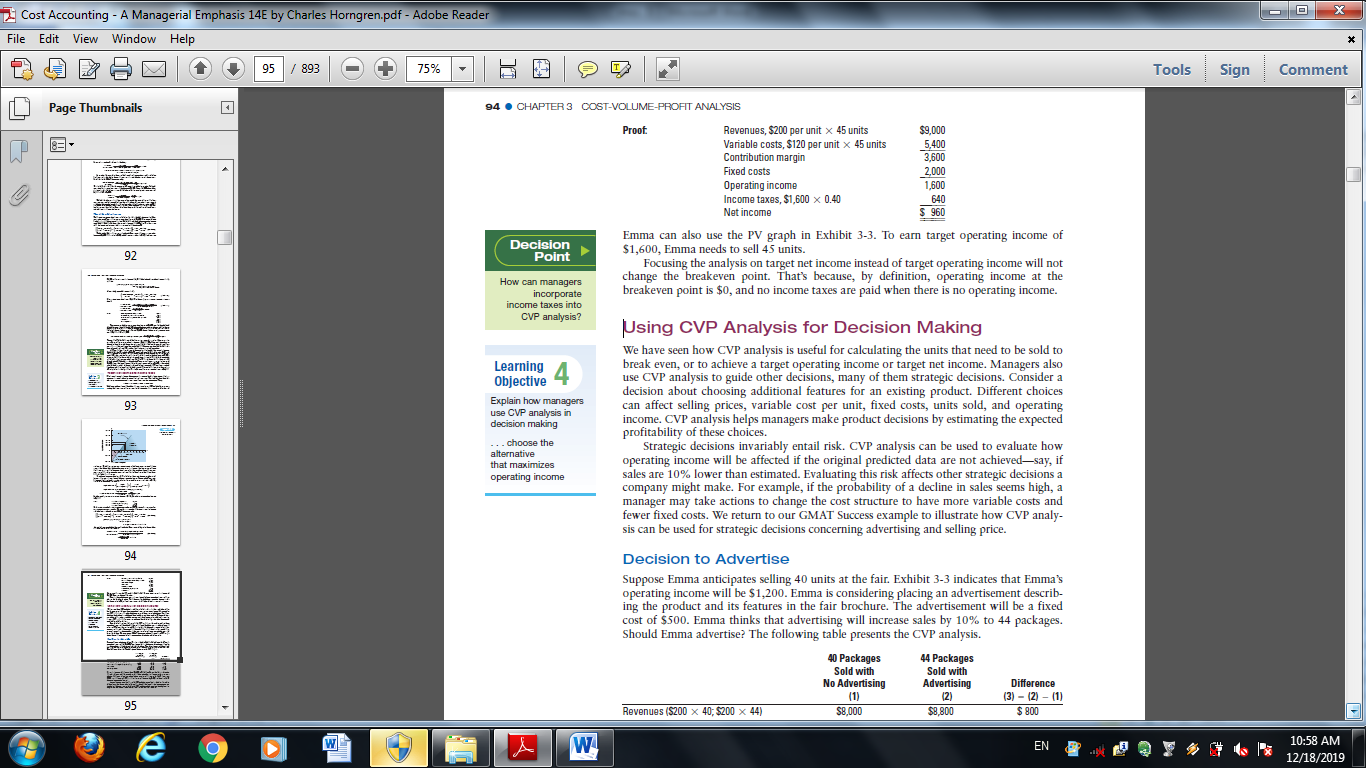
Net income is operating income plus non-operating revenues (such as interest revenue) minus non-operating costs (such as interest cost) minus income taxes. For simplicity, throughout this chapter we assume non-operating revenues and non-operating costs are zero. Thus,

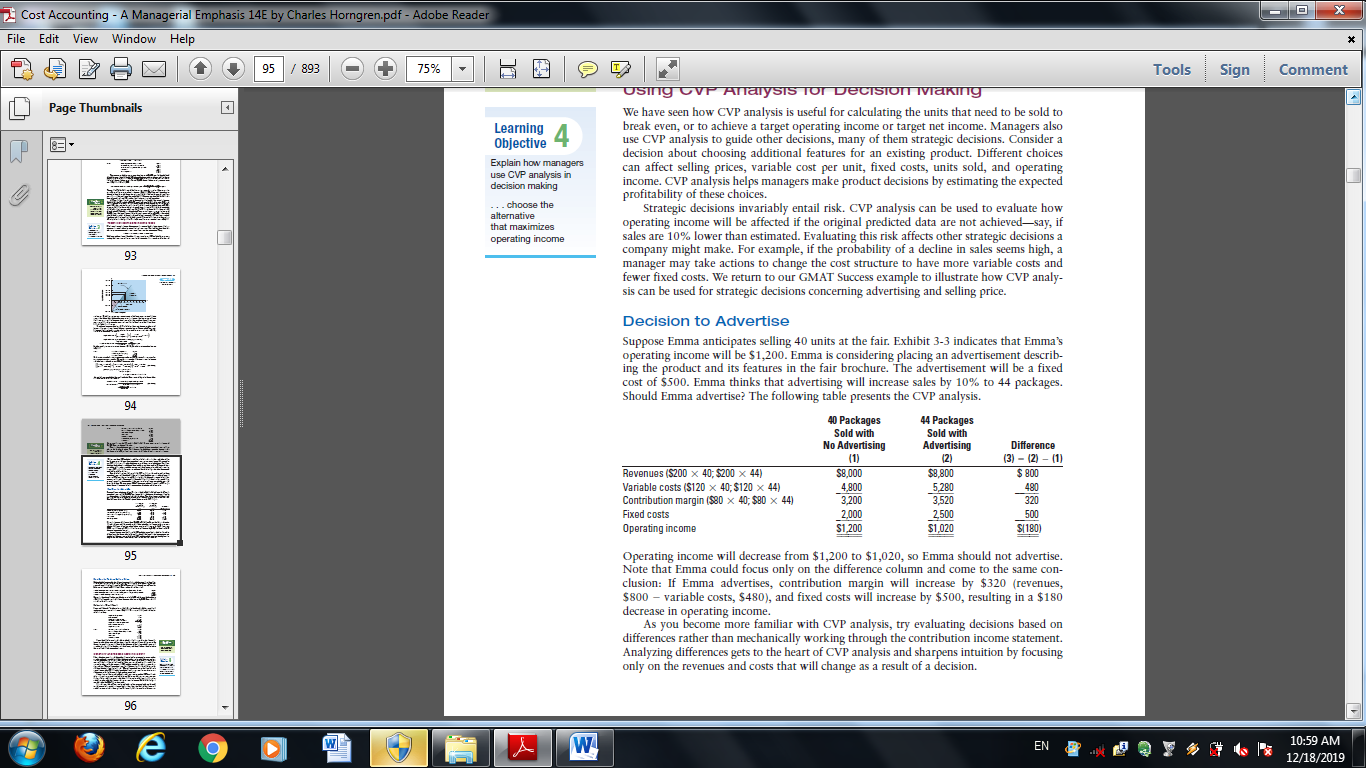
Net income = Operating income - Income taxes

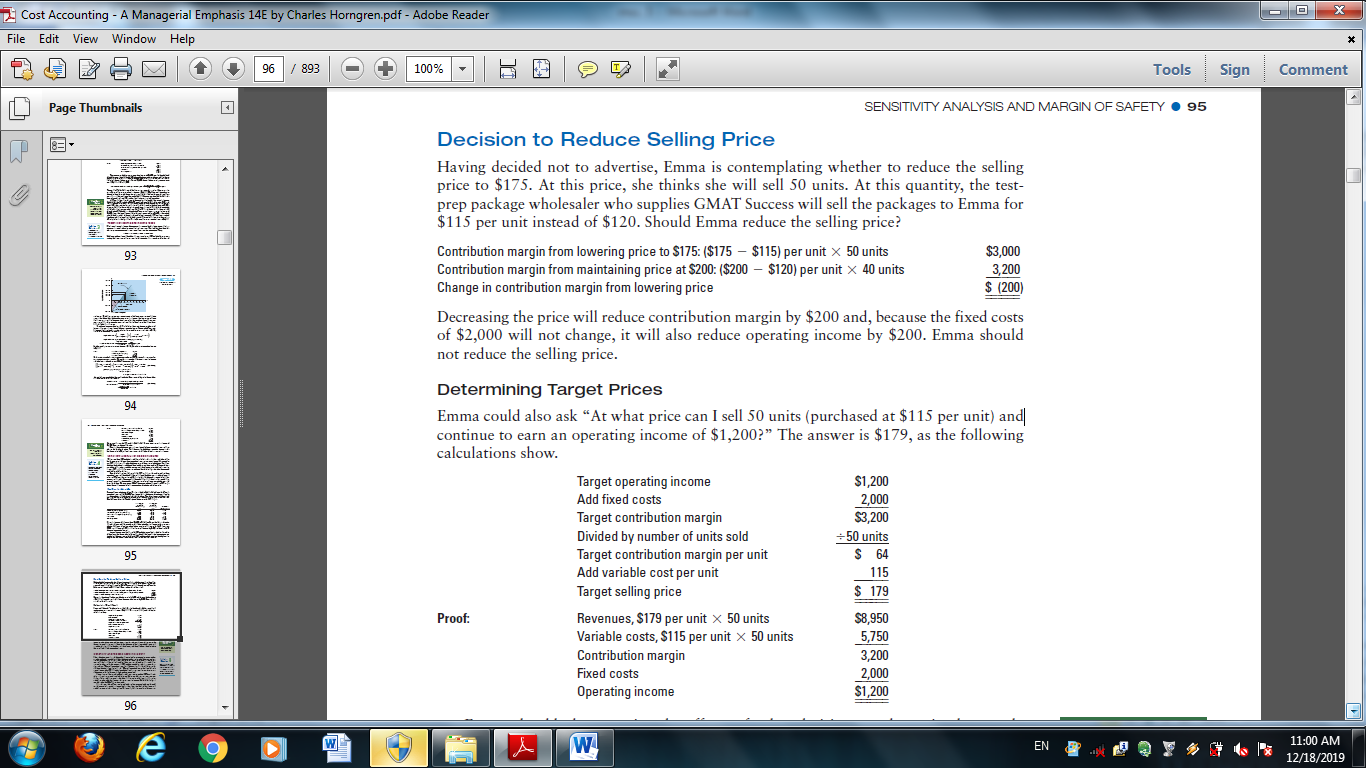
Until now, we have ignored the effect of income taxes in our CVP analysis. In many companies, the income targets for managers in their strategic plans are expressed in terms of





Q

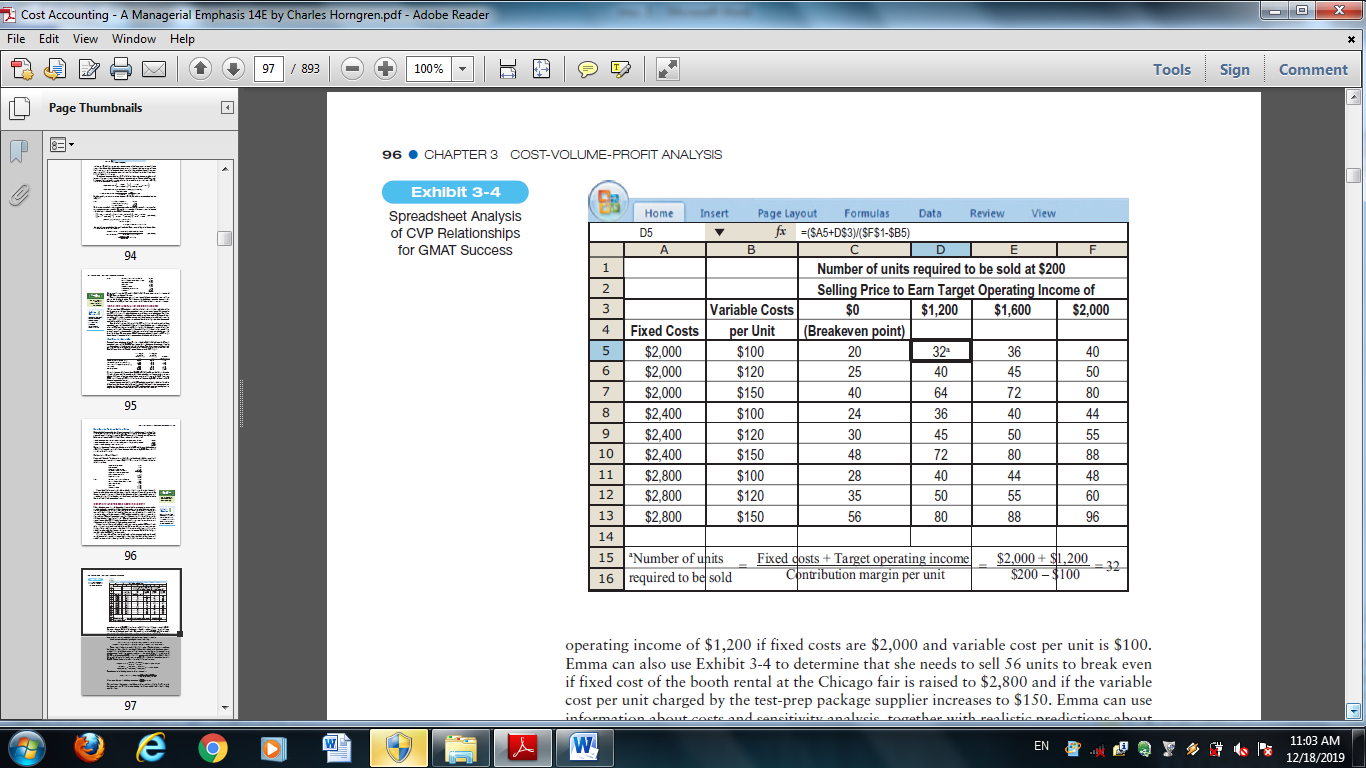




Emma should also examine the effects of other decisions, such as simultaneously increasing advertising costs and lowering prices. In each case, Emma will compare the changes in contribution margin (through the effects on selling prices, variable costs, and quantities of units sold) to the changes in fixed costs, and she will choose the alternative that provides the highest operating income.

**Sensitivity Analysis and Margin of Safety**

Before choosing strategies and plans about how to implement strategies, managers frequently analyze the sensitivity of their decisions to changes in underlying assumptions. 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. In the context of CVP analysis, sensitivity analysis answers questions such as, “What will operating income be if the quantity of units sold decreases by 5% from the original prediction?” and “What will operating income be if variable cost per unit increases by 10%?” Sensitivity analysis broadens managers’ perspectives to possible outcomes that might occur before costs are committed. Electronic spreadsheets, such as Excel, enable managers to conduct CVP-based sensitivity analyses in a systematic and efficient way. Using spreadsheets, managers can conduct sensitivity analysis to examine the effect and interaction of changes in selling price, variable cost per unit, fixed costs, and target operating income. Exhibit 3-4 displays a spreadsheet for the GMAT Success example. Using the spreadsheet, Emma can immediately see how many units she needs to sell to achieve particular operating-income levels, given alternative levels of fixed costs and variable cost per unit that she may face. For example, 32 units must be sold to earn an

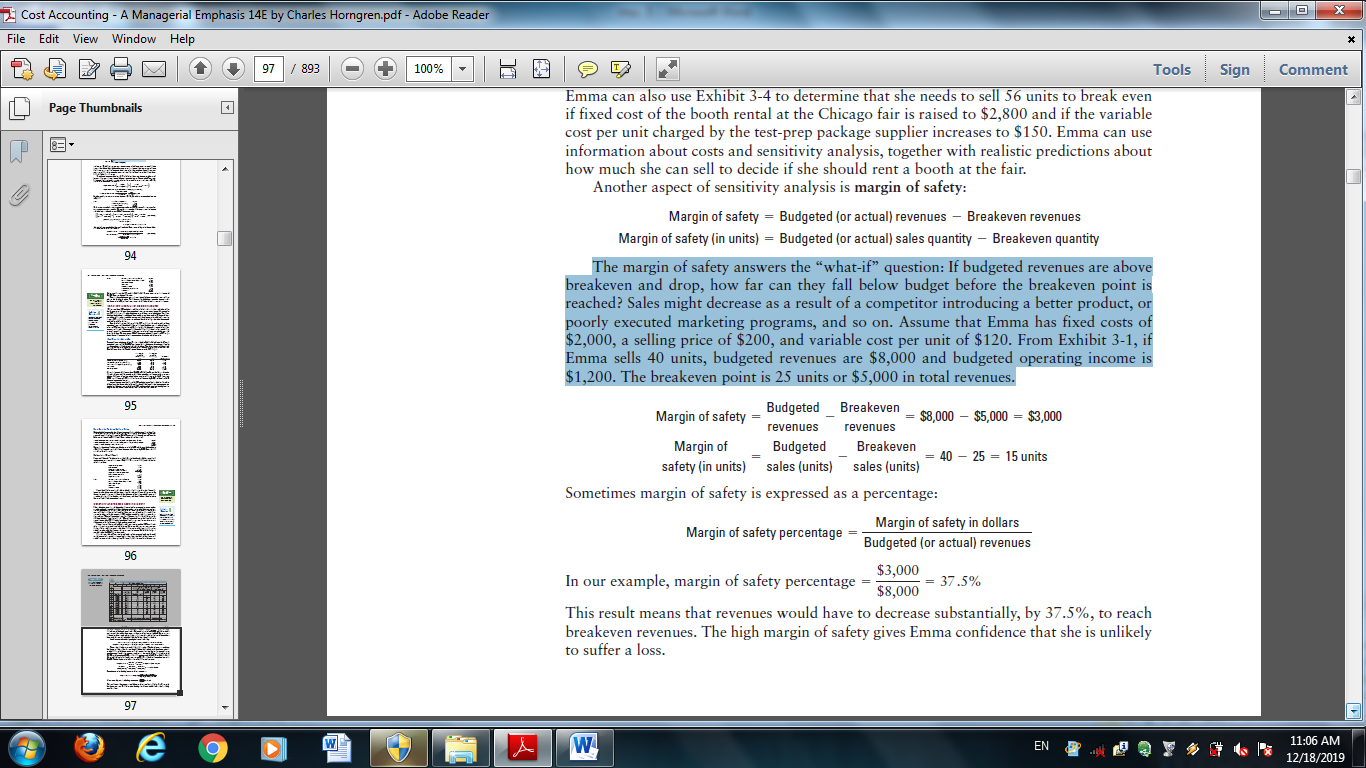


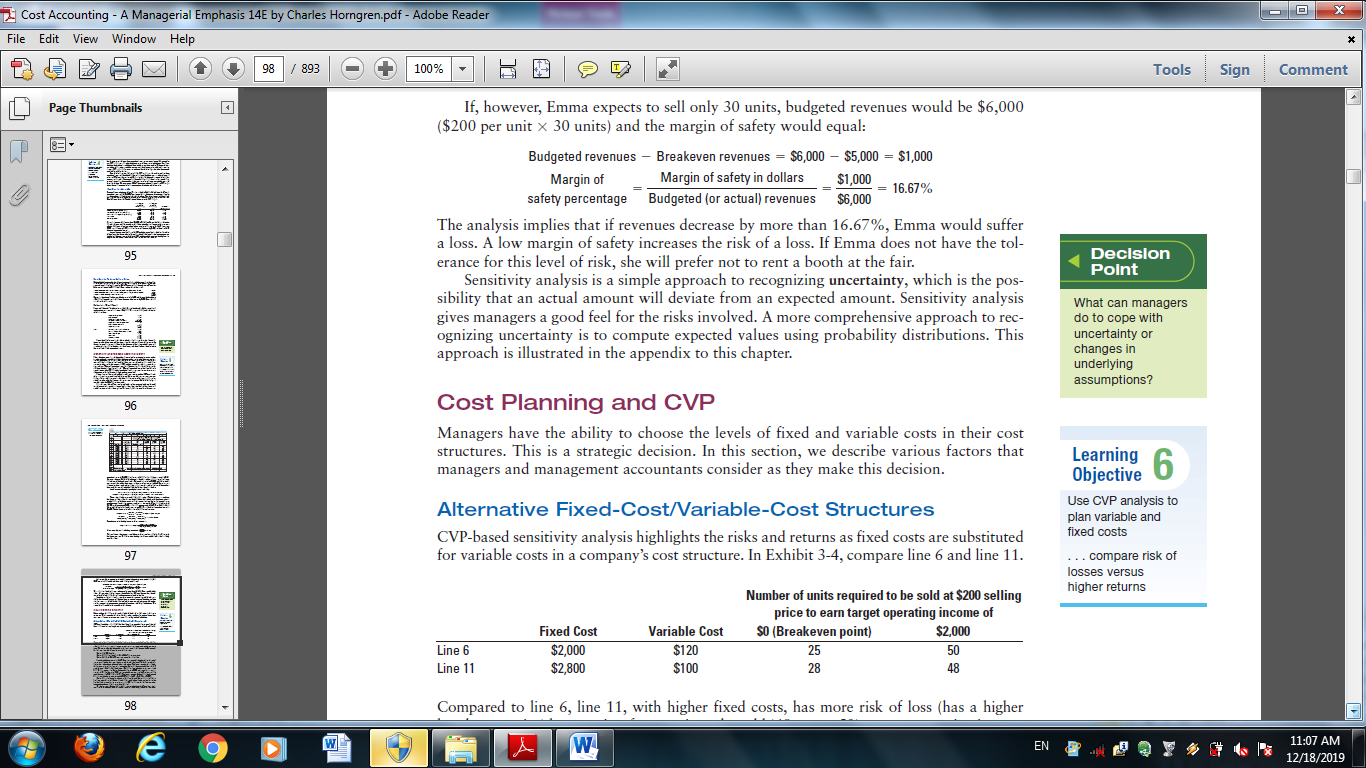
operating income of $1,200 if fixed costs are $2,000 and variable cost per unit is $100. Emma can also use Exhibit 3-4 to determine that she needs to sell 56 units to break even if fixed cost of the booth rental at the Chicago fair is raised to $2,800 and if the variable cost per unit charged by the test-prep package supplier increases to $150. Emma can use information about costs and sensitivity analysis, together with realistic predictions about how much she can sell to decide if she should rent a booth at the fair. Another aspect of sensitivity analysis is margin of safety:

Margin of safety (in units) = Budgeted (or actual) sales quantity - Breakeven quantity

Margin of safety = Budgeted (or actual) revenues - Breakeven revenues

The margin of safety answers the “what-if” question: If budgeted revenues are above breakeven and drop, how far can they fall below budget before the breakeven point is reached? Sales might decrease as a result of a competitor introducing a better product, or poorly executed marketing programs, and so on. Assume that Emma has fixed costs of $2,000, a selling price of $200, and variable cost per unit of $120. From Exhibit 3-1, if Emma sells 40 units, budgeted revenues are $8,000 and budgeted operating income is $1,200. The breakeven point is 25 units or $5,000 in total revenues.





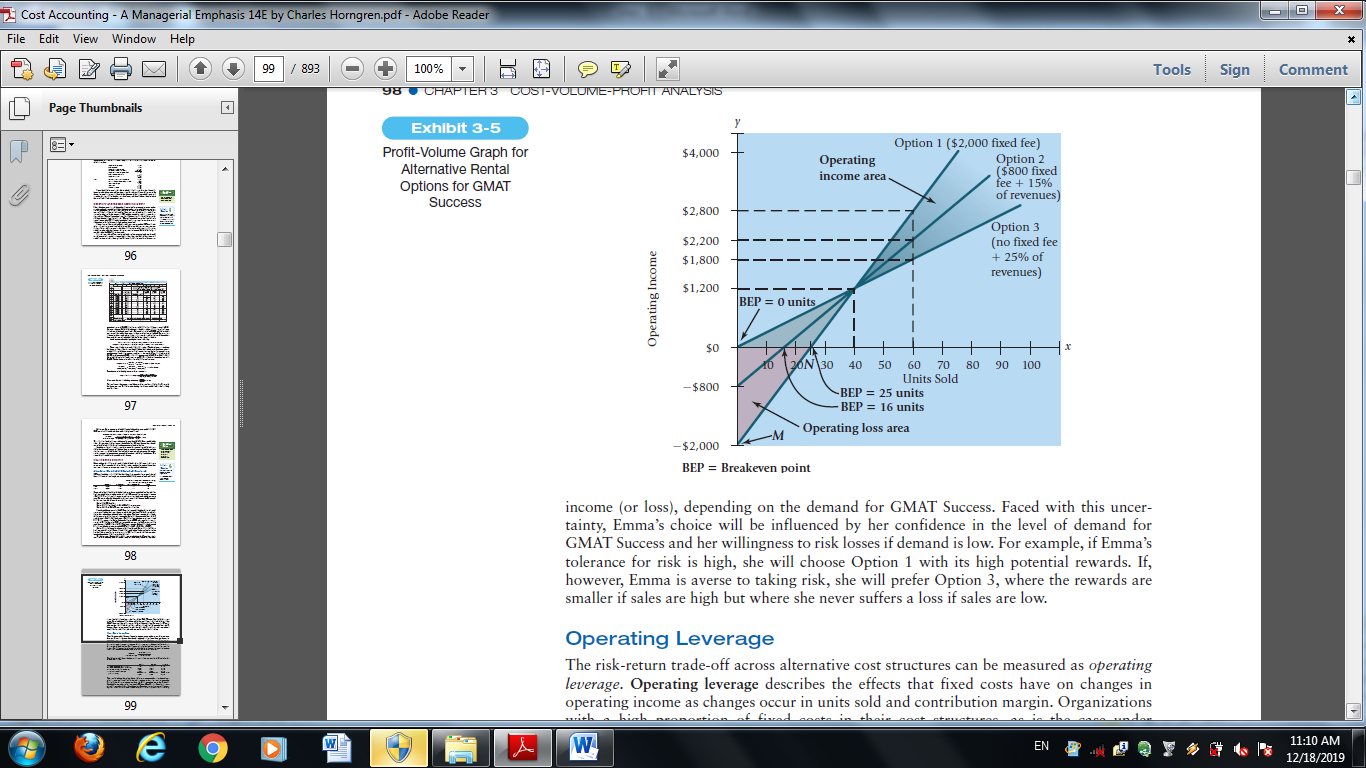
Compared to line 6, line 11, with higher fixed costs, has more risk of loss (has a higher breakeven point) but requires fewer units to be sold (48 versus 50) to earn operating income of $2,000. CVP analysis can help managers evaluate various fixed-cost/variable-cost structures. We next consider the effects of these choices in more detail. Suppose the Chicago college fair organizers offer Emma three rental alternatives:

Option 1: $2,000 fixed fee

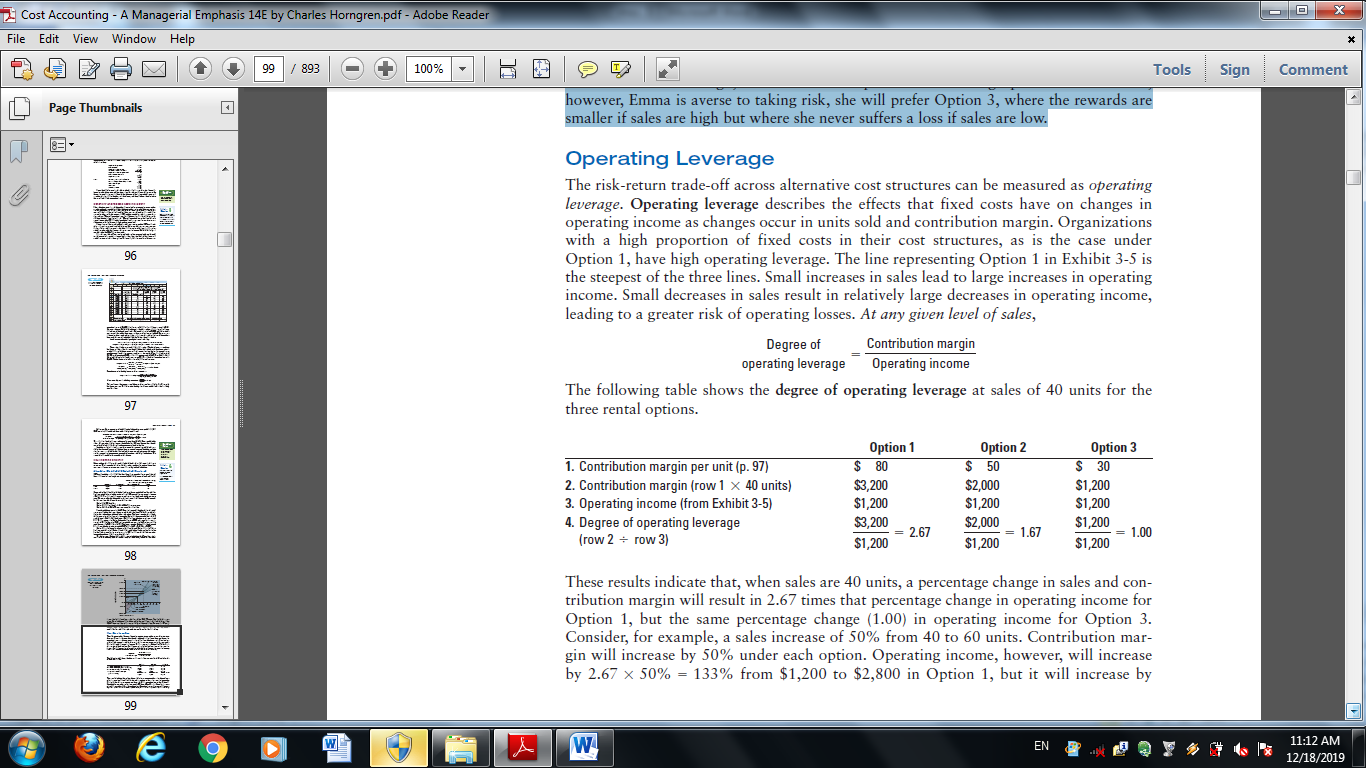
Option 2: $800 fixed fee plus 15% of GMAT Success revenues

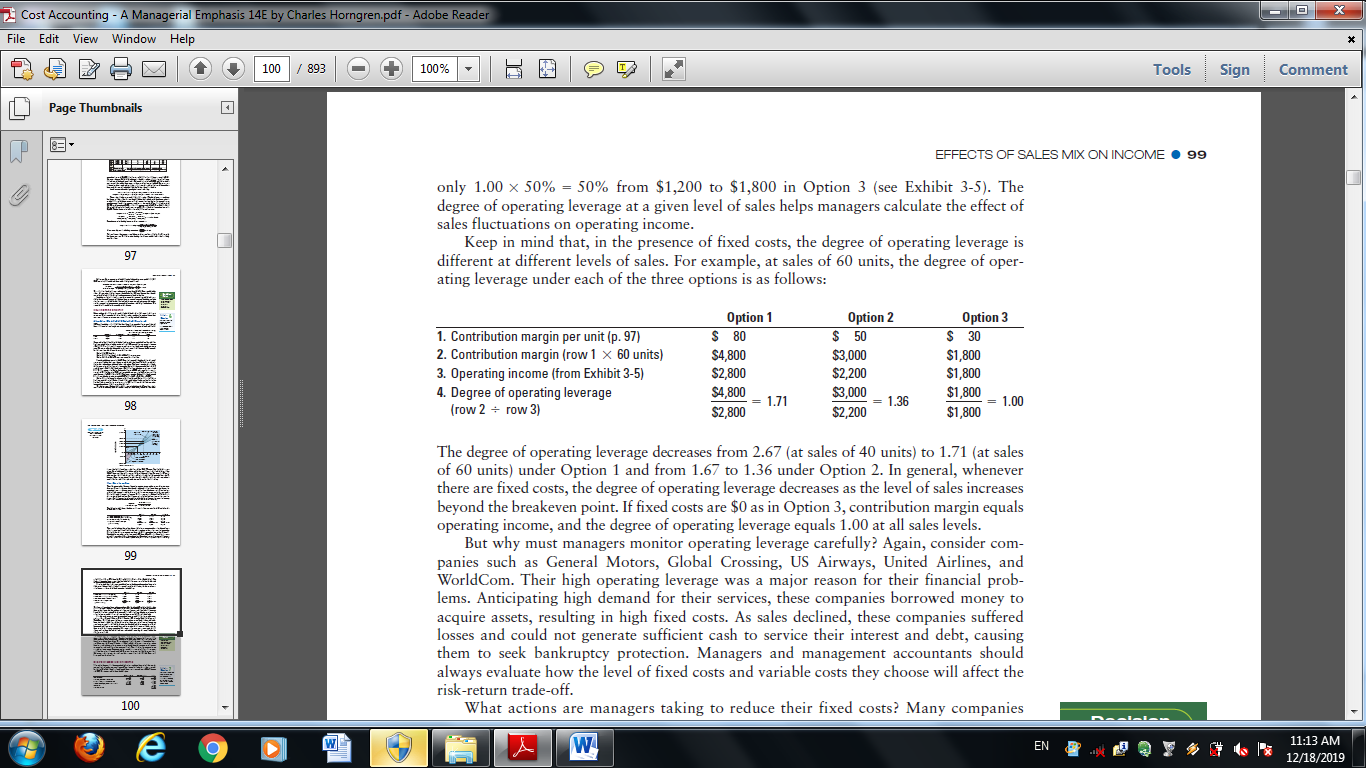
Option 3: 25% of GMAT Success revenues with no fixed fee

Emma’s variable cost per unit is $120. Emma is interested in how her choice of a rental agreement will affect the income she earns and the risks she faces. Exhibit 3-5 graphically depicts the profit-volume relationship for each option. The line representing the relationship between units sold and operating income for Option 1 is the same as the line in the PV graph shown in Exhibit 3-3 (fixed costs of $2,000 and contribution margin per unit of $80). The line representing Option 2 shows fixed costs of $800 and a contribution margin per unit of $50 [selling price, $200, minus variable cost per unit, $120, minus variable rental fees per unit, $30, (0.15\* $200)]. The line representing Option 3 has fixed costs of $0 and a contribution margin per unit of $30 [$200- $120- $50 (0.25 \* $200)]. Option 3 has the lowest breakeven point (0 units), and Option 1 has the highest breakeven point (25 units). Option 1 has the highest risk of loss if sales are low, but it also has the highest contribution margin per unit ($80) and hence the highest operating income when sales are high (greater than 40 units). The choice among Options 1, 2, and 3 is a strategic decision that Emma faces. As in most strategic decisions, what she decides now will significantly affect her operating



income (or loss), depending on the demand for GMAT Success. Faced with this uncertainty, Emma’s choice will be influenced by her confidence in the level of demand for GMAT Success and her willingness to risk losses if demand is low. For example, if Emma’s tolerance for risk is high, she will choose Option 1 with its high potential rewards. If, however, Emma is averse to taking risk, she will prefer Option 3, where the rewards are smaller if sales are high but where she never suffers a loss if sales are low.





What actions are managers taking to reduce their fixed costs? Many companies are moving their manufacturing facilities from the United States to lower-cost countries, such as Mexico and China. To substitute high fixed costs with lower variable costs, companies are purchasing products from lower-cost suppliers instead of manufacturing products themselves. These actions reduce both costs and operating leverage. More recently, General Electric and Hewlett-Packard began outsourcing service functions, such as post-sales customer service, by shifting their customer call centers to countries, such as India, where costs are lower. These decisions by companies are not without controversy. Some economists argue that outsourcing helps to keep costs, and therefore prices, low and enables U.S. companies to remain globally competitive. Others argue that outsourcing reduces job opportunities in the United States and hurts working-class families.