ACCTG 533, Section 1: Module 1: CVP Analysis: Lecture: CVP Analysis

[Slide Content]:

Cost-Volume-Profit (CVP) Analysis

[Jeanne H. Yamamura]:

Cost-Volume-Profit or CVP Analysis.

Last week, we introduced basic cost terminology and concepts. Then, in the case assignment, we began to apply those concepts in a cost management situation. Now we will move directly into quantitative cost-based analysis. Managers frequently find themselves making decisions based on such analyses, numbers that they have prepared themselves or asked someone else to prepare. In order to make the best decisions, managers need to understand how the analyses were prepared.

[Slide Content]:

The Need to Understand

- *The appearance of absolute precision*
- *Many judgments and assumptions made*
- *Not black and white!*
- *Changing them changes the answer!*

[Picture Shown]

[Jeanne H. Yamamura]:

Why? Quantitative analysis, or number-crunching, often appears very precise. After all, you can calculate an answer out to 10 or more decimal places. The ability to do so, however, doesn't mean that the number is really that accurate. Judgments and assumptions are a common part of every analysis – yet they are not necessarily highlighted and you may even forget that they are there. Which then causes you to assume that the answer is black and white. Changing the assumptions can change the answer. So you need to understand the process that goes into preparing the analysis.

[Slide Content]:

CVP Analysis

- *Based on fixed and variable costs and their relationship*
- *Enables prediction of effects of changes on profitability*
- *Commonly used to answer:*

- *Which products or services are more profitable?*
- *If we have to cut a product or service, which one do we cut?*
- *What is our breakeven point?*
- *How much do we need to sell to make X profit?*

[Jeanne H. Yamamura]:

CVP analysis is an analytical technique based on the fixed and variable cost concepts that were covered in Week 1. The relationship between fixed and variable costs is used to predict the effects of changes in sales, costs, and prices on profitability. CVP analysis is frequently used to answer these types of questions: Which products or services are more profitable? If we have to cut a product or service, which one do we cut? What is our breakeven point meaning what is the minimum amount of sales that we have to generate to cover costs? How much do we need to sell to reach a specified amount of profit (a target profit)?

So, I will start with a quick run-through of the basic formulas commonly used and then demonstrate with examples.

[Slide Content]:

Basic CVP Formulas

- *Profit = Revenue – Variable Costs – Fixed Costs*
- *Contribution Margin = Sales Price – Variable Costs*
    - *Scarce resource: CM/unit of resource*
    - *Multiple products: Weighted CM for sales mix*

[Jeanne H. Yamamura]:

The basic equation is a profit equation. Profit is simply revenue minus variable costs minus fixed costs.

This basic equation can then be rewritten or reworked in different ways in order to answer different questions.

If you want to figure out how profitable a product or service is, you start by calculating the contribution margin. The contribution margin is simply the sales price minus variable costs. You can calculate contribution margin on a per unit basis or for the entire amount of products or services sold.

An extra twist on this computation involves a scarce resource. If a scarce resource is involved, you calculate the contribution margin per unit of scarce resource, for example, CM per machine hour. We'll talk more about this when we talk about Profitability Analysis.

One more CM computation is done for multiple products. When multiple products are involved, you must first identify the sales mix, for example, 5 units of Product A sold for every 10 units of Product B. Then you can calculate a weighted CM for the sales mix.

[Slide Content]:

Basic CVP Formulas

- *At breakeven: Revenue – VC – FC = 0*
- *Breakeven in unites = Fixed Costs /CM per unit*
- *Breakeven in $$ = Fixed Costs/CM ration*
- *Revenue – VC – FC = Target Profit*
- *Target profit sales in unites = (Fixed Costs + TP)/CM per unit*

[Jeanne H. Yamamura]:

If you want to figure out break-even, you start by remembering that at breakeven, profit is zero. Revenue minus variable costs minus fixed costs equals zero. Then you can go on to use either the CM per unit or the CM ratio to calculate breakeven in units or in sales dollars. Breakeven in units is fixed costs minus contribution margin per unit where breakeven is sales dollars is fixed costs divided by the contribution margin ratio.

Finally, you can calculate the sales needed to achieve a target profit (this is really just a variation of breakeven): Now you have revenue minus variable costs minus fixed costs equal to your target profit. To compute the target profit sales in units you would take the fixed costs plus your target profit and divide by your contribution margin per unit.

[Slide Content]:

Example: Franklin Company

Franklin Company manufactures and sells a single product. The company's sales and expenses for the last year follow:

	Total	***Per unit***
Sales	*$450,000*	*$30*
Less: Variable expenses	*180,000*	*12*
Contribution margin	*270,000*	*18*
Less: Fixed expenses	*216,000*	
Operating profit	*$54,000*	

[Jeanne H. Yamamura]:

Now let's move on to some examples. Franklin Company manufactures and sells a single product. The sales and expenses for last year were $450,000 in sales, $180,000 in variable expenses giving us a contribution margin of 270,000 minus fixed expenses of $216,000 to result in an operating profit of $54,000. On a per unit basis, the selling price is $30, we have $12 of variable cost per unit giving us a CM of $18. We could, at this point, calculate our contribution margin ratio, that's the contribution margin of $18 divided by the selling price of $30 and that gives us a CM ration of 60%.

[Slide Content]:

Example: Franklin Company

1. *What is the breakeven point in units and in sales dollars?*
    - *Breakeven in units = Fixed Costs / CM per unit*
      $216,000 / $18 = 12,000 units
      *Check: (12,000 * $30)-(12,000 * $12) - $216,000 = 0*
      $360,000 - $144,000 - $216,000 = 0
    - *Breakeven in $$ = Fixed Costs / CM ratio*
      $216,000 / 60% = $360,000
      *Check: ($360,000 * 60%) - $216,000 = 0*
      $216,000 - $216,000 = 0'

[Jeanne H. Yamamura]:

Question one: What is the breakeven point in units and in sales dollars?

Breakeven in units is fixed costs divided by the contribution margin per unit. The fixed costs were $216,000; the contribution margin per unit was $18. That gives us 12,000 units. Once I've done the calculation, I always like to verify that my answer is correct and I do that by inserting my answer back into the profit formula. So, in this case, we would take the 12,000 units times the $30 selling price minus 12,000 units times $12 in variable costs per unit minus fixed costs of $216,000. That gives us $360,000 minus $144,000 minus $216,000 which is equal to zero and that verifies our breakeven answer of 12,000 units.

Breakeven in sales dollars is fixed costs divided by the contribution margin ratio. So $216,000 in fixed costs divided by 60% equals $360,000 (breakeven sales dollars). To verify, I can take the $360,000 times the 60% CM ratio minus the fixed cost of $216,000. That gives me 216 minus 216 equal to zero. I have verified my breakeven sales dollars of $360,000.

[Slide Content]:

Example: Franklin Company

2. *What is the total contribution margin at the breakeven point?*
    - *$216,000*
    - *The amount of fixed cost!*
    - *Revenue – Variable costs = Fixed costs*
      Contribution margin = Fixed costs

[Jeanne H. Yamamura]:

Number two: What is the total contribution margin at the breakeven point? The answer $216,000 is equal to the amount of fixed costs. Remember that revenue minus variable costs minus fixed costs equals zero as breakeven? So that means then that revenue minus variable costs will have to be equal to the fixed cost at the breakeven point and revenue minus variable costs is simply your contribution margin. So the total contribution margin at the breakeven point is going to be equal to the amount of fixed cost.

[Slide Content]:

Example: Franklin Company

3. *How many units would have to be sold to earn a target profit of $90,000?*
    - *Target profit sales in units = (Fixed Costs + TP)/CM per unit*

      ($216,000 + $90,000) / $18 =

      $306,000 / $18 = 17,000 units

      *Check: (17,000 * $18) - $216,000 = $90,000*

      $306,000 - $216,000 = $90,000

      $90,000 = $90,000

[Jeanne H. Yamamura]:

Number three: How many units would have to be sold to earn a target profit of $90,000? To get our target profit sales in units, we would take fixed costs plus our target profit and divide by the contribution margin per unit. $216,000 plus $90,000 gives us $306,000 which we divide by the $18 in contribution margin per unit to get 17,000 units. To verify that the 17,000 is the correct answer, now, this time I could have multiplied 17,000 times the selling price minus 17,000 times the variable cost per unit. I decided instead to take 17,000 times the

contribution margin per unit of $18 minus the $216,000 in fixed costs. That gives me $306,000 minus $216,000 or $90,000 which was the target profit that I was after.

[Slide Content]:

Example: Franklin Company

4. *What is the company's CM ratio? If sales increase by $50,000 per year and there is no change in fixed expenses, by how much would you expect annual net income to increase?*

    - *CM ratio = $18/$30 = 60%*
    - *Increase in annual operating profit = $50,000 * 60% = $30,000*

[Jeanne H. Yamamura]:

Number four: What is the company's Contribution Margin ratio? Remember we calculated that right up front as 18 divided by 30, or 60%. The question then goes on to say: If sales increase by $50,000 per year and there is no change in fixed expenses, by how much would you expect annual operating profit to increase? When you hold fixed expenses cost constant then an increase in sales will increase operating profit by the contribution margin ratio times those sales dollars or, in other words, operating profit will increase by the contribution margin of the incremental sales. So $50,000 times 60% equals $30,000. If sales increase by $50,000, the annual operating profit will increase by $30,000.

[Slide Content]:

Example: Fun in the Sun Company

Fun in the Sun Company makes two products, Maui Melody and Hawaii Hula. Present revenue, cost, and sales data on the two products follow. Fixed expenses total $475,800 per year.

	Maui Melody	***Hawaii Hula***
Selling price per unit	*$15*	*$100*
Variable expenses per unit	*9*	*20*
Number of units sold per year	*20,000*	*5,000*

[Jeanne H. Yamamura]:

Our next example is a multiple product example. We have Fun in the Sun Company with two products: Maui Melody and Hawaii Hula. The revenue, cost and sales data are provided. Fixed expenses are $475,800 per year. Maui Melody sells for $15 with variable expenses of 9 dollars

per unit and they sell 20,000 units per year. Hawaii hula sells for $100 with 20 dollars in variable expenses per unit and they sell 5,000 units of Hawaii Hula per year.

[Slide Content]:

Example: Fun in the Sun Company

1. *Compute the breakeven point in units and dollars for the two products.*

	Maui Melody	*Hawaii Hula*	*Total*
Number of units sold per year	*20,000*	*5,000*	
Sales mix	*4*	*1*	*5*
SP per unit	*$15*	*$100*	
VC per unit	*$9*	*$20*	
CM per unit	*$6*	*$80*	
Sales $ for sales mix	*$60*	*$100*	*$160*
CM $ for sales mix	*$24*	*$80*	*$104*
Weighted CM ratio for sales mix			*65%*

[Jeanne H. Yamamura]:

To compute the breakeven point in units and dollars, we need to come up with a weighted contribution margin (well, we actually don't need to come up with a weighted CM for units, but we do need to come up with a weighted CM for dollars). So, to start off, we have 20,000 units of Maui Melody and Hawaii Hula 5,000 units. Our sales mix, therefore, is we are selling four units of Maui Melody for every one unit of Hawaii Hula. That means that a set in our sales mix consists of five units: four Maui Melody and one Hawaii Hula. In a sales mix set, we will have $60 for Maui Melody in revenue and $100 for Hawaii Hula. The $60 came from the $15 price per unit times the four units sold, or $60, and Hawaii Hula was just one unit so that was the $100. If we combine the $60 for Maui Melody and the $100 for Hawaii Hula, we have $160 in sales revenue for a sales mix set. The contribution margin for the sales mix set is $24 for Maui Melody (that's 4 units times $6 CM per unit), $80 for Hawaii Hula, or a total of $104 in

Contribution for the sales mix set. The weighted Contribution Margin ratio is $104 divided by $160, or 65%.

[Slide content]:

Example: Fun in the Sun Company

Calculation of BE in units

- *Breakeven (sales mix set) = Fixed Costs / Total CM set*

  $475,800 / $104 = 4,575 sets

  *4,575 * 5 = 22,875 units*

  18,300 Maui Melody + 4,575 Hawaii Hula units

- *Check: (18,300 * $6) + (4,575 * $80) - $475,800 =*

  $109,800 + $366,000 - $475,800 = 0

[Jeanne H. Yamamura]:

To calculate breakeven in units, we take fixed costs divided by the total contribution margin per set. So the fixed costs, remember, were $475,800, the total CM per set was $104. That gives us 4,575 sets. Those sets consist of five units each so that means we're going to sell a total of 22,875 units. Of the 22,875, 18,300 will be Maui Melody and 4,575 will by Hawaii Hula. You could calculate that by taking the 22,875, dividing by 5, and then multiplying by 4 to give you the 18,300 Maui Melody. 22,875 divided by 5, times one gave you the 4,575 Hawaii Hula. Then again as always, the verification that our number is correct: 18,300 Maui Melody times $6 in CM per unit plus 4,575 times $80 CM per unit minus fixed costs of 475,800 and all of that adds up to zero. So we verified our breakeven.

[Slide Content]:

Example: Fun in the Sun Company

Calculation of BE in sales dollars

- *Breakeven (sales mix set) = Fixed Costs / CM ratio*

  $475,800 / 65% = $732,000

  *$732,000 * $60/$160 = $274,500 Maui Melody*

*$732,000 * 100/$160 = $457,500 Hawaii Hula*

- *Check: ($274,500 *40%) + ($457,500 * 80%) - $475,800 = $109,800 + $366,000 - $475,800 = 0*

[Jeanne H. Yamamura]:

To calculate breakeven in sales dollars, you'll use the weighted contribution margin ratio. You'll take fixed costs divided by the ratio, so $475,800 divided by 65% gives us 732,000 sales dollars. $732,000 times $60 over $160 gives us $274,500 in Maui Melody sales. $732,000 times $100 over $160 gives us $457,500 in Hawaii Hula sales dollars. To verify our breakeven, we take the $274,500 times the 40% CM for Maui Melody, the $457,500 time the 80% CM for Hawaii Hula, minus the fixed costs and that will again add up to zero verifying our breakeven.