

Lesson 6 – Breakeven & Sensitivity Analysis

Bell Ringer: Name 4 fixed costs in a vegetable enterprise, then identify 3 variable costs through the same business.

The 2nd Breakeven and Sensitivity Analysis Homework Exercise requires the use of a computer that can run an Excel spreadsheet. This can be done as an added learning exercise if you do not have access to a computer for everyone in the class that will open and utilize Excel.

A. Section 1 - Review main concepts from Lesson 5 (Enterprise budgets)

1. What is an enterprise budget?
2. What are the 3 main sections of an enterprise budget?
3. Why does a manager need to know the Return Above Operating Costs and the Return Above Total Costs?

B. Section 2 - Breakeven Analysis

1. Breakeven analysis tells a manager the “worst case situation” where they are just able to cover their costs. The most common types of breakeven analysis are:

a. Breakeven Quantity Sold

This is the lowest quantity you can sell, at a constant price, and still cover your costs. Again, we assume that all input use and prices remain constant. You should compare your breakeven quantity to the actual amount of production you expect. For example, if the breakeven number of mowing jobs is 5 lawns/week and you think you can reasonably mow 15 lawns/week, you are doing well!

b. Breakeven Selling Price

This is the lowest price per unit that a manager can get for his/her product and still cover the costs of the enterprise. We assume that everything else (all input use and prices, and quantity sold) remain constant. At this price, the total revenues for the enterprise are equal to the expenses (either operating or total). The breakeven selling price helps the manager determine the selling price for his/her products.

- c. From a personal aspect, you can use breakeven analysis to help make decisions. Assume you have living expenses of \$500/month. You can get a part-time job that pays \$10/hr after all taxes are deducted (that is, your “take home pay” is \$10/hr). How many hours do you need to work per month just to cover your living expenses (“to break even”)? (have students calculate this)

$$\text{\$500/month} / \text{\$10/hr} = \text{50 hrs/month}$$

Your “breakeven hours of work (breakeven quantity)” is 50 hours per month. If you work exactly 50 hours/month at \$10/hr you will earn exactly \$500 – just enough to cover your living expenses.

You can also calculate the minimum “take home pay” rate that you must get if you can only work 40 hours/month: (have students calculate this)

$$\text{\$500/month} / \text{40 hrs/month} = \text{\$12.50/hour}$$

You must be able to earn at least \$12.50/hour (take home) to cover your living expenses, assuming you can only work 40 hours/month

2. What is the minimum quantity sold (yield) you need to cover your costs?

- a. This is called the “breakeven yield” or “breakeven quantity” - a very important number for every manager to understand. When we calculate this, we assume that the only item that changes on the enterprise budget is the quantity sold – we hold everything else constant.
- b. It is useful to look at this from 2 different time frames – short run (over the next few years) and long run (over the next several years – 5 years or longer).
- c. Short-run breakeven yield only focuses on the total operating costs (TOC) of the enterprise. To calculate the short-run breakeven yield:

$$\text{Short-Run Breakeven Yield} = \text{Total Operating Costs} / \text{Selling Price per-unit}$$

For the lawn mowing business:

$$\text{SR BE Yield} = \$19,814.63 \text{ per year} / \$100/\text{lawn} = 198 \text{ lawns/year (rounded)}$$

This means the manager must be able to mow at least 198 lawns per year at an average price of \$100/lawn to cover the total operating costs of production. If you can mow more than 198 lawns/year you will earn short-run profits – that is, your RAOC will be greater than \$0; you will have some earnings to pay your fixed costs as well as yourself for your management & labor. If you do not think you can mow at least 198 lawns in one year, you will not be able to cover your total variable costs; therefore, you shouldn’t plan to operate the lawn mowing business this year.

For the lawn mowing business, the manager is expecting to mow 750 lawns in one year. This is much higher than the 198 lawns that he/she needs to mow to cover the operating costs of the enterprise. You always want to see your planned (or actual) quantity sold **greater** than your breakeven quantity sold.

- Note: This method assumes that all of the variable costs will remain constant, regardless of the actual amount produced and sold. In the real world, some of the operating costs may actually decrease due to the lower yield – but to be conservative in our estimates, we assume that these costs remain at the planned levels.

- d. Long run breakeven yield focuses on total costs (operating costs and overhead costs), because we need to be able to cover all of these costs year after year to stay in business.

$$\text{Long Run Breakeven Yield} = \text{Total Costs} / \text{Selling Price per-unit}$$

For the lawn business:

$$\text{LR BE Yield} = \$61,314.63 \text{ per acre} / \$100 \text{ per lawn} = 613 \text{ lawns/year (rounded)}$$

This means the manager must be able to mow at least 613 lawns/year to cover all of the costs of the lawn mowing enterprise. If he/she can mow more than 613 lawns/year the enterprise will be earning long run profits, and the enterprise will be able to stay in business for the long run. If you are not able to mow at least 613 lawns/year, you will have to make changes to the enterprise to try to improve the profitability. Without changes, you will not earn enough profits to replace your equipment over time, thus making your enterprise even less profitable.

3. What is the minimum selling price/unit that I need to get to cover my costs?

- a. This is referred to as the breakeven selling price. Again, a very important number for the manager to understand.
- b. This number is crucial to managing the risk of your enterprise. If you know the minimum price you need to get, now you have important information on how to price your products, or what prices to accept if you are signing contracts for your products.
- c. Again, we look at short run and long run breakeven prices
- d. Short-run breakeven price only focuses on the total operating costs (TOC) of the enterprise. To calculate the short-run breakeven price:

Short-Run Breakeven Price = Total Operating Costs / Amount Sold (or Yield)

For the lawn mowing business:

$$\text{SR BE Price} = \$19,814.63 \text{ per year} / 750 \text{ lawns/year} = \$26.40/\text{lawn (rounded)}$$

This means the manager must be able to charge an average price of \$26.40/lawn, assuming he/she can mow 750 lawns per year, to cover the total operating costs of production. If you can charge a price that is higher than \$26.40/lawn you will earn short run profits – that is, your RAOC will be greater than \$0; you will have some earnings to pay your fixed costs as well as yourself for your management & labor. If you do not think you can sell your tomatoes for at least \$26.40/lawn, you will not be able to cover your total variable costs; therefore, you shouldn't plan to produce tomatoes this year.

Another term for the short-run breakeven price is the short-run “cost of production” for the enterprise. This tells the manager what it typically costs to produce 1 unit of the product or service. For the lawn mowing enterprise, it says that it typically costs around \$26.42 to mow 1 lawn. So, as long as the manager can charge more than \$26.42/lawn the enterprise will more than cover its operating expenses.

- e. Long-run breakeven price focuses on total costs (operating costs and overhead costs), because we need to be able to cover all of these costs year after year to stay in business.

Long-Run Breakeven Price = Total Costs / Amount sold or Yield

For Lawns:

$$\text{LR BE Yield} = \$61,314.63 \text{ per year} / 750 \text{ lawns} = \$81.75/\text{lawn (rounded)}$$

This means the manager must be able to charge at least \$81.75/lawn to cover all of the costs of the mowing enterprise. If he/she charges more than \$81.75/lawn the enterprise will be earning long run profits, and the enterprise will be able to stay in business for the long run. If you are not able to charge at least \$81.75/lawn, you will have to make changes to the enterprise to try to improve the profitability. Without changes, you will not earn enough profits to replace your equipment over time, thus making your enterprise even less profitable.

C. Section 3 - Sensitivity Analysis

1. Sensitivity analysis is just a fancy term for seeing how a business is affected by a change in one or more key areas. For example, we can look at how the Return Above Operating Costs (RAOC) changes if the selling price of the product increases or decreases by 10%. We can do this sensitivity analysis by hand, but it is very easy to do on spreadsheet.
 - a. Let's see what happens to Return Above Operating Costs if your Price/Unit drops by 10%. That means you are now charging only \$90/lawn ($\$100 - (\$100 \times 10\%)$)
 - Put your cursor in cell F5 – this is the cell where the price/lawn is entered. It currently says “\$100”
 - Type “90” into this cell
 - You do not need to type the “\$”
 - You do not need to delete the “\$100”, simply type “90” and press Enter
 - What happened to your budget?
 - Total Revenues dropped from \$75,000 to \$67,500
 - Return Above Operating Costs dropped from \$55,185.37 to \$47,685.37
 - Thus, a 10% decrease in price/lawn leads to a \$7,500 decrease in RAOC
 - Minimum Yield Necessary to Cover Total Costs increased from 613 to 681 lawns per year
 - So, you will have to mow 68 more lawns just to cover your total costs.
 - A 10% decrease in price has a big impact on profitability!

It's just as easy to look at a change in quantity sold or input prices. Just change the one of the numbers with blue font and look at the results.

Tip – only change one item at a time to see how that will impact the profits of the enterprise. If you want to look at a change in another item, reset the first item to its original number, then change the new item.

Materials:

- Lawn Care Example**
- PowerPoint on Breakeven Analysis and Sensitivity Analysis**
- Note Organizer**
- In-class Exercise and Key**
- Homework Exercise and Key**
- Student Driven Activity**
- Take Home Reading**

Lawn Mowing Business Mowing Enterprise

Revenues	Quantity	Units	Price/Unit	Total
Mowing	750	lawns/year	\$100.00 /lawn	\$75,000.00
Other				\$0.00
Total Revenues				\$75,000.00 /year

Operating (Variable) Costs:

Fuel	0.60	gal/lawn	\$2.75 /gal	\$1,237.50
Oil	0.53	qts/year	\$3.00 /qt	\$1,200.00
Repairs	750	lawns/year	\$5.00 /lawn	\$3,750.00
Hired Labor	0.8	hours/lawn	\$18.00 /hour	\$10,800.00
Removal of grass - hauling	750	lawns/year	\$3.00 /lawn	\$2,250.00
Interest on Operating Capital	6%	6 months	\$19,237.50 /year	\$577.13
Total Operating Costs				\$19,814.63 /year
Return Above Operating Costs				\$55,185.37 /year
Minimum Yield Necessary to Cover Operating Costs				198.1 lawns/year
Minimum Price Necessary to Cover Operating Costs				\$26.42 /lawn

Overhead Costs

Depreciation - equipment	1	year	\$1,000 /year	\$1,000.00
Interest on equipment loans	1	year	\$800 /year	\$800.00
Office expenses	1	year	\$5,000 /year	\$5,000.00
Advertising	1	year	\$1,500 /year	\$1,500.00
Insurance premiums	1	year	\$1,200 /year	\$1,200.00
Office rent	1	year	\$7,000 /year	\$7,000.00
Owner Labor	1	owner	\$25,000 /year	\$25,000.00
Total Overhead Costs				\$41,500.00 /year
Total Costs				\$61,314.63 /year
Return Above Total Costs				\$13,685.37 /year
Minimum Yield Necessary to Cover Total Costs				613.1 lawns/year
Minimum Price Necessary to Cover Total Costs				\$81.75 /lawn

BREAKEVEN ANALYSIS & SENSITIVITY ANALYSIS



Breakeven Analysis

- Estimates the minimum performance a manager needs to cover the costs of an enterprise
- Main types:
 - Breakeven Quantity Sold
 - Breakeven Selling Price/Unit



Personal Breakevens

- You have living expenses of \$500/month
 - Your job pays \$10/hour (take-home)
 - You only have 40 hours/month that you can work
- What is the minimum number of hours you need to work to cover your living expenses ("breakeven quantity")?
 - $\$500/\text{month} / \$10/\text{hr} = 50 \text{ hours/month}$
 - But you can only work 40 hours/month - uh oh!



Personal Breakevens

- You have living expenses of \$500/month
 - Your job pays \$10/hour (take-home)
 - You only have 40 hours/month that you can work
- What is the minimum take-home wage that you must earn to cover your living expenses ("breakeven price")?
 - $\$500/\text{month} / 40 \text{ hrs/month} = \$12.50/\text{hour}$
 - You need a higher paying job to meet your needs!



Using Breakevens

- Compare your breakeven estimates to your planned sales quantity or price
 - If your breakeven is **less** than your planned - Good!
 - You are covering your expenses with money left over
 - If your breakeven is **higher** than your planned - Bad!
 - You need to make changes to improve your profits
 - Personal example:
 - You planned on \$10/hr but you NEED to earn \$12.50/hr
 - You planned on 40 hrs/month, but you need to work 50 hrs/month



Short Run vs Long Run

- Short Run
 - Refers to the next year or so
 - Only consider the **operating** expenses!
- Long Run
 - Refers to a long term decision (> 5 yrs)
 - Consider **total** expenses



Short Run Breakeven Quantity

- aka "SR Breakeven Yield"
- Use your enterprise budget
 - Assume the only thing that changes is quantity sold
 - Everything else stays the same
- SR BE Quantity
 - $\text{Total Operating Expenses} / \text{Selling Price/Unit}$
 - You need to sell this amount to cover your operating expenses



Lawn Care Example

- Short Run Breakeven Quantity
 - $\text{Total Operating Expenses} / \text{Selling Price/Lawn}$
 - $\$19,814/\text{year} / \$100/\text{lawn} = 198 \text{ lawns/year}$
 - You need to mow at least 198 lawns/year to cover your operating expenses
 - You plan to mow 750 lawns/year - good sign!
 - Assumes the total operating expenses will be \$19,814/yr
 - Assumes you've purchased most of the operating inputs already



Long Run Breakeven Quantity

- aka "LR Breakeven Yield"
- Use your enterprise budget
 - Assume the only thing that changes is quantity sold
 - Everything else stays the same
- LR BE Quantity
 - $\text{Total Expenses} / \text{Selling Price/Unit}$
 - You need to sell this amount to cover your total expenses



Lawn Care Example

- Long Run Breakeven Quantity
 - $\text{Total Expenses} / \text{Selling Price/Lawn}$
 - $\$61,315/\text{year} / \$100/\text{lawn} = 613 \text{ lawns/year}$
 - You need to mow at least 613 lawns/year to cover your total expenses
 - You plan to mow 750 lawns/year - good sign!



Short Run Breakeven Price

- aka "Breakeven Selling Price"
- Use your enterprise budget
 - Assume the only thing that changes is selling price
 - Everything else stays the same
- SR BE Price
 - $\text{Total Operating Expenses} / \text{Quantity Sold}$
 - You need to charge this price to cover your operating expenses
 - Assumes the quantity sold stays the same



Lawn Care Example

- Short Run Breakeven Price
 - $\text{Total Operating Expenses} / \text{Lawns/year}$
 - $\$19,814/\text{year} / 750 \text{ lawns} = \$26.40/\text{lawn}$
 - You need to charge at least \$26.40/lawn to cover your operating expenses
 - You plan to charge \$100/lawn - good sign!



Long Run Breakeven Price

- aka "LR Breakeven Selling Price"
- Use your enterprise budget
 - Assume the only thing that changes is selling price
 - Everything else stays the same
- LR BE Price
 - $\text{Total Expenses} / \text{Quantity Sold}$
 - You need to charge this price to cover your total expenses
 - Assumes the quantity sold stays the same



Lawn Care Example

- Long Run Breakeven Price
 - $\text{Total Expenses} / \text{Lawns/year}$
 - $\$61,315/\text{year} / 750 \text{ lawns} = \$81.75/\text{lawn}$
 - You need to charge at least \$81.75/lawn to cover your total expenses
 - You plan to charge \$100/lawn- good sign!



Know Your Breakevens!

- Every manager needs to have a good idea about the breakeven price and quantity
 - Helps make better decisions
 - Helps identify problems before it's too late
 - Helps get a loan from a lender



Sensitivity Analysis

- Looking at changes in profits due to changes in key areas of an enterprise
 - Selling price
 - Quantity sold
 - Input prices
- Look at changes of 10-25%
 - Individually, not everything at once!



Lawn Care Example

- Look at a 10% decrease in selling price
 - Currently charging \$100/lawn
- 10% decrease
 - $\$100 - (\$100 \times 10\%) = \$90/\text{lawn}$
 - Or $\$100 \times (100\% - 10\%) = \$90/\text{lawn}$
- At 750 lawns/year
 - Revenue = $\$90/\text{lawn} \times 750 \text{ lawns} = \$67,500$
 - A decrease of \$7,500 per year!



Lawn Care Example

- Impact on gross margin (RAOC)
 - Decreases from \$55,185 to \$47,685
 - Decrease of \$7,500
 - Simply due to charging a lower price/lawn
- But!
 - Will you gain more customers by charging a lower price?



Using the Spreadsheet

- Look at the Lawn Mowing Business enterprise budget
- Change the selling price from \$100 to \$90
 - Move your cursor to cell *F5*
 - Type in 90
- The spreadsheet automatically does the calculations
 - Revenue drops to \$67,500
 - Return Above Operating Costs drops to \$47,685



Other Sensitivity Analysis

- Reset the price to \$100/lawn
- Let's look at a 10% increase in the number of lawns mowed
 - You get 10% more customers than you planned!
- Move the cursor to cell *D5*
 - Enter 900 for the number of lawns mowed
 - Look at the impact on revenues and RAOC



Breakeven Analysis & Sensitivity Analysis- Notes Organizer

Breakeven Analysis

- Estimates the minimum performance a manager needs to cover the costs of an enterprise
- Main types:
 - _____
 - Breakeven Selling Price/Unit
- Personal Breakevens
 - You have living expenses of \$500/month
 - Your job pays \$10/hour (take-home)
 - You only have _____ that you can work
 - What is the minimum number of hours you need to work to cover your living expenses (“breakeven quantity”)?
 - $\$500/\text{month} / \$10/\text{hr} = \underline{\hspace{2cm}}$
 - But you can only work 40 hours/month – uh oh!
 - You have living expenses of \$500/month
 - Your job pays \$10/hour (_____)
 - You only have 40 hours/month that you can work
 - What is the minimum take-home wage that you must earn to cover your living expenses (“breakeven price”)?
 - $\$500/\text{month} / 40 \text{ hrs/month} = \underline{\hspace{2cm}}$
 - You need a higher paying job to meet your needs!
- Using Breakevens
 - Compare your breakeven estimates to your planned sales quantity or price
 - If your breakeven is **less** than your planned – Good!
 - _____
 - If your breakeven is higher than your planned – Bad!
 - _____
 - Personal example:
 - You planned on \$10/hr but you NEED to earn \$12.50/hr
 - You planned on 40 hrs/month, but you need to work 50 hrs/month

- Short Run vs Long Run
 - _____
 - Refers to the next year or so
 - Only consider the _____ expenses!
 - Long Run
 - Refers to a long term decision (> 5 yrs)
 - Consider _____ expenses

- Short Run Breakeven Quantity
 - aka “_____”
 - Use your enterprise budget
 - Assume the only thing that changes is quantity sold
 - _____
 - Total Operating Expenses / Selling Price/Unit
 - You need to sell this amount to cover your _____

- Lawn Care Example
 - Short Run Breakeven Quantity
 - Total Operating Expenses / Selling Price/Lawn
 - \$19,814/year / \$100/lawn = 198 lawns/year
 - You need to mow at least 198 lawns/year to cover your operating expenses
 - You plan to mow 750 lawns/year – good sign!
 - Assumes the total operating expenses will be \$19,814/yr
 - Assumes you’ve purchased most of the operating inputs already

- Long Run Breakeven Quantity
 - aka “LR Breakeven Yield”
 - _____
 - Assume the only thing that changes is quantity sold
 - _____
 - Total Expenses / Selling Price/Unit
 - You need to sell this amount to cover your total expenses

- Lawn Care Example
 - Long Run Breakeven Quantity
 - _____ / Selling Price/ _____
 - \$61,315/year / \$100/lawn = 613 lawns/year

- You need to mow at least 613 lawns/year to cover your total expenses
 - You plan to mow 750 lawns/year – good sign!
- Short Run Breakeven Price
 - aka “_____”
 - Use your enterprise budget
 - Assume the only thing that changes is selling price
 - Everything else stays the same
 - Total Operating Expenses / _____
 - You need to charge this price to cover your operating expenses
 - Assumes the quantity sold stays the same
- Lawn Care Example
 - Short Run Breakeven Price
 - Total Operating Expenses / _____/year
 - \$19,814/year / 750 lawns = \$26.40/lawn
 - You need to charge at least \$26.40/lawn to cover your operating expenses
 - You plan to charge _____ – good sign!
- Long Run Breakeven Price
 - aka “LR Breakeven Selling Price”
 - _____
 - Assume the only thing that changes is selling price
 - Everything else stays the same
 - Total Expenses / _____
 - You need to charge this price to cover your total expenses
 - Assumes the quantity sold stays the same
- Lawn Care Example
 - Long Run Breakeven Price
 - Total Expenses / Lawns/year
 - \$61,315/year / 750 lawns = \$81.75/lawn
 - You need to charge at least \$81.75/lawn to cover your total expenses
 - You plan to charge \$100/lawn – good sign!
- Know Your Breakevens!
 - Every manager needs to have a good idea about the breakeven price and quantity
 - _____

- Helps identify problems before it's too late
- Helps get a loan from a lender
- Sensitivity Analysis
 - Looking at changes in profits due to changes in key areas of an enterprise
 - _____
 - Quantity sold
 - _____
 - Look at changes of _____%
 - Individually, not everything at once!
 - Lawn Care Example
 - Look at a 10% decrease in selling price
 - Currently charging \$100/lawn
 - 10% decrease
 - $\$100 - (\$100 \times 10\%) = \$90/\text{lawn}$
 - Or $\$100 \times (100\% - 10\%) = \$90/\text{lawn}$
 - At 750 lawns/year
 - Revenue = $\$90/\text{lawn} \times 750 \text{ lawns} = \$67,500$
 - A decrease of \$7,500 per year!
 - Lawn Care Example
 - Impact on gross margin (RAOC)
 - Decreases from \$55,185 to \$47,685
 - Decrease of \$7,500
 - Simply due to charging a lower price/lawn
 - But!
 - Will you gain more customers by charging a lower price?
- Using the Spreadsheet
 - Look at the Lawn Mowing Business enterprise budget
 - Change the selling price from \$100 to \$90
 - Move your cursor to cell "F5"
 - Type in 90
 - The spreadsheet automatically does the calculations
 - Revenue drops to \$67,500
 - Return Above Operating Costs drops to \$47,685

- Other Sensitivity Analysis
 - Reset the price to \$100/lawn
 - Let's look at a 10% increase in the number of lawns mowed
 - You get 10% more customers than you planned!
 - Mover the cursor to cell "D5"
 - Enter 900 for the number of lawns mowed
 - Look at the impact on revenues and RAOC

Breakeven and Sensitivity Analysis In-Class Exercise

Let's look at Andy's Fresh-Market Tomato enterprise budget.

1. Andy isn't quite sure that all of his production estimates are accurate, so he wants to know how much "wiggle room" he has with this operation. Calculate the lowest tomato yield that Andy can get and still be able to pay ("cover") all of his operating costs.

Minimum Yield Necessary to Cover Operating Costs = Total Operating Costs / Price/carton

2. Andy isn't sure what price (\$/carton) to charge for his tomatoes. What is the lowest price than Andy needs to charge to cover all of his operating costs?

Minimum Price Necessary to Cover Operating Costs = Total Operating Costs / Cartons Sold

3. Andy is thinking long term. What is the lowest price that he can charge for his tomatoes and still cover all of the expenses of growing tomatoes?

Long-Run Breakeven Price = Total Costs / Cartons Sold/acre

4. What is the lowest number of cartons that Andy needs to grow and sell per acre to cover all of the expenses of growing tomatoes?

Long-Run Breakeven Price = Total Costs / Selling Price/carton

5. There has been a bumper crop of tomatoes this year. This greater supply of tomatoes has caused the selling price of tomatoes to drop significantly. What is the change in Return Above Operating Costs if Andy's selling price drops by 20%?

Fresh-Market Tomatoes (1 acre)

25 lbs/carton

Revenues	Quantity	Units/Acre	Price	Total
Tomatoes	500	cartons	\$10.00 /carton	\$5,000.00
Other				\$0.00
Total Revenues				\$5,000.00 /acre

Variable Costs:

Fertilizer				
Nitrogen	80	lbs	\$0.45 /lb	\$36.00
Phosphorus	100	lbs	\$0.32 /lb	\$32.00
Potassium	150	lbs	\$0.30 /lb	\$45.00
Lime	0.5	tons	\$30.00 /ton	\$15.00
Custom Application	1	acre	\$21.00 /acre	\$21.00
Pest Scouting	8	times	\$10.00 /time	\$80.00
Herbicides	1	acre	\$95.00 /acre	\$95.00
Fungicides	1	acre	\$500.00 /acre	\$500.00
Insecticides	1	acre	\$207.00 /acre	\$207.00
Land Preparation				
Plastic Mulch installation & removal	1	acre	\$70.00 /acre	\$70.00
Plastic Mulch	1	acre	\$300.00 /acre	\$300.00
Drip Irrigation (tape & labor)	1	acre	\$150.00 /acre	\$150.00
Tomato Transplants	5000	acre	\$100.00 /1,000	\$500.00
Stakes	2500	acre	\$100.00 /1,000	\$250.00
Labor				
Planting transplants	1	acre	\$90.00 /acre	\$90.00
Staking & tying	16	hours	\$8.50 /hour	\$136.00
Marketing & advertising	1	acre	\$50.00 /acre	\$50.00
Hand harvest	1	acre	\$800.00 /acre	\$800.00
Pest Control	1	acre	\$17.00 /acre	\$17.00
Cartons, lids, shipping	500	cartons	\$1.50 /carton	\$750.00
Fuel	15	gallons	\$2.20 /gallon	\$33.00
Repairs - Tractors & implements	1	acre	\$9.00 /acre	\$9.00
Interest on Operating Capital	6%	3 months	\$4,239.00 /acre	\$63.59
Total Variable Costs				\$4,302.59 /acre
Return Above Variable Costs				\$697.41 /acre
Minimum Yield Necessary to Cover Variable Costs				cartons/acre
Minimum Price Necessary to Cover Variable Costs				/carton

Fixed Costs

Tractors & Implements	1	acre	\$125 /acre	\$125.00
Drip Irrigation Equipment	1	acre	\$500 /acre	\$500.00
Land Charge	1	acre	\$150 /acre	\$150.00
Total Fixed Costs				\$775.00 /acre
Total Costs				\$5,077.59 /acre
Return Above Total Costs				(\$77.59) /acre
Minimum Yield Necessary to Cover Total Costs				cartons/acre
Minimum Price Necessary to Cover Total Costs				/carton

Breakeven and Sensitivity Analysis In-Class Exercise (KEY)

Let's look at Andy's Fresh-Market Tomato enterprise budget.

1. Andy isn't quite sure that all of his production estimates are accurate, so he wants to know how much "wiggle room" he has with this operation. Calculate the lowest tomato yield that Andy can get and still be able to pay ("cover") all of his operating costs.

Minimum Yield Necessary to Cover Operating Costs = Total Operating Costs / Price/carton

Short-run BE Yield = \$4,302.59 / \$10/carton = 430.3 cartons/acre

Note, this is less than the expected 500 cartons/acre, which is a good sign!

2. Andy isn't sure what price (\$/carton) to charge for his tomatoes. What is the lowest price than Andy needs to charge to cover all of his operating costs?

Minimum Price Necessary to Cover Operating Costs = Total Operating Costs / Cartons Sold

Short-run BE Price = \$4,302.59 / 500 cartons = \$8.61/carton

Note, this is less than the expected \$10/carton selling price, which is a good sign!

3. Andy is thinking long term. What is the lowest price that he can charge for his tomatoes and still cover all of the expenses of growing tomatoes?

Long-Run Breakeven Price = Total Costs / Cartons Sold/acre

Long-Run BE Price = \$5,077.59 / 500 cartons/acre = \$10.16/carton

Note – this is greater than the expected selling price – that means Andy needs to charge a higher price/carton than expected. Will his customers pay the higher price?

4. What is the lowest number of cartons that Andy needs to grow and sell per acre to cover all of the expenses of growing tomatoes?

Long-Run Breakeven Quantity Sold = Total Costs / Selling Price/carton

Long-Run BE Quantity = \$5,077.59 / \$10/carton = 507.8 cartons/acre

Note – this is greater than the expected yield/acre – that means Andy needs to get a higher yield/acre than he is expecting, if he only charges \$10/carton. Can he get a higher yield/acre without increasing his expenses too much?

5. There has been a bumper crop of tomatoes this year. This greater supply of tomatoes has caused the selling price of tomatoes to drop significantly. What is the change in Return Above Operating Costs if Andy's selling price drops by 20%?

A 20% decrease in price means his new selling price is \$8/carton ($\$10 - (\$10 * 20\%)$). At \$8/carton, with no other changes in yield or inputs, the new Return Above Operating Costs is (\$302.59) (that's a negative \$302.59). That is a \$1,000 decrease in profitability due to the lower selling price.

Fresh-Market Tomatoes

25 lbs/carton

Revenues	Quantity	Units/Acre	Price	Total	
Tomatoes	500	cartons	\$8.00	/carton	\$4,000.00
Other					\$0.00
Total Revenues					\$4,000.00 /acre
Variable Costs:					
Fertilizer					
Nitrogen	80	lbs	\$0.45	/lb	\$36.00
Phosphorus	150	lbs	\$0.32	/lb	\$32.00
Potassium	150	lbs	\$0.30	/lb	\$45.00
Lime	0.5	tons	\$30.00	/ton	\$15.00
Custom Application	1	acre	\$21.00	/acre	\$21.00
Pest Scouting	8	times	\$10.00	/time	\$80.00
Herbicides	1	acre	\$95.00	/acre	\$95.00
Fungicides	1	acre	\$500.00	/acre	\$500.00
Insecticides	1	acre	\$207.00	/acre	\$207.00
Land Preparation					
Plastic Mulch installation & removal	1	acre	\$70.00	/acre	\$70.00
Plastic Mulch	1	acre	\$300.00	/acre	\$300.00
Drip Irrigation (tape & labor)	1	acre	\$150.00	/acre	\$150.00
Tomato Transplants	5000	acre	\$100.00	/1,000	\$500.00
Stakes	2500	acre	\$100.00	/1,000	\$250.00
Labor					
Planting transplants	1	acre	\$90.00	/acre	\$90.00
Staking & tying	16	hours	\$8.50	/hour	\$136.00
Marketing & advertising	1	acre	\$50.00	/acre	\$50.00
Hand harvest	1	acre	\$800.00	/acre	\$800.00
Pest Control	1	acre	\$17.00	/acre	\$17.00
Cartons, lids, shipping	500	cartons	\$1.50	/carton	\$750.00
Fuel	15	gallons	\$2.20	/gallon	\$33.00
Repairs - Tractors & implements	1	acre	\$9.00	/acre	\$9.00
Interest on Operating Capital	6%	3 months	\$4,239.00	/acre	\$63.59
Total Variable Costs					\$4,302.59 /acre
Return Above Variable Costs					(\$302.59) /acre
Minimum Yield Necessary to Cover Variable Costs					537.8 cartons/acre
Minimum Price Necessary to Cover Variable Costs					\$8.61 /carton
Fixed Costs					
Tractors & Implements	1	acre	\$125	/acre	\$125.00
Drip Irrigation Equipment	1	acre	\$500	/acre	\$500.00
Land Charge	1	acre	\$150	/acre	\$150.00
Total Fixed Costs					\$775.00 /acre
Total Costs					\$5,077.59 /acre
Return Above Total Costs					(\$1,077.59) /acre
Minimum Yield Necessary to Cover Total Costs					634.7 cartons/acre
Minimum Price Necessary to Cover Total Costs					\$10.16 /carton

697.415 \$1,000.00

Breakeven and Sensitivity Analysis Homework Exercise

Use the attached Horse Boarding Enterprise Budget to answer the following questions. Nellie has estimated the revenues and expenses of her horse boarding operation on this enterprise budget. But she didn't know a few of the numbers so she had to make some "educated guesses". Help Nellie make management decisions for her horse boarding operation. **Show your work to receive full credit.**

1. What is the minimum monthly boarding price that Nellie must charge her customers to breakeven in the short run?

(Hint: Total Revenues = Number of Head x 12 months x Monthly Boarding Price)

2. What is the minimum number of horses that Nellie needs to board per month so that she can cover her operating costs. Assume that she charges \$500/horse per month and that all costs remain the same.
3. Nellie wants to be able to cover her total costs so that she can stay in business for many years (the long run). What monthly price per horse does she need to charge her customers so that she can cover her total costs?

4. Calculate the minimum monthly rate per horse that Nellie needs to charge so that she can cover her total costs and pay herself a salary of \$20,000 per year.

5. It is supposed to be a very dry year, so Nellie expects her grass hay price to increase. What will happen to her Return Above Variable Costs if her grass hay price increases by 20%? Use the spreadsheet to do the calculations for you.
 - a. What is her new grass hay price going to be if it increases by 20%?

 - b. What is her new Return Above Variable Costs after you plug in the new grass hay price?

 - c. How much did her Return Above Variable Costs decrease due to the higher grass hay price?

Extra Credit

Use Goal Seek in Excel to answer the following questions.

- A. Calculate the minimum boarding price that Nellie needs to charge so that she can cover her total costs in the long run. Show the information you entered into Goal Seek:

Set Cell: _____ (enter the correct cell reference – example: H5)

Equal To: _____ (enter the correct number – example \$0)

By Changing Cell: _____ (enter the correct cell reference)

Minimum Boarding Price: \$_____/month

- B. Calculate the minimum boarding price that Nellie must charge to earn a Return Above Total Costs of \$30,000/year.

Set Cell: _____ (enter the correct cell reference – example: H5)

Equal To: _____ (enter the correct number – example \$0)

By Changing Cell: _____ (enter the correct cell reference)

Minimum Boarding Price: \$_____/month

C. We haven't done an example like this, but I know that you can figure it out on your own. Nellie expects that she will have to pay a higher price for her grass hay this year. What is the maximum price (\$/ton) that she can pay for grass hay and still be able to cover her total variable costs?

Set Cell: _____ (enter the correct cell reference – example: H5)

Equal To: _____ (enter the correct number – example \$0)

By Changing Cell: _____ (enter the correct cell reference)

Maximum Grass Hay Price: \$_____/ton

Virginia Cooperative Extension

2023

Nellie's Horse Boarding Operation (Full Service)

20 Horses

90% Occupancy Rate

ITEM		UNIT	PRICE	QUANTITY	TOTAL	Your Estimate
1. GROSS RECEIPTS						
				Months		
Number Boarded	18 Head	12 Months	\$500.00 Per Month	12	\$108,000.00	_____
Lessons	0 /month	12 Months	\$35.00 Per Lesson	12	\$0.00	_____
Training	0 /month	12 Months	\$800.00 Per Horse	12	\$0.00	_____
Other: _____	0 /unit	0 Months	\$0.00 Per Unit	0	\$0.00	_____
2. TOTAL GROSS RECEIPTS					\$108,000.00	_____
3. VARIABLE COSTS						
	Feed Loss					
Alfalfa Hay	5.0%	Ton	\$225.00	0.00	\$0.00	_____
Timothy Hay	5.0%	Ton	\$180.00	0.00	\$0.00	_____
Mixed Hay	5.0%	Ton	\$175.00	0.00	\$0.00	_____
Grass Hay	5.0%	Ton	\$185.00	56.91	\$10,528.84	_____
Mixed Feed	2.0%	Ton	\$480.00	18.43	\$8,845.85	_____
Rolled Oats	2.0%	Cwt	\$24.00	0.00	\$0.00	_____
Other Feed	5.0%	Ton	\$0.00	0.00	\$0.00	_____
Grinding & Mixing		Cwt	\$1.40	0.00	\$0.00	_____
Salt & Mineral	91.00 Lbs per Horse	Cwt	\$30.00	18.20	\$546.00	_____
Vet & Medicine	\$/Horse	Head	\$156.22	20	\$3,124.40	_____
Farrier	8 Trips/year	Trip	\$0.00	0	\$0.00	_____
Supplies		Head	\$27.00	20	\$540.00	_____
Replacement Tack	15.0% Annually	Head	\$0.00	0	\$0.00	_____
Pasture Rent	Acres per Horse	Acre	\$21.00	0	\$0.00	_____
Pasture Clipping	0.20 Acres per Horse	Acre	\$17.50	4	\$70.00	_____
Fertilizer & Lime	2.00 Acres per Horse	Acre	\$32.00	0	\$0.00	_____
Building & Fence Repairs	5.0% of Facility Value	Head	\$210.00	20	\$4,200.00	_____
Haul to Ride		Miles	\$0.48	0	\$0.00	_____
Utilities		Head	\$60.00	20	\$1,200.00	_____
Insurance - horses	10.0% of Value	Head	\$570.00	0	\$0.00	_____
Bedding		Head	\$200.00	20	\$4,000.00	_____
Property Insurance		Year	\$2,000.00	1	\$2,000.00	_____
Liability Insurance	\$2 Millions of Coverage	Per Mil \$	\$500.00	2	\$1,000.00	_____
Lessons Horses Upkeep	0 Horses	Head	\$2,400.00	0	\$0.00	_____
Other: Marketing/Advertising		Year	\$1,500.00	1	\$1,500.00	_____
Other: _____		Head	\$0.00	20	\$0.00	_____
Labor	300 Hours per Horse	Hours	\$10.00	5400	\$54,000.00	_____
Unexpected Expenses	5.0% of variable costs (except labor)			\$37,555.08	\$1,877.75	_____
Operating Interest	6 Months	Dollars	6.00%	\$93,433.00	\$2,802.99	_____
4. TOTAL VARIABLE COSTS					\$96,235.83	_____
5. RETURN ABOVE VARIABLE COSTS					\$11,764.17	_____
6. ANNUAL OVERHEAD COSTS					\$20,000.00	_____
7. TOTAL COSTS					\$116,235.83	_____
8. RETURN ABOVE TOTAL COSTS					(\$8,235.83)	_____

NOTE: This budget is for the stable owner.

Developed by Virginia Cooperative Extension Farm Business Management Staff

Breakeven and Sensitivity Analysis Homework Exercise (KEY)

Use the attached Horse Boarding Enterprise Budget to answer the following questions. Nellie has estimated the revenues and expenses of her horse boarding operation on this enterprise budget. But she didn't know a few of the numbers so she had to make some "educated guesses". Help Nellie make management decisions for her horse boarding operation. **Show your work to receive full credit.**

1. What is the minimum monthly boarding price that Nellie must charge her customers to breakeven in the short run?

(Hint: Total Revenues = Number of Head x 12 months x Monthly Boarding Price)

Total Revenues = Total Variable Costs

Number of Head x 12 months x Monthly Boarding Price = Total Variable Costs

Monthly Boarding Price = Total Variable Costs / (Number of Head x 12 months)

Monthly Boarding Price = \$96,235.83 / (18 head x 12 months) = \$445.54/month

2. What is the minimum number of horses that Nellie needs to board per month so that she can cover her operating costs. Assume that she charges \$500/horse per month and that all costs remain the same.

Total Revenues = Total Variable Costs

Number of Head x 12 months x Monthly Boarding Price = Total Variable Costs

Number of Head = Total Variable Costs / (12 months x Monthly Boarding Price)

Number of Head = \$96,235.83 / (12 months x \$500/month) = 16 horses

3. Nellie wants to be able to cover her total costs so that she can stay in business for many years (the long run). What monthly price per horse does she need to charge her customers so that she can cover her total costs?

Total Revenues = Total Costs

Number of Head x 12 months x Monthly Boarding Price = Total Costs

Monthly Boarding Price = Total Costs / (Number of Head x 12 months)

Monthly Boarding Price = \$116,235.83 / (18 head x 12 months) = \$538.13/month

4. Calculate the minimum monthly rate per horse that Nellie needs to charge so that she can cover her total costs and pay herself a salary of \$20,000 per year.

Total Revenues = Total Costs + Desired Profit

Number of Head x 12 months x Monthly Boarding Price = Total Costs + Desired Profit

Monthly Boarding Price = (Total Costs + Desired Profit) / (Number of Head x 12 months)

Monthly Boarding Price = (\$116,235.83+\$20,000) / (18 head x 12 months) = \$630.72/month

5. It is supposed to be a very dry year, so Nellie expects her grass hay price to increase. What will happen to her Return Above Variable Costs if her grass hay price increases by 20%? Use the spreadsheet to do the calculations for you.

- a. What is her new grass hay price going to be if it increases by 20%?

New Grass Hay Price = \$185/ton x (1 + 20%) = \$222/ton

- b. What is her new Return Above Variable Costs after you plug in the new grass hay price?

New RAVC = \$9,486.79

- c. How much did her Return Above Variable Costs decrease due to the higher grass hay price?

\$11,764.17 - \$9,486.79 = \$2,277.38 decrease

6. What will happen to Nellie's Return Above Total Cost if she can reduce the hours of labor needed per horse by 15%? (Assume her grass hay price is the original \$185/ton)

- a. What is her new labor per horse (hours) going to be if it decreases by 15%?

$$\text{New Hours/Horse} = 300 \text{ hours} \times (1 - 15\%) = 255 \text{ hours/horse}$$

- b. What is her new Return Above Variable Costs after you plug in the new labor needs?

$$\text{New RAVC} = \$20,107.17$$

- c. How much did her Return Above Variable Costs increase due to the lower labor needs?

$$\$20,107.17 - \$11,764.17 = \$8,343 \text{ increase}$$

Extra Credit

Use Goal Seek in Excel to answer the following questions.

- A. Calculate the minimum boarding price that Nellie needs to charge so that she can cover her total costs in the long run. Show the information you entered into Goal Seek:

Set Cell: I48 (enter the correct cell reference – example: H5)

Equal To: \$0 (enter the correct number – example \$0)

By Changing Cell: F10 (enter the correct cell reference)

Minimum Boarding Price: \$ 445.54 /month

- B. Calculate the minimum boarding price that Nellie must charge to earn a Return Above Total Costs of \$30,000/year.

Set Cell: I51 (enter the correct cell reference – example: H5)

Equal To: \$30,000 (enter the correct number – example \$0)

By Changing Cell: F10 (enter the correct cell reference)

Minimum Boarding Price: \$ 677.02 /month

- C. We haven't done an example like this, but I know that you can figure it out on your own. Nellie expects that she will have to pay a higher price for her grass hay this year. What is the maximum price (\$/ton) that she can pay for grass hay and still be able to cover her total variable costs?

Set Cell: I48 (enter the correct cell reference – example: H5)

Equal To: \$0 (enter the correct number – example \$0)

By Changing Cell: F20 (enter the correct cell reference)

Maximum Grass Hay Price: \$ \$376.13 /ton

Break-even & Sensitivity Analysis – Student Driven Activity

Student Driven Learning Activity: You will have to have access to a computer and the excel program per group or per student to complete this exercise.

Utilizing the additional reading portion of the lesson have students divide into groups and read through the exercise and develop several scenarios that will test the sensitivity of Greta's enterprise. Be sure to test the sensitivity for the good (increased price/decreased inputs) and for the bad (decreased price/increased inputs). Be sure to lay out the scenario that caused these prices to fluctuate. Share your scenarios with the rest of the class and utilize the excel file that is associated with this lesson. Show the class how simply adjusting the numbers how it will affect the break-even.

Breakeven & Sensitivity Analysis – Take Home Reading

Nothing is certain in the business world - input prices can change dramatically; your competitors can lower their prices or have “doorbuster sales” to pull in new customers. In businesses that are affected by weather, such as agriculture and construction, poor weather can lead to lower crop yields or slower building times. Managers take their best estimates (“guesses”) of how many units they will sell in the upcoming year and of the average price they will charge for their goods and services. They use these estimates to build their income statements and enterprise budgets for the upcoming year. But they have no way of knowing how good their estimates are until the end of the year. For these reasons, managers like to do “breakeven analysis” and “sensitivity analysis” to see how sensitive their business profits are to changes in key items.

Breakeven analysis is a way to estimate the lowest selling price that you can charge so that you earn enough revenues to cover your costs. It can also be used to estimate the lowest amount of units that you need to sell at a certain price to cover your costs. Or, we can get fancy and calculate the highest price that you can afford to pay for one of your key inputs (labor, fertilizer, raw materials, etc.).

Sensitivity analysis is just a fancy term for estimating how your business’ profits are going to be impacted by changes in one or more key factors, such as the purchase cost of an input or the amount of units you actually sell. There are no “hard and fast rules” for doing sensitivity analysis. I would recommend that you keep it simple – choose one main factor to change at a time, then, change that factor by 10-25%. For example, you can analyze how your profits (return above operating costs or return above total costs) are hurt by a 10% decrease in the number of units you actually sell. Computer spreadsheets are great tools to use for sensitivity analysis.

Let’s look at the basics of breakeven analysis. “Breakeven” means that your revenues are just equal to your costs – so you’re just breaking even – you’re not making money, but you’re not losing money either. We can calculate breakevens for the upcoming year (the short run) or for the next several years (the long run).

It might be easier to understand breakeven analysis if we apply it to your personal life. Let’s assume that your monthly living expenses (rent, food, etc.) are \$1,000. You are working at a local business that pays you \$10/hour. For you to “breakeven”, your monthly earnings must be equal to your monthly expenses. How many hours do you need to work per month so that you can breakeven?

Total Earnings = \$10/hour x Hours Worked/month

Total Expenses = \$1,000/month

Total Earnings = Total Expenses

$$\text{\$10/hour} \times \text{Hours Worked/Month} = \text{\$1,000/Month}$$

$$\text{Hours Worked/Month} = \text{\$1,000} / \text{\$10/hour} = 100 \text{ hours/month}$$

So, your breakeven number of hours worked per month is 100 hours. If we assume that there are an average of 4 weeks per month you will need to work 25 hours/week (100 hours/ month / 4 weeks/month) to breakeven. We call this your “breakeven quantity”.

What if you know that you can only work 80 hours/month? What is the minimum wage rate that you have to earn to breakeven? Let’s start with the same basic formula:

$$\text{Total Earnings} = \text{Total Expenses}$$

$$\text{Wage Rate/Hour} \times 80 \text{ Hours Worked/Month} = \text{\$1,000/Month}$$

$$\text{Wage Rate/Hour} = \text{\$1,000/Month} / 80 \text{ Hours Worked/Month} = \text{\$12.50/Hour}$$

Your breakeven wage rate is \$12.50/hour if you can only work 80 hours per month. We call this your “breakeven price”.

In the business world we only use operating expenses for the “short run” (the upcoming year). In the short run, breakeven means that our total revenues are just equal to our total operating expenses. Let’s create a formula that will help you learn how to calculate short run breakevens. In the short run (the upcoming year), Total Revenues are equal to Total Operating Expenses. But, we can rewrite Total Revenues as follows: Total Revenues = Units Sold x Price/Unit. So, our main short run breakeven formula is:

$$\text{Units Sold} \times \text{Price/Unit} = \text{Total Operating Costs}$$

To calculate the minimum price that you need to charge to cover your operating costs, simply rearrange this formula to solve for Price/Unit:

$$\text{Price/Unit} = \text{Total Operating Costs} / \text{Units Sold}$$

Let’s calculate the breakeven price for Greta’s squash enterprise. She typically sells 100 pounds of squash per month. The operating expenses of her squash enterprise are \$550 per month. Greta’s breakeven price is:

$$\text{Price/Unit} = \text{Total Operating Costs} / \text{Units Sold}$$

$$\text{Price/Unit} = \text{\$550} / 100 \text{ pounds} = \text{\$5.50/pound}$$

Greta needs to charge at least \$5.50/pound for her squash. At this price her total revenues will be just equal to her total operating expenses.

$$\text{Total Revenues} = 100 \text{ pounds of squash} \times \text{\$5.50/pound} = \text{\$550}$$

$$\text{Total Operating Expenses} = \text{\$550}$$

So, Total Revenues = Total Operating Expenses when the selling price is \$5.50/pound

Let's calculate the minimum number of pounds of squash that Greta needs to sell to breakeven if she charges \$6.00/pound. We call this the "breakeven quantity". Assume that Greta has already purchased the squash and that her total operating expenses are still \$550 for the month. Her breakeven quantity of squash is:

$$\text{Units Sold} \times \text{Price/Unit} = \text{Total Operating Costs}$$

$$\text{Units Sold} \times \$6.00/\text{pound} = \$550$$

$$\text{Units Sold} = \$550 / \$6.00/\text{pound} = 91.67 \text{ pounds of squash sold}$$

Let's double-check our math:

$$\text{Total Revenues} = 91.67 \text{ pounds} \times \$6/\text{pound} = \$550$$

$$\text{Total Operating Expenses} = \$550$$

So, Total Revenues = Total Operating Expenses at 91.67 pounds sold per month.

How does Greta use these breakevens in managing her business? Greta looks at her competitor's prices for squash and sees that they are all charging an average of \$3.50/pound. But she must be able to charge \$5.50/pound to cover her operating costs. How can she compete with the other grocery stores if she has to charge \$2.00/pound more than they do? This helps Greta see that she needs to either reduce the operating costs of her squash enterprise so that she can charge closer to \$3.50/pound, or maybe she should think about not selling squash at all. Remember, we said that a business must always be able to cover its operating expenses in the short run. Breakeven analysis helps the manager make short run decisions.

Let's get a little more realistic. Most managers do not want to simply break even – they want to earn profits over their expenses. We can calculate the lowest price we need to charge, or the minimum amount of units we need to sell at a given price, that allows us to earn a desired profit. Now our total revenues must be equal to our total operating expenses plus our desired profit:

$$\text{Total Revenues} = (\text{Total Operating Costs} + \text{Desired Profit})$$

Assume that Greta wants to earn at least \$200 of profit per month from her squash enterprise if she sells an average of 100 pounds per month. Let's calculate the minimum selling price and quantity sold for her to earn \$200 of profit:

$$\text{Total Revenues} = (\text{Total Operating Costs} + \text{Desired Profit})$$

$$\text{Units Sold} \times \text{Price/Unit} = (\text{Total Operating Costs} + \text{Desired Profit})$$

$$100 \text{ pounds} \times \text{Price/Unit} = (\$550 + \$200)$$

$$\text{Price/Unit} = (\$750) / 100 \text{ pounds} = \$7.50/\text{pound}$$

Greta must charge \$7.50/pound to earn a profit of \$200/month.

$$\text{Units Sold} \times \text{Price/Unit} = (\text{Total Operating Costs} + \text{Desired Profit})$$

$$\text{Units Sold} \times \$5/\text{pound} = (\$550 + \$200)$$

$$\text{Units Sold} = (\$750) / \$5/\text{pound} = 150 \text{ pounds sold per month}$$

Greta must sell 150 pounds/month to earn a profit of \$200/month under these assumptions.

Managers are not just concerned about the short run. They need to think about staying in business for several years – the long run. In the long run the business must generate enough revenues to cover its total costs (operating costs plus overhead costs). This is the only thing that is different between short run and long run breakeven. Here's the general long run equation:

$$\text{Units Sold} \times \text{Price/Unit} = (\text{Total Operating Costs} + \text{Total Overhead Costs})$$

Greta's overhead costs for the squash enterprise are \$150/month. If she sells 100 pounds per month, with operating costs of \$550/month, her breakeven long run selling price is:

$$\text{Units Sold} \times \text{Price/Unit} = (\text{Total Operating Costs} + \text{Total Overhead Costs})$$

$$\text{Price/Unit} = (\text{Total Operating Costs} + \text{Total Overhead Costs}) / \text{Units Sold}$$

$$\text{Price/Unit} = (\$550 + \$150) / 100 \text{ pounds} = \$7.00/\text{pound}$$

Greta must charge a minimum of \$7.00/pound for her squash for her to stay in business for more than a few years (the long run). This will allow her to just cover her total expenses. If she wants to earn a profit above those total costs, we can add in the desired profit to this calculation like we did for the short run.

Greta's minimum level of sales (units) for the long run is she charges \$5.00/pound is:

$$\text{Units Sold} \times \text{Price/Unit} = (\text{Total Operating Costs} + \text{Total Overhead Costs})$$

$$\text{Units Sold} = (\text{Total Operating Costs} + \text{Total Overhead Costs}) / \text{Price/Unit}$$

$$\text{Units Sold} = (\$550 + \$150) / \$5.00/\text{pound} = 140 \text{ pounds of squash sold per month}$$

We can use a computer spreadsheet to calculate our breakeven prices and quantities. There are 2 ways to calculate breakevens with a spreadsheet. First, we can enter formulas:

$$\text{Short Run Breakeven Price} = \text{Total Operating Costs} / \text{Units Sold}$$

$$\text{Short Run Breakeven Units Sold} = \text{Total Operating Costs} / \text{Price/Unit}$$

$$\text{Long Run Breakeven Price} = \text{Total Costs} / \text{Units Sold}$$

$$\text{Long Run Breakeven Units Sold} = \text{Total Costs} / \text{Price/Unit}$$

In this spreadsheet, we use "cell references" instead of actual numbers. To enter a formula for short run selling price, we need to divide the cell that contains the total operating costs by the cell that contains the units sold. The Total Operating Costs are in cell "H29" – Column H, row 29. Units Sold are in cell "D5" – Column D, row 5. So our formula should look like this:

$$\text{Short Run Breakeven Price} = \text{H29} / \text{D5}$$

Click on cell H32 to see this formula for short run breakeven price. Now, look in the “formula bar” which is toward the top of the screen. You will see a formula that looks like:

$$= H29/D5$$

That’s all there is to it! This formula will automatically take whatever number is in cell H29 (Greta’s total operating costs) and divide it by the pounds sold (cell D5). Change the pounds sold to 200 pounds and see what happens to the breakeven selling price. Pretty neat, huh?!

We can do the same thing for the other breakeven formulas. Look at these cells to see the formulas:

$$\text{Cell H31 is Short Run Breakeven Units Sold} = H29/F5$$

$$\text{Cell H32 is Short Run Breakeven Selling Price} = H29/D5$$

$$\text{Cell H42 is Long Run Breakeven Units Sold} = H39/F5$$

$$\text{Cell H43 is Long Run Breakeven Selling Price} = H39/D5$$

The second method of calculating breakevens on a spreadsheet is by using a function called “Goal Seek”. The Goal Seek function is found on the “Data tab” – click on the Data tab. Now click on the “What-If Analysis” button. Then select “Goal Seek” from the menu.

Goal Seek basically need 3 pieces of information to calculate a breakeven:

1. The cell that contains the Return Above Operating Costs (RAOC) for short run breakevens, or the cell for Return Above Total Costs (RATC) for long run breakevens,
2. What you want to set the RAOC or RATC equal to. Use zero (\$0) to calculate the breakeven. Or, use the desired profit to calculate the minimum price or quantity needed to earn that profit,
3. The cell containing the factor you want to calculate. For breakeven selling price, choose the cell that contains the current selling price; for breakeven units sold, enter the cell that contains the current level of sales.

Here’s how to use Goal Seek to calculate the short run breakeven selling price for Greta’s Squash Enterprise:

Open Greta’s squash enterprise budget spreadsheet

Click on the Data tab

Click on the “What-If Analysis” button

Select “Goal Seek” from the dropdown menu

A box will appear that asks you for the 3 pieces of information that are needed:

1. Set cell – this is the RAOC or RATC cell reference
2. To value – this is what you want RAOC or RATC to be equal to
3. By changing cell – this is what you are solving for

To calculate Greta's short run breakeven selling price, enter the following information in the input box:

1. Set cell: H30
- H30 is the cell reference for Greta's Return Above Operating Costs
2. To value: \$0
- this tells the spreadsheet to set the RAOC to \$0
3. By changing cell: F5
- F5 is the cell reference for the current selling price

Once you have this information entered into the box press the "OK" button to solve for the short run breakeven selling price. You will get a message that says "Goal Seeking with Cell H30 found a solution." This means that it solved for the breakeven price. If you look at cell H30, it will show a value of \$0 – this means that Greta earned just enough revenue to cover her operating costs. Now, look at cell F5 to see what the breakeven selling price is – you will see that the price changed from \$5.00/pound to \$5.50/pound. This means that Greta's short run breakeven selling price is \$5.50/pound. This is what we calculated by hand and with the spreadsheet formula – if nothing else, Goal Seek will help you double-check your answers to your formulas!

Click "Cancel" to return the selling price to the original value of \$5.00/pound. If you accidentally click "OK" the spreadsheet will keep the \$5.50/pound price instead of the original \$5.00/pound --- not a problem, just type "5" into cell F5 to go back to the original price.

If you want to calculate the short run breakeven units sold, do the exact same thing we just did, except in enter the cell for the units sold (D5) in the "By changing cell" box. You should get 110 pounds as your short run breakeven units sold.

Reset your units sold back to the original 100 pounds and be sure that your price is \$5.00/pound. You can calculate the long run breakevens in the same fashion – the only difference is that you want to use the cell reference for the Return Above Total Cost (RATC) for the "Set cell" input. Everything else is the same! Try it and see if you get the same results as we got by hand.

Now, what if Greta wants to determine the price she needs to charge to earn a Return Above Operating Costs of \$200. This is a short run decision because she is only interested in covering her operating costs. The only thing that we have to do differently is enter \$200 instead of \$0 in the "To value:" input box. Here's what it will look like:

- | | | |
|-------------------|-------|------------------------------------|
| Set cell: | H30 | (cell reference for RAOC) |
| To value: | \$200 | (Greta's desired profit) |
| By changing cell: | F5 | (Cell reference for selling price) |

Press OK to solve. You should get a selling price of \$7.50/pound.

Sensitivity analysis is similar to breakeven analysis, but it's a lot easier. All you have to do is select a key factor that you want to analyze, and change the original value to something new. Again, I usually look at changes of 10-25% in these factors. Let's do some sensitivity analysis for Greta. Let's look at how a 10% decrease in units sold will impact her Return Above Operating Costs. Simply change the value in cell D5 (Units Sold) from 100 to 90. This represents a 10% decrease in the number of pounds of squash that are sold. ($100 \times (100\% - 10\%) = 90$). When you change the units sold from 100 to 90 you should see the following changes:

Total Revenues drops from \$500 to \$450

Total Operating Expenses remain the same at \$550

Return Above Operating Costs drops from negative \$50 to negative \$100

Minimum Price Necessary to Cover Operating Costs increases from \$5.50 to \$6.11/pound.

This sensitivity analysis tells Greta that if her sales drop from 100 pounds to 90 pounds (a 10% decrease), her short run profits will decrease by another \$50 to a total short run loss of \$100.

We can look at other changes besides price and units sold. Change the units sold back to 100 and the price to \$5.00 so that you are at the original numbers. What if Greta can reduce her labor for transplanting and for hand harvest to \$40/acre for each? How will this impact her short run profits? Change the price for "planting transplants" to \$40/acre. Change the price for "hand harvest" to \$40/acre. What happens to Greta's short run profits? With this change her Return Above Operating Costs is now \$31.20/acre (positive) instead of negative \$50/acre. This tells Greta that labor is an important resource that she needs to be able to control to make profits!

Here are a few tips for doing sensitivity analysis:

1. Always start from the original situation. This way you can easily compare the impact of all the changes.
2. Don't change too many factors at the same time. I usually look at 1 or 2 changes at a time. This makes it easier to see how sensitive the business is to those 1-2 changes. If you change 5-10 factors at the same time it is hard to determine what is really causing the changes. Keep it simple!
3. Focus on the most important factors of the business: selling price, units sold, and a few of the most expensive inputs.

Good managers always have an idea of their breakeven selling prices and/or breakeven units sold. This helps them make day-to-day decisions much more easily. For example, a local restaurant has a breakeven units sold of 50 breakfasts per day. If the manager doesn't expect to sell at least 50 breakfasts in a day he may think about not offering breakfasts anymore; instead, he will focus on the busier lunch and dinner times. Or, assume the restaurant has breakeven daily sales of 200 meals, and the restaurant is located in a college town. When the students leave for holiday break the restaurant may only have sales of 50 meals per day. If this is the case, the manager may decide to close the restaurant until the students come back into town.

Greta's Squash Enterprise

Revenues	Quantity	Units/Acre	Price	Total
Squash	100	pounds	\$5.00 /pound	\$500.00
Other				\$0.00
Total Revenues				\$500.00 /acre
Operating Expenses				
Fertilizer				
Nitrogen	80	lbs	\$0.45 /lb	\$36.00
Phosphorus	100	lbs	\$0.32 /lb	\$32.00
Potassium	150	lbs	\$0.30 /lb	\$45.00
Lime	0.5	tons	\$30.00 /ton	\$15.00
Custom Application	1	acre	\$21.00 /acre	\$21.00
Pest Scouting	2	times	\$10.00 /time	\$20.00
Herbicides	1	acre	\$25.00 /acre	\$25.00
Fungicides	1	acre	\$25.00 /acre	\$25.00
Insecticides	1	acre	\$25.00 /acre	\$25.00
Labor				
Planting transplants	1	acre	\$80.00 /acre	\$80.00
Marketing & advertising	1	acre	\$50.00 /acre	\$50.00
Hand harvest	1	acre	\$80.00 /acre	\$80.00
Pest Control	1	acre	\$33.00 /acre	\$33.00
Cartons, lids, shipping	50	cartons	\$0.20 /carton	\$10.00
Fuel	15	gallons	\$2.20 /gallon	\$33.00
Repairs - Tractors & implements	1	acre	\$11.87 /acre	\$11.87
Interest on Operating Capital	6%	3 months	\$541.87 /acre	\$8.13
Total Operating Expenses				\$550.00 /acre
Return Above Operating Costs				(\$50.00) /acre
Minimum Yield Necessary to Cover Operating Costs				<u>110.0 pounds/acre</u>
Minimum Price Necessary to Cover Operating Costs				<u>\$5.50 /pound</u>
Fixed Costs				
Tractors & Implements	1	acre	\$75 /acre	\$75.00
Land Charge	1	acre	\$75 /acre	\$75.00
Total Fixed Costs				\$150.00 /acre
Total Costs				\$700.00 /acre
Return Above Total Costs				(\$200.00) /acre
Minimum Yield Necessary to Cover Total Costs				<u>140.0 pounds/acre</u>
Minimum Price Necessary to Cover Total Costs				<u>\$7.00 /pound</u>

Interest on Operating Capital	6%	3 months	\$461.87 /acre	\$6.93
Total Operating Expenses				\$468.80 /acre
Return Above Operating Costs				\$31.20 /acre
Minimum Yield Necessary to Cover Operating Costs				93.8 pounds/acre
Minimum Price Necessary to Cover Operating Costs				\$4.69 /pound
Fixed Costs				
Tractors & Implements		1 acre	\$75 /acre	\$75.00
Land Charge		1 acre	\$75 /acre	\$75.00
Total Fixed Costs				\$150.00 /acre
Total Costs				\$618.80 /acre
Return Above Total Costs				(\$118.80) /acre
Minimum Yield Necessary to Cover Total Costs				123.8 pounds/acre
Minimum Price Necessary to Cover Total Costs				\$6.19 /pound