Lesson Plan 4: The Profit Function in Agribusiness

Materials:

- Random number generator linked here: **https://tinyurl.com/5c4phxh8**
- Calculators (TI84)
- Worksheet (attached below)
- WVSU Tutorial Video

Standards:

1. **Common Core State Standards (CCSS):**
    - **CCSS.MATH.CONTENT.8.F.A.3:**
      Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line. Use the function to solve problems in the context of a situation.
    - **CCSS.MATH.CONTENT.HSA.CED.A.2:**
      Create equations in two variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
    - **CCSS.MATH.CONTENT.HSA.REI.B.3:**
      Solve linear equations and systems of linear equations, interpreting the solutions in the context of the situation.
2. **Next Generation Science Standards (NGSS):**
    - **HS-ETS1-4:**
      Use mathematical models to represent and solve real-world problems, particularly applying algebraic reasoning to linear functions.

Student Learning Objective:

Students will understand the relationship between fixed costs, variable costs, and revenue by creating and graphing profit functions. They will apply this understanding to determine break-even points and analyze how changes in their costs or revenue affect their profitability.

Modeling: Begin with a class discussion on **profit** and the concept of **break-even**. Ask students: "What does it mean for a company to break even? Why is it important for businesses to understand their expenses and revenue?" Briefly review the formula for a **profit function**: Profit=Revenue−(Fixed Costs+Variable Costs)

Explain the terms:

Slope represents the **variable costs** (costs that change based on the number of items sold or produced). **Y-intercept** represents the **initial costs** (fixed costs, which remain constant regardless of production). **Revenue function** represents how much money the business makes from sales.

Modeling the activity: Demonstrate how to create a **profit function** by using randomly generated numbers. For example:

- **Fixed costs (initial costs)** = 500
- **Variable costs (slope)** = 2 (meaning the cost increases by 2 for every item produced)
- **Revenue function** = 5x (where each item is sold for $5)

- Write out the **profit function**, combining like terms as needed
- Demonstrate how to **graph the profit function** using a set of x-values (number of units produced). For example, plot points for x = 0, 100, 200, etc., and show how the graph intersects the x-axis to find the **break-even point**.

Practice/Activity:

- **Complete the guided worksheet.**

Profit Function in Agriculture- Application Assignment

Random Number Generator (follow link): https://tinyurl.com/5c4phxh8

Net Profit= Revenue-Costs **P(x) = R(x)-C(x)**

Problem 1 (Practice):

1. First let's find our revenue (the amount of money we make). We will generate 2 numbers this round. The first is the unit price, and the second is the number of units sold. Record them here:

   Unit price:

   Number sold:

   Revenue=Unit Price x number of units sold

   Revenue=

2. Now, we need our costs. Many costs go into producing items to sell, such as materials, equipment, employee salaries, packaging, and transportation of goods. Let's generate 5 numbers to represent these expenses and write them, in order, below.

Materials	$
Equipment	$
Salaries	$
Packaging	$
Transportation	$
Total Costs=	$

3. Now, make your profit function by plugging in your revenue and total costs into the equation: Profit=Revenue-Cost or P(x)=R(x)-C(x)

Problem 2: In our example, we used fixed costs, but in the real world costs can be much more complex. For example, most companies have startup expenses, recurring expenses, emergency expenses, and more. To more accurately develop a profit model, we should account for this. Read the directions below to develop a **MONTHLY** model for your profit.

A. You pay an initial $20,000 for your building.
B. You pay an initial $10,000 for equipment.
C. You pay $2,000 per month to maintain your equipment.
D. You pay a marketing contractor a one-time $5,000 fee to create a logo and marketing plan for your company
E. You have 30 workers in your company, each making $32,000 per year.
F. You pay $5,000 per month to store and transport your milk to local supermarkets.
G. You pay $1,500 per month for utilities per month

Break it down:

One-Time Expenses	Recurring/Monthly Expenses (Remember, you want MONTHLY analysis)
Total=	Total=

Lets produce a cost-equation in slope intercept form (C(x)=mx+b), where m is your total recurring costs, x is the number of months that have passed, and b is your total of initial and one time fees.

Equation: **C(x)=**

Now, we need to know our revenue. Your company sells milk for $6 per gallon. You sell, on average, 15,000 gallons of milk per month. How much money (revenue) do you produce per month?

R(x)=

Now we can make a more advanced profit function, using the same formula, but plugging in our full equation for the cost function C(x)

P(x)=R(x)-C(x)

Note: Remember to distribute the negative into the entire cost equation.

New Profit Function: P(x)=

The Breakeven Point: You want to know how long it is going to take to begin making a profit at your company. Whenever your profit function equals 0 (P(x)=0), we call this the "break even point." It means that any more sales after this point will become profit. Set your profit function equal to 0 and solve for x. This will tell us how many months it will take to break even.

Do you think this is a good amount of time until you begin to make a profit?

What are some aspects of your business you would have to adjust to reach a quicker break-even point?