

Practice Problem



Figure 2.12: Computer generated image of a farmer.

Source: <https://stablediffusionweb.com/>

Prompt: female hispanic farmer

Date Generated: July 8, 2023

You are a farmer. You buy seed, do a lot of work (till the soil, plant, irrigate, fertilize, and weed control), then harvest and sell your crop. To keep the optimization problem simple, we assume away almost all of this and ignore all labor, machinery, and any other costs except seed.

In our toy model, you simply buy seed, S , and it is transformed into output, say corn, via the function, $Q = 100\sqrt{S}$. For example, 64 pounds of seed makes 800 pounds of corn, 100 times the square root of 64. This functional form reflects the fact that you have a fixed amount of land so planting twice as much seed less than doubles the amount of corn. The square root means that the more seed increases output, but at a decreasing rate.

You sell your output at the market-given price, P , of \$8 per pound. You cannot sell at a price higher than this because there are many other farmers willing to sell at \$8 per pound so no one would buy your harvest at a price above the market price. To be clear, 1,000 pounds of corn generates \$8,000 of total revenue.

The seed costs you \$2 per pound. You can buy as much seed as you want at this price so your total cost function is linear, $TC = \$cS$, where c is the input price of seed. The total cost function tells us that, for example, 200 pounds of seed has total costs of \$400.

You want to buy the amount of seed that maximizes profits, which is total revenues minus total costs. You can see that choosing 100 pounds of seeds will get you $\$8,000 - \$200 = \$7,800$ of profits.

The question, however, is whether or not that's the best amount of seed to buy—in other words, is 100 pounds of seed the profit-maximizing solution? The questions below will lead you to an answer to this question and help reinforce what you know about Solver, data visualization, and comparative statics analysis.

STEP Open a blank Excel workbook and save it with an appropriate filename. Answer the questions below in the spreadsheet, saving the file after each question (in case there is a crash or other problem). For questions that require explanation, put your response in a text box (in the *Insert* tab on the *Ribbon*) with the question number.

1. What is the endogenous variable in this problem? Why is it endogenous?
2. Put the values for the output price of corn and input price of seed in two cells with labels next to them.
3. Implement this problem in Excel so that it is ready for Solver to work on it. You do this by adding other information in cells in addition to the cells you have from the previous question.
4. Use Solver to get the optimal solution.

5. The exactly correct answer is 40,000 pounds of seed with maximum profits of \$80,000. Since Solver does not give this exactly correct answer, do we say it is wrong? Explain.
6. Create a chart that displays the optimal solution.
7. What are the three steps in creating a chart in Excel? Did you do all three steps in the chart you made?
8. We know Solver can give miserable or disastrous results. What do these terms mean?
9. Does your chart give you confidence that Solver is not giving a disastrous result in this case? Explain.
10. Conduct a comparative statics analysis of changing the output price. Explain what you did and what you found.

RAND()

For the last question, you can change the output price to any number you choose, but you could also use Excel to generate a random number for the output price using the RAND() function. We will explain and use RAND() in the next chapter, but it is so easy to use and gives you a way to play with the exogenous variables in this problem that it is worth doing it now.

STEP In any empty cell, enter the formula `=RAND()` and press enter. Press the F9 key (you may have to use the function, *fn*, key to access F9 on your keyboard) repeatedly to see the number bounce around.

EXCEL TIP The F9 key is a keyboard shortcut for *Calculate Now* in the *Formulas* tab in the *Ribbon*. It recalculates the sheet and updates functions like RAND, thereby displaying a new random number.

You cannot run Solver with an objective function that depends on RAND() because every time Solver puts down a trial solution, the cell with RAND() would recalculate. There are, however, several ways to “deaden” RAND() and turn it into a number. Perhaps the easiest uses the F9 key when you are in the formula bar of the cell.

STEP Copy your RAND() cell and paste it in another empty cell. Press F9 repeatedly to see two bouncing numbers. Select one of the cells with RAND() and then click in the formula bar. Press F9 and then enter.

You replaced the formula in that cell with a single number that will no longer change when the sheet recalculates. You could create a cell formula for the output price like $=RAND()*4 + 6$ to generate random output prices from 6 to 10. You could get a specific, unchanging price by entering the formula bar of that cell and pressing F9. You can make many practice problems with different output prices with this method.