Developing spreadsheets for generalized problems

Consider the following problem:

> You are to create a spreadsheet that allows a clerk at Lawns-R-Us to type in the application rate (in pounds per 100 square feet) of a fertilizer and the square footage of the customer's lawn. The spreadsheet should automatically calculate how many pounds of fertilizer the customer needs.

Before we get started it is helpful to recognize that once we are done, we will have a tool that will allow us to easily solve an entire collection of related problems. To get started on this task, we must first pick one of *specific instances* from that collection. The beauty of the process is that it doesn't matter which specific instance we pick, just as long as we pick one. Let's pick an application rate of 2 lbs. per 100 sq. ft. and a lawn square footage of 2500. The we solve the specific instance on a separate piece of paper. We might attack it like this:

$$\frac{2 \text{ lbs}}{100 \text{ sq. ft.}} = \frac{n \text{ lbs}}{2500 \text{ sq. ft.}}$$

and get something like

$$n = \frac{2500 \text{ sq. ft.} * 2 \text{ lbs.}}{100 \text{ sq. ft.}} = 50 \text{ lbs}$$

Once we have used our algebra techniques to solve the specific instance, we can transfer the solution to our spreadsheet. We begin the process by again looking at the problem statement. The phrase "to type in" is a hint that we have to set up cells for the indicated numbers. Thus, in this problem we need two cells: one for the application rate and one for the square footage of the customer's lawn. We need to supply labels so the clerk knows where to type in the values. We get a spreadsheet that looks something like this.

	A	B	C
1	Application Rate (lbs/100 sq ft)	Lawn Area (sq ft)	
2			

We know that the clerk will type the actual application rate (2 in our previous example in cell A2 and the actual lawn area in cell B2.
Next we notice the value that we are trying to compute. It is identified by the words, "The spreadsheet should automatically calculate." We add another label to the spreadsheet to identify where the result of the calculation will be found (cell C2).

	A	B	C
1	Application Rate (lbs/100 sq ft)	Lawn Area (sq ft)	Pounds of Fertilizer
2			

Next we work the solution to our specific example into the spreadsheet. We start by identifying the values that are known in our specific instance–2 lbs./100 sq.ft. and 2500 sq.ft. and place them in the spreadsheet just like we expect the clerk to do.

	A	B	C
1	Application Rate (lbs/100 sq ft)	Lawn Area (sq ft)	Pounds of Fertilizer
2	2	2500	

Notice that since the units are on the labels, we do not include the units in the cells with the values. We know that 50 needs to show up in cell C2 after we put a formula into that cell. If we were interested in solving only the specific version of the problem we could simply type `=2*2500/100`. It is almost as easy to get a general solution. We start by typing an = and then we click on A2 (where the 2 is found), press *, then click on B2 (where the 2500 is found), and press / and type 100.

	A	B	C
1	Application Rate (lbs/100 sq ft)	Lawn Area (sq ft)	Pounds of Fertilizer
2	2	2500	=A2*B2/100

Pressing enter will give the desired result: 50 in cell C2. That's it! Now the clerk can type arbitrary values in cells A2 and B2 and know how much fertilizer to sell to the customer.
Here are the steps used to solve this kind of spreadsheet problem:

1. Identify a specific instance of the problem.
2. Solve the problem *by hand* using algebra.
3. Identify how many cells are needed to hold information that is to be typed in by the user of the spreadsheet.
4. Label the cells from the previous step.
5. Identify the value the spreadsheet is supposed to determine.
6. In your spreadsheet, label cell(s) for the value(s) to be determined.
7. Now, generalize your specific instance in your spreadsheet.
   (a) Put the actual values from your specific instance into the correct cells.
   (b) In the cell you are using to compute a value, press = and then put your algebraic expression into that cell, *except* where ever you have a number that appears in your specific example, click on the cell with that number so that the cell name appears as part of the formula.