POPULATION MODELS

Deterministic: Roc Basic + Sensitivity Analysis

Terri Donovan

recorded: January, 2010

Welcome back. You've just completed a sensitivity analysis of the Roc Population Model, and that is, you looked at how the ending population value changed depending on changes in various input values.

Now some of you, had done an exercise and thought that clutch size was very sensitive. Others might have thought bullets was a very sensitive parameter - meaning the ending population size is very sensitive to changes in this particular input. And still others might have thought that initial population size was a sensitive parameter.

One thing that's useful to do in a sensitivity analysis is to change each of these parameters one at a time while holding the other ones fixed or constant, and that lets us look at how these things might change in a more systematic way.

Now you don't want to just arbitrarily choose which numbers you're going to be looking at, because you want to really focus in on exactly how sensitive is the model to clutch size and how sensitive is it to bullets? So we're going to be carefully thinking about, what range of values we're going to be looking at for clutch size, and bullets in particular, and how those affect our ending result.

Now for this sensitivity analysis, I don't need to see the graph, and so I'm going to shrink this down a bit and scoot it over so that we have some space for our sensitivity analysis.

All right - let's start this by just typing in the words ‘Sensitivity Analysis’. And we're going to do this for just bullets and clutch size, which some of you thought were the most sensitive parameters. And what we're going to do is let bullets vary from 0 to 10 to 20 to 30. And these are going to be different levels of bullets. And so I'm going to enter the word ‘Bullets’ in cell G5. Select these cells, select the cells above it, and merge those into one header called ‘Bullets’, so there's my level of bullets.

And then we're going to let the clutch size vary from .8 to .9 to 1, 1.1, 1.2, and 1.3. And what we're going to do is, we're going to look and see and record under each of these conditions, when bullets are 0 and the clutch size is .8, what is our ending population size? When the clutch size is .8 and the bullets are 10, what is the ending population size? When the clutch size is .8 and the bullets are 20, what is the ending population size?

So we're going to basically be filling in a grid. So let's go ahead and highlight the cells in this grid and give them a border. And let's go ahead and center all of these values, just to clean it up a little bit.

So for example, if bullets are 0, I enter a 0. And if my clutch size is .8, my ending population size is 75, and I would fill that in right there. If the bullets are 10, my ending population size is 39, and I'm going to fill that in, in that cell. If the bullets are 20, the population size is 4, and so I would enter that there. And if the bullets are 30, the ending size is negative 32. We know that's not possible, and so we're going to enter a 0 in that particular case.

And that actually brings up a point. If I don't want to display a negative population size, what I can do is add an 'IF' function here that would say, "If the final population size in the year 2000 is less than 0, then just return a 0." Otherwise return the value that's currently in that particular cell. So let's go ahead - and we can go ahead and do that.

So I'm going to move my graph down and out of the way. I'm going to change the formula in cell E2, and I'm going to replace it with an 'IF' function. So I go to the Insert Function, and I'm going to look for the word 'IF.' Right now my spreadsheet is set up so that it's depicting the most recently used functions. If I click on the down arrow and ask it to show all functions, the spreadsheet reveals a list of all of the functions in alphabetical order. And I just click on the key 'i', and it brings me down to the functions that begin with the letter i. And I should be able to find my function fairly quickly that way.

So here's our IF dialogue box. It opens up, and what we want to do is to fill in the arguments of this particular function. So this function IF has three arguments.

First thing we need to do is enter a test so we're going to say, 'If this last cell in the projection is less than 0 - and that's our logical test - and the answer is always going to be true or false. If it's less than 0, then we want the spreadsheet to return a 0. And, if it's false, we want the spreadsheet just to return whatever's in value cell B15. And so, again, you can look and see Excel is showing you what the current results are. Is cell B15 less than 0? Yes, it is. Value if true, 0. Value if false, and it should return a 0, and it does.

<u>PAUSE the video</u>: What I'd like you to do is to pause the recording and go ahead and fill in the rest of this grid, and then we'll pick it back up again when you're finished.

Okay, we're back, and hopefully, your spreadsheet looks something like mine. And what we've done is a sensitivity analysis where we have systematically looked at the number of bullets, and we let them range from 0 to 30. And we also systematically changed clutch size from .8 to 1.3. And I'm going to go ahead and label that particular cell up in cell F5. I'm going to label that 'Clutch Size'. And there's a reason why that is labeled there - and I'll tell you about that in just a second. And this whole thing is our sensitivity analysis so I'm going to highlight those cells and merge them, and then color them in some color.

Now you can look at the numbers in your graph, and what they're doing, these numbers are the final population size under different combinations of parameters. And what's really critical here in a sensitivity analysis is that you don't just arbitrarily choose numbers and say, "Well, how sensitive is this?" What you want to do is find things that are realistically the best-and-worst-case scenario. It doesn't make any sense to graph and to model out something that's not possible.

I've chosen these numbers - and I would have to consult with Tony, or with the caliph, or whoever, or with you the modeler - to find out what is actually a good range of values to look at.

And what you can see is, under a given clutch size, as we increase the number of bullets the population size goes down, and that's totally expected. Now the question is - what we want to know is - are the changes along these axes due more to the increase in bullets, or are the changes in the numbers due more to changes in the clutch size?

One way to look at these results is to graph them. And what you're looking for is - Where does the population size change most dramatically under which combination of parameters?

And, to do that, we're going to select cells F6 through J12. And we're going to insert a line chart. So go up to the Ribbon and select the Insert tab. Choose the Line option, and choose the option that's labeled Line with Markers.

In your spreadsheet then, you should see that the spreadsheet automatically depicts a series. Here's the clutch size on the bottom axis. And these show the changes in population size, so the numbers that are graphed are actually the number of rocs over time - actually the number of rocs in the year 2000, under different scenarios versus 0 bullets, 10 bullets, 20 bullets, and 30 bullets.

What do I need to do with this chart? I need to add axes.

So I can click on the Layout tab on the chart ribbon, and I'm going to go ahead and add 'Axes Titles'. For the Horizontal Axis, I'm going to enter 'Clutch Size'. And I go back up to my Axes Titles. Now I choose the Vertical Axis, and here I want to enter 'Roc Population Size in the Year 2000'. That's what we are graphing. For my Legend, I have 0 bullets, 10 bullets, 20 bullets, and 30 bullets. And, if I click on the Legend key, I have several options here that tell me how I can possibly align my Legends, or, if I wanted to turn off the Legend, I have that option as well.

So what you're looking for in a graph like this - assuming that you've chosen numbers that are realistic to do a sensitivity analysis on, is where does this graph change the most abruptly between two values.

And, if you see relatively little difference, it means that that parameter is not very sensitive. The model is not very sensitive. And just looking at this, would you look, and would you say that the model is very sensitive to changes in the number of silver bullets?

I wouldn't, not compared to clutch size anyway, because the number of silver bullets basically follows the same trajectory over time, and there's really very little difference in the final population size when there are 30 bullets compared to 0 bullets. There's a far greater change in population size by varying the clutch size.

When the clutch size is .8, no matter how many bullets there are, the value is 0. But, as I increase that clutch size in fairly small increments, I get dramatically different results, in terms of what the final population size would be in the year 2000.

And that's one of the values of graphing your results. In this particular example, I'm graphing the results of many different trials in one graph. And so this is the kind of graph that you would use that would display a lot of your results over a lot of different model runs in one picture - that lets you to pull out the main conclusions of the model in terms of sensitivity.

Go ahead and save this file once again.

And now we'll move on to more things that we can do with the rocs.

< 00:14:22 END >