POPULATION MODELS

Environmental Stochasticity: Roc Flu 2

Terri Donovan

recorded: January, 2010

Okay. So now we have our random numbers, and we know whether or not that random number resulted in a flu for that particular century or not. And so our next step now is to define a formula that would tell us whether or not there were deaths that were related. And we're going to again use - we could use an IF function that would say - i there was a flu, then calculate how many deaths occurred. And, if there was not a flu, then there would be zero flu deaths as a result.

Now before I do that though, remember our time step here is - we're actually going to erase the first two numbers in our formula - because what we need to know is how many rocs were there in the time step previous that actually caught the flu. Now the formula we can use can be. like I said, it can use an IF function that would say - if there was a flu, if flu is equal to 1, then take the number of rocs in the previous time step and multiply that by the flu mortality rate. And that would tell us how many deaths there were. If the flu value was not 1, then return a 0.

So there's a couple ways we can do this, so that's using the IF function, and that would look something like this. Go up to the Function box. We're going to use an IF function and we would say - if the value in the cell to the left is equal to 1, then we want to reference the cell adjacent to the right, and multiply that number by the flu mortality rate. If there was no flu, then there would be just 0 deaths due to the flu, and we could press OK. Now we can copy this formula all the way down and be modeling how flues occur with an IF function.

The other way is a little bit faster so I'm going to delete those and show you a different way, and that is just to multiply our value. Flu deaths is equal to the number of rocs in the previous time step, times whether or not there was a flu, times the flu mortality rate. And that does the exact same thing as our IF function, but with a few fewer steps. Because, what happens is, if this number is 1, then you multiply the rocs times the flu mortality. And that just says right now 35 percent of these 700 rocs will die. But, if the flu is 0, then the result is 0 because you're multiplying a 0 through the equation, and you end up with 0 deaths. So we should have the same kind of result as we had before. Notice my random numbers are changing every time I press a calculate or enter a new equation in there.

We have now populated our spreadsheet. We know if there was a flu. We know how many flu deaths there were, and now we need an equation to calculate how many rocs are in the next time step. How would you do this?

Well, if you remember back to our last exercise, we talked about computing the number of rocs as the number of rocs in the previous time step minus those that were shot by silver bullets. And now, in this case, we also need to subtract off how many died by the flu. And that collective bunch of numbers, that's the breeding population, and those animals are able to reproduce with the Clutch Size that's given in cell B1.

So our formula is going to be equal to the number of rocs in the previous time step, minus those shot by bullets, minus the number that had died from the flu. All of that goes in parentheses because this represents now our breeding population size and, if we multiply that times the Clutch Size, that equation will generate the number of rocs in the year 1100. I press Enter, and I get a particular number. Now your number may or may not be the same as that. If you had a flu epidemic for your first year - right here, if my random number was .1, then my number would be quite different. Okay?

So at this point, we're able to take our equation here, and this is now our model workhorse, and we're going to drag that down. And, since these are numbers, I want to make these and format them correctly. I go back up to my Home tab and change those to a number, and I don't want to display any decimal points. If I wanted to clean this up a bit, I could center my columns. And there's my very basic roc flu model.

Now another important thing that I could do is create a new output called ‘Number of Flu Epidemics’. And in this particular cell, cell E3, I just want to sum how many times the flu occurred. And so I'm going to enter that with the SUM equation, which is just sum, and you can enter these numbers one at a time and separate them by columns. Or you can select them as a group and press OK, and it's summing that. And again, that's a model output, and so I want to shade that as a model output as well.

Now in my particular spreadsheet that's being shown right here, there were no flues. And so, given the clutch size and the number of bullets, this by chance, just happens to look exactly like what we did when we first built our basic roc model in the previous exercise. But, if I press F9, I generate brand new random numbers. And look, in the year 2000 - on my computer - a flu epidemic struck the roc population resulting in 329 deaths. And so our Final Population Size is

626. So our Ending Population Size is 626, with one flu epidemic. And these are the numbers I want to watch as I'm pressing F9. And I'm looking each time I press, I get a random number, a brand new random number. And I'm getting a new trajectory of roc population sizes. And each one is fairly different or, in some cases, very different from others. Your numbers will be different than my numbers.

And you certainly wouldn't want to go to the Caliph and run this model once and say, "Well, there's my answer. There's three flu epidemics, and 209 is the ending population size." And that's because, whether or not there is a flu is a stochastic process. And it's an environmental stochastic process where you really don't know, and can't predict or control what's going to happen.

And so in these cases, you'd want to run this particular model many, many times and try to get a sense of - What's the range of population sizes? How often do I get flu epidemics? And at what chance, at what level here do I want to say, "Yikes! The population is way too low?" And at what level do you want to say, "Things will probably be fine for the population of rocs and report that back to the Caliph?" And that's what we're going to do in our next clip.

< 00:09:34 END >