Elephant Management Model - Part 3

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We are going to look at different ways of exploring the results from our elephant contraceptive model. The first thing we're going to do is to review our last results, in which case we found that the proportion that needs to be contracepted is approximately 0.80. And that gives us a final lambda of one and a final population size of 4,229. When you're showing your results to a manager, as Tony said, you can get a lot more information from this model than what we're just depicting here.

For example, what if the manager said, "Well, I'm not interested in seeing the population go up for the first 40 years and then starting to decline. I'd like to maintain the population size stay at 3,500 throughout." How would you approach this?

Well, we could use Goal Seek once again, but this time we can have our target cell be the cell that reveals the final population size. Let's do that now. We'll go to the Data tab and then find Goal Seek. This time we'll set our final population size to 3,500 and we'll change the cell B6, and then we'll press Okay. This time Goal Seek finds a solution, and the proportion that are contracepted is 0.82.

Compare that to our last model, where the proportion that had contraceptive was 0.80. So very small changes in this number give us different population sizes. We're still aiming for a final lambda. This model, again, shows these funny dynamics, and this is expected when a population is being managed. We still see this same little hump, and ideally we could run this model out again for a longer period of time to make sure that it, in fact, has stabilized.

The second thing we want to go through in this spreadsheet module is really looking at the sensitivity to our results when we change the proportion of animals that receive a contraceptive.

We'll explore that by entering a series of values down column J. This would be the proportion that receive a contraceptive, and I'll just abbreviate that. And we'll start our series with zero, and then we'll go to 0.2. So zero percent of the females have a contraceptive, 20 percent, 40 percent, 60 percent, 80 percent, and we could go ahead and graph 1--what happens if we control all the females? Well, this is a pretty silly number to go ahead and do an analysis on, because we know that if all of the females receive contraceptive that the population would go extinct. So we'll go ahead and put down 0.99.

For each of these values, what we want to do is take this number, plug it in to cell B6, and record the final lambda and the final population size. That will give us a nice way to look at many of these results in a couple of different ways.

Rather than entering these one at a time, we're going to use a spreadsheet function called the 'Data Table', and this is a very handy tool in Excel. The Data Table is located under this What-If Analysis, just like the Goal Seek was located under there as well.

Before we invoke the Data Table, though, what we're trying to do and what we're going to do is take each of these inputs, which are listed down this column, and we're going to feed them into cell B6; it's kind of like our engine. We'll put it into cell B6, and we want to record the final lambda. We'll start with the lambda values. We need to reference the final lambda in cell K1. All I've done is reenter and make a reference that points to the final lambda. That is how the data table needs to be set up. There's a specific way that your entries need to be on your spreadsheet in order for the data table to work.

To use the data table, we need to select cells J1 through K7, so the whole block of cells there. We then find the Data Table option. This is the dialogue box that appears. There is an option for a Row Input cell and a Column Input cell. Our data for this problem are entered down this column, so we will leave the Row Input cell blank. We need to fill in a reference here, and this reference says, "When I take the values down these columns, down this one column, where should I insert them into?" And we're going to tell it to insert them into cell B6. That's all there is to it. We press Okay and what happens is the spreadsheet filters those numbers in, and it records what the lambda value is for each and every one of these different scenarios. This is a great tool for doing sensitivity analysis on a spreadsheet, and it also facilitates a graph like the one that Tony had made in the previous video.

<u>PAUSE the video</u>: Use a Data Table to report the final population size when contraceptives vary.

To graph this, let's just select cells J2 through K7. We'll go to the Insert tab; we'll insert a scatter graph, and this looks very similar to the graph that Tony made. Along the bottom axis, we have the proportion of females that receive a contraceptive, and along the vertical axis we are plotting lambda, the growth rate. Let's go ahead and clean this graph up. We'll go back up to the Chart Tools tab; we'll choose the Layout tab; and now we can add our axes. The horizontal axis is the proportion contracepted, and the vertical axis is the lambda value. We can fix these axes because this proportion can only go between zero and one, so we'll right-click on the axis, choose Format Axis, then we'll choose Fixed. We'll make the minimum be zero, and we'll make the maximum be one. And that's very much like the graph that Tony had showed us in the previous lecture.

Remember, this lambda value is the value after we've run the model for 80 years. So this is the lambda value at 80 years, and we want to make sure that this model is run out long enough so that we are reporting a lambda value that in fact has stabilized. Just to recap some of the things that Tony said. He said this is a fabulous graph to show managers. For any level of contraception, we can find out what the growth rate is expected to be after 80 years of population dynamics. As we found before, when 80 percent of the females receive a contraceptive, the population is more or less stabilized.

The other thing, though, that Tony pointed out is that this curve is really sharp around this area here. And that means that very small changes in this proportion really result in very different numbers for lambda.

For example, if we move up to 0.82, we could have a declining population; and if we move down to 0.78, we'd still have an increasing population. That's changed quite a bit though. The slope of this line at this point is fairly great compared to, say, the slope of the line at these points. This means that this is a very sensitive parameter, and if this is the area that you're targeting, in terms of how you want to manage the population, you need to be very careful about getting this number right. If you're aiming for 80 percent of the population to have a contraceptive, there's really not much room for error before you are at a different target lambda than what you were hoping for.

So let's move this graph down and out of the way a bit, so that we have more of our spreadsheet showing here. And what we want to do now is to focus on the last piece of information that we really want you to take home with this exercise. And that is that when you manage a population that has some kind of structure, in this case an age structure, the management itself changes the age structure, and let's show that to ourselves now.

There's a few ways we can explore how management affects age structure. Let's use cell D5 and create an entry called Calves, and then in E5 we'll enter Juveniles, and then in F5, we'll enter Adults. These will be headings, so let's bold and underline those. We want to count the number of calves, juveniles, and adults that were present pre-management, so we'll choose the row 10 that's shaded in green, and we'll just simply count the number of calves that were present where it was stabilized, so there was a stable age distribution because we started it that way.

Let's just go ahead and summarize how many animals are in each of these groups. So the number of juveniles is just the sum of cells C10 through M10, and then the number of adults we'll enter with a sum function as well, and we'll just sum all of the entries that are shaded green that are also adults. This represents the number of calves, juveniles, and adults in our population, and we'll just sum those. We should end up with 3,500, because that's how we set this model up.

In contrast, let's compare what the number of calves, juveniles, and adults would be, and we know that our final population size is 3,500. Let's figure out how many calves, juveniles, and adults there would be at year 80 after the population has been heavily managed. And here, all we have to do is reference the last row of our simulation. A trick that we can use to help us see these headings and get to that last row is we can go over to the right side of the spreadsheet. When the mouse turns into these crosshairs there, you can click once and pull this down. There's our first year of the simulation.

Now we can use the bottom portion of the screen and scroll down to the last year of our simulation. And it's year 80. Let's go ahead and shade that, just so that we know that that's the ending of our population size. By moving this scrollbar down, we're able to fix this portion of the screen and then move around down in the bottom portion of our screen so that we can see all of these headings.

We need to enter the number of calves in year 80. Here's the calves. We'll reference cell B90. The number of juveniles will be the sum of all of the columns that have this orange shading associated with that, so that would be cells C90 through M90. And the number of adults is also going to be a sum, and we'll sum the number of adults in the very last year of our simulation.

So this gives us one look at how managing the population is changing our distribution of how ages are distributed throughout that population. In the unmanaged case, we had 248 calves every year, stable population size of 3,500. When we go through some management exercises, we end up with 77 calves, a lower number of juveniles, and a much, much higher number of adults. And Tony emphasized that this change in the structure of the population can result in all kinds of perhaps unforeseen behavioral changes that could influence the population dynamics even further. To get rid of this line here, we'll just select it and move our mouse all the way back up to the top, and we have our full spreadsheet again.

That wraps up this exercise. Now we'll head back to Tony, who'll give us a wrap-up and a summary of some of the most important lessons we need to keep in mind when we're modeling populations where there is management. See you next time.

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