Introduction to Mathematical Modeling

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Logistic Models and Spreadsheets

Goal: Write a spreadsheet program for the Logistic Equation and do some mathematical analysis.

1. On a separate piece of paper write down the Logistic Recurrence relation. What are your variables? What are your parameters? Draw a compartmental diagram for the Logistic Equation.
2. Find the fixed points and stability for this system. *We did this in class, make sure you can do the calculation on your own*
3. Now open Excel (or another spreadsheet program). Start by listing all of your parameters at the top of your spreadsheet. To start let
   - the initial population be 25
   - the maximum growth rate be 0.5
   - the carrying capacity be 120.

   Build your model and make a graph plotting population vs. time.
4. Next we will test to see if the model is sensitive to any of our parameters.
   - Keeping the carrying capacity and growth rate the same, change the initial population. Vary it from above the carrying capacity down to zero. Is your model sensitive to initial population? Does your answer make sense? What if you set your initial population equal (or very close) to the carrying capacity?
   - Keeping the initial population and growth rate the same, change the carrying capacity. Is your model sensitive to the carrying capacity? Does your answer make sense?
   - Keeping the initial population and carrying capacity the same, change the maximum growth rate.
     - Vary R between $-2 < R < 0$. Our analysis said that $\bar{P} = 0$ is the stable fixed point. Do you see this in your model?
     - Vary R between $0 < R < 2$. Our analysis said that $\bar{P} = K$ is the stable fixed point. Do you see this in your model?
     - What happens when you are outside these ranges? Let $R = 2$, $R = -2$, or let R be way outside these ranges. What do you see? Try to describe in words what your model is telling you. We will talk about this at the end of class.
5. Summarize what you found by doing this analysis.

CHALLENGE!! See if you can redo this assignment for the Logistic Equation with hatching:

$$p(n+1) = p(n) + R\left(1 - \frac{p(n)}{K}\right)p(n) + h$$