Population Models II

Agenda and Checklist

The main goals of this worksheet are:

- To explore another model for population growth.
- To understand, compare, and interpret model projections.
- To see an example of model reparameterization.

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☑ Write the name(s) of your studio partner(s) here: Cory Knox

☐ By midnight ~~Thursday,~~ September ~~19.~~ 20. Scan this worksheet and submit it on Canvas.

☐ Read Chapters 9-10 for ~~Friday,~~ September 20.

Chapter Notebooks

Quadratic Growth

Work through the first two sections of the Chapter 7 notebook (*Quadratic growth, Equilibrium*).

Q1: Did you find any better parameters? How did you play around with setting `alpha` and `beta`, and how did you evaluate each choice?

alpha = 0.118

beta = 0.0225

we adjusted alpha & beta, so that when it undershot, we increased one of the values, and vice versa

Q2: What does "equilibrium" mean in this context?

equilibrium point - carrying capacity

equilibrium - growth <= 0

Dysfunctions

Work through the next section of the Chapter 7 notebook (*Dysfunctions*).

Q3: What are the four dysfunctions? Have you encountered them?

1. overwriting
2. not parameterizing
3. no return
4. dropping the return

I have encountered all of these at some point or another in the last few years of me learning to program

Reparameterization

Work through the exercise at the end of the Chapter 7 notebook.

Q4: Why might it be useful to reparameterize your model?

To make the values changeable within the program by not hard-coding them.

Reading Reflection Questions (15 minutes)

1. **A proportional growth model assumes a linear relationship between time and growth rate, whereas a quadratic model assumes a quadratic relationship. Why does a quadratic model always fit the data at least as well as a linear one? Does that mean that it is necessarily a better model?**

A quadratic model includes both a linear & a quadratic term, so if the data truly is linear, the quadratic coefficient will be very small, but if the data is non-linear, it will extrapolate a much better fit line. In quite a lot of applications, I would say it is a very useful model. With the exception of when you know that your data is not linear or quadratic.

2. **When we make a prediction using a model we are assuming that the assumptions of the model hold and that nothing happens to affect the parameters of the model. How might we use future data to test these assumptions?**

you can use future data to validate your model (& its assumptions), and use something such as an average % difference to quantify how well it is working.

For example, with the quadratic model we would be assuming the rate at which the proportional growth of the population is changing. We could compare next years data to the predicted value and calculate the difference.

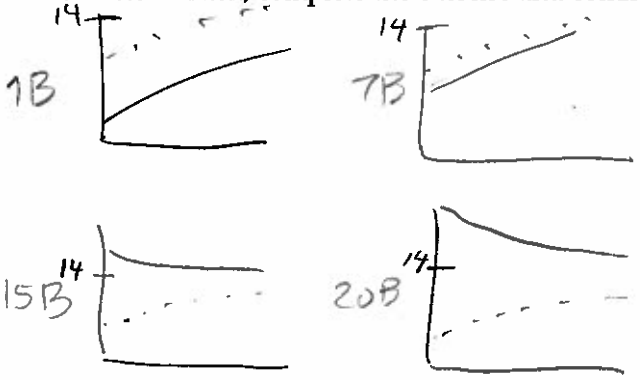
3. **In Chapter 8, the book says that a prediction can be credible even if the model assumptions are not strictly true. Explain what this means. How does this relate to our modeling mantras?**

Our models so far have been inherently limited to only use data as a comparison for validation. Our population model didn't have any kind of limit or asymptote written in to cap the population at carrying capacity. And yet, when using a quadratic best fit, the population still levelled off at 148 people. This is an example of how the model can extrapolate the underlying trends of the data, without knowing the cause of it, and still be credible even if not exactly true.

Generating Projections

Work through the first four sections of the Chapter 8 notebook up to (but not including!) the exercise at the end of the *Generating projections* section. Read the exercise.

Q5: Sketch what you expect to find as you vary the starting population below. Then, complete the exercise and comment on the results.



the model predictions all generally converge towards 14 Billion (what it must estimate as the carrying capacity)

Comparing Projections

Work through the next section of the Chapter 8 notebook (*Comparing projections*).

Q6: What factors might you consider in choosing a model? Using these criteria, would you choose the quadratic growth model to project future population size?

I would choose quadratic growth model to project future population size because it can change the population growth over time, more effectively taking into account carrying capacity.

Generating Good Questions (15 minutes)

We've been talking a lot about population models. On your own, spend five minutes generating questions you might ask that a population model could answer. Use sticky notes — one note per question. Generate as many as you can in five minutes, keeping in mind the pitfalls.

Now work with your studio partner(s). Pool all the questions you generated; now choose three to work with. Don't spend a lot of time choosing, just pick three that are appealing. What are the outputs you would need from your model to answer each question? What metrics would you use?

what is the projected population in 2050?

What is the carrying capacity of the Earth?

Can we model population in each country in the same way?

What are the "bad question" pitfalls you want to avoid?

- asking questions about the model itself
- asking questions that do not pertain in any way to the original inquiry that motivated the creation of this model

Worksheet Reflection Questions (15 minutes)

1. **What is the difference between a result and an interpretation? What is the relationship between the two? What's the problem with presenting results without interpretation?**

a result is the output of the model, while interpretation relates the result back to the original question and explains how it answers it

2. **Next class we will introduce Project 1. As part of this you will work through the QMRI (question, model, results, interpretation) process for a modeling question of your choice. Write 2–4 goals for your own learning during this project experience; try to write at least one for modeling and one for teaming.**

1. I want to learn how to more effectively subdivide work between individuals on this group project so that everyone on my team does a fair amount of work
2. I want to learn how to document and comment my work more effectively in order to communicate my ideas better