I am going to make some suggestions of things you could with your journal. You can't follow them all, and you need not follow any of them.

Tuesday, September 14

1. We arrived at this model:

$$\begin{aligned} S_{k+1} &= S_k - \alpha I_k S_k \\ I_{k+1} &= \alpha I_k S_k \\ R_{k+1} &= R_k + I_k \end{aligned}$$

   Sophia observed that instead of assuming that you know α, you can actually compute α from the history (assuming that there is an α). Suppose you observe the first 10 time epochs, and only then start modeling. Can you figure out a way of getting α (of course always assuming that there is an α) by observing the first 10 epochs?

2. Suppose that people become susceptible again a certain number of — let's call it m — epochs after recovering. How can you put that into the model? (You'd now have to have dependent variables $R_k^{(j)}$, where the superscript j denotes the number of epochs that have passed since the individual recovered.)

3. Suppose that a certain fraction, let's call it β, of recovered people become susceptible again in each epoch. Let's also make the modification of replacing αI_k by $\min(\alpha I_k, 1)$. Then our equations are:

$$\begin{aligned} S_{k+1} &= S_k - \min(\alpha I_k, 1) S_k + \beta R_k \\ I_{k+1} &= \min(\alpha I_k, 1) S_k \\ R_{k+1} &= R_k + I_k - \beta R_k \end{aligned}$$

   Write a program (if you can) to see what happens. For $\beta = 0$, we are guaranteed to converge to a state in which $I = 0$ — so we get herd immunity. What happens as you raise β to positive values? If the S_k, I_k, R_k converge, can you figure out what they have to converge to?

4. Google "SIR model" and see what else you learn.