Modeling in Differential Equations in a Virtual Setting

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- Teaching in the past face to face: like performing as a professional dancer
- Teaching remotely: like doing the same dance but backwards and in high heels!

Things to help us dance backwards

- Need to Know
- Videos created to go over the technique
- On-line homework assigned- work submitted online
- Break out groups
- Office hours
- Guide on the side scenarios
- Independent scenarios
- Scenarios in "their" real lives
- Interviews

How the first technique and scenarios were choreographed:

1. Need to Know
2. Technique: Separation of Variables
3. Scenario: Ebola Outbreak in West Africa
4. Scenario: COVID Outbreak in the United States
5. Follow up Scenario in December: COVID
6. Interview

1. Need to Know

- Review of Partial Fractions
- Exponential and Logistic Growth Models

2. Technique: Separation of Variables

- Short discussion in class
- Videos created to go over the technique
- On-line homework assigned- work submitted online

3. Scenario: Ebola Outbreak in West Africa

- First Scenario of the term
  - Started in class discussion and then break out groups
  - Modeling: EBOLA Outbreak in West Africa; Using data of WHO (UN)
  - I tweaked the following scenario so that variable names alligned with the textbook and videos
  - Lisa Driskell (2016), "1-038-T-Ebola," https://www.simiode.org/resources/2722.

Class Discussion

- The number of cases grows at a rate proportional to the total number of cases.
- Brainstorm for a differential equation modeling the rate of change of the number of cases of people infected with Ebola
- $dN/dt = rN$
- Solve this exponential differential equation using separation of variables
- $N(t) = ce^{rt}$
- What are the unknowns in the equation?
- Use the data to solve for a particular solution
- $N(t) = N_o e^{rt}$
- Broke up into groups to find r

Data

Date	t (months)	Total Cases
3/22/2014	0	49
4/14/2014	1	194
5/12/2014	2	260
6/16/2014	3	528
7/14/2014	4	982
8/13/2014	5	2,115

Moving on to a better model

- $dN/dt = rN(1 - N/k)$
- Solved together in class
- $N(t) = (k/(1 + ck^{-rt})$
- What are the unknowns in the equation?

Group Work

- Groups of three were randomly chosen
- I jumped in and out of groups.
- Zoom allowed students to summon me for questions
- I actually found students to be more vocal in online groups than in person
- Reporter: one student to give a brief oral report
- Scribe: one student to submit a brief written report
- Task:
  - Construct a specific model for spread of Ebola
  - Interpret and verify the model
  - Reflect

Review the modeling process:

- the wording of the project
- general differential equation to model the rate at which the virus spread
- general solution of that differential equation to model the actual number of cases
- using the data to find the parameters so as to arrive at a particular equation to model the spread of the ebola virus.
- Look at accuracy of your predictions
- Though you wanted to predict N(t) you first found the rate at which N changed and then found N(t)
- thoughtful answers

4. Scenario: COVID Outbreak in the United States

- First independent scenario of the term
  - Each student is assigned a state in the United States
  - Each student finds the data from the CDC site
  - Each student develops a logarithmic model for that particular state
  - Each student compares the model with the data
  - This scenario was completely independent

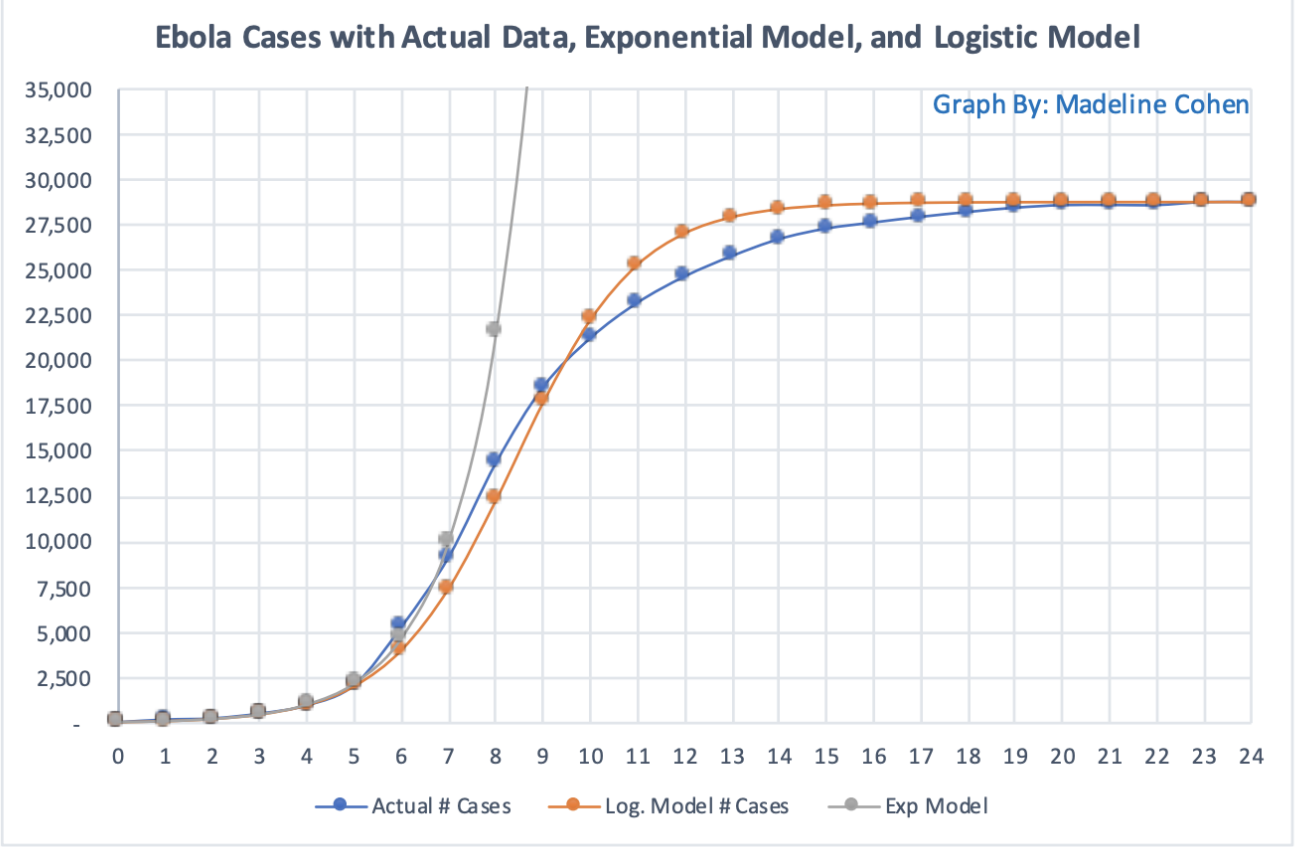
5. Follow up Scenario in December: COVID

- Last scenario of the term: now three months later use graphs to compare your model with the actual data

6. Interview

- How good was your model?
- Brainstorm: what would make it better?

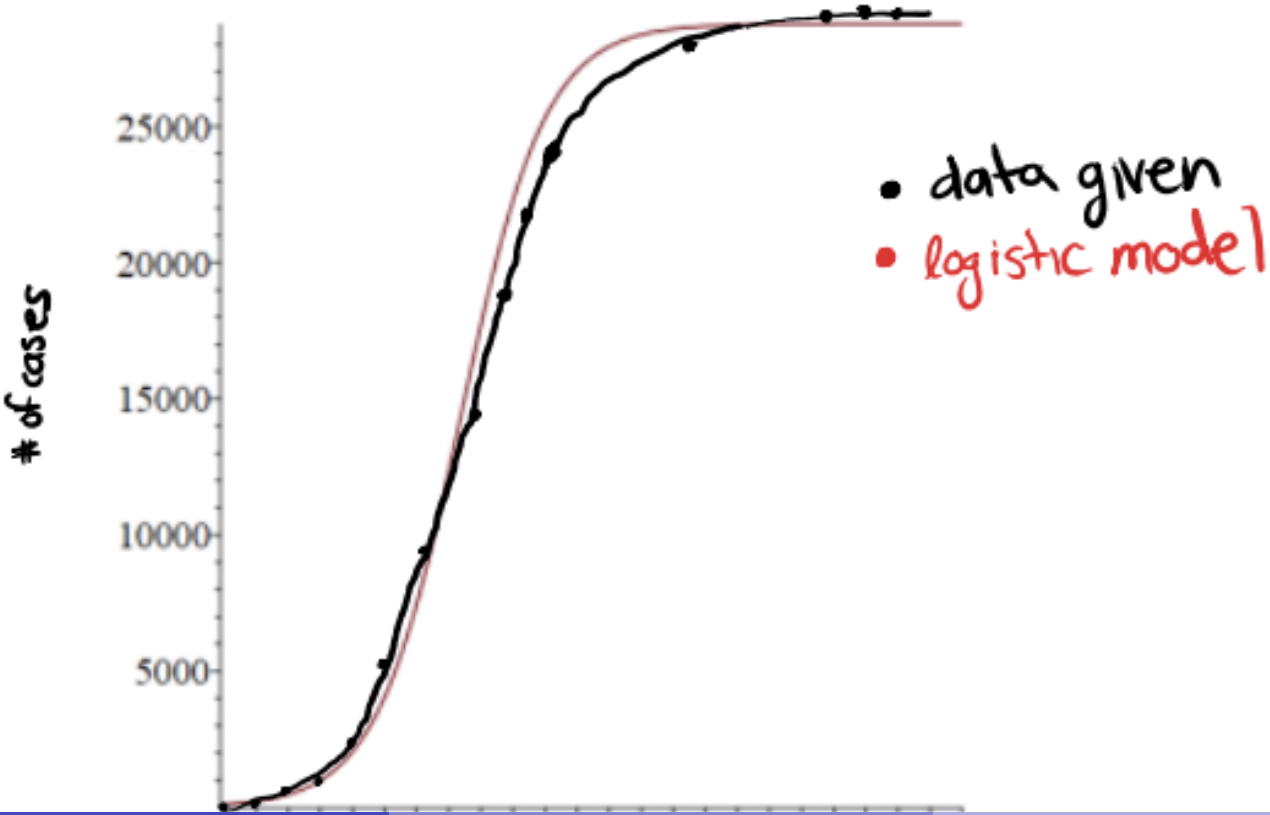
B: Ebola vs Data



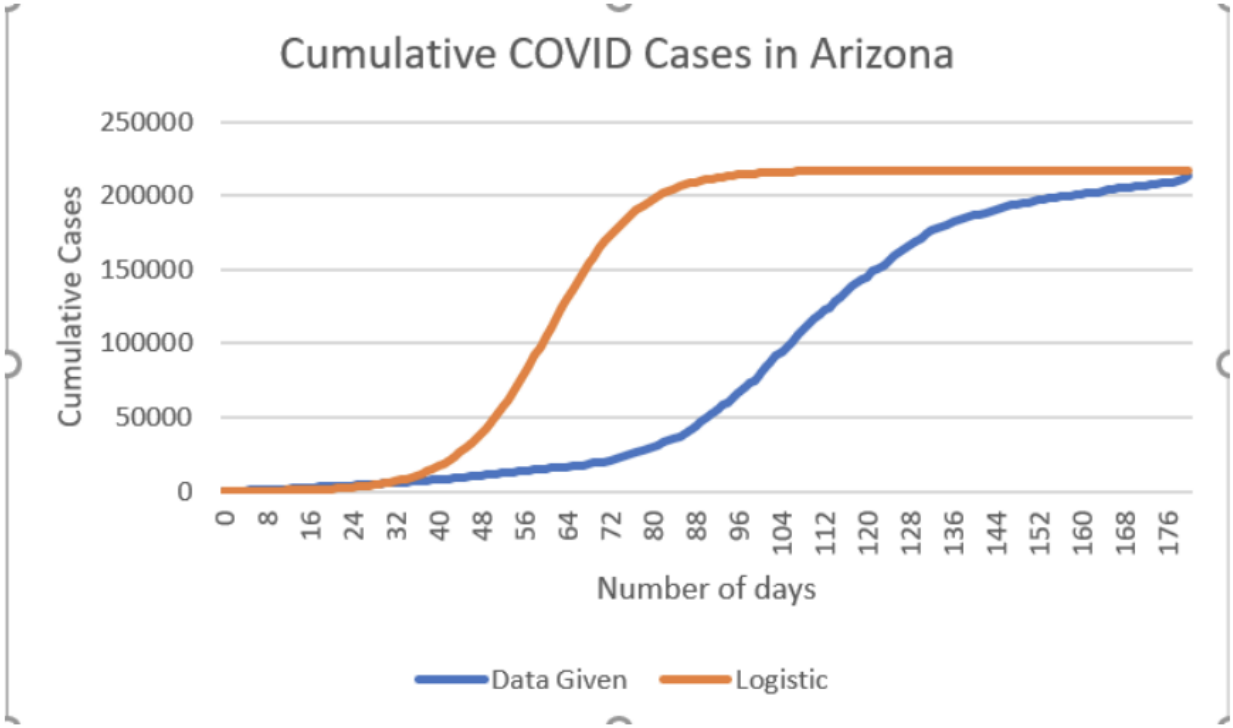
Ebola data vs logistic

$$\overline{(-0.7607 \cdot t)}$$

$$M := t \mapsto \frac{28766}{1 + 0.0204 \cdot 28766 \cdot e^{(-1) \cdot 0.7607 \cdot t}}$$

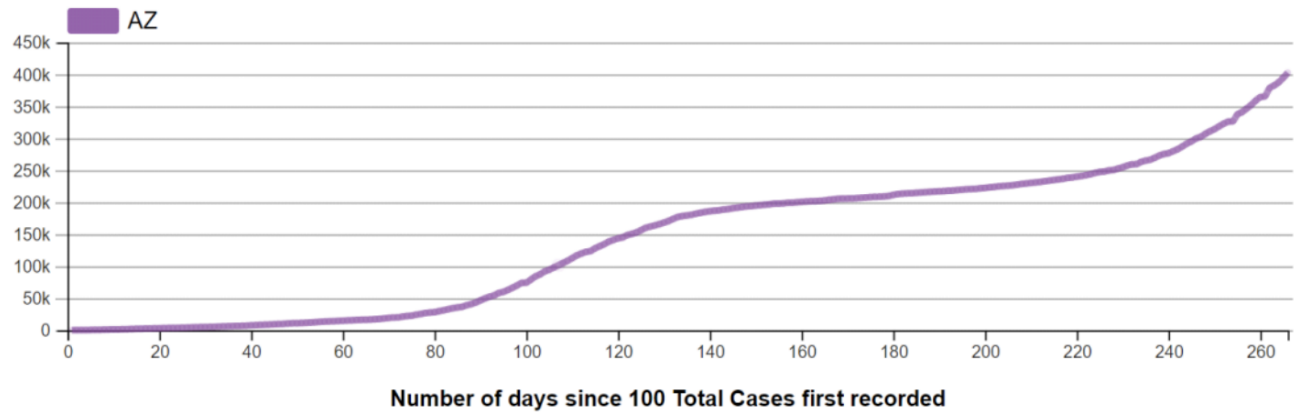


September Arizona

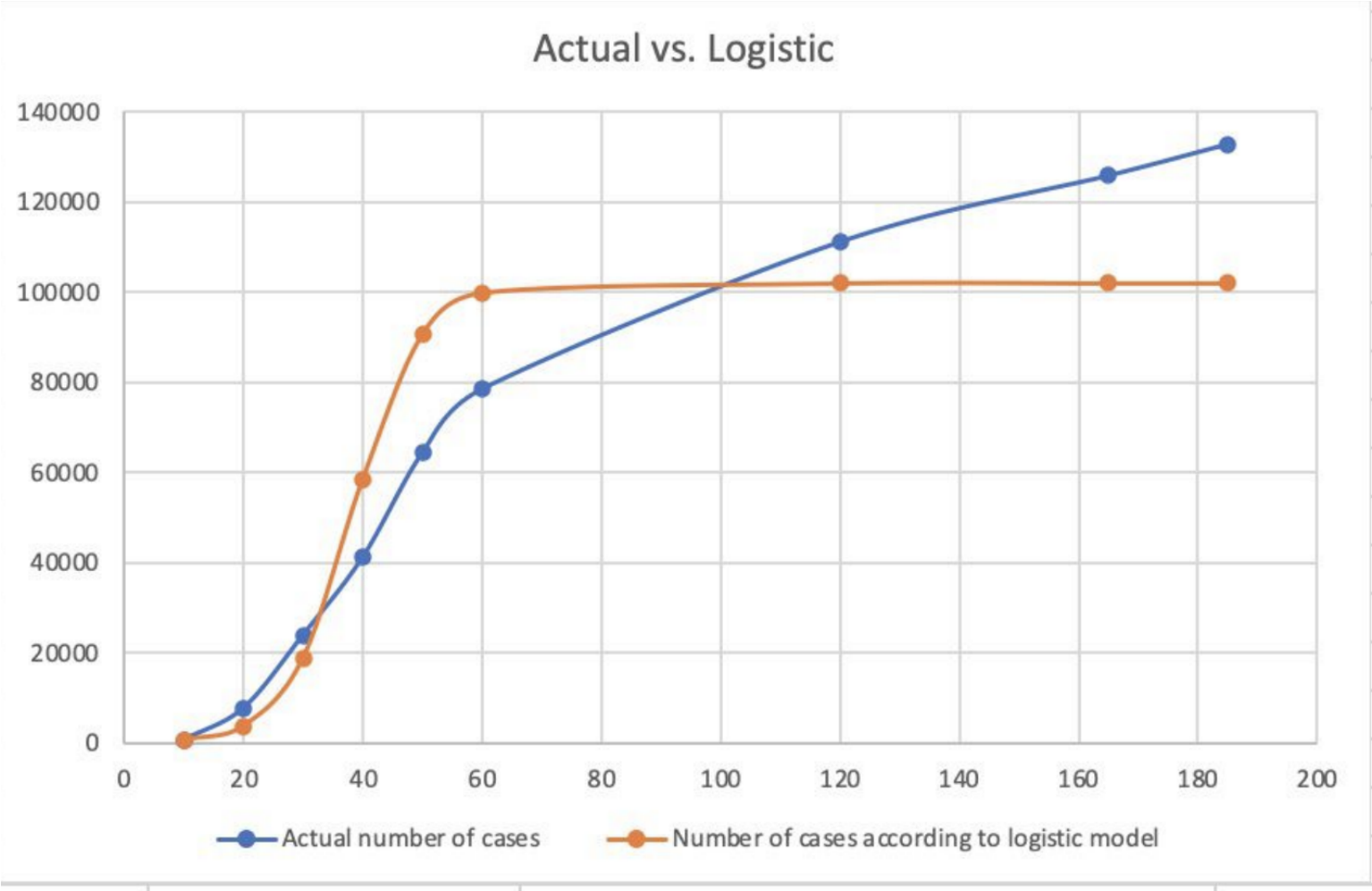


December Arizona

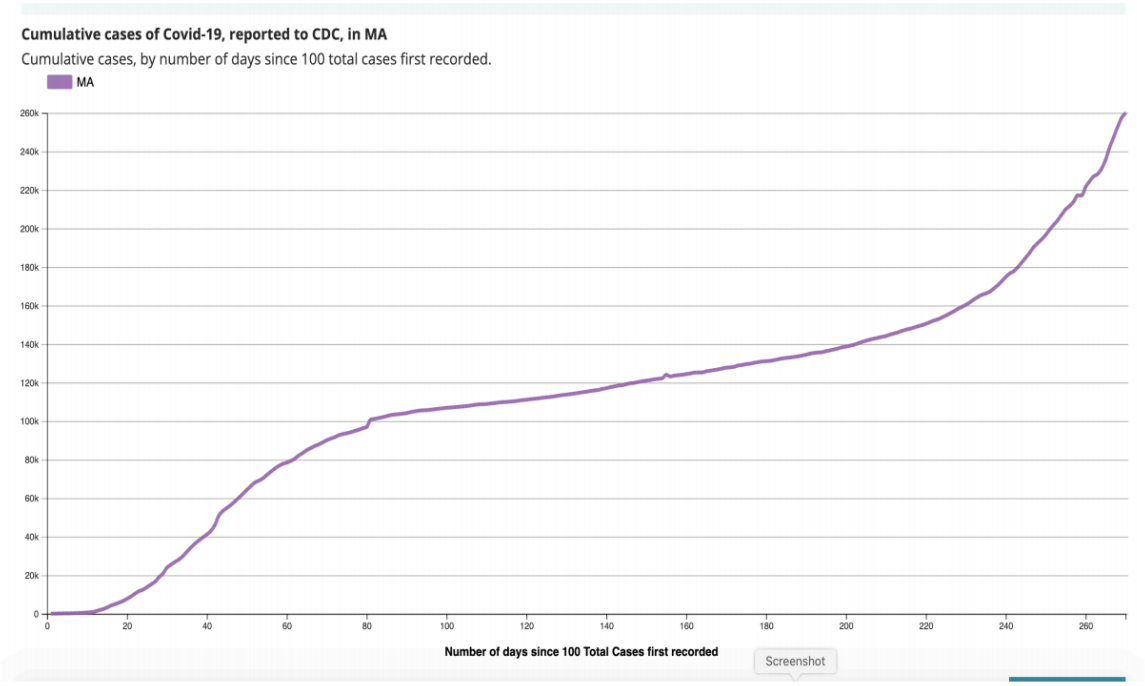
c)



September Massachusettes



December Massacusettes



Interview

- What did you think of the scenarios?
- What did you think of the group break out sessions?

- patrice.tiffany@manhattan.edu
- SIMIODE.org
- https://www.simiode.org/resources/2725/download/1-38-S-Ebola-StudentVersion.pdf
- https://covid.cdc.gov/covid-data-tracker/trendsdailytrendscases