Coronavirus wrap-up

After completing this section, students should be able to:

- Recognize if an exponential growth model is appropriate for a given growth pattern based on a plot or a log plot.
- Compare the results of the logistic curve model and the SIR model.
- Identify possible inaccuracies to the models that might account for some of the discrepancies.
- Compare model predictions to reality.

We have now analyzed the coronavirus in a variety of ways:
Using plots of data and log plots of data.

What can you tell about Spain and the US based on these plots of cases vs. time?
A. Both countries are experiencing exponential growth in cases.
B. US is experiencing exponential growth still but Spain is not.
C. Spain is experiencing exponential growth still but US is not.
D. Neither country is experiencing exponential growth still.
E. Can’t tell from these plots.
What can you tell about Spain and the US based on these plots of log(cases) vs. time?

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Good news for Italy.

Asym = 1.151779e+05
xmid = 8.184807e+01
scal = 5.063002e+00

Note 1.151779e+05 is scientific notation and means $1.151779 \times 10^5$ or 115177.9

What does this mean for the US in terms of length of epidemic and number of cases, if the US is like Italy?
Coronavirus Predictions and Reality

New York City:
NYC predictions made before spring break (based on China data):
  • Between 10,000 and 25,566 cases based on Hubei province (1.2 cases per 1000 people)
  • Inflection point at 100 days → epidemic over by May 18
NYC current reality:
  • Current total is 145,855 cases (about 17 cases per 1000)
NYC logistic curve on current data:
  • Puts asymptote at 160,879 cases
  • Puts inflection point at 99 days → April 8
  • Epidemic should be over by 137 days → May 16
The US:

US predictions made before spring break (based on China data):

- No more than 385,500 cases based on Hubei province (about a 1.2 cases per 1000 people)
- Inflection point on day 94 (April 3), epidemic essentially over by day 127 (May 6).
- 144000 cases by March 31

US current reality:

- Current total is 869,170 cases (2.7 cases per 1000 people)
- It looks like we have just about reached the inflection point now (April 23).
- There were 188,172 cases by March 31

US logistic curve on current data:

- Puts asymptote at 934,761 cases (but fit is not so good, looks like it will be more, maybe as much as double the current number, i.e. 1.6 million, as much as 5 cases per 1000 people – confirmed cases only!)
- Puts midpoint at 100 days → April 9 (but fit is not so good, looks like we might be approaching midpoint now at 114 days)
- Epidemic should be essentially over (less than 100 more confirmed cases) by 139
days → May 18 (but really graph looks like 153 days or so, which is June 1 or so
North Carolina

- We did not make predictions
- Too soon to fit a logistic curve, but it looks like we are close to inflection point – if so, might be done by around June 13.
SIR model:

\[ r_0 = 2.2 \]

\[ r_0 = 1.6 \]

Flattening the Curve
SIR model predictions:

- Epidemic lasts about 2 or 3 months
- A huge fraction of the population is infected - as much as 80%
- If we decrease $r_0$ from 2.2 down to, say 1.8 by social distancing, get a longer but less severe epidemic, but still over half of population infected.

Reality:

- This per capital incidence is about 100 times the per capita incidence based on the logistic curves!
- Could we have that much underreporting and symptomless cases that the confirmed cases are a small fraction of the total infections?
- In two California counties, it is estimated that between 2% and 5% of the population has been infected, based on antibody tests done on volunteers. Source: NYT, April 21, Coronavirus Infections May Not Be Uncommon, Tests Suggest
In break-up groups, discuss the following questions:

1) What has caught your attention in the news?

2) Is there anything you have noticed that makes sense in light of what we have talked about in class?

3) Is there anything in the news that contradicts what we have talked about in class?

4) Any other thoughts, ideas, or predictions?

Person whose birthday is closest to today’s date will be asked to report back one comment from the group. 5 minutes.