

For today, use the logistic model for the spread of an infection:

$$N(t) = \frac{N_0 T}{(T - N_0)e^{-ct} + N_0} \quad \text{where } N_0 = N(0) = \# \text{ cases at time } t = 0$$

$$\frac{dN}{dt} = \frac{c N_0 T (T - N_0) e^{-ct}}{((T - N_0)e^{-ct} + N_0)^2}$$

And use values

$T = 6,900,000$, the approximate population of Massachusetts

$N_0 = 164$, the number of COVID-19 cases in Massachusetts on March 15, 2020

1. Use $c = 0.05$ for the parameter related to the rate of spread.
 - (a) Find the formula for $N(t)$.
 - (b) What does the model predict that the total number of cases in Massachusetts on June 30, 2020 would be? on December 30, 2020?
 - (c) Compare your answers with actual number of cases on the dates. You can find this data at:
<https://www.mass.gov/info-details/archive-of-covid-19-cases-2020-2021>
 - (d) Find the formula for $\frac{dN}{dt}$.
 - (e) What does the model predict that the number of new cases in Massachusetts on June 30, 2020 would be? on December 30, 2020?
 - (f) Compare your answers with actual number of cases on the dates.
 - (g) Find the value of t at the inflection point of $N(t)$.
 - (h) What is the value of $\frac{dN}{dt}$ at the inflection point? What is the practical meaning of this value?
 - (i) Do you think the value of c is too big, too small, or just right?

2. Let $c = 0.03$ and repeat #1.

3.
 - (a) Graph your $N(t)$ functions from #1 and #2 on the same set of axes.
 - (b) Graph your $\frac{dN}{dt}$ functions from #1 and #2 on the same set of axes.
 - (c) Explain how your graphs and answers to #1 and #2 show why we heard the phrase “flatten the curve” so much in 2020.