MA103: Mathematical Modeling
Exponential Functions II **03 October 2025**

1. Build an exponential model using an empirical approach
2. Build an optimal exponential model using Excel
3. Define SSE and understand how minimizing it leads to an optimal solution for the parameters of an exponential model
4. Understand the connection between SSE and R^2 as measurements of the fit of a model
5. Think through ethical considerations for using an exponential model to make predictions

Example Problem: Modeling Anti-Depressants in Blood Stream

After taking a single dose of a commonly prescribed antidepressant, it's important to allow enough time for the body to clear the medication before beginning a new treatment. Overlapping drugs like this can be dangerous.

You are a pharmacist consulting with a therapist on a patient who needs to switch medications. The patient has recently taken a single dose of a commonly prescribed antidepressant. The lab measured the drug concentration in the bloodstream each day for a week.

Use the data below to build a model for the amount of medication remaining in the patient's bloodstream over time. Then determine the earliest day on which it is safe to begin a new prescription (once levels fall below 10 mg).

Day	Drug Level (mg)
0	59.55
1	46.22
2	34.22
3	25.46
4	18.59
6	13.94
6	10.4

Practice Problems:

1. You're analyzing how quickly a video clip spreads online. You notice that the number of views increases rapidly and seems to grow by the same percentage each hour (not the same number of views, but the same percentage increase relative to the current total). You track the number of views over the course of several hours and collect some data. Using the data develop a model. Then use your model to predict the number of views the video will have after 8 hours and how long it will take the video to reach 1,000 views.

Day	Drug Level (mg)
0	100
1	123
2	155
3	195
4	248
6	304
6	382

2. You are less than a day away from getting your phone back after having to put it away 48 hours ago to go to the field over the summer. You promised your significant other know you'd call them the moment you got your phone back, but you need at least 10% battery to make the call. You realized that you forgot to turn off your phone and didn't put it in airplane mode. Based on previous test, you tracked how your phone's battery drops over time when idle.

Use the data below to build a model for your phone's battery life and determine whether you'll have enough charge left to make the call when you get it back.

Time (hr)	Battery Level (%)
0	100
6	80
12	65
18	50
24	42
30	33
36	26

3. You're on a weekend field training exercise and one of your battle buddies opens your Monster! Your battle quickly recaps the can, but you know it's only a matter of time before it goes flat. How long do you have to drink the Monster before it tastes flat now that it's been opened?

Scientists have modeled the loss of carbonation as an exponential process, but this time you're given data from a lab that measured how much CO_2 remained in the drink over time. Use the data below to build your own model for CO_2 loss and estimate when the drink will taste flat (defined as 1.5g/L of CO_2.

Time (min)	CO_2 Level (g/L)
0	6.87
10	4.76
20	3.38
30	2.46
40	1.81
50	1.36
60	1.10