

# SAMSI PMED Hands-on problem set

Go to [https://github.com/johnnardini/SAMSI\\_PMED\\_UG](https://github.com/johnnardini/SAMSI_PMED_UG) and download patient\_data.Rdata

1. Load in and plot some of the patients' data over time. What can you infer about a patient's growth rate immediately from the visualization of the graph?
2. Plot patient 1's data over time as well as the ordinary least squares cost function over a range of values of  $k$ . What do you think their value of  $k$  is? **You may assume the initial volume of all patients is  $x_0=10$ .**
3. Use linear regression to estimate Patient 1's growth rate. How does this result change if you use Nelder-Mead? And what is the variance in their data?
4. Say that we label each patient's tumor as either benign if  $k \leq 0$  or malignant if  $k > 0$ . Estimate the value of  $k$  for all patients. Which patients are benign and which are malignant? Estimate each patient's variance to also understand how certain you can be of this decision
5. Load in patient data from patient\_logistic\_data.zip. Here, patient data is assumed to satisfy the logistic equation with solution

$$x(t) = \frac{L}{1 + \frac{L-x_0}{x_0} e^{-kt}}$$

with growth rate  $k$ , carrying capacity  $L$ , and initial value  $x_0$ . Estimate  $k$  and  $L$  for each patient. You may assume  $x_0 = 10$  for all patients.