1. Load the data from ps4_problem1.mat. Suppose that the data are from a V1 neuron in an awake monkey in two conditions. Suppose that x represents the contrast of the stimulus and that y1 represents the firing rate in response to each contrast (y1(1) is the response to the contrast x(1)) in a passive fixation condition while y2 represents the response in a memory task.
    A. Do the responses in the two conditions differ significantly at $p < 0.05$? Apply an appropriate statistical analysis to the data to answer the question.
    B. What fraction of the variability in firing rate can be predicted by the variability in contrast? Speculate on the identity of other variables that might account for the remaining variability in firing rate.

2. Load the data from ps4_problem2.mat. Suppose that g1 and g2 contain watermaze escape latencies for two groups of mice. There are 10 mice in each group and 40 trials, performed 4 per day. Each row of g1 and g2 represents the data from one animal across the 40 trials.
    A. Plot the trial data for the two groups in one plot. Each latency for each trial for each animal should be plotted as a single point. Use different colors or symbols for the two groups.
    B. Plot the means and standard errors for each trial for each group. Use either the matlab function ERRORBAR or the ERRORBAR2 function on the course website. Inspect the graph to determine if the two groups appear to be significantly different at any point.
    C. Fit the data using linear regression. Does this analysis indicate that the two groups differ? Plot the raw data and the fit with 95% confidence bounds above and below.
    D. Fit the data using non-linear regression. Which non-linear model is most appropriate? Does this analysis indicate that the two groups differ? Plot the raw data and the fit with 95% confidence bounds above and below.
    E. Calculate the explained variance for both linear and non-linear regression. Which is a better model, the linear regression or the non-linear regression?

3. Load the data from ps4_problem3.mat. Suppose these data represent the spike times recorded in the 300 ms following the onset of the first syllable of either a tutor song (spiketimes2) or a non-tutor song (spiketimes1). Each element of spiketimes1 and spiketimes2 represents the spikes from a single trial. Suppose that the trials were collected sequentially (first spiketimes1, then spiketimes2).
    A. Plot the mean and standard error of the mean in 10 ms bins for the two conditions. Do these graphs suggest a difference in the two conditions?
    B. Using a generalized linear model determine if the average rates across the entire 300 ms period are different in the two conditions.
    C. Divide the 300 ms period into a set of bins, compute the rate in those bins and repeat the GLM analysis on the binned data. The rate from each bin on each trial should go into the GLM model as an observation. Use your judgment to

determine the bin boundaries and note that they do not need to all be the same size.