MATLAB exercise

Maximum likelihood estimation

Overview: In this exercise, you will derive and implement two maximum likelihood estimators. Put your code in a MATLAB publisher file, you will be graded as follows:

80%: Technical Correctness of the code

10%: Quality of figures, meaning they should be annotated fully (legends, axes labels). You should also make judicious use of overlaid plots, or subplots, as appropriate. In general you should be striving to use only a few, well-annotated plots.

10%: Quality of comment in code. Your code should be well commented, with a few paragraphs describing your solution, referring to figures, as appropriate. The overall goal here is a single document that contains both your code and all necessary information so that someone with a general EE background could understand the document.

**Part 1:** Pencil and paper. Derive the ML estimates for the exponential and Rayleigh distributions. Both distributions have a single parameter, λ, although their functional form is different. Assume you have repeated, i.i.d. observations of these random variables. First, form the likelihood function; differentiate with respect to λ and set to zero. Solve for the parameter λ. Scan your derivation for both RVs and include it with your submission. If you are feeling bold, brave, or are just flat out bored, you may Latex this, but it is not required.

**Part 2:**  As we did in the previous estimation assignment, generate random draws from both of these random variables. You can use the EXPRND and RAYRND functions in MATLAB for this. Implement your ML estimators in MATLAB and plot the MSE with respect to # of observations. On separate plots, plot the bias and the variance of your estimators, with respect to the # of observations.

**Part 3:** The data in the .mat file, data.mat, has been drawn from either an exponential distribution, or a Rayleigh distribution. Compute the max-likelihood estimate of the parameter using both

1. Derive and implement max-likelihood estimates for both distributions of the parameter, λ.
2. Compute the max-likelihood estimates of the parameter. Which distribution do you think the data was drawn from? Justify your answer.