Stochastic sensing data analysis

This is a solo effort.

You have an engineered nanopore and can bind to two analytes, Analyte 1 and 2. Your job is to determine the unknown concentrations of Analyte 1 and 2.

You don't know what k_{on} and k_{off} of your pore is for either of these two analytes. You need to determine this. There will be a different k_{on} and k_{off} for each Analyte 1 and 2.

You determine k_{on} and k_{off} by exposing your pore to various known concentrations of the Analytes to calibrate your measurements.

You measure the current (in pA) through the pore every .5 ms for the following concentrations of Analytes 1 and 2:

200 nM Analyte 1, 0 nM Analyte 2
400 nM Analyte 1, 0 nM Analyte 2
600 nM Analyte 1, 0 nM Analyte 2
0 nM Analyte 1, 300 nM Analyte 2
0 nM Analyte 1, 600 nM Analyte 2
0 nM Analyte 1, 900 nM Analyte 2

You also have a Mystery Solution with an unknown concentration of Analyte 1 and 2. You need to find those concentrations.

Things to answer:

1. What is the average open current of the pore? What is the average blocked current when Analyte 1 is bound to the pore? What is the average blocked current when Analyte 2 is bound to the pore?
2. Find k_{off} for Analyte 1. Find this using the method of averages (discussed in class) and <u>also</u> as a fit to a histogram. Plot $1/\langle t_{bound} \rangle$ vs analyte concentration. Similarly, find k_{off} for Analyte 2 and plot $1/\langle t_{bound} \rangle$ for Analyte 2 vs analyte concentration. What is the error in your determined k_{off}? Can you combine the three k_{off} values to get a more accurate determination?
3. As for #2, find k_{on} for Analyte 1 and 2 by averages and histograms. Plot $1/\langle t_{unbound} \rangle$ vs analyte concentration for each analyte and find k_{on}. What is the error in your determined k_{on}? Can you combine the k_{on} from the three files to get a more accurate determination?
4. Find P_{bound}, the probability that the pore is bound, and P_{free}, the probability that it is not bound for each Analyte 1 concentration. Plot P_{bound}/P_{free} vs concentration for Analyte 1 and 2.
5. Now that you know k_{on} and k_{off} for your pore, find the mystery concentration of Analytes 1 and 2 from the MysteryData file. (Take your last name, count the letters in it, and divide by three. The remainder is the number of the Mystery Data file you should use.) Find the concentration of Analyte 1 and 2 using the method of averages, as a fit to a histogram, and using the graph you made in #4 above. What is the uncertainty in the concentration you have determined?