

# Statistical Methods Assignment

April 10, 2012

- **1.** Simulate a spectrum where the model is a constant (i.e., background) plus two Gaussians, with the following parameters: constant = 1 line 1 energy = 1.0 line 1 sigma = 0.05 line 1 norm = 1.0 line 2 energy = 1.1 line 2 sigma = 0.01 line 2 norm = 1.0 Simulate the spectrum with 100 bins from 0.5 to 1.5 and with a noise level of 0.1/bin.
- **2.** Randomize the input parameters by a factor of 10 and then use Levenburg-Marquardt method to fit the simulated spectrum. Plot the spectrum and fit together.
- **3.** Compute the errors on each parameter by a) freeze all but one parameter and b) "step" the parameter away from the best fit, refitting at each step (i.e., the other parameters are free) until  $\chi^2$  changes by 1.
- **(extra credit)** Repeat 1-2 for a large number (say 1000) simulations and tabulate the best-fit values for each parameter. Compute the 68% probability distribution for each parameter and compare it to the error derived in step 3 for  $\Delta\chi^2 = 1$ .
- **4.** Using the 1D KS test, determine which two of the following data sets are most likely drawn from the same probability distribution

$$a = \{1, 1, 3, 0, 0, 3, 1, 5, 4, 9, 0, 6, 5, 0, 8\}$$

$$b = \{4, 0, 2, 2, 1, 2, 0, 0, 3, 0, 3, 4, 2, 1, 0\}$$

$$c = \{2, 3, 2, 0, 3, 4, 0, 3, 4, 0, 0, 3, 0, 0, 2\}$$