

# ASTRO 410 – Homework 3

**2/17/2017 – DUE: 3/5/2017**

**NOTE:** The purpose of this homework is to build up your skills in implementing the algorithms taught in class and programming. Any copy of the routines from Numerical Recipes or other sources will result in ZERO point for this assignment. Submit your homework as a single tarred, gzipped (tgz) file named lastname-hw3.tgz through ANGEL.

This assignment is about data fitting with the least-square method introduced in Lectures 7-9.

- (1) [50 points] Write a program to fit the data hw3-fitting.dat on ANGEL first a Lorentzian

$$\phi(\nu) = \frac{1}{\pi} \frac{\alpha_L}{(\nu - \nu_0)^2 + \alpha_L^2}$$

and then a Gaussian

$$\phi(\nu) = \frac{1}{\alpha_D} \sqrt{\frac{\ln 2}{\pi}} e^{-\frac{(\ln 2)(\nu - \nu_0)^2}{\alpha_D^2}}$$

which is in the format  $\nu \ \phi \ e$ , where  $\nu$  is the frequency,  $\phi$  is the line strength, and  $e$  is the estimated error in each  $\phi$ .

- (2) [25 points] What values of  $\alpha_L$  and  $\nu_0$  do you get for the Lorentzian, and what values of  $\alpha_D$  and  $\nu_0$  do you get for the Gaussian? Also report the error estimates for the fitting parameters. Which model is a better fit to the data?
- (3) [25 points] Plot the data and the fittings. Be sure to include the error-bars.

**Hint:** you may use the `mrqmin()` routine of Levenberg-Marquardt method in Numerical Recipe to do the fitting, or use the one I wrote using GSL, or write your own fitting function,