

PHYS 310 – HOMEWORK #4

Reading:

- Hughes & Hase, Chapters 5, 6.1-6.2

Problems Due Tues 16 February

There are three problems in this set. You must download the data for these problems from the website <http://www.eg.bucknell.edu/physics/ph310/fit1.html> or Moodle.

- 1) Use the “hw4-1.dat” file for this problem. These data come from twenty (20) experiments nominally measuring the same physical quantity. The data for each measurement (point) is on a single line in the file. The first number on each line is the value of the measured quantity, and the second is the uncertainty in the measurement.
 - (a) What value do you quote for this quantity based on the data? (Include an uncertainty.)
 - (b) Each data point has its own uncertainty σ_i . How many of the data points lie within $1\sigma_i$ of the mean value you determined?
 - (c) What is the goodness-of-fit parameter χ^2 for these data? The definition of χ^2 is given in Eq. (5.9) of Hughes & Hase, and we calculated χ^2 for the cases of fitting to a linear and a quadratic in class. When we are just determining the mean, the function $y(x)$ in Eq. (5.9) is simply a constant, i.e., the value of the mean that you determined.
- 2) Use the “hw4-2.dat” file for this problem. The data come from an experiment in which there is a suspected linear relationship between measured values of x and y . The data for each point is on a single line in the file. The first number on each line is the value of x , the second is the value of y , and the third is the uncertainty of y . Uncertainties in x are negligible.
 - (a) Perform a weighted linear fit to these data.
 - (b) Plot your normalized residuals. How many of the data points lie within 1σ of the line you determined?
 - (c) Use Eq. (5.9) from Hughes & Hase to calculate the goodness-of-fit parameter χ^2 for these data.
 - (d) Does a linear fit to the data appear to be reasonable?
 - (e) What value do you quote for the slope and intercept based on the data? (Include uncertainties.)

- 3) Use the file “hw4-3.dat” on the website for this problem. The data come from an experiment in which the relationship between x and y is suspected to be

$$y = a_1 \sin(2\pi x) + a_2 \sin(4\pi x),$$

where a_1 and a_2 are the parameters to be determined. The data for each point is on a single line in the file. The first number on each line is the value of x , the second is the value of y , and the third is the uncertainty in y . Uncertainties in x are negligible.

- (a) Perform a linear fit using the assumed functional form.
- (b) Plot your residuals.
- (c) Use Eq. (5.9) from Hughes & Hase to calculate the goodness-of-fit parameter χ^2 for these data.
- (d) Is your fit good?
- (e) Give your values for a_1 and a_2 (including uncertainties).