PHYS 310 — Homework #4

Reading:

- Hughes & Hase, Chapters 5, 6.1-6.2

Problems due Thursday February 12:

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`. (There is a link to this website from the class homepage.) We remind you that you can download files directly into a Mathematica notebook using the URL in the `Import[]` function:

```
data = Import["http://www.eg.bucknell.edu/physics/..."]
```

1. Use the "Problem 1 data" on the website for this problem. This data comes from twenty 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 this 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 this 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 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 "Problem 2 data" on the website for this problem. This data comes 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 in y. Uncertainties in x are assumed to be negligible.

(a) Perform a weighted linear fit of this data to a straight line.

(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 this 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 "Problem 3 data" on the website for this problem. This data comes 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 determine. 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 the values of x are assumed to be negligible.

(a) Perform a linear fit of this data to assumed functional form.

(b) Plot your normalized residuals.

(c) Use Eq. (5.9) from Hughes & Hase to calculate the goodness-of-fit parameter χ^2 for this data?

(d) Is your fit good?

(e) Give your values for a_1 and a_2 (Include uncertainties.)