

Physics 414/521/Spring 2002/Homework Assignment 1
(From Lyons, *Statistics for Nuclear and Particle Physicists*)

1. A set of 13 measurements are made on a physical quantity. The following values are obtained: 0,1,2,3,4,5,6,7,8,9,10,11,12. Estimate the mean \bar{x} , the spread σ and the accuracy of the mean μ .
2. A new set of 36 measurements are made with the result that the values 0,1,2,...,5,6,7,...,11,12 occur 0,1,2,...,5,6,5,...,1,0 times, respectively. Estimate \bar{x} , σ and μ .
3. The function $y(x)$ is defined as
$$y = 1/L \text{ for } 0 \leq x \leq L$$
$$y = 0 \text{ otherwise.}$$
Find the average value of x and the spread σ for this distribution.
4. By measuring yourself with three different rulers, you obtain the following estimates of your height: 165.0 ± 1.0 , 164.9 ± 0.5 , and 165.6 ± 0.1 . What is the best estimate of your height, and how accurate is it?
5. Write a small program to create a gaussian distributed random variable by plotting the variable Y (say) 1000 times, where
$$Y = \sum_{i=1}^n (x_i - \frac{1}{2}),$$
 x_i is a random number between 0 and 1, and $n = 20$. Make a histogram of Y and fit a gaussian to it.
6. Three students A, B and C perform a pendulum experiment with the same apparatus in order to determine the acceleration due to gravity, g . An individual measurement consists of timing 100 pendulum swings, and this is what A does. However, B does this twice and averages the two values to obtain an improved answer, while C takes the average of ten sets of swings. If A's answer has an uncertainty σ_a , what are the expected accuracies of B's and C's determinations? (Assume that the dominant error is the random one associated with timing the swings.)

You now take the three students' determinations ($a \pm \sigma_a$, etc.) to obtain your own estimate of g and its error, using the prescription for combining experimental results (see eqs. 1.38 and 1.39 in Lyons; to be covered in class). Show that you get the same result as if you had taken all 13 measurements and averaged them, without regard to which student did each measurement.