PHYS 5061 Homework 5.
Due: Friday, May 3.

(1) Bevington 4.5

(2) Bevington 4.7

4.4. Work out the intermediate steps in Equation (4.19).

4.5. A student measures the period of a pendulum and obtains the following values.

Trial	1	2	3	4	5	6	7	8
Period	1.35	1.34	1.32	1.36	1.33	1.34	1.37	1.35

(*a*) Find the mean and standard deviation of the measurements and the standard deviation of the mean.
(*b*) Estimate the probability that another single measurement will fall within 0.02 s of the mean.

4.6 (a) Find the mean and the standard deviation of the mean of the following numbers

(3) Bevington 6.4. You need to go back to the very start of the χ^2 process. Do not use the results for the fit to a straight line with a non-zero y-intercept already derived. (And don't even contemplate asking canned software to do any of numerical implementation for you. At most use a calculator capable of doing sums.

(4) A student performing a free-fall experiment in General Physics uses a spark timer to record the position of a falling object at regularly spaced instants in time. The spark burns small dots in a waxed tape marking the position. The student has recorded the following data:

t (s)	0.00	0.05	0.10	0.15	0.20	0.25	0.30
x (cm)	0.0	9.7	21.9	36.7	53.6	73.0	94.7

The expected behavior is $x = v_0 t + \frac{1}{2} g t^2$. This is cast into a linear form by dividing by t: $\frac{x}{t} = v_0 + \frac{g}{2} t$. So with $y = x/t$ this can now be fit by straightforward least squares methods $y = v_0 + (g/2)t$.

(a) Calculate x/t (toss out the first point $t = 0$) and carry out a linear least squares fit to the (t, y) data, assuming equal weights to each point. Use the results to find g. You may do this by hand (and calculator), learn how to use LabVIEW's or Matlab's linear fit features. However, whatever you use, be certain that you understand what the software does, what it takes for inputs and what it produces for outputs. Read the documentation. Clearly explain anything and everything that the software hands back to you. Simple scribbled results will not do.

(b) Also find χ^2, assuming equal weights of 1, since you don't have uncertainties in advance. In the absence of specified uncertainties, the fit and resulting χ^2 can be used to estimate an assumed common uncertainty σ_y in y, by examining the scatter of the data about the best fit line. This is described in Bevington at the start of sec 6.4. Use this technique to estimate σ_y.

4.7. A counter is set to count gamma rays from a radioactive source. The total number of counts, including background, recorded in each 1-min interval is listed in the accompanying table. An independent measurement of the background in a 5-min interval gave 58 counts. From these data find:
(*a*) The mean background in a 1-min interval and its uncertainty.
(*b*) The corrected counting rate from the source alone and its uncertainty.

Trial	1	2	3	4	5	6	7	8	9	10
Total counts	125	130	105	126	128	119	137	131	115	116

6.3. Show that Equation (6.12) reduces to Equation [illegible]

6.4. Derive a formula for making a linear fit to data with an intercept at the origin so that $y = bx$. Apply your method to fit a straight line through the origin to the following coordinate pairs. Assume uniform uncertainties $\sigma_i = 1.5$ in y_i. Find χ^2 for the fit and the uncertainty in b.

x_i	2	4	6	8	10	12	14	16	18	20	22	24
y_i	5.3	14.4	20.7	30.1	35.0	41.3	52.7	55.7	63.0	72.1	80.5	87.9