Gan/Kass
Physics 416

Problem Set 5
Due May 21, 2012

1) Suppose our variables x and y are related by:

$$y = \alpha x + \beta x^3$$

Assume we have n measurement pairs: $(x_i, y_i \pm \sigma)$ (all y's have the same uncertainty, σ).
Use the method of Least Squares to derive formulas for the best estimate of α and β.

2) Taylor, Problem 8.14, page 202.

3) Two different experiments have measured the mass of the Ohio boson. Experiment #1 measured 1.00 ± 0.01 gm while experiment 2 measured 1.04 ± 0.02 gm.
a) What is the best estimate of the mass of the Ohio boson if we combine the two experiments?
b) Calculate the χ^2 for the two measurements in this problem using:

$$\chi^2 = \sum_{i=1}^{2} \frac{(m_i - m)^2}{\sigma_i^2}$$

with m_i the measurement from experiment i and σ_i the standard deviation of the measurement, and m the best estimate of the mass obtained by combining the two experiments.
c) How many degrees of freedom are there for this χ^2?
d) What's the probability of getting a value of χ^2 per degree of freedom $\geq$ to the one in this problem?

4) Taylor, Problem 8.24, page 205.

5) Taylor, Problem 12.7, page 280. Give the value of the constraint for problems 12.2, 12.3, 12.4.

6) Taylor, Problem 12.8, page 280.