Gan/Kass Physics 3700

## Physics 3700 Problem Set 5 Due November 5, 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,  $\sigma$ ). Use the method of Least Squares to derive formulas for the best estimate of  $\alpha$  and  $\beta$ .

2) Taylor, Problem 8.14, page 202.

3) Two different experiments have measured the mass of the Ohio boson. Experiment #1 measured  $1.00 \pm 0.01$  gm while experiment 2 measured  $1.04 \pm 0.02$  gm.

a) What is the best estimate of the mass of the Ohio boson if we combine the two experiments? b) Calculate the  $\chi^2$  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  $\sigma_i$  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  $\chi^2$ ?

d) What's the probability of getting a value of  $\chi^2$  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.