

**Physics 3700**  
**Problem Set 5**  
**Due November 18, 2013**

- 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.