PHYS 391, Homework #3

Key Concepts

- Weighted Mean
- Least Squares Fitting

Reading: Taylor Chapters 7-8

Homework Problems:

1. This problem has two parts and is worth twice the amount of points as the other problems.

   In practice, it can be difficult to determine which method of error analysis can give you the appropriate uncertainty. In lab 2 you had to evaluate the zeropoints of the B and V data and estimate the uncertainty by finding the average and standard deviation.
   (a) Why in this case is it better to calculate the error statistically rather than propagating errors? To answer this question use the fake data given below and find the uncertainty using statistics (SDOM). Compare this to finding the average error from the individual errors. Given what you know from earlier discussions, why is the SDOM better than the uncertainty calculated from averaging the individual errors?

44.472	± 0.002
44.271	± 0.002
44.441	± 0.003
44.421	± 0.005
44.3091	± 0.0001
44.366	± 0.003
44.349	± 0.002
44.594	± 0.005

   (b) Weighted averages: Sometimes it's not a good idea to weight data points. Using the same data set in part a, (i) calculate the weights for each data point and (ii) compare the average and SDOM determined from part (a) to the weighted average and error. (iii) Why don't the averages and associated errors overlap?

2. Problem 7.7

3. Problem 7.8

4. Problem 8.1 - First, do this "by hand" using the appropriate equations either on paper or in python (or excel etc), then try the python function `polyfit` which does a least-squares fit to a 1st order polynomial to confirm your answer. You will need to first import numpy:

   ```
   import numpy as np
   np.polyfit(x,y,1)
   ```

   the output will be a 2 element array containing A and B.

5. Problem 8.10 - In addition to the values A and B, you should also calculate the uncertainties on A and B (see problem 8.19 for the relevant equations). Again, either do this by hand on paper or python or excel...etc. Plot the data and both lines resulting from the weighted and unweighted fits.

6. Problem 8.20

7. Problem 8.25 - Here you do not need to worry about the errors.