Course Information v.1

Course: 2 units, S/NC only
2 hours lab, 1 hour lecture

Learning Goals for Physics 67

Top level goals – you will learn how to

- assign an error (uncertainty) to an experimental measurement
- have a defensible result from an experiment
- identify and quantify statistical and systematic errors in an experimental measurement

Techniques to learn that will help reach the goal:

- finding mean, variance, standard deviation of discrete and continuous data sets
- error propagation
- least squares curve fitting
- use distributions to predict statistical spreads in data (in this class, primarily Gaussian and Poisson distributions)

Instructors: Rick Pam rick.pam@stanford.edu
Varian 242 650-725-2365
Office Hours: Wed 4:30-6:00 (Location tbd)

Teaching Asst's: Aysha Abdel-Aziz ayshalyn@stanford.edu
Purnima Balakrishnan purnimab@stanford.edu
Office Hours: M 5:30-6:30 pm (tentative)

Lab Manager: **Julien Devin** jdevin@stanford.edu
Bldg 60-204

Lecture: Monday 4:30-5:20, STLC 115
Lectures will cover some of the physics for the labs, plus error analysis: error propagation, properties of distributions (especially Gaussian and Poisson), linear regression, etc. These will lead us to answer The Big Question: how exactly does one assign an error estimate to a measurement? The answer requires some art as well as math.

Lab Sections Bldg 60-207
Section 02 T 9:30-11:20
Section 03 T 11:30-1:20
Section 04 T 1:30-3:20

Prerequisites Both 40 and 60 series students can take this class. 40-series students should be in at least Physics 43 and expect to work a bit harder on some of the concepts. Of the math concepts, you should have seen partial derivatives and Taylor series.

Text Hughes and Hase, *Measurements and Their Uncertainties: A Practical Guide to Modern Error Analysis*, Oxford University Press, 2010. Available online through Stanford at https://searchworks.stanford.edu/view/8795034

Computer **Lab desktop computers are not online.** Bring your own laptop to every lab session.

Lab Notebook Use an online Collaboration in Canvas, essentially a Google doc.

References on 1-day reserve in Engineering/Physics Library

A Practical Guide to Data Analysis for Physical Science Students, Lyons 1991
A Guide to the Use of Statistical Methods in the Physical Sciences, Barlow 1989
An Introduction to Error Analysis: the Study of Uncertainties in Physics Measurements, Taylor, 1997
Data Reduction and Error Analysis for the Physical Sciences, Bevington 2003

Both Bevington and Taylor are classics of the genre.

Grading:

The course will consist of 4 labs (graded 0-5 pts), a small number of prelab and homework assignments to illustrate principles (graded 0-2 pts), and short reading assignments to be done before class, worth 1 pt. Passing the course requires an average of 60% of all points:

1. Labs with scores below 3 may be redone and resubmitted. ***All labs must be completed to pass the course***. Prelab and Homework assignments may not be resubmitted.
2. No Incomplete grades will be given.

Late Policy Lab assignments submitted late will have 1 pt deducted for the first 24 hrs, another point for the second 24hrs, etc. If you have not completed the assignment on time, or are confused about something, submit what you have on time along with questions that may be preventing you from completing the assignment.
Late Prelab and homework assignments will lose 50% the first 24 hrs, and thereafter will receive 0 points.

Lab Attendance Policies Laboratory section attendance is mandatory. If you need to miss a lab due to an unavoidable conflict, notify your TA and Rick at least a week ahead of time. If it's an emergency, notify us as soon as possible. Labs begin the week of April 1, and there will be 9 lab sessions plus an optional makeup week (week of June 3). No Incompletes will be given.

Collaboration Policy:

You will work in pairs in the lab (threes if we're short on setups). Your data will be acquired jointly, ie, the same raw data set for both of you. With your partner(s), you may discuss the data, how to analyze it, show each other how to analyze the data on computer. However, the writeup you submit must be your own work, and you analyze the data yourself. This particularly applies to any computer curve fits you may do—you need to be "flying solo" when you actually do your data analysis.

Students With Documented Disabilities

Students who have a disability that may necessitate an academic accommodation or the use of auxiliary aids and services in a class must initiate the request with the Disability Resource Center (DRC). The DRC will evaluate the request with required documentation, recommend appropriate accommodations, and prepare a verification letter dated in the current academic term in which the request is being made. Please contact the DRC as soon as possible; timely notice is needed to arrange for appropriate accommodations. The DRC is located in the Student Services Building at 563 SalvatierraWalk (phone 723-1066; TDD725-1067).

Classroom Environment/Social Rules (courtesy of Prof. Pat Burchat):

To facilitate the most effective and inclusive learning environment by promoting deliberate exploration of what we don't know, we have a couple of "social rules" :

1. Please resist acting surprised when people say they don't know something. Feigning surprise has no social or educational benefit.
2. Avoid subtle racism, sexism, homophobia, transphobia, and other kinds of bias. "Subtle -isms" are small things that make others feel uncomfortable. For example, saying "It's so easy my grandmother could do it" is a subtle -ism.

If you find yourself breaking one of these rules, please apologize, use it as a learning experience, and then move on. If you see repeated feigned surprise, or hear a subtle-ism, you can point it out to the relevant person, either publicly or privately, or you can ask a member of the teaching team to say something. After this, we ask that further discussion move off public channels. Please don't pile on to someone who made a mistake. The "subtle" in "subtle -isms" means that it may not be immediately obvious to everyone what was wrong with the comment. Please use it as a teachable moment, and then assume the message was received.

Tentative Schedule/Experiment List:

Week#	Week of	CLASS TOPICS	LAB
1	1-Apr	basic stats: mean, variance, std dev, std error	Pretest; Python
2	8-Apr	weighted means, error propagation, diffraction gratings	Atomic Spectra
3	15-Apr	Sample error propagation and analysis	Atomic Spectra (cont'd)
4	22-Apr	thermal radiation physics, Gaussian distributions,	Blackbody Radiation
5	29-Apr	least squares fitting	Blackbody Radiation (con't)
6	6-May	Probability distributions, Poisson statistics, Beta decay	Radioactive Statistics
7	13-May	More Poisson applications	Radioactive Statistics (con't)
8	20-May	(tbd)	(60s) Latent Heat of LN2 (40s) RC and RLC circuits
9	27-May	MemDay (no Monday class)	(60s) Latent Heat of LN2 (40s) RC and RLC circuits
10	43Jun		Makeups