Experimental Data Analysis Lab

**PHYS 391 - Fall 2018**

http://pages.uoregon.edu/~torrence/391/

Updated Wednesday September 26, 2018

**Home** | **Syllabus** | **Python** | **Homework** | **Labs** | **Canvas**

**Some motivation**

**HW 1** is posted

**Lab 1** is posted

**Instructor**

Prof. Eric Torrence

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Office Hours: TBA

**Lab Assistant**

Bishara Korkor

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Office Hours: TBA

**Lecture**

MW 4:00-4:50 Willamette 318

**Labs**

Friday Willamette 17
Overview

This course will introduce the basic concepts of data analysis and practical techniques for implementing them. Half of the course will emphasize the theoretical foundation of data analysis with lectures and homework assignments, while the other half will emphasize the practical application of data analysis in lab assignments. Development of programming techniques for performing data analysis and data visualization will also be covered using python. The following topics will be covered:

- Measurement Uncertainty and Error Propogation
- Statistical Inference
- Gaussian Distribution and Confidence Levels
- Least Squares and Linear Regression
- Binomial/Poisson Distributions
- Photon Counting Statistics
- Fourier Series and Fourier Transforms

Grading

Course grades will be based on five bi-weekly homework assignments from Taylor (50%), and five bi-weekly lab assignments (50%). There will be no examinations (midterm or final) for this course, so it is important for students to turn in all assigned work when it is due. Late assignments will either be significantly penalized or not accepted at the instructors discretion. The final lab assignment will be due during finals week in place of a final examination.

In order to pass the course, you must complete all of the labs!

Grades will be awarded based on the departmental grading policy, and students can assume that 90% will earn an A, 80% will earn a B, 70% will earn a C, 60% will earn a D, and below this will result in a failing grade. Modifiers (+/-) will be applied for scores within a few percent of these boundaries. I may adjust the grade boundaries depending upon the final distribution so that students with similar scores will receive similar grades.

Syllabus
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<th>Week</th>
<th>Topic</th>
<th>Lab</th>
<th>Homework</th>
<th>Reading</th>
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<td>HW1</td>
<td>Taylor Ch.</td>
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<td>Week 6</td>
<td>Binomial Distribution and Random</td>
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10/29 - 11/2

Week 7  Poisson Distribution and Counting Statistics  HW4  Taylor Ch. 11
11/5 - 11/9

Week 8  Random Processes  Photon Counting
11/12 - 11/16  due Wednesday

Week 9  Fourier Transforms  HW5  FFT Handout
11/19 - 11/23  No Labs Friday  due Thursday

Week 10  Oscillators  Fourier Transforms
11/26 - 11/30

Finals  Final Lab Due Thursday 12/6 at 5 PM
12/3 - 12/7

This syllabus is tentative, and is subject to change as the quarter progresses.

Python

One of the goals of this course is to give you the skills to properly do non-trivial data analysis of large data samples. There are many different tools available to do this, but
we had to pick something, and we are going to use python. Python is relatively easy to learn, very powerful, and widely used in Science disciplines. Python is also a good example of 'procedural programming', and the general techniques learned in this course can easily be transferred to the language or tool of your choice later. Python is widely (and freely) available at the University of Oregon and elsewhere. You will need to use Python extensively in this course, so you should invest some time in the first two weeks to make sure you have a working computing environment which you can use and you are happy with. Some possibilities are listed on the Python Information page. We will also encourage students to not use python directly, but rather use Jupyter Notebooks.

**Homework**

Homework will typically be assigned every other week on Monday and due on the following Monday at the start of class. The homework will mostly be problems from Taylor forcing you to work through a particular concept 'by hand' at least once. Supplemental problems to exercise your python skills may also be assigned.

- **HW 1 - Measurement Uncertainties** (due Oct. 1)
- **HW 2 - Statistical Inference** (due Oct. 15)
- **HW 3 - Linear Regression** (due Oct. 29)
- **HW 4 - Binomial and Poisson Distributions** (due Nov. 12)
- **HW 5 - Fourier Transforms** (due Nov. 29)

**Labs**

Lab assignments will be made every two weeks and will be due on Monday during weeks when homework is not due. It is expected that you will work on your labs during the two weeks before they are due. Assigned lab times will be available when TAs will be in room 17 to provide support and advice, although you are free to work on the labs whenever you have time available. You will be expected to work with a partner, although each member of the lab group is expected to turn in their own material including the data analysis and any associated code.

Formal write-ups will not be required, although I do expect you to keep a lab notebook which clearly shows the work you have done. I really want to see proof that you did the lab and understood the material. Neatly organized notes taken during the lab itself, answers to the questions posed in the lab writeup, plus a short summary giving the main quantitative results in your notebook is perfectly adequate. If you are very sloppy in your notes, you may also turn in a longer printed write up, but please get into the habit of taking neat legible lab notes. Either way, please turn in your lab notebook (legible or not) on Monday in class. For labs with significant computer work, your M-files and supplemental material should be emailed to me directly as well.
For an upper-division course, the university expects students to spend one hour in class and two hours out of class for each credit. While each student will vary, you should expect on average to put this much time into this course. In particular, you should not expect to complete all of the lab work during the scheduled lab times each week, although you certainly should be able to collect all of the necessary data during that time. Make sure you do not try to start your lab assignments at the last minute. Most students who struggle in this course simply don’t invest enough time in completing the labs.

- Lab 1 - Python Tutorial (due Oct. 8)
- Lab 2 - Speed of Light (due Oct. 22)
- Lab 3 - Brownian Motion (due Nov. 5)
- Lab 4 - Photon Counting (due Nov. 21)
- Lab 5 - Fourier Transforms (due Dec. 6)

**Academic Misconduct**

There is arguably a grey area between working together collaboratively on a homework assignment or lab, and just copying somebody else's work. In general, however, it is usually very apparent to the people involved whether a student is really contributing to a result, or just copying from others. Copying answers and passing them off as your own work, either from another student or from any other source is no different from plagiarism, and will be dealt with according to the UO rules and procedures for academic misconduct.

You are responsible for all the work you turn in for this course. You are encouraged to work with others to help your understanding, but anything you write down on your homework or you lab assignments needs to be your own work. You can certainly collect data with your lab partner and discuss the methods for analyzing the data and even compare your results, but all written and code work must be your own.

**Accessible Education**

The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

**Prohibited Discrimination and Harassment**
No forms of discriminating, harassing, or hostile behavior in class will be tolerated. Any student who has experienced sexual assault, relationship violence, sex or gender-based bullying, stalking, and/or sexual harassment may seek resources and help at safe.uoregon.edu. To get help by phone, a student can also call either the UO 24-hour hotline at 541-346-7244 [SAFE], or the non-confidential Title IX Coordinator at 541-346-8136. From the SAFE website, students may also connect to Callisto, a confidential, third-party reporting site that is not a part of the university. Students experiencing any other form of prohibited discrimination or harassment can find information at respect.uoregon.edu or aaeo.uoregon.edu or contact the non-confidential AAEO office at 541-346-3123 or the Dean of Students Office at 541-346-3216 for help. As UO policy has different reporting requirements based on the nature of the reported harassment or discrimination, additional information about reporting requirements for discrimination or harassment unrelated to sexual assault, relationship violence, sex or gender based bullying, stalking, and/or sexual harassment is available at Discrimination and Harassment. The instructor of this class, as a Student Directed Employee, will direct students who disclose sexual harassment or sexual violence to resources that can help and will only report the information shared to the university administration when the student requests that the information be reported (unless someone is in imminent risk of serious harm or a minor). The instructor of this class is required to report all other forms of prohibited discrimination or harassment to the university administration. Specific details about confidentiality of information and reporting obligations of employees can be found at titleix.uoregon.edu.

Mandatory Reporting of Child Abuse

UO employees, including faculty, staff, and GEs, are mandatory reporters of child abuse. This statement is to advise you that your disclosure of information about child abuse to a UO employee may trigger the UO employee's duty to report that information to the designated authorities. Please refer to the following links for detailed information about mandatory reporting: Mandatory Reporting of Child Abuse and Neglect.