ASTR 5550: Observations, Data Analysis and Statistics – Spring 2016

MWF 1:00-1:50 pm, Duane E126

Dave Brain: david.brain@colorado.edu 303-735-5606 Duane D133

Course webpage: http://learn.colorado.edu

Office Hours: Wednesdays 2-3pm or by appointment

Content:

This course provides an overview of the theoretical principles that underlie the recording and manipulation of astronomical observations, and practical skills for working with data. Course material is roughly divided into five units: probability (3 weeks), statistics (4.5 weeks), signal processing (2.5 weeks), imaging and spectroscopy (3 weeks), and detectors and data reduction (2.5 weeks).

Goals:

- Develop a critical eye for the presentation of data by other scientists
- Understand 'when to use' different data analysis techniques, and what you assume by using them
- Understand the limitations of the instruments we use to make astronomical measurements
- Learn to write useful computer programs that can be easily read and understood by others

Text:

There is no required textbook for this course. Lecture notes will be posted on the course webpage soon after each lecture, and taken together can be considered the 'text' for the course. However, there are myriad useful resources for working with astronomical data. Many of these can be found on the internet at no cost. Others are worth investing in now, as a professional astronomer. Here is an incomplete list:

- *Numerical Recipes* by Press et al. ← I recommend this most highly as a statistics resource
- *Practical Statistic for Astronomers* by Wall and Jenkins
- *Data Reduction and Error Analysis for the Physical Sciences* by Bevington and Robinson
- *Statistics in Theory and Practice* by Lupton
- *Electronic Imaging in Astronomy: Detectors and Instrumentation* by McLean
- *Modern Statistical Methods for Astronomy: With R Applications* by Feigelson and Babu

Computing:

You will need access to a computer and technical computing software for this course. You are welcome to use any software that you choose, except IRAF. The three most useful choices in terms of developing good programming skills might be Python, IDL, and Matlab. All three are powerful and fast for manipulating large datasets, enable rapid data visualization, and have modular programming – allowing you to build sophisticated analysis tasks from scratch. You may wish to consult with the research group that you are in or that you plan on joining before choosing a language to learn for this course; there is a growing trend toward Python both inside and outside astronomy. Ask me if you plan to use a different software package such as C, C++, Fortran, or Mathematica, or if you need help accessing one of these software packages.

Course Evaluation:

70%	Homework and Analysis Projects
20%	Final Project
10%	Clickers and Participation

Course Format:

The course will consist of in-class lectures and discussions, with occasional guest lectures. Note that a discussion-rich course requires your participation. I am willing to reconsider almost any element of this course (including how the course works on a day-to-day basis and the course evaluation) if there is general (>2/3) agreement among the class.

More Details on Coursework:

Homework and Analysis Projects – These will be assigned throughout the semester, and due at the beginning of lecture on the assigned due date (we may discuss solutions in class). You are encouraged to work together and exchange ideas in groups, but anything that you turn in for a grade must represent your own work. Each 2-week long project will be weighted as two problem sets, due to their increased length relative to problem sets assigned in the first part of the course.

Final Project – In lieu of a final exam there will be a final analysis project, similar to the ones described above. It will be worth 20% of your final course grade.

Clickers – We will try using clickers for the first three weeks of the semester, then evaluate as a group whether we'd like to continue using them. A couple of times each lecture I plan to ask you to think about some of the concepts we have covered. Each question will be graded out of two points, with one point for any answer and one point for the correct answer. I will drop your three lowest clicker days to account for a number of situations (bad day, family emergency, technical difficulty, etc.). I will loan clickers to those of you who don't have them.

University Legalese:

The University recommends that separate statements be added to the syllabus describing my policies with regard to the Honor Code, learning environment, discrimination and harassment, disability accommodations, and religious observances. Please ask me for details on these policies if you would like them. Here on the syllabus I will instead boil these statements down to a single sentence:

> **I will treat you with respect and as a unique human being, and hope that you do the same for each other and for me**.

Have a good semester!