SIO 221A, Data Analysis Part 1
Autumn Quarter 2024

Professor Jennifer MacKinnon
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Class meets T/Th from 9:30-10:50 in NH101

Course content:

Fundamental elements of analysis of geophysical and oceanographic time series, including sampling problems, least-squares techniques, spectral analysis, interpretation of time and space series. . Mean/standard deviation/pdfs— moments of pdfs - programming basics. Special PDFs - Gaussian, Chi-squared distribution.,. Error propagation. Correlation/covariance/projections onto modes. Fourier transform and spectra. Spectral uncertainties. Windowing—degrees of freedom. Aliasing. Multidimensional spectra (e.g. Frequency/wavenumber spectra). Coherence/cross spectra/transfer functions. Optional as time allows: spectrogram rotary spectra, multitaper, maximum entropy, advanced filtering, filter design, Monte Carlo

Textbooks:

Homework and exams will be based only on material covered in class. Useful additional information can be found in several textbooks, which have been placed on Canvas.   I'll update the daily syllabus on Canvas below with relevant chapter numbers as we go along.

Grading:

There will be a daily quiz at the beginning of most classes, which will be graded on a pass/fail basis. You can miss up to 2 quizzes with no consequence. The purposes of the quiz is primarily as feedback for me, to know what was clear in the previous class, and what was unclear (so we can go over it again).

There will be homework due roughly every 1-1.5 weeks. Homework will involve a combination of traditional analytical assignments, reading/analysis of relevant journal articles, and some hands on calculations from datasets that will be made available. You are encouraged to work in groups, but please write up your own assignment. Just as we do with professional science, please acknowledge those you have worked with on the homework.

There will be a **mid-term** in class on 5 November.

Final Presentations. In lieu of a final exam, you will prepare and present a final project based on a data set of your choosing. This will take place during the final exam time slot. The final exam will count as two problem sets: one grade for the oral presentation and a second for the write up.

The final grade will determined as follows: daily quizzes (10%), homework (40%), mid-term (25%), final project (25%).

Daily Schedule: (subject to evolve as we go along, the version on Canvas will be kept updated!)

9/26, L1: Introductions, logistics, mean and expectation values

10/1, L2 PDFs, Gaussian distributions, the central limit theorem.

10/3, L3. Non-Gaussian distributions. Errors and uncertainty.

10/8, L4 (HW1 due) Continued error and uncertainty.

10/10, L5 Fitting linear and sinusoidal shapes to data.

10/15, L6 Field trip to the beach! (Subject to move based upon weather).

10/17, L7

10/22, L8 (HW2 due)

10/24, L9

10/29, L10

10/31, L11 (HW3 due)

11/5: Midterm in class

11/7, L12:

11/12, L13:

11/14, L14: (HW4 due)

11/19, L15:

11/21, L16:

11/26: (Thanksgiving week, no class, start working on your final project)

12/3: L17

12/5: L18, Review and summary, maybe start final presentations.

Final exam date: Final report presentations in person.

Classroom Philosophy:

A respectful and inclusive classroom environment is essential both for learning within our classroom, and creating the community of science as we want it to be. Everyone in our class approaches the material and our discussions with different backgrounds, senses of self, histories, identities, and learning styles. I recognize that many identities have been historically excluded from science and academia, and many facets of racism, sexism, homophobia and ableism, amongst others, still permeate our community.   As a teacher, I strive to acknowledge my own biases while while also committing to the work of building and sustaining a campus community that increasingly embraces the core value of inclusion. Feel free to reach out any time if there are things that can be changed to make the environment a more supportive and productive one. Likewise, if anything comes up in class that makes you feel uncomfortable, please chat with me.

If for any reason you feel that your performance in class is being impacted by your experiences outside of class, please don't hesitate to let me know; everyone is human with lots of life going on outside of school and we can adjust as necessary to help you succeed in this class and more generally in graduate school.