Data and time series analysis in marine sciences

(ENVRON 329)

Description: Content will vary depending on student interests but will include topics such as: discrete sampling issues, data rejection and interpolation, coordinate rotations and principal axes, curve fits, regression, error and propagation of uncertainty, bootstrapping, filtering, spectral analysis, harmonic analysis, EOFs, wavelets. Course structured as mix of lectures and workshops applying methods to environmental data sets. Homework will use data provided by instructor. Each student will complete a final project, applying methods covered in class to datasets chosen them, hopefully as part of (or at least related to) their research.

Instructor: Jim Hench
Office: Room 309, Bookhout Research Lab
jim.hench@duke.edu

Meets: TBD, but equivalent to
Lecture: MW 10:00-11:00 (Repass classroom)
Data workshop: F 10:00-11:00 (computer lab)
Office hrs: MTW 2:15-3:15

Texts:

Emery, W. J., and R. E. Thomson. Data Analysis Methods in Physical Oceanography, 2nd Edition, Elsevier, 2001.

Taylor, J. R. Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements (2nd ed.), University Sciences Books,1996.

Software: Course will use MATLAB extensively

Grading: 70% Homework (roughly bi-weekly)
30% Final project

Honor code: See http://www.nicholas.duke.edu/people/students/advising/honorcode.html

Supplemental references for this class:

Kattan, P. I. MATLAB for Beginners: A Gentle Approach. CreateSpace, 2008.

Pratap, R. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, 2009.

Some other useful books:

Efron, B., and R. J. Tibshirani. An Introduction to the Bootstrap. Chapman and Hall, 1994.

Percival, D. B., and A. T. Walden. Spectral Analysis for Physical Applications. Cambridge Press, 1993.

Preisendorfer, R. W. Principal Component Analysis in Meteorology and Oceanography. Elsevier, 1988.

Press, W. H., S. A. Teukolsky, W. T. Vetterling, B. P. Flannery. Numerical Recipies 3rd Edition: The Art of Scientific Computing. Cambridge Press, 2007.

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Syllabus (approximate/intended)

	Date	Topic	Assignments
mon	30-Aug	**Sampling issues** (Nyquist freq., Rayleigh criterion, aliasing)	
wed	1-Sep	*cont.*	
fri	3-Sep	*data workshop*	
mon	6-Sep	**Data quality** (outliers, despiking, interpolation)	
wed	8-Sep	*cont.*	
fri	10-Sep	*data workshop*	HW1 due
mon	13-Sep	**Coordinate rotations and principal axes**	
wed	15-Sep	*cont.*	
fri	17-Sep	*data workshop*	
mon	20-Sep	**Curve fits and regression**	
wed	22-Sep	*cont.*	
fri	24-Sep	*data workshop*	HW2 due
mon	27-Sep	**Error and propagation of uncertainties**	
wed	29-Sep	*cont.*	
fri	1-Oct	*data workshop*	
mon	4-Oct	**Bootstrap / Monte Carlo methods**	
wed	6-Oct	*cont.*	
fri	8-Oct	*data workshop*	HW3 due
mon	11-Oct	*Fall break, no class*	
wed	13-Oct	**Filters (design, low-, high-, and band-pass)**	
fri	15-Oct	*data workshop*	
mon	18-Oct	*cont.*	
wed	20-Oct	***Spectral analysis (windowing, WOSA, multitaper)***	
fri	22-Oct	*data workshop*	HW4 due
mon	25-Oct	*cont.*	
wed	27-Oct	*cont.*	
fri	29-Oct	*data workshop*	
mon	1-Nov	*cont.*	
wed	3-Nov	*cont.*	
fri	5-Nov	*data workshop*	HW5 due
mon	8-Nov	**Harmonic analysis**	
wed	10-Nov	*cont.*	
fri	12-Nov	*data workshop*	

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mon	15-Nov	**EOFs**	
wed	17-Nov	*cont.*	
fri	19-Nov	*data workshop*	HW6 due
mon	22-Nov	**Wavelets**	
wed	24-Nov	*Thanksgiving break, no class*	
fri	26-Nov	*Thanksgiving break, no class*	
mon	28-Nov	Final project presentations	
wed	01-Dec	Final project presentations	
fri	03-Dec	Final project presentations	Projects due