Data and time series analysis in marine sciences

(ENVIRON 876A)

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 by 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: Lecture: T 9:30-11:00 (Lab 1 west)
Data workshop: H 9:30-11:00 (computer lab)
Office hrs: TH 11:00-12:00, or by appointment

Texts:

Emery, W. J., and R. E. Thomson. Data Analysis Methods in Physical Oceanography, 2nd Edition, Elsevier, 2001. (~$110)

Trauth, M. H., MATLAB Recipes for Earth Sciences, Springer, 2006. (~$60, or free online)

Software: Course will use MATLAB extensively

Grading: 50% Homework (roughly tri-weekly)
50% 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. (~$30)

Pratap, R. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, 2009. (~$30)

Some other useful resources:

Efron, B., and R. J. Tibshirani. An Introduction to the Bootstrap. Chapman and Hall, 1994. (~$95)

Percival, D. B., and A. T. Walden. Spectral Analysis for Physical Applications. Cambridge Press, 1993. (~$75)

Preisendorfer, R. W. Principal Component Analysis in Meteorology and Oceanography. Elsevier, 1988. (out of print)

Press, W. H., S. A. Teukolsky, W. T. Vetterling, B. P. Flannery. Numerical Recipies 3rd Edition: The Art of Scientific Computing. Cambridge Press, 2007. (~$55)

Taylor, J. R. Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements (2nd ed.), University Sciences Books,1996. (~$35)

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Syllabus (updated 18-Sep-2012)

	Date	Topic	Assignments
tue	28-Aug	**Course introduction and organization**	
thu	30-Aug	*Matlab intro*	
tue	4-Sep	**Sampling issues** (Nyquist freq., Rayleigh criterion, aliasing)	
thu	6-Sep	*Data workshop*	Project idea due
tue	11-Sep	**Data quality** (outliers, despiking, replacement)	
thu	13-Sep	*Data workshop*	
tue	18-Sep	**Error and propagation of uncertainties**	
thu	20-Sep	*data workshop*	HW 1 due
tue	25-Sep	**Bootstrap / Monte Carlo methods**	
thu	27-Sep	*data workshop*	
tue	2-Oct	**Covariance and correlation**	
thu	4-Oct	*data workshop*	HW2 due
tue	9-Oct	***Spectral analysis (windowing, WOSA)***	
thu	11-Oct	*Data workshop*	
tue	16-Oct	*Fall break, no class*	
thu	18-Oct	*Fall break, no class*	
tue	23-Oct	***Spectral analysis (multi-taper)***	HW3 due
thu	25-Oct	*Data workshop*	Project progress report due
tue	30-Oct	**Filtering**	
thu	1-Nov	*Data workshop*	HW4 due
tue	6-Nov	**Harmonic analysis**	
thu	8-Nov	*Data workshop*	
tue	13-Nov	**Wavelets**	
thu	15-Nov	No class (LTER meeting at UCSB)	
tue	20-Nov	**Numerical integration/differentiation**	HW5 due
thu	22-Nov	*Thanksgiving break, no class*	
tue	27-Nov	Final project presentations	
thu	29-Nov	Final project presentations	Projects due