

CLIM762: Statistical Methods in Climate Research

Instructor: Timothy DelSole

Semester: Fall 2010

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Office Hours: By appointment (request made by email).

Catalogue Description: Introduction to a core set of statistical methods that have proven useful to modern climate and predictability research. Topics include hypothesis testing, autoregression models, analysis of variance, statistical forecasting, linear regression, cross validation, principal component analysis, detection and attribution of climate change, and identifying coupled patterns of variability.

Prerequisites: undergraduate level linear algebra and probability, familiarity with programming.

Class Meeting: Mondays, 10:30am-1:15pm, Innovation Hall, Room 316

Grading: Homework: 60%, Exam: 25%, Project: 15%

Policy: Homework assignments will be distributed on Monday and are due in class the following Monday. Late assignments will be penalized one letter grade per day late (exceptions for medical reasons).

Honor System: About 50% of the homeworks were given in previous years. Students are expected to refrain from consulting answers for previous years' homeworks.

Class Web Site: http://mason.gmu.edu/%7Etdelsole/clim762/clim762_front.htm

Course Text There is no official text book for this course. Lecture notes will be made available electronically a few days after each lecture. The following texts may prove useful:

Probability and Statistics, by Spiegel, Schaums Outlines (**highly recommended**).

Applied Multivariate Statistical Analysis, by Johnson and Wichern.

Software Homework computations are expected to be done using the package **R**.

Class Schedule

- 8/30** mean, variance, independence, Gaussian distribution, central limit theorem, chi-squared distribution.
- 9/13** hypothesis tests
- 9/20** more hypothesis tests, confidence interval.
- 9/27** time series, stationary, white noise, autocorrelation, Bartlett's Theorem, AR(1) models.
- 10/4** predictability, analysis of variance.
- 10/12** (**Tuesday**) vectors, matrices, geometry, unitary, symmetric matrices, quadratic forms, positive definiteness.
- 10/18** random vectors, multivariate Gaussian, confidence ellipsoids, singular value decomposition.
- 10/25** linear regression
- 11/1** inferences in linear regression.
- 11/8** artificial skill, overfitting, data dredging.
- 11/15** principal component analysis, empirical orthogonal function analysis.
- 11/22** Exam.
- 11/29** climate detection and attribution, global warming.
- 12/6** coupled pattern analysis.

Project

Each student will choose an original research question. Examples of suitable research questions will be given by instructor at an appropriate time. Student will submit a proposal describing the research question to the instructor on 29 November 2010. Instructor will notify student of the appropriateness of the proposal by December 3. Student will address the question with appropriate statistical analysis. Student will present the results orally to the other students in a 15 minute presentation on either 15 or 20 December 2010 (exact date to be announced). Presentation slides will be submitted to the instructor at the end of the presentation.