

MARS 6300 - Multivariate Applications in Marine Science

http://www.pelagicos.net/classes_multivariate_stats_sp2016.htm

HAWAII PACIFIC UNIVERSITY
OCEANIC INSTITUTE (OI)
SPRING SEMESTER, 2016

TIME: 15:40 – 17:05
DAYS: Weds / Fri
LOCATION: OLC 103, OI

INSTRUCTOR

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OFFICE HOURS

Mon / Weds (HLC 2nd floor lanai) 9:30 – 11:30
Other days and times, by appointment

COURSE DESCRIPTION

This hands-on workshop focuses on the analysis and the interpretation of multivariate analyses commonly used by marine scientists. Lectures and assignments emphasize the conceptual understanding and the practical use of these methods, with the goal of providing students with a tool-kit they will use in their thesis research and beyond.

COURSE OBJECTIVES

With recent advances in data collection and synthesis, marine scientists are increasingly faced with the analyses of large datasets involving a myriad of variables measured concurrently. This course will provide participants with an overview of the statistical techniques available for quantifying ecological patterns in ecological datasets using multivariate statistics. Computer labs and assignments will provide students with the quantitative tool-box necessary to explore and test for patterns in large datasets. Additionally, students will complete and present an independent research project, whereby they will use a variety of tools to analyze their own datasets. This course is designed to help students with their individual research projects and thesis research.

The goal of this course is to introduce graduate students in ecology and marine science to the multivariate statistical techniques necessary to carry out sophisticated analyses and to critically evaluate scientific studies and papers using these approaches. This hands-on workshop emphasizing the analysis and interpretation of multivariate analysis, and covers the wide array of multivariate approaches commonly used by marine scientists. This course emphasizes the conceptual understanding and the practical use of these methods (not the matrix algebra or the computer programming), with the aim of providing students with a tool-kit that they will use in the analysis of their thesis data and beyond.

More specifically, the objectives of this course are to provide students with the following: (1) an overview of the use of multivariate statistics in ecological research; (2) a conceptual organization of the various multivariate techniques, with respect to the appropriate types of research questions and data sets; and (3) a working understanding of how to use and interpret the results of each technique, including a conceptual overview, list of assumptions, diagnostics for assessing whether these assumptions are met, mechanics of performing the analysis using software, and the interpretation of the statistical output of the analysis.

STUDENT LEARNING OBJECTIVES

The goal of this course is to give students the means to understand and implement multivariate analysis for direct application in their research. After taking this course, the students will be able to:

Employ the terminology and metrics used to characterize different aspects of the structure, composition and environmental correlates of ecological communities,

Evaluate the “best practices” for performing the analyses and reporting the results of ecological communities, by reviewing the published scientific literature,

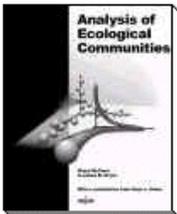
Implement these statistical analyses using software tools, by compiling a dataset, formatting it appropriately, analyzing using statistical software, and extracting the components necessary for reporting the results,

Critically evaluate the diverse approaches used for the analysis of ecological communities by comparing their assumptions and performance,

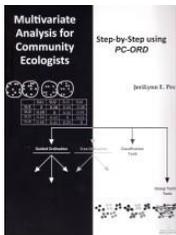
Select the most appropriate analytical approach for a specific application, by comparing and contrasting the benefits and limitations of the various statistical approaches available to characterize ecological communities.

REQUIRED TOOLS AND SUPPLIES

Textbooks There is no required text for this course, however I highly recommend the following:
(NOTE: I will provide you with pdfs of the relevant chapters, for use in the class)



McCune, B. and J. B. Grace. 2002.
Analysis of Ecological Communities.
MjM Software, Glenden Beach, Oregon, USA



Peck, J.E. 2010.
Multivariate Analysis for Community Ecologists.
MjM Software, Glenden Beach, Oregon, USA

We will also read background and reference materials from peer-reviewed papers and chapters from other ecology and statistics books.

Software

We will use PC-Ord. I will make the software available to students for use during this class. After the class, you may want to purchase a personal copy for future use for \$199.00.

METHOD OF INSTRUCTION

This course will involve lectures, homework sets, one exam and one individual project:

Lectures / Homeworks – Lectures will integrate both theoretical and practical aspects of multivariate statistics and will provide examples from the in-class software and the scientific literature. For each topic / technique there will be a formal lecture, followed by a computer demonstration, where the instructor will illustrate the use of the PC-Ord software to perform the specific multivariate analysis. These demonstrations will focus on the criteria for performing the test (e.g., the settings) and for interpreting the output (e.g., the results). The students will apply these lessons to several trial multivariate datasets, by completing the assigned homework using the software package.

Knowledge exam – Once the class has surveyed the tool-box of ordination and classification techniques available, this knowledge will be tested with an exam. Otherwise, there will be no final exam.

Final report and presentation – A significant portion of the course grade will be based on a final written report and peer review of other class members' paper (see below). The final paper will consist of the statistical analysis of a multivariate dataset (approved by the instructor). The nature of the question, the source of the data, and the kinds of analysis employed are flexible. The only requirement is that the data and analysis must address one or more specific ecological hypotheses, which are to be tested using several appropriate multivariate analysis methods. The primary goal of this exercise is to produce a coherent scientific report, not excessive number crunching.

Peer review – Students will review each other's reports (5 % points) and will conduct a re-analysis of their datasets (5% points). The peer-review, which will address critical assumptions and methodologies, will help students to critically evaluate the results of published multivariate analyses.

DATASETS

Personal dataset – A primary goal of this course is to provide students with the opportunity to get better acquainted with your own data. Thus, students are encouraged to use their own data - hopefully collected as part of their thesis research – for the class project. However, the data set used in this exercise may be your own, obtained from the literature or provided by the instructor. Ideally you should use data that you have collected or are otherwise somewhat familiar with. The data set should be one or more matrices of entities \times attributes (e.g., samples \times species, species \times characteristics of species, sites \times environmental factors). The only requirement concerning the type of data is that they should involve multiple biological and physical variables, measured concurrently in time and space. Students who do not have access to a multivariate dataset, will be able to use sample datasets provided by the instructor.

Class datasets – Even if students have their own multivariate datasets, it is unlikely that they will be suitable for using all of the techniques covered in this course. To address this limitation, I will provide several common datasets to all the students enrolled in the class at the beginning of the course. These datasets will allow students to conduct all the statistical approaches listed in the syllabus, and will serve as the basis for the homework assignments. Students will be expected to work with both their own dataset and the class datasets during the computer labs.

COURSE POLICIES

Academic Honesty

While collaborative work in groups is encouraged in this class, every student will submit individual assignments and will complete a unique project. Students are expected to behave according to HPU's academic code of conduct.

Plagiarism, defined as trying to pass off someone else's intellectual work (ideas, writing, results) as your own, is academically dishonest. Any single occurrence of academic dishonesty, in any form whatsoever, may result in a grade of FD for the course. The grade of FD represents an F for academic dishonesty, and it will remain a permanent part of your academic record, not subject to HPU's normal retake policy.

For additional information on plagiarism see the links in Campus Pipeline under the Libraries folder. Another excellent site explaining plagiarism can be found at the Purdue University's Online Writing Lab at: http://owl.english.purdue.edu/handouts/research/r_plagiar.html

Late Assignments / Homeworks

Homeworks and assignments will be turned in electronically – as an attachment via email. To ensure receipt of the emails, label your message and file “MARS6300 – HW# - your name”. I will penalize assignments not labeled properly by removing 5% of the points. Late assignments will be penalized further, by removing 5% of the points for every day (partial or full) after the deadline.

Grading Grades are based on the following criteria:

Homework	30 %	(6; 5% each)
Knowledge & Practical Exam	15 %	
Project Proposal	5 %	
Project Data Screening	5 %	
Project Analysis	10 %	
Project Write-up	10 %	
Project Presentation	5 %	
Project Logbook	5 %	
Project Peer Review	10 %	
<u>Participation (including quizzes)</u>	<u>5 %</u>	
Total Points	100 %	

Note: I will use the following grade cut-offs, and a series of pluses and minuses to fill in the gaps.

90 - 100% A 80 - 89% B 70 - 79% C 60 - 69% D < 60% F

Participation will be evaluated on the basis of student effort and commitment to learning, as evidenced by promptness and attendance to class, participation in class discussions, evidence of having carefully done the assigned reading, and – if needed - initiative to seek help from the instructor. Students should communicate with the instructor about anticipated absences, especially if they will take place during group activities. Occasionally, brief quizzes on the readings will be given at the beginning of the class and brief 5-minute papers will be given at the end of the class. These quizzes will be graded and will contribute towards the participation points for the class.

Other Class Policies:

Attendance - Attendance is mandatory; however roll will not be taken. There will be no make-up quizzes / 5-minute papers except in the case of documented medical necessity.

Coming to class late - Tardiness disturbs others. If you must come late or leave early discuss the need with me and try to make as small a disturbance as possible by sitting close to the door.

Mobile telephones are not allowed in class; turn them off before entering the room.

Laptops are allowed to take notes / view lecture pdfs; not to socialize or do work for another class. This privilege will be revoked if laptops are used for non-class activities (e.g., email / facebook).

HPU's Academic Integrity and Plagiarism Statement:

HPU's Academic Integrity policy states that any act of academic dishonesty will incur a penalty up to and including expulsion from the University. A student, who cheats on an academic exercise, lends unauthorized assistance to others, or who hands in a completed assignment that is not his or her work will be sanctioned. The term "academic exercise" includes all forms of work submitted either electronically or on paper for points, grade, or credit.

<http://www.hpu.edu/StudentServices/AcademicIntegrity/index.html>

HPU's Americans with Disabilities Act Statement:

Students with special needs will be accommodated in accordance with HPU's policy. Students with special needs will be accommodated and allowed more time to complete the assignments, in accordance with HPU's policy.

Under the Rehabilitation Act of 1973 (Section 504), the Americans with Disabilities Act Amendments Act 2008 (ADAAA), and Title III (Public Accommodations) Hawai'i Pacific University does not discriminate against individuals with disabilities. Any student who feels he/she may need an accommodation based on the impact of a disability is invited to contact the Disability Resources Office: <http://www.hpu.edu/StudentServices/disability-resources-office/>

Students Right-to-Know Information:

http://www.hpu.edu/About_HPU/3-Student_Right-to-Know_Information.html