

## MARS 6300 – MULTIVARIATE APPLICATIONS IN MARINE SCIENCE

[http://www.pelagicos.net/classes\\_multivariate\\_stats\\_sp18.htm](http://www.pelagicos.net/classes_multivariate_stats_sp18.htm)

HAWAII PACIFIC UNIVERSITY  
OCEANIC INSTITUTE (OI)  
SPRING SEMESTER, 2018

TIME: 9:10 – 10:35  
DAYS: Tues (T)/ Thurs (R)  
LOCATION: HLC, AC 102E

### **INSTRUCTOR:**

David Hyrenbach, Ph.D.  
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Email: khyrenbach@hpu.edu  
Office: CTSA Building #1, at Oceanic Institute

### **OFFICE HOURS:**

Mon (HLC 2<sup>nd</sup> floor lanai) 11:00 – 13:00  
Weds (HLC 2<sup>nd</sup> floor lanai) 12:00 – 14:00  
Other days and times, by appointment  
([www.pelagicos.net/images/office\\_map.JPG](http://www.pelagicos.net/images/office_map.JPG))

### **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,

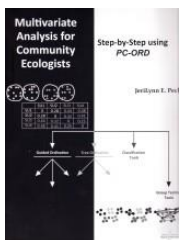
Select the most appropriate analytical approach for a specific application, by comparing and contrasting the benefits and limitations of the various statistical approaches available to characterize ecological communities.

## 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 (cost = \$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

### Turning in Assignments / Homework

Homeworks and assignments will be turned in electronically – as an attachment via email addressed to khyrenba@gmail.com. To ensure receipt of the emails, label your message and file “MARS6300 – *Assignment Name -Your Name*”. I will penalize assignments not labeled properly by removing 10% of the points.

**Grading:** Grades are based on the following criteria:

Homework (6 sets, 5% each)	30 %
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 (Includes quizzes / extra-credit)</u>	<u>5 %</u>
<b>Total Points</b>	<b>100 %</b>

**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).

Late assignments will be penalized further, by removing 10% of the points for every day (partial or full).

## OTHER UNIVERSITY POLICIES:

### Academic Honesty:

Students are expected to comply with HPU's academic honesty policies and are furthermore required to internalize the principles of scientific integrity. In particular, it is academically dishonest to **plagiarize** (i.e., to pass off someone else's intellectual work as your own). Directly quoting others, even with proper attribution of the source, is never done in scientific writing, so **there are no circumstances in which including someone else's writing in your papers will be acceptable in this course.**

All students are expected to comply with HPU's academic honesty policies. Any infringement can result in a grade of "F" for the course. Furthermore, students are required to understand the reasons for this policy and internalize the principles of scientific integrity. All students will follow these guidelines:

- It is academically dishonest to try to pass off someone else's intellectual work as your own, or to help someone else to do so.
- All research results must be documented with laboratory notebooks, computer files of raw data.
- All work must be original.
- Data analysis and results must be accompanied by clear and accurate descriptions of the methods; the results of others must be clearly identified and the appropriate sources must be cited.
- If you use published materials (for facts, statements, images, data, etc.) in completing an assignment, credit must be given by citing the source – failure to properly cite sources is considered plagiarism.
- Directly quoting others is not acceptable in scientific writing. Thus, there are no circumstances in which including someone else's writing in your papers is permissible.

For more information on what constitutes plagiarism, see the links in Campus Pipeline, under the Libraries folder. Another excellent site describing how to avoid committing plagiarism can be found at Purdue University's Online Writing Lab: [http://owl.english.purdue.edu/handouts/research/r\\_plagiar.html](http://owl.english.purdue.edu/handouts/research/r_plagiar.html)

Hawaii Pacific University provides a learning environment based upon academic excellence and integrity. In this course, it is expected that you will adhere to all Hawaii Pacific University guidelines regarding academic dishonesty. It is Hawaii Pacific University policy that any act of Academic Dishonesty will incur a penalty up to and including expulsion from the University. Any 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 for points, grade, or credit. Please see the Student Handbook for the full policy.

If you copy another student's assignment or use their homework or test to guide your work, each will receive a grade of "0" for that assignment and may receive an automatic "F" for the course. 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, and is not subject to HPU's normal retake policy. Depending on the severity of the case, a single event of academic dishonesty, in any form whatsoever, may result in either a zero on the assignment for everybody involved, an "F" in the course, or expulsion from the University.

If you unclear on what is and what is not plagiarism, please discuss it with me. All major writing assignments will be analyzed at Turnitin.com. For homework problems and any other take-home assignment, students may work with each other but must turn in their own answers to assigned problems. For additional information on plagiarism see the links in Campus Pipeline under the Libraries folder. Another excellent site explaining plagiarism (and how to avoid committing it) can be found at the Council of Writing Program Administrators website: <http://www.wpacouncil.org/node/9>

Special Needs Policy: Under the Rehabilitation Act of 1973 (Section 504), the Americans with Disabilities Act, Title III (Public Accommodations) and Title V (Employment), and the Hawai'i Fair Employment Practice Law, Hawai'i Pacific University does not discriminate against individuals with disabilities. HPU will make reasonable accommodations in its policies, practices and procedures in order to: 1) allow students with disabilities to benefit from the services and facilities offered by the University and 2) employ otherwise qualified individuals with disabilities who are able to do essential tasks of specific jobs. HPU will accommodate known disabilities, unless to do so would impose an undue hardship. This is interpreted to mean significant difficulty (fundamentally altering the nature of the services and facilities provided by the University) or expense.

**Note:** Any student with a documented disability who would like to request accommodations should contact the University Disability Services Office (933-0816 (V), 933-3334 (TTY), Campus Center Room 311) as early in the semester as possible.

Counseling and Behavioral Health Services: The Counseling and Behavioral Health Services (CBHS) department provides FREE and CONFIDENTIAL counseling services to current registered HPU students including the following counseling services: individual; couples; family; crisis Intervention; consultation services for students, parents, faculty and staff; grief and loss. To schedule an appointment or for more information, please contact the Academic Advising & Behavioral Health office at either of the following: DOWNTOWN (808) 544-1198 or HAWAII LOA (808) 236-3578. The CBHS department can also be reached by email at: [counseling@hpu.edu](mailto:counseling@hpu.edu). They are unable to take appointments online or through email. All appointments must be scheduled by calling the numbers listed above. If this is an emergency, please call 911 or go to the nearest emergency room or hospital.