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BIOS 7331: Multivariate Analysis

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Jiann-Ping Hsu College of Public Health

BIOS 7331: Multivariate Analysis
Spring 2018

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Class Time: Tuesday and Thursday, 3:30-4:45 PM
Location: IT building 3216
Office Hours: Wed and Thursday: 9:00 - 12:00 PM; and by appointment

Course Description: This course covers multivariate general linear models, including multivariate regression, multivariate analysis of variance, discriminant analysis, multivariate analysis of covariance, multivariate analysis of repeated measures, and longitudinal data analysis for general and generalized linear models. The linear model basis of principal components and factor analysis will also be covered from the canonical correlation perspective.

Texts:
Johnson, R.A. and Wichern, D.W. Applied Multivariate Statistical Analysis, 6th edition. Prentice Hall. ISBN 978-0131877153

References:
Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie. (2011). The Elements of Statistical Learning. : Springer

Dr.PH Core Student Learning Outcomes (CORE)

1. Demonstrate their readiness to work with communities to address public health problems.
2. Select and apply theoretically based interventions to address public health problems.
3. Apply appropriate research methods to address community health problems, particularly among rural and underserved populations.

Dr.PH Biostatistics Concentration Student Learning Outcomes

1. Construct a public health and biomedical research questions from ideas, conditions, and events that exist in a rural and urban community, region, state, and nation using critical thinking skills.
2. Demonstrate required skills for translating public health practice objectives to appropriate biostatistical framework for analysis and interpretation of results.
3. Illustrate sufficient substantive knowledge of advanced biostatistical methods such as multiple regression, logistic regression, survival analysis, longitudinal data analysis, and Bayesian and adaptive methods to interact with biostatisticians and realted public health researches in a meaningful and productive fashion.
4. Communicate biostatistical principles and concepts to lay and professional audiences through both oral and written communication.

Dr.P.H Biostatistics Concentration Competencies:

1. Design a public health and biomedical investigation in terms of the experimental design, data to be collected that reflect research objectives, number of subjects needed, and specification of appropriate methods for analysis.
2. Analyze public health and biomedical data using appropriate statistical software such as SAS, R.
3. Interpret analytic methods used in the public health and biomedical journals, as well as critique published reports of public health and biomedical experiments as to the validity of the inferential conclusions.
4. Develop new biostatistical methods and new ideas for applying existing biostatistical methods to applications in public health and the biomedical sciences.
5. Develop written and oral reports to communicate effectively with research investigators the pivotal aspects of a study, including: design, study objectives, data analysis methodology, results and conclusions.
6. Create a collaborative environment for working on written and oral reports.

Performance Based Objectives:

1. Conduct and interpret multivariate analyses using SAS or R;
2. Perform analysis using multivariate linear regression models and make inferences;
3. Compare multivariate means, including in repeated measures designs;
4. Implement and interpret principle components analysis, factor analysis, canonical correlation analysis, discrimination and classification analysis.
5. Gain skills necessary for reporting results in written form.

Computing: SAS and R will be used exclusively in this course.

Grading Scheme:
Assignments (assesses competencies 1-17): 60%
Final Exam (assesses competencies 1-17): 40%

Note: All exams and assignments will be graded and returned promptly so that students may accurately calculate their grades at any point in time during the semester.

Grading Scale:
A   90 - 100%
B   80 - 89%
C   70 - 79%
D   60 - 69%
F   0 - 59%

Exams: There will be 1 exams, the final exam (Tuesday, May 1– taken from the university's 2018 Final Exam Schedule).

Assignments: Assignments account for 60% of your course grade. You may work together or individually on these assignments, however each student must submit his/her own assignment and state with whom he/she worked, if applicable.

What does 'working together' mean? You are welcome to solve problems and discuss explanations in groups, however **it is not acceptable to submit assignments with identical wordings and explanations**.

Schedule of Exams:
FINAL EXAM: Tuesday, May 1

Tentative Course Schedule:

Week	Topics	Chapter	Homework& Test
1	**Introduction to Multivariate Techniques: An Overview** A. Multivariate Research Questions vs. Multiple Univariate Research Questions B. Overview of Techniques .	Chapter 1	HW1
2	**Matrix Operations and Random Vectors** Notation and Terminology Types of Matrices; Order (dimensions) of a Matrix a. Vectors b. Matrix Algebra c. PROC IML	Chapters 2&3	HW2
3	**Multivariate Normal Distribution**	Chapter 4	HW3
4-5	**Inferences about the Mean Vector** Large sample, confidence intervals, Hotelling's t-statistics, multivariate quality control charts, comparison of several multivariate means.	Chapters 5&6	HW4

6-8	**Multivariate Linear Regression** Least squares, model checking, Wilk's Lamda, leverage, influence, comparing models PROC GLM	Chapter 7	HW5
9-10	**Principal Components and Factor Analysis** Correlated observations, graphing technique, rotation, factor scores, cautions of interpretation.	Chapters 8&9	HW6
11	**Canonical Correlation** Canonical variates, sample measures, large sample inference, interpretation and reporting.	Chapter 10	TBD

12-13	**Discrimination and Classification**
	Separation of two populations, assumptions on the
	    covariance structures, more than two populations,
	    methods of discriminating.
		Chapter 11	TBD

14	**Clustering and Distance Methods (Optional)** A discussion of several clustering methods, multidimensional Scaling.	Chapter 12	TBD

Academic Integrity: Students are expected to follow guidelines outlined in the *Academic Dishonesty* policy found online in the course catalog. Any student found in violation of academic honesty will receive a grade of 'F' for the course. It is the student's responsibility to familiarize him/herself with the student policies and expectations set forth in the online GSU *Catalog*.

Plagiarism: According to the Academic Dishonesty Policy of GSU, Plagiarism includes (but is not limited to):

A. Directly quoting the words of others without using quotation marks or indented format to identify them.
B. Using published or unpublished sources of information without identifying them.
C. Paraphrasing material or ideas without identifying the source.
D. Unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic material.
If you are accused of plagiarism by a JPHCOPH, the following policy, as per the Judicial Affairs website (http://students.georgiasouthern.edu/judicial/faculty.htm) will be enforced:

PROCEDURES FOR ADJUDICATING ACADEMIC DISHONESTY CASES
First Offense - In Violation Plea

1. If the professor and the Dean of Students agree that the evidence is sufficient to warrant a charge of academic dishonesty, the professor should contact the Office of Judicial Affairs to determine if this is a first violation of academic dishonesty. The incident will be reported via the following website:
http://students.georgiasouthern.edu/judicial/faculty.htm

2. If it is a first violation, the professor should talk with the student about the violation. If the student accepts responsibility in writing and the professor decides to adjudicate the case, the following procedures will be followed:

a. The student will be placed on disciplinary probation for a minimum of one semester by the Office of Judicial Affairs.

b. The student will be subject to any academic sanctions imposed by the professor (from receiving a 0 on the assignment to receiving a failing grade in the class).
c. A copy of all the material involved in the case (Academic Dishonesty Report Form and the Request For Instructor to Adjudicate Form) and a brief statement from the professor concerning the facts of the case and the course syllabus should be mailed to the Office of Judicial Affairs for inclusion in the students discipline record.

First Offense - Not In Violation Plea (student does not admit the violation)
If the professor and the Dean of Students agree that the evidence is sufficient to warrant a charge of academic dishonesty, the professor should contact the Office of Judicial Affairs to determine if this is the first or second violation of academic dishonesty. The student will be charged with academic dishonesty and the University Judicial Board or a University Hearing Officer would hear the case. If the student is found responsible, the following penalty will normally be imposed:

a. The student will be placed on Disciplinary Probation for a minimum of one semester by the Office of Judicial Affairs.

b. The student will be subject to any academic sanctions imposed by the professor.
Second Violation of Academic Dishonesty
If the professor and the Dean of Students agree that the evidence is sufficient to warrant a charge of academic dishonesty, and if it is determined this is the second violation, the student will be charged with academic dishonesty and the University Judicial Board or a University Hearing Officer would hear the case.
If the student is found responsible, the following penalty will normally be imposed:
a. Suspension for a minimum of one semester or expulsion.

b. The student will be subject to any academic sanctions imposed by the professor.
NOT RESPONSIBLE FINDING
When a student is found not responsible of academic dishonesty, the work in question (assignment, paper, test, etc.) would be forwarded to the Department Chair. It is the responsibility of the Department Chair to ensure that the work is evaluated by a faculty member other than the individual who brought the charge and, if necessary, submit a final grade to the Registrar. For the protection of the faculty member and the student, the work in question should not be referred back to the faculty member who charged the student with academic dishonesty.
In the case of a Department Chair bringing charges against a student, an administrator at the Deans level will ensure that the students work is evaluated in an appropriate manner.

Attendance Policy & Class Participation: Due to the nature and structure of this course, class attendance is essential to succeeding in this course. You are responsible for any material covered or distributed in class, including any announcements, so please check with me or your colleagues if you miss class in order to obtain copies of notes or any announcements. Federal regulations require attendance be verified prior to distribution of financial aid allotments. Attendance will not be recorded after this initial period.

Furthermore, I believe it is important to foster student-teacher and student-student interactions within this course, so you will discover that I will ask questions throughout class. Although participation is not a formal part of your final grade, I will use it as a factor if your final grade is on the border between two letter grades. It is noted throughout the semester when you partake in class discussions. If your final course grade is on the border of two letter grades, then class participation will weight your final grade to the next highest letter grade. Otherwise, I do not round final numerical grades to the nearest letter grade.

Class Etiquette: Please turn off all cell phones during all class/lab/exam meetings, since ring tones are disruptive to others.

Dates to Remember: To see the important dates see the following website:

> *University Calendar*:
> http://students.georgiasouthern.edu/registrar/calendar.htm
>
> and on the Graduate School's website:
> http://cogs.georgiasouthern.edu/importantdates.html

Disclaimer: The contents of this syllabus are as complete and accurate as possible. The instructor reserves the right to make any changes necessary to the syllabus and course material. The instructor will make every effort to inform you of changes as they occur. It is the responsibility of the student to know what changes have been made in order to successfully complete the requirements of the course.

University Writing Center: For those of you who may need assistance with improving your writing for assignments, or for general writing, I encourage you to visit the University Writing Center. To learn more, visit their website: http://class.georgiasouthern.edu/writingc.