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BIOS 6331 - Regression Analysis in Biostatistics

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Georgia Southern University
Jiann-Ping Hsu College of Public Health

BIOS 6331: Regression Analysis in Biostatistics

Fall 2017

Instructor: Jingjing Yin
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Phone: 912-478-2413
Email: jyin@georgiasouthern.edu
Class Meeting: Monday and Wednesday 2:30pm-3:45pm,
Location: Information Technology Building, Room 2207
Office Hours: M and W 9-12 and by appointment via email

Course Description: This course introduces the methods for analyzing biomedical and health related data using linear regression models. The course will introduce the student to matrix algebra as used in linear models. The course will involve model selection, diagnosis and remedial techniques to correct for assumption violations. The students will learn how to apply SAS procedures PROC REG, PROC CORR, and PROC GLM and interpret the results of analysis. Emphasis will also be placed on the development of critical thinking skills.

Textbook:

Required: *Applied Regression Analysis and Other Multivariable Methods, 4 or 5th edition, Kleinbaum, Kupper, Nizam and Muller. Duxbury Press, Belmont California.*

Supplementary: *Applied Linear Statistical Models, 5th edition, Kutner, Nachtsheim, Neter, and Li*

The lectures will often follow the general organization of the text, but with some differences in emphasis and detail. Students will be responsible for **whatever material is covered in the lectures**, whether or not it is treated in the text.

Master of Public Health

MPH

Cross-cutting Competencies

1. Demonstrate effective written and oral skills for communicating with different audiences in the context of professional public health activities. (Communication and Informatics)
2. Use information technology to access, evaluate, and interpret public health data. (Communication and Informatics)
3. Describe the roles of history, power, privilege and structural inequality in producing health disparities. (Diversity and Culture)
4. Explain how professional ethics and practices relate to equity and accountability in diverse community settings. (Diversity and Culture)
5. Develop public health programs and strategies responsive to the diverse cultural values and traditions of the communities being served. (Diversity and Culture)

Biostatistics Concentration

1. Provide the biostatistical components of the design of a public health or biomedical experiment by: clarifying the research objectives or questions; determining data and endpoints to be collected appropriate for the objectives; translating the objectives into biostatistical questions via hypothesis testing or confidence interval frameworks; determining the appropriate sample size; and writing the statistical analysis section of the experiment.
2. Apply appropriate statistical analysis methods using SAS to analyze both categorical and quantitative data.
3. Develop written and oral reports to communicate effectively to research investigators pivotal aspects of a study, including its design, objectives, data, analysis methods, results, and conclusions ensuring that results and conclusions are valid and reliable and address the research objectives.
4. Create a collaborative environment for working on written and oral reports and developing critical thinking skills.
5. Describe key concepts and theory underlying biostatistical methodology used in probability and inferential, analytical, and descriptive statistics.

Performance-Based Objectives (PBO) Linked to Course Activities (Note: Activities Described in Next Section)

At the end of this course, students will be able to thoroughly understand and apply the following statistical concepts and methods (among others):

1. Interpret the regression coefficients for both continuous and categorical independent variables (including interactions) and apply inferential methods via confidence interval estimation and hypothesis testing for regression coefficients, correlation, the mean response and prediction of a new observation. Competency of this objective will be measured by Activities 1, 2, 3 and 4.
2. Describe the partitioning of total sums of squares, sequential and partial sums of squares and corresponding degrees of freedoms within an analysis of variance approach and apply lack-of-fit F-test for general linear test (i.e., full versus reduced model). Competency of this objective will be measured by Activities 1, 2, 3 and 4.
3. Apply fundamental matrix operations such as matrix addition, subtraction, multiplication, transpose, inverse, and linear dependence in the computations of a regression function. And to form linear regression model, parameter estimates, sum of squares in terms of matrix and quadratic forms. Competency of this objective will be measured by Activities 1 and 2.
4. Identify model departures (non-linearity, non-normality, heteroscedasticity, multicollinearity, etc.) and apply appropriate remedy (such transformations). Identify outliers in a regression analysis. Competency of this objective will be measured by Activities 1, 3 and 4.
5. Apply model selection procedures to select an appropriate regression model. Competency of this objective will be measured by Activity 4.
6. Develop written reports and orally present the data analysis to effectively communicate to research investigators pivotal aspects of a study, including study objectives, variables of interest, appropriate regression analysis methods (such as linear, polynomial and logistic regression), results, and conclusions. Competency of this objective will be measured by Activity 4.

Assessment of Student Learning

Activity 1: Weekly-assignments (Specific PBO and Comp, see table of Schedules)

Activity 2: Midterm in-class and take-home exams (PBO 1 to 3; Comp3, 4 and 5)

Activity 3: Final in-class and take-home exams (PBO 1 to 4; Comp2, 3, 4 and 5)

Activity 4: Perform regression analysis on a real data and give an oral presentation for the project. (PBO 1 to 6; Comp1 to 5)

Topics and Schedules: (subject to change)

| Chapter | Topic | Assignments |
|---|--|--|
| Week 1: Chapters 1, 2, 3, 4 | Preliminaries | Hw1 (PBO1; Comp3) |
| Week 2: Chapters 5.1-5.6 | Introduction of simple linear regression | Hw2 (PBO 1; Comp3) |
| Week 3: Chapters 5.7-5.11 and Chapter 7 | Inferences in simple regression | Hw3 (PBO1; Comp3 and 4) |
| Week 4: Chapter 6 | Correlation coefficient and Matrix introduction | Hw4 (PBO1 and 3; Comp3 and 4) |
| Week 5: Appendix B | Matrix intro and Matrix formulation in regression | Hw5 (PBO1 and 3; Comp3) |
| Week 6: Chapter 8 | Multiple regression intro | |
| Week 6: Chapter 9 | Multiple regression inferences based on sequential and partial sums of squares | Hw6 (PBO 1 to 3; Comp3 and 4) |
| Week 7: Chapter 10 | Correlations in multiple regression | Hw7 (PBO 1 to 3; Comp3 and 4) |
| Week 8: Chapter 11 | Interaction and confounding | |
| Week 9: Chapter 12 | Categorical variable and ANCOVA | |
| Week 10: Chapter 13 | Categorical variable and ANCOVA cont. | Hw8 (PBO 1 and 3; Comp3 and 4) |
| Week 11: NA | Mid-term | Project assigned |
| Week 12: Chapter 14 | Diagnostics | |
| Week 13: Chapter 16 | Model selection | Practice for final (PBO 1 to 5; Comp3 and 4) |
| Week 14: Chapter 15 (if time permits) | Polynomial regression/ Student oral presentation | |
| Week 15: NA | No classes (Thanksgiving) | |
| Week 16: NA | Student oral presentation | Final (PBO 1 to 5; Comp3 and 4) |

Grading Scheme:

Homework: 25%
Presentation: 25%
Midterm: 25%
Final Exam: 25%

Grading Scale:

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

Homework: Homework accounts for 25% of your course grade. Assignments are to be handed in **by the end of the lecture the day it is due**, unless otherwise announced in class. **Late homework will not be accepted** unless advanced permission was given by the instructor under extraordinary circumstances (e.g., serious illness/accident, death in the family, etc.).

Please describe and justify your answers with detailed reasoning, an answer with merely a final number receives no credit even it is correct. If SAS or R is used, please attach the commented code at the end of the homework, which I should be able to run and reproduce your results.

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. I will cheerfully address any homework questions during office hours. Emailing me about homework questions is not referred, but if you do, please allow me one business day to respond.

Project:

I will give an example report and presentation so you have an idea of the rubrics (and I will also provide a list of rubrics). The given data sets are provided kindly by my collaborators which are all publishable. One data set will be assigned to two of you randomly and the both of you should work **independently** on the data set and I will compare the work between two of you to see which one is better. And only the better one gets the chance to publish. **Note that your grade of the project will depend both on your comparative performance compared to your “competitor” as well as that compared to the whole class.** And each of you need to give peer-evaluations with comments according to the rubrics for your classmates and the grade of your project will also be based on the peer-evaluations.

You will have chance to get a publication as a co-author if 1) your work is better than the “competitor”; 2) the results are up to the standards for publication; and 3) if you are willing to continue the analysis as needed for publication after the course completion. If the work is below the standards, so that I have to redo the analysis, then you do not get the authorship.

Approximate Schedule of in Class Exams:

MIDTERM: to be announced

FINAL EXAM: Final exam week

NO make-ups for any missed exam

Academic Integrity: Students are expected to follow guidelines outlined in the *Student Conduct Code* policy regarding academic dishonesty. 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 *GSU Student Conduct Code*

Attendance Policy: Due to the nature and structure of this course, class attendance is of utmost importance. You are responsible for any material covered or distributed in class, including any announcements made in class, whether or not you are present. Furthermore, federal regulations require attendance be verified prior to distribution of financial aid allotments. Attendance will not be recorded after this initial period. However, if you are going to miss one class, it is recommended that you notify the instructor prior to the start of the class so that I could help you to make up for the lecture you have missed.

Class Participation & Etiquette: Attendance, attention, and participation are expected for each class! Note that although class participation is not a formal part of your course grade, I will use it as a factor if your final grade is on the border between two letter grades.

On a final note of etiquette, please do not text or use your cell phones during class, and silent your cell phones since ring tones are disruptive to others. If you have to use the cell phone, you may leave the classroom so that you do not interrupt others. And please do not chat or make noises while the instructor or your classmate is talking.

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.

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 student's 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 Dean's level will ensure that the student's work is evaluated in an appropriate manner.

CONFIDENTIALITY

In accordance with provisions of the Family Educational Rights and Privacy Act of 1974 and the Georgia Open Records Act, any information related to a violation of academic

dishonesty or the outcome of a judicial hearing regarding academic dishonesty, is prohibited and must be treated as confidential by members of the faculty."