

Spring 2015

# BIOS 9133 - Advanced Statistical Theory for Biostatistics II

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**Georgia Southern University**  
**Jiann-Ping Hsu College of Public Health**

BIOS 9133 – Advanced Statistical Theory for Biostatistics II  
Spring 2015

<b><u>Instructor:</u></b>	<b>Dr. Hani Samawi</b>
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<b><u>Office Hours:</u></b>	Tuesday and Thursday:10:00 am-noon Monday 1:00 pm-2:00 pm Other times by appointment
<b><u>Web Page:</u></b>	<a href="http://works.bepress.com/hani_samawi/">http://works.bepress.com/hani_samawi/</a>
<b><u>Class Meets:</u></b>	Tuesday and Thursday 5:00 pm-6:15pm IT Building Room 2203

-- Course schedules can be found at: <http://www.collegesource.org/displayinfo/catalink.asp> --

**Prerequisites:** Bios 9131 Advance Statistical Theory for Biostatistics I

**Catalog Description:** This course is a continuation of Advanced Statistical Inference for Biostatisticians I. The additional topics in this course consists of: sample moments and their distributions, the theory of point estimation, the Neyman-Pearson Theory of testing hypotheses, likelihood ratio test, chi-square tests, t-test, F-test, procedures in hypothesis testing, confidence estimation. Prerequisite: A minimum grade of “C” in BIOS 9131.

**Required Textbook:** Vijay K. Rohatgi and A. K. Md. Ehsanes Saleh (2000). *An Introduction to Probability and Statistics*, Second edition. John Wiley & Sons, INC.

**Secondary Text:** Peter J. Bickel and, Kjell A. Doksum (2006). *Mathematical Statistics*, 2nd Edition, by Prentice Hall.

**Dr.Ph Core Student Learning Outcomes (CORE)**

At the end of the Dr.Ph program, the students will be able to:

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**

At the end of Dr.PH program, students will be able to:

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 related 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. Upon graduation a student with a Dr.P.H. in Biostatistics should be able to:  
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 and S-plus.
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:**

At the completion of this course, the student will be able to:

1. Understand and use sample moments and their distributions, random sampling, sample characteristics and their distribution, Chi-square, t-, and F-distribution, Large-Sample theory, distribution of  $(\bar{X}, S^2)$  in sampling from a Normal Population and sampling from bivariate Normal distribution. (Activates 1, 2 and 3)
2. Understand and use of parametric point estimation, problem of point estimation, sufficiency, completeness and ancillarity, unbiased estimation, lower bound for the variance of an estimator, method of moments, maximum likelihood estimators, Bayes and minmax estimation, and the principle of equivariance. (Activates 1, 2 and 3)

3. Understand and use some fundamental notation of Hypotheses testing, Neyman-Pearson Lemma, families with monotone likelihood ratio, unbiased and invariant tests and locally most powerful tests. (Activates 1, 2 and 3)
4. Understand and use further results of hypotheses testing, generalized likelihood tests, Chi-square tests,  $t$ -tests,  $F$ -tests. (Activates 1, 2 and 3)
5. Understand and use confidence estimation, some fundamental notation of confidence estimation, methods of finding confidence intervals, and unbiased and equivariant confidence intervals. (Activates 1, 2 and 3)

### **Assessment of students Learning**

Activity 1: Use course lectures and class discussions to explain the basic terminology and definitions of biostatistical basic theories including but not limited to moments and their distributions, random sampling, sample characteristics and their distribution, Chi-square,  $t$ -, and  $F$ -distribution, Large-Sample theory, distribution of  $(\bar{X}, S^2)$  in sampling from a Normal Population, sampling from bivariate Normal distribution, parametric point estimation, problem of point estimation, sufficiency, completeness and ancillarity, unbiased estimation, lower bound for the variance of an estimator, method of moments, maximum likelihood estimators, Hypotheses testing, Neyman-Pearson Lemma, families with monotone likelihood ratio, unbiased and invariant tests, locally most powerful tests, generalized likelihood tests, Chi-square tests,  $t$ -tests,  $F$ -tests confidence estimation, some fundamental notation of confidence estimation, methods of finding confidence intervals, and unbiased and equivariant confidence intervals. Competence in basic terminology will be evaluated using two activities: (1) weekly homework (2) two in class exams.

Activity 2: Use course lectures, class discussions and class exercises illustrate proving theorems and deep understanding of biostatistical theories, including but not limited to moments and their distributions, random sampling, sample characteristics and their distribution, Chi-square,  $t$ -, and  $F$ -distribution, Large-Sample theory, distribution of  $(\bar{X}, S^2)$  in sampling from a Normal Population, sampling from bivariate Normal distribution, parametric point estimation, problem of point estimation, sufficiency, completeness and ancillarity, unbiased estimation, lower bound for the variance of an estimator, method of moments, maximum likelihood estimators, Hypotheses testing, Neyman-Pearson Lemma, families with monotone likelihood ratio, unbiased and invariant tests, locally most powerful tests, generalized likelihood tests, Chi-square tests,  $t$ -tests,  $F$ -tests, confidence estimation, some fundamental notation of confidence estimation, methods of finding confidence intervals, and unbiased and equivariant confidence intervals. Competence in biostatistical theories will be evaluated using two activities: (1) weekly homework (2) two take home exams.

Activity 3: Use course lectures, class discussions and real theoretical illustration to explain the basic applications of biostatistical theories as well as the integration of these theories across the biostatistics and public health spectrum. Competence in ability to integrate theories will be evaluated using challenging theoretical published papers for the students to write a report and present the theoretical concept of these papers in the class.

**Overview of the Content to be Covered During the Semester:**

Week	Topic	Readings	Assignment: Due within 1 week of completion of topic
1-4	Continue on some limit Theorems And Sample moments and their distribution. ( Learning Objectives: 1)	Chapter 6 and 7	6.2.2, 6.2.5, 6.2.9, 6.2.11, 6.3.5, 6.3.8, 6.4.1, 6.4.7, 6.5.1, 6.5.2, 6.5.5, 6.6.1, 6.6.2, 6.6.5, 7.2.1, 7.2.3, 7.3.4, 7.3.8, 7.4.3, 7.4.4, 7.5.1, 7.5.7, 7.6.6, 7.7.1
5-10	Parametric Point Estimation ( Learning Objectives: 2)	Chapter 8	8.2.2, 8.2.4, 8.2.6, 8.3.1, 8.3.2, 8.3.4, 8.3.11, 8.4.3, 8.4.5, 8.4.9, 8.4.11, 8.5.1, 8.5.5, 8.5.8, , 8.5.11, 8.6.5, 8.7.1, 8.7.2, 8.7.8, 8.7.10, 8.8.7, 8.9.1
11-14	Neyman-Pearson Theory of Testing Hypotheses & Some Further Results of Hypothesis testing ( Learning Objectives: 3, 4)	Chapter 9, 10	9.2.1, 9.2.6, 9.3.1, 9.3.4, 9.3.11, 9.4.1, 9.4.2, 9.4.6, 9.5.1, 9.5.4, 9.6.2, 10.2.1, 10.2.4, 10.3.1, 10.3.4, 10.4.3, 10.4.8, 10.4.10, 10.5.1, 10.5.5, 10.6.3
15-16	Confidence Estimation ( Learning Objectives: 5)	Chapter 11	11.3.3, , 11.3.5, 11.3.7, 11.3.13, 11.4.1, 11.4.5, 11.5.3, 11.5.3, 11.5.4, 11.5.5

Samples of your work may be reproduced for search purposes and/or inclusion in the professor's teaching portfolio. You have the right to review anything selected for use, and subsequently ask for its removal.

**Instructional Methods:** Class meeting will be a combination of lecture, class discussion and active participation. PowerPoint presentations ( you can find and download from Folio) will be used in the lecture portion of this course. Prior to each lecture, the student is encouraged to complete the recommended reading and actively participate in the class discussion. In this way, it is hoped that the learner will be better prepared to successfully accomplish the learning objective of each lecture experience.

**Exam Schedule and Final Examination:**

Midterm Examination: March 24, 2015  
 Final Examination: May 5, 2015; 5:30 pm-7:30 pm

**Grading:** Weighting of assignments for purposes of grading will be as follows:

Midterm Exam (in class and take home)	(Activities 1 & 2)	150 points (30%)
Final Exam (in class and take home)	(Activities 1 & 2)	150 points (30%)
Assignments and final	(Activities 1, 2 and 3 )	200 points (40%)
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Total Possible Points		500 points (100%)
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The following point scale will be utilized in grading:

- 450-to-500 points (90%) A
- 400-to-449 points (80%) B
- 350-to-399 points (70%) C
- 300-to-349 points (60%) D

A cumulative total of 299 points or less will be considered as failing.

For calculation of your final grade, all grades above will be included.

Your grades ***will not*** be posted. 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.

There are times when extraordinary circumstances occur (e.g., serious illness, death in the family, etc.). In such circumstances, and/or if you need additional time to satisfactorily complete any course requirement, please consult with the instructor within a reasonable amount of time. *Nota Bene:* Extensions are not guaranteed and will be granted solely at the discretion of the instructor.

NO EXTRA CREDIT PROJECTS WILL BE ASSIGNED!

**Academic Misconduct:** "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.

#### **Academic Handbook:**

Students are expected to abide by the Academic Handbook, located at <http://students.georgiasouthern.edu/sta/guide/>. Your failure to comply with any part of this Handbook may be a violation and thus, you may receive an F in the course and/or be referred for disciplinary action.

#### **University Calendar for the Semester:**

The University Calendar is located with the semester schedule, and can be found at: <http://www.collegesource.org/displayinfo/catalink.asp>.

#### **Attendance Policy:**

Federal regulations require attendance be verified prior to distribution of financial aid allotments. Attendance will not be recorded after this initial period.

#### **One Final Note:**

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 students 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.