Mel and Enid Zuckerman College of Public Health
University of Arizona

SYLLABUS

Statistical Consulting
STAT 688/BIOS 688
(Fall 2019)

Time: Wednesday 2:30 - 5:20 p.m.
Location: Drachman Hall A-119

Instructor Name and Contact Information:

Dean Billheimer, PhD
Professor of Biostatistics
College of Public Health
Director, Statistics Consulting Laboratory
BIO5 Institute
1230 N. Cherry Ave.
Room 261 BSRL
Tucson, AZ 85724
Telephone: 626-9902
dean.billheimer@arizona.edu
Website: http://stat688.bio5.org
Website: http://statlab.bio5.org/

Instructor Availability: By Appointment. Students are encouraged to meet with Dr. Billheimer.

Alternate Contact: Juli Riemenschneider (Consulting Sessions Coordinator)
jriemen@email.arizona.edu

Teaching Assistant: None

TA Office Hours: None

Catalog Description:
The goal of this course is to teach statistics students to be effective statistical consultants. This is an advanced course requiring statistical and scientific maturity. This course will provide students with the ability to effectively and accurately acquire and convey information in verbal and written presentations. The course also describes selection and use of tools and statistical methods to analyze and interpret scientific, business and medical studies.

Rev. August 22, 2019
Course Description:
Through class meetings, meeting with statistical consulting clients and statistical consulting projects, students will gain hands-on experience of statistical consulting.

Course Prerequisites:
Statistics: STAT/MATH 564 (Theory of Probability)
STAT/MATH 566 (Theory of Statistics)
AND:
STAT/MATH 571A (Advanced Statistical Regression Analysis)
STAT/MATH 571B (Design of Experiments)
OR:
BIOS 576A (Biostatistics in Public Health)
BIOS 576B (Biostatistics for Research)

Computing: Working knowledge of R, Stata, SAS, S-plus (or equivalent)

Preferred: Exposure to linear and generalized linear models

Course Objectives and Expected Learning Outcomes:

- **Course Objectives**

During this course, students will:
1. Identify and practice communication styles to ensure accurate flow of information between the client and the statistical consultant.
2. Identify the needs of the client through various questioning techniques, select and apply appropriate methods of analysis, and effectively communicate results through oral and written presentations.
3. Practice statistical consulting in a real-world setting.

- **Learning Outcomes**:

Upon completion of this course students will be able to:
   a. Participate in real-world, interdisciplinary consulting experiences.
   b. Assist the client to think through their scientific goal using a variety of questioning techniques.
   c. Employ listening skills to formulate direct, responsive answers from the client.
   d. Verify the needs of the client by restating the objectives.
   e. Compose and deliver clear presentation to the client, based on their specific request.

Course Notes: N/A

Texts or Readings:

Recommended Textbook:


Other Readings:
Additional readings will be posted on [http://stat688.bio5.org](http://stat688.bio5.org).

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Required or Special Materials: A laptop computer is useful but not required.

Course Requirements:
Students are required to actively participate in class discussion and activities include collaborative work with assigned team members during the semester. Class assignments, including reading assignments, homework and course projects, must be completed on time.

a. Class Participation: Class attendance and class discussion are considered as part of the in-class participation grade.

b. Weekly Meetings with University Researchers: Students are required to attend scheduled appointments with researchers seeking statistical consulting assistance. Each student will participate in approximately five consulting projects over the course of the semester.

c. Weekly Verbal Summaries: Students will report on consultations in class, prompting class participation of best practices.

d. Summary Reports: Student statistical teams will write a summary report for each project to be shared with the investigator.

Grading Scale/Student Evaluation and Policies:

Students’ final grade is determined by the following components:

<table>
<thead>
<tr>
<th>Assessment Methods</th>
<th>Due Dates</th>
<th>Total Points</th>
<th>Percent (point) in Final Grade</th>
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</thead>
<tbody>
<tr>
<td>Class Discussions and Participation</td>
<td>N/A</td>
<td>3</td>
<td>30%</td>
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<tr>
<td>Written and Verbal Summaries of Client Meetings</td>
<td>N/A</td>
<td>3</td>
<td>30%</td>
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<tr>
<td>Written Reports to Clients</td>
<td>N/A</td>
<td>4</td>
<td>40%</td>
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</table>

Assignment Format:
Students are encouraged to use methods of literate programming and reproducible research as described in class (e.g. R statistics language/LaTeX document preparation system/knitr package. See http://biostat.mc.vanderbilt.edu/twiki/bin/view/Main/StatReport for an overview). Investigator meeting summaries will be recorded on the Stat Lab course website. Website pages are the preferred medium for documenting progress. Special documents (e.g., photographs, extensive calculations) may be uploaded to the project web page. Project summary reports must be type-written.

Description of each Assessment and Competencies Covered by the Assessment

- MS/PhD Statistics – In-Person Program

MS Statistics
1. To demonstrate the ability to skillfully engage in statistical collaboration with mentors, colleagues, and clients.

   **Client Meetings:** During supervised meetings with statistical consulting clients, students will be observed interacting with clients and other members of the statistical team.

   **Written Reports for Clients:** Student statistical teams prepare written reports for clients. These reports are reviewed by the instructor before dissemination to clients.

2. To recognize strengths and weaknesses of proposed statistical approaches, including alternative designs, data sources, and analytical methods.

   **Class Discussion and Participation:** Consulting clients’ statistical problems are presented to the class by students on the consulting team. Proposed statistical approaches and alternatives are discussed, and their benefits and drawbacks are weighed with respect to the client’s questions and resources.

   **Written Reports for Clients:** Written reports for clients include a description of the proposed approaches along with their strengths and weaknesses. When appropriate, alternative approaches are presented to the client.

**PhD Statistics**

1. Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question.

   **Class Discussion and Participation:** Consulting clients’ statistical problems and their technical issues and solutions are presented in class by student statistical teams. Results of these analyses are also presented in class.

   **Written Reports for Clients:** Statistical teams apply descriptive and inferential methods to address client problems. The results and interpretation of these methods are included in the written reports for clients.

2. Communicate understanding of the assumptions necessary for a given statistical procedure as well as the ability to determine if the assumptions are met for a given study design or data set.

   **Client Meetings:** Student statistical teams communicate ideas of proposed statistical procedures and their assumptions to clients during supervised consulting meetings.

   **Class Discussion and Participation:** During class discussion of client problems, assumptions of procedures are examined in the context of client’s problems.

   **Written Reports for Clients:** Statistical teams apply analysis methods to address client problems. The checking of assumptions is conducted as a part of the analysis, and when appropriate, is included in the written reports for clients.

**Course Schedule:**

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>1</td>
<td>Aug 28</td>
<td>Introduction, Ground Rules, Consulting Process, Ideals</td>
<td>Chapters 1, 2</td>
<td></td>
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<tr>
<td>2</td>
<td>Sep 04</td>
<td>Reports, Communication, Meetings, Asking Questions</td>
<td>Chapters 3, 4, 5</td>
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<tr>
<td>Date</td>
<td>Topic</td>
<td>Chapter/Author</td>
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<td>Sep 11</td>
<td>Anatomy of a Study</td>
<td>Urquhart¹</td>
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<td>Sep 18</td>
<td>Data Management Basics</td>
<td>Excel &amp; REDCap</td>
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<td>Sep 25</td>
<td>Negotiating, Difficult Situations</td>
<td>Chapters 6, 8</td>
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<td>Oct 02</td>
<td>Measurement in Clinical Trials</td>
<td>Senn and Julious²</td>
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<td>Oct 09</td>
<td>Sample Size and Statistical Rules of Thumb</td>
<td>van Belle⁸</td>
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<td>Oct 16</td>
<td>Split Plot-Repeated Measures</td>
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<td>Oct 23</td>
<td>Paradoxes and Fallacies, “Small Data”</td>
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<td>Oct 30</td>
<td>Design of Observational Studies</td>
<td>Rubin³</td>
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<td>Nov 06</td>
<td>Reproducible Research</td>
<td>Stodden⁴, Baggerly⁵</td>
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<td>Nov 13</td>
<td>Graphics – Tool Cool for School</td>
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<td>Nov 20</td>
<td>Guest Speaker – Statistics in Industry</td>
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<td>Nov 27</td>
<td>Guest Speaker - Workflows for ‘Big Data”</td>
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<td>Dec 04</td>
<td>Predictive Models</td>
<td>Harrell⁶, Steyerberg⁷</td>
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<td>ALT</td>
<td>Likelihood Principle and Interim Analyses</td>
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<td>ALT</td>
<td>Bayesian Adaptive Clinical Trials</td>
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<td>ALT</td>
<td>Bayesian Analysis for Translational Research</td>
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<td>ALT</td>
<td>Choosing Statistical Methods/Model Selection</td>
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<tr>
<td>ALT</td>
<td>Bayesian Adaptive Trials</td>
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<td>ALT</td>
<td>p-value Hacking</td>
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**Attendance Policy:** All students are expected to attend lectures, discussions and assigned consulting meetings. A substantial portion of the course grade is based on participation in class discussions. If you are unable to attend a regularly scheduled consulting meeting, please arrange trading with a classmate. All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean designee) will be honored.

These resources are available from the course website.

¹ Urquhart – Anatomy of a Study
² Senn and Julious – Measurement in Clinical Medicine
³ Rubin – The design versus analysis of observational studies.
⁴ Stodden – Statistical Challenges in Assessing the Reproducibility of Scientific Research
⁵ Baggerly – Forensic Bioinformatics and Reproducible Research
⁶ Harrell – Regression Modeling Strategies
⁷ Steyerberg – Assessing performance of prediction models.
⁸ van Belle – Statistical Rules of Thumb

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Notification of Objectionable Materials: Many university research projects involve animal testing, and are required to follow IACUC guidelines (http://www.iacuc.arizona.edu/). If you choose to not participate in consulting projects involving animal experimentation, it is your responsibility to notify the instructor and to arrange trading with a classmate.

Communications: You are responsible for reading emails sent to your UA account from your instructor and the announcements that are placed on the course web site. Information about readings, news events, your grades, assignments and other course related topics will be communicated to you with these electronic methods. The official policy can be found at: https://www.registrar.arizona.edu/personal-information/official-student-email-policy-use-email-official-correspondence-students

UA Smoking and Tobacco Policy: The purpose of this Policy is to establish the University of Arizona’s (University) commitment to protect the health of University faculty, staff, students, and visitors on campuses and in its vehicles. The official policy can be found at: http://policy.arizona.edu/ethics-and-conduct/smoking-and-tobacco-policy

University Course Policies: (please see the following URL): https://academicaffairs.arizona.edu/syllabus-policies

Plagiarism: What counts as plagiarism?
• Copying and pasting information from a web site or another source, and then revising it so that it sounds like your original idea.
• Doing an assignment/essay/take home test with a friend and then handing in separate assignments that contain the same ideas, language, phrases, etc.
• Quoting a passage without quotation marks or citations, so that it looks like your own.
• Paraphrasing a passage without citing it, so that it looks like your own.
• Hiring another person to do your work for you, or purchasing a paper through any of the on- or off-line sources.

Gender Pronoun Guideline
It is recommended that instructors address, in one way or another, pronoun usage in their classroom, and that this be done the first day of class. It can be done in a fashion each instructor prefers, but for many, the following statement could work:

“It is already UA policy that class rosters are provided to instructors with a student’s preferred name. Students may share their preferred name and pronoun with members of the teaching staff and fellow students, as desired, and these gender identities and gender expressions will be honored in this course. As the course includes group work and in-class discussion, it is critical to create an educational environment of inclusion and mutual respect. In this class, to be inclusive of all gender identities and expressions, students will be referred to by their first or last names, the pronoun of their choice, or by default, the pronoun “they”.”

The application of this guideline in all instructional settings involving group interactions is strongly encouraged, but the means of carrying it out are left to each faculty member.

Content Advisory Guideline
It is recommended that instructors use “content advisories” when assigning certain kinds of course materials. The purpose of these advisories is to alert students to the possibility of unexpected exposure to content evocative of prior traumatic experiences. So alerted, students can talk with the instructor about alternate materials, if such is possible, since students will remain responsible for requirements of the course. The policy

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is not meant to restrict course content in any way, but to provide ample information about course content in advance, enabling students with legitimate concerns to plan better. Students are encouraged to speak with the instructor at the beginning of the semester prior to course content engagement to voice concerns.