

CSBL 5095
Experimental Design & Data Analysis

Spring 2017

CLASS DAYS and TIME: Wednesday 1:00 – 3:00 pm

CLASSROOM: AL&TC building, room 3.302 (lectures), room 3.303 (mid-term and final exams)

COURSE FACULTY: Wouter Koek, Ph.D., Course Director

OFFICE LOCATION and HOURS: By appointment; Office 741E5

(Need help? I will be available from 3:00 to 3:30 pm after each class period. If you need additional help, please contact me by e-mail or phone)

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TELEPHONE: 567-5478

READ THIS DOCUMENT CAREFULLY - YOU ARE RESPONSIBLE FOR ITS CONTENTS.

COURSE DESCRIPTION AND OBJECTIVES

A basic understanding of how experiments are designed and how their results are analyzed helps to interpret published findings and is necessary when you conduct your own research. This course presents principles of experimental design and statistical data analysis, shows how study design and statistics are interrelated, and explains why and how we use statistics in research. Evaluating the statistical significance of research findings requires knowledge of statistics, but additional skills are needed to evaluate their importance. There is a growing recognition by scientific journals and funding agencies of the need to report effect sizes along with the results of test of statistical significance and to quantify the statistical power of studies. The aim of this course is to help students acquire the skills necessary to meet these needs.

Pre-requisites – none

Semester credit hours – 3

By the end of this course, each student should be able to:

1. Identify different types of experimental designs and the statistical analyses appropriate for each type
2. Understand the role of statistics in hypothesis testing and in estimating effect size
3. Conduct basic, common statistical analyses with GraphPad Prism and RStudio
4. Conduct statistical power analysis with G*Power
4. Design experiments more effectively, and report them in accordance with guidelines endorsed by funding agencies and by journals that publish preclinical biological research.

COURSE ORGANIZATION

The main teaching modalities used in this course include:

1) conventional didactic lectures in which information is delivered to the class; **2) small group activities** involving solving assigned problems and reporting the results to the class; **3) reading and homework assignments** listed in the schedule of class meetings shown below; **4) student presentations** of the design and statistical analysis of experiments they plan to conduct.

Materials – Software: most if not all of you will be conducting your statistical analyses using statistical software packages. Therefore, understanding how such software functions and, most importantly, how analyses can be easily conducted *incorrectly* using such software will be an important aspect of this class. We will illustrate analyses with GraphPad Prism and with RStudio. Both programs will be used to conduct exercises during class and homework assignments, and will be used during the two in-class exams. In addition, we will show how to use GPower to conduct power analyses. Each of these programs is available in Windows and in Mackintosh versions.

GraphPad-Prism – course specific student license that allows each student one installation on one computer

RStudio - interface to R, freely available from <http://www.rstudio.org>

R - free and can be obtained from <https://cran.r-project.org/>

GPower – free download at <http://www.gpower.hhu.de/en.html>

Computer Access – Exercises during class, homework assignments, and in-class exams require access to a computer with GraphPad Prism, R and RStudio, and GPower.

Reading- and Homework Assignments –

| Date (Room) | Topic | Readings* (chapters) | Homework Due |
|-------------|---|----------------------|--------------|
| 1/11 | 1) Introduction & Class Overview | 1, 2 | |
| 1/18 | 2) Experimental design: Internal and external validity | | |
| 1/25 | 3) Populations vs Samples; Variables: Types & Distributions | 3, 5, 8 | |
| 2/1 | 4) Descriptive statistics: Central tendency & variability; Confidence intervals | 6, 7, 10, 11, 12 | I |
| 2/8 | 5) Hypothesis testing: Null hypotheses; Type 1 & 2 error; p values | 13, 14, 15, 16 | II |
| 2/15 | 6) Student's t-test: Independent & paired samples | 19 | III |
| 2/22 | 7) Power & Sample size | 18 | |
| 3/1 | 8) Analysis of Variance: One-way | 19 | IV |
| 3/8 | 9) ANOVA post-hoc comparisons | 17 | V |
| 3/15 | Spring Break | | |
| 3/22 | 10) MID-TERM EXAM | | |
| 3/29 | 11) Analysis of Variance: Two-way | | |
| 4/5 | 12) Linear Regression & Correlation | 22, 23 | |
| 4/12 | 13) Nonlinear, multiple, and logistic regression | 24 | |
| 4/19 | 14) Design & Analysis: Homework VII presentations | 19 | VI |
| 4/26 | 15) Non-normal distributions; Data transformations; Non-parametric alternatives | 9, 19, 20, 21 | VII |
| 5/3 | 16) Tests for Frequency Distributions | 4, 19 | VIII |
| 5/10 | 17) Resampling/Bootstrapping; Meta-analysis | | |
| 5/17 | 18) Key Concepts of Statistics & Statistical Traps to Avoid | 25, 26 | IX |
| 5/24 | 19) Optimizing Preclinical Research: Better Design | | |
| 5/31 | 20) Optimizing Preclinical Research: Better Reporting | | X |
| 6/7 | 21) FINAL EXAM | | |

*from required textbook: Motulski, Harvey. Essential Biostatistics: A Nonmathematical Approach.

ATTENDANCE

In order to achieve the expected level of competency, students must be fully engaged. Therefore, attendance for every class session is expected.

TEXTBOOKS

Required: Motulski, Harvey. Essential Biostatistics: A Nonmathematical Approach. Oxford University Press, 2016

GRADING POLICIES AND EXAMINATION PROCEDURES

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|--|-------|
| 10 Homework assignments to be answered outside of class and turned in on-line on the due date @ 20 points each: | 200 |
| Two in-class exams @ 80 points each: | 160 |
| Question of the day (posed before and answered at the beginning of class), small group participation: | 36 |
| | ----- |
| Maximum number of points | 396 |

Grading System

Grading scale used to determine final letter grades: A = 90-100% B = 80-89% C = 70-79% F = < 69%

REQUESTS FOR ACCOMODATIONS FOR DISABILITIES

In accordance with policy 4.2.3, **Request for Accommodation Under the ADA and the ADA Amendments Act of 2008 (ADAAA)**, any student requesting accommodation must submit the appropriate request for accommodation under the American with Disabilities Act (ADA, form 100) to his/her appropriate Associate Dean of their School and a copy to the ADA Coordinator. Additional information may be obtained at <http://uthscsa.edu/eeo/request.asp>.

ACADEMIC INTEGRITY AND PROFESSIONALISM

Any student who commits an act of academic dishonesty is subject to discipline as prescribed by the UT System Rules and Regulations of the Board of Regents. Academic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an exam for another person, signing attendance sheets for another student, and any act designed to give unfair advantage to a student or the attempt to commit such an act. Additional information may be obtained at <http://catalog.uthscsa.edu/generalinformation/generalacademicpolicies/academicdishonestypolicy/>

TITLE IX AT UTHSCSA

Title IX Defined:

Title of the Education Amendments of 1972 is a federal law that prohibits sex discrimination in education. It reads “no person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance.”

University of Texas Health Science Center San Antonio’s Commitment:

University of Texas Health Science Center San Antonio (UTHSCSA) is committed to maintaining a learning environment that is free from discriminatory conduct based on gender. As required by Title IX, UTHSCSA does not discriminate on the basis of sex in its education programs and activities, and it encourages any student, faculty, or staff member who thinks that he or she has been subjected to sex discrimination, sexual harassment (including sexual violence) or sexual misconduct to immediately report the incident to the Title IX Director.

In an emergency, victims of sexual abuse should call 911. For non-emergencies, they may contact UPD at 210-567-2800. Additional information may be obtained at <http://students.uthscsa.edu/titleix/>

EMAIL POLICY

Every student is issued a University e-mail address and account at the time of enrollment. As a matter of University Policy, communications between students and faculty that occur using the student's University e-mail address is considered official business. Therefore, students are expected to check their university email inboxes on a regular basis so that any announcements, instructions, or information regarding this course will be received in a timely way.

USE OF RECORDING DEVICES

Recording of lectures and other learning activities in this course by any means (e.g., video, audio, etc.) is only permitted if approved by the instructor or required for compliance with Americans with Disabilities Act (ADA).

ELECTRONIC DEVICES

Cell phones must be turned off during all class meetings and exams. Computers and electronic tablets are allowed only for participating in classroom activities (e.g., viewing slides presented in lecture or conference materials). No texting, tweeting, emailing, web-surfing, gaming, or any use of electronic devices that is not directly connected with classroom activities is permitted.

TENTATIVE CLASS SCHEDULE
CSBL 5095
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