PHRMACOL 603, Data Processing and Analysis: A Statistics Primer for Pharmacologists and Biomedical Scientists

Course Directors:  
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Teaching Assistant: Yang Zhao (ypharan@umich.edu)

Location:  
Mondays, 10-10:50 am: 2901 Taubman Health Sciences Library  
Wednesdays, 10-10:50 am: 5215 Taubman Health Sciences Library

Materials: No textbooks are required, but listed below are some supporting textbooks and tools:

1) Harvey Motulsky, Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking, 3rd edition,  
2) Harvey Motulsky, Biostatistics: A Nonmathematical Approach 1st Edition  
3) Graphpad Prism (For access to program, contact Dar-Weia.Liao, dwliao@umich.edu, x49949)  
4) Microsoft Excel  
5) STATA

Course Objectives: To provide students with working knowledge of and experience in experimental design, data processing, analysis, and interpretation necessary to produce rigorous and reproducible research and to communicate science effectively.

Prerequisites: Students enrolling in this course should have a basic knowledge of biomedical science. The course utilizes examples and principles rooted in pharmacology, but the material is designed to be accessible to students in most other biomedical fields. This is a companion course to the Pharmacology 601 course “From molecules to patients: Basic quantitative principles of Pharmacology.” Although Pharmacology 601 is not a formal prerequisite, the course is designed to be taken in conjunction with or subsequently to Pharmacology 601. Potential enrollees uncertain about their readiness for this course should contact the course directors for advice.

Primary concepts to be covered:
- Fundamentals of experimental design  
- Effective use of Microsoft Excel and GraphPad Prism for data management and analysis  
- Understanding descriptive statistics, measures of data spread, and basics of power analysis  
- Concepts of hypothesis testing  
- Approaches for data transformation and normalization  
- Parameter estimation using the application of nonlinear regression  
- Selecting appropriate and rigorous statistical tests  
- Conducting and interpreting statistical tests using GraphPad Prism

Course competencies: After completing PHRMACOL 603, students should:
1) have basic knowledge about experimental design, including types of experimental variables, biological and technical replicates, and power analysis.  
2) understand concepts of hypothesis testing.  
3) have working knowledge of Microsoft Excel and GraphPad Prism.  
4) be able to summarize and process data, while understanding concepts of descriptive statistics, measures of spread, and sources of variability.  
5) understand the rationale for data transformation, how data transformations are performed, and potential problems associated with data transformations.  
6) understand concepts of regression analysis, estimation of parameters generated from regression analysis, use of regression analysis in pharmacology, regression model comparison, and correlations.
7) be able to determine the most appropriate statistical tests to be used for analyzing a data set and perform analyses in GraphPad Prism.
8) be able to communicate about scientific data and analyses in written and oral forms (including graphical representations).
9) be able to work in diverse teams to interpret, analyze, and discuss data.

**Format:** Students will achieve these competencies through a combination of didactic sessions and hands-on, dry laboratory sessions in a computer lab with access to hardware and software. Monday sessions will consist of didactic lectures to introduce new material. The Wednesday sessions in the computer lab will be mostly practical application of the material presented earlier and consists of exercises and hands-on manipulation of data (including the student’s own data) with a variety of analysis and graphing software.

**Evaluation:** Competencies described above will be evaluated through a combination of class discussion, in-class activities (mini-exercises), take-home graded assignments, and the final exam. The final take home exam is a cumulative assignment, evaluating concepts and analyses learned over the course of the class. Students will be given a set of instructions and raw data to analyze and prepare a mini-paper reporting and interpreting the data.

**Schedule 2020:**

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<thead>
<tr>
<th>Session</th>
<th>Date</th>
<th>Location</th>
<th>Type</th>
<th>Assgn. due</th>
<th>Instructor</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>9/4/2019</td>
<td>5215 THSL</td>
<td>Lab</td>
<td>Both</td>
<td></td>
<td>Introduction: software tools</td>
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<td>2</td>
<td>9/9/2019</td>
<td>2901 THSL</td>
<td>Lect.</td>
<td></td>
<td>Jutkiewicz</td>
<td>Experimental design, power analysis principles, Software training</td>
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<td>3</td>
<td>9/11/2019</td>
<td>5215 THSL</td>
<td>Lab</td>
<td>Both</td>
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<td>Types of variables, distributions, summary statistics</td>
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<td>4</td>
<td>9/16/2019</td>
<td>2901 THSL</td>
<td>Lect.</td>
<td></td>
<td>Iñiguez</td>
<td>Sources of variation SD, SEM, CV, Confidence intervals, Outliers</td>
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<td>5</td>
<td>9/18/2019</td>
<td>5215 THSL</td>
<td>Lab</td>
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<td>6</td>
<td>9/23/2019</td>
<td>2901 THSL</td>
<td>Lect.</td>
<td></td>
<td>Iñiguez</td>
<td>Data Transformations, examples on how to transform data</td>
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<td>7</td>
<td>9/25/2019</td>
<td>5215 THSL</td>
<td>Lab</td>
<td>Both</td>
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<td>Hypothesis testing, Student’s t test, tails, power analysis</td>
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<td>2901 THSL</td>
<td>Lect.</td>
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<td>Jutkiewicz</td>
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<td>9</td>
<td>10/2/2019</td>
<td>5215 THSL</td>
<td>Lab</td>
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<td>Models, linear regression vs correlation</td>
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<td>10</td>
<td>10/7/2019</td>
<td>2901 THSL</td>
<td>Lect.</td>
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<td>Jutkiewicz</td>
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<td>Lab</td>
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<td>12</td>
<td>10/14/2019</td>
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<td>Lect.</td>
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<td>Iñiguez</td>
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<td>13</td>
<td>10/16/2019</td>
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<td>14</td>
<td>10/21/2019</td>
<td>2901 THSL</td>
<td>Lect.</td>
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<td>Iñiguez</td>
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**Grading:** Grading will be based on three components (1000 points total):

1) Graded assignments (40%): 4 assignments 100 points each for 400 points. Assignments will be a set of problems based on the covered material and involve processing of data supplied to the students. For the most part, the problems will be posted in Canvas as assignments with specific due dates. **You may not discuss the content with your fellow students,** the work you submit must be your own. You can consult the TA and lecturers for clarifications. Upload your completed assignments in Canvas. **Late assignments submitted within 24 hours of the due date and time will be subject to a 10 point deduction.** No assignments will be accepted beyond 24 hours of the due date and time and will be assigned a grade of 0. The answers will be posted approximately 24 hours after the assignment due date and time.

2) Class participation and mini-exercises (30%): We will assess participation in each session (30 points each session). Attendance: 15 points, oral contributions to class: 5 points, quiz/exercise 10 points. Lowest three scores (out of 13 total sessions) will be dropped.

3) Final take home exam (30%): The exam is cumulative and worth 300 points. You may not discuss the content with your fellow students, the work you submit must be your own. You can consult the TA and lecturers for clarifications.

The number of points needed to earn a particular grade will be determined at the end of the term. Boundaries between grades will be determined based on the point distributions so as to minimize the impact of a few points on any individual student’s final grade. The maximum number of points needed for each letter grade will follow the traditional pattern:
90% of total points will guarantee an A-
80% of total points will guarantee a  B-
70% of total points will guarantee a  C-
60% of total points will guarantee a  D-

So, for example, earning 800 points will guarantee at least a B-. You may receive a B- with less points but that will depend on the distribution and cutoffs.

**Academic Integrity**

The College of LSA is a community in which personal responsibility, honesty, fairness, respect, and mutual trust maintained. You are expected to practice the highest possible standards of academic integrity. Any deviation from this expectation will result in a minimum academic penalty of your failing assignment, and will result in additional disciplinary measures. This includes, but not limited to, cheating, using unauthorized material during exams, using or copying another student’s work, and any other form of academic misrepresentation. For a list of actions that constitute misconduct, and possible sanctions for those actions, please see the Code of Conduct at [http://www.lsa.umich.edu/academicintegrity](http://www.lsa.umich.edu/academicintegrity).

**Commitment to equal opportunity**

We are committed to a policy of equal opportunity for all persons and do not discriminate on the basis of race, color, national origin, age, marital status, sex, sexual orientation, gender identity, gender expression, disability, religion, height, or veteran status. Please feel free to contact us with any problem, concern, or suggestion. We ask that all students treat each other with respect.

**Accommodations for Students with Disabilities**

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make us aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734) 763-3000; [http://ssd.umich.edu](http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

**Student Mental Health and Wellbeing**

University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact Counseling and Psychological Services (CAPS) at (734) 764-8312 and [https://caps.umich.edu/](https://caps.umich.edu/) during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult University Health Service (UHS) at (734) 764-8320 and [https://www.uhs.umich.edu/mentalhealthsvcs](https://www.uhs.umich.edu/mentalhealthsvcs), or for alcohol or drug concerns, see [www.uhs.umich.edu/aodresources](http://www.uhs.umich.edu/aodresources). For a listing of other mental health resources available on and off campus, visit: [http://umich.edu/-mhealth/](http://umich.edu/-mhealth/).