*Module:* **PCOL:5204 – Basic Biostatistics and Experimental Design** **FALL 2020**

*Course Director*: Stefan Strack, PhD stefan-strack@uiowa.edu

*Lecturers*: Ron A. Merrill, PhD ronald-merrill@uiowa.edu
Jacob Michaelson, PhD jacob-michaelson@uiowa.edu
Mark K. Santillan, MD, PhD mark-santillan@uiowa.edu
Patrick Ten Eyck, PhD patrick-teneyck@uiowa.edu

*Zoom link:* https://uiowa.zoom.us/j/99603922733

*Course objective*: All scientific endeavors involve hypothesis testing, and all hypothesis testing involves experimental design and mathematical interpretation of resulting data. This module course is designed to provide a brief overview of the theory of experimental design and data analysis in the biological sciences for graduate-level students. At the completion of this module, students will feel comfortable identifying the types of analyses that are available for common types of data generated in the biomedical sciences, and will be empowered to critically review the statistical methods used in published studies. Importantly, this course will only provide a cursory coverage of the mathematical computations involved in various analytical tests, as such depth of understanding is reserved for courses provided elsewhere. Discussions of ethics issues in biomedical research (rigor, reproducibility, bias, power) will be integrated throughout the module.

*Course grading*: The course will be graded on two factors:

First, 50% of the module grade will come from a single final exam, completed at the end of the module (50 possible points).

Second, 50% of the module grade will come from student projects, in which students will write a critical review of the statistical design of a published manuscript (2 pages; 50 possible points; **due Dec. 1** – more details shared at first lecture).

Final grades will be issued in whole-grade increments as follows, unless curved (higher grade for lower score) at the discretion of instructors based on *class-wide* performance:

90-100 points = A 80-89 points = B 70-79 points = C 60-69 points = D 0-59 points = Fail

| Lecture | Lecturer | Topic |
|---|---|---|
| 1 *Nov 3 (8:30-9:50)* | Strack | **Introduction to the module, Basic vocabulary, P-values, & Bias**; Types of data, types of questions, parametric vs non-parametric analyses, interpreting one- and two-tailed P-values, and a brief overview of common software packages |
| 2 *Nov 5* | Merrill | **Parametric analyses**; Means, standard deviation, standard error, t-tests, ANOVA, interactions, independent vs pairwise / repeated measures data, and multiple-comparisons procedures |
| 3 *Nov 10* | Merrill | **Non-parametric analyses & Power analyses**; Medians, quartiles/quintiles, $X^2$ tests, Mann-Whitney U, Kruskal-Wallis, and Friedman's ANOVA; Contingency tables, beta, power, and sample size calculations |
| 4 *Nov 12* | Merrill | **Gene expression, Outlier analyses & Rigor and reproducibility issues**; Livak $2^{-\Delta\Delta CT}$ method and asymmetric error; Grubb's test; reproducibility |
| 5 *Nov 17* | Santillan | **Population studies**; Predictive statistics, ROC analyses, univariate / multivariate regression modeling, survival analyses / Kaplan-Meier curves |
| 6 *Nov 19* | Strack | **Isometric and Allometric scaling, Regressions & Basic receptor kinetics**; Scaling and normalization concepts, covariates, ANCOVA, curve fitting, $IC_{50}/EC_{50}$, $E_{max}$ |
| *<< Thanksgiving Recess >>* | | |
| 7 *Dec 1* | Michaelson | **Large datasets**; Microarrays, RNAseq, GWAS – 2 page manuscript review is due |

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| 8<br>*Dec 3* | Strack | **Image quantification**;<br>Densitometry, uses of ImageJ software, image manipulation |
| 9<br>*Dec 8* | *Ten Eyck* | **Regression / modeling**;<br>Generalized linear models, intro to ICTS Biostatistics & Research Design Core |
| 10<br>*Dec 10* | *N/A* | **Final Exam** |