

**BBSP 710 Course Syllabus**  
**Short Title:** Biostatistics for Laboratory Scientists  
**Effective Term:** Fall 2023

**Long Title:** Introductory Statistics for Laboratory Scientists

**Course Units/Hours (Virtually):** 2 credit hours; course meets Tuesday/Thursday 11:00a - 12:15p\*

**Grading Basis:** (GRAD – H, P, L, F)

**Course Component (lecture or lab):** Lecture/discussion

**Course Format:** Lectures on statistical concepts, Tutorials, & Prism workshops

**Course Director:** Dr. Stephanie Gupton, PhD ([sgupton@unc.edu](mailto:sgupton@unc.edu))

**Course Founder:** Dr. Robert Nicholas, PhD ([nicholas@med.unc.edu](mailto:nicholas@med.unc.edu))

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**Office Hours (Virtual):** Thursdays after class (12:15-1p) and by appointment

**Course Description:** BBSP 710 introduces basic concepts of statistics in the experimental biological sciences to 2nd year+ graduate students. Emphasis is on mastery of common statistical skills and familiarity with advanced analytical skills, with emphasis on mastery of graphing and statistical analysis using **GraphPad Prism**. Sample topics include experimental design, hypothesis testing, inferential statistics, power, correlation and regression. No previous background in statistics is required, but access to multiple devices and a stable internet connection is needed.

**Course Objectives (Learning Outcomes):** The objectives of this course are to provide graduate students in biomedical research programs familiarity with proper experimental design and basic biostatistics concepts for laboratory scientists, and to learn how to use GraphPad Prism for graphing and data analysis. By the end of the course, students should understand the principles of experimental design, be familiar with basic statistical methods (and how they are applied), and know how to graph and analyze data sets similar to those produced in their thesis laboratory.

**Learning Objectives:** By the end of the course, participants will be able to...

1. Demonstrate basic understanding of the conceptual background behind statistical tests and assess appropriateness of for chosen analysis data sets (*participation, tutorials*)
2. Apply foundational experimental principles and statistical knowledge to design experiments that address the research questions (*participation, tutorials, final project*)
3. Select applicable statistical tests to perform analyses, interpret results, and represent statistical findings accurately (*tutorials, final project*)
4. Author effective statistical methods, results, and discussion sections (display results effectively in text and graphically) (*tutorials, final project*)
5. Evaluate study design, analysis, and interpretation by providing constructive feedback through the peer-review process (*final project, peer review*)

**Prerequisites:** No previous background in probability or statistics is required, nor is experience with statistical computing. **Students are required to have GraphPad Prism 9.4 (licensing fee required) installed on their laptop computers and activated before the start of the course.** Download GraphPad Prism from UNC software acquisition ([software.unc.edu](http://software.unc.edu)). The cost for a 1-year license is ~\$30 (license renewal date - Nov 30).

**Note:** This course focuses on practical applications using **Graphpad Prism** software – we do not cover training using other statistical platforms (e.g., R, SAS) but there are excellent supplemental training options (HSL Hub workshops/series; Odum Institute; BIOS 610).

**Course Expectations:** The more you participate and apply the concepts you learn, the more you will get out of the course. In addition, peer-to-peer teaching and learning is one of the best ways to gain mastery

\*Note: Please note that topics or dates may be modified if needed, and any changes will be announced as early as possible if so.

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of the materials; hence, we encourage you to seek peer support, both in class and out, including comparing projects ideas and drafts. However, please ensure that your project is based your own individual effort. Course participation will be crucial to understanding the material, as will be completing the group and individual assignments. This course will require you to use a laptop and/or cell phone to meet via Zoom (available as a free downloadable app), as well as to respond actively using live polling software ([Poll everywhere](#), also free). This allows you to participate from anywhere, although we will have *synchronous virtual meetings* during the course meeting times listed above. If you finish answering poll questions or working on practical applications in Prism early, feel free to use the time to review your notes, work on related course assignments, or brainstorm final project ideas (we recommend using a “final project ideas” document to brainstorm as course content intersects with your own research and/or final project). Although we acknowledge that AI can be a powerful tool in some contexts, for this course the emphasis is on individual skill development that requires expertise gained by experience. For the purposes of learning the skills in this course and gaining this expertise, it is important to complete work independently without AI assistance. To maximize learning opportunities, use of AI is not allowed for generating or reviewing assignments, and will result in full loss of credit on affected course assignments.

**Course Environment:** We respect the differences that each course participant brings to the table, and we expect that you will show respect and courtesy, especially if differences of opinion occur. We are committed to maintaining an atmosphere of openness and welcome all questions, comments, and opinions. If you have a question, it’s likely others do too – so don’t hesitate to ask what’s on your mind! We hope to create an inclusive environment where student success is supported for everyone, whether you are a first-generation student, international student, differently-abled or neurodiverse student, are a parent, are from an underrepresented group or background (gender, sexuality, age, socioeconomic status, ethnicity, race, culture). Please reach out to the instructors if you have any questions or concerns throughout the course, we are here to support you.

**Course Grading Policy:** a) *Participation & Practical Applications* (30%); b) *Tutorials* (40%); and c) *Final Project* (30%).

**Course Assignments:**

a) *Participation & Practical Applications:* Participation & Practical applications will be employed to assess knowledge assimilation and to amplify important concepts from lectures. This is based on best-practices to enhance learning, especially in online environments. You will have the opportunity to earn points by participating in practical assessments in class by answering live online polling questions. Class will be interactive, with an average of 3-4 questions per class meeting to provide a check-on-learning to help assess your own (and the class’s) understanding of complex concepts and support your learning. For participation credit, you will earn full credit for participation for responding with any answer, and live discussion will be used to clarify any content when answers are not in alignment. This may also include written responses to provide practice and build writing skills. We encourage active participation in the chat as well!

Participation will be live-streamed and interactive (not recorded); so, if you miss class, you are responsible for reviewing the material. Attendance at all classes is expected, however you may miss up to 3 class meetings for presentations, illness, etc. (~15% of participation points) and still receive full credit.

While special permission is not required for these absences, we would appreciate a courtesy notification if you know in advance that you will be out. If you are ill, please let us know as soon as possible so that we can work with you to come up with a 1-on-1 customized plan to help keep you on track for the semester. Similarly, if instructors need to cancel or change the schedule due to unexpected illness or closures, we will provide as much notice as possible via Canvas. Please be sure you have email notifications turned on so you can receive timely updates if needed.

While the virtual format expands accessibility and increases class capacity to serve all of you, we also realize that some of you may be working from home, the lab, or other locations where your internet access

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or ability to participate may be disrupted – please let us know if this is the case. We realize that you may have disruptions to deal with. Given that, we highly recommend minimizing other electronic distractions (e.g., email, social media, etc.) in order to get the most out of the class.

*b) Tutorials:* Pre-recorded tutorials will be used to familiarize you with GraphPad Prism. There will be 4 Prism assignments that correspond to each tutorial using pre-assigned data sets. Completion of the assignment requires submission of a slide of your output and results from the tutorial to Canvas including a short written summary (e.g., results/discussion), and will be followed by live Poll Everywhere questions based on your slide results during the class it is due.

*c) Final Project:* A final project will be due at the end of the course. The final project will involve using the statistical methods discussed in the class to analyze a real-world data set. This data set should be data collected during your own research experiences or from your lab (e.g., lab/thesis/rotation project). The data selected must be sufficiently complex so as to allow you to apply at least one method discussed during the course to apply an inferential statistic (e.g., multiple t-tests, ANOVA, regression). The final project should include a written description of your analysis that includes: 1) how the data were collected, 2) the hypotheses that you tested, 3) descriptive statistics and frequency distributions of the data, 4) treatment of outliers if there are any, 5) statistical methods used to analyze the data and your justification, 6) power calculation and explanation of sample size choice, and 7) the results and conclusions of your analysis. The writing style should be suitable for a scientific journal and should be 1-2 pages in length. In addition to the written description of the analysis, you will provide feedback on peer projects, which will also allow you to gain exposure to other methods chosen by your classmates. Each person will complete an individual final project, which will be assessed according to the following grading scheme (final project grade is out of 100%): a full draft (30%), peer-ratings of drafts (20%), final project (30%), and peer-ratings of final projects (20%).

**Course Schedule\***

**Week 1: (Sep 7)**

**Thurs: Experimental Design + Intro, Pre-test, & Prism Tutorial Assignments**

1. Course Introduction
2. Observational Studies and Experiments
3. Experimental Design Basic Principles
4. Random Sampling

**Week 2 (Sep 12/14):**

**Tues: Description of Data**

1. Types of Variables
2. Graphical Methods for Summarizing Data (Histogram, Barplot, etc.)
3. Summary Statistics (Mean, Median, Standard Deviation, etc.)
4. Relationship Between Variables

**Thurs: Probability, Distributions, Confidence Intervals (*Prism Assignment 1 due*)**

**Week 3 (Sep 19/21):**

**Tues: Probability, Distributions and Confidence Intervals continued (*Prism Assignment 2 due*)**

1. Probability
2. Binomial and Normal Distributions
3. Sampling Distributions
4. Confidence Intervals for the Mean

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**Thurs: Final Project Planning Session (*Prism Assignment 3 due*)**

**Week 4 (Sept 26/28):**

**Tues: Intro to Hypothesis Testing**

**Thurs: Hypothesis Testing & Thurs: PRISM Tutorial**

1. Comparison of Two Independent Samples ( $t$  Test, Wilcoxon-Mann-Whitney Test)
2. Comparison of Paired Samples (Paired  $t$  Test, Wilcoxon Signed-Rank Test)

**Week 5 (Oct 3/5):**

**Tues: Intro to Multi-sample Inference**

**Multi-sample Inference (One-Way ANOVA)**

1. Hypothesis Testing in One-way ANOVA
2. Comparing Specific Groups in One-way ANOVA
3. Hypothesis Testing in One-way ANOVA
4. Comparing Specific Groups in One-way ANOVA

**Thurs: ANOVA PRISM Tutorial**

**Week 6 (Oct 10/12):**

**Tues: Multi-sample Inference - Advanced ANOVA (Factorial ANOVA & Repeated Measures)**

5. Two-way ANOVA
6. Repeated Measures ANOVA
7. Three-Way ANOVA (PRISM Tutorial)

**Thurs: Advanced ANOVA PRISM Tutorial/Review (*Prism Assignment 4 due*)**

**Week 7 (Oct 17/19):**

**Tues: Intro to Power**

**Thurs: Fall break (no class)**

**Weeks 8 (Oct 24-26):**

**Tues: Power Practical–Power Tutorial (G\*Power & NQuery Demos) + Bring Your Own Data (BYOD)**

**Thurs: Intro to Correlation and Regression**

**Week 9 (Oct 31/ Nov 2):**

**Tues: Correlation and Regression cont'd + PRISM Tutorial**

1. Correlation
2. Simple linear Regression
3. Non-linear Regression

**Thurs: Special Topics & Final Review Instructions**

**Weeks 10 (Nov 7/9): (*Final project draft due Weds*)**

**Tues: Special Topics– Chi Squared**

**Final Project Interactive Session (*in-class; Final Project Draft Due on Wed Nov 8*)**

**Thurs: Special Topics**

**Week 11 (Nov 14-16) – (*Monday draft reviews due; Feedback provided Tues*)**

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**Tues: No Class - Work on final project edits**

**Thurs: Special Topics**

**Week 12 (Nov 21):** *(Monday final revisions due)*

**Tues: Advanced topics**

1. Analysis Flowchart
2. Review with Examples

**Wrap-up & Course evaluations** *(in-class)*

**Sample Special Topics:** Survival, Non-Linear, Growth; MANCOVA ANCOVA MANOVA + GLM (SEM/Mediation); Factor Analysis + Logistic Regression

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**Important Dates:** *(submit all assignments, drafts, & peer-reviews via Canvas)*

**Prism Tutorials Assignments 1, 2, 3, & 4 – due 9/14, 9/19, 9/21, + 10/12** *(respectively)*

**Final Full Draft - due W 11/8 by 11a** *(automatic peer-review assignments)*

**Draft Reviews (2x each) – due M 11/13 by 11a** *(submit reviews)*

**Final Project – due M 11/20 by 11a** *(automatic peer-review assignments)*

**Final reviews (2x each) – due W 11/29 by 11a** *(submit reviews)*

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