Fundamentals of Biostatistics
DBBS L41 Bio5075
Mondays 2:30-4:00 pm, online via Zoom (meeting link distributed by email and through Canvas)
Fall 2020

Contact Information
Instructors: Zach Pincus, Mike White
TAs: Aidan Schneider, Yawei Wu
Office hours: By appointment
Instructor and tutor contact: bio5075-admin@lists.genetics.wustl.edu
Course website: http://genetics.wustl.edu/bio5075/

Course Description and Course Goals
The ability to quantitatively evaluate one’s data is increasingly important in scientific research. This two-credit course is a primer on fundamental statistical and computational skills and concepts for first-year DBBS students. It assumes no prior experience in statistics or programming. The course will cover common statistical practices and concepts in the life sciences, such summary statistics, probability and distributions, p-values and hypothesis testing, confidence intervals, bootstrap simulation, and power analysis. In parallel, the class will introduce basic statistical computation skills most applicable to biological data sets.

The course format emphasizes practical problem-solving skills by teaching both core statistical concepts W/O heavy math and computational methods to implement them. The course will cover the fundamentals of the Python programming language and demonstrate how to use Python to analyze biological data. Upon completing the course, students will be able to manipulate and analyze simple and genomic-style datasets, write simple data analysis scripts in Python, create the major types of statistical plots, and critically evaluate how best to assess the significance of and summarize their data.

Texts, Materials, and Supplies
In-class activities and homework are all done in free Jupyter Notebook software. Thus to participate in this course, you will need a laptop with the Anaconda Python distribution installed. (Follow the instructions here.) This laptop will be required for in-class work during the computation lectures (as noted in the Course Schedule), as well as weekly homework assignments. If you are an enrolled student and need to borrow a laptop for the class, please contact the instructors. We cannot lend laptops to auditing students.

Grading
This course is graded as pass/fail. Grades are based on the weekly homework assignments. Homework is due each Tuesday by the end of the day.

Late policy: Late assignments will be penalized by 5% and will be given no credit if more than two weeks past due. Since this is a skills-oriented course, and since homework assignments become progressively difficult, students who do not keep up with the assignments will find it challenging to finish all required assignments and achieve a passing grade for the course.
**Academic integrity:** Students are encouraged to work together to solve the homework problems and troubleshoot code. However, students are expected to write their own code for the homework assignments.

**Homework**

Homework: Problem sets are assigned after each class and are distributed via the course website at [http://genetics.wustl.edu/bio5075/class-files/](http://genetics.wustl.edu/bio5075/class-files/). All homework problem sets are code-based, and consist of Jupyter Notebook files. Students submit homework assignments via the Canvas course portal, accessed at [https://mycanvas.wustl.edu](https://mycanvas.wustl.edu). NOTE: Students auditing the course do not submit homework.

**Attendance and Participation**

Students are expected to added all classes. During computational classes (see Course Schedule), students will complete non-graded in-class programming activities.

**Course Schedule**

2020-09-14
Lecture 0 (Computation): Introduction to Jupyter and Python
- Course format
- Introduction to Jupyter Notebook

2020-09-21
Lecture 1 (Computation): Python Loops and Variables
- Variables
- Lists
- Flow control: FOR loops

2020-09-28
Lecture 2 (Computation): Dictionaries and Conditionals
- Dictionaries
- Flow control: conditional statements
- Coding strategies

2020-10-05
Lecture 3 (Computation): More lists, Reading Files, Functions
- Functions
- File input/output
- List comprehensions and manipulations

2020-10-12
Lecture 4 (Statistics): Summarizing Numbers
- Single number summaries: mean, median, mode
- Two numbers: variance and standard deviation
- Dot plots and histograms
- Distributions

2020-10-19 Lecture 5 (Statistics): Basic Probability
- Intuitive probability estimation from histograms
- Basic theory and notation
- How probabilities combine: “and” and “or”
- Independence and conditional probability
- Counting successes and failures

2020-10-26
Lecture 6 (Statistics): Simulation and Hypothesis Testing (I)
- Why simulate?
- Hypothesis testing and the null distribution
- What p-values are and are not
- Recent controversies in the use of p-values

2020-11-02
Lecture 7 (Computation): Compound data structures, Plots
- Lists of lists, dictionaries of lists, etc.
- Matplotlib

2020-11-09
Lecture 8 (Computation): Numpy arrays
- Numpy arrays vs lists

2020-11-16
Lecture 9 (Computation): Pandas, Bioinformatics
- Pandas dataframes
- Bioseq.IO

2020-11-23
Lecture 10 (Statistics): Simulation and Hypothesis Testing (II)
- Permutation testing
- Sampling from a population
- Bootstrap confidence intervals
- Bootstrap hypothesis testing

2020-11-30
- Statistical Power
• Paired tests
• The standard error and the t-test
• ANOVA

2020-12-07
• Chi squared tests

FINAL HOMEWORK DUE Tuesday, December 15.

University-Wide Policies

Statement on Military Service Leave
Washington University recognizes that students serving in the U.S. Armed Forces and their family members may encounter situations where military service forces them to withdraw from a course of study, sometimes with little notice. Students may contact the Office of Military and Veteran Services at (314) 935-2609 or veterans@wustl.edu and their academic dean for guidance and assistance. See: https://veterans.wustl.edu/policies/policy-for-military-students/.

Preferred Names and Gender Inclusive Pronouns
In order to affirm each person’s gender identity and lived experiences, it is important that we ask and check in with others about pronouns. This simple effort can make a profound difference in a person’s experience of safety, respect, and support. See: https://students.wustl.edu/gender-pronouns-information/, https://registrar.wustl.edu/student-records/ssn-name-changes/preferred-name/

Reporting Sexual Assault
If a student discusses or discloses an instance of sexual assault, sexual discrimination, sexual harassment, dating violence, domestic violence or stalking, or if a faculty member otherwise observes or becomes aware of such an allegation, they will keep the information as private as possible, but as a faculty member of Washington University, they are required to immediately report it to the Department Chair or Dean or directly to Ms. Jessica Kennedy, the University’s Title IX Directory, at (314) 935-3118, jwkennedy@wustl.edu. Additionally, you can report incidents or complaints to the Office of Student Conduct and Community Standards or by contacting WUPD at (314) 935-5555. Students who wish to speak with a confidential resource may wish to reach out to the Relationship and Sexual Violence Prevention Center (RSVP) at 935-8761 or by visiting the 4th floor of Seigle Hall.

Accommodations for Sexual Assault
The University is committed to offering reasonable academic accommodations (e.g., no contact order, course changes) to students who are victims of relationship or sexual violence, regardless of whether they seek criminal or disciplinary action. If you need to request such accommodations, please contact the Relationship and Sexual Violence Prevention Center (RSVP) at rsvpcenter@wustl.edu or (314) 935-3445 to schedule an appointment with an RSVP confidential, licensed counselor. Information shared with counselors is confidential. However, requests for accommodations will be coordinated with the appropriate University administrators and faculty.

Emergency Preparedness
Before an emergency, familiarize yourself with the building(s) that you frequent. Know the layout, including exit
locations, stairwells and the Emergency Assembly Point (EAP). Review the “Quick Guide for Emergencies” that is found near the door in many classrooms for specific emergency information and instructions. For additional information and EAP maps, visit emergency.wustl.edu. To ensure that you receive emergency notifications, make sure your information and cell phone number is updated in SIS, and/or download the WUSTL app and enable notifications.

To report an emergency:
Danforth Campus: (314) 935-5555
School of Medicine Campus: (314) 362-4357
North/West/South and Off Campus: 911 then (314) 935-5555

Resources for Students

The syllabus can be a place for students to find support for academic and non-academic challenges that can impact their learning. Resources for students that can be highlighted in the syllabus include those listed below.

Disability Resources
Washington At Washington University we strive to make the academic experience accessible and inclusive. If you anticipate or experience barriers based on disability, please contact Disability Resources at 314.935.5970, disabilityresources@wustl.edu, or visit our website for information about requesting academic accommodations. See: https://students.wustl.edu/disability-resources/

The Writing Center
The Writing Center, located in Olin Library, offers free one-on-one writing tutorials to WashU students, as well as workshops designed to help students become better writers. The Writing Center staff can assist by providing feedback on the strength of an argument, clarity, and organization. Contact them at 935-4981 or writing@wustl.edu.

Engineering Communications Center
The Engineering Communications Center offers students in the McKelvey School of Engineering one-on-one help with oral presentations, writing assignments, and other communications projects. They are located in Urbauer Hall, Rm. 104.

The Learning Center
The Learning Center works collaboratively with University partners to provide undergraduate students key resources, like academic peer mentoring, to enhance their academic progress. Contact them at learningcenter.wustl.edu to find out what support they may offer for your classes.

Mental Health Services
Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends and family, concerns about eating or drinking patterns, and feelings of anxiety and depression. For more information, visit: www.students.wustl.edu/mental-health-services/

Relationship and Sexual Violence Prevention Center (RSVP)
The Relationship and Sexual Violence Prevention Center (RSVP) offers support for those who have experienced
sexual violence, sexual misconduct, dating violence, domestic violence or stalking. RSVP can help those who are not sure what steps they wish to take to respond to their experiences. They offer confidential support and can help arrange for necessary classroom accommodations. To get help, contact the RSVP Center at 935-3445 or rsvpcenter@wustl.edu. Their office is located in Seigle Hall, Suite 435.

Bias Report and Support System (BRSS)
The University has a process through which students, faculty, staff, and community members who have experienced or witnessed incidents of bias, prejudice, or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. To report an instance of bias, visit www.brss.wustl.edu.

Center for Diversity and Inclusion (CDI)
The Center for Diversity and Inclusion (CDI) supports and advocates for undergraduate, graduate, and professional school students from underrepresented and/or marginalized populations, collaborates with campus and community partners, and promotes dialogue and social change to cultivate and foster a supportive campus climate for students of all backgrounds, cultures and identities. See:  https://diversityinclusion.wustl.edu/