LIFS5310 Biostatistics: Theory and Application in Life Science Research, Spring 2023

Instructor

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Office Hour: TBA

Meeting Time and Venue

Lectures: Tue, 9am to 11:50am at Rm 1032, LSK Bldg

Course description

Statistical analysis has become an essential component in research for testing hypotheses and designing experiments. This course is tailored to PG students in Life Science and related disciplines. We will introduce common methodologies used in research, such as ANOVA, linear regression, nonparametric methods, and bootstrapping. The students will also gain practical skills in using R for analysis.

Prerequisite

The students are expected (i) to know calculus and basic probability and (ii) to have some experience of programming (in any language). **Requirement (ii) can be satisfied by learning any R tutorial on their own before the course.**

No auditing policy: Please register. Commitment and participation are essential for this course. The homework assignments will take time to complete but are necessary to ensure effective learning.

Exclusion

None

Weekly outline

Week 1,2 Introduction, basic probability concepts
Week 3 Hypothesis testing, t test and p-values
Week 4 Analysis of variance (ANOVA)
Week 5 Two-way ANOVA and multiple testing
Week 6 Experimental design
Week 7 Model assumptions and nonparametric tests
Week 8 Linear regression
Week 9 Conditional dependence and partial correlation
Week 10 Model selection
Week 11 Logistic regression and generalized linear model
Week 12 Bootstrapping
Week 13 Review and synthesis

Intended Learning Outcomes

Upon successful completion of this course, students should be able to:

1. Know how to translate scientific questions into appropriate statistical models and hypothesis
2. Know how to perform statistical analysis using R given experimental data
3. Know how to interpret analysis results in the scientific context
4. Know how to determine the power of hypothesis testing and use it to guide experimental design
5. Develop statistical thinking and understand the basic theories, potential pitfalls, and limitations of main methods

Teaching and Learning Activities

Scheduled weekly activities: 3 hours

Teaching Activities	Course ILOs
Lecture	1,2,3,4,5

Evaluation

Credit points: 3

Assessment	Course ILOs
Homework 50%	1,2,3,4
In-class discussions and participation 15%	1,3,4,5
Final exam 35%	1,2,3,5

Homework includes derivations, proofs, and numerical, and programming problems.
Final exam format: open book exam (more details on this will be given later).

We will use Canvas to distribute and collect the homework and exam. We will also send course announcements via Canvas. So please turn on the notification or check regularly. When you have a question, you are encouraged to post it under the Discussion tab on Canvas, so others can see it and may also help to answer. The instructor will also check and answer the Discussion tab regularly.

Important: You can and are encouraged to discuss and collaborate with classmates on homework, as long as each person writes and submits their own answers (copy-and-paste is not allowed).

References

Lecture slides are the primary reference materials and will be uploaded to Canvas before the lecture (usually the evening before).

Optional textbook/reference:

Biostatistical analysis by J. Zar [reserved at HKUST library]

Introductory Statistics with R by P. Dalgaard [available online from HKUST library]

Acknowledgment

The course has benefited from related course materials from Chi-Wai Yu, Dong Xia, Thomas Lumley.