STAT/MATH 415, Introduction to Mathematical Statistics

Instructor: Le Bao   lebao@psu.edu

Section 04: TuTh 9:05AM - 10:20AM   Ag Engineering 113

Section 05: TuTh 10:35AM - 11:50AM   Ag Engineering 113

TA: Yujie Liao   yxl629@psu.edu

Office hours: Wed 4:30pm – 6:00pm or by appointment

Zoom Meeting ID: https://psu.zoom.us/my/yujieliao

Prerequisites: STAT/MATH 414

Recommended Materials:

> ➤ *Probability and Statistical Inference, ninth edition,* by Hogg, Tanis and
> Zimmerman. (Chapters 5~9).

General description of the course:

This course provides an introduction to mathematical statistics, covering the
fundamentals of statistical inference. The topics covered will include Estimation and
Hypothesis Testing, Nonparametric statistics, Bayesian Inference, and some theory. It is
more of a theoretical course but with examples helping you understand the materials.

Required Work:

Assignments and Exams	Weight	Date
Homework Assignments	30%	Weekly (Friday, submitted on Canvas)
Mid-term Exam 1	20%	TBA
Mid-term Exam 2	20%	TBA
Final Exam	25%	Final Exam Week
Participation	5%	

Grading policy: Overall scores will be calculated using the following scheme:

A: 94-100%,   A-: 90-93%,   B+: 88-89%,   B: 84-87%,   B-: 80-83%,

C+: 78-79%,   C: 70-77%,   D: 60-69%,   F: 0-59%

Course Rules:

1. Homework assignments will be given on every Friday and due one week after. Late submission will not be accepted and receive 0 grade, but we automatically drop the lowest HW score at the end of the semester.
2. Students are responsible for all announcements and supplements given within any lecture. Class announcements and materials will be regularly posted on CANVAS, so it is recommended that you check the site frequently.

Academic Integrity:

All Penn State and Eberly College of Science policies regarding academic integrity apply to this course. A typical sanction of violation in this class is assigning 0 point to the entire category (HW, Midterm1, Midterm2, Final). **I do NOT negotiate on the sanction.**

Types of offenses and corresponding sanctions can be found at

https://undergrad.psu.edu/aappm/sanctioning-guidelines.html

Additional sanctions will be used when the violation involves two or more students.

https://undergrad.psu.edu/aappm/G-9-academic-integrity.html

http://www.science.psu.edu/academic/Integrity/index.html

Instruction Modes:

We follow the university guideline for the instruction modes:
https://www.registrar.psu.edu/registration/instruction-modes.cfm

The current plan is to offer 24% of the lectures asynchronously. The plan is subject to change as the COVID epidemic evolves.

Masking policy:

Penn State University requires everyone to wear a face mask in all university buildings, including classrooms, regardless of vaccination status. ALL STUDENTS MUST wear a mask appropriately (i.e., covering both your mouth and nose) while you are indoors on campus. This is to protect your health and safety as well as the health and safety of your classmates, instructor, and the university community. Anyone attending class without a mask will be asked to put one on or leave. Instructors may end class if anyone present refuses to appropriately wear a mask for the duration of class. Students who refuse to wear masks appropriately may face disciplinary action for Code of Conduct violations. If you feel you cannot wear a mask during class, please speak with your adviser immediately about your options for altering your schedule.

Learning Objectives: Upon successful completion of this course, students are expected to understand following items.

Parameter Estimation

1. the difference between a population of interest and a sample obtained from that population

2. what a statistical estimator is and how to compare two estimators in terms of bias and variance

3. how to find an estimator using the maximum likelihood approach

4. how to derive confidence interval limits for a population parameter using a sample estimator that is approximately normally distributed

5. how to interpret and compare confidence intervals in terms of width and coverage probability

6. how sample size affects the margin of error of a confidence interval and how to use a desired margin of error to determine the sample size required for collection

7. how to state the simple regression model and its assumptions

8. the least-squares approach to parameter estimation, particularly for the simple regression model

9. the difference between a prediction interval and a confidence interval for a mean response when using a regression model

10. what correlation is and how to compute the correlation coefficient from sample data

11. how to use sample order statistics to construct a confidence interval for a population percentile

12. how Bayes' formula is used to define a prior and posterior distribution for a population parameter

13. what a loss function is in the Bayesian context and how it is used to determine a Bayes estimator

Hypothesis Testing

1. how to state null and alternative hypotheses and understand the difference between one and two-sided alternatives

2. how a Type I error and a Type II error are defined for a hypothesis test

3. how to compute and interpret a test statistic for a hypothesis test, particularly when considering one population mean, the difference between population means, one population proportion, or the difference between population proportions

4. what a p-value is and how it is used to state a hypothesis test conclusion, given a specified threshold

5. how to interpret exactly what it means to reject a null hypothesis or to fail to reject a null hypothesis

6. how power is defined for a hypothesis test and how this relates to sample size and the assumed value(s) of the population parameter(s)

7. how to conduct a hypothesis test for a linear relationship using the regression model

8. how to state the analysis of variance (ANOVA) model and its assumptions

9. how to state the hypotheses for the ANOVA model, both in words and in terms of the population parameters involved

10. how an ANOVA table is constructed

11. how to conduct a hypothesis test for association with categorical data in a contingency table

12. how to conduct a hypothesis test for goodness of fit

13. how to conduct a hypothesis test for a population median using the sign test and the Wilcoxon signed rank test

Addition Topics (TBD)

ECOS Code of Mutual Respect and Cooperation:

The Eberly College of Science Code of Mutual Respect and Cooperation:

http://www.science.psu.edu/climate/Code-of-Mutual-Respect final.pdf embodies the values that we hope our faculty, staff, and students possess and will endorse to make The Eberly College of Science a place where every individual feels respected and valued, as well as challenged and rewarded.

"Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site athttp://equity.psu.edu/ods/.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at http://equity.psu.edu/ods/guidelines/documentation-guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester."

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Campus emergencies:

Campus emergencies, including weather delays, are announced on Penn State Live (http://news.psu.edu/) and communicated to cellphones, email, the Penn State Facebook page, and Twitter via PSUTXT (to sign up, please see http://psutxt.psu.edu).