Probability and Statistics (MA-130) Westmont College, Spring 2023

What is this course about?

Statistics is the science of making inferences from data. Probability is the mathematical theory at the foundation of statistical methods. Topics in probability include random variables, conditional probability, density functions, discrete and continuous distributions, important distributions (e.g., normal, binomial, Poisson), the law of large numbers, and the central limit theorem. Statistical applications include hypothesis testing, confidence intervals, regression models, and statistical learning. This course will be a mix of theory and applications. (Prerequisite: Calculus II.)

Is there a textbook?

Yes! In fact there are three textbooks, and they are all freely available online. We will cover a selection of material from the following sources.

- [GS]: *Grinstead and Snell's Introduction to Probability*, The Chance Project.
- [JWHT]: *An Introduction to Statistical Learning*, James, Witten, Hastie, Tibshirani.
- [ER]: *Probability and Statistics*, Evans and Rosenthal.

The first unit on probability theory will draw mainly from [GS], while the second unit on statistical practice will draw mainly from [JWHT]. Occasionally, [ER] will be consulted as an additional resource. You are also expected to install R and RStudio on your laptop.

What is the coursework and how is it graded?

You should expect an **assignment** due the night before every class meeting. You will submit them on Canvas in a variety of formats (e.g, scanned PDFs, R scripts, knitted HTML). There will be two written midterm **exams**, and a cumulative **final exam** on the scheduled date. The following table shows how these assessments are weighted to determine your final grade.

Assignments	40%
Midterms	20% each
Final Exam	20%

What other policies should students be aware of?

If you miss a significant number of classes, you will almost definitely do poorly in this class. If you miss more than four classes without a valid excuse, I reserve the right to terminate you from the course with a failing grade. Work missed (including tests) without a valid excuse will receive a zero.

I expect you to check your email on a regular basis. If you use a non-Westmont email account, please forward your Westmont email to your preferred account. I'll send out notices on Canvas, so make sure you receive Canvas notifications in your email.

Learning communities function best when students have academic integrity. Cheating is primarily an offense against your classmates because it undermines our learning community. Therefore, dishonesty of any kind may result in loss of credit for the work involved and the filing of a report with the Provost's Office. Major or repeated infractions may result in dismissal from the course with a failing grade. Be familiar with the College's plagiarism policy, found at https://www.westmont.edu/office-provost/academic-program/academic-integrity-policy.

In particular, providing someone with an electronic copy of your work is a breach of the academic integrity policy. Do not email, post online, or otherwise disseminate any of the work that you do in this class. If you keep your work on a repository, make sure it is private. You may work with others on the assignments, but make sure that you write or type up your own answers yourself. You are on your honor that the work you hand in represents your own understanding.

Other Information

Professor: David J. Hunter, Ph.D. (dhunter@westmont.edu). Student hours are in Winter Hall 303 from 1:30–4pm on Tuesdays and Thursdays.

Tentative Schedule: The following schedule is a rough first approximation of the topics in [GS], [JWHT], and [ER] that we plan to cover; it is subject to revision at the instructor's discretion.

- Probability Theory: Random variables, Monte Carlo simulations, discrete and continuous distributions and densities, important distributions, expected value and variance, the law of large numbers, and the central limit theorem.

    Midterm #1

- Statistical Practice: Hypothesis testing and confidence intervals, statistical learning models, the bias-variance trade-off, linear regression, logistic regression, cross validation, bootstrapping, model selection.

    Midterm #2

- Further Applications: Time permitting, a selection of topics from principal components analysis, decision trees, random forests, support vector machines, or other statistical learning methods.

    Final Exam (cumulative)

Accommodations for Students with Disabilities: Students who have been diagnosed with a disability (learning, physical or psychological) are strongly encouraged to contact the Disability Services office as early as possible to discuss appropriate accommodations for this course. Formal accommodations will only be granted for students whose disabilities have been verified by the Disability Services office. These accommodations may be necessary to ensure your equal access to this course. Please contact the Office of Disability Services (ods@westmont.edu) or visit https://www.westmont.edu/disability-services for more information.

Program and Institutional Learning Outcomes: The mathematics department at Westmont College has formulated the following learning outcomes for all of its classes. (PLO's)

1. Core Knowledge: Students will demonstrate knowledge of the main concepts, skills, and facts of the discipline of mathematics.
2. Communication: Students will be able to communicate mathematical ideas following the standard conventions of writing or speaking in the discipline.
3. Creativity: Students will demonstrate the ability to formulate and make progress toward solving non-routine problems.
4. Christian Connection: Students will incorporate their mathematical skills and knowledge into their thinking about their vocations as followers of Christ.

In addition, the faculty of Westmont College have established common learning outcomes for all courses at the institution (ILO's). These outcomes are summarized as follows: (1) Christian Understanding, Practices, and Affections, (2) Global Awareness and Diversity, (3) Critical Thinking, (4) Quantitative Literacy, (5) Written Communication, (6) Oral Communication, and (7) Information Literacy.

Course Learning Outcomes: The above outcomes are reflected in the particular learning outcomes for this course. After taking this course, you should be able to:

- Demonstrate understanding of the theoretical basis for statistical practice. (PLO 1, ILOs 3,4)

- Write and evaluate mathematical arguments according to the standards of the discipline. (PLO 2, ILOs 3,5)

- Construct solutions to novel problems, demonstrating perseverance in the face of open-ended or partially-defined contexts. (PLO 3, ILO 3)

- Consider the ethical implications of the subject matter. (PLO 4, ILO 1)

These outcomes will be assessed by assignments and written exams, as described above.