

MATH 120 : Elementary Statistics : Spring 2022 (3 credits)

MWF 9-9:50 am, CST 103

Instructor	Anand Pardhanani CST 210	Email: pardhan@earlham.edu Phone: 765-983-1683
Office hours	The following hours are tentative - I'll finalize office hours after the 1st week M: 10-11am. T: 10-11am. W: 10-11am. And by appointment or walk-in. The best way to contact me, in order of preference, is: [1] in person, [2] by email, [3] by phone. Open door policy: I keep my posted office hours to a bare minimum, to avoid being locked into a rigid schedule all semester. However, I am happy to assist students well beyond my office hours. Students are encouraged to just drop by whenever needed. Anytime my office door is open you're welcome to stop by and check whether I am available. Also, please do not hesitate to make an appointment if my posted office hours don't work for you.	
Class website	https://cs.earlham.edu/~pardhan/courses/statistics/ The website is a central component of this class, and you are responsible for regularly checking it for announcements, homework assignments and various supplementary handouts. I prepare for class with the assumption that students have reviewed the website and followed through on posted instructions.	

A note of welcome

It is my pleasure to welcome you to this class! Statistics is, hands down, among the most versatile and practically useful disciplines in the world. Whether you plan to be a scientist, economist, artist, entrepreneur, political activist, or homemaker, there is guaranteed to be a way for you to benefit from the use of statistical methods. You may well find that the skills you pick up in this class will be of value long after you graduate, in everyday life and in your profession.

A word of caution

Many students take this course with misguided perceptions about how much time, effort and work it involves. Perhaps the course-title, with the word "Elementary" in it, is part of the culprit! To set the record straight, this class covers a vast range of materials, and is fairly challenging if a student doesn't devote adequate time to it. Please be advised that failure and dropout rates in this class tend to be high. For further details and individual guidance, students are welcome to visit the instructor.

Textbook

[Introductory statistics](#), by Barbara Illowsky, Susan Dean, and openstax.org.
Digital edition ISBN13 = 978-1-947172-05-0; Paperback ISBN13 = 978-1-50669-823-6
Additional supplementary material will be provided by the instructor for some topics.

Course credits

This course is worth 3 credits, and will meet 3 times per week for 50-minute in-person classes.

Requirements this class fulfills

Several Earlham majors and programs recommend or require students to take this class. These include: Biology, Biochemistry, Chemistry, Data Science, Exercise Science, Global Management, Neuroscience. In addition, this class fulfills the Quantitative Reasoning component of Earlham's General Education requirements.

Description & objectives

The broad goal of this course is to introduce students to the foundational principles and practical methods of doing statistical analysis. More specifically, this course will teach you fundamental statistical concepts and techniques for organizing, analyzing, and interpreting data, as well as for other common statistical tasks such as correlation & regression, experimental design, probability, hypothesis testing and statistical inference. In addition, this course will introduce students to use the R software package for doing statistics. We will cover most topics in Chapters 1-12 of the textbook.

Student learning goals and outcomes

Upon successful completion of this course, students will be able to

1. Organize, summarize and interpret data.
2. Use technology tools to analyze data.
3. Design and conduct a basic statistical research study.
4. Understand fundamental probability concepts.
5. Infer statistically valid conclusions using confidence intervals and hypothesis tests.
6. Interpret and communicate the findings of their analyses.
7. Strengthen logical reasoning, and quantitative skills.
8. Use statistics to structure their understanding of the world around them, and to investigate interesting questions.

These aspirations broadly support all 5 learning goals of the Math Department, and the 7 goals of an Earlham education (see the [Appendix attached to this Syllabus](#)).

Course prerequisites

High-school algebra, and a score of at least 50 on Earlham's Quantitative Skills Assessment (QANS).

Assessment & grading policy

In my approach to grading, correct process and method receive far more credit than correct answers. I always ask you to show all your work, and I grade all of your work!

Your final grade will be based on combined performance on: (1) quizzes, (2) two in-class exams, (3) a comprehensive final exam, (4) a term project, (5) homework problems, (6) classwork and labs. Each will contribute the following proportions:

Quizzes	20%
Two in-class exams	15% + 15%
Final exam	15%
Homework	15%
Classwork and labs	20%

Letter grade boundaries for this course are not set in advance. They will be determined at the end of the semester based on factors such as overall class performance, level of difficulty of tests,

quizzes, and assigned work, etc. At a minimum, the following standard scale for letter grades will be honored:

A+: 97.0-100; A: 93.0-96.9; A-: 90.0-92.9;
B+: 87.0-89.9; B: 83.0-86.9; B-: 80.0-82.9;
C+: 77.0-79.9; C: 73.0-76.9; C-: 70.0-72.9;
D+: 67.0-69.9; D: 63.0-66.9; D-: 60.0-62.9; F: below 60.

NOTE that all students must also satisfy the following minimum requirements to receive a grade of C- or better:

- * Take at least 75% of the quizzes.
- * Take all the exams (2 during the semester, plus the final).
- * Turn in at least 75% of the homework, classwork and labs.

More details about assessment categories

Quizzes: There will be frequent short quizzes based on readings, homework, classwork and/or other assigned tasks. The primary purpose of quizzes is to encourage regular and timely engagement with the materials, and to provide continuous assessment of your work. The quizzes will help us accomplish most of the learning goals listed above.

Classwork and labs: Classwork will be similar to doing homework problems, and will serve the purpose of hands on learning and practice in class. This will support all the learning goals listed above. The primary purpose of labs will be to learn how to do statistical analysis using the R software package. This will help us accomplish learning goals 1, 2 and 5, in particular.

Homework: The purpose of homework problems is to build skills in the material. Exercises will be assigned from the textbook and other sources at various points throughout the semester. These must be turned in at the beginning of class on the indicated due dates. Homework exercises will help us accomplish most learning goals listed above.

Exams: There will be two exams during the semester, plus a final exam at the end of the semester. The tentative dates of the mid-semester exams are:

Exam 1: March 2. Exam 2: April 13.

The final exam date and time is set by the registrar's office. According to their calendar, the final exam will be held **Monday, May 16, in CST 103 at 8 am.**

The final exam date and time is not negotiable. Please arrange any travel plans accordingly.

Important dates

- * Last day to add this course: February 4.
- * Last day to drop: April 15.
- * Date of final exam: May 16.

NOTE: Last drop date applies to Earlham students only. Students cross-registered through IU-East or other institutions must follow the dates and rules of their own institution.

Academic integrity

After several years of writing standard, boiler-plate stuff in this section, I have decided to replace it with a more authentic message from my heart to yours. Before getting into details, I would like to share 3 key ideas that profoundly shape my thinking, and prompt me to explore more effective ways towards academic integrity:

1. Academic infractions are a much bigger problem at Earlham than many of us would like to believe or admit.
2. The problem is **NOT** our students! Earlham students are as good (or better!) than their peers

at other institutions in terms of moral values and ethical standards.

3. Infractions at Earlham can be significantly reduced using a combination of strategies, collectively developed by students and faculty.

These three points summarize my overall perspective, and will frame the rest of my discussion on this subject.

By far the single biggest phenomenon that has radically transformed today's academic integrity / infraction landscape is technology -- particularly the internet and cell phones. In my view, Earlham's traditional approach to academic integrity has been rendered completely obsolete by these technologies. If I were an Earlham student today, I would encounter many situations where the temptation to infract would be extremely high, because these technologies make it so easy, and the risk of getting caught is virtually zero. This is the main reason why I say that you, the student, are not the problem. You are human, just like me and my faculty colleagues. It is a fact of life that many humans succumb to temptation when the rewards are sufficiently high, and the risks sufficiently low.

Yet, the fact remains, a growing rate of academic infractions is a terrible thing to ignore: They sink an institution's reputation, decrease the value of students' education, lower student & faculty morale, and more. Clearly, we need to explore and develop new strategies that are more effective for our times, and also preserve Earlham's distinctive approach to such matters. We will set aside some class time to discuss and formulate specific policies for helping students (joyfully!) meet and exceed the highest standards of integrity in this class. In the meantime, I invite you to reflect on some practical ways that would most help and support you in avoiding the use of inappropriate sources for completing and turning in your graded work.

I would like to conclude with the following excerpt from the Earlham Academic Integrity Policy: "The College trusts students who enroll at Earlham to be honest seekers of truth and knowledge. This trust is extended to all students by other students and by teachers ... Giving or receiving aid inappropriately on assignments and tests, or plagiarizing by using another person's words or ideas without credit, constitutes a serious breach of our trust in one another and in the integrity of the search for truth. Those who believe they have witnessed violations of academic integrity should feel the obligation to speak about this to the suspected offender. The witness also should feel obligated to report the suspected offender to the instructor if the person fails to offer a satisfactory explanation and refuses to report him or herself. ... Violations of academic integrity, because they undermine our trust in one another and in the credibility of the academic enterprise, are taken very seriously. Penalties for violations range from failing assignments or tests to suspension or expulsion from the College. "

Makeups

In-class items: There will be no makeup for missed in-class items (e.g., quizzes, classwork, class participation, etc.) regardless of reason. I will drop your lowest two scores as an implicit way of making up for missed items.

Homework: Past-due assignments will not be accepted except in rare circumstances, provided the student receives prior consent from the instructor.

Exams: Make-up exams will not be given except in cases of documented illness or emergency.

Academic accommodations

Students with a documented disability (e.g., physical, learning, psychiatric, visual, hearing, etc.)

who need to arrange reasonable classroom accommodations must request accommodation memos from the Academic Enrichment Center (main floor of Lilly Library) and contact their instructors each semester. For greater success, students are strongly encouraged to visit the Academic Enrichment Center within the first two weeks of each semester to begin the process. For further details, please visit

<https://earlham.edu/academics/academic-support-and-special-programs/academic-enrichment-center/accessibility-services/>

Other sources of help

1. **The Academic Enrichment Center:** The Academic Enrichment Center (AEC), located in Lilly Library, provides assistance with study habits and skills as well as a peer tutoring service. The AEC is staffed by trained peer tutors for either pre-arranged group tutoring sessions (provided for many math, science and social science courses) or one-on-one tutoring sessions for other courses. Peer tutoring is a free service offered to all Earlham students. Please visit <https://earlham.edu/academics/academic-support-and-special-programs/academic-enrichment-center/peer-tutoring/> for more information.
2. **The Earlham Writing Center:** The Writing Center is dedicated to providing students with advice and resources about writing. Students can meet one-on-one with trained consultants who will contribute feedback to writers at any stage of the writing process: brainstorming, drafting, researching, revising, and polishing. This is a free, walk-in service on the main level of Lilly Library. In addition to dropping by, students may also schedule an appointment in advance using the online scheduler found at: <http://www.earlham.edu/writing-center/>. Also, if you want help with specific grammar topics related to your own writing, <https://www.grammarly.com/edu> is available for all Earlham students to proofread their papers and learn more about grammatical errors.

[Syllabus Appendix \(click here to view\)](#)

Appendix to the Syllabus

Math department student learning goals

Curiosity: an encounter with mathematical meaning, beauty, and joy.

Mathematics is an art as well as a craft. Depending on how one counts, somewhere between five and all of the classical seven liberal arts have significant mathematical content. We'd like to help students encounter seriously both the beauty and the utility of an art without which neither the world around us nor the last two and a half millennia of human culture are at all intelligible.

Craft: using mathematical tools.

Mathematics is a craft as well as an art. Much of our work involves exposing our students to the concrete mathematical tools they need to succeed in other disciplines and in a world shot through by mathematics. Those tools range from fancy machinery for quantum physicists to using simple algebraic or differential equations to model phenomena in biology and economics to techniques to manage randomness in data in the social sciences to the basic vocabulary needed to read newspaper stories with numbers in them.

Confidence: an ability to create and use mathematics themselves.

Mathematics is also the product of human beings, who work individually and collectively to discover or invent mathematical truth. We work to inculcate in our students a spirit of inquiry and to empower them to discover that they are able as individuals and working with others to make mathematical discoveries and to utilize mathematics in creative ways. Math is the work of humans, and as humans, our students have all the prerequisites they need to do and to use mathematics.

Communal Inquiry: mathematical community and communication.

Mathematics is a communal enterprise, and even a glance at the words shows that one can't have community without communication. We'd like our students to practice mathematical communication. This means that they need to learn to verify and to convey to others the results of their mathematical inquiries by writing precise, concise, and completely persuasive arguments in idiomatic mathematical language. In mathematics, the products of this writing are called *proofs*. It also means that students need to practice reading carefully and critically the mathematical works of others so as to be able to share in a community of inquiry and to learn new mathematics on their own.

Continuity: lasting mathematical experience.

Mathematics does not end with what one learns in four years at college. We wish to equip our majors for further study in mathematics at the post-

baccalaureate level, though we accept that with our current program, the path available to most students wishing to do graduate work will require them using as a stepping stone a Masters program at something other than a first-tier university. We would also hope that our non-majors might carry the spirit of joy, skill, confidence, and cooperative inquiry with them after they leave Earlham.

Earlham College learning goals

(See <https://earlham.edu/registrar/curriculum-guide/learning-goals/>)

Students should be able to:

- **Communicate** effectively and work collaboratively across diverse contexts via multiple media. Effective communication involves both social and expressive skills and the ability to communicate in multiple settings and cultures.
- **Investigate** and analyze information, materials, problems and texts using a variety of techniques. Thoughtful and careful analysis requires the ability to collect, understand, interpret and evaluate multiple pieces of evidence, with systematic understanding and overt application of qualitative, quantitative, analytical and abstract reasoning.
- **Integrate** knowledge, experience, and skills across domains and contexts. Integration involves connecting and developing ideas, as well as synthesizing and transferring learning to new and complex situations.
- **Diversify** personal and cultural experiences, ways of knowing, and social relationships. The practice of diversity involves embracing opportunities to explore outside their interests and typical frame of reference.
- **Create** and innovate across a variety of disciplines. Creativity and innovation require a willingness to take risks, be open to new possibilities, and produce new knowledge and artistic and social forms.
- **Reflect** critically on their learning experiences, ethical and vocational choices, lifestyle, and beliefs in light of multiple understandings of the world. Reflection involves the ability to examine past experiences and apply their lessons to future contexts.
- **Apply** knowledge and skills to real world problems and situations as well as to improve their own mental, spiritual and physical well-being. Applying learning effectively is a key skill of a lifelong learner.