Statistics
EPSY 3264: Basic and Applied Statistics

Sponsoring U of M Academic Department: Department of Educational Psychology

Credits: Three University of Minnesota semester credits

Additional Credit Information: EPSY 3264:
- is a 3xxx-level introduction to statistics
- satisfies the University of Minnesota liberal education core requirement for a mathematical thinking
- is *not* a substitute for an AP Statistics course

U of M Requirements Met with this Course: Meets a University of Minnesota liberal education requirement in mathematical thinking

U of M Catalog Description: Introductory statistics. Emphasizes understanding/applying statistical concepts/procedures. Visual/quantitative methods for presenting/analyzing data, common descriptive indices for univariate/bivariate data. Inferential techniques.

Additional Course Information: This course can be taught over an entire high school semester or academic year.

EPsy 3264 is designed to engage students using a modeling and simulation approach to inference. Statistics is more than just an application of mathematics or a methodology used in some other discipline. Statistics is a principled way of thinking about the world. In particular, it is a principled approach to data collection, prediction, and scientific inference. In today's dynamic and interdisciplinary world, success in confronting new analytical issues requires both substantial knowledge of a scientific or technological area and highly flexible problem-solving strategies. This course uses pedagogical principles that are founded in research, such as daily small group activities and discussion. Upon completion of this course, students should have an understanding of the foundational concepts of data, variation and inference, as well as an appreciation for the fundamental role that statistics plays in a host of disciplines, such as business, economics, law, and medicine.

This is *not* a class where students come to class each day, listen, watch, and take notes! The primary method for learning new statistical concepts and methods is by students reading the provided materials before class, participating in class activities and discussions, and working through homework assignments.

This course makes extensive use of *small group and large group activities and discussions* to introduce ideas and content, as well as to deepen students' understanding of material encountered in the readings. Students' learning experience is thus dependent—to some extent—on their classmates and vice versa. Because of this, it is essential that students not only attend class each day and participate in the activities and discussions, but that they show up prepared having completed the homework and readings assigned.

Internalizing a disciplines' way of thinking about and solving problems is a time consuming process, with the keyword being "process". It is not something that can be taught to students in a semester, or even year-long, course. Learning statistics takes much more than memorizing formulae or software commands. It requires active participation and questioning both in and out of the classroom. There are many opportunities to learn the material through class activities, readings, and homework assignments, but in the end, students will have to do all of the hard work of actually learning that material.

Student Learning Outcomes: EPsy 3264 addresses two components of the University of Minnesota's required learning outcomes. After completing this course, students will know the basic terms, concepts, principles, methods, and perspectives of statistics and will be able to build a framework of knowledge within the major themes of the course(***Component 3: Have mastered a body of knowledge and mode of inquiry.***).

Students will also be able to communicate the results of a statistical analysis with others, as well as discuss both ideas and applications of the discipline with peers (***Component 5: Can communicate effectively***).

Instructor Qualifications: There is very little lecture in this course. Teachers must be more "navigators" than "pilots"—allowing the students to teach themselves rather than "telling". Their primary purpose in the classroom is to raise questions and lead student discussions. To better understand the philosophical and pedagogical orientation of the course, prospective teachers of Basic and Applied Statistics are asked to visit *at least* two sessions of the course (to see it in action) at the University of Minnesota.

Required qualifications:

- Minnesota teaching license in mathematics or valid waiver
- At least 3 years of teaching experience
- Bachelor's degree (or equivalent) in statistics, mathematics, or a STEM discipline;
- Experience (or an interest in) presenting mathematics using non-lecture based pedagogies (for example, modeling, project-based learning, or guided discussion); and
- Evidence of intellectual curiosity and continued interest in learning statistics. For example:
    - taking advanced coursework in statistics
    - participating in discipline-specific professional development opportunities
    - attending sessions focused on statistics at local, regional or national mathematics/statistics meetings

Preferred qualifications:
- Advanced degree in statistics, mathematics, or a STEM discipline
- More than 3 years of teaching experience

Student Eligibility: Students must be juniors or seniors in high school and have successfully completed (B+ or higher) a high school algebra course.

Textbooks: Zieffler, A., & Catalysts for Change. (2014). *Statistical Thinking 2.0: A Simulation Approach to Modeling Uncertainty.* Minneapolis, MN: Catalyst Press.
Available at https://github.com/zief0002/Statistical-Thinking

Teachers need to use this text.

Software: *TinkerPlots™.* University of Massachusetts, Amherst: Scientific Reasoning Research Institute.
Available at http://www.srri.umass.edu/tinkerplots/download

Technology: EPSY 3264 uses technology on a regular basis during both instruction and assessments (e.g., homework assignments, exams, etc.). Because of this, students enrolled in the course should be familiar with computers and technology (e.g., internet browsing, Microsoft Word, opening/saving files, etc.).

Required access to computers and the Internet: Students must have access to the internet and computers for this class. In class, there needs to be one computer per three students daily, and internet access for certain activities.

For homework, students need regular access to the Internet and one computer per student.

Faculty Coordinator: *Andrew Zieffler* is a Senior Lecturer and researcher in the *Quantitative Methods in Education* program within the *Department of Educational Psychology* at the University of Minnesota. In a previous life he taught mathematics and A.P. Statistics at the high-school level. He currently teaches graduate-level courses in statistics, oversees the undergraduate statistics program, trains and supervises graduate students who teach statistics. Andrew has participated as a co-PI on many past and current NSF-funded statistics education research projects, including the *Change Agents for Teaching and Learning Statistics* (CATALST) project. He is the author of several papers and book chapters related to statistics education, and has co-authored two textbooks that serve as an introduction to modern statistical and computational methods for students in the educational and behavioral sciences. He also serves as a co-editor of the journal *Technology Innovations in Statistics Education* and as a member of the *Consortium for the Advancement of Undergraduate Statistics Education (CAUSE) Research Advisory Board.*
zief0002@umn.edu
612-624-6083

Frequently Asked Questions:

Are the texts and readings specified or mandated by the University of Minnesota? If not, what are some of the choices?
Yes. EPSY 3264 requires the use of *Statistical Thinking 2.0: A Simulation Approach to Modeling Uncertainty.* This textbook is available for free as a PDF on GitHub

(https://github.com/zief0002/Statistical-Thinking). You can also order a paperback printed version from CreateSpace (https://www.createspace.com/3970536) for $45.

Is the software specified or mandated by the University of Minnesota? If not, what are some of the choices?

Other software programs (e.g., R, Python, Fathom) might be possible, but would need to be approved by the faculty coordinator. Graphing calculators would *not* be a suitable replacement for the software.

Do teachers have choice in assignments? Are there required assignments?

All schools are required to implement the same quizzes and tests used in the class at the University of Minnesota.

Who creates the exams?

The University of Minnesota.

Is there a training and mentoring system for *Basic and Applied Statistics* teachers new to CIS?

Yes. When you begin teaching *Basic and Applied Statistics* you will be joining a group of high school teachers who share ideas and materials with each other through e-mail and teacher workshops held in the summer and throughout the school year. New teachers also benefit from an orientation to College in the Schools that will familiarize them with the support available through CIS as well as prepare them for administrative tasks such as registering students and posting grades.

High school class schedules vary; can a teacher in the block system teach Basic and Applied Statistics?

This course is taught either over a semester or an entire high school academic year.

What happens at typical teacher workshops?

Typical activities at CIS workshops include meeting University faculty and hearing about their recent research in the discipline; reviewing and/or developing student assessment tools; sharing instructional materials; discussing particular content, pedagogy, or assessment of the University course; and receiving updates on CIS program policies and practices. *Basic and Applied Statistics* workshops focus especially on discussion of in-class activities, discussion, and using the *TinkerPlots*™ software.

How does EPsy 3264 differ from AP Statistics?

There are many differences between EPsy 3264 and AP Statistics. One of the main differences is the content. EPsy 3264 focuses on statistical inference throughout the entire course. AP Statistics includes statistical inference, but only as a part of the curriculum.

The manner in which statistical inference is performed also differs between these two courses. EPsy 3264 uses a simulation approach to performing statistical inference. AP Statistics takes a mathematical or "conventional approach" to statistical inference (for example, using a mathematical formula to compute a *t*-statistic).