MATH 3410
Statistics for Secondary Mathematics Teachers
Fall 2019
Mon/Wed/Fri 2:00-2:50
LCB 215

Instructor: Amanda Cangelosi
Office: JWB 217
Email: cangelos@math.utah.edu

Office Hours: By appointment

Course Web Site: Canvas (link from www.utah.edu, using your student ID and CIS password)

Prerequisites: C or higher in Math 3070 or equivalent.

Course Content: This three-credit course addresses secondary school probability and statistics content from an advanced perspective, with attention to historical development and modern computational tools. From a teaching perspective (i.e., drawing connections to the Utah Core Standards for Mathematics), topics include random variables, distributions, moments, the central limit theorem, descriptive statistics, hypothesis testing, estimation, linear regression, and experimental design. Essential learning outcomes are developed from the those enumerated by the National Council of Teachers of Mathematics, utilizing the language of the educational community. Students will use open source software (e.g., GeoGebra) and, to a larger extent, a statistical programming language (e.g., R or Python) to investigate statistical questions, both at and beyond the secondary level. Prerequisites include the successful completion of Math 3070.

Textbooks: Please visit the mathematics department webpage for purchasing options. The following three books (either paperback or e-book) are required for Math 3410:

   • e-Book ISBN: 978-0-87353-853-4
   • paperback ISBN: 978-0-87353-672-1

   • e-Book ISBN: 978-0-87353-852-7
   • paperback ISBN: 978-0-87353-676-9

   • e-Book ISBN: 978-0-87353-737-7
   • paperback ISBN: 978-0-87353-737-7

How You Will Be Graded:

- In-class activities and reflections: 20%
- Reading assignments: 20%
- Quizzes: 20%
- Lesson plans and demo lessons: 15%
- Final report and presentation: 15%
- R labs: 10%

In-class activities and reflections: To support a vibrant learning environment, active participation is expected. Written reflections will be collected roughly each day at the end of class. Work from in-class activities and discussions will be collected sporadically.
**Reading assignments:** Roughly daily, reading and writing assignments will be posted to Canvas. Class discussion and activities will be conducted around themes from our textbooks and supplemental materials. Reading assignments should be turned in electronically via Canvas.

**Quizzes:** Roughly every few weeks, there will be a quiz on content discussed or assigned in class.

**Lesson plans and demo lessons:** In the spirit of the Utah Effective Teaching Standards, NCTM’s *Principles to Actions* and 5 Practices for Orchestrating Productive Mathematical Discourse, and the UITE lesson plan template, students will create two secondary-level statistics lessons: One middle school lesson and one high school lesson, each utilizing technology appropriately. Students will conduct a shortened version of their lessons to the class.

**Final report and presentation:** Students will write a report on a statistics education topic of interest, generating a dynamic report (utilizing packages such as knit, Sweave function, or R Markdown file format). The report will contain a content section and an educational practices section, demonstrating competency in explaining a particularly challenging secondary statistics topic.

**R labs:** Work from Math 3070 will be extended here, with an emphasis on applications to the secondary classroom. This not only makes us better teachers, but it also satisfies the computing requirement to obtain your mathematics degree at the University of Utah.

**Essential Learning Outcomes:**

1. **Secondary Classroom Connections**
   
   (a) Students will familiarize themselves with the Statistics and Probability strands of the Utah Core Standards for Mathematics, identify vertical alignment of standards among grades 6-12, and connect the Standards to content learned in Math 3070.
   
   (b) Students will understand that probability and mathematical statistics are subsets of mathematics, while the practice of statistics (data analysis) is a subset of science; students will parse confounding language between the communities of mathematics, statistics, science, and education.
   
   (c) Students will utilize open source secondary classroom software, such as Geogebra and Desmos, to learn and teach statistics and probability.
   
   (d) Students will utilize an open source statistical programming language (e.g., R or Python), as well as the LATEX typesetting system, to create secondary-level classroom materials.

2. **Probability and Mathematical Statistics**
   
   (a) Students will understand the concepts of random variable and probability measure as functions and demonstrate competency in explaining these concepts in secondary-school-appropriate language.
   
   (b) Students will understand basic laws of probability (e.g., relationships regarding conditional probability, independent events, the law of large numbers, and the central limit theorem) and communicate them in secondary-school-appropriate language.
   
   (c) Students will identify scenarios under which the following random variables are useful in statistical modeling and comprehend their probability density/mass functions: uniform; binomial; Poisson; geometric; exponential; normal.

3. **Statistics: Data Analysis** (NCTM’s *Developing Essential Understandings of Statistics*)
   
   (a) Students will explain the difference between descriptive and inferential statistics and identify examples of each, including where each resides in the Utah Core Standards.
   
   (b) Students will understand that data consist of structure and variability; statistical models describe variability around structure and are evaluated upon usefulness.
   
   (c) Students will identify similarities and differences between population and sampling distributions, as well as the role of inferential statistics in drawing conclusions about a population from a random sample.
   
   (d) Students will understand that simulation can be used to approximate sampling distributions, and they will utilize open source software (e.g., Geogebra) and statistical programming languages (e.g., R; Python) for simulation.
(e) Students will understand that hypothesis testing involves making decisions about competing hypotheses while quantifying uncertainty, and students will understand the role played by \( p \)-values and their relationship to confidence intervals.

(f) Students will understand that bivariate distributions describe trends in covariability; conditional relative frequency distributions are useful for establishing association between two categorical variables, while a correlation coefficient is a useful measure of association strength between quantitative variables.

(g) Students will understand the importance of data collection methods, comparing observational studies versus controlled experiments, and random assignment versus random selection in experimental design.

(h) Students will engage in hypothesis testing and parameter estimation, and they will understand the difference between hypothesis testing and estimation as subsets of inferential statistics.

(i) Students will understand that estimators are evaluated on the basis of their performance in repeated sampling, that estimators can be biased, that the standard error describes the precision of an estimator, and that confidence intervals are estimation tools that convey information about precision.

4. Computing Requirement

(a) Students will demonstrate competency in utilizing open source statistical programming languages, such as R or Python, to learn and teach statistics and probability.

(b) Students will write their own functions, attending to arguments, return values, conditional evaluation, and looping.

(c) Students will use a programming language to identify and change class attributes of data sets.

(d) Students will develop programming confidence regarding problem-solving, debugging, and processing/acquiring data.

(e) Students will generate dynamic reports (utilizing packages such as knitr, Sweave function, or R Markdown file format).

5. History

(a) Students will understand the historical underpinnings of statistics, including Fisher’s ideas regarding experimental design and hypothesis testing, as well as Kolmogorov’s axiomatic basis for probability.

(b) Students will understand that statistics is a rapidly evolving field that is heavily influenced by developments in computation.

(c) Students will understand that there are alternatives to traditional frequentist statistics, including Bayesian statistics and non-parametric methods, and students will contrast the underlying premises of different statistical approaches.

Policies and Expectations: Active participation is expected. To support a vibrant learning environment, student attendance and engagement in class activities and discussion are necessary. Thus, no late assignments nor late labs will be accepted, unless a student has a serious extenuating circumstance. Similarly, quizzes cannot be made up, nor can they be taken early, unless there is an exceptional circumstance. Furthermore, to support a productive learning environment, students must be present in class to turn in homework. As shiny devices tend to distract humans both near and far from said shiny devices, as a courtesy please keep phones put away unless explicitly invited by the instructor. Laptops will be used during lab activities; keep them “clam-shelled” while not being used during instruction.

Grade Breakdown by Percent:
A (100-93); A- (92-90); B+ (89-87); B (86-83); B- (82-80); C+ (79-77); C (76-73); C- (72-70); D+ (69-67); D (66-63); D- (62-60); E (59-0).
Tentative Schedule: Homework information and all assignment due dates are posted on Canvas.

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<thead>
<tr>
<th>Dates</th>
<th>Tentative Topic</th>
<th>Notable Events</th>
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<tbody>
<tr>
<td>Aug 19-23</td>
<td><em>Dice Games;</em> probability basics; <em>Random Walks</em></td>
<td><em>EUS 6-8 pp. v-24</em></td>
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<td>Aug 26-30</td>
<td><em>Utah Core Standards;</em> binomial expansion</td>
<td>*EUS 6-8 pp. 24-50</td>
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<td>Sept (2)-6</td>
<td><em>Probability variables;</em> Geogebra/Desmos; R Lab 1</td>
<td>9/2 holiday; *Quiz 1; EUS 6-8 pp. 51-80</td>
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<tr>
<td>Sept 9-13</td>
<td><em>Probability rules and Central Limit Theorem</em></td>
<td>*EUS 6-8 pp. 81-104</td>
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<td>Sept 16-20</td>
<td><em>Demo Lesson 1: prep and present</em></td>
<td>*EUS 9-12 pp. vii-43</td>
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<td>Sept 23-27</td>
<td><em>Hypothesis testing &amp; estimation</em></td>
<td>*Quiz 2; EUS 9-12 pp. 44-66</td>
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<td>Sept 30-Oct 4</td>
<td><em>R Lab 2: Markdown &amp; prep Demo 2</em></td>
<td>*EUS 9-12 pp. 67-88</td>
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<td>Oct 7-11</td>
<td>NO CLASS</td>
<td>FALL BREAK</td>
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<td>Oct 14-(18)</td>
<td><em>Bivariate data and least squares regression</em></td>
<td>*NCTM Regional! EUS 9-12 pp. 89-113</td>
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<td>Oct 21-25</td>
<td><em>Demo Lesson 2: prep and present</em></td>
<td>*PEUP pp. 1-32</td>
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<td>Oct 28-Nov 1</td>
<td><em>Median-median line; R Lab 3: programming</em></td>
<td>*Quiz 3 PEUP pp. 33-58</td>
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<td>Nov 4-8</td>
<td><em>Statistical Questions from the Classroom</em></td>
<td>*PEUP pp. 59-90</td>
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<td>Nov 11-15</td>
<td><em>Famous secondary statistics tasks</em></td>
<td>*PEUP pp. 91-106</td>
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<tr>
<td>Nov 18-22</td>
<td><em>Famous secondary statistics tasks</em></td>
<td>*PEUP pp. 107-126</td>
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<td>Nov 25-(29)</td>
<td><em>Final report check-in</em></td>
<td>*Quiz 4: No Class Nov 27-29</td>
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<td>Dec 2-4</td>
<td>History of statistics</td>
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<td>Dec 11</td>
<td>Final Report Presentations</td>
<td>1:00-3:00 pm in LCB 215</td>
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Safety Statement: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

Wellness Statement: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the students legal name as well as Preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your U-ID card, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

Classroom Social Equity: I strive to be ethical, kind, fair, inclusive and respectful in my classroom and expect students to behave likewise. In this regard, I have these requests of students:

1. Please do tell me, discreetly, if you have any sort of anxiety disorder, TBI, PTSD, C-PTSD, or any other challenge that would cause psychological harm to you by me calling on you in class. I want students to feel a little uncomfortable and stretched during class, while working on problems as a large group, but I definitely don’t want to cause any human being harm. So, please discreetly tell me if that is the case for you and I will confidentially accommodate your request.

2. If your preferred name is different than your legal first name (the preferred name you chose does indeed show up in CIS on my roll sheet, but not yet in Canvas), please log into Canvas and go to Account (on far left) → Settings and change your Display Name to be the name you prefer to be addressed by. This will help me greatly to know students’ names, and to address you correctly when responding to Canvas quiz comments.

3. If there is ever a time that you feel this course or the curriculum is not equitable, please email me or meet with me to discuss your concerns so I have a chance to address that.
**ADA Statement:** The Americans with Disabilities Act requires that reasonable accommodations be provided for students with physical, cognitive, systemic, learning, and psychiatric disabilities. A qualifying student needs to have such a disability approved by the Center for Disability Services (162 Olpin Union Building, 581-5020) in order to have the accommodations provided. The instructors need to be informed about such a disability and approved accommodations at the beginning of the semester. The Center for Disability Services will work with students and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the CDS.

**Disclaimer:** The instructor reserves the right to modify this syllabus to better suit class needs at any time during this semester. Any changes that are made will be immediately communicated during class and via Canvas.