

UNIVERSITY OF KENTUCKY
COLLEGE OF ARTS AND SCIENCES

Course Syllabus
STA 623-001 Theory of Probability
Fall 2020

This is a fully online course which will have asynchronous and synchronous components.

My lectures will be delivered asynchronously. You will be given access to lecture notes, plus accompanying video or audio recordings, on a regular basis. You should try to read the notes and listen to the recordings within about one week of their availability, but you are not required to be present each week at a specific time such as 2 p.m. on Tuesday and Thursday.

Each student is required to have a synchronous check-in with me on at least 10 occasions during the semester, roughly once per week from late August to mid November. More details appear under “Course requirements and learner evaluation” below. Additional synchronous meetings are available upon reasonable request.

Contact information

Instructor: Dr. Richard Charnigo, Professor of Biostatistics, Professor of Statistics

Telephone: Cell phone number available upon request. E-mail is preferred.

Electronic mail: richard.chnigo@uky.edu

I try to reply within one business day, if a response is called for. Please include “STA 623” in the subject line.

Zoom: Besides required check-ins, I am available for Zoom {<https://uky.zoom.us/>} meetings with students upon reasonable request.

Canvas: Course materials will be posted on Canvas {<https://www.uky.edu/canvas/>}. These will include typewritten lecture notes and recorded commentaries, as well as homework assignments, the take-home examinations, and any practice problems that are provided.

Course description

Axioms of probability, conditional probability, distribution functions, density and moment generating functions, expected values, discrete and continuous distributions, joint, marginal, and conditional distributions, transformations, covariance and correlation, inequalities, properties of sums from a random sample.

Course prerequisites

This course is open only to graduate students in Statistics.

Student Learning Outcomes and Course Objectives

The first column shows program-level student learning outcomes for the M.S. program in Statistics. Course objectives are shown in the second column.

Program-Level Student Learning Outcomes	Course Objectives
<p>Graduates of the M.S. program will have demonstrated:</p> <ol style="list-style-type: none">1. an understanding of non-measure theoretic probability and its role in the foundations of inference.2. an understanding of statistical theory at a mathematical level which does not use real analysis or measure theory.3. an ability to apply statistical methods and theory to real data in order to be able to draw valid conclusions.4. an ability to use appropriate computational techniques and software.5. an ability to communicate statistical work and reasoning effectively.	<p>Objectives specific to this course are as follows:</p> <p>A. You will learn how to calculate unconditional and conditional probabilities involving sets that may or may not be explicitly defined in terms of random variables.</p> <p>B. You will learn how to calculate expected values and higher order moments of random variables.</p> <p>C. You will become familiar with commonly encountered parametric families of discrete and continuous distributions as well as the broad classes of exponential and location/scale families.</p> <p>D. You will learn how to define and calculate joint, marginal, and conditional probabilities involving two or more random variables.</p> <p>E. You will become familiar with random sampling and properties of sums of random variables.</p> <p>These objectives are primarily geared toward learning outcomes 1, 2, and 5.</p>

Textbook

The following textbook is required for the course. (Please do not use an illegal pirated version.)

Casella and Berger (2002). *Statistical Inference*, second edition. Pacific Grove, CA: Duxbury.

Course requirements and learner evaluation

Group assessments (homework) and synchronous interactions: You will have four group assessments, which you may think of as homework assignments. I will make an initial assignment of groups, but you are free to change the groups as the semester progresses, as long as groups remain of the same sizes. Actually, I highly encourage you to change the groups as the semester progresses, so that each one of you gets a chance to work at least one time with every other student in the class.

For each of the four homework assignments, each group is to meet with me by Zoom {<https://uky.zoom.us/>} twice: once to ask me questions before the assignment is formally

submitted for grading, and once to go over the formally submitted assignment with me. Specific times for these meetings can be chosen based on convenience and preference of all involved, but the first meeting should be within the 10 days preceding the due date and the second meeting should be within the 7 days following the due date.

The homework assignments will be due at 11:59 p.m. Eastern time on the Thursdays of 03 September, 17 September, 22 October, and 05 November. There will, however, be a 24-hour grace period, within which late homework assignments will be accepted without question or penalty. Submission after the grace period may receive no credit, except for circumstances indicated in the late work policy.

Each group must prepare and is responsible for its own submitted work, although discussing homework assignments with other groups is permitted; if you do discuss a problem with another group, please acknowledge this in your submitted work.

In each group, every group member is expected to work on each problem and to understand the response which is submitted for grading; a “divide and conquer” approach, whereby the different members of a group assume sole responsibility for various problems, is not acceptable. For example, do not assign problem 1 to person A, problem 2 to person B, and problem 3 to person C.

Each group is to submit one set of solutions. In the unlikely event that group members do not come to an agreement on the solution to a particular problem, differing opinions on the solution should still be presented within a single document for the whole group.

Typed submissions (using Latex or Word) are preferred, but neatly handwritten submissions are acceptable. In any case, homework assignments are to be submitted by e-mail. Please include “STA 623” in the subject line of the e-mail.

Individual assessments (examinations) and synchronous interactions: You will have two individual assessments, which you may think of as a midterm and a final examination.

For the first assessment (midterm), you will be given some problems to solve over a timeframe of approximately two weeks. You will meet with me by Zoom twice: once to ask me questions before the midterm is formally submitted for grading, and once to go over the formally submitted midterm with me.

For the second assessment (final), you will again be given some problems to solve over a timeframe of approximately two weeks. You are invited -- but not required -- to meet with me by Zoom before and/or after formal submission of the final.

The midterm and final examinations will be due at 11:59 p.m. Eastern time on Thursday 01 October and Thursday 03 December. There will, however, be a 24-hour grace period, within which a late examination will be accepted without question or penalty. Submission after the grace period may receive no credit, except for circumstances indicated in the late work policy.

The examinations are open-book and open-notes, but they are individual activities. You may not discuss the midterm or final examination with anyone else (until all students have submitted it), except to ask me for clarifications or hints. You may only consult Internet sources which existed before the examination; you may not ask questions in online forums nor create (or ask anyone else to create) a new Internet source.

Typed submissions (using Latex or Word) are preferred, but neatly handwritten submissions are acceptable. In any case, examinations are to be submitted by e-mail. Please include “STA 623” in the subject line of the e-mail.

Grading Components: Each of the four homework assignments will count for 50 points (40 points for the written work, 10 points for the two associated check-ins). The midterm examination will count for 100 points (90 points for the written work, 10 points for the two associated check-ins). The final examination will count for 100 points. Some extra credit opportunities may be offered.

The thresholds will be 90%, 75%, and 60% for “A”, “B”, and “C” respectively. There will not be a “D” grade because this is a graduate course. If a student misses the threshold for an

“A” or a “B” by no more than one percentage point, the final examination will be the primary basis for deciding whether to award the higher letter grade.

Instructor expectations

1. I expect you to listen to all video/audio commentaries (and review the corresponding lecture notes) in a timely manner, generally within one week of what is indicated in the suggested schedule below.
2. Please check the e-mail address under which you registered for the course regularly. As a courtesy, I will add alternate e-mail addresses to my mailing list upon request. You are responsible for all material and announcements conveyed by e-mail; a full mailbox or bouncing of messages by your e-mail provider does not remove this responsibility.
3. You are encouraged to ask questions by e-mail. Besides the required Zoom check-ins, you may request appointments with me on Zoom. Prior permission from me (and from any other attendees, if applicable) is required to record a Zoom meeting.
4. Grading of written work will be based primarily on appropriateness of concept or methodology, technical accuracy or logic, and soundness of conclusions. I may also consider clarity, succinctness, and adherence to appropriate conventions of English language.
5. If you wish to appeal my grading, you may present an appeal in writing. However, this must be done within one week of the time my grading is conveyed.
6. I hope that my lecture notes and video/audio commentaries are valuable and well-received. However, you are also expected to consult corresponding parts of the textbook as needed.

Academic Policies

The student is responsible for being informed concerning all regulations and procedures required by the program of study, College, and University. Students should become familiar with the Graduate School Bulletin (<https://gradschool.uky.edu/graduate-school-bulletin>) and other program-specific materials (e.g., program handbooks) as appropriate. Academic disputes will be addressed in accord with policies contained therein, which are formally incorporated into this document by reference.

The College of Public Health, in which I also have an appointment, has compiled several standard policies at <http://www.uky.edu/publichealth/student-resources/academic-policies>. Policies that are available include:

- Academic Integrity
- Accommodations Due to Disability
- Religious Observances
- Inclement Weather
- Excused Absences Policy
- Verification of Absences
- Student Resources

Late work policy

Cases involving the following will be handled individually: excused absences (including religious observances), University-prescribed academic accommodations, and recommendations for special consideration from the office of an appropriate Dean or the Ombud. Otherwise, apart from 24-hour grace periods where mentioned above, late work may not be accepted for credit.

Note: I understand that life has been altered because of COVID-19. If you have difficulty keeping up for any reason related to COVID-19, please let me know. While I won't promise in advance to agree to every request that is made of me, I will try to be reasonable in accommodating students' needs.

Course schedule and topics

In listening to video/audio commentaries, please try to stay within one week of this suggested schedule.

Objective 1: You will learn how to calculate unconditional and conditional probabilities involving sets that may or may not be explicitly defined in terms of random variables.

Tuesday 18 August. Set theory.

Thursday 20 August. Basics of probability theory.

Tuesday 25 August. Conditional probability and independence.

Thursday 27 August. Random variables.

Tuesday 01 September. Distribution functions.

Thursday 03 September. Density and mass functions.

Objective 2: You will learn how to calculate expected values and higher order moments of random variables.

Tuesday 08 September: Distributions of functions of a random variable.

Thursday 10 September: Expected values.

Tuesday 15 September: Expected values, continued.

Thursday 17 September: Moments and moment generating functions.

Tuesday 22 September: Moments and moment generating functions, continued.

Objective 3: You will become familiar with commonly encountered parametric families of discrete and continuous distributions as well as the broad classes of exponential and location/scale families.

Thursday 24 September: Discrete distributions.

Tuesday 29 September: Discrete distributions, continued.

Thursday 01 October: Continuous distributions.

Tuesday 06 October: Continuous distributions, continued.

Thursday 08 October: Exponential families.

Tuesday 13 October: Location and scale families.

Thursday 15 October: Inequalities and identities.

Objective 4: You will learn how to define and calculate joint, marginal, and conditional probabilities involving two or more random variables.

Tuesday 20 October: Joint and marginal distributions

Thursday 22 October: Joint and marginal distributions, continued.

Tuesday 27 October: Conditional distributions and independence.

Thursday 29 October: Bivariate transformations.
Tuesday 03 November: [Presidential election]
Thursday 05 November: Covariance and correlation.
Tuesday 10 November: Multivariate distributions.
Thursday 12 November: Inequalities.

Objective 5: You will become familiar with random sampling and properties of sums of random variables.

Tuesday 17 November: Basic concepts of random samples.
Thursday 19 November: Sums of random variables from a random sample.

Additional topics: Students are asked to listen to video/audio commentaries on these topics as well, although these topics will not be directly tested in STA 623.

Tuesday 24 November: Differentiating under the integral sign.

Class Recording Notification

The University of Kentucky Student Code of Conduct defines Invasion of Privacy as using electronic or other devices to make a photographic, audio, or video record of any person without their prior knowledge or consent when such a recording is likely to cause injury or distress.

Meetings of this course may be recorded. All video and audio recordings of lecturers and class meetings, provided by the instructors, are for educational use by students in this class only. They are available only through the Canvas shell for this course and are not to be copied, shared, or redistributed.

As addressed in the Student Code of Conduct, students are expected to follow appropriate university policies and maintain the security of linkblue accounts used to access recorded class materials. Recordings may not be reproduced, shared with those not enrolled in the class, or uploaded to other online environments.

If the instructor or a University of Kentucky office plans any other uses for the recordings, beyond this class, students identifiable in the recordings will be notified to request consent prior to such use. In anticipation of such cases, students may be asked to complete an "authorization of use" form by a faculty member.

Video and audio recordings by students are not permitted during the class unless the student has received prior permission from the instructor. Any sharing, distribution, and or uploading of these recordings outside of the parameters of the class is prohibited. Students with specific recording accommodations approved by the Disability Resource Center should present their official documentation to the instructor.

All content for this course, including handouts, assignments, and lectures are the intellectual property of the instructors and cannot be reproduced or sold without prior permission from the instructors. A student may use the material for reasonable educational and professional purposes extending beyond this class, such as studying for a comprehensive or qualifying examination in a degree program, preparing for a professional or certification examination, or to assist in fulfilling responsibilities at a job or internship.

Other Course-Related Information

Occasionally, unforeseen contingencies may arise. Instead of trying to provide a document that is loophole-free, I will simply augment what is already written with the following: if an unforeseen contingency arises that requires a new policy, or if some clarification is warranted, then I will make an appropriate announcement.

Face Covering / Distancing

Although not directly applicable to this fully online course, I am including the recommended language on face covering / distancing, as an extra reminder for everyone to be cautious because of COVID-19.

- In accordance with University guidelines, students must wear UK-approved face coverings in the classroom and academic buildings (e.g., faculty offices, laboratories, libraries, performance/design studios, and common study areas where students might congregate). If UK-approved face coverings are not worn over the nose and mouth, students will be asked to leave the classroom.
- Students should complete their daily online wellness screening before accessing university facilities and arriving to class.
- Students should not move chairs or barriers in classrooms and should socially distance at all times, leaving a six (6) foot radius from other people. Masks and hand sanitizer can be found {specific location in building} if needed.
- Students should leave enough space when entering and exiting a room. Students should not crowd doorways at the beginning or end of class.
- The instructor may choose to remove a mask when pedagogically necessary at the front of the classroom and behind a clear barrier. The instructor's mask will be replaced when it is no longer necessary to have it removed, or when the class meeting is complete.