2020

STAT 463: Introduction to Mathematical Statistics II - A Peer Review of Teaching Portfolio

Qi Zhang

Objective of Peer Review Course Portfolio

STAT 463 (Introduction to Mathematical Statistics II: Statistical Inference) is the second part of the two-semester sequence on mathematical statistics. The goal of this portfolio is to elaborate the author's thought on the goal of the course, planned changes in the teaching method, and analyze the student performance, despite the fact that the course was disrupted by university closure due to pandemic.

Course Description

Context and Enrollment

STAT 463 is the second part of the two-semester sequence on mathematical statistics, and entitled "Introduction to Mathematical Statistics II: Statistical Inference". Its prerequisite is receiving C or above in the first half of the sequence STAT 462 "Introduction to Mathematical Statistics I: Distribution Theory", which in turns prerequires Calculus III (e.g., MATH 208 or MATH107H). It also serves as the prerequisite for some advance courses in actuarial science. It is by far the most advanced mathematical statistics course that the statistics department offers to undergraduate students. It is required by Actuarial Science major and de facto required by Statistics minor. We do not have an undergraduate major program in statistics yet.

We usually offer two sections in each spring with 50-70 students in each. The majority of these students are juniors majoring in actuarial science or mathematics with statistics minor. Since they have survived Calculus III and STAT 462, their mathematical background is good overall. But their background in statistics varies significantly as not all of them have taken STAT 380, even though it is strongly recommended for STAT 462.

Course Goal and Objectives

The students are expected to comprehend the concepts in statistics with certain mathematical sophistication, reason with these concepts critically, make decisions based on numerical evidence with statistical rigor, and elaborate their statistical thinking process with their peers effectively. In particular, there are the following objectives.

1. Students will illustrate their understanding of the maximum likelihood principle and the methods of moments for parameter estimation, and be able to apply these methods to solve real data problems.
2. Students will be able to state a hypotheses testing problem, elaborate the practical implications of its Type I and Type II errors, and make statistically rigorous decisions using the hypothesis testing methods for the given significance level.
3. Students will appreciate the uncertainty in estimation, understand the concept of confidence interval, and estimate the quantity of interests with uncertainty by calculating confidence interval from the given data or summary statistics.

4. Students will be able to translate a real life problem to a statistical problem (e.g., estimation, hypothesis testing) that is solvable if appropriate data are collected. If such dataset is given, they will be able to apply statistical techniques to solve their problems, and communicate their model assumptions, reasoning, and conclusions to their peers.

Teaching Methods

Teaching Methods

The lectures are given twice a week, 75 minutes each. An incomplete lecture notes is posted on CANVAS before each chapter, and the students need to print it and bring to classroom. The instructor puts a copy of incomplete lecture note under document camera which projects the notes to a big screen, and fills the blanks in the notes in front of the students. The students are expected to complete their lecture notes in class. The blanks in the incomplete lecture notes are key components of the theorems and conclusions to be delivered, and the solutions of example questions. Some of these examples could have very long solutions. Essentially, this is similar to the conventional teaching method where the instructor simply presents mathematical contents on white board. The filled lecture notes will not be posted on CANVAS.

Each section of the lecture notes always start with a motivating example, and the main theorem, followed by several examples. However, due to the nature of the materials, one section does not necessarily aligned with one lecture. During the lectures and before presenting a main theorem, the instructor may present additional motivating examples and insights that are not in the lecture notes. When working on an example, the instructor may ask the whole class a pop question to complete a simple step. When there are many examples that are similar to each other, after presenting one such example, the instructor may ask the students complete the next example by following the workflow in the example that is just presented. If time allows and if the example is not too complicated, the instructor may even ask a student to present their solution.

Occasionally, the instructor also gives pop quiz at the end of some sections. The nature of these quizzes is explaining a concept or working out a simple example. They are usually graded based on participation.

There are also in-class group activities. The students are assigned groups of 3-4 students, and they need to sit together during lectures. The group activities are on solving problems and R coding. When they are working on group activities, the instructor walks around the classroom to encourage discussions, and provide additional help if needed.

Course activities

There are 3 exams, and no final. The exams are closed book/notes, and the students can only use basic calculators. Each exam covers 4-5 weeks of materials. But the content of this class

naturally accumulates. Thus there are overlaps in coverage. The students need to solve problems by hand in the exam. The problems are similar to the lecture notes examples and homework questions.

Homework are the main exercises for the students outside of classroom. There are about 8 homework, and the students usually have one week to complete it. Some of the homework questions are from the textbook, while the others are not. The students are free to use any materials or to discuss with anyone to complete their homework, but they need to submit their own copy. The homework is graded partially by completeness and partially by accuracy, because they are too long for the graders if being completed graded by accuracy.

The students need to sign up for a recitation section for this class. The recitations are led by undergraduate TAs who were successful in this class in previous years. They help the students with homework questions, and may provide reviews for the exam and help in R coding.

There are also group assignments outside classroom. These assignments are usually on completing a written summary of reading assignment, and R coding for solving a problem. Their grading will take into account group participation, i.e., the groups with inefficient communication between members may get a lower grade.

One special type of group assignment is a term project. The project requires the students to apply their conceptual, mathematical and coding skills to solve a real-life problem. Each group will give a short presentation at the end of the semester.

Course materials

Course materials used in this class includes textbook, lecture notes, and occasionally supplementary reading materials. The lecture notes is the backbone of the class. The textbook is used more as a reference and resource of examples and exercises.

Rationale for teaching methods and course activities

The main goals of this course are conceptual understanding and problem solving. Problem solving skills could serve as a way of evaluating their conceptual understanding. In this class, the students observe my workflow for solving a problem when I complete an example in the lecture notes, then practice the workflow by themselves during lectures, and through completing the homework. Hopefully, these repeated practices will enhance their conceptual understanding of the rationale of the workflow. Finally, they are evaluated in exams in terms of how well they can solve similar problems.

Conceptual understanding is an objective that is hard to be evaluated. Another aspect of it is how well the students can communicate the statistical/mathematical ideas. Given the large class size (50-80 students), the most cost-effective way of evaluating the success of statistical communication is through group activities and presentations. It is expected that the groups with

better outcomes in group activities also have smoother within-group communications and better conceptual understanding of the class content.

In the era of data science, the students need to understand that problem solving is beyond solving a mathematical problem, and learn how to apply their conceptual understanding in real world problems. One way to achieve these goals is through the practice of solving a real world problem, and programming is inevitably a part of it. The students will gain skills in R programming through the R group activities in-class and outside the classroom, and exercise it in the term project.

Main difference from previous year

In this year, I improved the implementation of in-class activities, and fully integrated R computing as this class.

Transition to online

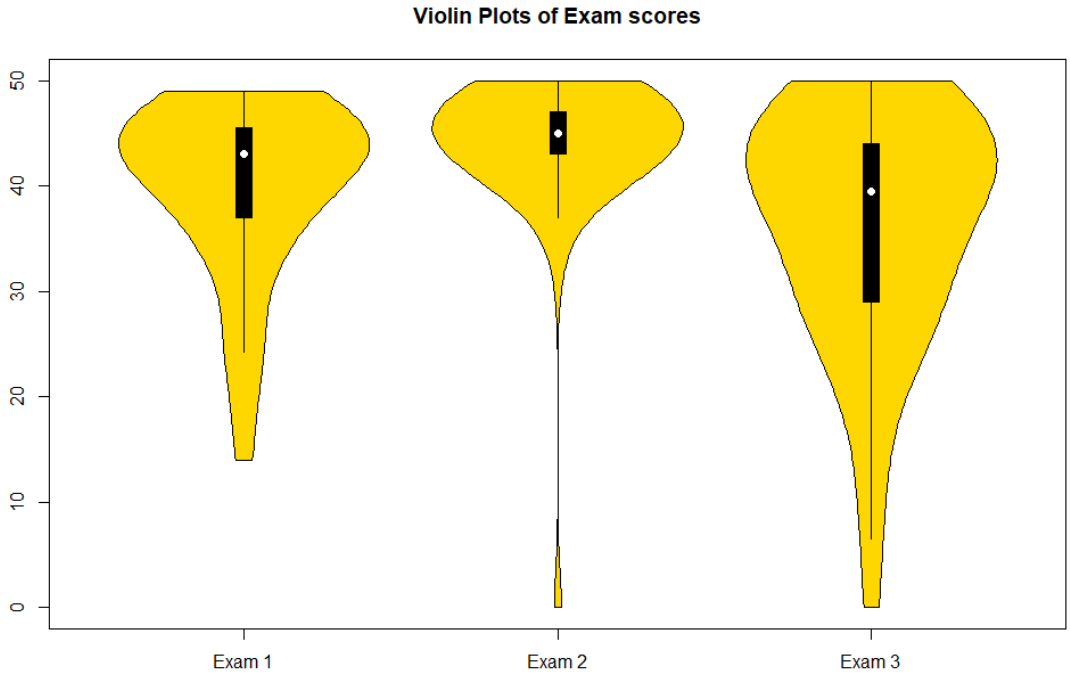
As UNL transitions to virtual learning, the real-time interaction between the instructor and the students and among the students would be lost due to the large class size and the limitation of internet bandwidth. With this expectation, I decided to upload pre-recorded short videos for lectures instead of holding real-time lectures. It would provide additional flexibility for those who may have unexpected challenges or responsibilities, and allow the students to follow the lecture for more than once. It also allowed me to remake the videos if the first attempt was not satisfactory. Then I held virtual office hours at the scheduled lecture time to answer questions. The recitation TAs held their virtual recitations in real-time. But they also emailed to students to collect questions ahead of time. For this class, the exams are usually closed-book exams allowing one page formula sheet. They do not have multiple choices, and are mostly short answers including formulas and hand calculations. After transitioning to online learning, we held the exams in real-time. I uploaded the exam questions to CANVAS as an assignment, and the students submitted their scanned answers to CANVAS. It worked well in the sense that it did not require high internet bandwidth, and all students submitted their works on time. The drawback is that it was difficult to enforce any academic integrity policy. Partially for this reason, the exams become open-book exams to reduce the potential gain of academic dishonesty.

Analysis of Student Learning

The quizzes and other in-class activities are largely participation based, and the students got a lot of help from the recitation TAs for homework. Thus the exam scores are the only assignment that differentiates the students.

Usually there are three exams throughout the semester, each of which is worth 50 points, and no final for this course. Comparing the exam scores between different cohort or different

exams if not a reliable measure of learning, this is because the materials and the difficulty levels of different exams are naturally different.



The above Violin plots show the distributions of the scores of the three exams in this semester. The class medians of the three exams are 43, 45 and 40. In comparison, they were 33, 37 and 32 for the last cohort taught by myself in last year. Exam 1 took place before UNL's response to COVID19. Thus it was not affected by it. Its high score could be partially due to the fact that the questions this year appeared to be easier from the students' perspective. It is also fact that the students in this cohort illustrated better understanding of the materials. Nevertheless, we would have expected the medians of the other two exams to be below 40 if they were held in classroom.

Mathematical statistics is a hard topic. Many students tried really hard but still cannot grasp the basic principles, while many other students are naturally more experienced in it. On top of it, there are variations in the difficulty level of each exam. Thus class average/median is not the best measure of class performance. From the educators' perspective, on measure of success is reducing the variation among the student performance by bringing the below-average students closer to the above average students (while still maintaining reasonable high class average). I used interquartile range (IQR), i.e., the difference between the 75% and 25% quantiles, to quantify the variation among the students. I considered a low IQR (with reasonably high class average) as a success of overall student learning, as it indicated the majority of the students illustrated an acceptable level of understanding. It is also a more robust measure for comparison among different exams as it has been internally "normalized". In this year, the IQRs of the three exams are 8.5, 4 and 15. In comparison, they were 20, 15 and 21 last year. I observed clear

evidence that the performance of the students is more homogeneous in this year than in last year, at least in the first two exams. Interestingly, Exam 1 took place before the university closed, Exam 2 took place in the first week after the university closed, covering the materials taught in-person as planned, and only Exam 3 covered the materials learned virtually. We observed 11.5 and 11 points deduction in IQR for the first two exams, but only 6 points deduction in Exam 3. It suggested that the implementation of the proposed changes in in-person teaching method worked, but it did not have much carryover effect after transitioning to virtual learning.

This result also suggested some students were hit disproportionally hard after UNL closed. One natural hypothesis is that maybe the below average students are more likely to suffer more after the transition. Thus I measured the pre-pandemic performance of each student using the sum of their first two exams, and their post/pre-pandemic difference using the difference of Exam 3 score and Exam 2. Only Exam 2 was subtracted from Exam 3 score, as it was also open-book, while Exam 1 is close book. The scatter plot did show some positive trend, and many outliers. But the correlation was about 0.2, and the linear model analysis was not significant (p-value=0.168). I remark that regardless, it is difficult to determine whether those who performed worse after UNL closed were underprepared for virtual learning itself, or distracted by the pandemic damage in other aspects of their lives.

Reflection on the course and Summary

Overall, the students' performance in this course in this year was good, and better than in the cohort I taught last year. This suggested that carefully planned in-class and group activities and integrated R activity do improve students' illustrated understanding of the materials.

In the future, I would like to re-think about the homework and course project. Based on the student feedback, homework could have been more streamlined to encourage learning, and the team-based course project was not very helpful. The latter may be partially due to the pandemic situation, and it was difficult to reach teammates in a different time-zone.

A second aspect is to rethink the goal of this course. Most students in this course are from actuarial science and math. Thus this course has more "service" mentality, and I focused on helping the majority of the students to pass. The next level challenge would be how to further inspire the very top students to pursue graduate school in statistics/data science through modernization of the course materials.

At last but not least, with all uncertainties ahead, I have to think about how to encourage student engagement, and implement in-class activities and group activities for a relatively large class (50-70 students) in a virtual learning environment or in classroom with social distancing. How to help the students to get to know each other better and feel comfortable talking to each other for their group assignment? It is also important to identify and reach out to those who start disengaging in the class before it is too late.

Appendix

Original Syllabus

Updated Syllabus after transitioning to virtual learning

Statistics 462 Fall, 2018

Introduction to Mathematical Statistics I: Distribution Theory

Instructor: Dr. Qi Zhang

Office: 354C Hardin Hall North Wing

email: qi.zhang@unl.edu

Office Hours: 2:30 - 4:00 Tuesday; 9:30 - 11:00 Thursday; other times by appointment

Textbook: *Mathematical Statistics with Applications*, 7^{th} edition; Wackerly, Mendenhall and Scheaffer, 2008.
The student solution manual is on reserve in the Math Library in Avery Hall.
We'll be using the same book next semester–don't sell it back!

Other References: *Introduction to Probability and Mathematical Statistics*, 2^{nd} edition; Bain and Engelhardt, 1992.
Introduction to Mathematical Statistics, 5^{th} edition; Hogg and Craig, 1995.
Introduction to Probability Theory and Statistical Inference, 3^{rd} edition; Larson, 1982.

Prerequisites: MATH107H or MATH208 (Calculus III), or the equivalent.

Course Goals: This course will prepare you for future coursework in statistics. In addition to learning basic distribution theory, you will learn to think and reason statistically. My role as the instructor is to facilitate this type of learning by providing you with a variety of meaningful activities and opportunities to learn, as well as creating an environment conducive to learning. This will manifest in a variety of ways: group work, direct instruction, individual practice, exploration and discovery activities, writing, discussions and/or student-led instruction. The course is structured for understanding as opposed to mere memorization. Ultimately, **you are responsibile for your own learning**, so please put into the class what you hope to get out of it.

Course Expectations: In this course, you are expected to have professional behavior. You are expected to attend all class meetings, be curious, ask questions, seek opportunities to learn, and be open and responsive to constructive feedback. In addition:

* Be an active participant–statistics is not a spectator sport!
* Be committed, take your work seriously
* **Engage** with the in-class activities and homework sets
* Help others–if you understand the material being discussed, practice your mentoring skills. **This does not means sharing answers**, but instead helping others understand the concepts.
* Complete assigned readings

You are also expected to exhibit a professional demeanor (language, attitude) toward others. Disagreement during discussions is welcome and often productive in developing a deeper understanding of the concepts being discussed. However, disagreement does not warrant yelling or disrepectful language or behavior. Unprofessional behavior will not be tolerated, and appropriate actions will be taken to prevent future occurrences.

Grading:

Homework	10%	Exam 1	20%
Participation	10%	Exam 2	25%
Recitation	10%	Exam 3	25%

Grading Scale:

Grade	Final Percentage Range
A	94.0-100
A-	90.0-93.99
B+	88.0-89.99
B	84.0-87.99
B-	80.0-83.99
C+	78.0-79.99
C	74.0-77.99
C-	70.0-73.99
D+	68.0-69.99
D	64.0-67.99
D-	60.0-63.99
F	<60.0

Homework: Approximately 8-10 homework assignments will be made over the course of the semester. You will typically have one week to work on each of the assignments. The only way to learn statistics is to practice working problems, and homework is therefore an essential part of the course. Homework is due at the **beginning of class** on the due date, and late homework should be avoided in all but the most dire emergencies. If this policy is abused, it will be changed to "No late homework will be accepted." (TIP: Last year, this policy WAS changed.) If you opt to submit your homework via email, it must be typed (not scanned or photos of handwritten work). Homework will be graded partially on completenes and partially on accuracy. Bear in mind that homework is for your benefit, not the instructor's. When you have read this syllabus all the way through, email me a picture of a dinosaur.

Participation: Critical thinking is an integral component of the course. To help you develop your critical thinking skills and better understand some of the ideas presented this semester, you will be asked to do some in-class writing assignments and activities. These writing assignments may include 'minute' essays, a summary of the lecture, or others. Because these writing activities are designed to assist in your learning, rather than to demonstrate what you have learned, these assignments will be graded on a participation basis. From time to time, you will also complete in-class 'discovery exercises.' These will typically involve group work. These assignments may (but will not necessarily) be graded on a participation basis. They also may require additional work outside of class in preparation for the following class.

Recitation: All STAT 462 students must be enrolled in a recitation section. Recitation will give you a chance to work additional practice problems and receive more one-on-one help. Through recitation activities, you will hopefully gain a 'big-picture' view of the STAT 462 material. Recitation may include group simulation and problem-solving activities, the introduction of statistical software and discussion. Please reference the recitation syllabus for more information.

Calculators: We will be using a great deal of calculus in this course. While I realize that many calculators will do the calculus we'll use, such calculators will **NOT** be permitted

on exams. This is for your own good – you can't use the calculators on the actuarial exam either. Don't get too reliant on them for homework!

Writing Assignment: Written communication is an essential part of any job. To help you get used to writing about statistics, as well as to reinforce and assess understanding of class concepts, you will assigned a formal writing project. More details on the writing assignment will be distributed later.

Exams: Three in-class exams will be given during the course of the semester, on 21 September, 2 November, and 30 November. These exams are closed book and notes. The exams will evaluate your understanding of the material, as well as your ability to synthesize and transfer that knowledge to other scenarios and situations; questions will assess conceptual understanding as opposed to mere memorization.

You are expected to take exams at the scheduled times. If this is impossible due to extreme circumstances (illness, death in the family, previously scheduled activities vital to academic program), please notify me and provide appropriate documentation. No make-up exams will be given if I am not notified prior to the examination. You will be required to obtain a note from your physician or advisor explaining the nature of the conflict.

Discussion Board: Canvas has discussion board forums where you can access and ask questions about homeworks, exams, etc. A new thread for each homework, exam, etc. will be created in its respective forum. Questions about homework problems, exam material, etc. should be posted as replies to the corresponding thread. I will answer your questions by replying to your posts. I will not respond to emails containing homework questions.

Academic Dishonesty: You are encouraged to work together on problems and discovery exercises, but the work you turn in must be your own (unless the assignment specifically states otherwise). Work on exams must be your own. Any act of academic dishonesty will result in a score of zero on the **entire assignment/exam** and notification of department and university officials. Further action may be taken as warranted. The dinosaur should be a stegosaurus.

Disabilities: Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accomodation. It is the policy of the University of Nebraska–Lincoln to provide flexible and individualized accomodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accomodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

Disclaimer: Information contained in this syllabus was, to the best knowledge of the instructor, considered correct and complete when distributed at the beginning of the term. However, this syllabus should not be considered a contract between UNL and any student. The instructor reserves the right, acting within the policies and procedure of UNL, to make changes in course content or instructional technique without notice or obligation.

TENTATIVE COURSE OUTLINE

Week	Day	Topic	Book Section(s)
August. 20	Tues	Introduction to Statistics; Probability Basics	1.1-1.6, 2.1-2.5
	Thurs	Probability; Counting	2.6-2.8
August. 27	Tues	Conditional probability; Bayes' Theorem	2.7, 2.10
	Thurs	Bayes' Theorem; Independence	2.8-2.10
September. 3	Tues	Random variables; CDFs	2.11-2.13, 3.1-3.2, 4.1-4.2
	Thurs	Density and mass functions	3.2, 4.2
September. 10	Tues	Expected values; Moments; Variance	3.3, 3.9, 4.3, 4.9
	Thurs	MGFs	3.9, 4.9, 6.5
September. 17	Tues	Review; MGFs	6.5
	Thurs	EXAM 1	
September. 24	Tues	Discrete Distributions	3.1-3.9, 3.12
	Thurs	Discrete Distributions	3.1-3.9, 3.1
October. 1	Tues	Continuous distributions	4.1-4.9, 4.12
	Thurs	Continuous distributions	4.1-4.9, 4.12
October. 8	Tues	Multiple RVs; Marginals; Independence	5.1-5.6
	Thurs	Multiple RVs; Marginals; Independence	5.1-5.6
October. 15	Tues	FALL BREAK	
	Thurs	Conditional distributions/densities; Conditional expectations	5.3, 5.11
October. 22	Tues	Covariance; Correlation	5.7-5.8, 5.12
	Thurs	Bivariate normal distribution; multinomial distribution	5.9-5.10
October. 29	Tues	Review; Catch-Up	
	Thurs	EXAM 2	
November. 5	Tues	Transformations	6.1-6.4
	Thurs	Transformations	6.1-6.4
November. 12	Tues	Bivariate transformations	6.5-6.6,6.8
	Thurs	Random Samples; Sampling from a Normal Distribution	7.1-7.2, 7.6
November. 19	Tues	Sampling from a Normal Distribution	7.1-7.2, 7.6
	Thurs	THANKSGIVING BREAK	
November. 26	Tues	Sampling from a Normal distribution; Review	7.1-7.2, 7.6
	Thurs	EXAM 3	
December. 3	Tues	Sampling from a Normal Distribution; CLT	7.1-7.4, 7.6
	Thurs	CLT	7.3-7.4

Statistics 463 Spring, 2020

Introduction to Mathematical Statistics II: Statistical Inference

Instructor: Dr. Qi Zhang

Office: 354C Hardin Hall North Wing, East Campus

Email: qi.zhang@unl.edu

Office Hours: 2:00-3:00 Wednesdays, 1:45-2:15 Tuesdays and Thursdays; or by appointment (generally available 10:30-11:30 on Thursdays)

Textbook: *Mathematical Statistics with Applications*, 7^{th} edition; Wackerly, Mendenhall and Scheaffer, 2008.

Other References: *Introduction to Probability and Mathematical Statistics*, 2^{nd} edition; Bain and Engelhardt, 1992.
Introduction to Mathematical Statistics, 5^{th} edition; Hogg and Craig, 1995.
Statistical Inference, 2^{nd} edition; Casella and Berger, 2002

Prerequisites: STAT 462; MATH107H or MATH208 (Calculus III), or the equivalent

Course Goals: This course will prepare you for future coursework in statistics. In addition to learning basic distribution theory, you will learn to think and reason statistically. My role as the instructor is to facilitate this type of learning by providing you with a variety of meaningful activities and opportunities to learn, as well as creating an environment conducive to learning. This will manifest in a variety of ways: group work, direct instruction, individual practice, exploration and discovery activities, writing, discussions and/or student-led instruction. The course is structured for understanding as opposed to mere memorization. Ultimately, **you are responsible for your own learning**, so please put into the class what you hope to get out of it.

Course Expectations: In this course, you are expected to have professional behavior. You are expected to attend all class meetings, be curious, ask questions, seek opportunities to learn, and be open and responsive to constructive feedback. In addition:

* Be an active participant–statistics is not a spectator sport!
* Be committed, take your work seriously
* **Engage** with the in-class activities and homework sets
* Help others–if you understand the material being discussed, practice your mentoring skills. **This does not means sharing answers**, but instead helping others understand the concepts.

Grading:

Homework	12%	Exam 1	23%
Project	5%	Exam 2	23%
Participation	12%	Exam 3	17%
Recitation	8%		

Grading Scale:

Grade	Final Percentage Range
A	94.0-100
A-	90.0-93.99
B+	88.0-89.99
B	84.0-87.99
B-	80.0-83.99
C+	78.0-79.99
C	74.0-77.99
C-	70.0-73.99
D+	68.0-69.99
D	64.0-67.99
D-	60.0-63.99
F	<60.0

Homework: Approximately 8-10 homework assignments will be made over the course of the semester. You will typically have one week to work on each of the assignments. The only way to learn statistics is to practice working problems, and homework is therefore an essential part of the course. Homework is due at the **beginning of class** on the due date, and **late homework will not be accepted** unless due to the most dire emergencies. Both handwritten and typed homework are acceptable. No email submission! Canvas submission is welcomed! Homework will be graded partially on completeness and partially on accuracy. Bear in mind that homework is for your benefit, not the instructor's.

Participation: Critical thinking is an integral component of the course. To help you develop your critical thinking skills and better understand some of the ideas presented this semester, you will be asked to do some in-class writing assignments, quizzes and activities. These assignments may include 'minute' essays, a summary of the lecture, or others. Because they are designed to assist in your learning, rather than to demonstrate what you have learned, these assignments will be graded on a participation basis. **There is no make-up participation unless in the most extreme circumstances.**

Group Assignment: Some in-class activities are group activities. It means that you should discuss with your teammates. **But you need to turn in your own work.** The teams will be assigned randomly by the end of the second week, after the deadline for enrolling or dropping classes. **The students in the same group will sit together at the assigned seats throughout the semester.**

R programming: Some in-class activities and homework will involve programming in the statistical analysis software R/Rstudio. The goal of these activities is to verify the formulas/math we have learned using computer simulations. At least one student in each team needs to bring a computer to the classroom when it is required for the in-class activity. R/Rstudio could be installed on Windows/MacOS/Linux. There is also a cloud-based version that you can access through web browser without installing any software (but you need to register a free account). See my R guide for details.

Recitation: All STAT 463 students must be enrolled in a recitation section. Recitation will give you a chance to work additional practice problems and receive more one-on-one help. Through recitation activities, you will hopefully gain a 'big-picture' view of the STAT 463 material. Recitation may include group simulation and problem-solving activities and discussion.

Exams: Three in-class exams will be given during the course, on **Thursday, 13 February; Thursday, 19 March; Thursday, 23 April**. Exams are closed book and notes. **Graphing calculators (e.g., TI-84 or above) are NOT allowed in exams. One page (A4 size, one-sided) formula sheet is allowed. You must write your name on it and turn it in. No staples/tape/glue. Bringing more than one pages, two-sided or larger sheets will be considered as violation of the exam rules. No earplugs, and cellphones and smart watches must be stored out of reach**, e.g., in your bag placed in front of the classroom. Not in your pocket, not on the table. You are expected to take exams at the scheduled times. If this is impossible due to extreme circumstances (illness, death in the family, previously scheduled activities vital to academic program), please notify me and provide appropriate documentation. No make-up exams will be given if I am not notified prior to the examination. You will be required to obtain a note from your physician or adviser explaining the nature of the conflict.

Project: You will be completing a project which will include programming and written component. More details on the project will be distributed later.

Academic Dishonesty: You are encouraged to work together on problems and discovery exercises, but the work you turn in must be your own (unless the assignment specifically states otherwise). Work on exams must be your own. Any act of academic dishonesty will result in a score of zero on the **entire assignment/exam** or even the **entire course** and notification of department and university officials. Further action may be taken as warranted according to Student Code of Conduct (https://studentconduct.unl.edu/student-code-conduct).

ADA Statement: The University strives to make all learning experiences as accessible as possible. If you anticipate or experience barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can discuss options privately. To establish reasonable accommodations, I may request that you register with Services for Students with Disabilities (SSD). If you are eligible for services and register with their office, make arrangements with me as soon as possible to discuss your accommodations so they can be implemented in a timely manner. SSD contact information: 232 Canfield Admin. Bldg.; 402-472-3787

Emergency Preparedness: If the Fire Alarm is activated, exit the building by the nearest safe exit. If it is a weather emergency, follow the instructions for your building. For other emergency situations, consider the following
(1) If immediate evacuation seems to be the best option, direct students to the closest exits away from the source of the emergency. Students should hold hands in the air when exiting the building.
(2) If immediate evacuation does not appear to be safe or feasible, consider one of these options
A. If you room has a solid door with a lock, lock the door. If there is a second door in the room, also lock that door. Turn off the lights. Have students get low and away from the door. Have everyone silence their cell phones and stay quiet
B. If the room is unable to be locked, consider whether a door that opens inward can be blocked.
C. If the room is unable to be locked or the door blocked, consider having personnel

hide in locations where appropriate.
When the emergency is over and the group is exiting, remind everyone to move slowly and hold their hands in the air.

Disclaimer: Information contained in this syllabus was, to the best knowledge of the instructor, considered correct and complete when distributed at the beginning of the term. However, this syllabus should not be considered a contract between UNL and any student. The instructor reserves the right, acting within the policies and procedure of UNL, to make changes in course content or instructional technique without notice or obligation.

TENTATIVE COURSE OUTLINE

Note: there will be assignments due additional to the regular homework listed below.

Week	Day	Topic
Jan. 13	M (Recitation)	Review sampling distributions, useful for HW1
	Tues	STAT 462 Wrap-Up; Order statistics
	Thurs	Order statistics
Jan. 20	M (Recitation)	Martin Luther King Day
	Tues	**HW1 due.** Introduction to point estimation, method-of-moments
	Thurs	method-of-moments
Jan. 27	M (Recitation)	Homework 2 discussion
	Tues	**HW2 due.** Maximum likelihood estimators
	Thurs	Maximum likelihood estimators
Feb. 3	M (Recitation)	Homework 3 discussion
	Tues	**HW3 due.** Maximum likelihood estimators (R Activity)
	Thurs	Evaluating estimators
Feb. 10	M (Recitation)	Practice problem 1 discussion
	Tues	Review
	Thurs	**EXAM 1**
Feb. 17	M (Recitation)	R activity on evaluating estimators
	Tues	Sufficiency
	Thurs	Sufficiency and completeness
Feb. 24	M (Recitation)	Homework 4 discussion
	Tues	**HW4 due.** Sufficiency, completeness and best estimation
	Thurs	Introduction to hypothesis tests
Mar. 2	M (Recitation)	Homework 5 discussion
	Tues	**HW5 due.** Errors and power, size and level of tests
	Thurs	Errors and power, size and level of tests
Mar. 9	M (Recitation)	Homework 6 discussion
	Tues	**HW6 due.** Errors and power, size and level of tests
	Thurs	Likelihood ratio tests
Mar. 16	M (Recitation)	CANCELED
	Tues	CANCELED
	Thurs	CANCELED
Mar. 23		SPRING BREAK
Mar. 30	M (Recitation)	Practice problem 2 discussion
	Tues	**EXAM 2 (online)**
	Thurs	Likelihood ratio tests,Approximate Distribution Theorem for LRTs
Apr. 6	M (Recitation)	Homework 7 discussion
	Tues	**HW7 due.** Likelihood ratio tests,Approximate Distribution Theorem for LRTs
	Thurs	p-values
Apr. 13	M (Recitation)	Homework 8 discussion
	Tues	**HW8 due.** Intro to interval estimation
	Thurs	Inverting test statistics; inverting LRTs
Apr. 20	M (Recitation)	Homework 9 discussion
	Tues	**HW9 due.** Pivotal quantities
	Thurs	Evaluating interval estimates
Apr. 27	M (Recitation)	Practice problem 3 discussion
	Tues	**EXAM 3 (online)**
	Thurs	**Final project written report and video presentation due.**