

**STAT F651: Statistical Theory I; Fall 2022**  
**CRNs 76251 (in-person) and 76252 (zoom); 3 credits**  
Lecture: MWF 10:30-11:30, Chapman 206 and online (zoom)  
(Version date: August 26, 2022)

**Instructor:** Dr. Margaret Short, 201B Chapman Hall

**Contact:** phone: 474-5249, e-mail: mshort18@alaska.edu, mailbox: Chapman 101.  
Email is the best way to get in touch with me.

**Office hours:** Tuesday 10:30-11:30 in-person; Tuesday & Thursday 3:00-4:00 by zoom.  
Other times by appointment.

**Text:** Statistical Inference, 2nd ed., by George Casella and Roger L. Berger. Duxbury Press. We will cover chapters 1–5; see tentative lecture schedule.

**Canvas use:** A course Canvas site has been created for this course. I will post homework assignments, lecture notes, and other handouts there.

**Prerequisites:** Math F253X (Calc III), Math F314 (Linear Algebra), previous statistics course, or permission of instructor. In particular, this course will put to use the calculus you learned in your earlier coursework (differential and integral calculus, as well as multivariable calculus (iterated integrals)).

**Course description:** From the UAF course catalog, this class will cover “probability and distribution of random variables. Conditional probability and stochastic independence. Distributions of functions of random variables. Expected values. Limiting distributions. Distributions derived from the normal distribution. Designed to combine mathematical statistics with applications from a variety of fields.”

**Goals and Expected Learning Outcomes:** Students completing this course will have an understanding of the basics of probability and random variables, and know how to use R statistical software to carry out small simulation experiments. By the end of the course, students will be able to:

- calculate probabilities of events and carry out calculations for random variables (RVs), including expectation and variance.
- define and perform calculations involving density functions and cumulative distribution functions.
- find distributions of functions of RVs.
- calculate moment generating functions and use them to find moments.
- exponential families and location and scale families.
- define joint distributions; find marginal and conditional distributions.
- calculate and interpret covariance and correlation.
- apply properties of random samples, especially sums of RVs.
- work with normal distributions and distributions defined using them (e.g.  $t$  and  $F$  distributions).
- define order statistics and perform calculations for them.
- define convergence of random variables; determine with sequences of RVs converge using a variety of theorems (CLT, Slutsky, etc.)

**Calculator and Computer Use:** The coursework consists almost entirely of hand-calculations, but there will also be a small amount of statistical computing. For the computing, we'll use the software package R, which is available for free at

<http://www.r-project.org/>

We'll discuss what you need to know about R as the need arises. Calculators will not be allowed on in-class exams.

**Grading Policy:** Semester letter grades will be determined by weighting scores for each component (described below) in the following manner:

Homework	35%	
Midterm 1	15%	Friday, September 30, 2020
Midterm 2	20%	Friday, October 28 + takehome handed out
Final exam	30%	<b>Wednesday, Dec. 14, 10:15-12:15 + takehome</b>

Semester letter grades are determined based on these overall scores. Cutoff points may vary from one semester to another based on my perception of the difficulty of the exams. However, course scores are roughly associated with letter grades as follows: 93-100% A, 90-93 A-, 87-90 B+, 83-87 B, 80-83 B-, 77-80 C+, 73-77 C, 70-73 C-, 67-70 D+, 63-67 D, 60-63 D-, <60 F. An incomplete grade is given only at my discretion and should not be assumed. If you are unable to complete the course in a timely fashion, you (or a representative, in cases of emergency) should contact me prior to the end of the current semester.

**Exams:** The first midterm will be in-class only. The second midterm and the final exam will have both an in-class and a take home component. The second midterm and final exam will be comprehensive (cumulative). If you must miss an exam for some reason, please talk to me in advance (even if you are sick); do not presume you may take a late exam. Exam questions may include material from the text, handouts and lecture material. In-class exams will be closed book, closed note, although I may allow a handwritten sheet of notes. I will provide a table of common probability distributions as well as any necessary statistical tables with the exams.

**Homework:** Reading assignments and assigned exercises will be posted on Canvas. Your completed assigned exercises (homework) will be due approximately weekly; due dates will be announced in class. The first submission (not an actual homework assignment) is due on **Friday, September 2**; it will largely be a check to see whether you are able to submit work via electronically.

Homework will be scanned and submitted through the online software, Gradescope. I have posted a help file on Canvas to get you started with Gradescope if you haven't used it before. Homework assignments will be equally weighted, and the lowest score will be dropped. I'll post a deadline for each assignment but have Gradescope allow late submissions (without penalty) for several hours after that. Exceptions will be made on a case-by-case basis, typically only for documented health or university sponsored activities.

You are encouraged to discuss homework solutions with your fellow students, but your written work must be your own. You are also encouraged to ask me about homework problems prior to the due date or after the homework has been graded and returned.

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**COVID-19 statement:** Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website: <https://sites.google.com/alaska.edu/coronavirus/uaf?authuser=0>

Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

**Student protections statement:** UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: <https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/>.

**Disability services statement:** I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities.

**ASUAF advocacy statement:** The Associated Students of the University of Alaska Fairbanks, the student government of UAF, offers advocacy services to students who feel they are facing issues with staff, faculty, and/or other students specifically if these issues are hindering the ability of the student to succeed in their academics or go about their lives at the university. Students who wish to utilize these services can contact the Student Advocacy Director by visiting the ASUAF office or emailing [asuaf.office@alaska.edu](mailto:asuaf.office@alaska.edu).

### **Student Academic Support:**

- Speaking Center (907-474-5470, [uaf-speakingcenter@alaska.edu](mailto:uaf-speakingcenter@alaska.edu), Gruening 507)
- Writing Center (907-474-5314, [uaf-writing-center@alaska.edu](mailto:uaf-writing-center@alaska.edu), Gruening 8th floor)
- UAF Math Services, [uaf-traccloud@alaska.edu](mailto:uaf-traccloud@alaska.edu), Chapman Building (for math fee paying students only)
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, <https://www.ctc.uaf.edu/student-services/student-success-center/>)
- For more information and resources, please see the Academic Advising Resource List ([https://www.uaf.edu/advising/lr/SKM\\_364e19011717281.pdf](https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf))

### **Student Resources:**

- Disability Services (907-474-5655, [uaf-disability-services@alaska.edu](mailto:uaf-disability-services@alaska.edu), Whitaker 208)
- Student Health & Counseling [6 free counseling sessions] (907-474-7043, <https://www.uaf.edu/chc/appointments.php>, Gruening 215)

- Center for Student Rights and Responsibilities (907-474-7317, [uaf-studentrights@alaska.edu](mailto:uaf-studentrights@alaska.edu), Eielson 110)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, [asuaf.office@alaska.edu](mailto:asuaf.office@alaska.edu), Wood Center 119)

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UAF Department of Equity and Compliance

1692 Tok Lane, 3rd floor, Constitution Hall, Fairbanks, AK 99775

907-474-7300

[uaf-deo@alaska.edu](mailto:uaf-deo@alaska.edu)

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Lecture Schedule (approximate) – Stat F651, Fall 2022

Aug.	29	<b>Ch. 1: Probability theory</b>	
		Introduction	1.1
	31	Sigma algebras; Axioms of Probability	1.2.1-1.2.2
Sept.	2	Counting	1.2.3
	5	Labor Day, no class	
	7	Enumerating outcomes	1.3
	9	Conditional probability; Bayes Rule; Independence	1.3
	12	Random variables (RVs)	1.4
	14	Labor Day, no class.	
	16	Cumulative distribution functions (cdfs)	1.5
	19	Density functions (pmfs and pdfs)	1.6
		<b>Ch. 2: Transformations and expectations</b>	
	21	Distributions of functions of RVs	2.1
	23	Continued	2.1
	26	Continued	2.1
	28	Expectation	2.2
	30	<b>Exam 1.</b>	
Oct.	3	Moments and moment generating functions	2.3
	5	Mgf's, continued.	
	7	Differentiating under an integral sign	2.4
		<b>Ch. 3: Common families of distributions</b>	
	10	Discrete distributions	3.1,3.2
	12	Continued	
	14	Continuous distributions	3.3
	17	Continued	
	19	Exponential families	3.4
	21	Location and scale families	3.5
	24	Inequalities and identities	3.6
		<b>Ch. 4: Multiple random variables</b>	
	26	Joint and marginal distributions	4.1
	28	<b>Exam 2 in-class + hand out take home portion.</b>	
	31	Conditional distributions; independence	4.2
Nov.	2	Bivariate transformations	4.3
	4	Hierarchical models; $\mathbb{E}(X) = \mathbb{E}(\mathbb{E}(X Y))$	4.4
	7	Covariance and correlation	4.5
	9	Multivariate distributions	4.6
	11	Inequalities	4.7

Nov.	14	<b>Ch. 5: Properties of random samples</b>	
		Basic concepts of random samples	5.1
	16	Sums of RVs from random sample	5.2
	18	Sampling from normal distributions	5.3
	21	Student's t and Snedecor's F distributions	
	23-25	Thanksgiving – no class	
	28	Order Statistics	5.4
	30	Continued	
Dec.	2	Convergence of distributions: in probability; almost sure	5.5.1
	5	Convergence in distribution; Delta Method (Dorfman)	5.5.2,5.5.3
	7	Generating random samples	5.6
	9	Continued	
	12	Review for final exam (Last day of class)	

**Final Exam: Wednesday, Dec. 14, 2022, 10:15-12:15**