CSI-672: Statistical Inference / Fall 2021

Dr. Kent L. Miller

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Basic Information

About the Instructor	
Name	Dr. Kent L. Miller, Ph.D.
Title	Adjunct Professor
Phone	N/A
Mason email	`kmille60@gmu.edu`
	(Please allow 2 day response M-F)
Website	N/A
Office hours	By appointment

About the Course	
Course title	Statistical Inference
Course number-sec	CSI-672-001
Credit hours	3
Department	Computational Science
	& Informatics
Meeting day/time	T 7:20pm-10pm
Classroom	Innovation Hall 203
Modality	Face-to-face
Prerequisites	STAT 544, min. Grade B-,
	or instructor permission
Required purchase	none
Required text	none
Required freeware	GNU R; and
	TeX Live or Overleaf

Modality

Course instruction is face-to-face for all students. If university authorities so order, instruction will convert to concurrent face-to-face and web-conferencing.

Textbook

No textbook is required. The instructor will prepare a workbook that can be used in class or at home, so that the course can be completed on-line, if university authorities so require. The workbook will contain text, computer code, in-class examples, and assignments. The workbook will be posted one chapter per week on Blackboard.

The instructor recommends a text for any student, for whom the instructor waived the prerequisite course, STAT 544 Applied Probability. Namely, *Statistical Inference*, 2nd edition, 2002, George Casella and Roger L. Berger. Casella *et al* covers two semesters of material. Included is one chapter on probability (prerequisite to this course), several chapters that cover material presented in this course, and two chapters (on regression) that go beyond this course. It may be possible to find a free scanned copy of the book on-line in PDF format.

Software

The student may use either an on-line service, or install the software on the student's platform

On-line service

GNU R is available as an on-line service. See `https://rdrr.io/snippets/`. To save a plot, right-click on the image, and save as a PNG file.

LaTeX is available as an on-line service. See `https://www.overleaf.com/`.

Installation

GNU R can be installed on your platform. Depending on your platform, try one of:

```
https://cran.r-project.org/bin/linux
https://cran.r-project.org/bin/macosx
https://cran.r-project.org/bin/windows
```

LaTeX can be installed on your platform. Try TeX Live which is available from `http://www.tug.org/texlive/acquire-netinstall.html`. Download takes about two and an half hours. Pick a time, such as during the late evening, when the download will not be interrupted.

If you are a thesis student, then you should install GNU R and TeX Live on your own platform. This is a precaution. Sometimes on-line providers go out of business, or are hacked, and then your thesis and years of work are lost.

If you are a scientist, then you should use a Linux distribution. Linux distributions come with tens of thousands

of software packages, including GNU R and LaTeX, and are very easy to maintain.

About the Course

Description of the course

The big picture: Evidence based reasoning is better than the alternatives. Evidence based reasoning proceeds in three steps: first, experiment design and data collection (sampling); second, draw conclusions from the data (statistical inference); and third, report the findings.

Statistical inference is a critical skill to have in a data driven world. It is rare to have the financial and human resourses to examine an entire population (e.g. U.S. Census). More common it is to draw a sample from a population (e.g. clinical trial, market survey, opinion poll); and then, based on the sample, to make inferences about the population (e.g. How effective is our new medication? How many people will buy our new product? Where do voters stand on a particular issue?). One looks for an underlying probability distribution that best explains the sample, and then one uses that distribution to make estimates and to test hypotheses about the population.

The instruction will be handled in a lecture/lab format. Statistical Inference is more than a traditional knowledge transfer course. It also develops hands-on skills with computational tools to help the student solve problems. A student with modest software skills should be able to complete the course on-line, which may be necessary if university authorities so order.

GMU course catalog description:

Statistical Inference. 3 credits. Fundamental principles of estimation and hypothesis testing. Topics include limiting distributions and stochastic convergence, sufficient statistics, exponential families, statistical decision theory and optimality for point estimation, Bayesian methods, maximum likelihood, asymptotic results, interval estimation, optimal tests of statistical hypotheses, and likelihood ratio tests. Offered by Computational & Data Sciences (`http://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/`). May not be repeated for credit. Equivalent to STAT 652.

Course goals and objectives

By the end of the course, students will have learned the concepts of statistical inference, and gained hands-on experience with handling data, drawing conclusions from the data, visualization of data, and typesetting reports as required for masters and PhD theses and for scientific publications.

Grading and Course Requirements

Coursework is weighted as follows:

Coursework	Val	Qty	Max
Homework	5	13	65
Project	15	1	15
Midterm exam	10	1	10
Final exam	10	1	10
Total			100

The instructor does **not** grade on a curve. Numerical grades are cumulative and translate to final letter grades as follows:

A+	97.00–100.00	C+	77.00–79.99
A	93.00–96.99	C	73.00–76.99
A-	90.00–92.99	C-	0.00–72.99
B+	87.00–89.00		
B	83.00–86.99		
B-	80.00–82.99		

Due dates

Assignments must be posted on Blackboard before 12:00 noon the day of the following class or exam. Late assignments will be reviewed but will **not** be graded (see the section on Late Assignments on page 3).

Format

Each assignment states what is deliverable. All deliverables must be prepared in LaTeX (a typesetting software required by many mathematical and scientific journals, and for theses) and submitted in PDF format. How to use LaTeX and how to convert to PDF will be taught in the first week. Students will not need prior knowledge of how to do this. The first homework assignment will be done in class, to be sure that all the software works from end-to-end (GNU R, LaTeX, and Blackboard).

Level of research expected

The level of learning expected from each assignment is as follows:

Coursework	Level
Homework	Mid–High
Project	High
Exams	Low

Here we are using Bloom's Taxonomy.

Level	Skill	Description
High	Creating	Designing, constructing, inventing, devising, ...
	Evaluating	Hypothesizing, judging, checking, critiquing, ...
	Analyzing	Organizing, structuring, outlining, integrating, ...
Mid	Applying	Using, implementing, ...
	Understanding	Summarizing, inferring, interpreting, comparing, ...
Low	Remembering	Recognizing, listing, naming, identifying, ...

Criteria for grading

Coursework	Criteria
Homework	Submit deliverables
Project	Components of research paper
Midterm exam	Correct answers
Final exam	Correct answers

For homework and exams, partial credit for a wrong answer is possible, but only if the student showed the steps in his or her reasoning.

Purpose of each assignment

Coursework	Purpose
Homework	Gain experience with components of statistical inference
Project	Put the components together to write a well formatted research paper
Exams	Test knowledge and understanding

The project is a kind of capstone. The student should meet with the instructor to pick a suitable topic. The instructor would like to see the student dig into something that excites him or her. A thesis student may wish to pick the data analysis part of his or her thesis topic.

Put another way, the assignments assess the following:

Coursework	Assessment
Exams	Do you remember the material?
Homeworks	Can you apply what you learned?
Project	Can you create with what you learned?

General Course Policies

Attendance and participation

Attendance is optional, because university authorities may require the course to be completed on-line. Sta-tistical Inference is not a traditional knowledge transfer course which can be done by reading a text. Some of the course learning objectives involve skills development (e.g. computer programming). In a sense, this course is more akin to an apprenticeship. One learns by doing, with an instructor nearby. That said, a student with computer skills should be able to complete the course on-line.

Late assignments and make up exams

Four grounds for a late assignment will be accepted:

1. the student had a medical emergency, documented with a valid doctor's note;

2. the student is a member of a GMU sports team and was required to participate in an out-of-town game, documented with a valid note from the coach;

3. the student is a member of the armed services and was called up for duty, documented with a copy of the order; and

4. the student required an academic accommodation (see the section on Disability Accommodations on page 4).

Incompletes

The instructor discourages the use of Incomplete. Three grounds for requesting an Incomplete will be accepted:

1. the student had a medical emergency that prevented the student from completing the semester, documented with a valid doctor's note;

2. the student was arrested, deported, detained, or otherwise physically restrained from completing the semester, documented with a valid lawyer's note; or

3. the student is a member of the armed services and was called up for duty, documented with a copy of the order.

To convert the Incomplete to a passing grade, any remaining assignments and exams must be submitted soon after the end of the semester. The University academic calendar states the deadline.

Electronic devices

Some devices not allowed

No cellphones are allowed. Such devices distract both the student and the classmates.

Personal computer allowed

If the student owns a laptop computer, the student may bring it to class. The student may use said laptop in *lieu* of the university's computer. Computers are to be used for coursework only.

Exception for emergencies

Safety first. Nothing in this syllabus prevents the student from using electronic devices in response to an emergency (e.g. to make a 911 call).

University Policies

The Stearns Center for Teaching and Learning recommends all syllabi include the following statements.

Academic integrity

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using the appropriate format for this class. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

Basic course technology requirements

Activities and assignments in this course will regularly use the Blackboard learning system, available at `https://mymason.gmu.edu`. Students are required to have regular, reliable access to a computer with an updated operating system (recommended: Windows 10 or Mac OSX 10.13 or higher) and a stable broadband Internet connection (cable modem, DSL, satellite broadband, etc., with a consistent 1.5 Mbps [megabits per second] download speed or higher. You can check your speed settings using the speed test on this website.)

If university authorities order a "pivot" to on-line instruction, then the following will apply.

Activities and assignments in this course will regularly use web-conferencing software (Blackboard Collaborate / Zoom). In addition to the requirements above, students are required to have a device with a functional camera and microphone. In an emergency, students can connect through a telephone call, but video connection is the expected norm.

Campus closure

If the campus closes, or if a class meeting needs to be canceled or adjusted due to weather or other concern, students should check Blackboard for updates on how to continue learning and for information about any changes to events or assignments.

Course materials and student privacy

All course materials posted to Blackboard or other course site are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.

Videorecordings—whether made by instructors or students—of class meetings that include audio, visual, or textual information from other students are private and must not be shared outside the class.

Live video conference meetings (e.g. Collaborate or Zoom) that include audio, textual, or visual information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class.

Disability Accommodations

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit `http://ds.gmu.edu/` for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: `ods@gmu.edu` — Phone: (703) 993-2474.

Covid-19 Note: Students who have a Covid-related disability should contact the Disability Services office; DS will contact faculty using standard protocols about any students who require accommodations. Faculty are not

expected to create accommodations for students outside of the Disability Services official guidelines.

Diversity and Inclusion

TBD. A university committee will convene this semester to draft language for inclusion on syllabi.

The instructor welcomes diversity.

Privacy

Students must use their Mason email account to receive important University information, including communications related to this class. I will not respond to messages sent from or send messages to a non-Mason email address.

Recording and/or sharing class materials

Some kinds of participation in online study sites violate the Mason Honor code: these include accessing exam or quiz questions for this class; accessing exam, quiz, or assignment answers for this class; uploading of any of the instructor's materials or exams; and uploading any of your own answers or finished work. Always consult your syllabus and your professor before using these sites.

Safe return to campus statement

All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (`https://www2.gmu.edu/safe-return-campus`). Similarly, all students in face-to-face and hybrid courses must also complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, or Red email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class.

Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021, all community members are required to wear a facemask in all indoor settings, including classrooms. An appropriate facemask must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed; however, students who prefer to wear masks either temporarily or consistently will always be welcome in the classroom.

Sexual harrassment, sexual misconduct, and interpersonal violence

Notice of mandatory reporting of sexual or interpersonal misconduct: As a faculty member, I am designated as a "Non-Confidential Employee," and must report all disclosures of sexual assault, sexual harassment, interpersonal violence, stalking, sexual exploitation, complicity, and retaliation to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-993-3686 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance or support measures from Mason's Title IX Coordinator by calling 703-993-8730, or emailing `titleix@gmu.edu`.

Student and faculty names and pronouns

Gender identity and pronoun use: If you wish, please share your name and gender pronouns with me and how to address you in class and via email. I use the third-person pronoun "he" for myself and you may address me as "Kent Miller," "Dr. Miller," "Prof. Miller," or "Kent" in email and verbally. Mason allows students to update their name and pronoun on Mason records.

Tentative Course Schedule

CSI-672 schedule

	CSI-672-002					
Wk	Date		Chap	HW Due	Proj	Exam
1	08-24	F	1			
2	08-31	F	2	1		
3	09-07	F	3	2		
4	09-14	F	4	3		
5	09-21	F	5	4		
6	09-28	F	6	5		
7	10-05	F		6		Midterm
8	10-12					Fall break
9	10-19	F	7			
10	10-26	F	8	7		
11	11-02	F	9	8	Topic	
12	11-09	F	10	9		
13	11-16	F	11	10	Draft	
14	11-23	F	12	11	Draft	
15	11-30	F	13	12	Draft	
16	12-07	F		13	Draft	Reading day
17	12-14	F			Final	Final exam

Note: F = face-to-face, O = on-line.

Disclaimer: Information in this syllabus is subject to change. The most frequent cause of change is university closure due to snow.