

# CSI-672: Statistical Inference / Fall 2020

Dr. Kent L. Miller

August 20, 2020

## Basic Information

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

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About the Course	
Course title	Statistical Inference
Course number-sec	CSI-672-002
Credit hours	3
Department	Computational Science & Informatics
Meeting day/time	T 7:20pm-10pm
Classroom	Planetary Hall 131
Prerequisites	STAT 544, min. Grade B-, or instructor permission
Required purchase	none
Required text	none
Required freeware	GNU R; and $\text{\TeX}$ Live or Overleaf

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## 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 complete 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*, 2<sup>nd</sup> 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.

## 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://rdr.io/snippets/>. To save a plot, right-click on the image, and save as a PNG file.

$\text{\LaTeX}$  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>

$\text{\LaTeX}$  can be installed on your platform. Try  $\text{\TeX}$  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  $\text{\TeX}$  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  $\text{\LaTeX}$ , 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 resources to examine an entire population (e.g. U.S. Census). More common it is to draw a sample from a larger 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: “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.”

## 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, and typesetting reports as required for masters and PhD theses and for scientific publications.

## Grading and Course Requirements

Coursework is weighted as follows:

<i>Coursework</i>	<i>Val</i>	<i>Qty</i>	<i>Max</i>
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 below).

## Format

Each assignment states what is deliverable. All deliverables must be prepared in L<sup>A</sup>T<sub>E</sub>X (a typesetting software required by many mathematical and scientific journals, and for theses) and submitted in PDF format. How to use L<sup>A</sup>T<sub>E</sub>X 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, L<sup>A</sup>T<sub>E</sub>X, and Blackboard).

## Level of research expected

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

<i>Coursework</i>	<i>Level</i>
Homework	Mid–High
Project	High
Exams	Low

Here we are using Bloom’s Taxonomy.

<i>Level</i>	<i>Skill</i>	<i>Description</i>
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

<i>Coursework</i>	<i>Criteria</i>
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

<i>Coursework</i>	<i>Purpose</i>
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:

<i>Coursework</i>	<i>Assessment</i>
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. Statistical 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

Three 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; and
3. the student required an academic accommodation (see the section on Accommodations on page 4).

## Incompletes

The instructor discourages the use of Incomplete. Two 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; or
2. the student was arrested, deported, detained, or otherwise physically restrained from completing the semester, documented with a valid lawyer's note.

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 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

you 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 MLA or APA format. 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.

### Accommodations

Disability Services at George Mason University is committed to providing equitable access to learning opportunities for all students by upholding the laws that ensure equal treatment of people with disabilities. If you are seeking accommodations for this class, please first visit <https://ds.gmu.edu/> for detailed information about the Disability Services registration process. Then please discuss your approved accommodation with me. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: [ods@gmu.edu](mailto:ods@gmu.edu), Phone: (703) 993-2474.

### Campus Closure

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

### Digital Communication

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

### Health

All students taking courses in person must take Safe Return to Campus Training before coming to campus. Training is available in Blackboard.

Students must follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage. All students taking in-person 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 response 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.

### Respect for Diversity

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

### Title IX

**Notice of mandatory reporting of sexual assault, interpersonal violence, and stalking:** As a faculty member, I am designated as a "Responsible Employee," and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1412. If you wish to speak with someone confidentially, please contact the Student Support and Advocacy Center (703-380-1434) or Counseling and Psychology Services (703-993-2380). You may also seek assistance from Mason's Title IX Coordinator (703-993-8730; [titleix@gmu.edu](mailto:titleix@gmu.edu)).

### Tentative Course Schedule

#### CSI-672 schedule

CSI-672-002					
<i>Wk</i>	<i>Date</i>	<i>Chap</i>	<i>HW Due</i>	<i>Proj</i>	<i>Exam</i>
1	08-25	1			
2	09-01	2	1		
3	09-08	3	2		
4	09-15	4	3		
5	09-22	5	4		
6	09-29	6	5		
7	10-06		6		Midterm
8	10-13				Fall Break
9	10-20	7			
10	10-27	8	7		
11	11-03	9	8	Topic	
12	11-10	10	9		
13	11-17	11	10		
14	11-24	12	11		
15	12-01	13	12	Draft	
16	12-08		13		Reading Days
17	12-15			Final	Final 7:20pm-10pm

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