Course Syllabus

STAT 513: Statistical Inference

Winter 2021

Instructor: Fang Han (fanghan@uw.edu)
Office hour:
• Monday, 9:00-10:00AM in https://washington.zoom.us/j/94741849266 (password: 513513).

Teaching assistant: Gang Cheng (gangc@uw.edu) and Zhen Miao (zhenm@uw.edu). Office hours:
• Gang Cheng:
  – Friday, 1:00-2:00PM in https://washington.zoom.us/j/93014756753 (password: 513513).
• Zhen Miao:
  – Wednesday, 7:00-8:00PM in https://washington.zoom.us/j/97655049912 (password: 513513).

Course website: https://www.stat.washington.edu/people/fanghan/teaching/STAT513

Class schedule: There will be two sessions a week:
• (Remote Lecture) MWF, 10:30-11:20 PM in https://washington.zoom.us/j/96835167901 (password: 513333)
• (Remote Quiz Session) W, 12:30-1:20PM in https://washington.zoom.us/j/99027121518 (password: 513333)
  – The TAs will review exercises/HWs in the quiz session

Course overview: This is a 10-week course focused on introducing basic concepts in statistical inference. We start from a touch of dimension-reduction/efficient-estimation through sufficient, ancillary, and complete statistics, then take a tour of the information inequality and MLE, and end the course with an introduction to elementary decision theory.

Course content: There are three parts in this course:
• Principles of data reduction: sufficient, minimally sufficient, ancillary, complete statistics; Fisher-Neyman Factorization Theorem; Basu Theorem; UMVUE via complete sufficient statistics
• Elementary inference: information inequality; the maximum likelihood estimator; consistency and convergence in distribution; nuisance parameter adjustment
• Elementary decision theory: the Bayes estimator, the minimax estimator, admissibility

Prerequisites: This course requires multivariable calculus (limits, infinite series, partial derivatives, and multiple integrals), linear algebra (vectors, matrices, determinants, inverses, Cauchy-Schwartz inequality, orthogonal and positive definite matrices, eigenvalues), and familiarity with elementary probability theory (Math/Stat 394-5) and statistical theory (STAT 512). Please do not hesitate to approach the instructor if you have any question.

Grades: Your grades come from three parts:
• seven homework assignments (30%)
• a midterm exam (take-home, 30%)
• a final exam (take-home, 40%).

Format of HWs: There will be 7 homework assignments (each worth 5%); the lowest one will be dropped and there is no HW due in the weeks of exams. It will be out Friday night and be due at the end of the next Friday (23:59:59). Late HWs will be penalized 20% per day (For instance, a homework turned in two days late will receive only 60% credit). Exceptions to these rules will of course be made for serious illness or other emergency circumstances; in these cases, please contact me as soon as you are aware of the problem. You need to upload your answers to the Canvas. Teamwork is allowed, but it is encouraged to think by yourself first; plagiarism is strictly forbidden. Technical correctness, clarity, and completeness are equally important.
Format of the exams: There will be a midterm and a final exam, both take-home and intended to be done in any 2-hour window, on Feb 10 and March 12. You will need to upload your answers to canvas. The exams will be open book, though neither access to the internet nor teamwork is allowed; they will be considered as cheating.

Course textbook: This course is built on Professor Michael Perlman’s fabulous lecture notes.

1. M. Perlman, STAT512/STAT513 Course Pack (available on Canvas)

   The following book and two lecture notes will also be referenced from time to time.


Religious accommodations: “Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW’s policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).”

Academic integrity: The University takes academic integrity very seriously. Behaving with integrity is part of our responsibility to our shared learning community. If you’re uncertain about if something is academic misconduct, ask me. I am willing to discuss questions you might have.

Acts of academic misconduct may include but are not limited to:

   - Cheating (working collaboratively on quizzes/exams and discussion submissions, sharing answers and previewing quizzes/exams)
   - Plagiarism (representing the work of others as your own without giving appropriate credit to the original author(s))

Concerns about these or other behaviors prohibited by the Student Conduct Code will be referred for investigation and adjudication by (include information for specific campus office).

Students found to have engaged in academic misconduct may receive a zero on the assignment (or other possible outcome).

Guidance to students taking courses outside the U.S.: Faculty members at U.S. universities – including the University of Washington – have the right to academic freedom which includes presenting and exploring topics and content that other governments may consider to be illegal and, therefore, choose to censor. Examples may include topics and content involving religion, gender and sexuality, human rights, democracy and representative government, and historic events.

If, as a UW student, you are living outside of the United States while taking courses remotely, you are subject to the laws of your local jurisdiction. Local authorities may limit your access to course material and take punitive action towards you. Unfortunately, the University of Washington has no authority over the laws in your jurisdictions or how local authorities enforce those laws.

If you are taking UW courses outside of the United States, you have reason to exercise caution when enrolling in courses that cover topics and issues censored in your jurisdiction. If you have concerns regarding a course or courses that you have registered for, please contact your academic advisor who will assist you in exploring options.

Course schedule:
<table>
<thead>
<tr>
<th>Date (M)</th>
<th>Content</th>
<th>Date (W)</th>
<th>Content</th>
<th>Date (F)</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/04</td>
<td>Introduction and review</td>
<td>01/06</td>
<td>SStat: Basic concept</td>
<td>01/08</td>
<td>SStat: Examples I</td>
</tr>
<tr>
<td>01/11</td>
<td>SStat: Examples II</td>
<td>01/13</td>
<td>SStat: Examples III</td>
<td>01/15</td>
<td>SStat: Lemma 11.2</td>
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<tr>
<td>01/18</td>
<td>MLK Day: no class</td>
<td>01/20</td>
<td>SStat: Fisher-Neyman Factorization</td>
<td>01/22</td>
<td>SStat: Minimal sufficiency</td>
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<tr>
<td>01/25</td>
<td>SStat: Lehmann-Scheffe</td>
<td>01/27</td>
<td>L-S: Examples</td>
<td>01/29</td>
<td>Ancillary Statistics</td>
</tr>
<tr>
<td>02/01</td>
<td>Complete Statistics: Basu</td>
<td>02/03</td>
<td>CStat: Expo. Family</td>
<td>02/05</td>
<td>CStat: Examples</td>
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<tr>
<td>02/08</td>
<td>UMVUE</td>
<td>02/10</td>
<td>Midterm</td>
<td>02/12</td>
<td>UMVUE: RBLS Theorem</td>
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<tr>
<td>02/15</td>
<td>Presidents' Day: no class</td>
<td>02/17</td>
<td>UMVUE: Examples</td>
<td>02/19</td>
<td>Information Inequality</td>
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<td>02/22</td>
<td>Cramer-Rao Lower Bound</td>
<td>02/24</td>
<td>Nuisance parameters</td>
<td>02/26</td>
<td>MLE: Wald</td>
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<tr>
<td>03/01</td>
<td>MLE: Fisher-Cramer</td>
<td>03/03</td>
<td>MLE: adjust for NP</td>
<td>03/05</td>
<td>MLE: Examples</td>
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<tr>
<td>03/08</td>
<td>Element. DT: minimax/Bayes estimators</td>
<td>03/10</td>
<td>Elementary DT: Examples</td>
<td>03/12</td>
<td>Final</td>
</tr>
</tbody>
</table>

SStat: sufficient statistics  
CStat.: complete statistics  
Expo. family: exponential family  
MLE: maximum likelihood estimator  
NP: nuisance parameter  
DT: decision theory

Figure 1: Course schedule (tentative).