Instructor: Abhishek Kaul
Office: Neil 217
Phone: (509) 335-5279
E-mail: akaul@math.wsu.edu

Lectures: MWF 2:10-3:00 pm (Todd 301)
Lab: Friday: Friday 3:10-5:40 pm (Todd 301)
Office Hours: WF: 12:15pm – 1:30pm and by appointment

Course Assessment:
Assignments: 60%
One mid-term exam: 25%
One Final Project: 15%

Text Books:
Monte Carlo Statistical Methods,
By C.P. Robert & G. Casella, Springer.
Modern Applied Statistics with S,
By W.N. Venables & B.D. Ripley, Springer.
Other resources as appropriate

With the increasing power of computers and the modern developments in statistical computing, statisticians, applied mathematicians and computer scientists are able to handle far more complex problems today than ten years ago. Statistical computing enhances one’s understanding of statistical theories and ability to handle complex problems.

Topics covered in class can be classified into three categories:

1. Random number generation and stochastic simulation
2. Statistical computing as a tool to enhance the understanding of statistical theories.
3. Computationally intensive methods to solve complex problems that cannot be solved otherwise without the power of computing. One of the methods is the Markov Chain Monte Carlo technique that is capable of estimating a large number of parameters.

Specific topics that will be covered in the course include:
• Generation of random numbers and Monte Carlo simulation
• Constrained and unconstrained optimization
• EM algorithm and its variants with applications to mixed effects models
• Markov Chain Monte Carlo methods and their applications
• Bootstrap, Jackknife, and randomization methods

The course will have lab sessions to provide hands-on experience in programming techniques and their practice. The examples in the lab enable students to write their own programs for various computational purposes. After completion of this course, students will be able to utilize statistical computing in research and data analysis, spanning the areas of applied mathematics, statistics and computer sciences.

The statistical package R (www.r-project.org) together with the user interface R Studio (https://www.rstudio.com/), will be used for computational needs. Grades will be based on Assignments (60%), Mid-term Exam (25%) and a Final Project (15%). Prerequisites for this course are: good background in probability distributions, and exposure to writing computer programs. No prior knowledge of working with R will be assumed.

Assignments: There will be bi-weekly (approximately) assignments that involve derivations, writing R-code and implementation. Students must write their own programs. Copying from someone is a serious violation and will be dealt with in accordance with WSU policies. Such violations will have serious consequences for those that copy as well as those that allow such access. Note: While submitting assignments, you must provide any necessary derivations and your computer code saved on a flash drive as an Rmarkdown file (.rmd), which are reproducible electronic notebooks available within R-studio.

Mid-term: The Mid-term exam will be scheduled in all likelihood during the 13th week.

Grade Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>A</td>
</tr>
<tr>
<td>85-89</td>
<td>A-</td>
</tr>
<tr>
<td>80-84</td>
<td>B+</td>
</tr>
<tr>
<td>75-79</td>
<td>B</td>
</tr>
<tr>
<td>70-74</td>
<td>B-</td>
</tr>
<tr>
<td>67-69</td>
<td>C+</td>
</tr>
<tr>
<td>63-66</td>
<td>C</td>
</tr>
<tr>
<td>60-62</td>
<td>C-</td>
</tr>
<tr>
<td>55-59</td>
<td>D+</td>
</tr>
<tr>
<td>50-54</td>
<td>D</td>
</tr>
<tr>
<td>&lt;50</td>
<td>F</td>
</tr>
</tbody>
</table>

Expected Learning Outcomes: Good working knowledge on how to write computer programs on R for purpose of fitting advanced statistical models. First, students learn methods of generating random variables through Monte Carlo simulation. Then learning statistical methods such as maximum likelihood estimation and the EM algorithm are essential. The MCMC method and its applications are an important learning outcome of this course. The learning also includes methods of Bootstrap. Jackknife and other related statistical methods for parameter estimation and tests of hypotheses.

Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, please visit the Access Center. All accommodations MUST be approved through the Access Center (Washington Building, Room 217). Please stop by or call 509-335-3417 to make an appointment with an Access Advisor.