

# Math 475 - Fall 2018

## Statistical Computing

Duncker 101 12:00 - 1:00pm MWF

**Instructor:** Dr. Nicholas Syring

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Website: <https://www.math.wustl.edu/~nasyring/home.html>

Office Hours: MWF 11:00am – 12:00pm

Office Location: Cupples I 203

### Course Description:

Introduction to modern computational statistics. Pseudo-random number generators; inverse transform and rejection sampling. Monte Carlo approximation. Nonparametric bootstrap procedures for bias and variance estimation; bootstrap confidence intervals. Markov chain Monte Carlo methods; Gibbs and Metropolis-Hastings sampling; tuning and convergence diagnostics. Cross-validation. Time permitting, optional topics include numerical analysis in R, density estimation, permutation tests, subsampling, and graphical models.

**Prerequisites:** Prior knowledge of R at the level used in Math 494 is required. Math 233, 309, 493, 494 (not concurrently). To benefit more from this class, students should have also taken at least one course on statistical models such as Math 322, Math 420, Math 439, Math459, Math 460, or equivalent.

**Text:** *Statistical Computing with R*, by Maria L. Rizzo.

**References:** “An Introduction to R” at

[http://cran.r-project.org/doc/contrib/Lam-IntroductionToR\\_LHL.pdf](http://cran.r-project.org/doc/contrib/Lam-IntroductionToR_LHL.pdf),

“simpleR - Using R for Introductory Statistics” at

<http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf>, and (advanced)

“R for Data Science” by Hadley Wickham and Garrett Grolemund at

<http://r4ds.had.co.nz/>.

**Software:** This course will utilize the R and (highly recommended) RStudio software programs. These can be downloaded at <http://cran.wustl.edu/> and at <https://www.rstudio.com/products/rstudio/download/>.

**Course schedule:** The following course schedule is tentative and subject to changes.

Week	Topic
1	Introduction, R and R markdown
2	Data and visualization in R, Labor Day
3	Optimization I
4	Optimization II
5	Numerical Integration
6	Sampling random variables I
7	Sampling random variables II, Midterm 1
8	Monte Carlo methods I, Fall Break
9	Monte Carlo methods II
10	EM Algorithm
11	Bootstrap I
12	Bootstrap II
13	Permutation tests, Midterm 2
14	MCMC I, Thanksgiving
15	MCMC II

**Grade Distribution:**

Homework 40%

Two Midterm Exams 40%

Final Exam 20%

**Letter Grade Distribution:**

A+ 95 – 100	B+ 80 – 85	C+ 65 – 70	D 50 – 55
A 90 – 95	B 75 – 80	C 60 – 65	F 0 – 50
A– 85 – 90	B– 70 – 75	C– 55 – 60	

**Homework:** There will be homework assignments due about every other Friday in class. Assignments will be posted on my website. These should be written up clearly and in detail and include R codes in addition to output. It is suggested but not required that you use R markdown and LaTeX for assignments. Discussion amongst students is encouraged, but students are to write up homework on their own. Offering and accepting solutions from others is an act of plagiarism. Looking up solutions online or in other sources is also an act of plagiarism. No late work will be accepted.

**Exams:** There will be two midterm exams, each worth 20% of the final grade. Each exam will cover material from the beginning of the semester up to and including the Friday of the week before the exam. There will be a cumulative final exam from 10:30am – 12:30pm on Wednesday, December 19. Exams will include take home

portions to be done independently. The instructor requires one week notice before a midterm exam to provide for a make-up in the event of a conflict. If a student misses a midterm exam for a legitimate absence (with verifiable documentation provided), the final grade will be calculated with additional weight placed evenly on the other midterm and the final exam. However, an “Incomplete” will be given if the final exam is missed no matter for what reason.

**Calculators:** Graphing calculator with Z, t, chi-square and F distribution functions (such as the TI-83 series) are recommended (but not required). You may not use cell phones during any exams.

**Attendance and Absences:** Students are expected to attend each class. It is the absentee’s responsibility to get all missing notes and materials.

**Academic Integrity:** This course will strictly follow the Washington University academic integrity policy. This policy is discussed in detail at <https://wustl.edu/about/compliance-policies/academic-policies/undergraduate-student-academic-integrity-policy/>.