STAT 753-01: Nonparametric Statistics and Bootstrapping

Syllabus and Course Information – Fall 2020

2020 August 12

1 Overview

1.1 Course Description from RIT

The emphasis of this course is how to make valid statistical inference in situations when the typical parametric assumptions no longer hold, with an emphasis on applications. This includes certain analyses based on rank and/or ordinal data and resampling (bootstrapping) techniques. The course provides a review of hypothesis testing and confidence-interval construction. Topics based on ranks or ordinal data include: sign and Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests, runs tests, chi-square tests, rank correlation, rank order tests, Kolmogorov-Smirnov statistics. Topics based on bootstrapping include: estimating bias and variability, confidence interval methods and tests of hypothesis.

1.2 Computing Environment

We will make extensive use in this course of Jupyter notebooks (running Python 3.7) for lessons, homework and exams. There is a JupyterHub environment in which you can run these, or if you prefer, you can install the Python 3.7 version of the Anaconda distribution from `https://www.anaconda.com/distribution/`

1.3 Textbooks

- **Required:** Conover, W. J., *Practical Nonparametric Statistics*, 3rd edition (Wiley, 1999)
- **Required:** Efron, B. and Tibshirani, R. J., Conover, W. J., *An Introduction to the Bootstrap*, 1st edition (CRC, 1994)
- **Possibly useful:** Hollander, M., Wolfe, D. A., and Chicken, E., *Nonparametric Statistical Methods*, 3rd edition (Wiley, 2014)
  Available electronically via the Wallace Library: `https://albert.rit.edu/record=b3692426~S3`
- **Possibly useful:** Higgins, J. J., *Introduction to Modern Nonparametric Statistics*, 1st edition (Brooks/Cole, 2004)
- **Possibly useful:** Gibbons, J. D. and Chakraborti, S., *Nonparametric Statistical Inference*, 5th edition (CRC, 2011)
- **Possibly Useful:** Wasserman, L., *All of Nonparametric Statistics*, 1st edition (Springer, 2007)
  Available electronically via the Wallace Library: `https://albert.rit.edu/record=b3210246~S3`

1.4 Instructor

Dr. John T. Whelan; `jtwsma@rit.edu`
Office Hours: by appointment (slack or zoom).

1.5 Prerequisites

This course is restricted to students in the MS or Advanced Certificate program in Applied Statistics. Students should also have taken an introductory statistics course.

2 Course Structure

This is a 3-credit online course; you should expect to spend at least nine hours per week on activities for this class.

2.1 List of Topics

1 Review/Basics of Probability and Statistical Inference (Conover Chapters One and Two)
2 Binomial Tests (Conover Chapter Three)
3 Rank-Based Tests (Conover Chapter Five)
4 Kolmagorov-Smirnov Statistics (Conover Chapter Six)
5 Bootstrapping (Efron)

2.2 Timetable for the Course

See the course outline at `outline.html`

2.3 Getting Started

There is a "week zero" of preliminary material consisting of an introduction and overview, and a brief Python tutorial. This material has no due dates, but will be available 2020 August 12, one week before the semester starts. It is availble in mycourses and listed in the outline above.

2.4 Lessons

The course is divided into weeks. (Due to the change in RIT's calender, a week runs from Wednesday to Tuesday.) Each week includes a brief video introduction and one to three lessons, presented as Jupyter notebooks, available in mycourses. (The notebooks can be run on the JupyterHub server or saved to your computer and run within Jupyter locally.) These notebooks provide explanations interspersed with Python demonstrations, to be executed one step at a time. You are encouraged to tinker with the commands to explore how the demo changes if parameters, procedures, etc are modified.

2.5 Homework

Each week has a problem set, due the following Friday at 9am Eastern Time. The problem set is in the form of a Jupyter notebook, and is to be completed by including notebook cells with LaTeX/markdown (for explanations and formal calculations) and Python commands (for numerical computations). Problem sets should be turned in with all of the cells excecuted. Solutions in the form of executed notebooks will be made avalable after the problem set is due. Problem sets will not be accepted after the solutions have been released. Note that homeworks will be checked for completeness, and a subset of the problems checked for correctness, so it's important to go through the solutions yourself. We will also have an area on the discussion forum for followup questions about the homework.

2.6 Exams

There will be two preliminary exams, one covering weeks 1-4 and one covering weeks 5-8. The exams will be open book, open notes, in Jupyter notebook format, and available for a 27-hour period, but designed to be done in a couple of hours in one sitting. The final exam will be taken under similar conditions, but over a 36-hour timespan and proportionally longer.

2.7 Discussion Board

There is a discussion board in mycourses, on which you are encouraged to ask about and discuss both conceptual and practical aspects of the week's materials with me and your peers.

3 Course Policies

3.1 Student Identity Verification

As with all RIT Online courses, students must complete the Student Identity Verification Checklist.

3.2 Collaboration

It is acceptable and encouraged to discuss and brainstorm with your peers while doing the homework, but each student should turn in their own work. Collaborating on exams with people in or outside the course is of course cheating and will not be tolerated.

3.3 Grades

Grades will be based on the following components:

- Homework [15%]
- First Prelim Exam [25%]
- Second Prelim Exam [25%]
- Final Exam [35%]

Your score on each component of the course (each prelim, the final, and all the homeworks together) will be converted to a numerical "grade point" score, and the weighted average of those five scores will be your final grade, converted to a letter grade according to the scale below.

3.4 Grading Scale

$3.8\overline{3}$ to 4.5	3.5 to $3.8\overline{3}$	$3.1\overline{6}$ to 3.5	$2.8\overline{3}$ to $3.1\overline{6}$	2.5 to $2.8\overline{3}$
A	A-	B+	B	B-
$2.1\overline{6}$ to 2.5	$1.8\overline{3}$ to $2.1\overline{6}$	1.5 to $1.8\overline{3}$	0.5 to 1.5	-0.5 to 0.5
C+	C	C-	D	F

3.5 Graded Feedback

I will check homeworks for completeness and give feedback on the correctness of a subset of the problems. Solutions will be made available, and **you are responsible** for going through your own homework submissions and learning from any mistakes. You will receive updates on your grades

to date (a grade for each exam and a preliminary composite grade for the homeworks so far) three times during the semester: after each preliminary exam, and before the final exam. You are welcome to discuss with me your progress in between these milestones.

3.6 University Policies

3.6.1 Academic Integrity

As an institution of higher learning, RIT expects students to behave honestly and ethically at all times, especially when submitting work for evaluation in conjunction with any course or degree requirement. RIT Online encourages all students to become familiar with the RIT Honor Code and with RIT's Academic Integrity Policy.

3.6.2 Reasonable Accommodations

RIT is committed to providing reasonable accommodations to students with disabilities. If you would like to request accommodations such as special seating or testing modifications due to a disability, please contact the Disability Services Office. It is located in the Student Alumni Union, Room 1150; the Web site is `www.rit.edu/dso` . After you receive accommodation approval, it is imperative that you contact me so that we can work out whatever arrangement is necessary.

3.6.3 Use of copyrighted material

Certain materials used in this course are protected by copyright and may not be copied or distributed by students. You can find more information at `http://www.rit.edu/academicaffairs/policiesmanual/sectionC/C3_2.html`

3.6.4 Emergencies

In the event of a University-wide emergency course requirements, classes, deadlines and grading schemes are subject to changes that may include alternative delivery methods, alternative methods of interaction with the instructor, class materials, and/or classmates, a revised attendance policy, and a revised semester calendar and/or grading scheme.

3.6.5 Student support availability

Student Learning, Support & Assessment offers a wide range of programs and services to support student success including the Academic Support Center, College Restoration Program, Disabilities Services, English Language Center, Higher Education Opportunity Program, Spectrum Support program, and TRiO Support Services. Students can find out about specific services and programs at `www.rit.edu/slsa`