

**Course Syllabus**

1. **Course Prefix, Number, and Title:** STAT 7900 Special Topics: Nonparametrics

(Note: STAT 8210 is prerequisite). Class meeting times are Mondays and Wednesdays, 6:30-9:15 PM in Clendenin 1005.

1. **Instructor, Office, and Telephone Number:** Bradley Barney; Clendenin Building, Room 3013; 470-578-2491
2. **Learning Objectives:** Upon completion of the course, students are expected to be able to:
   * *Clearly articulate the advantages and disadvantages of nonparametric methods vis-à-vis parametric methods;*
   * *Determine which nonparametric test(s) are appropriate in a given circumstance;*
   * *Conduct and properly interpret the results of permutation tests for one-sample, two-sample, and k-sample situations with numeric and with categorical responses;*
   * *Use Monte Carlo methods to approximate the sampling distribution of statistics, with particular emphasis on permutation tests and bootstrapping;*
   * *Determine which bootstrap confidence interval(s) are appropriate in any given circumstance and compute said intervals;*
   * *Implement nonparametric regression with one or more predictor variables.*
   * *Adeptly communicate statistical results; and*
   * *Implement all analyses using R and/or SAS®.*
3. **Texts:** **Required**--*Introduction to Modern Nonparametric Statistics* (Higgins, 2004). ISBN 0-534-38775-6

**Optional**-- *Practical Nonparametric Statistics, 3rd Edition* (Conover, 1999).

*Randomization, Bootstrap, and Monte Carlo Methods in Biology, 3rd Edition* (Manly, 2006).

*Generalized Additive Models: An Introduction with R* (Wood, 2006).

SAS® documentation (available at <http://support.sas.com/documentation/> )

R website for download, documentation (<http://www.r-project.org/> )

1. **Course Requirements/Assignments:** The course will have two exams, multiple homeworks, and projects. A few comments on each now follow:

The *MIDTERM EXAM* is tentatively scheduled for Monday, June 27th in class. You are held accountable for taking the exam when it is administered unless you have made arrangements with me at least one week in advance and have extenuating circumstances.

The *FINAL EXAM* is tentatively scheduled for the evening of Monday, July 25th. You are held accountable for taking the exam at the announced time unless you have made arrangements with me at least one week in advance and have extenuating circumstances. Don’t make other arrangements that will interfere with this exam. Besides, is there really someplace you would rather be than enjoying a statistical learning experience?

Details on the *PROJECTS* will be provided later in the semester. The projects are especially important because they allow you to showcase what you have learned and they give you practice in statistical reporting. Each project will either be a group effort or an individual effort. You may not discuss a project with ANYONE other than me (B. Barney) and—if a group project—your group members. *The completed project reports must be submitted in a hard copy as well as an electronic copy.* You will also present your project results to the class for one of your projects (time permitting).

You are permitted to discuss *HOMEWORK* with others. *However, this does not give you license to copy another’s work.* Homework may be discussed between classmates, but all work you turn in must be your own work and written in your own words. I consider this easiest to practice when you are by yourself while writing up the results of your work. Also, unless requested otherwise, I expect you to turn in your computer code along with your writeups, and that you explicitly and fully answer the questions. If I ask for, say, an indication of significance, I don’t want you to just circle a p-value on the computer output and turn that in, or worse yet, just turn in computer output without any comments. In your writeup, you should be specific. *Part of your grade will be based on how adequately you present the information to answer the question(s).*

1. **Evaluation and Grading:** The grade that *you earn* will be determined based on your performance in several areas. There will be homework, group and individual projects, a midterm exam, and a final exam. I reserve the right to grade only selected homework problems of my choosing.

The requirements for each letter grade are:

A 90%--100%

B 80%--89.999%

C 70%--79.999%

D 60%--69.999%

F 0%--59.999% or cheating

Your course grade is based on a weighted average of your component-specific scores. The weights are:

Homework, Projects 55%

Midterm Exam 20%

Final Exam 25%

*Cheating is not tolerated at all!* I reserve the right to check any and all submitted work for plagiarism with TurnItIn. Cheating on an assignment or exam may result in a score of 0% for the assignment/exam. If there is a second infraction, an automatic F in the course may be assigned. In addition, suspected cheating may result in an academic hearing, as described in Section VII below.

*Policy on Late Work:* Due dates (and times) for homework and the projects will be posted on KSU Brightspace. Late work WILL NOT be accepted without prior written approval from me, and only in extenuating circumstances occurring well in advance of the due date. It is also possible that late work which had prior written approval will still carry with it a late penalty, but this will be contingent upon the circumstances surrounding the late work request and will be specifically noted in the prior written approval.

1. **Academic Honesty Statement:** The following statement is taken verbatim from the 2014-2015 KSU Faculty Handbook (<http://kennesaw.edu/handbooks/faculty/section2_13.php>)

**Academic Integrity Statement (Required)**  
Every KSU student is responsible for upholding the provisions of the Student Code of Conduct, as published in the Undergraduate and Graduate Catalogs. Section II of the Student Code of Conduct addresses the university’s policy on academic honesty, including provisions regarding plagiarism and cheating, unauthorized access to university materials, misrepresentation/falsification of university records or academic work, malicious removal, retention, or destruction of library materials, malicious/intentional misuse of computer facilities and/or services, and misuse of student identification cards. Incidents of alleged academic misconduct will be handled through the established procedures of the Department of Student Conduct and Academic Integrity (SCAI), which includes either an “informal” resolution by a faculty member, resulting in a grade adjustment, or a formal hearing procedure, which may subject a student to the Code of Conduct’s minimum one semester suspension requirement. See also <https://www.kennesaw.edu/scai/content/ksu-student-code-conduct>.

1. **Attendance Policy:** You are expected to attend each class. I do not accept late work without first having given prior approval in writing, and such prior approval will only be granted in extenuating circumstances such as a major illness occurring well in advance of the due date. Computer or Citrix problems, for example, are NOT cause for exceptions to the no-late-work policy. Remember, you can always submit your homework in advance of the due date. As for lecture notes, I am not responsible to reteach a lecture for you. I would suggest making friends with your fellow classmates and exchanging contact information so you can get any notes you may have missed.

If you do not attend any classes nor turn in any work, a grade of NA will be assigned. If you stop participating after the withdrawal deadline but before the last week of classes, your grade may be a WF (unless your class performance was otherwise enough to earn better than an F).

1. **Reference/Bibliography:** None, other than the required and optional course textbooks (see section IV).
2. **Additional Content:**

**Office Hours:** Mondays and Wednesdays, 5:00-6:15 PM. My office is located in the Clendenin Building, room 3013.

**Email:** [**bbarney2@kennesaw.edu**](mailto:bbarney2@kennesaw.edu)

**Course Updates, Notes, Announcements:** In this class we will make extensive use of KSU Brightspace (formerly D2L). The electronic notes, datasets, sample codes, and assignments will be posted there. Announcements will be made in class or posted online.

**Course Overview:** (Short version) The proper use of many statistical methods depends, sometimes quite heavily, on certain conditions being met. Nonparametric statistics present a viable alternative in situations where these conditions are not met. This course will expand students’ ability to make statistical inferences by educating the students on nonparametric techniques such as bootstrapping, loess regression, permutation tests, and rank-based transformations.

(Longer version) Most courses in the Master of Science in Applied Statistics curriculum focus on parametric methods, but there are instances where nonparametric analysis is preferred. In many ways, this course is a survey course. Students will learn that virtually every technique they have already encountered has nonparametric variants. For many of these parametric techniques we will learn about and implement some such variants, focusing primarily on permutation tests and rank-based transformations. Monte Carlo techniques will be stressed for the computation of permutation tests with moderate to large sample sizes. We will also go into substantial depth on bootstrapping techniques for one-sample and regression analyses. Furthermore, we will discuss the great flexibility afforded by nonparametric regression. Students will be given the opportunity to complete and present a project illustrating the use of nonparametric methods.

**Computation:** Throughout the semester, you will learn to use SAS and R to implement various analyses. Emphasis is placed on R, but some things are easier to do in SAS. Regardless of which is easier, there is value in knowing how to use both of these software packages. Programming is not the only component of statistical analysis, of course, and you will be expected to be able to do more than write and run code.

SAS and R access will be available in class on the local computer drives. It is easy to have your personal copy of R. For out of classroom course work, you will have access to the Citrix server to remotely access SAS. *During class time, we will not use Citrix. Citrix use of SAS for this course is meant for use outside of our scheduled class time.* I strongly recommend that you bring a USB drive to class to save your work.

**Changes to Syllabus:** Any changes made to this syllabus will be announced in class and/or in D2L. Such changes are according to my discretion.

**Withdrawal Deadline (to receive W instead of WF):** June 27, 2016. Note that if you have too many W’s, you are penalized for all subsequent withdrawals. If you do not attend any classes nor turn in any work, a grade of NA will be assigned. If you stop participating after the withdrawal deadline but before the last week of classes, your grade may be a WF (unless your class performance was otherwise enough to earn better than an F).

**Additional Statements:** The following statement is taken verbatim from the 2014-2015 KSU Faculty Handbook (<http://kennesaw.edu/handbooks/faculty/section2_13.php>)

**Disruption of Campus Life Statement (Optional)**  
It is the purpose of the institution to provide a campus environment, which encourages academic accomplishment, personal growth, and a spirit of understanding and cooperation. An important part of maintaining such an environment is the commitment to protect the health and safety of every member of the campus community. Belligerent, abusive, profane, threatening and/ or inappropriate behavior on the part of students is a violation of the Kennesaw State University Student Conduct Regulations. Students who are found guilty of such misconduct may be subject to immediate dismissal from the institution. In addition, these violations of state law may also be subject to criminal action beyond the university disciplinary process.

**Tentative Schedule**:

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| Date | Reading Assignment (to complete prior to class) | Topics for lecture |
| June 1 | Chapter 0 (Preliminaries),  Chapter 1 (One-Sample Methods) | Syllabus; Parametrics vs. Nonparametrics; Hypothesis Tests Based on Median; CDF Confidence Intervals |
| June 6 | Chapter 2 (Two-Sample Methods) | 2-Sample Permutation Tests; Wilcoxon Rank-Sum Test; Mann-Whitney Test; Scoring |
| June 8 |  | Testing Scale Equality; Omnibus Test; Relative Efficiency of Various Tests; Approximations (intended for large samples) |
| June 13 | Chapter 3 (K-Sample Methods) | Permutation Tests; Kruskal-Wallis Test; Multiple Comparisons |
| June 15 | Chapter 4 (Paired Comparisons and Blocked Designs) | K-sample Tests with Ordered Alternative Hypothesis; Tests for Paired Comparisons with Permutation Test, Wilcoxon Signed-Rank Test, and Otherwise; |
| June 20 |  | Tests for Randomized Complete Block Designs |
| June 22 | Chapter 5 (Tests for Trends and Association) | Correlation/Slope Permutation Tests; Spearman’s Correlation and Kendall’s Tau; Contingency Table Permutation Tests |
| June 27 |  | Midterm Exam over Chapters 0-4 (in class) |
| June 29 |  | Fisher’s Exact Test; Ordered Contingency Table Tests; Mantel-Haenszel Test; McNemar’s Test |
| July 4 | No Class--Holiday | |
| July 6 | Chapter 8 (Nonparametric Bootstrap Methods) | Introduction to the Bootstrap; Bootstrap Confidence Intervals for Population Mean, Variance |
| July 11 |  | Bootstrap Intervals for Correlation/Regression, 2-sample Tests, and Multiple Regression |
| July 13 | Chapter 10 (Smoothing Methods and Robust Model Fitting) | Kernel Density Estimation; Kernel-based Smoothing; Loess Estimation |
| July 18 |  | Robust Regression |
| July 20 | Chapter 9 (Multifactor Experiments) | Multifactor ANOVA/ Project Presentations (time permitting) |
| July 25 | (Specific time TBA) | Final Exam (in class; time TBA) |