

JOHN JAY COLLEGE OF CRIMINAL JUSTICE
The City University of New York
524 West 59th Street, New York, NY, 10019

Syllabus for: FOS/FCM 705
Mathematical Statistics for Forensic Scientists

Professor's name: Nicholas Petraco

Lecture location: NB 6.61

Office Contact hours: Thursdays 1:30pm and Open Door Policy

E-mail address: npetraco@gmail.com

Course website: <https://npetraco.github.io/705/>

Contact hours: Tuesdays 6:00pm-8:00pm

Course Description:

Evidence in the forensic sciences has been “put under the microscope” since the 2009 publication of the National Academy of Sciences report “Strengthening Forensic Science in the United States: A Path Forward”. The implementation of more quantitative and statistically-based standard operating procedures is a foregone conclusion. The purpose of this hands-on course is to acquaint forensic science and computing graduate students with a survey of commonly applied work horse statistical data analysis methods, as well as issues and pitfalls to be aware of when applying these techniques.

Classical methods are known as “frequentist” and “Fisherian” methods. They are extremely useful and have been successfully applied for almost one hundred years. A complementary set of statistical tools are known as “Bayesian” methods. Related to Bayes’ Theorem and relying on a definition of probability as “belief”, they offer very intuitive interpretation and a naturally “coherent” methodological framework for inference. Both styles of analysis along with national and international standards of professional statistical practice in science will be examined in this course.

This course will also build expertise in the general scientific/statistical computing environment R (<http://www.r-project.org/>). The course assumes minimal knowledge of statistical procedures and numerical computing. It is designed to build the student’s skill set and confidence in both of these areas. Topics covered will include basic data descriptive tools, graphing, probability theory, discrete/continuous distributions, estimation, hypothesis testing, outlier detection, linear regression, applications of analysis of components of variance, performance testing, introductory multivariate methods and select Bayesian methods.

Course materials will be posed on the following website:

<https://npetraco.github.io/705/>

Course Learning Goals:

1. Recognize the importance of accuracy and objectivity in collecting/sampling data for applications to the law.
2. Acquire an understanding of the types of data that can be recorded and analyzed, such as quantitative trace, fire debris, toolmark, DNA and spectrochemical data.
3. Acquire an understanding of frequentist and select Bayesian statistical tools that can be used to analyze collected data.
4. Understand the limitations of the frequentist and Bayesian statistical methods used for data analytics and how not to misrepresent the capabilities of these methods to the courts or clients (ethics).
5. Obtain skill with the general computing/statistical software R (<http://www.r-project.org/>).
6. Develop oral and written communication skill as to how to present the results of sophisticated quantitative analysis to officers of the course and lay juries, in terms that are understandable to them.

Required Resources:

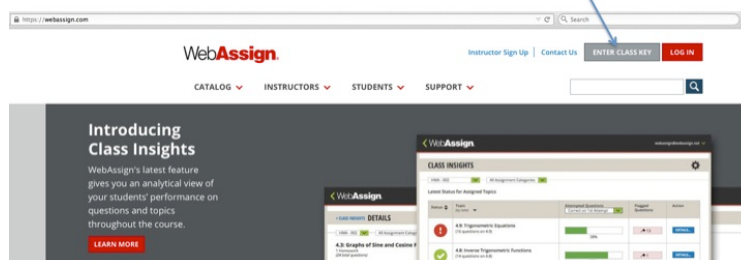
Computer:

A laptop running Windows, Mac OS or Linux operating systems is required for this course. If a student is not in possession of a laptop, one can be [borrowed from the school](#). A tablet or Microsoft surface will not suffice for this course.

Webassign:

- WebAssign: Can be purchased at:
 - <https://webassign.com/>
 - In order to purchase click on “**Enter Class Key**”:

Click to begin purchasing process



- **You should see a place to enter the class key:**

- Class Key: **jjay.cuny 1286 4251**



Let's get you enrolled in your courses!

Start by entering the Course Key provided by your instructor. Don't have a Course Key?
Reach out to your instructor to request it.

If your course is integrated with your campus Learning Management System (i.e. Blackboard, Brightspace by D2L, Canvas or Moodle), head there to enroll in your course or follow this [quick walkthrough](#).

Enter your Course Key

Enter your Course Key, Class Key or Course Registration Link

[What is a Course Key?](#)

ENROLL

- After logging in/creating-account, select your class and the website will prompt you to purchase the required materials
- Purchase “MAT/FOS 705 section 1”, which should be ~\$25.95:



Ready to buy?



Homework Only (single-term access)

FOS/FCM 705

1st Edition

WebAssign

WebAssign

9781337827577

\$25.95

Already purchased?

[Enter access code](#)

Reference textbooks:

The R Book

MJ Crawley

ISBN-10: 8126569719

A Course in Statistics with R

PN Tattar, S Ramaiah, BG Manjunath

ISBN-10: 1119152720

Supplementary texts and resources:

NIST Statistics Handbook

<https://www.itl.nist.gov/div898/handbook/dtoc.htm>

NIST Forensic Statistics

<https://www.nist.gov/spo/forensic-science-program/evidential-statistics>

Guide to Measurement Uncertainty (The GUM)

<https://www.bipm.org/en/committees/jc/jcgm/publications>

Introduction to Data Analysis with R for Forensic Scientists

J Curran

ISBN-10: 1420088262

Course lecture/laboratory calendar:

Lecture	Date	Topic
1	1/30	Introduction Introduction to R and Rstudio
2	2/6	Definitions, Graphs and Estimation 1
3	2/13	Working with Probability Distributions
4	2/20	Estimation 2, Sampling Distributions and the Bootstrap
5	2/27	Intervals
6	3/5	Hypothesis Testing
7	3/12	Outlier Analysis
8	3/19	Linear Regression
9	3/26	Analysis of Variance
10	4/2	Combined Uncertainty and Uncertainty Budgets
11	4/9	Gauge R and R
12	4/16	Performance Testing and ROC Analysis
	*4/23	Break, no class
	*4/30	Break, no class
13	5/7	Introduction to Multivariate Analysis Techniques
14	5/14	Topics in Bayesian Statistics

Grading:

The grades for this course are based on homework sets (100%). After each unit/lecture is complete there will be a homework set consisting of exercises which reenforce and illustrate the material discussed in the lecture. They are due one week after they have been assigned. Home works up to one week late can be turned in for a 25% penalty. After one week of unexcused lateness, HW sets will receive a zero grade.

Course Requirement and Policies:

Course announcements and important reminders will be discussed in class and emailed to you. *As such you must give me email addresses that you check on a regular basis, including your John Jay email.* Homework sets will be administered through WebAssign. See above for details.

Students must check the course website and the e-mail account(s) they gave for this course regularly.

Students are responsible for all course information, assignments, announcements, and communication that occurs in class, through the course website and your email accounts.

Students must be in possession of a laptop running Microsoft Windows, Mac OS or Linux for this class. If a student is not in possession of a laptop, one can be [borrowed from the school](#). A tablet or Microsoft surface will not suffice for this course. Students are responsible for being in possession of a laptop installed with the course software (R <https://www.r-project.org/> and RStudio <https://posit.co/download/rstudio-desktop/>) before *each and every* lecture.

Attendance in lecture is mandatory. More than five unexcused absences from any of these components will result in an automatic failing grade. Unexcused lateness or early departure will count as ½ an absence, up to 30 minutes. After 30 minutes students will be marked absent.

Unethical/unprofessional conduct which includes cheating will result in a failing grade and referral for additional action. These include copying others' work and sharing work when explicitly forbidden.

Americans with Disabilities Act (ADA) Policies:

Students with disabilities will be provided reasonable academic accommodations if determined eligible by the Office of Accessibility Services (OAS). Prior to granting disability accommodations in this course, the instructor must receive written verification of a student's eligibility from the OAS which is located at L66 in the new building (212-237-8031). It is the student's responsibility to initiate contact with the office and to follow the established procedures for having the accommodation notice sent to the instructor in enough time to be effective.

Statement of the College Policy on Plagiarism:

"Plagiarism is the presentation of someone else's ideas, words, or artistic, scientific, or technical work as one's own creation. Using the ideas or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations require citations to the original source.

Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism. It is the student's responsibility to recognize the difference between statements that are common

knowledge (which do not require documentation) and restatements of the ideas of others. Paraphrase, summary, and direct quotation are acceptable forms of restatement, as long as the source is cited.

Students who are unsure how and when to provide documentation are advised to consult with their instructors. The Library has free guides designed to help students with problems of documentation.”

Policy and Source Material:

<http://johnjay.jjay.cuny.edu/files/cunypolicies/JohnJayCollegePolicyofAcademicIntegrity.pdf>