



University of Nebraska
Lincoln

Statistics

WEEKLY SEMINAR

FALL 2024

The Statistics department at UNL invites you to join us for a
seminar by

Alicia Carriquiry

Distinguished Professor and President's Chair

Director of the Center for Statistics and Applications in Forensic Evidence

Iowa State University



Statistics and Its Application in Forensic Science and the Criminal Justice System

The United States has the dubious honor of leading the Western world in terms of the proportion of its citizens it incarcerates. The number of persons in jail in the US has been on the decline for the last decade; however, even today there are more prisoners in the US than in all of the European countries combined.

Mass incarceration has impacted Black and Brown communities disproportionately. For many reasons, including the fact that those communities are policed more intensely, minorities of color are significantly over-represented in the prison system. Perhaps not surprisingly, mass incarceration has led to a large number of individuals who were wrongly convicted and spent years, even decades, in jail for crimes they did not commit. Since the development of forensic DNA analysis, in the 1990s, over 3,400 wrongfully convicted persons have been exonerated (<https://newkirkcenter.uci.edu/national-registry-of-exonerations/>). While not the main cause, faulty or ad-hoc forensic methods account for about 35% of all wrongful convictions.

A National Research Council report entitled *Strengthening Forensic Science in the United States* (NAP 2009) was sharply critical of the practice of forensic science in the US criminal justice system, and called for research to develop the statistical framework of all forensic disciplines except for DNA. The recommendations in the report motivated a small number of statisticians to focus on forensic problems.

Forensic applications present unique challenges for statisticians. Until recently, it was difficult to find any relevant data that were non-proprietary and that were useful for research. Further, much of the data that arise in forensic problems are non-standard, and include low quality images, voice recordings, and stain patterns, to name a few. In those cases, even defining analytical variables may require out-of-the-box thinking. In criminal cases, the question of interest is often one of source. Some evidence is recovered from a crime scene; was the defendant the source of that evidence? For example, did the defendant's gun fire the bullets embedded in a wall? Other forensic questions refer to the cause of an effect. Here, the difficulty arises because the standard causal framework is not appropriate to answer individual causation questions: we know that smoking causes cancer, but did it cause the cancer of the specific person who is suing a tobacco company? In consequence, it is often the case that traditional statistical approaches are not well suited to address the questions of interest to jurors, legal professionals and forensic practitioners.

The presentation introduces some of the statistical and algorithmic methods proposed recently that have the potential to impact forensic practice in the US. Some of this research is mature enough to be already undergoing pilot testing at actual crime labs, although no new technology has yet been implemented in real case work. Two examples are used for illustration: the analysis of questioned handwritten documents and of marks imparted by firearms on bullets or cartridge cases. In both examples, the question we address is the question of source: do two or more items have the same source? In the first case, we apply "traditional" statistical modeling methods, while in the second case, we resort to algorithmic approaches to quantify similarity between two items, followed by a statistical test for the hypothesis of same source.

ALICIA L. CARRIQUIRY



Distinguished Professor, Iowa State University | Director of CSAFE

Alicia Carriquiry is a Distinguished Professor of Liberal Arts and Sciences and a Professor of Statistics at Iowa State University. She researches applications of statistics in human nutrition, bioinformatics, forensic sciences and traffic safety, and has published over 100 peer-reviewed articles in corresponding academic journals. She received an MSc in animal science from the University of Illinois, and an MSc and a PhD in statistics and animal genetics from Iowa State University.

Dr. Carriquiry is the lead investigator for the CSAFE program, providing scientific oversight and research expertise. Along with Dr. Stern and Dr. Daniels, she was among the first to question the probative value of bullet lead analysis. A 2000 report to the FBI that suggested the probability of a coincidental match might not be negligible led to the establishment of a NAS committee to explore the issue. Carriquiry also served as a member of the NAS committee on ballistic imaging.

Professor Carriquiry has spoken at the International Conference on Forensic Inference and Statistics (ICFIS) and participates in the Forensic Sciences certificate program at Iowa State University. She also serves on the OSAC subcommittee on Materials and Trace Evidence, and was recently named to the National Academy of Medicine and elected as a fellow to AAAS.

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**Sep 11, 3 - 4 pm
228 Hardin Hall**