

# Maria Cuellar

(Current as of May, 2024)

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## FACULTY APPOINTMENTS

2024 **Visiting Assistant Professor of Biostatistics**  
 Johns Hopkins Bloomberg School of Public Health

2021- **Assistant Professor of Statistics and Data Science**  
 University of Pennsylvania, The Wharton School

2018- **Assistant Professor of Criminology**  
 University of Pennsylvania

## POSTDOCTORAL TRAINING

2018 **Postdoctoral Fellow**  
 University of Pennsylvania, Department of Criminology

## EDUCATION

2017 **Ph.D. in Statistics and Public Policy**  
 Carnegie Mellon University (Advisors: Stephen E. Fienberg, Edward H. Kennedy)  
 Dissertation: "Causal reasoning and data analysis in the law: Estimation of the probability of causation"  
 Norman Breslow Prize, Statistics in Epidemiology Section of the American Statistical Association

2016 **M.Phil. in Public Policy**  
 Carnegie Mellon University (Advisor: Stephen E. Fienberg)  
 Thesis: "Shaken Baby Syndrome on trial: A statistical analysis of arguments made in court"  
 Best paper award, Heinz College of Public Policy

2015 **M.S. in Statistics**  
 Carnegie Mellon University (Advisor: Jonathan P. Caulkins)  
 Thesis: "Weeding out underreporting: A study of trends in reporting of marijuana consumption"

2009 **B.A. in Physics**  
 Reed College (Advisor: Mary James)  
 Thesis: "Using weak gravitational lensing to find dark matter distributions in galaxy clusters"

## AWARDS AND RECOGNITIONS

2023 **Oracle for Research Grant**, Cloud storage and computational help for studying forensic toolmarks.

2021 **Significance Magazine Recognition**, Top 10 most read articles (Stern HS, Cuellar M., Kaye D, 2019)

2018 **Norman Breslow Prize**, Top prize of Statistics in Epidemiology Section, American Statistical Association

2017 **Stephen Fienberg Travel Award**, Center for Statistics and Applications in Forensic Evidence

2016 **Wray Jackson Smith Scholarship**, Government Statistics Section, American Statistical Association

2016 **George Duncan Award for Excellence in Doctoral Studies**, Heinz College of Public Policy

2015 **Mihaela Serban Memorial Award**, For starting CMU Women in Statistics group

2009 **Commendation for Academic Excellence**, Reed College

## PUBLICATIONS

### Peer reviewed

- Rosenblum, M., Chin, E.T., Ogburn, E.L., Nishimura, A., Westreich, D., Datta, A., Vanderplas, S., Cuellar, M. and Thompson, W.C., (2024). Misuse of statistical method results in highly biased interpretation of forensic evidence in Guyll et al. *Law, Probability and Risk*, 23(1), p.mgad010.
- Cuellar, M., Mauro, J., Luby, A. (2022); A probabilistic formulation of contextual bias in forensic analysis, *Journal of the Royal Statistical Society, Series A*. 185 (2) (S620–S643).
- Cuellar, M., Gonzalez, C., Dror, I. (2022). Human and machine similarity judgments in forensic firearm comparisons. *Forensic Science International: Synergy*, (5) 100283.
- Chalfin, A., Kaplan, J., Cuellar, M. (2021). Measuring marginal crime concentration: A new solution to an old problem. *Journal of Research in Crime and Delinquency*, 58(4), 467–504.
- Lowenstein, M., Feuerstein-Simon, R., Dupuis, R., Herens, A., Hom, J., Sharma, M., Sheni, R., Encarnacion, L., Flaherty, C., Cuellar, M., Cannuscio, C. (2021). Overdose Awareness and Reversal Trainings at Philadelphia Public Libraries. *American Journal of Health Promotion*, 35 (2), 250-254.
- Cuellar, M., & Kennedy, E. H. (2020). A non-parametric projection-based estimator for the probability of causation, with application to water sanitation in Kenya. *Journal of the Royal Statistical Society: Series A*, 183(4), 1793-1818.
- Mejia, R., Cuellar, M., Salyards, J. (2020). Implementing Blind Proficiency Testing in Forensic Laboratories: Motivation, Obstacles, and Recommendations. *Forensic Science International: Synergy*, (2), 293-298.
- Ling, S., Kaplan, J., Cuellar, M. (2020). Public Beliefs About the Accuracy and Importance of Forensic Evidence in the United States. *Science & Justice*, 60(3), 263-272.
- Moral, J., Hundl, C., Lee, D., Neuman, M., Grimaldi, A., Cuellar, M., Stout, P. (2019). Implementation of a blind quality control program in blood alcohol analysis. *Journal of Analytical Toxicology*, 43(8), 1-7.
- Cuellar, M. (2018). Trends in Underreporting of Marijuana Consumption in the United States. *Statistics and Public Policy*, 5(1), 1-10.
- Cuellar, M. (2017). Causal reasoning and data analysis: Problems with the abusive head trauma diagnosis, *Law, Probability and Risk*; 16(4): 223-239.

### Invited

- Cuellar, M. (2022). Causes of Effects and Effects of Causes. In *Statistics in the Public Interest, Data Sciences Book Series*, (pp. 211-233). Springer, Cham.
- Cuellar, M. (2022). Discussion of ‘Experimental Evaluation of Algorithm-Assisted Human Decision-Making: Application to Pretrial Public Safety Assessment’, *Journal of the Royal Statistical Society: Series A*, 2022, forthcoming.
- Stern, H.S., Cuellar, M., Kaye, D. (2019). Reliability and Validity of Forensic Evidence. *Significance Magazine*, 16(2), 21-24.
- Mejia, R., Cuellar, M., Delger, D., Eddy, W. (2019). What Does a Match Mean? A Framework for Understanding Forensic Comparisons. *Significance Magazine*, 16(2), 25-28.
- Cuellar, M., Mentch, L., Spiegelman, C. (2019). Association does not imply discrimination: Flawed analyses that lead to wrongful convictions. In *Handbook of Forensic Statistics*, (pp. 131–142). Chapman & Hall/CRC Handbooks of Modern Statistical Methods.

### Not peer-reviewed

- Cuellar, M. (2017). Short fall arguments in court: A Probabilistic Analysis, 50 *U. Mich. J. L. Reform* 763.

## WORK IN PROGRESS

- An algorithm for forensic toolmark identification – H. Hofmann, S. Gao (<https://doi.org/10.48550/arXiv.2312.00032>)
- A hierarchical model to study forensic toolmark identification – with Shane Jensen, Alex Knorre
- A causal analysis of prevention and awareness campaigns for Shaken Baby Syndrome
- Accuracy and fairness in police use of facial recognition

## GRANTS

- 2022–2023 **Awardee**, Oracle for Research Grant, to develop an algorithm to compare 3D forensic toolmarks.
- 2021–2024 **Statistical Consultant**, Award Number: 15PNIJ-21-GG-04192-RESS, National Institute of Justice, Office of Justice Programs, 2021 Research and Development in Forensic Science for Criminal Justice Purposes.
- 2020–2025 **Principal Investigator**, NIST grant to study forensic toolmark analysis for CSAFE.
- 2018 **Research Affiliate**, Quattrone Center grant to study contextual bias in forensic science.

## SOFTWARE

R package, nonparametric estimation of probability of causation: [github.com/mariacuellar/pcausation](https://github.com/mariacuellar/pcausation)

## PROFESSIONAL SERVICE

- 2024–2026 **Program Chair**, Social Statistics Section, American Statistical Association (ASA)
- 2022–2023 **Member**, Discussion Meetings Committee, Royal Statistical Society (RSS)
- 2021–2023 **Chair (previously vice-chair and member)**, ASA Advisory Committee on Forensic Science
- 2021–2023 **Member**, Royal Statistical Society (RSS) Statistics and Law Section
- 2021–2023 **Affiliate (previously member)**, Friction Ridge Subcommittee within the OSAC for Forensic Science
- 2019–2020 **Publications Officer**, American Statistical Association Biometrics Section
- 2018–2023 **Expert Witness**, The Innocence Project, and others
- 2018 **Co-organizer**, CSAFE workshop about blinding in forensic proficiency testing and casework

## TEACHING

### *Primary Instructor*

- 2021-2023 Instructor for “Statistics for the Social Sciences” (Penn CRIM 604-250)
- 2019-2023 Instructor for “Criminal Justice” (Penn CRIM 604-200)
- 2018-2023 Instructor for “Forensic Analysis” (Penn CRIM 604-240)

## STUDENT ADVISING

- 2024 **Nicole Mendez**, Undergraduate senior thesis in criminology.  
TBD.
- 2023 **Dane Isenberg**, Master’s thesis in biostatistics.  
“The probability of causation: Evaluating Respiratory Health and Indoor Air Pollution”
- 2022 **Kaiyla Jolley**, Undergraduate senior thesis in criminology.  
“Discrimination in forensic pathology decisions”
- 2022 **Theodora Athanitis**, Undergraduate senior thesis in criminology (Best thesis award in the department).  
“Racial disparities in Shaken Baby Syndrome diagnoses and criminal trials”.
- 2022 **Eliza Epstein**, Undergraduate senior thesis in criminology.  
“Medical Care in Jails: A Study of the Accessibility of Healthcare in Correctional Facilities”.
- 2019 **Jakob Lennart Dührsen**, Undergraduate senior thesis in sociology.  
“Reporting Behavior of Victims of Same-Sex Intimate Partner Violence”.

## JOURNAL REFEREE SERVICE

2023	Annals of Applied Statistics
2022	Journal of Quantitative Criminology (2018-2022)
2021	Journal of the Royal Statistical Society, Series A
2021	Forensic Science International
2020	Handbook of Forensic Statistics, Chapman & Hall/CRC Handbooks of Modern Statistical Methods
2019	Journal of Causal Inference
2019	Science Advances
2019	Health Services and Outcomes Research Methodology
2019	Statistical Science
2018	Statistics in Medicine
2018	Trauma, Violence, and Abuse
2018	Law, Probability and Risk
2014	International Journal of Drug Policy

## PRESENTATIONS

### Invited

1. Johns Hopkins Biostatistics Seminar (5/2024)  
**“An Algorithm for Forensic Toolmark Comparisons”**
2. Temple University (4/2024)  
**“A nonparametric estimator for the probability of causation”**
3. ENAR Conference (3/2024)  
**“Accuracy and Fairness of Facial Recognition Algorithms in Law Enforcement”**
4. Association of Firearm and Tool Mark Examiners Conference (5/2024), CSAFE All Hands Meeting (6/2024), Joint Statistical Meetings (8/2023), CMStat Conference (12/2023), Gun Violence Center, Johns Hopkins (3/2024)  
**“An Algorithm for Forensic Toolmark Comparisons”**
5. American Academy for the Advancement of Science (9/2023)  
**“A nonparametric estimator for the probability of causation”**
6. Blackwell Seminar, University of Washington, Statistics Department (10/27/2023)  
**“Statistics and the law: Causal inference, forensic analysis, and systemic bias in criminal justice”**
7. Joint Statistical Meetings (8/10/2022)  
**“An Algorithm for Forensic Toolmark Comparisons”**
8. Joint Statistical Meetings (8/10/2022)  
**“The Impact of COVID-19 Lockdowns on Crime: Causal Evidence from Bogota, Colombia”**
9. JRSS Series A Discussion Paper Meeting, Discussant (2/8/2022)  
**Discussion of ‘Experimental Evaluation of Algorithm-Assisted Human Decision-Making’**
10. ASA Florence Nightingale David Award Lecture, Discussant (8/12/2021)  
**“Alicia, Forensics, and the Public Good”**
11. Northwestern University, Statistics Seminar (5/19/2021)  
**“A Nonparametric Estimator for the Probability of Causation”**
12. Board for Judicial Administration, Conviction Integrity Units and Innocence Organizations (3/10/2021)  
**“A statistical perspective on forensic science”**
13. University of Massachusetts Amherst, Mathematics and Statistics Seminar (2/26/2021)  
**“A Nonparametric Estimator for the Probability of Causation”**
14. Vanderbilt University, Biostatistics Seminar (2/24/2021)  
**“A Nonparametric Estimator for the Probability of Causation”**

15. Royal Statistical Society International Conference (9/2020)  
**“Causation in Statistics: Tools to Formalize and Analyze Legal Arguments”**
16. Joint Statistical Meetings (8/12/2020)  
**“A Probabilistic Formalization of Contextual Bias in Forensic Analysis”**
17. Joint Statistical Meetings (7/2020)  
**“Re-Examining the Law of Crime Concentration: Between- and Within-City Evidence”**
18. Drexel University, Epidemiology and Biostatistics Seminar (10/2019)  
**“A Nonparametric Estimator for the Probability of Causation”**
19. Oregon Health and Sciences University, Department of Internal Medicine Seminar (10/2019)  
**“A Nonparametric Estimator for the Probability of Causation”**
20. Yale University, Quantitative Research Methods Workshop (9/2019)  
**“A Nonparametric Estimator for the Probability of Causation”**
21. Capital Habeas Corpus of Pennsylvania Conference, Plenary talk (4/2019)  
**“A Statistical Perspective on Forensic Science”**
22. NYU School of Medicine, Biostatistics Seminar (1/2019)  
**“A Nonparametric Estimator for the Probability of Causation”**
23. Harvard University, Biostatistics Seminar (12/2018)  
**“A Nonparametric Estimator for the Probability of Causation”**
24. Rutgers School of Public Health, 21st Century Seminar Series (10/2018)  
**“A Nonparametric Estimator for the Probability of Causation”**
25. Harvard University, Data Science Initiative (10/2018)  
**“A Nonparametric Estimator for the Probability of Causation”**
26. University of Cambridge, Isaac Newton Institute for Mathematical Sciences (9/2016)  
**“Shaken Baby Syndrome: A Statistical Analysis of Arguments Made by Defense and Prosecution”**
27. West Virginia Law Review, Symposium on Flawed Forensics and Innocence panel (3/2016)  
**“A Probabilistic Analysis of Short Fall Arguments in Legal Cases of Abusive Head Trauma”**
28. University of Michigan Law School, Child Abuse Evidence Symposium (11/2015)  
**“A Probabilistic Analysis of Short Fall Arguments in Legal Cases of Abusive Head Trauma”**

#### Contributed

1. Joint Statistical Meetings (7/2016, 7/2017, 7/2018, 7/2019), Included:  
**“Weeding Out Underreporting: A Study of Trends in Reporting of Marijuana Consumption in the US”**
2. Atlantic Causal Inference Conference (5/2017, 6/2018, 5/2019), Included:  
**“Can We Attribute Suicide to an App? An Application of the Probability of Causation”**
3. CSAFE All Hands Meeting at Iowa State University (6/2017, 6/2018, 5/2019), Included:  
**“Human and Algorithmic Similarity Judgments in Forensic Firearm Comparisons”**
4. Blinding in Forensic Laboratories Workshop (11/2018)  
**“Blinding in Forensic Laboratories: Proficiency Testing and Casework”**
5. Quattrone Center Advisory Board Meeting (4/2018)  
**“A comparison of Similarity Scores Between Bullet Casings”**
6. 10th International Conference on Forensic Inference & Statistics (9/2017)  
**“Causes of Effects and Effects of Causes: A Statistical Analysis of Shaken Baby Syndrome”**
7. Shaken Baby Syndrome Webinar (7/2017)  
**“Observational Studies and Systematic Reviews”**
8. American Academy of Forensic Sciences 69th Meeting (02/2017)  
**“Review of a Statistical Tool to Aid in the Diagnosis of Abusive Head Trauma”**

9. Statistical and Applied Mathematical Sciences Institute, Forensics Workshop (5/2016)  
**“Shaken Baby Syndrome on Trial: Sources of Contextual Bias”**
10. Statistical and Applied Mathematical Sciences Institute, Women in Mathematical Sciences (4/2016)  
**“A Probabilistic Analysis of Short Fall Arguments in Legal Cases of Abusive Head Trauma”**

## PRACTICE ACTIVITIES

### EXPERT WITNESS IN CRIMINAL TRIALS ABOUT SCIENTIFIC VALIDITY OF FORENSIC METHODS

I have written reports and court records for the cases described in this section. I have worked as an expert witness on the statistical foundations of forensic science, mostly for public defenders and always for the defense. Participating as an expert in legal cases has allowed me to learn how statistical concepts are used in forensic science practice, both in laboratories and in the courts. It has given me ideas for research and teaching. I also believe that this work is valuable to effect change in the lives of individuals who were wrongfully convicted, and those who will be tried in the future, since my records can be used as legal precedent.

- 2020      **Appeals of two death sentences, Court of Common Pleas of Clearfield County, PA.**  
 Expert witness for the defense, the Capital Habeas Unit of Pennsylvania, which represents both state and federally death-sentenced prisoners in post-conviction proceedings. My role was to write an expert report and advise the defense about the lack of validity of forensic hair microscopy, according to my assessment of the literature. I also gave oral testimony.
- 2021      **Appeal of a life in prison sentence, Colorado Court of Appeals, CO.**  
 Consultant for the defense, the Innocence Project of New York, which defends wrongfully convicted individuals. My role was to review all the relevant literature about forensic toolmark analysis (approx. 300 articles) and advise the defense about the lack of validity of forensic toolmark comparisons, according to my assessment of the literature.
- 2022      **Appeal of a death sentence, Court of Common Pleas of Greene County, OH.**  
 Expert witness for the defense, the Capital Habeas Unit of Ohio, which represents both state and federally death-sentenced prisoners in post-conviction proceedings. My role was to write an expert report and advise the defense about the lack of validity of forensic hair microscopy, according to my assessment of the literature.
- 2022      **Dropping charges in traffic stop, Boston Juvenile Court, MA.**  
 Expert witness for the defense, the Public Defender Division of the Committee for Public Counsel Services, which defends juveniles in the Boston courts. My role was to do a statistical analysis to test whether the police had disproportionate traffic stops based on race. These charges were dropped, so I did not give an oral argument.
- 2023      **Ongoing case, Court of Appeals of Pennsylvania.**  
 Expert witness for the defense, a private attorney. My role is to analyze the arguments made by the prosecution's expert about whether bruises can be used to determine whether a case is a Shaken Baby Syndrome case, based on my assessment of the literature. I wrote a report, advised the defense, and plan to give oral testimony.
- 2023      **Appeal of a homicide case with long sentences, Court of Appeals of Illinois.**  
 Expert witness for the defense, the Innocence Project of Illinois. My role is to analyze the arguments made by the prosecution's expert about whether buttons found at the crime site can be used to argue that the defendants committed a homicide. I wrote an expert report and will give oral testimony about trace evidence for the defense.
- 2023      **Ongoing case, Court of Appeals of California.**  
 Expert witness for the defense, the Northern California Innocence Project. My role is to analyze the arguments made by the prosecution's expert about whether a short fall can be used to determine whether a case is a Shaken Baby Syndrome case, based on my assessment of the literature. I wrote a report, advised the defense, and plan to give oral testimony.

## OTHER LEGAL WORK

Amicus briefs are read by judges to become informed about the facts of a case by individuals who are not part of the defense or prosecution. The briefs in which I have been involved have set important precedents for the introduction of blood spatter and firearms testimony in court that is not based on evidence.

- 2019      **Participant** in Amicus brief, Joe Bryan case, blood spatter evidence, Texas Court of Criminal Appeals.
- 2023      **Participant** in Amicus brief, Kobina Ebo Abruquah case, firearms evidence, Maryland Court of Appeals.