

Statistics and Applied Mathematics in Forensic Science

Final Report on 2015–16 SAMSI Program

Program Leader: Cliff Spiegelman, Texas A& M University

SAMSI Directorate Liaisons: Nell Sedransk and Richard Smith

1 Overview of Program

Forensic science uses scientific principles and methods to analyze materials collected at crime scenes, in order to connect these materials to suspects. According to the Locard exchange principle, every contact will cause a transfer of material. Thus, criminals leave material at crime scenes. Forensic scientists investigate this material.

Forensic science is, in major part, based upon statistical comparisons of the characteristics of a material left at a crime scene to characteristics of a source or suspect. These comparisons are often acknowledged by forensic scientists to be highly subjective. Indeed, some forensic scientists deny the need for statistics. For example in firearm/toolmarks, they many testify that “they do not need the science of statistics because they dont use numbers”.

Over the past several years, the National Research Council (NRC) has convened committees that have raised deep questions about major forms of forensic evidence, including:

- Bullet lead: “the bullet recovered from the victim matches the bullets found in the suspects house” (NRC, 2004);
- Ballistic evidence: “the marks on the bullet recovered at the crime scene match the suspects gun” (NRC, 2008);

The 2009 NRC report *Strengthening Forensic Science in the United States: A Path Forward* made a clear case for a needed statistical underpinning for forensic procedures, including fingerprints, patterns and impressions (footprints and tire tracks), toolmarks and firearms, hair, fibers, documents, paints and coatings, bloodstains, and fire debris.

For example, in regard to friction ridge analyses (fingerprints) the NRC wrote, “To properly underpin the process of friction ridge identification, additional research is also needed into ridge flow and crease pattern distributions on the hands and feet. This information could be used to limit the possible donor population of a particular print in a statistical approach and could provide examiners with a more robust understanding of the prevalence of different ridge flows and crease patterns. Additionally, more research is needed regarding the discriminating value of the various ridge formations and clusters of ridge formations. This would provide examiners with a solid basis for the intuitive knowledge they have gained through experience and provide an excellent training tool. It also would lead to a good framework for future statistical models and provide the courts with additional information to consider when evaluating the reliability of the science. Recently, research has begun to build some of this basis [emphases added].”

The need for increased presence of mathematical techniques and mathematical underpinnings has also been documented elsewhere. There have been 316 DNA exonerations in the United States. Presently, unvalidated and improper forensic science has contributed to approximately half of all DNA exonerations. According to the NAS report, “Many of the processes used in the forensic science disciplines are largely empirical applications of sciencethat is, they are not based on a body of knowledge that recognizes the underlying limitations of the scientific principles and methodologies used for problem solving and discovery. It is therefore important to focus on ways to improve, systematize, and monitor the activities and practices in the forensic science disciplines and related areas of inquiry. Thus, in this report, the term ‘forensic science’ is used with regard to a broad array

of activities, with the recognition that some of these activities might not have a well-developed research base, are not informed by scientific knowledge, or are not developed within the culture of science.” (p. 39)

Thus, forensic science is data-driven. The central goal of the SAMSI program was to strengthen the statistical and applied mathematical bases of forensic science.

Cliff Spiegelman served as the lead chair for the program, assisted by Karen Kafadar (University of Virginia) and Cedric Neumann (South Dakota State University).

We now list the major events of the program. Detailed schedules for the workshops are given in the Appendix.

2 Program Leadership and Visitors

2.1 Program Leaders

- Cliff Spiegelman, Texas A& M University
- Cedric Neumann, South Dakota State University
- Karen Kafadar, University of Virginia
- Eugene Fiorini, Muhlenberg College
- Anil Jain, Michigan State University
- William Tobin, Forensic Engineering International
- Sandy Zabell, Northwestern University

2.2 Local Scientific Coordinators

- Len Stefanski, NCSU
- David Banks, Duke
- Alan Karr, RTI International

2.3 SAMSI Directorate Liaisons

- Nell Sedransk
- Richard Smith

2.4 Postdoctoral Scholars

- Lucas Mentch, mentored by Len Stefanski (NCSU)
- Duy Thai, mentored by David Banks (Duke)

2.5 Graduate Fellows

- Munir Winkle, mentored by Len Stefanski (NCSU)
- Christopher Glynn, mentored by David Banks (Duke)

2.6 Visitors

- Cliff Spiegelman, Texas A& M University
- Cedric Neumann, South Dakota State University
- Karen Kafadar, University of Virginia
- Stephan Huckemann, University of Göttingen, Germany
- Michael Lavine, University of Massachusetts Amherst
- Vered Madar, Chapel Hill, NC
- Christopher Saunders, South Dakota State University

3 Activities

3.1 Planning Workshop: September 19, 2014

Organizer: Nell Sedransk (SAMSI/NISS)

An initial planning meeting was held at SAMSI to bring together organizers and leading participants in the program.

3.2 NISS Workshop: Crime Lab Needs and Statistics/Mathematics Potential Contributors, May 11, 2015

Organizer: Nell Sedransk (SAMSI/NISS)

This one-day working session was held at the Washington headquarters of NISS (1050 Connecticut Avenue, NW, Washington, DC 20036). The purpose was understanding priorities for attacking mathematical and statistical issues that can affect the quality or the credibility of pattern evidence.

3.3 Tutorial on Forensics: August 27–29, 2015.

Organizers: Cliff Spiegelman (Texas A&M University) and Len Stefanski (North Carolina State University)

This 2.5-day workshop was held at SAMSI and aimed to introduce participants at all levels (from graduate students, to postdocs, to junior and senior faculty in academic institutions) and all mathematical backgrounds (statistics, applied mathematics, computation and computing/information technology) to current state-of-the-art forensic science and point out the need for research in statistical methods for pattern evidence. It served also to create a forum for generation and discussion of ideas for tackling the challenges in placing forensic science on a sound statistical/applied mathematical foundation, and to provide the necessary background for participation in the 2015-2016 SAMSI program.

3.4 Opening Workshop: August 31–September 4, 2015.

The Opening Workshop was held at the North Carolina Biotechnology Center in Research Triangle Park, NC, and featured 2.5 days of invited talks followed by a Working Group Formation session. The last two days were devoted to initial meetings of the working groups. By a special arrangement with RTI International, the entire workshop was videotaped and livestreamed. Highlights of the workshop included a Distinguished Lecture by Peter Neufeld of The Innocence Project, and a lunchtime talk by Gerald LaPorte of the National Institute of Justice, which focussed on funding opportunities at the National Institute of Justice.

In addition to a wide range of academic speakers, there were speakers representing The National Academies, The law firm Black & White Forensics, Israeli Police, the Houston Forensics Science Center, the Virginia Department of Forensic Sciences, Federal Circuit Court of Appeals, and The Innocence Project.

The organizers viewed the workshop as successful despite the relatively low in-person attendance. The webstream service provided by RTI proved to be popular and there were about 140 participants combining those in-room and online. The last two days of the workshop resulted in seven working groups — WG1 (bias) seemed rather small and of unclear focus, while WG7 (on communication and education issues, led by Colin Aitken and Anjali Mazumder) had a different focus from the others, their main objective being a substantial survey paper for publication in a legal journal and possible discussion with various European organizations concerned with forensic science. However, the communications difficulties associated with maintaining a transatlantic working group proved to be insuperable and the intended paper was never produced. In between these two, however, there were five research-oriented WGs with a clear focus:

- WG2, quality metrics, led by Karen Kafadar (Virginia) and Anil Jain (Michigan State)
- WG3, quasi-experiments, led by Dennis Lin (Penn State)
- WG4, image analysis focusing on shoeprints and on ballistic images (Nell, Cliff, Sarena Wiseman from Israel). This may split into two groups.
- WG5, ordered lists, Len Stefanski
- WG6, interpretation of forensic evidence, led by Cedric Neumann (meeting together with WG4)

The visit by Gerry LaPorte from the National Institute of Justice was considered a great success. He clearly engaged the audience and his visit coincided with the announcement of a new funding opportunity which may be suitable for researchers in math sciences.

It was agreed that it would be desirable to continue to access RTI's archives of the meeting.

3.5 Undergraduate Workshop: February 22-23, 2016

The undergraduate workshop featured a series of lectures at SAMSI and a tour of the Raleigh/Wake CCBI Laboratory.

3.6 Shoeprint Workshop

The shoeprint workshop held in March 2016 purpose was to advance three forensic papers in progress. Current forensic papers posit that accidental marks used to forensically link crime scene prints to suspect shoes are uniformly distributed on the contact surface of shoes and also the accidentals are assumed mutually independent. SAMSI researchers analyzed one of the two known shoeprint databases conclusively showing both assumptions are false. This was planned to be the content of one paper. According to the well known 2009 NRC report on forensic science, the main defect of forensic pattern methods such as firearm/toolmarks, shoeprints, tire marks etc. is the lack of a standard operating procedure (SOP).

A second paper from this group was planned to provide a path forward to an SOP for shoeprints. A third paper will deal with a machine learning approach to element (designed squares, waves, triangles, etc. of shoe soles) and also some automated detection of accidentals.

3.7 Transition Workshop: May 9-11, 2016

The transition workshop included presentations from the five main active working groups: Fingerprints; Images; Pattern Evidence; Shoeprints and Ballistics; and Bias. The last day looked forward to future activities in both research and education.

4 Graduate Courses

There was a two-part course entitled "Statistics and Applied Mathematical Science Aspects of Forensic Science" taught in Fall 2015 and Spring 2016. Most of the classes featured guest lectures from within the Triangle and beyond. The list of individual classes is as follows:

- August 25 Theresa Newman (What is forensic science and why does it matter?)
- September 1 (opening workshop, no class)
- September 8 Andy Parker (How does a crime lab operate and what does it do?)
- September 22 Cedric Neumann (Inference on identity of source part 1 (introduction to decision models.)
- September 29 Chris Saunders (inference of identity of source part 2, Bayes' factors, LR, specific versus common source.)

- October 6 Cedric Neumann (pattern matching, via web)
- October 13 Cedric Neumann (stat science contributions to fingerprints, via web)
- October 20 Cliff Spiegelman (firearm toolmarks)
- October 27 Arun Ross (automated fingerprints)
- November 3 Mary and Peter Bush (bite marks)
- November 10 David Sheets (statistical matching for bite marks)
- November 17 Cliff Spiegelman or Bill Tobin (bullet lead)
- December 1 Bill Thompson (human factors and bias)
- January 13 Sandy Zabell (Human Factors in Forensic Science)
- January 20 David Banks (Expert Witness: The Sheriff Johnson Trial)
- January 27 Michael Lavine (Bayesian inference)
- February 3 Austin Hicklin (Validation of Large Scale Biometric Systems)
- February 10 Cedric Neumann (Introduction to interpretation of forensic evidence — interpretation of trace evidence)
 - February 17 Karen Kafadar (Bullet Lead Analysis / Eyewitness Identification)
 - February 24 Cedric Neumann (Functional Data Analysis of inks)
 - March 2 Nick Petraco (Statistical Models for Toolmarks)
 - March 23 Don Gants, Sciometrics (Statistical models for Fingerprints/Questioned Documents)
 - March 30 Cedric Neumann (Introduction to Forensic DNA Statistics)
 - April 6 Simone Gittleson, NIST (Forensic DNA mixture interpretation)
 - April 13 Simone Gittleson, NIST (Bayes Nets in Forensic DNA interpretation)
 - April 20 Student presentations, coordinated by Cedric Neumann and Len Stefanski

5 Working Group 1 report (Bias)

Regular participants were: William Thompson (UC Irvine), Maria Cuellar (gradUATE student at Carnegie Mellon), Lucas Mentch (SAMSI postdoc), Clifford Spiegelman (Texas A&M). Also participating were Jared Murray (Carnegie Mellon), Michael Lavine (University of Massachusetts at Amherst) and Vered Madar (SAMSI visitor).

The goals were to advance the understanding of bias and the statistical tools needed to reduce and model bias. There were two main thrusts. The first was to show that forensic markers used for AHT (known as shaken baby syndrome) and arson etc. resulted from bad statistical designs. Those bad designs are not dissimilar to other bad designs used for cancer biomarkers. The results are demonstrably tragic. The second thrust with William Thompson as the leader showed that blinding in crime labs can be done effectively despite many saying it is not possible. The group worked with the Houston Forensic Science LGC (HFSLGC) and developed a paper from this effort. Four of the SAMSI workgroup participants (Thompson, Cuellar, Murray and Spiegelman) visited the HFSLGC in February 2016.

6 Working Group 4 report (Shoeprints)

The regular participants were: Sarena Wiesner and Yaron Shor (Israeli Police); Naomi Kaplan (graduate student from Israel); Yoram Yukutieli (Hadassah Academic College, Israel); Stephan Huckemann (Georgia Augusta University, Göttingen, Germany); Anton Nickel (graduate student of Stephan Huckemann), Vered Madar (SAMSI); David Banks (Duke); Munir Winkle (NCSU); Cliff Spiegelman (Texas A&M University).

The goals of the group were to advance the understanding and set a foundation for shoeprints. They also did IR image ballistics as a subgroup with Winkle and Spiegelman. It was intended to do more ballistics but with the csafe center issues but they got dropped. The group worked on segregating shoe elements, from accidentals (design elements from tears and other identifying marks), and also creating residual images. They also modeled shoe image dependence. They worked on three

papers. The first was on characteristics of discredited techniques. A second was by Huckemann on segmented images, and a third on the independence of size, shape, and location models for shoeprint accidentals. SAMSI postdoc Lucas Mentch was involved in both workgroup projects. Sources of data: David Sheets provided his longitudinal shoeprint study prints and the Israelis made their shoeprint accidentals available to SAMSI.

7 Working Group 6 report (Evidence)

The main participants were: Cedric Neumann (Group leader) — Assistant Professor of Statistics, Department of Mathematics and Statistics, South Dakota State University; Dr. Michael Lavine — Professor of Statistics, Department of Mathematics and Statistics, University of Massachusetts Amherst; Christopher P. Saunders — Assistant Professor of Statistics, Department of Mathematics and Statistics, South Dakota State University; Vered Madar — Research Fellow at SAMSI; Elham Tabassi — Electronics Engineer, National Institute of Standard and Technology; Naomi Kaplan — PhD candidate in Statistics, Department of Statistics, Hebrew University of Jerusalem, Israel.

The purpose of the working group was to investigate and develop statistical models for the quantification of forensic evidence, and in particular fingerprint and shoeprint. More specifically, the goal of the working group was to propose models to characterize the variation in the spatial distribution of landmarks (e.g., friction ridge events, such as minutiae; or cuts and damages on shoe soles) given that (1) the landmark originates from a given person/shoe, and (2) a population of individuals/shoes. Since there is a debate on the use of similarity-scores for the assignment of probability distributions to fingerprint features, the WG decided to investigate alternative approaches to quantify the weight of forensic evidence. These alternative approaches are based on the modeling of the features of the objects, rather than the level of similarity of pairwise comparisons.

The WG members identified two main statistical areas of research: (1) common principal component analysis and (2) statistical models for deformable templates. In addition to (1), which is based on the distribution of PCA scores, (1b) will explore the possibility of using test statistics developed based on Cholesky decomposition. These areas are based on the research by:

- Allasonniere, S., Amit, Y., Troune, A. (2007), Towards a Coherent Statistical Framework for Dense Deformable Template Estimation, *Journal of the Royal Statistical Society, Series B* **69(1)**, 3–29
- Haufe, S., Nikulin V.V., Ziehe, A., Mueller, K.-R., Nolte, G. (2008), Estimating vector fields using sparse basis field expansions, *Advances in Neural Information Processing Systems* **21** — Proceedings of the 2008 Conference. 617–624
- Flury, B.N. (1984), Common Principal Components in K Groups, *Journal of the American Statistical Association* **79(388)**, 892–898
- Olkin, I. (1985). Estimating a Cholesky decomposition. *Linear Algebra and its Applications* **67**, 201–205.

Both approaches were investigated by the WG members. In particular, Drs. Lavine, Neumann and Madar worked together on these projects with the aim of proposing 1-2 publication(s) on behalf of the working group within the timeframe of the SAMSI program.

Fingerprint data for this particular WG was provided by Dr. Cedric Neumann from datasets available at SDSU. The fingerprint data is anonymous (all PII have been removed) and currently used in a NIJ funded project. The raw data cannot be made available at the end of the project.

**APPENDIX:
WORKSHOPS FOR THE SAMSI FORENSICS PROGRAM**

1. 2015-16 Forensics Program Planning Meeting, September 19, 2014, at SAMSI.

Background and Fundamental Quantitative Issues for Forensics

- | | |
|---------------|---|
| 9:00 – 9:15 | Nell Sedransk , NISS - Welcome |
| 9:15 – 9:35 | Cliff Spiegelman , Texas A&M University & Karen Kafadar ,
University of Virginia |
| 9:35 – 9:55 | Cedric Neumann , South Dakota State University |
| 9:55 – 10:15 | Lyn Haber , Human Factors Consultants |
| 10:15 – 10:35 | Gene Fiorini , Rutgers University |
| 10:35 – 11:00 | Break |
| 11:00 – 12:00 | Richard Smith , SAMSI - Program Objectives and Elements |
| 12:00 – 1:00 | Lunch (SAMSI Commons) |

Observations and Discussion of Topics

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|-------------|---|
| 1:00 – 1:30 | Bill Tobin , Forensic Engineering Int'l & Harry Wechsler , George Mason
University - Discussants |
|-------------|---|

Planning the SAMSI Program

- | | |
|-------------|--|
| 1:30 – 3:00 | Framing the Key Elements of the Program & Additional Questions
– Richard Smith , SAMSI |
| 3:00 – 3:30 | Break |
| 3:30 – 5:00 | Specific Plans and Action Items |
| 5:00 | Adjourn |

2. Tutorial Workshop: August 27 – 29, 2015, SAMSI.

Thursday, August 27th

What is Forensic Science?

- 8:30 Registration
- 9:00 **Bill Tobin**, Forensic Engineering International
“What is ‘Forensic Science’? A USMC Methodology for Amplification”
- 10:00 **Bill Tobin**, Forensic Engineering International
“What Does the Law Say about Scientific Evidence used in Court and how do the Courts Interpret it?”
- 11:00 Break
- 11:30 **Cliff Spiegelman**, Texas A&M University
“The Practice of Firearm/Toolmarks and a Reasonable Path Forward “
- 12:30 Lunch
- 2:30 **Andy Parker**, CCBI
Lab: Crime Scene
“Gathering Evidence at a Mock Crime Scene; Sample Reports and Evidence that go to Crime Labs are Provided to Participants”
- 4:45 Wrap-up and Summary

Friday, August 28th

What is Pattern Evidence?

- 9:00 **Cedric Neumann**, South Dakota State University
“What is Pattern Evidence?”
- 10:00 Break
- 10:30 **Herbert David Sheets**, Cansius College and University at Buffalo
“Bitemark Analysis”
- 11:30 Lunch
- 1:00 Lab: Pattern Evidence
“Marking up Fingerprints, Shoe Prints, etc. and Making Comparisons”

3:15 Wrap-up and Summary

Saturday, August 29th

How Should Evidence be Presented in Court?

9:00 **Cedric Neumann**, South Dakota State University
“Presenting Evidence to Be Relevant, Correct and Convincing”

10:00 Break

10:30 **Sandy Zabell**, Northwestern University
“Human Factors in Forensic Science”

11:30 Lunch

1:00 Lab: Bias
“Conducting a Mock Bias Experiment and Practicing Presentation of Evidence”

3:15 Wrap-up and Summar

3:30 Adjourn

3. Opening Workshop: August 31 – September 4, 2015, North Carolina Biotechnology Center.

Monday, August 31st

Hamner Conference Center Auditorium

- 8:30-8:45 Registration
- 8:45 **Richard Smith**, SAMSI
Welcome
- 9:00 **Bill Tobin**, Forensic Engineering International
“What Is . . .?”
- 9:45 Discussant: **Anne-Marie Mazza**, The National Academies

 Open Discussion
- 10:00-10:15 Break
- 10:15 **Karen Kafadar**, University of Virginia
“The Role of Statistics in Forensic Science”

 Open Discussion
- 11:15 Distinguished Lecture
Peter Neufeld, Innocence Project
“Upstream Remedies to Prevent Wrongful Convictions: The Statistical Significance of Research”
- 12:00-1:15 Lunch (Galleria)
- 1:15 **John Black**, Black & White Forensics, LLC
“Fundamental Tenets of Latent Fingerprint Examination”
- 2:00 **Elham Tabassi** - NIST
“Automated Fingerprint ID”

 Open Discussion
- 3:00-3:30 Break
- 3:30 **Sarena Wiesner**, Israel Police
“Shoepri nts, Casts and Imaging”
- 4:15 **Jacqueline Spier**, West Virginia University

Imaging Science and Shoeprints”

Open Discussion

5:30-7:00

Reception and Poster Session

(The board dimensions are 4 ft. wide by 3 ft. high. They are tri-fold with each side being 1 ft. wide and the center 2 ft. wide. Please make sure your poster fits the board. The boards can accommodate up to 16 pages of paper measuring 8.5 inches by 11 inches.)

Tuesday, September 1st

Hamner Conference Center Auditorium

8:45-9:00

Registration

9:00

Stephan Huckemann, University at Gottingen
“Challenges in Image Analysis of Fingerprints”

9:45

Yoram Yekutieli, Hadassah Academic College, Jerusalem
“Challenges in Image Analysis of Shoeprints”

Open Discussion

10:30-11:00

Break

11:00

Anil Jain, Michigan State University
“Forensic Pattern Recognition”

Open Discussion

12:00-1:30

Lunch (Galleria)

Lunch Speaker: (Dogwood Room)

Gerald LaPorte, National Institute of Justice
“Research Priorities and Funding Opportunities at the National Institute of Justice”

1:30

William Thompson, University of California at Irvine
“Managing Contextual Bias in Forensic Science”

2:15

Sandy Zabell, Northwestern University
“Detecting Bias: Approaches and Examples”

Open Discussion

- 3:15-3:45 Break
- 3:15 **Colin Aitken**, University of Edinburgh
*“Evaluation and Interpretation of Evidence:
What Can Be Done, What Is Done, What Should Be Done”*
- 4:00 **Clifford Spiegelman**, Texas A&M University
*“Firearm/Toolmarks: Finding and Planting the Seeds of Engineering and
Science”*
- Open Discussion

Wednesday, September 2nd
Hamner Conference Center Auditorium

- 8:30-8:45 Registration
- 8:45 Panel:
Dan Garner, Houston Forensics Science Center;
Dennis Lin, Pennsylvania State University
“Two Perspectives on Crime Laboratory Quality Control”
- Open Discussion
- 9:45-10:15 Break
- 10:15 Panel:
Cedric Neumann, South Dakota State University;
Kathleen O’Malley, Federal Circuit Court of Appeals
Dana Delger, Innocence Project
Linda Jackson, Virginia Department of Forensic Sciences
“Presenting Evidence to Be Relevant, Correct and Convincing”
- Open Discussion
- 11:15 **Gene Fiorini**, Muhlenberg College
“Education: Connecting Forensics and Mathematical Sciences”
- Open Discussion
- 12:15-1:30 Lunch (Galleria)
- 1:30 **Steve Fienberg**, Carnegie Mellon University
*“Making Forensic Science More Scientific: Statistics and the Evaluation of
Forensic Evidence”*

Open Discussion

2:30-3:00 Break

3:00 Working Group Formation

Thursday, September 3rd at SAMSI

9:00 - 12:00 Initial Meetings of Working Groups

12:00 - 1:00 Lunch (2nd Floor Commons)

1:00 – 5:00 Working Group Meetings

Friday, September 4th at SAMSI

9:00 - 12:00 Working Group Meetings

12:00 - 1:00 Box Lunch

1:00 Adjourn

4. Undergraduate Workshop: February 22-23, 2016

Monday, February 22 [at SAMSI](#), Room 150

- 8:15-8:30 Shuttle to SAMSI (meet in hotel lobby)
- 8:30-9:00 Registration (**Duy Hoang Thai** and **Karem Jackson**, SAMSI)
- 9:00-9:15 **Sujit Ghosh**, SAMSI/NCSU and **Jamie Nunnally**, SAMSI/NISS
Welcome and Introduction
- 9:15-10:30 **Cliff Spiegelman**, Texas A&M University
Title: What does the counting of bullets used to assassinate President Kennedy and Humpty Dumpty have in common?
- 10:30-11:45 **Andy Parker**, Raleigh/Wake CCBI Lab
Title: "The Real CSI"
- 11:45-12:30p Group Photo and Lunch at SAMSI
- 12:30p-12:45p Shuttle to CCBI Lab (Meet in Parking lot)
- 12:45p-2:00p **Sam Pennica** & Andy Parker, CCBI Lab
Overview of the crime lab and tour of facilities
- 2:00p-2:15p Shuttle back to SAMSI (meet in Lab's reception)
- 2:15p-3:15p **Lucas Mentch**, SAMSI
Title: "Making Sense of Making a Murderer"
- 3:15p-3:30p **Break**
- 3:30p-4:30p **Lucas Mentch**, SAMSI
A Tutorial on Creating Distribution-based Quality Metrics (with R demos)
- 4:30p-4:45p **Break**
- 4:45p-5:30p SAMSI Graduate students and Postdoctoral fellows
Moderators: **Adam Jaeger**, **Ben Risk**, **Munir Winkel** & **Sarah Vallelian**
Panel Discussion: Career in Mathematical Sciences
- 5:30p-6:45p Meet with SAMSI members and Dinner (2nd Floor Commons)
- 7:00p Shuttle to the Hotel

Tuesday, February 23 [at SAMSI](#), Room 150

- 8:15-8:30 Shuttle to SAMSI (Check out and meet in hotel lobby)
- 9:00-9:15 Recap: **Sujit Ghosh**, SAMSI, NCSU
- 9:15-10:30 **Cedric Neumann**, South Dakota State University
Title: Statistical analysis of fingerprint
- 10:30-11:45 **Karen Kafadar**, University of Virginia
Title: Identifying the culprit: Challenges in forensic science

5. Shoeprint Workshop: March 14 – 15, 2016

Monday, March 14, SAMSI Room 150.

8:15– 8:30 Welcome and Introductions by SAMSI Director: Richard Smith and Cliff Spiegelman, Texas A&M University

8:30 –10:00 Lecture: Shoeprint Segmentation
Stephan Huckemann (University of Göttingen)

10:00– 10:15 Break

10:15–11:45 Discussion: For Paper Describing Emerging Pattern Procedures
Cliff Spiegelman, Texas A&M University and Yaron Shor, Israel Police HQ

11:45–1:00 Lunch

1:00–2:30 Discussion: Shape Issues
Yoram Yekutieli, Hadassah Academic College Jerusalem and David Sheets, Canisius College

2:30–3:00 Break

3:00–4:45 Open Discussion and Outline of Papers

4:45 Shuttle to Hotel and Dinner on Your Own

Tuesday, March 15th SAMSI Room 150

8:00 Shuttle to SAMSI

8:30–10:00 Discussion: Shoeprint Data Analysis, Independence, and Other Topics
Naomi Kaplan, Hebrew University of Jerusalem

10:00–10:15 Break

10:15–11:45 Breakout into Paper Outlining/Writing Subgroups

11:45–1:00 Lunch

1:00–3:00 Open Discussion of To Dos

3:00 Adjourn and Shuttle to RDU Airport

6. Transition Workshop: May 9-11, 2016

Monday, May 9th

SAMSI Room 150

- 8:00-8:40 Shuttle and Registration
- 8:40– 9:00 Introductions **Richard Smith** (SAMSI) / **Cliff Spiegelman** (Texas A&M University)
Fingerprint Group
Cedric Neumann (South Dakota State Univ)
Similarity-Based Models for the Quantification of the Weight of Forensic Evidence
- 9:00 –9:30 **Michael Lavine** (U Mass)
Modeling the Spatial Relationship between Features of Forensic Interest in Fingerprints
- 9:30-10:00 Discussion
- 10:00– 10:15 Break
- 10:15-10:45 Image Group
- 10:45–11:15 **Duy Thai** (SAMSI)
Textured Image Deconvolution and Decomposition
- 11:15-11:30 Discussion
Database group
- 11:30-12:00 **Heidi Eldridge** (RTI International)
Generic Principles for the Selection of Databases to Represent the Background Population
- 12:00-12:15 Discussion
- 12:15–1:30 Lunch (2nd Floor Commons)
Pattern Evidence Group
- 1:30–2:00 **Karen Kafadar** (UVA)
Quality Metrics for Pattern Evidence
- 2:00-2:30 **Henry Swofford** (Defense Forensic Science Center)
Development and Evaluation of a Model to Quantify the Weight of Fingerprint
- 2:30–3:00 **Robin Richter** (University of Goettingen)
A Quality Measure Based on the Global 3 Parts Decomposition

3:00-3:30 Break

3:30-4:00 **Cedric Neumann** (South Dakota State University)
Possible Options to Improve AFIS Workflow and Output using Fingerprint Statistics

4:00-4:15 Discussant, **Heidi Eldridge** (RTI)

4:15-4:30 Discussant, **Alicia Rairden** (Houston Forensic Science Center)

4:30-4:35 **Karen Kafadar** (UVA): Future work

4:35-5:00 General Discussion

5:00 Shuttle departs to hotel

Tuesday, May 10th

SAMSI Room 150

8:30 Shuttle

Shoeprint and Ballistics Group

Naomi Kaplan (Hebrew University)
9:00-9:40 *Shoe Prints: an Exploratory Analysis of the Relationship among Accidental Mark Characteristics*

Robin Richter (University of Goettingen)
9:40-10:20 *Decomposing Shoeprint Images*

10:20-10:50 Break

Sarena Wiesner (Israeli Police Forensic Center)
10:50-11:30 *Shoeprint Comparison - the Path from Practice to Science*

Cliff Spiegelman (Texas A&M University)
11:30-12:10 *Why there is Reason to be Optimistic about Shoeprints*

12:10-12:40 Discussion

12:40-1:40 Lunch (2nd Floor Commons)

Bias Group

Maria Cuellar (Carnegie Mellon University)
1:40-2:20 *Shaken Baby Syndrome on Trial: Sources of Contextual Bias*

Lucas Mentch (SAMSI and University of Pittsburgh)
2:20-3:00 *Making Sense of 'Making a Murderer'*

3:00-3:30 Break

- 3:30-4:10 **William Thompson** (University of California at Irvine)
Optimizing Human Performance in Crime Laboratories through Testing and Feedback
- 4:10-4:50 **Cliff Spiegelman** (Texas A&M University)
When Marker Study Designs Fail the Markers Follow
- 4:50-5:20 Discussion
- 5:20 Shuttle departs to hotel

Wednesday, May 11th

SAMSI Room 150

- 8:30 Shuttle
- 9:00–9:45 **Nell Sedransk** (National Institute of Statistical Sciences)
What Next? Building Statistics Resources for Forensic Sciences
- 9:45–10:15 Break
- 10:15-11:00 **Donia Slack**, RTI International
Technology Transition through the Forensic Technology Center of Excellence
- 11:00-11:45 **Mark Stolorow**, NIST
OSAC Standards Implementation
- 11:45-12:15 Discussion
- 12:15 Adjourn, Box Lunch and Shuttle to RDU Airport