JULIA K. ELROD

Updated November 4, 2025

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SUMMARY

I am a fourth-year PhD student advised by Dr. Will Townes in the Department of Statistics & Data Science at Carnegie Mellon University (CMU). I am passionate about applying and developing statistical methods for health data. Before coming to CMU, I worked on cancer epidemiology at NIH. My current research focuses on genomics, and I am thrilled to be collaborating with the Torok lab at the University of Pittsburgh Medical Center (UPMC) studying pediatric scleroderma single-cell data. After completing my PhD, I plan to pursue a postdoctoral fellowship in statistical genomics or computational biology before becoming faculty at an academic institution.

EDUCATION

Carnegie Mellon University, Pittsburgh, PA

- *Ph.D. Candidate in Statistics & Data Science*. Expected May 2027
  Committee: Will Townes (Chair), Kathryn Roeder, Wei Chen, & Kathryn Torok.
- *Master of Science in Statistics.* May 2024

Kenyon College, Gambier, OH May 2020

- *Bachelor of Arts in Mathematics & Statistics*, magna cum laude.

RESEARCH EXPERIENCE

CMU & University of Pittsburgh Medical Center (UPMC), Pittsburgh, PA Spring 2024-Present
Statistics Ph.D. Student | Advisor: Will Townes, Ph.D. (CMU)
Co-advised by Kathryn Torok, M.D. (UPMC)

- Collaboration with Dr. Torok's pediatric scleroderma lab at UPMC Children's Hospital
- *Project:* CITE-seq analysis of juvenile systemic sclerosis (jSSc) peripheral blood mononuclear cells (PBMCs) following autologous stem cell transplant (ASCT).
- *Cell type annotation:* In single-cell RNA-seq analysis, it is standard to label cell types by clustering cells according to RNA expression and annotating based on canonical gene markers. CITE-seq technology yields both RNA expression and protein expression (based on a pre-selected panel of antibodies) for each individual cell. To take advantage of this additional layer of information, I integrated principal components from both modalities using a shared nearest neighbors graph, which I then used for clustering and UMAP generation. I then worked with the lab's immunologist to label cell types based on both RNA and protein markers. This resulted in more precise cell types, and allowed us to identify rare disease-related subpopulations.
- *Longitudinal differential expression analysis*: A common goal of scRNA-seq studies is to see which genes are differentially expressed between two groups (e.g., patients vs. healthy controls, or patients before and after treatment). Many methods exist for two-way gene expression comparisons, but they are insufficient to capture longitudinal trends in our data. To address this challenge, I implemented a negative binomial generalized linear model regressing total gene expression per patient sample against time since ASCT. The model included an offset term to adjust for differing numbers of viable cells per sample. Using a quasi-likelihood ratio test, I compared the full model to a reduced model and identified genes of interest for each cell type (e.g., monocytes, T cells, etc.) I then searched biomedical literature to investigate the role of these genes in scleroderma and related autoimmune conditions.
- *Future directions*: Skin cell samples for the same patients and time points are available. I am working on integrating the skin and PBMC data to better understand the immunopathology of jSSc and the impact of ASCT. We also have T cell receptor (TCR) and B cell receptor (BCR) PBMC data for these same patients and time points, which we plan to investigate.

National Cancer Institute, National Institutes of Health (NIH), Bethesda, MD Fall 2020-Spring 2022
Postbaccalaureate CRTA Research Fellow | Supervisor: Philip Rosenberg, Ph.D.

- Developed novel statistical methodology in cancer surveillance.
- Created RStudio software for the application of these methods by biomedical researchers.
- Methodology includes age-period-cohort modeling, kernel smoothing algorithms, model selection techniques, changepoint detection, and generalized linear models.
- Applications include quantification of trends in breast, pancreas, and oral cancer incidence, as well as clinical recommendations for patient hip fracture risk assessment.

The Ohio State University, Columbus, OH Summer 2018
Statistical Genetics Research Assistant | Supervisor: Asuman Turkmen, Ph.D.

- Compared the efficacy of three multivariate methods for detecting relationships between genes and disease risk in Genome Wide Association Study (GWAS) data to three similar methods popular in the field of statistics.
- Conducted simulation studies and applied methods to Dallas Heart Study data, noting which methods picked up on the known relationship between rare variations in the ANGPTL5 gene and reduced triglyceride levels.
- Participated in a weekly journal club with Ohio State doctoral students in statistics, biostatistics, and epidemiology. Met with faculty in these departments to learn about their career paths and areas of research.

PUBLICATIONS

- Storandt, M. H., Tella, S. H., Wieczorek, M. A., Hodge, D., **Elrod, J. K.**, Rosenberg, P. S., Jin, Z., & Mahipal, A. (2024). Projected Incidence of Hepatobiliary Cancers and Trends Based on Age, Race, and Gender in the United States. *Cancers*, *16*(4), Article 4. https://doi.org/10.3390/cancers16040684
- Rosenberg, P. S., Filho, A. M., **Elrod, J.**, Arsham, A., Best, A. F., & Chernyavskiy, P. (2023). Smoothing Lexis diagrams using kernel functions: A contemporary approach. *Statistical Methods in Medical Research*, 09622802231192950. https://doi.org/10.1177/09622802231192950
- Zumsteg, Z. S., Luu, M., Rosenberg, P. S., **Elrod, J. K.**, Bray, F., Vaccarella, S., Gay, C., Lu, D. J., Chen, M. M., Chaturvedi, A. K., & Goodman, M. T. (2023). Global Epidemiologic Patterns of Oropharyngeal Cancer Incidence Trends. *JNCI: Journal of the National Cancer Institute*, djad169. https://doi.org/10.1093/jnci/djad169
- Allbritton-King, J. D., **Elrod, J. K.**, Rosenberg, P. S., & Bhattacharyya, T. (2022). Reverse engineering the FRAX algorithm: Clinical insights and systematic analysis of fracture risk. *Bone*, 159, 116376.

TALKS

"Longitudinal model of paired peripheral blood CITE-seq and skin scRNA-seq data in juvenile systemic sclerosis (jSSc) patients following autologous stem cell transplant (ASCT) reveals reduced expression of SSc marker genes" October 2025

- American College of Rheumatology (ACR) Convergence 2025, Chicago, IL (Selected for oral abstract session).

"Longitudinal cross-tissue modeling of single-cell multi-omics data, with an application in juvenile systemic sclerosis" October 2025

- CMU Statistics & Data Science Department (Thesis proposal).

"Longitudinal CITE-seq analysis of stem cell transplants in pediatric scleroderma"

- Paul Szabolcs Lab (UPMC, bone marrow transplantation and cellular therapies) June 2025
- Robert Lafyatis Lab (UPMC, systemic sclerosis). June 2025
- Kathryn Torok Lab (UPMC, pediatric scleroderma). April 2025, May 2025
- Kathryn Roeder Lab (CMU, statistical genetics). April 2025

"Evaluating genetic colocalization analysis techniques with an application in schizophrenia etiology" Nov. 2023

- CMU Statistics & Data Science Department (Advanced Data Analysis project presentation).

"An R Package for Kernel Filtration of Rates on a Lexis Diagram" April 2021

- NIH Postbac Poster Day.

"Using Multivariate Association Measures to Identify Relationships Among Genetic Variants and Multi-Dimensional Structured Traits" July 2018

- The Ohio State University Comprehensive Cancer Center & Kenyon College Pelotonia Partnership Undergraduate Research Symposium.

TEACHING & MENTORING EXPERIENCE

Carnegie Mellon University, Pittsburgh, PA

Undergraduate Statistics Teaching Assistant

- Deep Learning (46-937) & Natural Language Processing (46-924) for M.S. in computational finance — Fall 2025
- Machine Learning II for M.S. in computational finance (46-927) — Spring 2025
- PhD Regression Analysis (36-707) — Fall 2024
- Foundations of Data Science Online Graduate Certificate (36-640 and 36-641) — Spring 2024
- Statistical Methods in Health Sciences (36-470) — Spring 2024
- Undergraduate Advanced Data Analysis (36-402) — Spring 2023
- Modern Regression (36-401) — Fall 2022

National Institutes of Health, Bethesda, MD

College Summer Opportunities to Advance Research (CSOAR) Mentor — Summer 2021

- Served as a primary mentor through CSOAR, which provides research opportunities to college students disadvantaged by circumstances that have negatively impacted their educational opportunities.
- Taught student age period cohort analysis and oversaw final project, "Recent Trends in Oral Tongue Cancer Incidence in the United States by Region".

Summer Internship Program (SIP) Mentor — Summer 2021

- Co-mentored a college student through SIP, sharing the ins and outs of government biomedical research.
- Introduced student to statistical methodology in changepoint detection and complementary RStudio software.
- Showed student how to run simulation studies comparing methods, resulting in the final presentation, "Estimating Changes in Average Annual Percentage Change of Disease Rates: Alternatives to Join-Point Regression".

Kenyon College, Gambier, OH

Career Services Associate — Spring 2018-Spring 2020

- Workshopped résumés and cover letters with college students, helping students effectively market their skills.

Apprentice Teacher of Spanish — Fall 2017 & Spring 2020

- Planned language-learning activities for college students in introductory Spanish classes using online resources, games, and activities designed to facilitate listening, speaking, reading, and writing practice.
- Taught supplementary Spanish lessons four times per week, with an emphasis on conversation practice.

Association for Women in Mathematics Secretary — Spring 2018-Spring 2020

- Nominated for national membership by Kenyon mathematics faculty.
- Planned and organized mathematics education outreach events, such as a campus-wide STEM activities fair.

STEM and Data Teaching Assistant — Summer 2017

- Collaborated with science faculty to introduce underrepresented first-year students to STEM at Kenyon.
- Facilitated evening homework help sessions for students five nights per week.

AWARDS & CERTIFICATES

- Health Science Communication & Policy Workshop Certificate, NIH Office of AIDS Research — Spring 2021
  - Gained practical knowledge in developing and evaluating a health communication campaign.
  - Studied the health policy legislative process, including securing research funding and resources.
- Fulbright English Teaching Assistant Award, Spain, 2020-2021 — Spring 2020
  - Declined due to the COVID-19 pandemic.
- Sigma Xi – Scientific Research Honor Society, Kenyon-Denison Chapter — Spring 2020
- Wendell D. Lindstrom Memorial Prize — Spring 2018
  - Recognizes first or second-year college students who have demonstrated great promise in mathematics.
- Pi Mu Epsilon – Honorary National Mathematics Society — Spring 2018
- Kenyon College National Merit Scholarship — Fall 2016-Spring 2020