Remembering Elizabeth Meckes

Elizabeth, her husband Mark, and their two children Juliete and Peter were spending the 2020-2021 academic year at Oxford visiting Jon Keating, when late in 2020 she was diagnosed with colon cancer. She passed away a few weeks later only six months after her fortieth birthday. Even though she was young and MathSciNet lists only 27 papers, she left a considerable mathematical legacy.

Elizabeth received her Ph.D. from Stanford in 2006 working with Persi Diaconis. Her thesis concerned an "Infinitesimal version of Stein's method," which she developed into a powerful tool for solving problems. Closely related to her thesis is a paper with Sourav Chatterjee on a multivariate version of the method of exchangeable pairs. A method that had previously been applied only to univariate distributions but that has now become part of the standard toolbox. With 58 citations, this is her most cited work. If you want to learn about exchangeable pairs there is a survey by Chatterjee, Diaconis, and Meckes in volume 2 of Probability Surveys

After graduating from Stanford in 2006, she spent a year at Cornell supported by an AIM fellowship and working with Laurent Saloff-Coste. He remembered her as "a very able mathematician with talent for hard computation." Elizabeth became a fellow of the IMS in 2019. Writing in support of her nomination to be an IMS fellow, Laurent pointed to her work on "Asymptotic Normality of Eigenfunctions of the Laplacian" and "Linear functions on classical matrix groups." Both of these papers were published in the Transactions of the AMS (in 2009 and 2008). After the year at Cornell, she returned to her alma mater Case Western Reserve in 2007 with her husband Mark who had earned his bachelor's degree there in 1999.

In 2011, she wrote a ground breaking paper with Matt Kahle on random simplicial complex. For a mental picture think of a lot of triangles glued together along their edges. These objects are a multidimensional generalization of Erdos-Renyi random graphs and have a phase transition. The topology of these complexes is boring when the number of triangles is small or too large. However, in a narrow range of values the topology is quite complicated, when measured by their Betti numbers. Remarkably they were able to prove a central limit thoerem for the Betti numbers. The mathematics in this paper required a synthesis of ideas from algebraic topology, combinatorics, and geometric measure theory.

Elizabeth has written a large number of interesting and important papers on random matrices, often in collaboration wither husband Mark. They have introduced new ideas and tools for proving concentration inequalities for spectra of random measures. One paper of theirs was published in Probability Theory and Related Fields. Concerning that paper Elizabeth wrote on her web page. : I think of this paper as being unofficially dedicated to our children: Peter, who stubbornly refused to be born while most of the work in this paper was done; and Juliette, who told me one morning that it would make her happy if I proved a theorem that day (I'm pretty sure it was what became Theorem 3.5).

An example of Elizabeth's work in this area Is "Projections of Probability Distributions: A Measure-Theoretic Dvoretsky theorem" that was published in Geometric Aspects of Functional Analysis. This paper is an elegant piece of pure mathematics but is of fundamental importance in the foundations of data science. Specifically, her work on very low dimensional marginal of high dimensional probability measures are being used in compressive sensing.

In the summer of 2019 she published a book on *Random Matrix Theory for Classical Compact Groups.* To quote from the description on the Cambridge University Press web site “This is the first book to provide a comprehensive overview of foundational results and recent progress in the study of random matrices from the classical compact groups, drawing on the subject's deep connections to geometry, analysis, algebra, physics, and statistics.” Jon Keating, whose group at Oxford which she joined for a year said “Her papers have opened up new avenues of research and her book was an extraordinary achievement.”

From this brief description of her research you can see that she worked on a wide variety of topics, being “most interested in situations in which probability arises naturally in other fields, e.g. differential geometry, convex geometry, and number theory”. The next Southeastern Probability conference to be held May 2021 will honor Elizabeth’s her life and work. Eight of her collaborators and friends will speak. An announcement appears in this Issue of the IMS Bulletin. By the time this article has appeared you can read about the details of how you can participate on the conference web site. The bad news is that the conference will be virtual, but the good news is that many people from across the country and ibeyond will be able to participate via Zoom.