

Topics in Probability

Probability is a broad subject with many interactions and applications across mathematics, statistics and beyond. Suitable topics for PhD research include random walks (on graphs, lattices, groups), Brownian motion, interacting particle systems, random matrices, random tilings and other algebraic and/or combinatorial objects. Such research topics often begin with very concrete questions. For example, how many shuffles does it take to mix up a deck of cards? What does a ‘typical’ (i.e. random) permutation of n objects look like? How many fixed points is it likely to have? How many cycles? How many times does a Brownian motion on the plane wind around the origin before exiting a disk? What kind of ‘knots’ is it likely to form around several points? If we randomly glue together the edges of an even-sided polygon to make an orientable surface, what is the probability that it is topologically a sphere? Such questions can lead to fascinating theoretical developments, often with surprising connections to other, seemingly unrelated, areas of mathematics. This research project is quite flexible, and would begin with some toy problems similar to those outlined above, depending on the interests and background of the student.