

A Statistical and Probabilistic Potpourri of Problems in Applied Algebraic Topology

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The last few years have seen an exciting development in what is reputedly one of the most esoteric areas of pure mathematics: Algebraic Topology. A small but rapidly growing group of dedicated mathematicians is actually trying to apply it to real world problems, and, as a result, 'Applied Algebraic Topology' is no longer an oxymoron. Parts of this project are not totally new, but what is completely new is the mathematical sophistication of the techniques now being applied to areas as widespread as data mining, dimension reduction, and manifold learning, all topics familiar to statisticians, as well as to areas classically outside of Statistics.

In the talk I shall describe some of the new ideas that have arisen in Applied Algebraic Topology, and discuss the challenges they raise for Statistics and Probability. I will give examples via easy to understand (but not so easy to prove) results about the persistent homologies of random fields and random complexes, describing both their theory and applications.

The main aim of this lecture will be to convince statisticians and probabilists that there is an entire new area crying out for probabilistic modelling and statistical analysis, and to maybe motivate some of them to participate in solving the exciting challenges it is already providing.