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# Preface

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Information geometry studies invariant properties of a family of probability distributions that can be applied to various problems in science. Statisticians use statistical models for inference, a family of probability distributions, to forms, in most cases, a finite-dimensional manifold. What are the intrinsic properties of such a manifold? How is the geometrical structure related to characteristics of statistical inference? Information geometry emerged from these questions.

C.R. Rao first introduced the Riemannian structure using the Fisher information matrix, and N.N. Centsov proved that this is a unique invariant metric. He also demonstrated that there is a family of invariant affine connections, leaving B. Efron to expose the relationship between statistical curvature and the characteristics of inference. H. Nagaoka and S. Amari gave a dual structure to information geometry, a finding that has played a fundamental role in developing more applications of information geometry. P. Pistone and P. Giblisco gave a mathematical foundation that extended information geometry to the function space. H. Nagaoka and D. Petz studied the information geometry of quantum probability. These very brief historical remarks highlight just how many researchers have contributed to the development of information geometry in theory and in application.

Information geometry has been presented with a dualistic structure of the Riemannian manifold. In particular, a dually flat structure gives a mathematical foundation to convex analysis and the Legendre transformation. Because of this, information geometry has been applied, not just to statistics, information theory, control systems, but also to artificial intelligence, combinatorics neural networks, physics, psychology, and many other fields. Quantum information theory is a new field, in which information geometry is expected to be further exploited.

Information geometry is interdisciplinary in its character and of international interest. David Cox organized the first workshop in 1984 as part of the 150th Memorial Meeting of Royal Statistical Institute in London. Since then, a num-

ber of international workshops and symposia on this subject have been held in the UK, Denmark, Japan, and Italy.

As a continuation of the symposium on information geometry held in Pescara, Italy, in 2002, the second symposium was held in Tokyo in 2006. Nearly 60 researchers joined from all over the world. A wide variety of topics was presented, often followed by heated discussions.

In this issue, the *Annals of Institute of Statistical Mathematics* (AISM) presents a special issue on information geometry based primarily on results from the symposium. This important issue provides a review of current state of information geometry and provides new perspectives for its future development.

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