MĀNOA LECTURE SERIES
IN MACHINE LEARNING AND COMPUTATIONAL NEUROSCIENCE

INFORMATION GEOMETRY AND DISTINGUISHABILITY OF HYPOTHESES

How different are two statistical models inferred from a finite number of measurements? How do we assess if a difference is distinguishable by measurement? These very general questions are quite common in statistical and engineering applications such as signal processing and computer vision. Although there are some techniques appropriate to particular situations, current statistical methodology does not generalize across arbitrary families of probability distributions. New statistical measures that are generalizable have emerged from the concept of information distance in probability spaces, as formulated in the language of differential geometry. These distances have received some attention in the scientific literature, and there have been theoretical remarks connecting information geometry and hypothesis testing, but there exists little framework connecting the geometric theory to statistical practice, apparently due to mathematical difficulties in finding explicit solutions. By making use of numerical integration methods, we develop the necessary connections between theory and methodology that allow the information geometric distance to be used as an effect size statistic. In particular, we define the confidence interval for the information geometric distance, introduce a general algorithm to compute it, and extend its use into a framework of null hypothesis significance testing and power analysis for an arbitrary family of probability distributions.

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