



THE UNIVERSITY OF CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

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Maximum Likelihood Density Estimation Under Total Positivity

THURSDAY, January 25, 2017, at 5:00 PM
Jones 226, 5747 South Ellis Avenue

ABSTRACT

Nonparametric density estimation is a challenging problem in theoretical statistics—in general the maximum likelihood estimate (MLE) does not even exist! Introducing shape constraints allows a path forward. This talk offers an invitation to non-parametric density estimation under total positivity (i.e. log-supermodularity) and log-concavity. Totally positive random variables are ubiquitous in real world data and possess appealing mathematical properties. Given i.i.d. samples from such a distribution, we prove that the maximum likelihood estimator under these shape constraints exists with probability one. We characterize the domain of the MLE and show that it is in general larger than the convex hull of the observations. If the observations are 2-dimensional or binary, we show that the logarithm of the MLE is a tent function (i.e. a piecewise linear function) with “poles” at the observations, and we show that a certain convex program can find it.

In the general case the MLE is more complicated. We give necessary and sufficient conditions for a tent function to be concave and supermodular, which characterizes all the possible candidates for the MLE in the general case.

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