Speaker: Oliver Feng (University of Bath)

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Title: Convex loss selection via score matching

Abstract:
We consider a linear regression model in which the regression coefficients are estimated by minimising the empirical risk based on a convex loss function. The accuracy of the estimator depends on the choice of loss function; for instance, when the errors are non-Gaussian, ordinary least squares can be outperformed by estimators based on alternative loss functions. A natural question then is how to select a data-driven convex loss function that leads to optimal downstream estimation of the regression coefficients. We propose a nonparametric approach that approximates the derivative of the log-density of the noise distribution by a decreasing function, and explicitly identifies the convex loss function for which the asymptotic variance of the resulting M-estimator is minimal. We show that this optimisation problem is equivalent to a version of score matching, which corresponds to a log-concave projection of the noise distribution not in the usual Kullback–Leibler sense, but instead with respect to the so-called Fisher divergence.