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Simple Le Cam optimal inference for the tail weight of multivariate Student t distributions: testing procedures and estimation

Christophe Ley, Anouk Neven

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The multivariate Student t distribution is at the core of classical statistical inference and is also a well-known model for empirical financial data. In the present paper, we propose optimal (in the Le Cam sense) inferential procedures about its tail weight parameter ν. We start by establishing the uniform local asymptotic normality (ULAN) property of the multivariate location-scatter-tail weight Student t model, which happens to be a non-trivial result. The ULAN structure then enables us to derive locally and asymptotically optimal (in the maximin sense) tests for tail weight under unspecified location and scatter. The Le Cam approach permits to replace these unknown quantities by any root-n consistent estimators. The resulting tests thus improve on the classical approaches (likelihood ratio test, Wald test, Rao score test) by their flexibility and simplicity; moreover, we can write out explicitly the power of our tests against sequences of contiguous local alternatives. Regarding tail weight estimators, the one-step estimation procedure inherent to the ULAN property allows us to turn existing root-n consistent estimators into fully efficient ones (in particular, we render the Mardia estimator optimal under multivariate Student distributions with $\nu>8$). The finite-sample properties of our tests and estimators are analyzed in a large Monte Carlo simulation study, and we finally apply our methods on a financial data set.

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