Quantile tomography: using quantiles with multivariate data, with applications to multivariate growth charts

by

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Abstract

Directional quantile envelopes—essentially, depth contours—are a possible way to condense the directional quantile information, the information carried by the quantiles of projections. In typical circumstances, they allow for relatively faithful and straightforward retrieval of the directional quantiles, offering a straightforward probabilistic interpretation in terms of the tangent mass at smooth boundary points. They can be viewed as a natural, nonparametric extension of "multivariate quantiles" yielded by fitted multivariate normal distribution, and, as illustrated on data examples, their construction can be adapted to elaborate frameworks that require more sophisticated estimation methods than simply evaluating quantiles for empirical distributions. The examples of such frameworks include estimation of extreme quantiles, and directional quantile regression. The estimates are affine equivariant whenever the estimators of directional quantiles are translation and scale equivariant; quantile regression estimates can be used to obtain bivariate growth charts, with possible adjustments for concomitant variables and other refinements. Finally, there may be certain potential for curvilinear generalizations.

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