

# A new algorithm for the Fermat-Weber problem, and a new concept of data-depth in multivariate data-analysis

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10th of December, 1999

The Fermat-Weber problem (sometimes called the multivariate  $L_1$  median or, more accurately, the  $L_1 - L_2$  median) has been around for nearly three centuries, and the most widely used algorithm for it is the well known Weiszfeld algorithm, which has certain convergence problems. We propose a new algorithm (equally simple and elegant as the Weiszfeld algorithm) which is guaranteed to converge monotonically to the desired median. We further define a new concept for "data-depth" of a multivariate distribution, and show that for the Fermat-Weber median this new definition gives a simple closed-form formula which is easy to compute in any dimension, making the new concept a practical multivariate data-analytic tool.