

# Near-consistent robust estimations of moments for unimodal distributions

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**A. Robust Estimations of the Central Moments.** In 1979, Bickel and Lehmann (1), in their final paper of the landmark series *Descriptive Statistics for Nonparametric Models*, generalized a class of estimators called measures of spread, which "do not require the assumption of symmetry." From this, a popular efficient scale estimator, the Rousseeuw-Croux scale estimator (2), was derived in 1993. While they had already considered one version of the trimmed standard deviation, which is a measure of dispersion, in the third paper of that series (3); in the final section of that paper (1), they explored another two versions of the trimmed standard deviation based on pairwise differences, one is modified here for comparison,

**Theorem A.1.**

*Proof.*

□

1. PJ Bickel, EL Lehmann, Descriptive statistics for nonparametric models iv. spread in *Selected Works of EL Lehmann*. (Springer), pp. 519–526 (2012).
2. PJ Rousseeuw, C Croux, Alternatives to the median absolute deviation. *J. Am. Stat. association* **88**, 1273–1283 (1993).
3. PJ Bickel, EL Lehmann, Descriptive statistics for nonparametric models. iii. dispersion in *Selected works of EL Lehmann*. (Springer), pp. 499–518 (2012).