

## On Quantile and Expectile Regression

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Applications of quantile regression (QR), which have increased markedly over recent years, can be found in fields such as biostatistics, ecology and econometrics. Common QR methodologies include the classical regression quantiles ([1]) and the LMS-type methods (e.g., [2]). The classical approach minimizes the sum of weighted absolute residuals. A related methodology minimizes the sum of weighted squared residuals—by asymmetric least squares (ALS)—and these are known as expectiles ([3], [4]). This paper compares QR with expectile regression for some distributions in the exponential family ([5] extends ALS to asymmetric maximum likelihood (AML) estimation), such as the normal, Poisson and binomial. Software for these, which are in the VGAM package for R, is described and illustrated with real and simulated data.

## References

- [1] Koenker R, Bassett G (1978) Regression quantiles. *Econometrica* 46:33–50
- [2] Cole TJ, Green PJ (1992) Smoothing reference centile curves: The LMS method and penalized likelihood. *Statistics in Medicine* 11:1305–1319
- [3] Newey WK, Powell JL (1987) Asymmetric least squares estimation and testing. *Econometrica* 55:819–847
- [4] Efron B (1991) Regression percentiles using asymmetric squared error loss. *Statistica Sinica* 1:93–125
- [5] Efron B (1992) Poisson overdispersion estimates based on the method of asymmetric maximum likelihood. *Journal of the American Statistical Association* 87:98–107