

## Second-Order Approximation of the Entropy in Nonlinear Least-Squares Estimation

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*Abstract:* Measures of variability of the least-squares estimator  $\hat{\theta}$  are essential to assess the quality of the estimation. In nonlinear regression, an accurate approximation of the covariance matrix of  $\hat{\theta}$  is difficult to obtain (Clarke 80). In this paper, a second-order approximation of the entropy of the distribution of  $\hat{\theta}$  is proposed, which is only slightly more complicated than the widely used bias approximation of Box (Box 71). It is based on the "flat" or "saddle-point approximation" of the density of  $\hat{\theta}$ . The neglected terms are of order  $\mathcal{O}(\sigma^4)$ , while the classical first order approximation neglects terms of order  $\mathcal{O}(\sigma^2)$ . Various illustrative examples are presented, including the use of the approximate entropy as a criterion for experimental design.

*Keywords:*

*AMS Subject Classification:*