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The $L_p$-norm estimation of the parameters for the Jelinski–Moranda model in software reliability

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Abstract. The exponential model of Jelinski and Moranda [Software reliability research, in Statistical Computer Performance Evaluation, W. Freiberg, ed., Academic Press, New York, 1972, pp. 465–484] is one of the earliest models proposed for predicting software reliability. The estimation of its parameters has been approached in the literature by various techniques. The focus of this paper is on the $L_p$-norm ($1 \leq p < \infty$) fitting approach. Special attention is paid to the nonlinear weighted least squares (LS) estimation. We show that it is possible for the best $L_p$-norm estimate to not exist. As the main result, a necessary and sufficient condition for the existence of the best $L_p$-norm estimate is obtained. This condition is theoretical in nature. We apply it to obtain two theorems on the existence of the LS estimate. One of them gives the necessary and sufficient conditions which guarantee the existence of the LS estimate. To illustrate the problems arising with the nonlinear normal equation approach for solving the LS problem, some illustrative examples are included.