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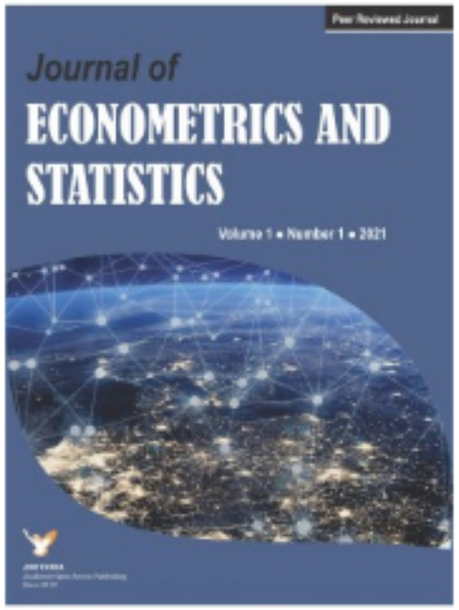

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ROBUST FIRST-ORDER EFFICIENT DESIGNS INVARIABLY APPLICABLE FOR MANY LIFETIME DISTRIBUTIONS

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Abstract: Lifetime distributions are mostly Weibull, exponential, gamma and lognormal, and these observations may be correlated. For lifetime improvement experiments, optimal settings of the operating conditions are identified using D-optimal, or rotatable designs. Therefore, for correlated lifetime observations with different distributions, locating the optimal operating settings is the primary requirement to the quality engineers. The current report derives some efficient rotatable designs for autocorrelated and a particular form of compound symmetry correlated error structures for the above mentioned four lifetime distributions. Note that the derived designs depend on the concerned correlated error structure but free of correlation coefficient values and the lifetime distributions..

Keywords: Autocorrelated errors; Compound symmetry structure; Invariably designs; Lifetime distributions; Mean lifetime model; Robust first-order rotatability.

1. Introduction

In usual response surface methodology (RSM), response distribution is assumed as normal with uncorrelated errors and equal variance (Box and Hunter 1957; Box and Draper 2007). In lifetime betterment experiments, usual RSM is adopted for searching the optimal level combinations to reach the specific target (Nair *et al.* 1992; Myers *et al.* 2002; Das and Lee 2009). A lifetime random variable commonly follows gamma, or lognormal, or exponential, or Weibull distributions (Lawless, 1982; Das 2013), and oftenly the lifetime observations may be correlated (Myers *et al.* 2002). So, the usual RSM is not appropriate for lifetime betterment experiments, as it does not meet the necessary lifetime conditions. First and second-order response surface designs with correlated errors under normal distribution have been introduced by Panda and Das (1994) and Das (1997), respectively. First-order response surface designs under correlated errors with the above four lifetime