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Optimal design for linear models with correlated observations

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(Submitted on 12 Mar 2013)

In the common linear regression model the problem of determining optimal designs for least squares estimation is considered in the case where the observations are correlated. A necessary condition for the optimality of a given design is provided, which extends the classical equivalence theory for optimal designs in models with uncorrelated errors to the case of dependent data. If the regression functions are eigenfunctions of an integral operator defined by the covariance kernel, it is shown that the corresponding measure defines a universally optimal design. For several models universally optimal designs can be identified explicitly. In particular, it is proved that the uniform distribution is universally optimal for a class of trigonometric regression models with a broad class of covariance kernels and that the arcsine distribution is universally optimal for the polynomial regression model with correlation structure defined by the logarithmic potential. To the best knowledge of the authors these findings provide the first explicit results on optimal designs for regression models with correlated observations, which are not restricted to the location scale model.

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