Latin hypercube designs and block-circulant matrices

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Abstract

Computer simulations are usually needed to study a complex physical process. In this paper, some procedures for constructing orthogonal block-circulant Latin hypercube designs are proposed. The basic concept of these methods is to use vectors with a constant periodic autocorrelation function to obtain suitable block-circulant Latin hypercube designs. Using this method one is able to construct orthogonal and near-orthogonal Latin hypercube designs with favorable properties. Orthogonal Latin hypercube designs (OLHDs) with fixed number of factors and flexible run sizes can be constructed using a slightly modified technique. Some new multiplication structures and constructions are also provided. For example, it is shown how one may obtain orthogonal Latin hypercube designs with $(runs, factors) = (2n\ell+s, m\ell)$, for $\ell = 12, 16, 20, 24$ and $s = 0, 1$ by using an $OLHD(n, m)$. The properties of the generated designs are further investigated and a brief comparison with known designs is given.

Keywords

Computer experiments, Fold-over designs, Circulant matrices, Autocorrelation function, Orthogonal designs, Construction.

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