

Optimal Crossover Designs for Comparing Test Treatments to a Control Treatment When Subject Effects are Random

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The statistical optimality and efficiency of crossover designs for the purpose of comparing several test treatments with a control treatment when the subject effects are random depend heavily on the unknown ratio (θ) of the variance of subject effects and the error variance. However, it is proved that if the class of competing designs contains a totally balanced test-control incomplete crossover designs (TBTCI), as defined by Hedayat and Yang (2005), then this TBTCI design is simultaneously A- and MV-optimal for all values of θ . This result is essentially a generalization of a result in Hedayat and Yang (2005) since their statistical model is based on fixed subject effects, where the Fisher information matrix would be identical to that of random subject effect model when θ goes to infinity.

Although the construction of TBTCI designs where the control treatment is taken by each subject exactly once, has been extensively studied, it is proved for the sake of statistical optimality alternative TBTCIs should be constructed when the number of periods (p) in the design is greater than 5 or $p = 3, 4, 5$ and θ is small. It is shown that type I orthogonal arrays are very useful for the construction of optimal TBTCI design when p is 3. A special type of optimal TBTCI designs has also been constructed when p is 4. The constructed optimal TBTCIs for $p = 3, 4$ and small θ are relatively robust with respect to changes in θ . General methods for constructing optimal TBTCI designs for $p \geq 5$ is still open. The advantage of the newly introduced TBTCI designs should still be valid for large p , albeit their constructions become more difficult.

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