Design Theory - Part III

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Unbiased Orthogonal Designs

Let D_1, D_2 be orthogonal designs of order n and type $(s_1, \ldots, s_u)$ in variables $x_1, \ldots, x_u$. D_1 and D_2 are *unbiased with parameter* α if α is a positive real number and there exists a $(0, 1, -1)$-matrix W such that

$$D_1 D_2^\top = \frac{s_1 x_1^2 + \cdots + s_u x_u^2}{\sqrt{\alpha}} W.$$

The study of unbiased orthogonal designs provides a unified approach to the study of a variety of unbiased matrices.

Upper bounds, an asymptotic existence result, and some methods of construction will be presented. The application includes the proof of the existence of mutually quasi-unbiased weighing matrices with various parameters.

This is joint work with Sho Suda.

TRENT MARBACH, Nankai University

Balanced Equi-n-squares

In this presentation, we present recent work undertaken to understand d-balanced equi- n-squares. With the requirement that d is a divisor of n, these structures are $n \times n$ matrices containing symbols from $\mathbb{Z}_n$ in which any symbol that occurs in a row or column, occurs exactly d times in that row or column. There are connections with Latin square of order n that decompose into $d \times (n/d)$ subrectangles, which we exploit to construct d-balanced equi-n-squares. We also show connections with α-labellings of graphs, which enables us to both construct new d-balanced equi-n-squares and construct new α-labellings of graphs.

BRETT STEVENS, Carleton University

Affine planes with ovals for blocks

A beautiful theorem states that the reverse of a line in the Singer Cycle presentation of a projective plane is an oval. This implies that for every Desarguesian projective plane there is a companion plane all of whose blocks are ovals in the first. This fact has been exploited to construct a family of very efficient strength 3 covering arrays. We show that there exist pairs of Desarguesian affine planes whose blocks are ovals in the other plane for any order a power of 2. These can be used to construct efficient covering arrays.

DOUG STINSON, University of Waterloo

Constructions of optimal orthogonal arrays with repeated rows

We construct orthogonal arrays $\mathrm{OA}_\lambda(k, n)$ (of strength two) having a row that is repeated m times, where the ratio m/λ is as large as possible; these OAs are termed optimal. We provide constructions of optimal OAs for any $k \geq n + 1$, albeit with large λ. We also study basic OAs; these are optimal OAs in which $\gcd(m, \lambda) = 1$. We construct a basic OA with $n = 2$ and $k = 4t + 1$, provided that a Hadamard matrix of order $8t + 4$ exists.

This is joint work with Charlie Colbourn and Shannon Veitch.