Further Contributions to Factorial Designs of Resolution Ten and Balanced Arrays of Strength Nine

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An array with m rows (factors, constraints), N columns (runs, treatment-combinations), and with two levels (say, 0 and 1) is a matrix T of size $(m \times N)$ with entries 0 or 1. When some combinatorial structure is imposed, these arrays become very useful in statistical design of experiments. A balanced array (B-array) of strength t with m rows $(m \geq t)$ and N columns is a matrix T of size $(m \times N)$ with entries 0 or 1 such that in every $(t \times N)$ submatrix T^* of T, every $(t \times 1)$ vector with i $(0 \leq i \leq t)$ 1s in it occurs with the same frequency (say, μ_i times). The vector $\underline{\mu}' = (\mu_0, \mu_1, \mu_2, \ldots, \mu_t)$ is called the parameter set of T. If each $\mu_i = \mu$ for all i, then the B-array is called an orthogonal array, which have been extensively used in information theory, coding theory, quality control, theory of statistics, etc. B-arrays have been extensively used (for different values of t), where under certain conditions, give rise to balanced fractional factorial designs of different resolutions. For example, a B-array with $t = 9$ would give us a design of resolution ten (allowing us to estimate all the effects up to and including, 4-factor interactions in the presence of 5-factor interactions while higher-order interactions are negligible). We obtain some necessary existence conditions for the B-arrays T with parameters m and $\underline{\mu}'$. These results are then used to obtain results on the maximum number of constraints for T, with a given $\underline{\mu}'$.

Key words: array, balanced array, orthogonal array, runs, fractional factorial design, treatment-combinations, estimates of effects