On the Maximum Number of Constraints for some Balanced Arrays of Strength Ten with Two Levels and Applications

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An array T with m rows (constraints, factors), N columns (runs, treatment-combinations), s symbols (levels of factors) is merely a matrix T $(m \times N)$ with s elements (say, $0, 1, 2, \ldots, s-1$). In this paper, we restrict our attention to arrays T with $s = 2$ (i.e., elements 0 and 1). Under some combinatorial structure, the arrays T assume great importance. One such structure leads us to the definition of a balanced array (B-array): An array T $(m \times N)$ with two levels (0 and 1) is called a B-array of strength t $(\leq m)$ if in every t-rowed submatrix T^* of T (clearly there are $\binom{m}{t}$ submatrices), the following condition is satisfied: In every $(t \times 1)$ column of T^*, every $(t \times 1)$ column vector of T^* of weight i $(0 \leq i \leq t)$ appears a constant number (say μ_i, $i = 0, 1, 2, \ldots, t$) of times. The vector $\underline{\mu}' = (m; \mu_0, \mu_1, \mu_2, \ldots, \mu_t)$ is called the index set of T. Given $\underline{\mu}'$, it is clear that $N = \sum_{i=0}^{t} \binom{t}{i} \mu_i$. One can see that if $\mu_i = \mu$ for each i, the B-array is reduced to an orthogonal array (O-array). Of course, there are other combinatorial areas related to B-arrays. In this paper, we restrict ourselves to B-arrays with two levels and of strength $t = 10$. We derive some inequalities involving the parameters of array T which are necessary existence conditions for such arrays. Then we make use of these inequalities to obtain the maximum value of m which is possible.

Key words: array, balanced array, orthogonal array, strength ten