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 $\mu_i$, $i = 0, 1, 2, \ldots, t$) of times. The vector $\mu' = (m; \mu_0, \mu_1, \mu_2, \ldots, \mu_t)$ is called the index set of $T$. Given $\mu'$, 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