Magic arrays with empty cells

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A magic array of order $m \times n$ with precisely r filled cells in each row and precisely s filled cells in each column, denoted $MA(m, n; r, s)$, is an arrangement of the numbers from 0 to $mr - 1$ in an $m \times n$ array such that each number occurs exactly once in the array, the sum of the entries of each row is the same and the sum of entries of each column is also the same. In this presentation we study the existence of $MA(m, n; r, 2)$, $MA(m, km; ks, s)$, and $MA(am, bm; bs, as)$. We also show that there exists a magic square set $MSS(m, s; t)$ if and only if $m = s = t = 1$ or $3 \leq s \leq m$ and s is even or mt is odd.

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