

## Mutually Orthogonal Rectangular Gerechte Designs

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Our purpose is to construct gerechte designs possessing rectangular regions, and to investigate mutually orthogonal families of such gerechte designs. One may think of these gerechte designs as generalized sudoku grids. More specifically: Let  $q$  be a prime power and  $r, s, m, n$  positive integers. We construct families of mutually orthogonal gerechte designs of order  $q^{r+s}$  with rectangular regions of size  $q^r \times q^s$ . This leads to a lower bound on the size of a family of mutually orthogonal gerechte designs of order  $mn$  with rectangular regions of size  $m \times n$ . The construction is linear-algebraic; surrounding theory employs companion matrices and Toeplitz matrices over finite fields.

Keywords: orthogonality, latin square, sudoku, gerechte design, toeplitz matrix