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"Multimagic" Latin Squares

(research with Adam Rogers and Ian Cameron, Department of Physics and Astronomy)

Boyer has popularized multimagic squares where the rows, columns and main diagonals of full cover magic squares have common "magic" linesums for integer powers p of each element. Bimagic squares corresponding to p=2 begin at orders 8 and 9, trimagic for p=3 begin at order 12, etc. Rogers observed before 2007 that Latin squares are "multi-semi-magic" for rows and columns. Eggermont called diagonal Latin squares "infinitely-multimagic squares" in a 2004 talk. Now after Nordgren drew our attention to Knut Vik Latin designs (which begin at orders 5,7,11,...) and have the pandiagonal property that all transversals parallel to the main diagonals have a common linesum, we realized that Knut Vik squares are "pandiagonal multimagic" to all integer powers. In fact to any power! Moreover following Heyadat and Federer, and our recent studies (Cameron, Rogers and Loly 2013), these can be compounded to construct Knut Vik designs of multiplicative orders 5*5,5*7,... The corresponding matrices are highly singular. Some properties which can be compounded and iterated are discussed. C. Boyer, http://www.multimagie.com/English/; Ian Cameron, Adam Rogers and Peter D. Loly, Signatura of magic and Latin integer squares: isentropic clans and indexing", Discussiones Mathematicae Probability and Statistics, 33(1-2) (2013) 121-149, or http://www.discuss.wmie.uz.zgora.pl/ps; C. Eggermont, http://www.win.tue.nl/ ceggermo/math/; A. Hedayat and W. T. Federer Ann. Statist., 3(2)(1975), 445-447, On the Nonexistence of Knut Vik Designs for all Even Orders; R. Nordgren, Pandiagonal and Knut Vik Sudoku Squares, Mathematics Today, 49 (2013) 86-87 and Appendix.