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Orthogonal matrices with zero diagonal

Motivated by work of the Discrete Mathematics Research Group at the University of Regina on the question of determining the minimum number of distinct eigenvalues of graphs, we consider real orthogonal $n \times n$ matrices where the diagonal entries are all zero and the off-diagonal entries are all non-zero. We show that such matrices exist if and only if $n \notin \{1, 3\}$, and that symmetric examples exist if and only if n is even and $n \neq 4$. We also give a complete solution to the existence of orthogonal matrices with partially-zero diagonal.

This is joint work with Robert Craigen (University of Manitoba).