JAMES GUYKER, Buffalo State College, 1300 Elmwood Avenue, Buffalo, New York 14222, USA
Vector Spaces of Magic Squares

An interesting example to use to illustrate the notions of linear algebra is the vector space $M(n)$ of real magic squares of order n. In 1910 E. Bergholt obtained a formula for generating magic squares of order four from eight arbitrary real numbers, thereby extending the solution to the ancient problem of constructing one with sixteen consecutive integers. J. Chernick generalized this formula in 1938 in describing a basis for the space $M(n)$ for any n. We show that the orthogonal projection of any $n \times n$ matrix onto $M(n)$ has a simple, closed form and its complementary projection may be explicitly described in terms of the projections onto the spaces of affine, coaffine, and doubly affine matrices.