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Projecting onto rectangular matrices with prescribed row and column sums

In 1990, Romero presented a beautiful formula for the projection onto the set of rectangular matrices with prescribed row and column sums. Variants of Romero's formula have been rediscovered by Khoury and by Glunt, Hayden, and Reams, for bistochastic (square) matrices in 1998. These results have found various generalizations and applications.

In this paper, we provide a formula for the more general problem of finding the projection onto the set of rectangular matrices with prescribed scaled row and column sums. Our approach is based on computing the Moore-Penrose inverse of a certain linear operator associated with the problem. In fact, our analysis holds even for Hilbert-Schmidt operators and we do not have to assume consistency. We also perform numerical experiments featuring the new projection operator.