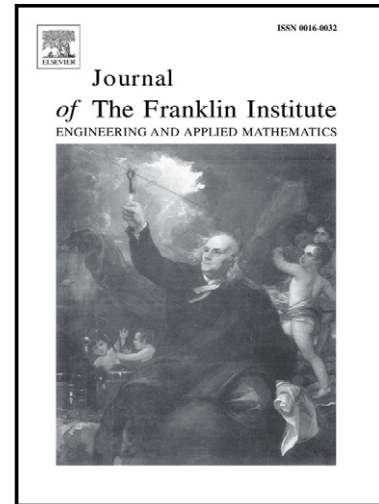


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# The minimal rank of matrix expressions with respect to Hermitian matrix—revised

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## Abstract

This paper presents representations for the minimal rank of  $A - BXC$  with respect to Hermitian matrix  $X$  and the minimal rank of  $A - BX - YD$  with respect to Hermitian matrix  $X$  and  $Y$ . These results prove, in a distinctive way, the solvability conditions of the matrix equations  $BXC = A$  and  $BX + YD = A$ , where  $X$  and  $Y$  are arbitrary matrices with  $X = X^*$ .

**Keywords:** minimal rank, Hermitian matrix, Singular value decomposition (SVD), Sylvester's law of inertia, rank formulas

**Mathematics Subject Classifications (2010):** 15A03; 15A09; 15A24

## 1 Introduction

We adopt the following notation in this paper. Let  $\mathbb{C}^{m \times n}$  denote the set of  $m \times n$  matrices with complex entries. The symbols  $\mathbb{H}(n)$  ( $\mathbb{H}_{\geq}(n)$ ) and  $\mathbb{U}(m)$  stand for the set of all  $n \times n$  Hermitian (Hermitian nonnegative-definite) matrices and that of all  $m \times m$  unitary matrices, respectively. The *conjugate transpose* of a matrix  $A$  is denoted by  $A^*$ . For  $A \in \mathbb{H}(n)$ ,  $n_+(A)$  and  $n_-(A)$  denote the numbers of the positive and negative eigenvalues of  $A \in \mathbb{H}(n)$  counted with multiplicities, respectively. The *Moore-Penrose inverse* of  $A \in \mathbb{C}^{m \times n}$  is defined as the unique  $X \in \mathbb{C}^{n \times m}$  satisfying

$$(1) AXA = A, (2) XAX = X, (3) (AX)^* = AX, (4) (XA)^* = XA,$$

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