Errata

The argument in question0029-2(c,d) does work for symmetric matrix. For general matrix, There is no such simple relation between positivity and eigenvalues.

Statement: M arbitrary matrix, C arbitrary invertible matrix, then: Positivity of M is the same as Positivity of C^tMC
Proof:
for a vector v, let $w = Cv$, then $v^tC^tMCv = [Cv]^tM[Cv] = w^tMw$. this will be (semi)positive if M is (semi)positive. Similarly, one can show that M is (semi)positive if C^tMC is.

This is not true for M and $C^{-1}MC$.

For general matrix, all we can say is the following
(1) if there is one negative eigenvalues, the matrix will not be semipositive.
(2) The fact that no eigenvalues less than 0 doesn't guarantee matrix be a semipositive.

The reason is
For (1): If $\lambda < 0$, v be the λ-eigenvector, then $v^tMv = v^t\lambda v = \lambda v^tv < 0$.
For (2): The difference between symmetric matrix and non-symmetric matrix is that:
(a) For symmetric matrix M, one can find orthonormal matrix A such that $A^{-1}MA = A^tMA = D$(diagonal).
(b) For non-symmetric M, one only have $AMA^{-1} = D$, and $A^{-1} \neq A^t$.
Therefore, by statement above, for symmetric matrix, the question of M being (semi)positive is reduced to the question whether D is (semi)positive, and is further linked to positivity of eigenvalues, because D is consist of eigenvalues as diagonal. While, For non-symmetric matrix, one can not always make the first reduction, and then, no similar conclusion on eigenvalues and positivity.

Back to the question0029-2, since CXC^{-1} is not symmetric, argument in c,d is not valid. So, there is no way but compute CXC^{-1}, and find v=[1,0,0] will make $v^tCXC^{-1}v$ negative. Therefore, the answer will be **NO** in (c,d).