Math Diversion 982

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In mathematics, you don't understand things.
You just get used to them.
— John von Neumann

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Source: https://www.youtube.com/watch?v=zhMzgB0Mcdg
Title: GRE Mathematics Subject Test - A matrix code
 Presenter: Math Out Loud
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1 Problem

The problem is a spy-vs-spy math thriller. For details, consult the video. But it boils down to solving the following matrix equation for M:

$$MC = \begin{bmatrix} 51 & -3 \\ 31 & -8 \end{bmatrix}, \tag{1}$$

where M is a 2×2 matrix and

$$C = \begin{bmatrix} 2 & -1 \\ 1 & 1 \end{bmatrix}. \tag{2}$$

2 Solution

Now, since the rows of C are not multiple of each other, C is invertible, thus (1) becomes

$$M = \begin{bmatrix} 51 & -3 \\ 31 & -8 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 1 & 1 \end{bmatrix}^{-1} \tag{3}$$

$$= \begin{bmatrix} 51 & -3 \\ 31 & -8 \end{bmatrix} \begin{bmatrix} 1/3 & 1/3 \\ -1/3 & 2/3 \end{bmatrix} \tag{4}$$

$$= \begin{bmatrix} 18 & 15 \\ 13 & 5 \end{bmatrix}. \tag{5}$$

On converting the numbers to their alphabetic equivalents, going first left-to-right and then down, I get "ROME."