Name: ______________________________

DATA 470 — Fall 2025

Quiz #4

Sep. 9, 2025

1. What are the dimensions of the matrix M?

$$M = \begin{bmatrix} 2 & 9 & 11 & -3 \\ 1 & 0 & \pi & 4 \\ -3.2 & -9.6 & -1.1 & 2 \end{bmatrix}$$

   3×4.

2. If M is used as a linear transformation, what is the dimensionality of the vectors in its domain?

   4, or $\mathbb{R}^4$ vectors. (In other words, expressed as a function, $M : \mathbb{R}^4 \to \mathbb{R}^3$. If you don't believe me, try matrix vector multiplication on it.)

3. If M is used as a linear transformation, what is the dimensionality of the vectors in its range/codomain?

   3, or $\mathbb{R}^3$ vectors.

4. Here's another matrix for a different linear transformation, Q:

$$Q = \begin{bmatrix} 2 & 0 \\ 0 & \frac{1}{2} \end{bmatrix}$$

   a. What is the output if I give the input $\overrightarrow{\mathbf{x}}$ to this linear transformation, where $\overrightarrow{\mathbf{x}} = \begin{bmatrix} 6 \\ 2 \end{bmatrix}$?

   $Q(\overrightarrow{\mathbf{x}}) = \begin{bmatrix} 12 \\ 1 \end{bmatrix}$

   b. And what's the value of $Q\Big(\begin{bmatrix} -1 \\ 1 \end{bmatrix}\Big)$?

   $Q\Big(\begin{bmatrix} -1 \\ 1 \end{bmatrix}\Big) = \begin{bmatrix} -2 \\ \frac{1}{2} \end{bmatrix}$

   c. In words, what is the overall function/purpose/operation/effect of the linear transformation Q?

   It doubles the width and halves the height of the vector it takes as input. (Or, it doubles the first element and halves the second element of the vector it takes as input.)