

Math 194 Units 1–4 Summary

<i>Context</i>	<i>Example</i>	<i>Visualization</i>	<i>Question 1</i>	<i>Question 2</i>	<i>Question 3</i>
Systems of Linear Equations	Solve $2x_1 - 3x_2 = 4$, $x_1 + 5x_2 = 3$.	Intersecting lines, planes, and so on	Is the system consistent?	If so, is the solution unique?	Is the system consistent for all possible right hand sides?
Vector Equations	Solve $x_1 \begin{bmatrix} 2 \\ 2 \\ 1 \end{bmatrix} + x_2 \begin{bmatrix} -3 \\ 5 \\ 3 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \\ 3 \end{bmatrix}$.	Head-to-tail addition of scaled vectors	Is $\begin{bmatrix} 4 \\ 4 \\ 3 \end{bmatrix}$ a linear combo of $\begin{bmatrix} 2 \\ 2 \\ 1 \end{bmatrix}$ and $\begin{bmatrix} -3 \\ 5 \\ 3 \end{bmatrix}$?	Are the vectors $\begin{bmatrix} 2 \\ 2 \\ 1 \end{bmatrix}$ and $\begin{bmatrix} -3 \\ 5 \\ 3 \end{bmatrix}$ linearly independent?	Do the vectors $\begin{bmatrix} 2 \\ 2 \\ 1 \end{bmatrix}$ and $\begin{bmatrix} -3 \\ 5 \\ 3 \end{bmatrix}$ span \mathbb{R}^3 ?
Matrix Equations	Solve $A\mathbf{x} = \begin{bmatrix} 4 \\ 4 \\ 3 \end{bmatrix}$ where $A = \begin{bmatrix} 2 & -3 \\ 2 & -3 \\ 1 & 5 \end{bmatrix}$.	None	Is $\begin{bmatrix} 4 \\ 4 \\ 3 \end{bmatrix}$ a linear combination of the columns of A ?	Are the columns of A linearly independent?	Do the columns of A span \mathbb{R}^3 ?
Subspaces	Consider $A = \begin{bmatrix} 2 & -3 \\ 1 & 5 \end{bmatrix}$ and $\mathbf{x} = \begin{bmatrix} 4 \\ 4 \\ 3 \end{bmatrix}$.	Points, lines, planes, and so on	Is \mathbf{x} in the column space of A ?	Does the null space of A have dimension 0?	Is the column space of A all of \mathbb{R}^2 ?
Linear Transformations	Let $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ have standard matrix $\begin{bmatrix} 2 & -3 \\ 1 & 5 \end{bmatrix}$.	Reflections, rotations, and so on (for some transformations)	Is $\begin{bmatrix} 4 \\ 4 \\ 3 \end{bmatrix}$ in the range of T ?	Is T one-to-one?	Is T onto?
<i>To Answer:</i>	Not applicable	Not applicable	Row-reduce the augmented matrix. Look for a row of all zeros except for a nonzero entry in the rightmost column.	Row-reduce the augmented matrix. Check for free variables.	Row-reduce the coefficient matrix. Check for a row of all zeros.