Here are some counter-example type problems that you can play with. There may be more in the book. I may or may not extract problems from this pool. The following are false statements. Find a counter-example for each statement:

1 Let A be $m \times n$. If $Av = 0$ for some $v \in \mathbb{R}^n$, then $A = 0$.

2 Let A be $m \times n$ and B, C be $n \times p$. If $AB = AC$, then $B = C$.

3 A, B be $n \times n$. If $\det(A) = \det(B)$, then $A \sim B$.

4 If $AB = 0$, then $A = 0$ or $B = 0$.

5 If A, B have the same set of eigenvalues, then A, B have the same eigenspaces.

6 If A, B have the same set of eigenvalues, then $A \sim B$.

7 If A has eigenvalue λ with eigenvector u and B has eigenvalue μ with eigenvector v, then $A + B$ has eigenvalue $\lambda + \mu$ with eigenvector $u + v$.

8 If A has eigenvalue λ and B has eigenvalue μ, then AB has eigenvalue $\lambda\mu$.

9 If A, B are symmetric, then AB is symmetric.

10 $(AB)^{-1} = A^{-1}B^{-1}$.

11 $T \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} y \\ x^2 \end{pmatrix}$ is a linear transformation.

12 If U, W are subspaces of V. Then $U \cup W$ is a subspace of V also.