1. For the example on p.42 of notes.
   (a) Verify that $V_1^\perp, V_2^\perp, V^\perp$ are as given.
   (b) $V_1$ is not orthogonal to $V_2$.
   (c) Verify the statement $P_V \neq P_{V_1} + P_{V_2}$ by computing $p(y | V), p(y | V_1), p(y | V_2)$ for $y = [(1, 2, 3, 4)]^T$, as suggested.
   (d) Show that $P_V \neq P_{V_1} + P_{V_2}$ by computing $P_{V_3}P_{V_1}P_{V_2}$ directly.

2. Verify the result $C(X^TX) = C(X^T)$ for

$$X = \begin{pmatrix} 1 & 2 \\ -1 & 0 \end{pmatrix}$$

3. For each of the following matrices or quadratic forms, determine whether it is positive definite, positive semidefinite, or neither:

   a. $Q(x_1, x_2, x_3) = 12x_1^2 + 3x_2^2 + 3x_3^2 + 2x_1x_2 - 10x_1x_3 + 4x_2x_3.$

   b.

   $$A = \begin{pmatrix} 2 & 1 & 2 \\ 1 & 2 & 1 \\ 2 & 1 & 4 \end{pmatrix}$$

   c.

   $$A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 1 \\ 3 & 1 & -2 \end{pmatrix}$$

4. For $A = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}$ find a matrix $B$ such that $A = BB^T$.

5. Problem 2.35.


7. Problem 2.71 $(a,b,c)$, and also these additional parts:

   d. For $k = 3$, verify the property $A^k v = \lambda^k v$ for each eigenpair of $A$.

   e. Find $\text{tr}(A)$ and $|A|$ and verify that $\text{tr}(A) = \sum_{i=1}^3 \lambda_i$ and $|A| = \prod_{i=1}^3 \lambda_i$ where $\lambda_1, \lambda_2, \lambda_3$ are the eigenvalues