Lab5. Yuxuan Zhang

Q1-1

$\Sigma_{ij} = E[(X_i - E(X_i))(X_j - E(X_j))]$

$= Cov(X_i, X_j)$.

Q2-2.

$\Sigma = E[(X-E(X))(X-E(X))^T]$

$= E[XX^T - X(E(X))^T - E(X)X^T + E(X)E(X)^T]$

$= E(XX^T) - E(X)(E(X))^T - E(X)(E(X))^T + E(X)(E(X))^T$

$= E(XX^T) - E(X)(E(X))^T$

Q1-3:

$Cov(Y) = E[(AX - E(AX))(AX - E(AX))^T]$

$= E[(AX - AE(X))(AX - AE(X))^T]$

$= AE[(X-E(X))(X-E(X))^T]A^T$

$= A\Sigma A^T$.

Q1-4:

We know that $u^TAu = \|u\|_2\|Au\|\cos\theta$.

$\Rightarrow$ the magnitude of u^TAu depends on $\cos\theta$.

when $\theta = 0$, $\cos\theta = 1$, u^TAu is at its maximum.

when $\theta = 90°$, $\cos\theta = 0$.

Thus, for $u^TAu \geq 0$, θ has to be 0 or acute.