Given a set of 2D points X on a line that makes 45 degree to the x-axis:

$$X = \{[1,1]^T, [2,2]^T, [3,3]^T [4,4]^T, [5,5]^T\}$$

We compute the covariance matrix, and its eigen values and eigen vectors. Then:

(A) **[Ans]** $\lambda_2 = 0$

(B) $\lambda_1 = \lambda_2$

(C) $\lambda_1 = -1$

(D) **[Ans]** Σ is singular

(E) none of the above

Given a set of 2D points X on a line that makes 45 degree to the x-axis:

$$X = \{[-2, 2]^T, [-3, 3]^, [-4, 4]^T, [-5, 5]^T [-6, 6]^T\}$$

We compute the covariance matrix, and its eigen values and eigen vectors. Then:

(A) **[Ans]** $\lambda_2 = 0$

(B) $\lambda_1 = \lambda_2$

(C) $\lambda_1 = -1$

(D) **[Ans]** Σ is singular

(E) none of the above

Given a set of 2D points X on the vertical line $x_1 = 5$,

$$X = \{[5,1]^T, [5,2]^T, [5,3]^{,}[5,4]^T, [5,5]^T\}$$

We now add an additional point $[4,3]^T$ to X. We compute the covariance matrix, and its eigen values and eigen vectors. Then:

(A) **[Ans]** $\lambda_1 \geq \lambda_2$

(B) $\mathbf{u}_1$ and $\mathbf{u}_2$ are nearly orthogonal, but not perfectly orthogonal.

(C) Σ is singular

(D) **[Ans]** Σ is diagonal

(E) None of the above.

Given a set of 2D points X on the vertical line $x_2 = 5$,

$$X = \{[1,5]^T, [2,5]^T, [3,5]^T [4,5]^T, [5,5]^T\}$$

We compute the covariance matrix, and its eigen values and eigen vectors. Then:

(A) **[Ans]** $\lambda_1 \geq \lambda_2$

(B) **[Ans]** μ is on the same line.

(C) **[Ans]** Σ is singular

(D) **[Ans]** Σ is diagonal

(E) None of the above

Set X has 10 points. 5 of them are on a line that makes 45 degrees with the x_1 axis and another 5 from on a line that makes 135 degrees with the x_1 axis. We compute the covariance matrix, and its eigen values and eigen vectors. Then:

(A) $\lambda_1 = \lambda_2 \neq 0$

(B) Σ is singular

(C) Σ is diagonal

(D) μ is on either of these lines.

(E) **[Ans]** None of the above