

- * Reduce the dimension from 2 to 1 using the principal component (PCA). Compute the first PC.

Feature	Ex 1	Ex 2	Ex 3	Ex 4
X_1	4	8	13	7
X_2	11	4	5	14

- * Eigen values : $\lambda_1 = 30.3849$
 $\lambda_2 = 6.6151$

- * Eigen vectors : $e_1 = \begin{bmatrix} 0.5574 \\ -0.8303 \end{bmatrix}$
 $e_2 = \begin{bmatrix} 0.8303 \\ 0.5574 \end{bmatrix}$

Step-2: Mean for $X_1 = \frac{4+8+13+7}{4} = 8$

Mean for $X_2 = \frac{11+4+5+14}{4} = 8.5$

$$X_{\text{centered}} = \begin{bmatrix} 4-8 & 8-8 & 13-8 & 7-8 \\ 11-8.5 & 4-8.5 & 5-8.5 & 14-8.5 \end{bmatrix}$$

$$= \begin{bmatrix} -4 & 0 & 5 & -1 \\ 2.5 & -4.5 & -3.5 & 5.5 \end{bmatrix}$$

Step-3: Largest Eigen value = λ_1

Corresponding eigen vector = $e_1 = \begin{bmatrix} -0.5574 \\ -0.8303 \end{bmatrix}$

Step-4: $Z = e_1^T \cdot X_{\text{centered}}$

$$Z = [0.5574 \quad -0.8303] \begin{bmatrix} -4 & 0 & 5 & -1 \\ 2.5 & -4.5 & -3.5 & 5.5 \end{bmatrix}$$

$$Z_1 = (0.5574)(-4) + (-0.8303)(2.5)$$

$$Z_1 = 1.5385$$

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$$Z_2 = 3.73635$$

$$Z_3 = 0.11905$$

$$Z_4 = -4.00925$$

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$$\begin{bmatrix} N & F & 22.0 \\ \cos 8.0^\circ \end{bmatrix} = 1.0$$

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$$R = F + B + G + N = 1.0$$

$$2.8 = \frac{N + F + B + G}{4} = 1.0$$

$$\begin{bmatrix} R & F & 8.8 & 8.8 \\ 2.8 & 2.8 & 2.8 & 2.8 \end{bmatrix} = 1.0$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = 1.0$$

$$\begin{bmatrix} N & F & 22.0 \\ \cos 8.0^\circ \end{bmatrix} = 1.0$$