

## الضرب الداخلي Inner Product

The inner product of two vectors with the same number of elements is the sum of the products of the corresponding elements of the two vectors

Since the inner product is a scalar.

$$\underline{X}' \underline{Y} = (x_1 \ x_2 \ \dots \ x_n) \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} = \sum_{i=1}^n x_i y_i = (\underline{X}, \underline{Y})$$

$$\underline{X}' \underline{X} = (x_1 \ x_2 \ \dots \ x_n) \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \sum_{i=1}^n x_i^2 = (\underline{X}, \underline{X})$$

the length of the vector

length of vector denoted by  $\|X\|$  is the

square root of the inner product  $\Rightarrow$  scalar

$$\|X\| = \sqrt{(\underline{X}, \underline{X})} = \sqrt{\sum_{i=1}^n x_i^2} = (X'X)^{\frac{1}{2}}$$

now

the distance between two vectors  $\underline{X}, \underline{Y}$

$$\|\underline{X} - \underline{Y}\| = \sqrt{(\underline{X} - \underline{Y}, \underline{X} - \underline{Y})} = \left[ (\underline{X} - \underline{Y})' (\underline{X} - \underline{Y}) \right]^{\frac{1}{2}}$$