Covariance matrix of a two-dimensional dataset

TOTAL POINTS 5

1. Compute the covariance matrix for the following dataset

1/1 point

$$\mathcal{D} = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 5 \\ 4 \end{bmatrix} \right\}$$

Here, every column vector represents a data point.

Do the exercise using pen and paper.

- (●) $\begin{bmatrix} 4 & 2 \\ 2 & 1 \end{bmatrix}$
- ( ) $\begin{bmatrix} 2 & 2 \\ 4 & 1 \end{bmatrix}$
- ( ) $\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$

✓ **Correct**

Good job!

2. Consider a data set $\mathcal{D}$ with covariance matrix $\begin{bmatrix} 3 & 2 \\ 2 & 4 \end{bmatrix}$.

1/1 point

What is the covariance matrix if we multiply every vector in $\mathcal{D}$ by 2?

- ( ) $\begin{bmatrix} 3 & 2 \\ 2 & 4 \end{bmatrix}$
- (●) $\begin{bmatrix} 12 & 8 \\ 8 & 16 \end{bmatrix}$
- ( ) $\begin{bmatrix} 16 & 8 \\ 8 & 12 \end{bmatrix}$
- ( ) $\begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$

✓ **Correct**

Yes, every element in the covariance matrix is multiplied by 4.

3. Consider the data set $\mathcal{D} = \left\{ \begin{bmatrix}1\\2\end{bmatrix}, \begin{bmatrix}7\\4\end{bmatrix} \right\}$ with covariance matrix $\begin{bmatrix}9 & 3\\3 & 1\end{bmatrix}$.

1 / 1 point

Compute the new covariance matrix when we add $\begin{bmatrix}2\\2\end{bmatrix}$ to each element in $\mathcal{D}$.

- ○ $\begin{bmatrix}11 & 5\\5 & 3\end{bmatrix}$
- ○ $\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$
- ◉ $\begin{bmatrix}9 & 3\\3 & 1\end{bmatrix}$

✓ **Correct**

Well done. The covariance will not change.

4. Provide a valid 2x2 covariance matrix by replacing the -1 entries in the code below.

1 / 1 point

```
def covariance_matrix():
  """Return a valid 2x2 covariance matrix"""
  covariance_matrix = np.array([[9, 3],
                                [3, 1]])
  return covariance_matrix

print(covariance matrix())
```

Run

Reset

```
[[9 3]
 [3 1]]
```

✓ **Correct**

Good job!

5. We are looking at a data set $\mathcal{D}$ where every element in $\mathcal{D}$ consists of an x and y coordinate. The data covariance matrix is given by

$$\begin{bmatrix} 1 & 0.8 \\ 0.8 & 1 \end{bmatrix}$$

Which of the following statements is correct?

- (selected) x and y are positively correlated, i.e., when x increases then y increases on average, and vice versa.
- x and y are negatively correlated, i.e., when x increases then y decreases on average, and vice versa.
- x and y are uncorrelated, i.e., when x increases then y does not change on average (and vice versa).

✓ **Correct**

Well done!