## Covariance Simplified: Learn It Once, Understand It Forever! Data Science and A.I. Lecture Series

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$$\operatorname{Cov}(X,Y) = \frac{1}{n} \sum_{i=1}^{n} |\mathbf{x}_i \mathbf{y}_i| - |\mathbf{x}_i \bar{\mathbf{Y}}| - |\mathbf{\bar{X}} \mathbf{y}_i| + |\mathbf{\bar{X}} \bar{\mathbf{Y}}|$$

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$$Cov(X, Y) = \frac{1}{n} \sum_{i=1}^{n} x_i y_i - \frac{\bar{Y}}{n} \sum_{i=1}^{n} x_i - \frac{\bar{X}}{n} \sum_{i=1}^{n} y_i + \frac{\bar{X}\bar{Y}}{n} \sum_{i=1}^{n} 1$$

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• Or equivalently:

$$\operatorname{Cov}(X,Y) = \frac{1}{n} \sum_{i=1}^{n} x_i y_i - \left(\frac{1}{n} \sum_{i=1}^{n} x_i\right) \left(\frac{1}{n} \sum_{i=1}^{n} y_i\right)$$

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 $\operatorname{Cov}(X,Y) = ($ Mean of the product of values of X and Y) - (Product of means of X and Y).

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• This simplified formula helps:

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 $\operatorname{Cov}(X, Y) = ($ Mean of the product of values of X and Y) - (Product of means of X and Y).

- This simplified formula helps:
  - Ease computation.

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 $\operatorname{Cov}(X, Y) =$  (Mean of the product of values of X and Y) - (Product of means of X and Y).

- This simplified formula helps:
  - Ease computation.
  - Provide insights into the relationship between X and Y.

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# Thank You!