The kurtosis value of -0.6444 indicates a playkurtic distribution (kurtosis less than 3), meaning the distribution has lighter tails and fewer & extreme outliers compared to a normal distribution.

COVARIANCE AND CORRELATION:

Covariance: Covariance measures the degree to which two variables (eg, asset returns) change together. It indicates whether an asset's returns tends to move in the same direction as another asset's return tends to move in the same direction as another asset's return (positive covariance) or opposite directions (negative covariance).

Formula:

$$Cov(X,Y) = \frac{1}{N-1} \sum_{i=1}^{N} (X_i - \bar{X})(Y_i - \bar{Y})$$

where,

* X_i and Y_i are the returns of the two assets for the i^{th} period.
* $\bar{X}$ and $\bar{Y}$ are the means (averages) of the returns of the two assets.
* N is the number of data points (periods).

Positive Covariance: The asset tends to move in the same direction. If one asset goes up, the another tends to go up as well.

Example:

Assume we have monthly returns for two stocks, Stock A and stock B, over 5 months:

Stock A Return : 4%, 6%, 3%, 7%, 5%

Stock B Return : 2%, 5%, 4%, 8%, 6%

Calculate the covariance and correlation between the returns of two stocks:

Step 1: Calculate the Mean (Average Returns)

For stock A:

$$\bar{X} = \frac{4+6+3+7+5}{5} = \frac{25}{5} = \boxed{5\%}$$

For stock B:

$$\bar{Y} = \frac{2+5+4+8+6}{5} = \frac{25}{5} = \boxed{5\%}$$

Step 2: Calculate the covariance

Month	Stock A X_i	Stock B Y_i	$X_i - \bar{X}$	$Y_i - \bar{Y}$	$(X_i-\bar{X})(Y_i-\bar{Y})$
1.	4%	2%	4-5 = -1%	2-5 = -3%	(-1%) × (-3%) = 3%.
2.	6%	5%	6-5 = 1%	5-5 = 0%	(1) × (0) = 0%
3.	3%	4%	3-5 = -2%	4-5 = -1%	(-2) × (-1) = 2%
4.	7%	8%	7-5 = 2%	8-5 = 3%	(2) × (3) = 6%
5.	5%	6%	5-5 = 0%	6-5 = 1%	(0) × (1) = 0%

Negative Covariance: The assets tend to move in opposite direction. If one asset goes up, the other asset tends to go up as well.

Zero Covariance: No relationship. The assets returns are independent of each other.

CORRELATION:

Correlation is a normalized version of covariance. It measures both the strength and direction of the relationship between two variables. The value of correlation ranges from -1 to +1.

Formula:

$$\gamma_{XY} = \frac{Cov(X,Y)}{\sigma_X \sigma_Y}$$

where:

$Cov(X,Y)$ is the sample covariance between X and Y

$\sigma_x \sigma_y \rightarrow$ Standard Deviation of X and Y

Interpretation of Correlation:

+1 → Perfect positive linear relationship (the assets move in the same direction at all times).

0 → No linear relationship (the assets returns are unrelated).

-1 → Perfect negative linear relationship (the assets move in opposite directions at all times).

Between 0 and 1 : A positive, but not perfectly linear, relationship.

Between 0 and -1 : A negative, but not perfectly linear, relationship

Sum $= 3+0+2+6+0 = 11$

$$Cov(X,Y) = \frac{1}{5-1} \times 11 = \frac{11}{4} = 2.75$$

Step 3: Calculate the Standard Deviations of Stock A (Stock A) and Stock B.

$$Variance_X = \frac{1}{4}\sum_{i=1}^{5}(X_i - \bar{X})^2$$

$$= \frac{1}{4}((-1)^2 + 1^2 + (-2)^2 + 2^2 + 0^2)$$

$$= \frac{1}{4}(1+1+4+4+0) = \frac{10}{4} = 2.5$$

$$SD = \sigma_X = \sqrt{2.5} = 1.58$$

Stock B:

$$Variance_Y = \frac{1}{4}\sum_{i=1}^{5}(Y_i - \bar{Y})^2 = \frac{1}{4}((-3)^2 + 0^2 + (-1)^2 + 3^2 + 1^2)$$

$$= \frac{1}{4}(9+0+1+9+1) = \frac{20}{4} = 5$$

$$S.D = \sigma_Y = \sqrt{5} = 2.24$$

Step 4: Calculate the correlation:

$$r_{X,Y} = \frac{Cov(X,Y)}{\sigma_X \sigma_Y} = \frac{2.75}{1.58 \times 2.24} = \frac{2.75}{3.5392} = 0.777$$

* The covariance of 2.75 indicates a positive relationship between the returns of stock A and stock B. When one stock increases in value, the other tends to increase as well.

* The correlation of 0.775 suggests a strong positive linear relationship between the two stocks.