Statistical Measures of Asset Returns

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Sample Mean (Arithmetic Mean)

$$
\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} \tag{1}
$$

Where:

- X_i: value of observation i
- $\bar{X}$: sample mean
- n: number of observations in the sample

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## Sample Mean (Arithmetic Mean)

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Where:

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Range

$$\text{Range = Maximum value - Minimum value} \tag{2}$$

Where:

- Maximum value: largest observation in the dataset
- Minimum value: smallest observation in the dataset

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## Range

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Where:

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* $\text{Minimum value}$: smallest observation in the dataset
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Mean Absolute Deviation (MAD)

$$\text{MAD} = \frac{\sum_{i=1}^{n} |X_i - \bar{X}|}{n} \tag{3}$$

Where:

- X_i: value of observation i
- $\bar{X}$: sample mean
- n: number of observations in the sample
- $|...|$: indicate the absolute value of what is contained within these bars

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Sample Variance

$$
s^2 = \frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n - 1} \tag{4}
$$

Where:

- s^2: sample variance
- X_i: value of observation i
- $\bar{X}$: sample mean
- n: number of observations

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Where:

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Sample Standard Deviation

$$
s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n - 1}} \tag{5}
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Where:

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- X_i: value of observation i
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Sample Target Semideviation Formula

$$
S_{\text{target}} = \sqrt{\sum_{\text{for all} X_i \leq B}^{n} \frac{(X_i - B)^2}{n - 1}} \tag{6}
$$

Where:

- S_{target}: target semideviation
- X_i: value of observation i
- B: target return
- n: total number of observations

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## Sample Target Semideviation Formula

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S_{\text{target}}
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$$

Where:

* $S_{\text{target}}$: target semideviation
* $X_i$: value of observation $i$
* $B$: target return
* $n$: total number of observations
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Coefficient of Variation (CV)

$$CV = \frac{s}{\bar{X}} \tag{7}$$

Where:

- CV: coefficient of variation
- s: sample standard deviation
- $\bar{X}$: sample mean

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## Coefficient of Variation (CV)

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CV = \frac{s}{\bar{X}} \tag{7}
$$

Where:
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* $CV$: coefficient of variation
* $s$: sample standard deviation
* $\bar{X}$: sample mean
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Sample Skewness (Approximation)

$$
\text{Skewness} \approx \left(\frac{1}{n}\right)\frac{\sum_{i=1}^{n} (X_i - \bar{X})^3}{s^3} \tag{8}
$$

Where:

- Skewness: is computed as
  - the average cubed deviation from the mean,
  - standardized by dividing by the standard deviation cubed
  - to make the measure free of scale.
- X_i: value of observation i
- $\bar{X}$: sample mean
- s: sample standard deviation
- n: number of observations (100 or more)

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Sample Excess Kurtosis (Approximation)

$$
K_E \approx \left(\frac{1}{n}\right)\frac{\sum_{i=1}^{n} (X_i - \bar{X})^4}{s^4} - 3 \tag{9}
$$

Where:

- K_E: sample excess kurtosis
- X_i: value of observation i
- $\bar{X}$: sample mean
- s: sample standard deviation
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## Sample Excess Kurtosis (Approximation)

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Sample Covariance

$$
s_{XY} = \frac{\sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y})}{n - 1} \tag{10}
$$

Where:

- s_{XY}: sample covariance between X and Y
- X_i: observation i of variable X

- Y_i: observation i of variable Y
- $\bar{X}$: sample mean of X
- $\bar{Y}$: sample mean of Y
- $n-1$: ensures that the sample covariance is an unbiased estimate of population covariance.
- n: number of paired observations

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## Sample Covariance

$$
s_{XY} = \frac{\sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y})}{n - 1} \tag{10}
$$

Where:

* $s_{XY}$: sample covariance between $X$ and $Y$
* $X_i$: observation $i$ of variable $X$
* $Y_i$: observation $i$ of variable $Y$
* $\bar{X}$: sample mean of $X$
* $\bar{Y}$: sample mean of $Y$
* $n-1$: ensures that the sample covariance is an unbiased estimate of population covariance
* $n$: number of paired observations
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Sample Correlation Coefficient

$$
r_{XY} = \frac{s_{XY}}{s_X s_Y} \tag{11}
$$

Where:

- r_{XY}: sample correlation coefficient
- s_{XY}: sample covariance between X and Y
- s_X: sample standard deviation of X
- s_Y: sample standard deviation of Y

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