

Learning Module 3: Statistical Measures of Asset Returns

Q.102 Last year, the S&P 500 has had the following returns: 2% in the first quarter, -3% in the second quarter, 5% in the third quarter, and 11% in the last quarter. The S&P 500's yearly return is *closest to*:

- A. 3.63%
- B. 11.00%
- C. 15.31%

The correct answer is **A**.

To calculate the annual return of the S&P 500, we need to combine the quarterly returns. We can use the following formula to calculate the total return:

$$\begin{aligned}\text{Total Return} &= (1 + Q_1 \text{ Return}) \times (1 + Q_2 \text{ Return}) \times (1 + Q_3 \text{ Return}) \times (1 + Q_4 \text{ Return}) - 1 \\ \text{Yearly return} &= [(1 + r_1)(1 + r_2) \dots (1 + r_n)]^{\frac{1}{n}} - 1 \\ &= [(1 + 0.02)(1 - 0.03)(1 + 0.05)(1 + 0.11)]^{\frac{1}{4}} - 1 \\ &= 0.0363 \approx 3.63\%\end{aligned}$$

Q.235 Which of the following statements is *most likely* in a positively skewed distribution:

- A. Mean = Median
- B. Mode > Median
- C. Mean > Median

The correct answer is **C**.

The mean is greater than the median for positively skewed distribution.

A is incorrect. The mean is greater than the mode in a positively skewed distribution.

B is incorrect. The median is greater than the mode in a positively skewed distribution.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.236 You are provided the following sample values:
{ 12, 7, 14, 11 }

The sample variance is *closest to*:

- A. 5.20.
- B. 6.50.
- C. 8.67.

The correct answer is **C**.

We know that the sample variance is given by:

$$\begin{aligned}\text{Sample variance} &= \sum \frac{(X - E(X))^2}{n - 1} \\ &= \frac{(12 - 11)^2 + (7 - 11)^2 + (14 - 11)^2 + (11 - 11)^2}{4 - 1} = 8.67\end{aligned}$$

Steps Using a financial Calculator

Set the calculator to "DATA" by pressing 2ND 7.

X01=12 ENTER ↓ ↓, X02=7 ENTER ↓ ↓, X03=14 ENTER ↓ ↓, X04=11 ENTER
2ND QUIT

Set the calculator to "STAT" by pressing 2ND 8

↓ ↓ ↓ $S_x = 2.9439$.

Square it to get the variance. $2.9439^2 = 8.67$

For population variance, the value to be picked would have been σ_x .

A is incorrect. It assumes an $(n+1)$ in the formula.

B is incorrect. It ignores the $(n-1)$ in the formula.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.410 Which one of the following statements is *most likely* accurate?

- A. The geometric mean is always less than or equal to the arithmetic mean.
- B. The geometric mean is always more than or equal to the arithmetic mean.
- C. The geometric mean and the arithmetic mean are always equal.

The correct answer is **A**.

The only time the two means are equal is when there is no variability in the observation.

B is incorrect. The geometric mean may be less than or equal to the arithmetic mean but not more than the arithmetic mean.

C is incorrect. The geometric and arithmetic mean are not always equal. Sometimes, the arithmetic mean may be more than the geometric mean.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.778 Which of the following statements is *most* accurate if two securities are perfectly correlated?

- A. Risk-return opportunity set will be represented by a straight line connecting these two securities.
- B. Risk-return opportunity set will be represented by a curve bulging on the left.
- C. Risk-return opportunity set will be represented by a curve bulging on the right.

The correct answer is **A**.

If two assets are perfectly correlated, the risk-return opportunity is represented by a straight line connecting these two assets. The line contains portfolios formed by changing the weight of each asset invested in the portfolio.

B is incorrect. The returns of the securities move together in the same direction and to the same extent, leaving no room for risk reduction through diversification.

C is incorrect. Proposing that the risk-return opportunity set will be represented by a curve bulging on the right is also incorrect for two perfectly correlated securities. A curve bulging to the right would suggest an inefficient risk-return trade-off, where increasing risk does not proportionately increase expected returns. However, in the case of perfect correlation, the risk-return trade-off is linear, as the returns of the two securities move in tandem, allowing for a predictable increase in expected returns with an increase in risk, represented by a straight line rather than a curve.

Q.2686 The South Korea Stock Exchange posted returns of 10% for the past fiscal year. The 10 mutual funds in the same market underperformed and overperformed the South Korean market return at different scales. The following table shows the interval of returns under and above the South Korean market return, while the returns of mutual funds are -5.75%, -3.5%, -1.7%, 0.9%, 1.2%, 2.3%, 3.2%, 5.5%, 5.8%, and 6.25%.

Interval	Values
A	(-5.75 to -2.75)
B	(-2.75 to 0.25)
C	(0.25 to 3.25)
D	(3.25 to 6.25)

Using the given data, the relative frequency of Interval C is *closest to*:

- A. 30%
- B. 40%
- C. 70%

The correct answer is **B**.

To solve this question we need to calculate the frequency distribution table as shown below. The relative frequency is calculated by dividing the absolute frequency of a specific interval by the number of observation.

$$\text{Relative frequency of Interval C} = \frac{\text{Absolute frequency}}{\text{Total number of observation}} = \frac{4}{10} = 40\%$$

Intervals	Absolute Frequency	Relative Frequency (%)	Cumulative Frequency	Cumulative Relative Frequency
A (-5.75 to -2.75)	2	20.00%	2	20.00%
B (-2.75 to 0.25)	1	10.00%	3	30.00%
C (0.25 to 3.25)	4	40.00%	7	70.00%
D (3.25 to 6.25)	3	30.00%	10	100.00%

A is incorrect. The percentage relates to Absolute Frequency of Interval D as indicated above.

C is incorrect. The percentage represents Cumulative Relative Frequency of Interval C.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.2688 Which of the following is the *most appropriate* example of the mean of time-series data?

- A. The mean annual P/E ratio in the steel sector.
- B. The mean profit margin of the Fast 500 companies in 2016.
- C. The quarterly mean EPS of the technology sector for the last 10 years.

The correct answer is **C**.

Observation or data that spreads through time is called time-series data. Option C) is the most appropriate example of a mean of time series data as it calculates the mean EPS of the technology sector based on the quarterly EPS data that spread over 10 years.

A is incorrect. It represents cross-sectional data. Cross-sectional data is data that is collected by observing a number of subjects at one point in time. P/E ratio of the steel sector at a particular point in time represents cross-sectional data.

B is incorrect. It represents the mean of cross-sectional data, not time series data.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2689 MZJ Corp. is the market leader firm in the consultancy business. The data related to daily share price for the month of February 2015 is provided in the following table.

Date	High Price (\$)	Close Price (\$)
Monday, February 02, 2015	19.15	19.01
Tuesday, February 03, 2015	19.27	19.10
Wednesday, February 04, 2015	19.30	19.27
Thursday, February 05, 2015	20.10	19.50
Friday, February 06, 2015	21.00	20.75
Monday, February 09, 2015	21.00	19.80
Tuesday, February 10, 2015	20.00	18.97
Wednesday, February 11, 2015	19.00	18.50
Thursday, February 12, 2015	18.50	17.95
Friday, February 13, 2015	19.50	18.00
Monday, February 16, 2015	18.20	17.44
Tuesday, February 17, 2015	17.46	17.40
Wednesday, February 18, 2015	17.20	16.99
Thursday, February 19, 2015	18.00	17.95
Friday, February 20, 2015	19.00	18.75
Monday, February 23, 2015	20.10	19.55
Tuesday, February 24, 2015	19.60	19.55
Wednesday, February 25, 2015	21.00	20.75
Thursday, February 26, 2015	21.00	19.91
Friday, February 27, 2015	20.20	19.25

Using the given data, the arithmetic mean of the 'high price' of MZJ stock for the month of February is *closest to*:

- A. \$13.87.
- B. \$18.92.
- C. \$19.43.

The correct answer is **C**.

The mean of the high prices of MZJ shares for the month of February is calculated as

$$\frac{\text{Sum of observation (high prices)}}{\text{Number of observation}} = \frac{388.58}{20} = 19.43 \text{ (as calculated in the following table)}$$

Date	High Price (\$)	Close Price (\$) Sorted Ascending
Wednesday, February 18, 2015	17.20	16.99
Tuesday, February 17, 2015	17.46	17.40
Monday, February 16, 2015	18.20	17.44
Thursday, February 19, 2015	18.00	17.95
Thursday, February 12, 2015	18.50	17.95
Friday, February 13, 2015	19.50	18.00
Wednesday, February 11, 2015	19.00	18.50
Friday, February 20, 2015	19.00	18.75
Tuesday, February 10, 2015	20.00	18.97
Monday, February 02, 2015	19.15	19.01
Tuesday, February 03, 2015	19.27	19.10
Friday, February 27, 2015	20.20	19.25
Wednesday, February 04, 2015	19.30	19.27
Thursday, February 05, 2015	20.10	19.50
Monday, February 23, 2015	20.10	19.55
Tuesday, February 24, 2015	19.60	19.55
Monday, February 09, 2015	21.00	19.80
Thursday, February 26, 2015	21.00	19.91
Friday, February 06, 2015	21.00	20.75
Wednesday, February 25, 2015	21.00	20.75
Sum of High Prices	\$388.58	
Arithmetic Mean	\$19.43	

A is incorrect. It is the sum of observations, and not the mean, of “high price.”

B is incorrect. It is the arithmetic mean of “close price,” as shown in the table above.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2691 The data related to the hypothetical sovereign debt rating of Latin American countries is provided below:

Country	Sovereign Debit Rating
Bolivia	BB-
Brazil	BB+
Chile	AA-
Colombia	BBB+
Costa Rica	BB
Dominican Republic	BB-
Ecuador	B
Mexico	BBB+
Panama	BBB
Peru	AA
Uruguay	BBB-
Venezuela	CCC

The data related to the sovereign debt rating is *most likely*:

- A. bimodal.
- B. trimodal.
- C. unimodal.

The correct answer is **A**.

A mode is the most frequently occurring value in the data set. In the given question, the sovereign debt ratings of BB- and BBB+ are occurring twice while all other ratings are occurring once. Therefore, the data is bimodal because the data has two modes.

B is incorrect. A trimodal data will have three modes.

C is incorrect. A unimodal data will have only one mode.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2693 The data pertaining to the profit margin of Gecko Inc. from 1990 to 1995 is provided in the following table.

Year	Profit Margin (%)
1990	11%
1991	15%
1992	5%
1993	9.50%
1994	15%
1995	17%

Using the given data, which of the following statements is *least likely* correct?

- A. The median profit margin lies between 1992 and 1993.
- B. The median profit margin of Gecko Inc. falls between 1990 and 1991.
- C. The median profit margin of Gecko Inc. is more than the mean return.

The correct answer is **A**.

To find the median profit margin, it is required to arrange the data in ascending order as shown in the table below. Since the sample data has an even number of observations the median profit margin will fall between the $n/2=6/2=3$ rd and $(n+2)/2=8/2=4$ th observation. Therefore, option A) is LEAST likely correct.

Year	Profit Margin (%) Ascending Order
1992	5%
1993	9.50%
1990	Median: 11%
1991	Median: 15%
1994	15%
1995	17%

B is incorrect. It is a true statement. The median return of Gecko Inc falls between 1990 and 1991, as seen in the table above.

C is incorrect. It is a true statement. The median return of Gecko Inc is greater than its mean return. The mean return of Gecko Inc is

$$\frac{5\% + 9.5\% + 11\% + 15\% + 15\% + 17\%}{6} = 12.08\%$$

while the median return of Gecko Inc is

$$\frac{11\% + 15\%}{2} = 13\%.$$

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2694 Smith Hermes is a portfolio manager that invests in small cap stocks that are subject to mergers and acquisitions. The asset allocation and the return data of Smith's portfolio are provided in the following table. Using the given data, the deviation of the weighted average (mean) return from the arithmetic mean return of the portfolio will be *closest to*:

Asset	Asset Return	Asset Allocation
Solar Panel Corp.	21%	13%
Crowd fund Inc.	17.50%	24%
Peer-Loaning Co.	-11%	27%
Dimitri Bogus Ltd.	-9%	17%
Hanover Corp.	27%	19%

- A. The weighted average mean deviates by -1.54%
- B. The weighted average mean deviates by 7.80%
- C. The weighted average mean deviates by 1.21%

The correct answer is **A**.

Weighted average return on each asset = Weight of asset × Return of asset

Note the above formula has been used in the following table. We then sum up the individual weighted means of all the assets to get the weighted mean of the portfolio

Deviation of the weighted average mean = Weighted average mean – Arithmetic mean return from the arithmetic mean return

$$= 7.56\% - 9.10\%$$

$$= -1.54\%$$

Asset	Asset Return	Asset Allocation	Weighted Avg.
Solar Panel Corp.	21%	13%	2.73%
Crowd fund Inc.	17.50%	24%	4.20%
Peer-Loaning Co.	-11%	27%	-2.97%
Dimitri Bogus Ltd.	-9%	17%	-1.53%
Hanover Corp.	27%	19%	5.13%
Arithmetic Mean	9.10%		
Weighted Average Mean	7.56%		

Note the arithmetic and weighted average mean is calculated as:

$$\text{Weighted Average mean} = \frac{(21\% \times 13\%)}{100\%} + \frac{(17.5\% \times 24\%)}{100\%} + \frac{(-11\% \times 27\%)}{100\%} + \frac{(-9\% \times 17\%)}{100\%} + \frac{(27\% \times 20\%)}{100\%} \\ = 7.56\%$$

$$\text{Arithmetic mean} = \frac{21\% + 17.5\% + (-11\%) + (-9\%) + 27\%}{5} = 9.10\%$$

B is incorrect. It indicates the Weighted Average Mean.

C is incorrect. It indicates the Arithmetic Mean.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2696 Jennifer Hollanda is a long-term trader who purchased a Petro Co. share at the price of \$50 at the beginning of the year. Assuming that the price of the share increased to \$100 in Year 1, decreased to \$50 in year 2, decreased to \$25 in year 3 and increased to \$50 in year 4, the geometric mean return of the Petro Co. share is *closest to*:

A. -50%

B. 0%

C. 100%

The correct answer is **B**.

Return for year 1: $\frac{100}{50} - 1 = 100\%$

Return for year 2: $\frac{50}{100} - 1 = -50\%$

Return for year 3: $\frac{25}{50} - 1 = -50\%$

Return for year 4: $\frac{50}{25} - 1 = 100\%$

Before we find the geometric mean, we must convert the percentage rates of return to $(1 + R_t)$.

Year 1: $= 1 + 100\% = 2$

Year 2: $= 1 - 50\% = 0.5$

Year 3: $= 1 - 50\% = 0.5$

Year 4: $= 1 + 100\% = 2$

$$\text{Geometric mean} = (2 \times 0.5 \times 0.5 \times 2)^{\frac{1}{4}} - 1 = 0\%$$

A is incorrect. It indicates the returns for years 2 and 3, respectively.

C is incorrect. It indicates the returns for years 1 and 4, respectively.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2698 After the 2008 financial crisis, the emerging market economies have demonstrated tremendous GDP growth. The following table contains the hypothetical GDP of 10 emerging markets.

Emerging Markets	GDP (Trillion USD)
Taiwan	1.1
Thailand	1.1
Pakistan	1.3
Iran	1.4
Turkey	1.5
Saudi Arabia	1.6
Korea	1.8
Mexico	2.2
Indonesia	2.8
Brazil	3.2

Using the given data, the 60th percentile of emerging markets GDP is *closest to*:

- A. USD 6.6 trillion
- B. USD 2.68 trillion
- C. USD 1.72 trillion

The correct answer is **C**.

Since $n=10$, then

$$60\text{th percentile} = (n + 1) \times \frac{L}{100} = (10 + 1) \times \frac{60}{100} = 6.6$$

The $X_6 = 1.6$ and $X_7 = 1.8$. Therefore

$$\text{Estimated 60th percentile} = X_6 + 0.6(X_7 - X_6) = 1.6 + 0.6 \times (1.8 - 1.6) = 1.72$$

A is incorrect. It indicates the approximate value of a percentile.

B is incorrect. It indicates the arithmetic mean of the resulting GDPs.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.2699 Muller Investments has been investing in Curex Pharma for the last 6 years. The returns

of Curex Pharma's shares are provided in the following table:

Year	Returns
2001	45%
2002	29%
2003	-16%
2004	-9%
2005	13%
2006	16%

Given the information, the mean absolute deviation (MAD) of the returns of Curex Pharma over the 6-year period is *closest to*:

- A. 13%
- B. 17%
- C. 61%

The correct answer is **B**.

Recall that:

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

The calculation of the mean absolute deviation of Curex Pharma returns are provided in the following table:

Year	Returns	$ X_i - \bar{X} $
2001	45%	$ 45\% - 13\% $
2002	29%	$ 29\% - 13\% $
2003	-16%	$ -16\% - 13\% $
2004	-9%	$ -9\% - 13\% $
2005	13%	$ 13\% - 13\% $
2006	16%	$ 16\% - 13\% $
Arithmetic Mean	$78\%/6 = 13\%$	Total = 102%
MAD	$102\%/6 = 17\%$	

A is incorrect. It denotes the Arithmetic Mean and not MAD.

C is incorrect. It represents the range of the returns.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset

Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.2700 Muller Investments has been investing in Curex Pharma for the last 6 years. The returns of Curex Pharma's shares are provided in the following table. As an analyst, the variance of the returns is *closest to*:

Year	Returns
2001	45%
2002	29%
2003	-16%
2004	-9%
2005	13%
2006	16%

- A. 5.23%
- B. 13.00%
- C. 17.00%

The correct answer is **A**.

The calculation of the Mean Absolute Deviation of the share's returns are provided in the following table:

Year	Returns	Return - Arithmetic Mean	Variance
2001	45%	45% - 13%	$(45\% - 13\%)^2$
2002	29%	29% - 13%	$(29\% - 13\%)^2$
2003	-16%	-16% - 13%	$(-16\% - 13\%)^2$
2004	-9%	-9% - 13%	$(-9\% - 13\%)^2$
2005	13%	13% - 13%	$(13\% - 13\%)^2$
2006	16%	16% - 13%	$(16\% - 13\%)^2$
Arithmetic Mean	78%/6 = 13%		
MAD	102%/6 = 17%		
Variance	0.2614/5 = 5.23%		

B is incorrect. It denotes the Arithmetic Mean.

C is incorrect. It denotes the mean absolute deviation (MAD).

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.2751 The continuous compounded daily return of Galata Corp's shares is given in the following table. The standard deviation of share returns during this four-day period is *closest to*:

Date	Compounded Daily Return
2-Jan-14	0.0298
15-Jan-14	0.0132
5-Feb-14	-0.0202
8-Mar-14	-0.0300

A. -0.18%

B. 2.43%

C. 5.89%

The correct answer is **B**.

First, we calculate the mean return of the population in percentages as:

$$\mu = \frac{2.98\% + 1.32\% - 2.02\% - 3.00\%}{4} = -0.18\%$$

Then, we calculate the variance and standard deviation:

$$\begin{aligned}\sigma^2 &= \frac{\sum(x_i - \mu)^2}{N} \\ &= \frac{(2.98 - (-0.18))^2 + (1.32 - (-0.18))^2 + (-2.02 - (-0.18))^2 + (-3.00 - (-0.18))^2}{4} \\ &= 5.8934 \\ \Rightarrow \sigma &= \sqrt{5.8934} \\ &\approx 2.43\%\end{aligned}$$

A is incorrect. It denotes the value of the mean in the above calculation. **C is incorrect.** It denotes the value of the variance in the above calculation.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.3429 Which of the following is *least likely* accurate regarding frequency distributions?

- A. Risk managers can use frequency distributions to find out tail events.
- B. While constructing a frequency distribution, an observation can fall in more than one interval.
- C. A frequency distribution can help in identifying whether the distribution is evenly distributed or lopsided.

The correct answer is **B**.

Frequency distribution displays the observations falling in a particular interval. Hence, frequency distributions help risk managers find out the frequency of a particular tail event. As it shows the frequency at which observations occur, it can be useful in identifying whether the distribution is evenly distributed or lopsided. However, an observation can fall in only one interval.

A is incorrect. Frequency distribution displays the observations falling in a particular interval. Hence, frequency distributions help risk managers find out the frequency of a particular tail event.

C is incorrect. As it shows the frequency at which observations occur, it can be useful in identifying whether the distribution is evenly distributed or lopsided.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.3431 Consider the following statements:

- I. The geometric mean is always greater or equal to the arithmetic mean.
- II. The geometric mean measures the compounded rate of return.
- III. If the returns in a data set have no volatility, then the geometric mean is equal to the arithmetic mean.

Which of these statements is/are *most accurate*?

- A. I, II & III.
- B. I & II only.
- C. II & III only.

The correct answer is **C**.

Statement I is incorrect. The geometric mean is always smaller or equal to the arithmetic mean.

Statement II is correct. The geometric mean measures the compounded rate of return.

Statement III is correct. If the returns in a data set have no volatility (volatility = 0), then the geometric mean is equal to the arithmetic mean.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.3432 The returns generated by a sample of five stocks from the Karachi Stock Exchange are given in the exhibit below.

Exhibit: Karachi Stock Exchange Returns – Sample of 5 Stocks

Stock	Return
A	12%
B	13%
C	5%
D	4%
E	20%

The standard deviation is *closest* to:

- A. 5.84%

B. 6.53%

C. 10.80%

The correct answer is **B**.

$$\text{Mean} = (0.12 + 0.13 + 0.05 + 0.04 + 0.2) / 5 = 0.108$$

Stock	Return	X - Mean	X - Mean ²
A	12%	1.2%	0.000144
B	13%	2.2%	0.000484
C	5%	-5.8%	0.003364
D	4%	-6.8%	0.004624
E	20%	9.2%	0.008464
Total			0.017080

$$\text{Sample deviation} = \left(\frac{0.017080}{4} \right)^{\frac{1}{2}} = 6.53\%$$

Note: The standard deviation calculated with a divisor of n-1 is a standard deviation calculated from the sample as an estimate of the standard deviation of the population from which the sample was drawn.

Steps using the financial calculator. Set the calculator to “DATA” by pressing 2ND 7.

X01=12 ENTER ↓ ↓, X02=13 ENTER ↓ ↓, X03=5 ENTER ↓ ↓, X04=4 ENTER, X05=20 ENTER ↓ ↓

2ND QUIT

Set the calculator to “STAT” by pressing 2ND 8

↓ ↓ ↓ S_x = 6.53.

If the data was for a population and not for a sample, the value to be picked would have been σ_x = 5.845 .

A is incorrect. It denotes the value of the population and not a sample.

C is incorrect. It denotes the mean.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.3436 For a unimodal positively skewed distribution:

- A. Mode < Median < Mean.
- B. Median < Mode < Mean.
- C. Mean < Median < Mode.

The correct answer is **A**.

For a positively skewed distribution that only has one mode, Mode < Median < Mean.

B is incorrect. For a positively skewed distribution the median is always greater than the mode.

C is incorrect. For a positively skewed distribution the mean is always greater than both the Median and the Mode.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3484 A research analyst has compiled the yearly returns of AZN stock in the following exhibit.

Exhibit: AZN Stock - Yearly Returns

12% | 10% | 4% | 16% | 18% | 15% | 25% | 20%

The second quartile of the distribution of returns is *closest* to:

- A. 15%
- B. 15.50%.
- C. 16%.

The correct answer is **B**.

Second quartile is the point below which 50% of the observations lie.

$$L_y = (n + 1) \times \frac{y}{100}$$

As per the formula, the point can be identified as:

$$\text{Point} = (\text{No. of observations} + 1) \times \left(\frac{50}{100}\right) = (8 + 1) \times \left(\frac{50}{100}\right) = 4.5$$

The second step is to arrange the observations in ascending order:

4%, 10%, 12%, 15%, 16%, 18%, 20%, 25%

The 4th observation = 15%

The 5th observation = 16%

The second quartile lies between 15% and 16%, therefore the second quartile = 15.50%

A is incorrect. It represents the 4th observation.

C is incorrect. It represents the 5th observation.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.3485 The annual returns of a fund of funds is given in the exhibit below.

Exhibit: Annual Returns - Fund of Funds

Portfolio	Annual Return
Fund A	12%
Fund B	15%
Fund C	-5%
Fund D	5%

The mean absolute deviation (MAD) of the returns generated by the four funds is *closest* to:

- A. 5.25%
- B. 6.75%.
- C. 11.75%

The correct answer is **B**.

$$\text{Mean return} = \frac{(12\% + 15\% - 5\% + 5\%)}{4} = 6.75\%$$

Absolute difference from each individual observation:

Portfolio	Difference from Mean
Fund A	$ 12\% - 6.75\% = 5.25\%$
Fund B	$ 15\% - 6.75\% = 8.25\%$
Fund C	$ -5\% - 6.75\% = 11.75\%$
Fund D	$ 5\% - 6.75\% = 1.75\%$

We know that:

$$\begin{aligned}\text{MAD} &= \frac{\sum |X_i - \bar{X}|}{n} \\ &= \frac{(5.25\% + 8.25\% + 11.75\% + 1.75\%)}{4} = 6.75\%\end{aligned}$$

A is incorrect. It depicts the difference from mean for Fund A.

C is incorrect. It depicts the difference from mean for Fund C.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset

Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.3486 A leptokurtic distribution is *most likely* defined as:

- A. more peaked than a normal distribution.
- B. a less peaked than a normal distribution.
- C. similarly peaked to a normal distribution.

The correct answer is **A**.

A leptokurtic distribution is more peaked than a normal distribution.

A platykurtic distribution is less peaked than a normal distribution.

A mesokurtic distribution is similarly peaked as a normal distribution.

B is incorrect. A distribution that is less peaked than normal is known as a platykurtic distribution.

C is incorrect. A distribution that is similarly peaked to a normal distribution is known as a mesokurtic distribution.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3504 If a security has a mean expected return of 7% and a standard deviation of 0.005, its coefficient of variation is *closest* to:

A. 0.00035.

B. 0.0714.

C. 14.

The correct answer is **B**.

$$\text{Coefficient of variation} = \frac{(\text{Std. deviation})}{(\text{Mean})} = \frac{0.005}{0.07} = 0.0714$$

A is incorrect. It results in the multiplication of the mean expected return and the standard deviation.

C is incorrect. It results in the division of the mean expected return and the standard deviation.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.3505 Which of the following statements is *most* accurate?

Skewness refers to the extent the distribution is:

- A. symmetrical. In negatively skewed distributions, the mean is to the left of the peak.
- B. non-symmetrical. In the left-skewed distribution, the mean is to the left of the peak.
- C. non-symmetrical. In negatively skewed distributions, the mean is to the right of the peak.

The correct answer is **B**.

Skewness is an asymmetry in a statistical distribution. It can be quantified to define the extent to which a distribution differs from a normal distribution.

A left-skewed distribution is called a negatively skewed distribution because its long tail is in the negative direction on a number line. The peak of the distribution is what defines "peakness." A peak that tends to the left is left-skewed distribution.

A is incorrect. In symmetrical distributions, the mean is to the center of the distributions.

C is incorrect. In a non-symmetrical distribution, the mean is to the left of the peak.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3506 An equity analyst's performance measurement is linked with its historical returns generated by his investment decisions. The *best* way to measure the returns is the:

- A. geometric mean.
- B. arithmetic mean.
- C. Both will provide the same result.

The correct answer is **A**.

The geometric mean captures how the total returns are linked over time. Hence, for measuring historical return, a geometric mean must be used.

B is incorrect. The arithmetic mean is mostly used to predict future performances.

C is incorrect. Geometric mean is best used to determine past performance, while arithmetic mean is best used to predict future performance. The two do not necessarily provide the same answer.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.3721 Which of the following best describes the concept of skewness in statistics?

- A. The degree to which a distribution is symmetric about its mean.
- B. The degree to which a distribution is nonsymmetric about its mean.
- C. The degree to which a distribution is nonsymmetric about its median.

The correct answer is **B**.

Skewness in statistics describes the asymmetry from the normal distribution in a set of data. Such a dataset differs from a normal curve which is bell-shaped and perfectly symmetrical. In layman's language, a symmetrical curve can be divided into two equal halves with the mean in the middle. When this is not possible, the curve (and the underlying data) is said to be skewed. A distribution can either be positively or negatively skewed, depending on where there is a higher concentration of data points.

A is incorrect. Skewness relates to the degree of non-symmetry and not to the degree of symmetry. The skewness in a symmetrical distribution is zero.

C is incorrect. A distribution is symmetric about its mean and not its median.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3722 Which of the following statements is *least* accurate about kurtosis?

- A. Excess kurtosis that's positive indicates a leptokurtic distribution.
- B. Excess kurtosis that's negative indicates a platykurtic distribution.
- C. Excess kurtosis is a measure relative to the normal distribution, which has a kurtosis of 1.

The correct answer is **C**.

Statement C is the least likely true statement. Kurtosis basically measures the peakedness of a distribution. Data sets with high kurtosis tend to have many data points at the tails (outliers). Kurtosis is measured relative to the normal distribution, which has a kurtosis of exactly 3.

A is incorrect. It is a true statement. Positive excess kurtosis (>3) indicates a leptokurtic distribution.

B is incorrect. It is a true statement. Excess kurtosis that is negative (< -3) indicates a platykurtic distribution.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3723 Mary Noel, CFA, is tasked with analyzing the returns of two different assets – A and B. She finds that the two assets have the same mean, variance, and skewness, but A has a higher kurtosis than B. Which of the following statements is *most likely* true?

- A. Asset B is riskier than asset A.
- B. Asset A is riskier than asset B.
- C. We cannot conclude anything based on the given information.

The correct answer is **B**.

In finance, Kurtosis affects the riskiness of an asset. The asset with a higher kurtosis is considered riskier than the one with a lower kurtosis. The underlying logic is that a high kurtosis indicates a high number of outliers, meaning that the return for such an asset is highly variable, and therefore highly risky.

A is incorrect. The higher the kurtosis, the riskier the asset. Asset A is riskier than asset B since it has a higher kurtosis.

C is incorrect. Kurtosis can help analysts deduce the riskiness of an asset. A higher kurtosis implies higher risk.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3736 At a certain investment firm, each of the firm's 5 managers is tasked with overseeing a project. During a given one-year period, the managers reported the following individual returns from their projects:

[24%, 26%, 30%, 18%, 20%]

The population variance of these returns is *closest to*:

A. 0.182%.

B. 0.228%.

C. 0.236%.

The correct answer is **A**.

Note that the data given is comprised of the entire population and NOT a sample. As such, we should use the formula for calculating the population variance. We know that

$$\sigma^2 = \frac{\sum (X_i - \mu)^2}{N}$$

where N is the size of the population and

$$\mu = \frac{(0.24 + 0.26 + 0.30 + 0.18 + 0.20)}{5} = 0.236$$

Thus,

$$\begin{aligned}\sigma^2 &= \frac{[(0.24 - 0.236)^2 + (0.26 - 0.236)^2 + (0.30 - 0.236)^2 + (0.18 - 0.236)^2 + (0.20 - 0.236)^2]}{5} \\ &= \frac{0.000016 + 0.000576 + 0.004096 + 0.003136 + 0.001296}{5} \\ &= 0.001824 = 0.1824\%\end{aligned}$$

Note: Had we been given sample data, the formula for the mean would remain unchanged but when calculating the variance, we would divide the sum of squared deviations by (n - 1) to remove bias.

B is incorrect. It represents the sample size variance.

C is incorrect. It represents the population mean.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.3987 Consider the following annual returns of a stock for a period of 10 years:

{ 15%, 17%, 12.5%, 16%, 13.6%, 19%, 14.6%, 10%, 11%, 16% } The population mean is *closest to*:

A. 14.47%.

B. 14.80%.

C. 14.82%.

The correct answer is **A**.

The population mean is determined as follows;

$$\text{Population mean} = \frac{0.15 + 0.17 + 0.125 + 0.16 + 0.136 + 0.19 + 0.146 + 0.1 + 0.11 + 0.16}{10} = 14.47\%$$

B is incorrect. It assumes a sample mean for the first 5 years as follows:

$$\text{Sample Mean} = \frac{0.15 + 0.17 + 0.125 + 0.16 + 0.136}{5} = 14.82\%$$

C is incorrect. It assumes the median values as follows:

Rearranging the values in an ascending order: 10%, 11%, 12.5%, 13.6%, 14.6%, 15%, 16%, 16%, 17%, 19%. So that the median is given by:

$$\text{Median Value} = \frac{0.146 + 0.15}{2} = 14.80\%$$

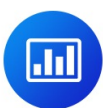
CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (a) Calculate, interpret, and evaluate measures of central tendency and location to address an investment problem.

Q.3988 In kurtosis, the distribution that has thinner tails than the normal distribution is *best described* as:

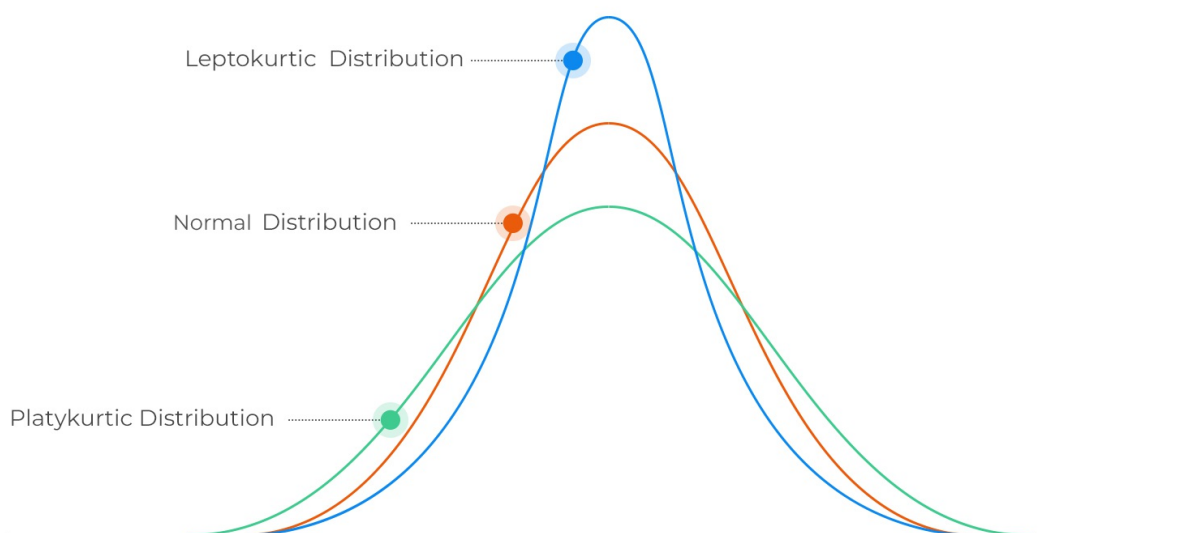
- A. leptokurtic.
- B. mesokurtic.
- C. platykurtic.

The correct answer is **C**.

Platykurtic, also known as thin tailed, is the distribution that has thinner tails (lower peak) than the normal distribution.



Kurtosis



A is incorrect. Leptokurtic distribution has fatter tails (more peaked) than the normal distribution and is also referred to as fat-tailed distribution.

B is incorrect. Mesokurtic distribution refers to distribution like the normal distribution concerning relative weight in the tails.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (c) Interpret and evaluate measures of skewness and kurtosis to address an investment problem.

Q.3989 Given two variables, X and Y, variable X has a mean of -0.87, with variable Y having a mean of 0.46, and a negative covariance exists between the two variables. The correlation between variables X and Y is *most likely* :

- A. zero.
- B. negative.
- C. positive.

The correct answer is **B**.

Covariance is a measure of the relationship between two variables. A positive covariance indicates that the variables tend to move in the same direction, while a negative covariance indicates that the variables tend to move in opposite directions.

Correlation is a standardized measure of the relationship between two variables. It ranges from -1 to 1, with a value of 1 indicating a perfect positive correlation, a value of -1 indicating a perfect negative correlation, and a value of 0 indicating no correlation.

Since we know that the covariance between variables X and Y is negative and a negative covariance indicates a negative correlation, it is most likely that the correlation between variables X and Y is negative. Therefore, the correct answer is (B) negative.

A is incorrect. If two variables have zero correlation, it indicates that they're not related in any way.

C is incorrect. A positive correlation and covariance for two variables exist when both variables are above or below their means.

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.

Q.3991 Consider the following returns of a portfolio.

Month	Return (%)
Jan	6
Feb	4
Mar	-2
Apr	-5

The target downside deviation when the target return is 4% is *closest* to:

- A. 6.24%

B. 7.51%

C. 8.66%

The correct answer is **A**.

$$S_{\text{Target}} = \sqrt{\sum_{\text{For all } X_i \leq B}^n \frac{(X_i - B)^2}{n - 1}}$$

Where;

B = The target

n = Total number of sample observation

The calculation can be summarized in the table below;

Month	Observation	Deviation from 4% target	Deviations below the target	Squared de
Jan	6	2	0	
Feb	4	0	0	
Mar	-2	-6	-6	
Apr	-5	-9	-9	

$$\text{Target semi-deviation} = \sqrt{\frac{117}{4 - 1}} = 6.24\%$$

B is incorrect. It assumes the total sum of the deviation from the 4% target in the calculation as follows;

$$\text{Target semi-deviation} = \sqrt{\frac{-13^2}{4 - 1}} = 7.51\%$$

C is incorrect. It assumes the total sum of the deviations below the target is squared as follows;

$$\text{Target semi-deviation} = \sqrt{\frac{-15^2}{4 - 1}} = 8.66\%$$

CFA Level 1, Quantitative Methods, Learning Module 3: Statistical Measures of Asset Returns, LOS (b) Calculate, interpret, and evaluate measures of dispersion to address an investment problem.
