

R34 Security Market Indexes

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1. Introduction

An index is an indicator, sign, or measure of something. Since an index is a single measure and reflects the performance of the entire security market, it makes it easy for investors to measure and track performance.

Security market indexes were first introduced as a simple measure to reflect the performance of the U.S. stock market. Dow Jones Average, the world's first security market index, was introduced in 1884 comprising only nine railroad and two industrial companies. Until then, investors gathered data of individual securities to assess performance.

Now, security market indexes have multiple uses that help an investor track performance of various markets, estimate risk, and evaluate the performance of an investment. Major indexes include S&P 500, FTSE, and Nikkei.

This reading defines what a security market index is, explains how to calculate the returns of an index, how indexes are constructed, the need for market indexes, and the types of indexes.

2. Index Definition and Calculations of Value and Returns

A security market index measures the value of different target markets such as security markets, market segments, and asset classes. The index value is calculated on a regular basis using actual or estimated prices of constituent securities. Constituent securities are the individual securities comprising an index.

Each index often has two versions based on how the return is calculated:

- A **price return index** or price index measures only the percentage change in price of the constituent securities within the index.
- A **total return index** considers the prices of constituent securities and the reinvestment of all income (dividend and/or interest) since inception.

The value of both versions will be the same at inception. However, as time passes, the value of the total return index will exceed the value of the price return index.

2.1 Calculation of Single-Period Returns

The price return and total returns for an index can be computed using the following formulae:

Price return of an index:

$$PR_I = (V_{PRI1} - V_{PRI0})/V_{PRI0}$$

where:

PR_I = price return of an index (in decimal)

V_{PRI1} = value of the price return index at the end of the period

V_{PRI0} = value of the price return index at the beginning of the period

Total return of an index:

$$TR_I = \frac{V_{PRI1} - V_{PRI0} + Inc_1}{V_{PRI0}}$$

where

TR_I = total return of the index portfolio

V_{PRI1} = value of the price return index at the end of the period

V_{PRI0} = value of the price return index at the beginning of the period

Inc_1 = income from all the securities in the index over the period

2.2 Calculation of Index Values over Multiple Time Periods

Once returns are calculated for each period, the calculation of index values over multiple periods is done by geometrically linking returns.

For example, if the value of a total return index at the start of period 1 is 100 and the total returns over three periods are: 16%, 11%, and -4%, the index value at the end of period three will be: $100 \times 1.16 \times 1.11 \times 0.96 = 123.61$.

3. Index Construction

Constructing and managing an index is similar to building a portfolio of securities. The difference is that an index is a paper portfolio but a real portfolio consists of actual securities. The following factors must be considered when constructing a security index:

- Target market. E.g., U.S. equities.
- Security selection. E.g., large cap securities.
- Weight allocated to each security in the index.
- Index rebalancing.
- Reconstitution.

3.1 Target Market and Security Selection

The target market determines the investment universe. It can be defined broadly (for example, all U.S. equities) or narrowly (for example, large cap telecom stocks in China). If the target market is U.S. equities, then the constituent securities for the index will come from the universe of U.S. equities. The target market may also be based on market capitalization, asset class, geographic region, industries, sizes, exchange, and/or other characteristics.

3.2 Index Weighting

Index weighting determines how much of each security to include in the index. This decision impacts index value. We will see four methods to determine the weight of the securities in an index:

- Price weighting
- Equal weighting
- Market-capitalization weighting

- Fundamental weighting

For each weighting method, there could be a price return index or a total return index.

Price-Weighted Index

The weight of each security is calculated by dividing its price by the sum of all prices. One example of a price-weighted index is the Dow Jones Industrial Average.

$$\text{Price - weighted index} = \frac{\text{Sum of stock prices}}{\text{Divisor (number of stocks in the index adjusted for splits)}}$$

Example

Consider three securities A, B, and C comprising an index with the following beginning of period (BOP) and end of period (EOP) values. Using a divisor of 3, compute a) the index value, b) the price return and the total return.

	Beginning of period price	Beginning of period weight	End of period price	Dividends/share
A	4	20%	2	0
B	6	30%	6	1
C	10	50%	14	2

Solution:

Using the above equation, value of the index at start of the period = $\frac{\text{Sum of the security values}}{\text{Divisor}}$

$$= \frac{20}{3} = 6.67$$

$$\text{Value of index at end of the period} = \frac{22}{3} = 7.33$$

$$\text{Price return} = \frac{7.33 - 6.67}{6.67} = 9.89\%$$

$$\text{Dividend return} = \frac{\text{Income}}{\text{Beginning of period price}} = \frac{3}{20} = 15\%$$

$$\text{Total return} = \text{Price return} + \text{Dividend return} \approx 25\%$$

The divisor is adjusted to remove the impact of stock splits, security addition or deletion.

Example

In the previous example, if there is a 2-for-1 split in stock C during the period, what is the impact on index value and return calculations?

Solution:

Initial divisor was 3 and end-of-index value = 7.33. End-of-period price of C is 7 after the split.

The divisor must be adjusted to prevent the stock split and the new weights from changing

the value of the index.

$$\text{Value of index} = \frac{\text{Sum of constituent securities}}{\text{Divisor}} = \frac{2+6+7}{3}$$

$$7.33 = \frac{15}{\text{Divisor}}$$

$$\text{Divisor} = 2.05$$

Note that every time there is a stock split, the value of the divisor will decrease.

Advantage of price weighted index: Simplicity.

Limitations of price weighted index:

- Results in arbitrary weights for securities.
- If the price of a security is high, it will receive a relatively high weight, even though its market capitalization might be low.

Equal Weighted Index

The equal weighting method assigns an equal weight to each constituent security at inception.

An equal weighted index can be created by allocating an equal amount of money to all securities.

Let's say, you have \$180,000 to invest. You will invest \$60,000 each in shares of A, B, and C trading at \$4, \$6, and \$10 respectively. This would mean 15,000 shares of A, 10,000 shares of B, and 6,000 shares of C. However, at the end of the period, the index will no longer be equally weighted as share prices may have changed. So, it requires rebalancing (buy shares of depreciated stock, sell shares of appreciated stock) for the index to be equal weighted.

The return of an equal weighted index is calculated as a simple average of the returns of the index stocks.

$$\text{Equal weighted index} = \text{Initial index value} * \left(1 + \frac{\text{average of percentage change in prices}}{100}\right)$$

Example

Given the following data, compute the price return and total return.

	Beginning of period Price	End of period Price	Dividend/share
A	4	2	0
B	6	6	1
C	10	14	2

Solution:

Price return for A: -50%; B: 0%; C: 40%.

Since weights are equal, price return = $\frac{-50+0+40}{3} = \frac{-10}{3} = -3.3\%$.

Dividend return for A: 0%; B: 16.67%; C: 20%.

Total dividend return = $\frac{0+16.67+20}{3} = \frac{36.67}{3} = 12.22\%$.

Total return = Price return + Dividend return = $-3.3 + 12.22 = 8.9\%$.

Advantage of equal weighting: Simplicity.

Limitations of equal weighting:

- Securities with largest market value are underrepresented; those with lowest market value are overrepresented.
- Maintaining equal weights requires frequent rebalancing. If not rebalanced periodically, the chances of drifting away from the weights are high.

Market-Capitalization Weighted Index

In this method, the weight of each security is determined by dividing its market capitalization with total market capitalization.

Weight of a security =
$$\frac{\text{Market cap of the security}}{\text{Total market cap of all index securities}}$$

Market Capitalization index =
$$\frac{\text{current total market value of index stocks}}{\text{base year total market value of index stocks}} * \text{base year index value}$$

Example

The following data is given:

	Shares outstanding	Beginning of period price	End of period price	Dividends per share
A	500	4	2	0
B	100	6	6	1
C	100	10	14	2

- Given the data, what divisor must be used such that the initial index value is 1,000?
- Compute: 1) the final index value 2) the price return and total return.
- Compute the price return if stock C has a market float of 40%.

Solution:

1. Sum of market capitalization of all securities = $500 \times 4 + 100 \times 6 + 100 \times 10 = 3,600$

Initial index value = $1,000 = \frac{3,600}{\text{divisor}}$; divisor = 3.6.

This value of the divisor is used to calculate the index value anytime in the future.

2. The weights of the three securities are tabulated below:

	Price return	Market capitalization weights
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A	$(2 - 4) / 4 = -0.5$	$2,000 / 3,600 = 0.56$
B	$(6 - 6) / 6 = 0$	$600 / 3,600 = 0.17$
C	$(14 - 10) / 10 = 0.4$	$1,000 / 3,600 = 0.28$

$$\text{Final index value} = \frac{500 \times 2 + 100 \times 6 + 100 \times 14}{3.6} = \frac{3,000}{3.6} = 833.33.$$

$$\text{Price return} = \frac{833.33 - 1000}{1000} = -16.67\%.$$

Price return can also be calculated as:

$$\text{Price return} = w_A \times PR_A + w_B \times PR_B + w_C \times PR_C = 0.56 \times (-50) + 0.17 \times 0 + 0.28 \times 40 = -16.8\%.$$

$$\text{Dividend return} = \frac{0 + 1 \times 100 + 2 \times 100}{3600} = 8.3\%.$$

$$\text{Total return} = -16.67 + 8.3 = \sim -8.3\%.$$

3. Assume the remaining 60% of stock C is not available for trading as the founding family owns them. Only 40% of shares are available for trading. To calculate the price return, instead of using 100%, only 40% of shares are used in calculation. In this case, 40 shares.

The sum of market capitalization of all securities = $500 \times 4 + 100 \times 6 + 40 \times 10 = 3,000$

$$\text{Initial index value} = 1,000 = \frac{3,000}{\text{divisor}}; \text{ divisor} = 3.$$

$$\text{Final index value} = \frac{500 \times 2 + 100 \times 6 + 40 \times 14}{3} = \frac{2,160}{3} = 720.$$

$$\text{Price return} = \frac{720 - 1000}{1000} = -28\%.$$

A float-adjusted market-capitalization weighted index weights each of its constituent securities by price and the number of its shares available for public trading, i.e., by excluding the shares held by the promoter group, etc.

Advantages of market-capitalization weighting: Constituent securities are correctly represented in proportion to their value in the market.

Limitations of market-capitalization weighting: Securities whose prices have risen or fallen the most see a big change in their weights. Stocks whose prices have increased are over weighted; similarly, stocks whose prices have fallen are underweighted.

Fundamental Weighted Index

Fundamental weighting addresses the disadvantages of using market capitalization as weights. Instead of using a stock's price as a measure, fundamental weighting uses measures such as book value, cash flow, revenue, earnings, and dividends to calculate the weight of each security. For instance, a stock with higher earnings yield (earnings/price) than the overall market will have more weight in a fundamental-weighted index than in a market-weighted index. This weighting method is biased towards value stocks. This is sometimes

called a ‘value tilt’ and is illustrated in the example below.

Example

Compute the price return for the following index. Weight the securities based on earnings.

	Shares outstanding (in million)	Beginning of period price	Earning (in \$ million)	End of period price
A	500	4	20	2
B	100	6	20	6
C	100	10	20	14

Solution:

All the three companies have earnings of \$20 million and total earnings of \$60 million.

Earnings yield, earnings weight, and price return of the three companies:

	Earnings yield	Earnings weight	Price return
A	$20 / (500 \times 4) = 1\%$	$20 / 60 = 33.3\%$	$(2 - 4) / 4 = -0.5$
B	$20 / (100 \times 6) = 3.3\%$	$20 / 60 = 33.3\%$	$(6 - 6) / 6 = 0$
C	$20 / (100 \times 10) = 2\%$	$20 / 60 = 33.3\%$	$(14 - 10) / 10 = 0.4$

$$\text{Price return} = w_A \times PR_A + w_B \times PR_B + w_C \times PR_C$$

$$= 0.33 \times (-50) + 0.33 \times 0 + 0.33 \times 40 = -3.3\%.$$

All the three securities have equal weights here as the earnings are equal. Under the market capitalization method, A would have highest weight and B would have the lowest weight. In other words, a value stock like B (low P/E ratio or high earnings yield) has more weightage in the fundamental-weighted method than it would have in the market-capitalization method.

Summary of Results

The table below compares all the weighting methods.

	Number of shares	BOP price	EOP Price	Earnings	Dividends/share
A	500	4	2	20	0
B	100	6	6	20	1
C	100	10	14	20	2

Method	Price Return	Total Return
Price	10%	25%
Equal	-3.3%	8.9%
Market Cap	-16.7%	-8.3%
Fundamental	-3.3%	8.9%

The pros and cons of the different index weighting methods are shown below.

Method	Pros	Cons
Price	Simple	Arbitrary weights.
Equal	Simple	High market cap stocks are under-represented. Requires frequent rebalancing.
Market Cap	Securities held in proportion to their value	Influenced by overpriced securities.
Fundamental	Value tilt	Does not consider market value. Requires rebalancing.

4. Index Management: Rebalancing and Reconstitution

4.1 Rebalancing

Rebalancing means adjusting the weights of constituent securities in an index to maintain the weight of each security in the index. The weights do not remain constant as the prices of securities change. For weighting methods like price-weighted and market-weighted index, rebalancing is not necessary as the weight is determined by the price. However, as we saw in the case of equal-weighting method, the weights digress heavily when the price of a security appreciates/depreciates. If rebalancing happens too often, then the transaction costs will be high. If rebalancing does not happen often enough, then the portfolio will digress from equal weights.

4.2 Reconstitution

Reconstitution is the process of changing the constituent securities in an index. It is part of the rebalancing cycle. The frequency of reconstitution varies from index to index. When a constituent security no longer meets the necessary criteria it is removed from the index and a new security is added. For example, a stock might be part of a large-cap index but after an erosion of over 80% of its market cap it no longer meets the large cap criteria. This stock will be removed from the index and another one which meets the criteria will be added.

5. Uses of Market Indexes

Security indexes serve the following purpose:

- Index performance serves as a proxy of market sentiment.
- Investment management performance can be better evaluated in comparison with a suitable index that serves as a benchmark.
- Serves as a proxy for measuring and modeling returns, systematic risk, and risk-adjusted performance.
- Serves as a proxy for asset class performance in asset allocation models.
- Useful in creation of passive portfolios that track index funds and ETFs.

6. Equity Indexes

Equity indexes can be classified into:

Broad market index

- Provides a proxy for the overall market performance.
- Typically, 90% of the securities in the market are represented in the index.
- Example: Wilshire 5000 index

Multi-market index

- Constructed from several indexes of different countries.
- Countries included can be based on national markets, geographic region (Latin America index), development groups (emerging market index), etc.

Sector index

- Constructed to track performance of a specific economic sector such as finance, technology, energy, health care, etc., or on a national or global basis.

Style index

Constructed to track performance of securities that are classified based on characteristics like:

- Market capitalization: Securities are classified based on market capitalization to form indexes like large-cap, mid-cap, and small-cap indexes.
- Value/Growth: Includes securities based on value/growth criteria to form growth and value indexes. (uses price-to-earnings and dividend yields to classify securities)
- Combination of market capitalization and value/growth: Includes these combinations: Large-cap value, large-cap growth, mid-cap value, mid-cap growth, small-cap value, small-cap growth indexes.

7. Fixed-Income Indexes

7.1 Construction

Compared to equity indexes, fixed-income indexes are difficult to construct and replicate.

They are challenging to construct because:

- There are a large number and variety of fixed-income securities ranging from zero coupon bonds to callable and putable bonds. Pricing data is not always available.
- Many fixed-income securities are not liquid, i.e., not easy to replicate.

7.2 Types of Fixed-Income Indexes

Like equities, fixed-income securities can be classified based on the issuer, geographic region, maturity, type of issuer, market sector, style, credit quality, currency of payments, etc. The following table illustrates how the fixed-income securities can be organized based on various dimensions.

Dimensions of Fixed Income Indexes	
Market	Global Regional Country or currency zone
Type	Corporate Collateralized/securitized/mortgage backed Government agency Government
Maturity	Short term (e.g. < 1 year) Medium term (e.g. 7 - 10 years) Long term (e.g. 20 + years)
Credit Quality	Investment grade (e.g. S&P rating of BBB or above) High yield

8. Indexes for Alternative Investments

8.1 Commodity indexes

Commodity indexes consist of futures contracts on one or more commodities such as agricultural products (like wheat and sugar), precious metals (like gold), and energy (like crude oil). It is important to recognize the following points related to commodity indexes:

- Since commodity indexes are based on futures indexes, the performance of the index and the underlying commodities can be different.
- It is common to have multiple indexes with the same commodities but in different proportions or weights. For example, while one commodity index may have a higher weight for energy, the other may be overweight on agricultural products. This also leads to a different risk-return profile.

8.2 Real Estate Investment Trust Indexes

Real estate indexes represent markets for real estate securities (such as REITs) and the market for actual real estate. Examples of actual real estate investments include properties such as apartment buildings, retail malls, office buildings, etc. Real estate is a highly illiquid market with few transactions and non-transparent pricing. There are several types of real estate indexes: appraisal indexes, repeat sales indexes, and REIT indexes. This material is covered in detail under alternative investments.

8.3 Hedge Fund Indexes

Hedge fund indexes reflect the returns on hedge funds. Research organizations collect data on hedge fund returns and compile this information into indexes. Since hedge funds are not

required by regulation to report their performance, the research firms rely on voluntary cooperation of hedge funds to report returns. Here are some important points to consider when evaluating hedge fund indexes:

- Constituents determine the index.
- Poorly performing hedge funds are less likely to report.
- Returns of hedge fund indexes are likely to be overstated/biased upward due to survivorship bias.

Summary

LO.a: Describe a security market index.

An index is a single measure that reflects the performance of the entire security market. It makes it easy for investors to measure and track performance.

LO.b: Calculate and interpret the value, price return, and total return of an index.

Price return index or price index measures only the percentage change in price of the constituent securities within the index.

$$PR_I = (V_{PRI1} - V_{PRI0}) / V_{PRI0}$$

Total return index reflects the prices of constituent securities and the reinvestment of all income (dividend and/or interest) since inception.

$$TR_I = (V_{PRI1} - V_{PRI0} + Inc_1) / V_{PRI0}$$

Calculation of index values over multiple periods is done by linking returns.

LO.c: Describe the choices and issues in index construction and management.

Index providers must consider the following:

- Which target market should the index represent? E.g., U.S. Equities.
- Which securities should be selected from that market? E.g., Large cap securities.
- How much weight should be allocated to each security in the index?
- When should the index be rebalanced?
- When should the security selection and weighted decision be re-examined?

Target market can be defined broadly or narrowly. It may also be based on asset class, geographic region, industries, sizes, exchange, and/or other characteristics.

LO.d: Compare the different weighting methods used in index construction.

Index weighting determines how much of each security to include in the index. This decision impacts index value. Various methods used to determine the weight of the securities in an index are:

Price Weighting: The weight on each security is determined by dividing its price by the sum of all prices.

Equal Weighting: Assign equal weight to each constituent security at inception.

Market-Capitalization Weighting: Weight of each security is determined by dividing its market capitalization with total market capitalization.

Fundamental Weighting: Instead of using a stock's price as a measure, fundamental weighting uses measures such as book value, cash flow, revenue, earnings, and dividends to calculate the weight of each security.

Method	Pros	Cons
Price	Simple	Arbitrary weights.
Equal	Simple	High market cap stocks are under-represented. Requires frequent rebalancing.
Market Cap	Securities held in proportion to their value	Influenced by overpriced securities.
Fundamental	Value tilt	Does not consider market value. Requires rebalancing.

LO.e: Calculate and analyze the value and return of an index given its weighting method.

$$\text{Price weighted index} = \frac{\text{Sum of Stock Prices}}{\text{No. of stocks in index adjusted for splits}}$$

Market Capitalization index

$$= \frac{\text{current total market value of index stocks}}{\text{base year total market value of index stocks}} * \text{base year index value}$$

$$\text{Equal weighted index} = \text{Initial index value} * \left(1 + \frac{\text{average of percentage change in prices}}{100}\right)$$

LO.f: Describe rebalancing and reconstitution of an index.

Rebalancing means adjusting the weights of an index's constituent securities. The weight of each security in an index should reflect the weighting method used. The weights do not remain constant as the prices of securities change.

Reconstitution is the process of changing the constituent securities in an index. It is part of the rebalancing cycle. The frequency of reconstitution varies from index to index.

LO.g: Describe uses of security market indexes.

The most important use of indexes is that they give a sense for how a particular security market performed over a particular period. Indexes also serve as:

- Indicators (gauges) of market sentiment.
- Proxies for measuring and modeling returns, systematic risk, and risk adjusted performance.
- Proxies for asset classes in asset allocation models.
- Benchmarks to evaluate the performance of a portfolio.
- Model portfolios for index funds and ETFs.

LO.h: Describe types of equity indexes.

Equity indexes can be classified into: broad market, multi-market, sector, and style indexes.

The broad market index tries to represent the entire market. Typically, 90% of the securities

of the selected market are represented in the index.

The multi-market index includes indexes from different countries as they represent multiple security markets based on national markets, geographic region, development groups, etc.

The sector index focuses on a specific economic sector such as consumer goods, finance, energy, health care, technology, etc., on a national or global basis.

The style index contains securities based on certain characteristics like market capitalization, value, growth, or a combination of any of these.

The market-capitalization index contains securities based on market capitalization such as large cap, mid cap and small cap.

The value/growth index contains a group of stocks based on value/growth criteria.

The market-capitalization and value/growth index combine the three market capitalization groups with value/growth classification resulting in the following six basic index style categories: Large-cap value, large-cap growth, mid-cap value, mid-cap growth, small-cap value, small-cap growth.

LO.i: Describe types of fixed-income indexes.

Dimensions of Fixed Income Indexes	
Market	Global Regional Country or currency zone
Type	Corporate Collateralized/securitized/mortgage backed Government agency Government
Maturity	Short term (e.g. < 1 year) Medium term (e.g. 7-10 years) Long term (e.g. 20+ years)
Credit Quality	Investment grade (e.g. S&P rating of BBB or above) High yield

LO.j: Describe indexes representing alternative investments.

Commodity indexes consist of futures contracts on one or more commodities such as agricultural products (like wheat and sugar), precious metals (like gold), and energy (like crude oil).

Real estate indexes represent markets for real estate securities (such as REITs) and the market for actual real estate.

Hedge fund indexes reflect the returns on hedge funds. Research organizations collect data on hedge fund returns and compile this information into indexes.

LO.k: Compare types of security market indexes.

Security market indexes represent asset classes and target markets that can be classified based on geographic location, sector, industry, economic growth, value stocks, growth stocks, etc. Some globally known indexes include Dow Jones Industrial average, S&P, Barclays Capital Global aggregate Bond Index, etc.

Practice Questions

1. Catherine has gathered the following information on performance of an security index:

Value of index at the end of the year	500
Interest income over the year	20
Dividend income over the year	30
Total return on index over the year	4.50%

The value of the index at the start of the year is *closest* to:

- A. 507.20.
 - B. 478.50.
 - C. 526.30.
2. Which of the following is *most likely* true with regards to security market indexes?
- A. Once defined, the constituent securities are not changed.
 - B. Security market indexes measure the value of security markets only.
 - C. Index values are calculated using estimated or actual values of constituent securities.
3. The third major question to address when constructing an index is *most likely*:
- A. When should the index be rebalanced?
 - B. Which securities should be selected from the target market?
 - C. What weights should be allocated to each security in the index?
4. The market index that *most likely* requires frequent rebalancing is:
- A. Price weighted.
 - B. Equal weighted.
 - C. Market-capitalization weighted.
5. The index weighting method that *most likely* has a contrarian effect is:
- A. Equal weighting.
 - B. Market-capitalization weighting.
 - C. Fundamental weighting.
6. The index weighting method that *most likely* requires an adjustment to the divisor for stock splits and changes in composition of index is:
- A. Price-weighted index.
 - B. Equal-weighted index.
 - C. Fundamental-weighted index.
7. Calculate the one-year return on an index which includes three stocks as shown below:

Stock	Start Share price	Start Shares Outstanding	End Share price	End Shares Outstanding

A	\$20	5,000	\$30	5,000
B	\$10	8,000	\$15	8,000
C	\$300	500	\$290	500

The price-weighted, equal-weighted and market-capitalization weighted returns of the above is *closest* to:

	<u>Price-weighted</u>	<u>Equal-weighted</u>	<u>Market-cap weighted</u>
A.	25.8%	1.5%	32.2%
B.	1.5%	32.2%	25.8%
C.	32.2%	1.5%	25.8%

8. David is trying to construct a price-return float-adjusted market-capitalization weighted equity index which includes the three stocks as shown below:

Stock	Shares Outstanding	% Shares in Market Float	Beg of Period Price (\$)	End of Period Price (\$)	Dividends Per Share (\$)
A	10,000	70	20	30	2
B	20,000	80	10	5	1
C	30,000	90	50	70	5

Assuming the beginning value of the float-adjusted market-capitalization weighted equity index is 100, the ending value is *closest* to:

- A. 123.1.
 - B. 132.1.
 - C. 112.7.
9. Which of the following is *least likely* to be a use of an index?
- A. Benchmarking performance of a mid-cap manager with a broad market index.
 - B. Measuring market return, beta, and excess returns.
 - C. As a reflection of market sentiment.
10. Which of the following statements regarding fixed-income indexes is *least likely* to be accurate?
- A. Fixed-income indexes have broader market and a higher turnover than equity indexes.
 - B. Fixed-income indexes vary in their constituent securities and are difficult and expensive to replicate.
 - C. Data for fixed-income securities is relatively easy to find.
11. Which of the following statements regarding indexes representing alternative investments *least likely* to be true?
- A. In a hedge fund index, the constituents determine the hedge fund index rather than the index providers determining the constituents.

- B. Commodity indexes have issues because they have different weighting methodologies and are based on the performance of future contracts.
 - C. Commodity indexes track the spot market performance and are subject to upward bias.
12. An index based that includes growth stocks is *most likely* a type of:
- A. style index.
 - B. broad market index.
 - C. sector index.

Solutions

1. C is correct. Total return on an index uses both the price and income earned on the security to determine the overall return earned. Thus it measures the price appreciation, interest, and dividend income over a period, which is expressed as a percentage of the beginning value of the index.

$$\text{Total return} = \frac{(\text{Index value}_{\text{end}} - \text{Index value}_{\text{start}} + \text{income earned})}{\text{Index value}_{\text{start}}}$$

$$4.5\% = \frac{(500 - \text{Index value}_{\text{start}} + 20 + 30)}{\text{Index value}_{\text{start}}}$$

$$\text{Index value}_{\text{start}} = \frac{(500 + 20 + 30)}{(1 + 4.5\%)} = 526.31$$

2. C is correct. Most major indexes are reconstituted periodically. Security market indexes measure the value of different target markets (security markets, market segments, asset classes).
3. C is correct. The first major question to address is what is the target market? The second major question is what securities to select from the target market? The third question is what weights to allocate to each security in the index. Fourth question pertains to index rebalancing and last question belongs to index reconstitution.
4. B is correct. After the initial construction of an equal-weighted index, the prices of constituent securities change and the index is no longer equally weighted. To bring the securities back in equal weights, frequent rebalancing has to be done to the index. Market-capitalization weighted indexes generally will have a momentum effect.
5. C is correct. Fundamental weighting is based on factors like company earnings, revenue, assets, or cash flow. Fundamental weighting leads to indexes that have a relative value tilt, i.e., a contrarian effect. In such an index, portfolio weights will shift away from securities that have increased in relative value and towards securities that have fallen in relative value, whenever the portfolio is rebalanced.
6. A is correct. In a price-weighted index, the divisor is initially equal to the number of securities in the index. This divisor must be adjusted so the index value immediately after the split is the same as the value immediately prior to split.
7. B is correct.

Price-weighted index:

$$\text{Price-weighted index} = \frac{\text{sum of stock prices}}{\text{number of stocks in index adjusted for splits}}$$

$$\text{Price-weighted index}_{\text{start}} = \frac{20 + 10 + 300}{3} = 110$$

$$\text{Price-weighted index}_{\text{end}} = \frac{30 + 15 + 290}{3} = 111.67$$

$$\text{Price-weighted index}_{\text{return}} = \frac{111.67 - 110}{110} = 1.5\%$$

Equal-weighted index:

$$\text{Equal-weighted index} = (1 + \text{average percentage change in index stocks})$$

$$\text{Equal-weighted index} = \left[\left(\frac{30}{20} - 1 \right) + \left(\frac{15}{10} - 1 \right) + \left(\frac{290}{300} - 1 \right) \right] \left(\frac{1}{3} \right) = 32.2\%$$

Market capitalization-weighted index:

Total portfolio value at the start of the period:

$$20(5,000) + 10(8,000) + 300(500) = 330,000$$

Total portfolio value at the end of the period:

$$30(5,000) + 15(8,000) + 290(500) = 415,000$$

$$415,000 / 330,000 - 1 = 25.8\%$$

8. B is correct. This is a price return index (not a total return index). Hence we only consider changes in prices and ignore the dividends. In float-adjusted market-capitalization weighting, the weight on each constituent security is determined by adjusting its market capitalization for its market float. Per computations shown below, the ending value of the index so computed equals 132.1.

Stock	Shares Outstanding	% Shares in Market Float	Shares in Index	Beg. of Period Price (\$)	Beg. Float Adj. Market Cap (\$)	End of Period Price (\$)	Ending Float Adj. Market Cap (\$)
	(1)	(2)	(1) x (2) = (3)	(4)	(3) x (4) = (5)	(6)	(3) x (6)
A	10,000	70	7,000	20	140,000	30	210,000
B	20,000	80	16,000	10	160,000	5	80,000
C	30,000	90	27,000	50	1,350,000	70	1,890,000
Total					1,650,000		2,180,000
Index Value					100.0		132.1

Most of the global indexes are market-capitalization weighted with a float adjustment.

9. A is correct. Indexes are used to benchmark performance of portfolio managers. However, the comparison should be with an appropriate benchmark. Here, a mid-cap manager's performance should be benchmarked with a mid-cap index.
10. C is correct. Fixed income securities are largely traded by dealers and are often illiquid. Hence, data is more difficult to obtain.
11. C is correct. Performance disclosures by hedge funds are voluntary and hence only better performing hedge funds are likely to be part of an index. This causes the hedge fund index to have an upward bias, as the performance of poor performing funds is not captured. Commodity indexes have issues because they have different weighting methodologies and are based on the performance of future contracts and not on the performance of actual commodities.
12. A is correct. Style indexes represent groups of securities classified according to market capitalization, value, growth, or a combination of these characteristics.