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CFA® Program Level I

Quantitative Methods: 48 Free Practice Questions

2027 curriculum · 11 readings · answers and full explanations

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Contents

How to use these questions **1**

Quantitative Methods (questions 1–48) **2**

Answers and explanations: Quantitative Methods 18

Keep going at credguild.com **38**

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The 48 free questions on credguild.com for Quantitative Methods, 2027 CFA® Program Level I curriculum, each with its answer and full explanation.

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- At exam pace, 90 seconds a question, a topic of 40 questions takes about an hour.

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If these questions help you, pass the file on to someone else who is studying.

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CFA® PROGRAM LEVEL I · FREE PRACTICE QUESTIONS

Quantitative Methods

Questions 1–48 · 11 readings

1 Rate of Return

Question 1

A macro strategist's dashboard displays the central bank policy interest rate, the USD/JPY exchange rate and the level of the Euro Stoxx 50 index. These three items are best classified as:

A financial assets.

B financial instruments.

C financial indicators.

Question 2

Olivia Brandt put €50,000 into a sector fund that rose 20% in year one and then dropped 20% in year two. To express the true average yearly change in her wealth, she should use the:

A arithmetic mean return.

B geometric mean return.

C capital distribution return.

Question 3

A company must pay a supplier €250,000 in exactly one year. Its treasurer discounts this payment at a stated annual rate of 6%. Under which compounding convention will the present value of the payment be *lowest*?

A Annual compounding.

B Monthly compounding.

C Semiannual compounding.

Question 4

Which statement about the real risk-free interest rate is *most accurate*? It:

A includes a premium for expected inflation but no premium for default risk.

B excludes both expected inflation and any uncertainty about the amount or timing of cash flows.

C includes a liquidity risk premium because instruments paying this rate may be hard to sell quickly.

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Question 5

The managers of the Arcadia Opportunities Fund are considering borrowing to raise the fund's investment exposure from €100 million of investor capital to €150 million. Compared with remaining unleveraged, this borrowing will *most likely*:

A magnify gains but limit losses.

B diminish gains and magnify losses.

C magnify both gains and losses.

2 Types of Financial Returns

Question 6

Tomasz Wierzbicki holds a portfolio of traditional fixed-coupon bonds. Which statement *best* describes how his total return is typically made up?

A Most of the return comes from the fixed coupon payments, with price return making up a smaller share.

B Most of the return comes from changes in the bonds' market prices, with the coupons contributing a smaller share.

C The fixed coupons and the price return typically contribute roughly equal shares.

Question 7

An analyst compares the multiyear return history of Corvane Mining shares with that of a broad, diversified market index. Which conclusion is *most accurate*?

A Because the index is less volatile, the arithmetic mean will overstate the index's multiperiod return by more than it overstates the stock's.

B Because the stock is more volatile than the index, its geometric mean return tends to be pulled down relative to the index's.

C The arithmetic mean return will tend to understate the stock's multiperiod performance relative to the index.

Question 8

Rafael Oduya's retirement account holds 65% in equities and 35% in government bonds. He expects a total return of 9.0% on the equities and 3.8% on the bonds. The account's expected total return is *closest* to:

A 7.18%.

B 6.40%.

C 5.62%.

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3 Benchmarking Returns

Question 9

Hannah Kowalczyk makes the following trades in Silverleaf Foods shares, with no taxes or transaction costs:

- Today: buys one share at $30.00.
- One year from today: buys a second share at $36.00.
- Two years from today: sells both shares at $41.00 each.

Silverleaf pays a dividend of $1.50 per share at the end of year 1 and $2.00 per share at the end of year 2. Dividends are not reinvested. Kowalczyk's required return is 10%. Her money-weighted rate of return is *closest* to:

A 15.9%.

B 21.3%.

C 22.2%.

Question 10

Which of the following statements about a total return index is *most accurate*?

A Its value reflects only the price changes of its constituent securities.

B It grows from its beginning value by compounding each period's total return.

C It can rise more slowly than a price return index built from the same securities with the same weights.

Question 11

The prices of the stocks in a price-weighted index add up to $270, and the divisor is 1.80. One constituent, trading at $90, then completes a 3-for-1 stock split. The divisor that should be used immediately after the split is *closest* to:

A 0.60.

B 1.40.

C 1.80.

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Question 12

An equal-weighted index contains the three stocks shown in the table below. After the period's price changes, and before any rebalancing, Kestrel Aerospace's index weight is *closest* to:

Equal-weighted index: reference values and price returns for the period

Stock	Reference value at start	Price return for the period
Kestrel Aerospace	$25,000	+12%
Linden Packaging	$25,000	+4%
Oakmere Retail	$25,000	−6%

A 33.3%.

B 34.8%.

C 36.1%.

Question 13

The sponsor of the Harrowgate Midcap 200 Index removes Velden Tools, which was delisted after filing for bankruptcy, and adds Corvin Optics, which now meets the index's size criteria. This change is *best* described as:

A reconstitution.

B rebalancing.

C redefinition.

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4 Time Value of Money

Question 14

Brisa Therapeutics expects to receive the licensing fees shown in the table below. Its finance team discounts them at a stated annual rate of 6%, compounded monthly. The present value of the three fees today is *closest* to:

Expected licensing fees

Received at the end of year	Fee
1	$5,000
2	$9,000
3	$12,000

A $22,722.

B $22,802.

C $25,708.

Question 15

Brightwater Utilities has preferred stock outstanding that pays a fixed annual dividend of $2.60 per share with no maturity date. An investor who requires a 7.2% rate of return should be willing to pay, per share, a maximum of *closest* to:

A $18.72.

B $33.69.

C $36.11.

Question 16

Chiara Lombardi holds a 7-year corporate bond with a 5.3% annual coupon. Her monthly statement shows that the bond's yield to maturity rose from 5.1% last month to 5.6% this month. Over the month, the bond's price has *most likely*:

A decreased.

B increased.

C remained flat.

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Question 17

A small business project is expected to generate the following cash flows:

Expected year-end cash flows

End of year	Cash flow
1	$3,000
2	$5,000
3	$0
4	−$1,500

At a discount rate of 8%, the present value of this cash flow stream is *closest* to:

A $5,962.

B $7,064.

C $8,167.

Question 18

A stock trades at $40. In one year it will either rise by 25% or fall by 20%. A one-year call option on the stock has an exercise price of $44, and the risk-free rate is 4%. Using a one-period binomial model, the value of the call option today is *closest* to:

A $2.88.

B $3.08.

C $3.20.

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5 Skewness and Kurtosis

Question 19

The table below shows one-year returns for seven equity funds.

One-year returns of seven equity funds

Fund	Return (%)
Harbor Growth	5
Juniper Value	11
Lakeview Income	10
Meridian Core	11
Northgate Select	15
Oakmont Small Cap	3
Pinecrest Global	17

Which of the following statements about these returns is *most accurate*?

A The mean is equal to the median.

B The mean is equal to the mode.

C The median is equal to the mode.

Question 20

Priya Raman plans to model the monthly percentage changes in a copper price index. Her statistical tests will be most reliable if the series is stationary, which means that:

A its geometric mean and arithmetic mean are the same.

B its mean and median both lie within its interquartile range.

C the mean and variance of its distribution do not change over time.

Question 21

A histogram of a biotech fund's daily returns shows a long tail stretching to the right, created by a few very large gains. For this unimodal distribution, which relationship among the measures of central tendency is *most likely*?

A mean < median < mode

B mean = median = mode

C mean > median > mode

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Question 22

The covariance between the returns on Norland Utilities and Quarry Point Materials is 21.6 (percent squared). The standard deviation of Norland's returns is 8% and that of Quarry Point's returns is 6%. The correlation coefficient of the two return series is *closest* to:

A +0.34.

B +0.45.

C +0.60.

Question 23

A multi-asset portfolio produced the returns shown below over the last four years.

Annual returns of a multi-asset portfolio (sample)

Year	Return
1	19.0%
2	7.5%
3	−9.6%
4	4.9%

Treating these returns as a sample, their coefficient of variation is *closest* to:

A 0.46.

B 1.87.

C 2.16.

6 Lognormal Distribution

Question 24

A random variable X can take only the values 0, 1, 2 and 3. Which of the following proposed functions is a valid probability function for X?

A $p(0) = 0.40, p(1) = 0.35, p(2) = 0.30, p(3) = -0.05$

B $p(x) = 0.30$ for each of the four values

C $p(x) = (x + 1)/10$

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Question 25

A consultant at Northgate Partners has estimated the scenario returns shown in the table below. The standard deviation of returns on Fund Alder is *closest* to:

Scenario forecasts for Fund Alder and Fund Birch

Scenario	Probability	Return on Fund Alder	Return on Fund Birch
Boom	20%	19%	12%
Expansion	25%	15%	11%
Stagnation	35%	9%	10%
Contraction	20%	1%	8%

A 1.34%.

B 6.18%.

C 6.78%.

Question 26

Each week, the fixed-income desk at Corrib Securities submits competitive bids in 25 separate government bond auctions. The desk's chance of winning an allocation is 0.36 in every auction, and the result of one auction does not affect any other. For the number of auctions the desk wins in a week, the expected value and the variance are, respectively:

A 16.0 and 5.76.

B 9.0 and 2.40.

C 9.0 and 5.76.

Question 27

A commodity desk simulates thousands of possible copper price paths and wants to be certain that no simulated price is ever negative. Which distribution for the price level is *best* suited to this goal?

A Normal.

B Logistic.

C Lognormal.

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Question 28

A high-yield portfolio holds 40% BB-rated bonds and 60% B-rated bonds. Historically, 10% of BB-rated bonds and 30% of B-rated bonds default within five years. If a bond chosen at random from the portfolio defaults within five years, the probability that it was BB-rated is *closest* to:

A 0.100.

B 0.182.

C 0.333.

7 Null Hypothesis

Question 29

A fixed-income analyst splits the universe of investment-grade corporate bonds into five credit-rating buckets. From each bucket she randomly draws a number of bonds proportional to that bucket's share of the universe and then combines the draws into one sample of 400 bonds. Her approach is best described as:

A simple random sampling.

B systematic sampling.

C stratified random sampling.

Question 30

A multi-asset portfolio is worth €40 million, and its daily returns have a standard deviation of 1.2%. Using the parametric method and assuming a daily mean return of zero, the portfolio's daily 5% value at risk (VaR) is *closest* to:

A €0.79 million.

B €0.94 million.

C €1.12 million.

Question 31

A researcher keeps her sample size unchanged but tightens the significance level of her test from 5% to 1%. As a result, the probability of:

A a Type II error increases.

B rejecting a true null hypothesis increases.

C failing to reject a false null hypothesis decreases.

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Question 32

An analyst tests whether a currency strategy's mean daily return is zero and obtains a p-value of 0.021. Which conclusion is *most accurate*?

A The null hypothesis is rejected at the 1% significance level.

B There is a 2.1% probability that the null hypothesis is true.

C The null hypothesis can be rejected at any significance level above 2.1%.

Question 33

A credit researcher compiles the following default data for bond issuers in three sectors:

Bond issuers by sector and default status

Sector	No default	Technical default	Actual default	Total
Energy	94	16	15	125
Healthcare	108	9	13	130
Utilities	126	8	16	150
Total	328	33	44	405

Assuming sector and default status are independent, the expected number of energy issuers in technical default is *closest* to:

A

B

C

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8 Portfolio Standard Deviation

Question 34

Nadia Okafor builds the two-fund portfolio shown in the table below and does not rebalance it at any point. Okafor's portfolio return for Year 2 is *closest* to:

Okafor portfolio: starting values and annual returns

Holding	Value at start of Year 1	Return in Year 1	Return in Year 2
Equity fund	$60,000	20%	−10%
Bond fund	$40,000	2%	6%

A −2.00%.

B −3.60%.

C −4.21%.

Question 35

Brookline Endowment holds an equally weighted portfolio of 50 stocks. The average variance of returns of the individual stocks is 0.09, and the average correlation between pairs of stocks is 0.30. Using the approximation for a portfolio with a large number of assets, the standard deviation of the portfolio's returns is *closest* to:

A 2.7%.

B 9.0%.

C 16.4%.

Question 36

An adviser measures a client's utility with the function $U = E(r) - \frac{1}{2}A\sigma^2$ and estimates the client's coefficient of risk aversion, A, at 3. Based on the table below, which fund gives this client the highest utility?

Funds under consideration

Fund	Expected return	Standard deviation of returns
Northgate Growth Fund	11%	20%
Westbury Balanced Fund	8%	12%
Eastholm Income Fund	6%	5%

A Northgate Growth Fund.

B Westbury Balanced Fund.

C Eastholm Income Fund.

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Question 37

Using the capital asset pricing model (CAPM) and the data in the table below, the expected return on Gorham Textiles shares is *closest* to:

Inputs for Gorham Textiles

Input	Value
Beta of Gorham Textiles	0.8
Market risk premium	6%
Risk-free rate	3%

A 7.8%.

B 5.4%.

C 4.8%.

9 Simulation of Financial Asset Prices and Returns

Question 38

Which of the following is *most likely* an advantage of historical simulation compared with a parametric approach that assumes normally distributed returns?

A It remains reliable after a regime change that makes the future unlike the past.

B It captures fat tails and volatility clustering without imposing a distributional assumption.

C It can generate outcomes more extreme than any observed during the lookback period.

Question 39

An analyst builds each bootstrap scenario for an eight-quarter horizon by drawing from a dataset of 40 historical quarterly returns. Within a single scenario, any one historical observation can be drawn:

A up to eight times.

B only once.

C up to 40 times.

Question 40

Compared with historical simulation and bootstrap resampling, an advantage of Monte Carlo simulation is that it:

A has lower data requirements.

B produces results that are easier to explain.

C can model hypothetical scenarios.

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10 Least Squares Regression

Question 41

A credit analyst gathers data on 80 bond issuers at a single date to see whether an issuer's interest coverage ratio helps explain the yield spread on its bonds. In her simple linear regression, the dependent variable is:

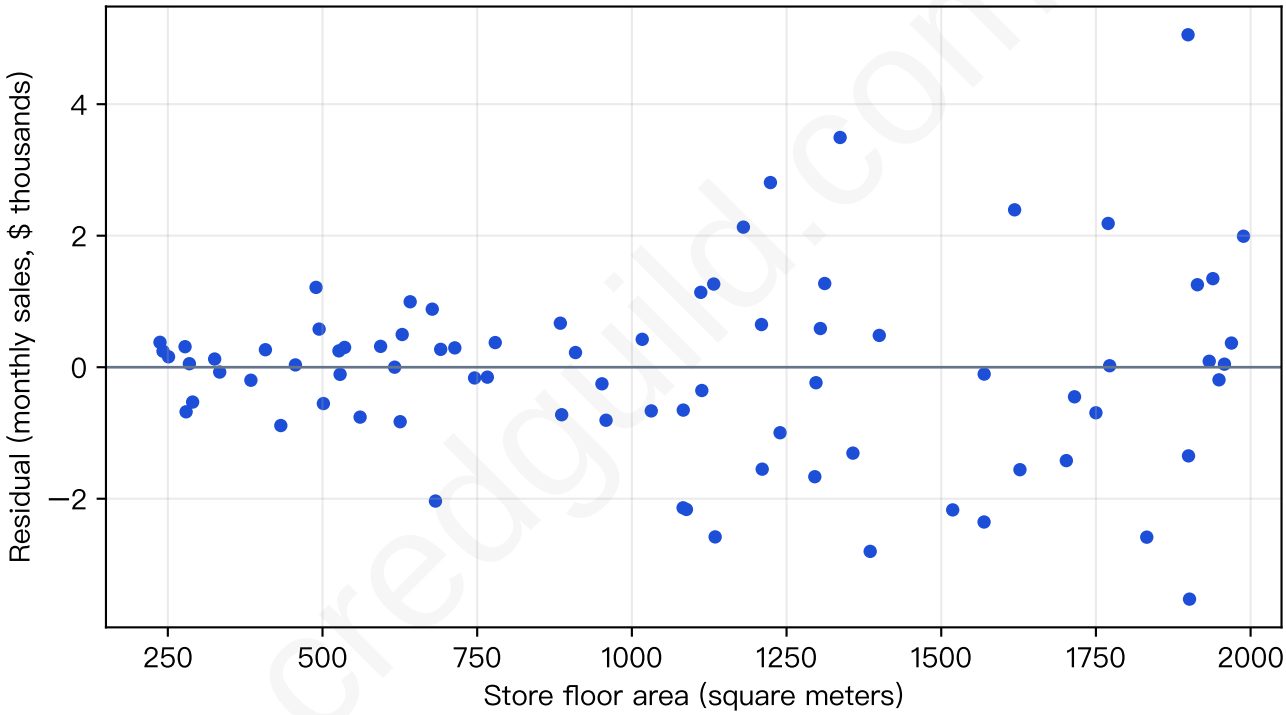
A the interest coverage ratio, because it is the explanatory variable.

B the yield spread, because it is the variable being explained.

C neither, because data from a single date cannot be used in a regression.

Question 42

An analyst regresses the monthly sales of 80 stores on each store's floor area. The figure below plots the regression residuals against floor area. The pattern *most likely* indicates that the regression's residual term:



Residuals plotted against store floor area

A does not have a constant variance.

B is not normally distributed.

C is not independently distributed.

Question 43

An analyst regresses a fertilizer producer's monthly stock returns on monthly changes in a crop price index, using 32 observations. The estimated coefficients are in the table below. She expects next month's change in the index to be −0.015 and computes a standard error of the forecast of 0.028. Critical t-values with 30 degrees of freedom are 1.310 with 10% in one tail and 1.697 with 5% in one tail. The 90% prediction interval for next month's return is *closest* to:

Regression of monthly stock returns on crop price changes

	Coefficient	Standard error
Intercept	0.0040	0.0035
Crop price change	0.6500	0.2100

A −0.0533 to 0.0418.

B −0.0424 to 0.0309.

C −0.0338 to 0.0613.

Question 44

To estimate a stock's beta, an analyst regresses the stock's excess returns on the market risk premium and obtains an intercept of −0.15 and a slope of 0.72. Based on this model, the stock's beta is:

A negative.

B between 0 and 1.

C greater than 1.

11 Machine Learning in Finance

Question 45

A new analyst at Ottery Capital drafts three glossary entries for the firm's research team. Which entry about fintech is *most accurate*?

A Fintech covers only payment apps and online banking services sold to consumers.

B Fintech is another name for financial data science, the analysis of financial data.

C Fintech is the meeting of finance and technology, such as tools that aid quantitative analysis.

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Question 46

Voice recordings of earnings calls, satellite images of shipping ports and posts on social media platforms are all examples of:

A unstructured data.

B structured data.

C semi-structured data.

Question 47

A data team at Larchmont Analytics is documenting the steps it uses to process data. Which of the following statements about these data processing methods is *most accurate*?

A Search is the process of archiving data so that they can be retrieved later.

B Curation involves cleaning the data, for example by correcting errors and dealing with missing values, so that the data are of good quality.

C Capture is the process of moving data from a storage medium to the analytical tool that will use them.

Question 48

A lender at Brackenridge Credit trains a model on records of past borrowers, each tagged with the borrower's financial ratios and whether the borrower eventually defaulted. The model learns to map the ratios to the default outcome and is then applied to new loan applicants. This machine learning process is best described as:

A unsupervised learning.

B supervised learning.

C reinforcement learning.

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QUANTITATIVE METHODS

Answers and explanations

Answer key: 1. C · 2. B · 3. B · 4. B · 5. C · 6. A · 7. B · 8. A · 9. B · 10. B · 11. B · 12. C · 13. A · 14. A · 15. C · 16. A · 17. A · 18. B · 19. C · 20. C · 21. C · 22. B · 23. C · 24. C · 25. B · 26. C · 27. C · 28. B · 29. C · 30. A · 31. A · 32. C · 33. A · 34. C · 35. C · 36. B · 37. A · 38. B · 39. A · 40. C · 41. B · 42. A · 43. A · 44. B · 45. C · 46. A · 47. B · 48. B

Question 1 **Answer: C**

Interest rates, exchange rates and market index levels are financial indicators: observable measures of value that do not produce any cash flows on their own. They matter because they are used to value other things, such as the securities and contracts that are financial instruments.

Why the other options are wrong

- **A.** Financial assets are items an investor can own that carry value, such as cash, shares or loans. Nobody owns an interest rate or an index level, and these items pay nothing to anyone.
- **B.** Financial instruments are standardized vehicles for trading financial assets in markets, such as listed shares, bonds or standardized derivative contracts. An index *level* or an exchange *rate* is a measurement and cannot itself be traded.

Key takeaway An indicator is an observed measure (rates, FX, index levels); an instrument is a standardized, tradable vehicle; an asset is something an investor owns that has value.

Reading 1: Returns of Financial Assets and Instruments. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/rate-of-return/

Question 2 **Answer: B**

The geometric mean builds in compounding, so it is the constant annual rate that turns the starting value into the ending value. Here it is $\sqrt{1.20 \times 0.80} - 1 = -2.02\%$, consistent with her €50,000 becoming €60,000 and then €48,000.

Year 1: $50{,}000 \times 1.20 = €60{,}000$; Year 2: $60{,}000 \times 0.80 = €48{,}000$.

Geometric mean: $(1.20 \times 0.80)^{1/2} - 1 = 0.96^{0.5} - 1 = -2.02\%$. Check: $50{,}000 \times 0.9798^2 = €48{,}000$.

Why the other options are wrong

- **A.** The arithmetic mean is $(20\% - 20\%)/2 = 0\%$, implying her wealth was unchanged, yet she ended with €48,000, less than she started with. The arithmetic mean treats each year as if the same €50,000 were invested.
- **C.** The capital distribution return measures only cash income (dividends, interest) relative to the beginning price. It says nothing about the compound effect of price movements over two years.

Key takeaway A gain and loss of equal percentage size leaves the investor worse off; only the geometric mean shows it.

Reading 1: Returns of Financial Assets and Instruments. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/rate-of-return/

Question 3 **Answer: B**

For a given stated annual rate, more frequent compounding raises the effective rate used to discount the cash flow. A higher effective discount rate means a smaller present value (and, correspondingly, a larger future value for a sum invested today). Monthly is the most frequent of the three conventions, so it produces the lowest present value.

Annual: $PV = 250{,}000/1.06 = €235{,}849.06$

Semiannual: $PV = 250{,}000/(1 + 0.06/2)^2 = 250{,}000/1.0609 = €235{,}648.98$

Monthly: $PV = 250{,}000/(1 + 0.06/12)^{12} = 250{,}000/1.061678 = €235{,}476.33$

Why the other options are wrong

- **A.** Annual compounding is the *least* frequent convention, so it produces the *highest* present value: €235,849.
- **C.** Semiannual compounding gives €235,649. That is lower than annual but still higher than monthly, because compounding twice a year gives a smaller effective discount rate than compounding 12 times.

Key takeaway More compounding periods mean a higher effective rate, so a higher FV and a lower PV.

Reading 1: Returns of Financial Assets and Instruments. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/rate-of-return/

Question 4 **Answer: B**

The label "risk-free" rules out any doubt over the amount or timing of the cash flows (so no default risk), while "real" rules out any allowance for expected inflation. The real risk-free rate therefore contains neither, reflecting only time preference.

Why the other options are wrong

- **A.** A rate that includes an inflation premium but has zero probability of default is a *nominal* risk-free rate, not a real one.
- **C.** A liquidity risk premium is compensation for a type of risk. A risk-free rate contains no risk premiums of any kind, including a liquidity risk premium.

Key takeaway Real risk-free rate: no inflation, no risk premia. Adding expected inflation gives the nominal risk-free rate; adding risk premia to that gives the required return on a risky asset.

Reading 1: Returns of Financial Assets and Instruments. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/rate-of-return/

Question 5 **Answer: C**

Leverage lets investors control more assets than their own capital would allow. When the portfolio return exceeds the borrowing cost, the return on equity rises; when the portfolio loses money, the loss on the smaller equity base is larger. Leverage magnifies results in both directions and offers no protection against losses.

Illustration with a 5% borrowing rate: a portfolio return of +10% gives $(15 - 2.5)/100 = +12.5\%$ vs. +10% unleveraged; a portfolio return of −10% gives $(-15 - 2.5)/100 = -17.5\%$ vs. −10% unleveraged.

Why the other options are wrong

- **A.** Borrowing does not cushion losses. If the unleveraged portfolio loses money, the fund still owes the borrowed amount plus interest, so the loss on investor capital is larger, not smaller.

- **B.** When the portfolio earns more than the interest rate on the borrowing, leverage *raises* the return on investor capital, so gains in good years are amplified.

Key takeaway Leverage magnifies losses, and it magnifies gains as long as the portfolio return exceeds the borrowing rate.

Reading 1: Returns of Financial Assets and Instruments. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/rate-of-return/

Question 6 **Answer: A**

A bond's coupon is a fixed capital distribution, and for traditional bonds it is usually the largest part of total return. The bond's market price can move while it is held, which creates some price return, but that is normally the smaller part.

Why the other options are wrong

- **B.** Price return as the dominant source describes equities, whose value is driven by changes in earnings prospects. It does not fit traditional fixed-coupon bonds.
- **C.** There is no general tendency toward an equal split. For traditional bonds the fixed coupon usually dominates.

Key takeaway Bonds: return mainly from fixed capital distributions (coupons). Equities: return mainly from price return.

Reading 2: Types of Financial Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/types-of-financial-returns/

Question 7 **Answer: B**

Volatility reduces compound (geometric) returns. A single stock is less diversified and more volatile than an index, so its geometric mean return tends to fall further below its arithmetic mean than the index's does. For similar arithmetic means, the stock therefore compounds to a lower return than the index.

Illustration: returns of $+25\%$ and -20% have an arithmetic mean of 2.5%, but $(1.25 \times 0.80)^{1/2} - 1 = 0\%$ geometric. Steadier returns of $+3\%$ and $+2\%$ have an arithmetic mean of 2.5% and a geometric mean of $(1.03 \times 1.02)^{1/2} - 1 = 2.50\%$. Same arithmetic mean, but the more volatile series compounds to less.

Why the other options are wrong

- **A.** The overstatement grows with volatility. The arithmetic mean overstates the multiperiod return of the more volatile individual stock by more than that of the less volatile index.
- **C.** The arithmetic mean ignores the compounding drag of volatility, so it overstates, not understates, the multiperiod performance of a volatile stock.

Key takeaway More volatility widens the gap between the arithmetic and geometric means and lowers the compound return of the volatile asset.

Reading 2: Types of Financial Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/types-of-financial-returns/

Question 8 **Answer: A**

A portfolio's expected return is the weighted average of the expected returns of its components, using the allocation weights.

$$E(R_p) = 0.65 \times 9.0\% + 0.35 \times 3.8\% = 5.85\% + 1.33\% = 7.18\%$$

Adding the two returns without weights, $9.0\% + 3.8\% = 12.80\%$, counts each asset class as if it had a 100% allocation; the weights must sum to 100%, which gives the weighted 7.18%.

Why the other options are wrong

- **B.** 6.40% is the simple average $(9.0\% + 3.8\%)/2$. It would only be right with a 50/50 allocation.
- **C.** 5.62% swaps the weights, $0.35 \times 9.0\% + 0.65 \times 3.8\%$, putting 65% on the bonds. Each weight must go with its own asset class.

Key takeaway Portfolio expected return $= \sum_i w_i E(R_i)$; with non-negative weights it must lie between the lowest and highest component returns.

Reading 2: Types of Financial Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/types-of-financial-returns/

Question 9 **Answer: B**

The money-weighted return is the internal rate of return of the cash flows the investor actually pays and receives. At the end of year 1 the $1.50 dividend on the first share is netted against the $36.00 purchase. At the end of year 2 she receives the sale proceeds and the dividends on two shares. The 10% required return is not an input.

t	Cash flow
0	−30.00
1	+1.50 − 36.00 = −34.50
2	2 × 41.00 + 2 × 2.00 = +86.00

$$-30.00 - \frac{34.50}{1+r} + \frac{86.00}{(1+r)^2} = 0 \;\Rightarrow\; r = 0.2131 \approx 21.3\%$$

TI BA II Plus: `[CF] [2ND] [CLR WORK]`; CF0 = −30; C01 = −34.5, F01 = 1; C02 = 86, F02 = 1; `[IRR] [CPT]` = 21.31.

Why the other options are wrong

- **A.** 15.9% is the IRR after ignoring both dividends (CF1 = −36, CF2 = +82). Dividends that are paid out are cash received by the investor.
- **C.** 22.2% is the time-weighted return: $HPR_1 = (36 - 30 + 1.5)/30 = 25.0\%$ and $HPR_2 = (41 - 36 + 2)/36 = 19.4\%$, so $\sqrt{1.250 \times 1.194} - 1 = 22.2\%$. This measure ignores the fact that more money was invested in year 2.

Key takeaway For an MWR share problem, net the dividend received against any purchase on the same date, and include dividends on all shares held at the end.

Reading 3: Benchmarking Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/benchmarking-returns/

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Question 10 **Answer: B**

The value of a total return index grows by compounding its periodic total returns: $V_n = V_0(1 + R_1)(1 + R_2) \cdots (1 + R_n)$. Each periodic total return includes both price changes and income such as dividends and interest.

Why the other options are wrong

- **A.** An index whose value reflects only price changes is a price return index. A total return index also includes the income (dividends, interest, other distributions) paid by the constituents.
- **C.** Income paid by the constituents can never be negative. A total return index therefore always rises at least as fast as (or falls no faster than) the matching price return index.

Key takeaway Total return index ≥ price return index; values compound by geometric linking.

Reading 3: Benchmarking Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/benchmarking-returns/

Question 11 **Answer: B**

A stock split must not change the value of a price-weighted index. The divisor is reset so that the new sum of prices, with the splitting stock at its post-split price, gives the same index value as before.

Index value before the split: $270/1.80 = 150.0$

Post-split price of the stock: $90/3 = \$30$, so the sum of prices falls by \$60 to \$210.

$$D_{new} = \frac{210}{150.0} = 1.40$$

Why the other options are wrong

- **A.** 0.60 treats every constituent as splitting 3-for-1 ($270/3 = 90$, and $90/150 = 0.60$). Only the one stock's price is divided by 3.
- **C.** 1.80 is the old divisor. If it were kept, the index would drop to $210/1.80 = 116.7$ purely because of the split.

Key takeaway Price-weighted index + split: recompute the sum with the new price, keep the index value, solve for the new (smaller) divisor.

Reading 3: Benchmarking Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/benchmarking-returns/

Question 12 **Answer: C**

An equal-weighted index starts with the same weight in each stock. After prices move, each stock's weight is its new value divided by the new total, until the index is rebalanced. Stocks that outperformed now carry more than one-third.

Stock	Start value	Return	End value	End weight
Kestrel	25,000	+12%	28,000	36.1%
Linden	25,000	+4%	26,000	33.5%
Oakmere	25,000	−6%	23,500	30.3%
Total	75,000		77,500	100%

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$$w_{Kestrel} = \frac{28{,}000}{77{,}500} = 36.1\%$$

A tempting shortcut is to grow the starting one-third weight by Kestrel's own return: $33.33\% \times 1.12 = 37.33\%$. That is wrong because it keeps the old 75,000 total in the denominator; the new weight must divide the new position value by the new total value (77,500).

Why the other options are wrong

- **A.** 33.3% is the starting weight. It assumes the weights stay equal after price changes, but equal weights are only restored when the index is rebalanced.
- **B.** 34.8% drops the minus sign on Oakmere's −6% return, so the new total becomes $25{,}000 \times (1.12 + 1.04 + 1.06) = 80{,}500$ and $28{,}000/80{,}500 = 34.8\%$. Oakmere lost value, so the total is only 77,500.

Key takeaway Between rebalancing dates, equal-weighted index weights drift toward the winners. New weight = new position value ÷ new total.

Reading 3: Benchmarking Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/benchmarking-returns/

Question 13 Answer: A

Reconstitution changes the index's membership. It is needed when a constituent ceases to exist (for example after a merger, a bankruptcy or delisting, or a bond maturing) or no longer meets the index criteria, and replacements that meet the criteria are added.

Why the other options are wrong

- **B.** Rebalancing resets the weights of existing constituents to their target weights. It does not swap one security for another.
- **C.** Redefinition is not one of the index maintenance steps. The index's objective and rules stay the same; only its membership changes.

Key takeaway Membership change = reconstitution; weight reset = rebalancing.

Reading 3: Benchmarking Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/benchmarking-returns/

Question 14 Answer: A

The fees are unequal, so each one is discounted to today on its own and the present values are added. With monthly compounding, the rate per period is 6%/12 = 0.5% and each year has 12 periods, so the fees are discounted over 12, 24 and 36 months.

$$PV = \frac{5{,}000}{1.005^{12}} + \frac{9{,}000}{1.005^{24}} + \frac{12{,}000}{1.005^{36}}$$

$$= 4{,}709.53 + 7{,}984.67 + 10{,}027.74 = \$22{,}721.94$$

Calculator (P/Y = C/Y = 1, END mode), first fee: N = 12; I/Y = 0.5; PMT = 0; FV = 5,000; CPT PV = −4,709.53. Then N = 24; FV = 9,000; CPT PV = −7,984.67, and N = 36; FV = 12,000; CPT PV = −10,027.74.

Why the other options are wrong

- **B.** \$22,802 discounts at 6% with annual compounding (1.06, 1.06^2 and 1.06^3). Monthly compounding raises the effective annual rate to $1.005^{12} - 1 = 6.17\%$, so the present value is lower.

- **C.** $25,708 uses the monthly rate of 0.5% but discounts over only 1, 2 and 3 periods, counting years instead of months.

Key takeaway With m compounding periods a year, discount at r/m over $m\times$ years periods, and value unequal cash flows one at a time.

Reading 4: The Time Value of Money in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/time-value-of-money/

Question 15 **Answer: C**

A fixed dividend paid forever is a perpetuity. Its value is the annual dividend divided by the investor's required rate of return.

$$V_p = \frac{D_p}{r_p} = \frac{2.60}{0.072} = \$36.11$$

Why the other options are wrong

- **A.** $18.72 multiplies the dividend by the required return (2.60×7.2) instead of dividing by it.
- **B.** $33.69 discounts the perpetuity value one extra year, $(2.60/0.072)/1.072$. The formula D_p/r_p already gives today's value when the first dividend is one year away.

Key takeaway Preferred stock (perpetual fixed dividend): value = dividend ÷ required return.

Reading 4: The Time Value of Money in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/time-value-of-money/

Question 16 **Answer: A**

Price and yield to maturity are inversely related. The yield to maturity is the discount rate that equates the bond's cash flows with its price. A higher yield means the same fixed cash flows are discounted more heavily, so the price must have fallen.

Why the other options are wrong

- **B.** A price increase would go with a lower yield to maturity, not a higher one.
- **C.** A flat price would leave the yield to maturity almost unchanged (only the passage of one month would move it slightly). It could not produce a 0.5 percentage point rise.

Key takeaway Price and YTM are inversely related: when the yield rises, the price falls.

Reading 4: The Time Value of Money in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/time-value-of-money/

Question 17 **Answer: A**

By the cash flow additivity principle, the PV of an uneven stream is the sum of the PVs of its individual cash flows. Each flow is discounted for its own number of years, and the year 4 outflow enters with a negative sign.

$$PV = \frac{3{,}000}{1.08} + \frac{5{,}000}{1.08^2} + \frac{0}{1.08^3} - \frac{1{,}500}{1.08^4}$$

$$= 2{,}777.78 + 4{,}286.69 + 0 - 1{,}102.54 = \$5{,}961.93$$

Calculator: [CF] [2ND] [CLR WORK]; CF0 = 0; C01 = 3,000, F01 = 1; C02 = 5,000, F02 = 1; C03 = 0, F03 = 1; C04 = −1,500, F04 = 1; [NPV] I = 8, [↓] [CPT] = 5,961.93. Inflows are entered as positive and the year 4 outflow as negative.

Why the other options are wrong

- **B.** $7,064 includes only the year 1 and year 2 inflows and leaves out the year 4 outflow.
- **C.** $8,167 adds the PV of the year 4 cash flow ($+1{,}102.54$) instead of subtracting it. It is an outflow.

Key takeaway PV of an uneven stream $= \sum_t CF_t/(1+r)^t$, keeping the signs of outflows.

Reading 4: The Time Value of Money in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/time-value-of-money/

Question 18 **Answer: B**

Writing one call and buying the hedge ratio h of shares creates a portfolio worth the same whether the stock rises or falls. That riskless portfolio must earn the risk-free rate. The option value is the cost of the shares minus the present value of the riskless portfolio.

Stock at expiration: up $= \$50$, down $= \$32$. Call payoff: up $= \max(50-44, 0) = \$6$; down $= \$0$.

$$h = \frac{6-0}{50-32} = 0.3333$$

Portfolio at expiration: up $= 0.3333 \times 50 - 6 = 10.667$; down $= 0.3333 \times 32 - 0 = 10.667$.

$$\text{PV} = \frac{10.667}{1.04} = 10.256 \qquad c_0 = 0.3333 \times 40 - 10.256 = 13.333 - 10.256 = \$3.08$$

Why the other options are wrong

- **A.** $2.88 weights the up and down payoffs equally ($0.5 \times 6/1.04$). The binomial value does not depend on 50/50 (or any subjective) probabilities; it comes from the hedge ratio, the up and down prices and the risk-free rate.
- **C.** $3.20 is an undiscounted value: it equals 1.04×3.08, i.e. 0.5333×6, where $0.5333 = (1.04 - 0.80)/(1.25 - 0.80)$ is the risk-neutral probability of an up move. Omitting the division by $1 + R_f = 1.04$ overstates the option value.

Key takeaway Binomial model: $h = (c_u - c_d)/(S_u - S_d)$; $c_0 = hS_0 - \text{PV of the riskless portfolio at } R_f$.

Reading 4: The Time Value of Money in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/time-value-of-money/

Question 19 **Answer: C**

Sorted, the returns are 3, 5, 10, 11, 11, 15, 17. The middle (fourth) value is 11%, and 11% is also the only value that appears twice, so the median and the mode are both 11%. The mean is lower, at about 10.29%.

Sorted: 3, 5, 10, 11, 11, 15, 17. The fourth value is the median, 11%.

Mode $= 11\%$ (appears twice).

$$\bar{X} = \frac{5+11+10+11+15+3+17}{7} = \frac{72}{7} = 10.29\%$$

Why the other options are wrong

- **A.** The mean (10.29%) is below the median (11%) because the low returns of 3% and 5% pull the average down.
- **B.** The mean (10.29%) is not equal to the mode (11%).

Key takeaway Compute all three measures explicitly; the mean is rarely exactly equal to an observed value.

Reading 5: Statistical Characteristics of Asset Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/skewness-and-kurtosis/

Question 20 **Answer: C**

Data are stationary when the mean and variance of the underlying distribution stay constant through time. When these characteristics shift, the series is nonstationary, and inferences about future outcomes drawn from past data become unreliable. For this reason analysts usually model percentage changes rather than trending price levels.

Why the other options are wrong

- **A.** The geometric and arithmetic means coincide only when every observation is identical; that has nothing to do with stationarity.
- **B.** The median always lies inside the interquartile range, and the mean usually does unless the data are extremely skewed. This says nothing about whether the distribution is stable over time.

Key takeaway Stationary = stable mean and variance over time. Price levels are usually nonstationary; returns (percentage changes) are more likely to be stationary.

Reading 5: Statistical Characteristics of Asset Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/skewness-and-kurtosis/

Question 21 **Answer: C**

A long right tail means the distribution is positively skewed. The large positive outliers pull the mean upward the most, the median less, and the mode (the peak) not at all, so mean > median > mode.

Why the other options are wrong

- **A.** This ordering describes a negatively skewed distribution with a long left tail.
- **B.** Equality of the three measures describes a symmetrical distribution, which has no long tail.

Key takeaway Positive (right) skew: mode < median < mean.

Reading 5: Statistical Characteristics of Asset Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/skewness-and-kurtosis/

Question 22 **Answer: B**

Correlation standardizes covariance by dividing it by the product of the two standard deviations.

$$\rho = \frac{\text{Cov}}{\sigma_N \sigma_Q} = \frac{21.6}{8 \times 6} = \frac{21.6}{48} = 0.45$$

Why the other options are wrong

- **A.** +0.34 divides the covariance by Norland's variance only $(21.6/64)$.

- **C.** +0.60 divides the covariance by Quarry Point's variance only ($21.6/36$).

Key takeaway $\rho = \mathrm{Cov}/(\sigma_1\sigma_2)$; dividing by a single variance gives a slope-type ratio.

Reading 5: Statistical Characteristics of Asset Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/skewness-and-kurtosis/

Question 23 **Answer: C**

The coefficient of variation is the sample standard deviation divided by the mean return. Because the returns are a sample, the standard deviation uses $n - 1$ in the denominator.

Mean $= (19.0 + 7.5 - 9.6 + 4.9)/4 = 21.8/4 = 5.45\%$.

Year	Return	(Return – 5.45)^2
1	19.0	183.60
2	7.5	4.20
3	−9.6	226.50
4	4.9	0.30
	Sum	414.61

$$s = \sqrt{\frac{414.61}{4-1}} = \sqrt{138.20} = 11.76\% \qquad \frac{s}{\bar{X}} = \frac{11.76}{5.45} = 2.16$$

Why the other options are wrong

- **A.** 0.46 inverts the ratio: $5.45/11.76$.
- **B.** 1.87 uses the population standard deviation, $\sqrt{414.61/4} = 10.18\%$, giving $10.18/5.45$; the returns are to be treated as a sample.

Key takeaway Sample coefficient of variation: compute s with n – 1, then divide by the mean.

Reading 5: Statistical Characteristics of Asset Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/skewness-and-kurtosis/

Question 24 **Answer: C**

A probability function must satisfy two conditions: every probability lies between 0 and 1 inclusive, and the probabilities over all possible outcomes add up to exactly 1. Only $p(x) = (x + 1)/10$ meets both: it gives 0.1, 0.2, 0.3 and 0.4, each within [0, 1], summing to 1.0.

- Set with $p(3) = -0.05$: sum $= 0.40 + 0.35 + 0.30 - 0.05 = 1.00$, but $p(3) = -0.05 < 0$, so it fails condition 1.
- Constant $p(x) = 0.30$: each value is within [0, 1], but the sum is $4 \times 0.30 = 1.20 \neq 1$, so it fails condition 2.
- $p(x) = (x + 1)/10$: $p = 0.1, 0.2, 0.3, 0.4$; all in [0, 1] and $\sum p = 1.0$, so it is valid.

Why the other options are wrong

- **A.** The probabilities sum to one, but a negative probability is impossible; satisfying only the 'sum to one' condition is not enough.
- **B.** Each probability is between 0 and 1, but together they sum to 1.20. A probability function must exhaust exactly 100% of the probability; an equal-probability function over four outcomes would need 0.25 each.

Key takeaway Check both conditions every time: $0 \le p(x) \le 1$ for each x, and $\sum p(x) = 1$.

Reading 6: Statistical Distributions for Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/lognormal-distribution/

Question 25 **Answer: B**

The standard deviation of Fund Alder is the square root of the probability-weighted average squared deviation of Alder's scenario returns from Alder's expected return. Fund Birch's column is irrelevant to this question.

1. Expected return on Alder

$$E(R) = 0.20(19) + 0.25(15) + 0.35(9) + 0.20(1) = 3.8 + 3.75 + 3.15 + 0.2 = 10.9\%$$

2. Variance (percent units)

$$\sigma^2 = 0.20(8.1)^2 + 0.25(4.1)^2 + 0.35(-1.9)^2 + 0.20(-9.9)^2$$

$$= 13.122 + 4.2025 + 1.2635 + 19.602 = 38.19\ (\%^2)$$

(in decimals, 0.003819)

3. Standard deviation

$$\sigma = \sqrt{38.19} = 6.18\%$$

Why the other options are wrong

- **A.** 1.34% is the standard deviation of Fund Birch, computed from the wrong column (variance 1.7875 %²).
- **C.** 6.78% ignores the probabilities and treats the four scenarios as equally likely (mean 11%, variance 46 %²).

Key takeaway Read the column carefully in two-asset tables, and weight squared deviations by the scenario probabilities.

Reading 6: Statistical Distributions for Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/lognormal-distribution/

Question 26 **Answer: C**

The number of wins is a binomial random variable: there is a fixed number of independent trials (25 auctions), each with only two outcomes (win or lose) and the same probability of success ($p = 0.36$). Its mean is np and its variance is $np(1-p)$.

$$E(X) = np = 25 \times 0.36 = 9.0$$

$$\sigma^2(X) = np(1-p) = 25 \times 0.36 \times 0.64 = 5.76$$

(The standard deviation would be $\sqrt{5.76} = 2.40$.) As with any discrete count, the mean of 9.0 is the long-run average number of wins per week, not a guaranteed result.

Why the other options are wrong

- **A.** 16.0 uses the probability of *losing* an auction, 25×0.64, so it is the expected number of losses. The variance of 5.76 is right, because $np(1-p)$ is the same whichever outcome is called a success.
- **B.** The mean of 9.0 is right, but 2.40 is the *standard deviation*, $\sqrt{5.76}$, which is the square root of the variance.

Key takeaway Binomial: $E(X) = np$ and $\sigma^2 = np(1-p)$. Define "success" as the outcome being counted, and do not stop at the standard deviation when the variance is asked.

Reading 6: Statistical Distributions for Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/lognormal-distribution/

Question 27 **Answer: C**

The lognormal distribution is bounded below by zero, so it can never generate a negative price, which is why it is the usual choice for modeling asset price levels. Both the normal and the logistic distributions extend to minus infinity.

Why the other options are wrong

- **A.** A normal distribution is unbounded below, so with enough simulated paths some prices would turn negative; it is unsuitable for modeling price levels directly.
- **B.** A logistic distribution is also symmetric and unbounded, allowing negative as well as positive values (and its fat tails make extreme negative draws even more likely than under a normal).

Key takeaway When simulated prices must never be negative, model the price level as lognormal.

Reading 6: Statistical Distributions for Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/lognormal-distribution/

Question 28 **Answer: B**

This is a Bayesian update: the prior probability that a bond is BB-rated (0.40) is revised using the information that the bond defaulted. The posterior is the joint probability of 'BB and default' divided by the unconditional probability of default.

$$P(\text{BB and D}) = P(D \mid BB)P(BB) = 0.10 \times 0.40 = 0.04$$

$$P(\text{B and D}) = P(D \mid B)P(B) = 0.30 \times 0.60 = 0.18$$

$$P(D) = 0.04 + 0.18 = 0.22$$

$$P(BB \mid D) = \frac{0.04}{0.22} = 0.182$$

Why the other options are wrong

- **A.** 0.100 is $P(\text{default} \mid \text{BB})$, the likelihood. The question asks for the reverse conditional probability, the posterior $P(\text{BB} \mid \text{default})$.
- **C.** 0.333 is the ratio of the two default rates ($0.10/0.30$); it ignores the portfolio weights (priors) and the unconditional probability of default.

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Key takeaway $P(A \mid B) \neq P(B \mid A)$. Build the joint probabilities, add them for the denominator, then divide.

Reading 6: Statistical Distributions for Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/lognormal-distribution/

Question 29 **Answer: C**

The analyst first divides the population into subgroups (strata) using a classification scheme (here, credit rating) and then draws a random sample within each stratum, pooling the results. That is stratified random sampling. Sampling each stratum in proportion to its weight ensures that the rating mix of the sample mirrors the population.

Why the other options are wrong

- **A.** In simple random sampling every bond in the universe would have the same chance of selection from a single, undivided list; here the population is first split into rating buckets and each bucket is sampled separately.
- **B.** Systematic sampling selects every k-th member of an ordered population list. The analyst makes random draws inside each rating bucket instead.

Key takeaway Dividing the population into groups first and then sampling randomly within every group is stratified random sampling.

Reading 7: Estimation and Hypothesis Testing. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/null-hypothesis/

Question 30 **Answer: A**

Parametric value at risk assumes normally distributed returns. With a zero mean, the 5% VaR is the loss that sits 1.645 standard deviations below the mean, with the *whole* 5% in the left tail. It means there is a 5% probability of losing that amount or more on any given day.

One-tailed critical value for 5%: $z_{0.05} = 1.645$ (exact 1.6449; many texts round to 1.65).

$$\text{VaR}_{5\%} = z_{0.05} \times \sigma \times \text{portfolio value} = 1.645 \times 0.012 \times €40{,}000{,}000 = €789{,}600 \approx €0.79 \text{ million}$$

(With 1.65 the result is €792,000 — still closest to €0.79 million.)

Why the other options are wrong

- **B.** €0.94 million uses 1.96, the two-tailed 5% value (2.5% in each tail). VaR is one-tailed, so the full 5% belongs in a single tail (z = 1.645).
- **C.** €1.12 million uses 2.33, the one-tailed critical value for 1%, which gives the 1% VaR.

Key takeaway VaR puts the whole α in one tail: 1.28 for 10%, 1.645 for 5% and 2.33 for 1%. It is the minimum loss at that probability; larger losses remain possible.

Reading 7: Estimation and Hypothesis Testing. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/null-hypothesis/

Question 31 **Answer: A**

Lowering the significance level lowers the probability of a Type I error. For a fixed sample size, the rejection region shrinks, so a false null is less likely to be rejected: the probability of a Type II error rises and the power of the test falls.

Why the other options are wrong

- **B.** Rejecting a true null is a Type I error, whose probability is the significance level; it falls from 5% to 1%.
- **C.** Failing to reject a false null is a Type II error; its probability *increases* when α is reduced with no change in sample size. A null is never 'accepted'; a test can only fail to reject it.

Key takeaway With n fixed, a lower α means a higher β and a lower power.

Reading 7: Estimation and Hypothesis Testing. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/null-hypothesis/

Question 32 **Answer: C**

The p-value is the smallest significance level at which the null hypothesis can be rejected. The null is rejected whenever the chosen α exceeds the p-value, so here it is rejected at 5% or at 2.5% but not at 1%.

Why the other options are wrong

- **A.** At 1%, the p-value of 0.021 is above α = 0.01, so the null is not rejected.
- **B.** The p-value is computed assuming the null is true: it is the probability, under H_0, of a test statistic at least as extreme as the one observed. It does not measure the probability that H_0 itself is true.

Key takeaway Reject H_0 when the p-value is below α. A p-value of 0.021 rejects at 5% but not at 1%.

Reading 7: Estimation and Hypothesis Testing. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/null-hypothesis/

Question 33 **Answer: A**

Under independence, the expected count for a cell is (row total × column total) / total number of observations. For energy issuers in technical default, use the Energy row total (125) and the Technical default column total (33).

$$E_{i,j} = \frac{\text{total for row } i \times \text{total for column } j}{\text{total number of observations}} = \frac{125 \times 33}{405} = \frac{4{,}125}{405} = 10.2$$

Why the other options are wrong

- **B.** About 14 (13.6) uses the Actual default column total (44) instead of the Technical default column total: $125 \times 44/405 = 13.6$.
- **C.** 16 is the *observed* number of energy issuers in technical default; the question asks for the count expected under independence.

Key takeaway Expected count = row total × column total / grand total.

Reading 7: Estimation and Hypothesis Testing. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/null-hypothesis/

Question 34 **Answer: C**

Without rebalancing, the weights drift with market values (portfolio drift). Each period's portfolio return must use the weights at the start of that period, so the Year 2 return is computed with the weights at the end of Year 1, not the original 60/40 split.

1. Values at the end of Year 1

Equity fund: $\$60{,}000 \times 1.20 = \$72{,}000$; bond fund: $\$40{,}000 \times 1.02 = \$40{,}800$; total $= \$112{,}800$.

2. Weights at the start of Year 2

$$w_{\text{equity}} = \frac{72{,}000}{112{,}800} = 0.6383, \qquad w_{\text{bond}} = \frac{40{,}800}{112{,}800} = 0.3617$$

3. Year 2 portfolio return

$$R_{P,2} = 0.6383(-10\%) + 0.3617(6\%) = -6.383\% + 2.170\% = -4.21\%$$

Check: end values $\$64{,}800 + \$43{,}248 = \$108{,}048$; $108{,}048/112{,}800 - 1 = -4.21\%$.

Why the other options are wrong

- **A.** −2.00% is the equal-weighted average of the two Year 2 returns, $(-10\% + 6\%)/2$; it ignores both the original and the drifted weights.
- **B.** −3.60% uses the original weights, $0.60(-10\%) + 0.40(6\%)$. That would be right only if the portfolio had been rebalanced back to 60/40 at the end of Year 1.

Key takeaway No rebalancing means the weights drift: recompute each weight from start-of-period market values before weighting the period's returns.

Reading 8: The Return and Risk of a Financial Portfolio. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/portfolio-standard-deviation/

Question 35 **Answer: C**

For an equally weighted portfolio of many assets, the individual variances matter little and portfolio variance is approximately the average correlation times the average variance. The standard deviation is the square root of that variance.

$$\sigma_P^2 \approx \bar{\rho}\,\bar{\sigma}^2 = 0.30 \times 0.09 = 0.027$$

$$\sigma_P \approx \sqrt{0.027} = 0.164 = 16.4\%$$

The approximation ignores the finite-N term. If every stock had the same variance of 0.09, the exact equal-weight formula would add $(1 - \bar{\rho})\sigma^2/N = 0.70(0.09)/50 = 0.00126$, giving $\sigma_P^2 = 0.02826$ and $\sigma_P = 16.8\%$, still closest to 16.4%. With unequal variances, the exact result depends on the average covariance, which the given averages do not pin down, so the question asks for the approximation. The average single stock has a standard deviation of $\sqrt{0.09} = 30\%$; diversification cuts this to about 16%, and the remainder is systematic risk.

Why the other options are wrong

- **A.** 2.7% is the approximate portfolio *variance* (0.027) quoted as if it were the standard deviation.
- **B.** 9.0% multiplies the average correlation by the average standard deviation ($0.30 \times 30\%$). The approximation multiplies the correlation by the average *variance*, and the square root is taken afterward.

Key takeaway For a large portfolio, $\sigma_P^2 \approx \bar{\rho}\bar{\sigma}^2$. Diversification removes unsystematic risk, but the average covariance (systematic risk) remains.

Reading 8: The Return and Risk of a Financial Portfolio. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/portfolio-standard-deviation/

Question 36 **Answer: B**

Utility rewards expected return and penalizes variance in proportion to the coefficient of risk aversion. Computing the utility of each fund (with returns and standard deviations in decimals and the standard deviation squared) shows that the balanced fund offers the best trade-off for this client.

$$U = E(r) - \tfrac{1}{2}(3)\sigma^2 = E(r) - 1.5\sigma^2$$

Fund	$E(r)$	σ^2	U
Northgate Growth	0.11	0.0400	$0.11 - 0.0600 = 0.0500$
Westbury Balanced	0.08	0.0144	$0.08 - 0.0216 = 0.0584$
Eastholm Income	0.06	0.0025	$0.06 - 0.00375 = 0.05625$

Westbury Balanced has the highest utility (5.84%).

Why the other options are wrong

- **A.** Northgate Growth has the highest expected return, but its large variance creates the biggest utility penalty ($1.5 \times 0.04 = 0.06$), leaving a utility of only 5.00%.
- **C.** Eastholm Income has the lowest risk and is the choice that results if the standard deviation is used instead of the variance in the penalty term. With the variance, its utility (5.625%) is slightly below that of the balanced fund.

Key takeaway Use σ^2 (in decimals) and the $\frac{1}{2}$ in the utility function; neither the highest return nor the lowest risk is automatically the best choice.

Reading 8: The Return and Risk of a Financial Portfolio. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/portfolio-standard-deviation/

Question 37 **Answer: A**

Under the CAPM, an asset's expected return equals the risk-free rate plus beta times the market risk premium. The market risk premium is given directly, so it is multiplied by beta without subtracting the risk-free rate again.

$$E(R_i) = R_f + \beta_i\,[E(R_M) - R_f] = 3\% + 0.8(6\%) = 3\% + 4.8\% = 7.8\%$$

Why the other options are wrong

- **B.** 5.4% treats 6% as the market *return* and subtracts the risk-free rate again: $3\% + 0.8(6\% - 3\%)$. The 6% is already the market risk premium.
- **C.** 4.8% is only the asset's risk premium, $0.8 \times 6\%$; the risk-free rate must be added.

Key takeaway Check whether the question gives the market return or the market risk premium before plugging into the CAPM.

Reading 8: The Return and Risk of a Financial Portfolio. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/portfolio-standard-deviation/

Question 38 **Answer: B**

Historical simulation is nonparametric: it uses actual past changes, so the scenarios automatically carry the fat tails, skewness and volatility clustering present in the data. A normal-distribution model tends to understate extreme outcomes.

Why the other options are wrong

- **A.** Reliance on the past is the main weakness of historical simulation; after a regime change, past data may no longer represent the future.
- **C.** Historical simulation can only reproduce outcomes that actually occurred in the lookback period; simulating conditions never seen before is an advantage of Monte Carlo simulation.

Key takeaway Historical simulation is nonparametric, captures fat tails and volatility clustering and is easy to explain; its limit is that it can only replay what actually happened.

Reading 9: Simulation of Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/simulation-of-financial-asset-prices-and-returns/

Question 39 **Answer: A**

Bootstrapping samples with replacement: after each draw the observation is returned to the dataset. An eight-quarter scenario needs eight draws, so the same observation could in principle be pulled on every one of them, although with a 1/40 chance per draw this is extremely unlikely.

Each scenario consists of 8 draws of a random integer from 1 to 40, each mapped to one historical quarterly return. The probability that a given observation is chosen on any single draw is $1/40$, and the maximum number of appearances in one scenario equals the number of draws, 8.

Why the other options are wrong

- **B.** "Only once" describes sampling *without* replacement. Bootstrap resampling replaces each observation, so repeats are possible.
- **C.** Forty is the size of the dataset; a scenario of eight quarters contains only eight draws.

Key takeaway Sampling with replacement: repeats are possible, capped by the number of draws in the scenario.

Reading 9: Simulation of Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/simulation-of-financial-asset-prices-and-returns/

Question 40 **Answer: C**

Monte Carlo scenarios are generated from distributions chosen by the analyst, so the method can simulate hypothetical or extreme conditions that never appeared in the historical record. Historical simulation and bootstrapping can only reuse what actually happened.

Why the other options are wrong

- **A.** Monte Carlo usually has heavy data requirements, because volatilities, correlations and other parameters must be estimated.
- **B.** Monte Carlo models are more complex and harder to communicate than methods that replay or resample actual history.

Key takeaway Monte Carlo is forward-looking: it can model scenarios with no historical precedent.

Reading 9: Simulation of Financial Asset Prices and Returns. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/simulation-of-financial-asset-prices-and-returns/

Question 41 **Answer: B**

The dependent variable is the one whose variation the model explains, here the yield spread. The interest coverage ratio does the explaining, so it is the independent (explanatory) variable. Observations of many issuers at one date are cross-sectional data, which a simple linear regression can use as readily as time-series data.

Why the other options are wrong

- **A.** An explanatory variable is the independent variable. Making the coverage ratio the dependent variable reverses the roles set by the analyst's question.
- **C.** Data on many subjects at one point in time are cross-sectional data, and a regression can be run on them. Time-series data are not required.

Key takeaway Dependent variable (Y): explained, endogenous, predicted. Independent variable (X): explanatory, exogenous, predicting. The research question decides which is which.

Reading 10: Applications of Simple Linear Regression in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/least-squares-regression/

Question 42 **Answer: A**

The residuals fan out as floor area increases: their spread (variance) grows with the independent variable. A residual variance that is not constant across observations is heteroskedasticity, a violation of the homoskedasticity assumption.

Why the other options are wrong

- **B.** The plot shows residuals centered on zero with a changing spread; nothing in it points specifically to a nonnormal shape, and normality is judged from the shape of the residuals' distribution. How their spread changes with X is a separate question.
- **C.** Non-independence (autocorrelation) shows up as residuals that are correlated with one another, such as a recurring seasonal pattern over time. A widening spread with X is a variance problem.

Key takeaway Residual spread widening with X = heteroskedasticity (non-constant residual variance).

Reading 10: Applications of Simple Linear Regression in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/least-squares-regression/

Question 43 **Answer: A**

A prediction interval is the predicted value plus or minus the critical t-value times the standard error of the forecast. A two-sided 90% interval leaves 5% in each tail, so with n − 2 = 30 degrees of freedom the critical value is 1.697.

- Predicted return: $\hat{Y} = 0.0040 + 0.6500(-0.015) = 0.0040 - 0.00975 = -0.00575$
- Half-width: $t_c \times s_f = 1.697 \times 0.028 = 0.0475$
- Interval: -0.00575 ± 0.0475, that is, -0.0533 to 0.0418

Calculator: `0.65` `[×]` `0.015` `[=]` gives 0.00975; `1.697` `[×]` `0.028` `[=]` gives 0.047516.

Why the other options are wrong

- **B.** This interval uses 1.310, the critical value with 10% in one tail. A two-sided 90% interval splits the 10% between the two tails, so each tail holds 5%.

- **C.** This interval is centered on $0.0040 + 0.00975 = 0.01375$, which drops the minus sign of the forecast change in the index.

Key takeaway Prediction interval $= \hat{Y} \pm t_c s_f$, with n − 2 degrees of freedom and α/2 in each tail. Keep the sign of the forecast X when computing $\hat{Y}$.

Reading 10: Applications of Simple Linear Regression in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/least-squares-regression/

Question 44 **Answer: B**

In the regression $(R_i - R_f) = b_0 + b_1(R_M - R_f) + \varepsilon$, the slope coefficient is the estimate of the asset's beta. The slope is 0.72, so beta lies between 0 and 1: the stock's excess returns tend to move less than one-for-one with the market risk premium.

$$(R_i - R_f) = -0.15 + 0.72\,(R_M - R_f) \;\Rightarrow\; \hat{\beta} = \hat{b}_1 = 0.72$$

Why the other options are wrong

- **A.** The negative number is the intercept, which is not beta. Beta is the slope, 0.72.
- **C.** A beta above 1 would require a slope above 1; the estimated slope is 0.72.

Key takeaway Beta = slope of the excess-return regression; the intercept is irrelevant to beta.

Reading 10: Applications of Simple Linear Regression in Finance. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/least-squares-regression/

Question 45 **Answer: C**

Fintech refers to the meeting of the finance and technology worlds. In investment management the developments of most interest are those that aid quantitative analysis, such as big data tools and machine learning. The term is also used more broadly for technology applied to financial services and for the firms that build it.

Why the other options are wrong

- **A.** Consumer payment and banking apps are one use of fintech. Limiting the term to them leaves out the investment tools, such as machine learning and big data processing, that matter most to analysts.
- **B.** Financial data science is the quantitative and qualitative analysis of financial information to gain insight into a financial question. Fintech is the technology that supports such work and other financial services, so the two terms are related but different.

Key takeaway Fintech is where finance meets technology; financial data science is the analysis that some of that technology makes possible.

Reading 11: Introduction to Financial Data Science. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/machine-learning-in-finance/

Question 46 **Answer: A**

Unstructured data lack a predefined, tabular organization; examples include social media content, voice recordings, pictures and sensor output. Because they are hard for a person to handle efficiently, analyzing them usually requires ML algorithms, AI or specialized code.

Why the other options are wrong

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- **B.** Structured data are held in tables of rows and columns in a database (e.g., balance sheet data, market price records). Audio, images and social media posts are not in that form.
- **C.** Semi-structured data cannot be stored in tables but are tagged so they can be stored in an organized way, such as HTML code. The examples given have no such tagging structure.

Key takeaway Social media, voice, pictures, video and sensor data are unstructured.

Reading 11: Introduction to Financial Data Science. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/machine-learning-in-finance/

Question 47 **Answer: B**

Curation is the processing step that assures data quality: errors are corrected and bad or missing observations are adjusted for before analysis. The other two statements attach the description of one processing step to the name of a different step.

Why the other options are wrong

- **A.** Archiving data and accessing them later describes storage. Search means querying data that are already stored to locate the information needed.
- **C.** Moving data from their source or a storage medium to the analytical tool is transfer. Capture is the collection of data and their conversion into a usable form in preparation for analysis.

Key takeaway Learn the five processing methods as pairs that are easy to mix up: capture vs. transfer, and storage vs. search. Curation is always about data quality.

Reading 11: Introduction to Financial Data Science. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/machine-learning-in-finance/

Question 48 **Answer: B**

Supervised learning works with labeled data: every input record comes with its known output, the machine learns how the outputs relate to the inputs, and the fitted model is then used on new data to forecast outcomes. Here the ratios are the inputs, the default outcome is the labeled output, and the model is applied to new applicants, so it is supervised learning.

Why the other options are wrong

- **A.** Unsupervised learning receives unlabeled inputs only, with no target outputs; the machine uncovers structure and patterns on its own (e.g., customer segmentation, anomaly detection). The lender does supply outputs (default or not).
- **C.** Reinforcement learning models learn by trial and error, improving through feedback in the form of rewards or penalties. No reward system is described here.

Key takeaway Labeled inputs and outputs: supervised. No outputs: unsupervised. Rewards and penalties: reinforcement.

Reading 11: Introduction to Financial Data Science. Notes: credguild.com/cfa/level-1/notes/quantitative-methods/machine-learning-in-finance/

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