



CFA一级培训项目

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Quantitative methods (1)

- ➤ When analyzing investment returns , which of the following statements is correct?
 - A. The geometric mean will exceed the arithmetic mean for a series with non-zero variance.
 - B. The geometric mean measures an investment's compound rate of growth over multiple periods.
 - C. The arithmetic mean accurately estimates an investment's terminal value over multiple periods.

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Quantitative methods (1)

> Solution: B.

The geometric mean compounds the periodic returns of every period, giving the investor a more accurate measure of the terminal value of an investment.





Quantitative methods (2)

- An analyst finds that the probability of stock A outperform the market is 65%. What is the odds for of the stock A underperform the market?
 - A. 0.5385
 - B. 0.4615
 - C. 1.8571
- Solution: A.

The probability of underperform = 1-65% = 35%The odds for of underperform = 35%/65% = 0.5385

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Quantitative methods (3)

- ➤ A perpetual preferred stock makes its first quarterly dividend payment of \$2.00 in five quarters. If the required annual rate of return is 6% compounded quarterly, the stock's present value is closest to:
 - A. \$31.
 - B. \$126.
 - C. \$133.

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Quantitative methods (3)

> Solution: B.

The value of the perpetuity one year from now is calculated as: PV = A / r where PV is present value, A is annuity, and r is expressed as a quarterly required rate of return because the payments are quarterly.

PV = \$2,00/(0.06/4) = \$133.33,

The value today is (where FV is future value)

 $PV = FV_N(1+r)^{-N}$

 $PV = $133.33(1+0.015)^{-4} = $125.62 \approx $126.$





Quantitative methods (4)

- ➤ An analyst gathered some information of a portfolio: mean return=9.8%, Sharpe ratio=18.2%. If the risk-free rate of return is 3.0 percent, the coefficient of variation of this portfolio is:
 - A. 2.03.
 - B. 1.93.
 - C. 3.81.

Solution: C.

Sharpe ratio = [E(R_p) - r_f]/ σ . Based on the Sharpe ratio formula, $\sigma = [E(R_p) - r_f]/ \text{ Sharpe ratio, } \sigma = (9.8\%-3\%) / 18.2\%=37.36\%,$ $CV = \frac{\sigma}{\bar{\chi}} = 37.36\% / 9.8\% = 3.81.$

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Quantitative methods (5)

- Shawn Choate is thinking about his graduate thesis. Still in the preliminary stage, he wants to choose a variable of study that has the most desirable statistical properties. The statistic he is presently considering has the following characteristics:
 - The expected value of the sample mean is equal to the population mean.
 - The variance of the sampling distribution is smaller than that for other estimators of the parameter.
 - As the sample size increases, the standard error of the sample mean rises and the sampling distribution is centered more closely on the mean.

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Quantitative methods (5)

Select the best choice. Choate's estimator is:

- A. Unbiased, efficient, and consistent.
- B. Efficient and consistent.
- C. Unbiased and efficient.

> Solution: C.

A consistent estimator is one for which the accuracy of the parameter estimate increases as the sample size increases. Unbiasedness represents that the variance of its sampling distribution is smaller than all the other unbiased estimators of the parameter you are trying to estimate. An unbiased estimator is also efficient if the variance of its sampling distribution is smaller than all the other unbiased estimators of the parameter you are trying to estimate.





Quantitative methods (6)

- > Jonkson and Toark are tossing a coin with two tries. If Jonson gets both head-sides, he will receive \$4 from Toark, otherwise, he will acquire nothing. What is Jonkson's expected earnings?
 - A. 1.0
 - B. 1.5
 - C. 2.0
- Solution: A

The probability that Jonkson will succeed twice in 2 trails is:

$$C_n^k p^k (1-p)^{n-k} = C_2^2 \times \left(\frac{1}{2}\right)^2 \left(1 - \frac{1}{2}\right)^{2-2} = 0.25$$

The expected earning is: $4 \times 0.25 + 0 \times (1 - 0.25) = 1$

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Quantitative methods (7)

> An investor plans to invested securities A and B. The covariance matrix between the two securities is as the following:

| | Α | В |
|---|----------|----------|
| А | 289 (%²) | 200 (%²) |
| В | 200 (%²) | 225 (%²) |

Calculate the correlation coefficient of two securities?

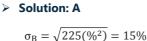
- A. 0.78.
- B. 0.40.
- C. 0.62.

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$$\sigma_{A} = \sqrt{289(\%^{2})} = 17\%$$

 $\rho = \text{Cov}(A, B)/(\sigma_A \sigma_B) = 0.02/(0.17 \times 0.15) = 0.7843.$





Quantitative methods (8)

- An analyst gathered the information about a stock's return and price, and found that the return of the stock followed normal distribution, the distribution of stock's price was most likely:
 - A. symmetric.
 - B. right skewed.
 - C. left skewed.
- Solution: B.

If the return of a stock is normal distribution, then the price of the stock must be lognormal, lognormal is right skewed.

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Quantitative methods (9)

- ➤ The probability of event A is 0.2 and the probability of event B is 0.6. If the two events are independent, the probability that neither event A nor B will occur equals to:
 - A. 0.15.
 - B. 0.32.
 - C. 0.68.

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Quantitative methods (9)

Solution: B.

When two events are independent, we have $P(AB)=P(A)P(B)=0.2\times0.6=0.12$ and P(A or B)=P(A)+P(B)-P(AB)=0.2+0.6-0.12=0.68. P(A or B) means the probability of at least one of two events will occur, therefore the joint probability of both event A and B will not happen equals to 1- P(A or B)=0.32.





Quantitative methods (10)

➤ The return of a portfolio is normally distributed with a mean return of 7% and risk of 9%. What is the probability that this portfolio's return is between 16% and 25%:

| x or z | 0 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.90 | 0.8159 | 0.8186 | 0.8212 | 0.8238 | 0.8264 | 0.8289 | 0.8315 | 0.8340 | 0.8365 | 0.8389 |
| 1.00 | 0.8413 | 0.8438 | 0.8461 | 0.8485 | 0.8508 | 0.8531 | 0.8554 | 0.8577 | 0.8599 | 0.8621 |
| 1.10 | 0.8643 | 0.8665 | 0.8686 | 0.8708 | 0.8729 | 0.8749 | 0.8770 | 0.8790 | 0.8810 | 0.8830 |
| 1.90 | 0.9713 | 0.9719 | 0.9726 | 0.9732 | 0.9738 | 0.9744 | 0.9750 | 0.9756 | 0.9761 | 0.9767 |
| 2.00 | 0.9772 | 0.9778 | 0.9783 | 0.9788 | 0.9793 | 0.9798 | 0.9803 | 0.9808 | 0.9812 | 0.9817 |
| 2.10 | 0.9821 | 0.9826 | 0.9830 | 0.9834 | 0.9838 | 0.9842 | 0.9846 | 0.9850 | 0.9854 | 0.9857 |

- A. 14%.
- B. 29%.
- C. 45%.

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- > Solution: A.
 - $P(16\% < X < 25\%) = P\left(\frac{16\% 7\%}{9\%} < Z < \frac{25\% 7\%}{9\%}\right)$
 - P(Z > 1) = 0.8413
 - P(Z > 2) = 1 0.9772 = 0.0228
 - P(1 < Z < 2) = 1 0.8413 0.0228 = 0.1359 or
 - P(1 < Z < 2) = P(2) P(1) = 0.9772 0.8413 = 0.1359

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Quantitative methods (11)

- Compared to normal distribution, the minimum probability that observations lie within two standard deviations of the mean, without knowing the shape of the distribution is:
 - A. larger.
 - B. The same.
 - C. smaller.

> Solution: C.

Using the Chebyshev's inequality, the minimum proportion of observations that must lie within two standard deviations of the mean, regardless of the shape of the distribution is $1-(1/2)^2=75\%$. If the distribution is normal, the probability that observations lie within two standard deviations of the mean is larger than 95%.





Quantitative methods (12)

- > If the distribution of the population from which the samples are drawn is positively skewed, and given that the sample size is large, the sampling distribution of the sample means is most likely:
 - A. approximately normally distributed.
 - B. to have a variance equal to that of the entire population.
 - C. to have a mean smaller than the mean of the entire population.

> Solution: A.

The central limit theorem establishes that the sampling distribution of sample means will be approximately normal, will have a mean equal to the population mean, and will have a variance equal to the population variance divided by the sample size.

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Quantitative methods (13)

- ➤ Which of the following can most likely reject null hypothesis?
 - A. Test statistic is as extreme or more extreme than critical value.
 - B. P-value is larger than the significance level.
 - C. Power of test is greater than a pre-specified probability.

Solution: A

The null hypothesis should be rejected when the test statistic is **as extreme or more extreme than** the critical value or the P-value is smaller than the significance level.

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Quantitative methods (14)

- For a one-tailed test, we indicates a rejection point, $z_{\alpha r}$ using the symbol for the test statistic with a subscript " α " indicating:
 - A. the specified probability of a Type I error.
 - B. the specified probability of a Type II error.
 - C. the specified power of a test.

> Solution: A

For a one-tailed test, we indicate a rejection point using the symbol for the test statistic with a subscript indicating the specified probability of a Type I error, α ; for example, z_{α} . For a two-tailed test, we indicate $z_{\alpha/2}$. To illustrate the use of rejection points, suppose we are using a z-test and have chosen a 0.05 level of significance.





Quantitative methods (15)

- Which of the following can most likely make the confidence interval narrower?
 - A. The reliability factor gets smaller.
 - B. The population standard deviation gets larger.
 - C. The sample size gets smaller.

> Solution: A.

The width of the confidence interval is 2 × reliability factor × standard error, and $Standard\ error=Standard\ deviation/\sqrt{n}$. Therefore, a smaller reliability factor can make the confidence interval narrower.

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Quantitative methods (16)

- ➤ An analyst gathered 48 monthly returns from 2015 to 2018 and calculated the average return of a mutual fund is 10.5% and the monthly standard deviation of the returns is 18%. If returns are approximately normal, what is the 95% confidence interval for the mutual fund return next month?
 - A. 24.78% to 45.78%.
 - B. -45.78% to 24.78%.
 - C. 5.41% to 15.59%.

> Solution: C.

Here μ and σ are 10.5% and 18%, respectively.

Thus, the 95% confidence interval for the return next month is:

 $10.5 \pm 1.96(18/\sqrt{48}) = 5.41\%$ to 15.59%.

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Quantitative methods (17)

An analyst gathered the following information about a common stock investment:

| | Date | Amount | |
|----------------|-----------------|--------|--|
| Stock purchase | 1 January 2017 | 50.00 | |
| Stock sale | 1 February 2017 | 51.00 | |

The bond equivalent yield on the common stock investment using actual/365 is closest to:

- A. 20.00%
- B. 26.26%
- C. 24.73%



Quantitative methods (17)

Solution: C

Because HPY = (51 - 50)/50 = 2% and t=31, the bond equivalent yield can be calculated as following:

$$(1 + \frac{BEY}{2})^2 - 1 = EAR = (1 + HPY)^{\frac{365}{t}} - 1 = (1 + 2\%)^{\frac{365}{31}} - 1 = 0.2626$$

$$\Rightarrow$$

$$BEY = (\sqrt{EAR + 1} - 1) \times 2 = 24.73\%$$

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Quantitative methods (18)

- ➤ On 1 January 2004, the value of an investor's portfolio is \$99,000. The investor plans to donate \$8,000 to charity organization and pay \$2,000 to his insurance account on 31 December 2004, but meanwhile he does not want the year-end portfolio value to be below \$99,000. If the expected return on the existing portfolio is 13% with a variance of 0.0225, the safety-first ratio that would be used to evaluate the portfolio based on Roy's criterion is closest to:
 - A. 0.193.
 - B. 0.328.
 - C. 0.471.

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Quantitative methods (18)

> Solution: A

Roy's safety-first criterion states that the optimal portfolio minimizes the probability that the return of the portfolio falls below some minimum acceptable level. This minimum acceptable level is called the "threshold" level. Symbolically, Roy's safety-first criterion can be stated as: Maximize the SFR where SFR = $[E(R_p) - R_L] / \sigma$, Where:

 R_n = portfolio return;

 R_L = threshold level return

 $R_1 = 10,000/99,000 = 10.1\%$

SFR = $(13\%-10.1\%)/(0.0225^{-1/2}) = 0.0301 / 0.15 = 0.193$





Quantitative methods (19)

- ➤ Jurgen is considering two strategies to invest his one million dollars into 100 different assets. Strategy 1 consists of buying all the 100 different assets with equal weights and gets a mean return, while strategy 2 consists of randomly choosing one asset and gets its entire return. Assuming identify independent distribution, Which strategy has a lower volatility?
 - A. Strategy 1.
 - B. Strategy 2.
 - C. Both.

> Solution: A

Assume the sample variance is σ^2 , according to central limit theorem, the variance of sample mean distribution = σ^2/n , which is smaller.

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Quantitative methods (20)

- ➤ An investor will invest \$700 at the beginning of the following 8 years. If the stated annual rate of the investment is 7% and the investment is compounded monthly, the future value of the investment 8 years later is:
 - A. \$7,691.97.
 - B. \$7,764.84.
 - C. \$7,466.25.

> Solution: B.

The period interest rate is the effective annual rate, which is $(1+7\%/12)^{12} - 1=7.229\%$. Use the financial calculator, switch to BGN mode first, input N=8, I/Y=7.229, PMT=700, PV=0, CPT FV=-7764.84.

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Quantitative methods (21)

➤ A fund manager invests a project. His initial investment is \$200million. Six month later, the total value of this project becomes \$150million, and he invests another \$50million into this project immediately. At the end of the year, he withdraws all of fund from this project with \$250million. What is the fund manager's time-weighted rate of return and money-weighted rate of return?

Money-weighted rate of return Time-weighted rate of return

A. 79.13% 83.75% B. 79.13% -6.25% C. 0 -6.25%



Quantitative methods (21)

> Solution: C.

 $HPY_1 = (150-200)/200 = -25\%, HPY_2 = (250-200)/200 = 25\%,$ TWRR = (1-25%)(1+25%) -1 = -6.25%,

 $MWRR(IRR), CF_0 = -200, CF_1 = -50, CF_2 = 250 CPT IRR = 0$

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Quantitative methods (22)

- ➤ A bill's effective annual return is 15%, if it is continuously compounded.

 What is its effective annual return, if it is monthly compounded?
 - A. 14.88%.
 - B. 14.91%.
 - C. 14.97%

> Solution: B.

The stated annual return of the bill is: r=ln(1+15%)If it is monthly compounded, its EAR= $(1+r/12)^{12}$ -1=14.91%

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Quantitative methods (23)

- ➤ If a distribution is left skewed, the relationship of its mode, median and mean would be:
 - A. mean < median < mode.
 - B. mode < median < mean.
 - C. median < mean < mode.

> Solution: A.

Positively/right skewed: mean > median > mode;

Negatively/left skewed: mean < median < mode.





Quantitative methods (24)

- ➤ Which of the following is not a momentum oscillator?
 - A. MACD.
 - B. Stochastic oscillator.
 - C. Bollinger Bands.

> Solution: C.

Bollinger Bands are price-based indicators, not momentum oscillators, which are constructed so that they oscillate between a high and a low or around 0 or 100.

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Portfolio (1)

- Which of the following is not consistent with a risk-budgeting approach to portfolio management?
 - A. Limiting the beta of the portfolio to 0.75.
 - B. Allocating investments by their amount of underlying risk sources or factors.
 - C. Limiting the amount of money available to be spent on hedging strategies by each portfolio manger.



Portfolio (1)

Solution: C.

Risk budgeting is any means of allocating a portfolio by some risk characteristics of the investments. This approach could be a strict limit on beta or some other risk measure or an approach that uses risk classes or factors to collocate investments. Risk budgeting does not prohibit hedging, although hedging is available as an implementation tool to support risk budgeting an overall risk governance.

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Portfolio (2)



- ➤ Which of the following least likely affect the result of Strategic asset allocation:
 - A. Combining the constraints and objective articulated in the IPS and long-term capital market expectations regarding the asset classes.
 - B. The risk tolerance of investor and behavior bias.
 - C. The decision to deliberately deviate from the policy exposures to systematic risk factors with the intent to add value based on forecasts of the near-term returns of those asset classes.

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Portfolio (2)

Solution: C

The decision to deliberately deviate from the policy exposures to systematic risk factors with the intent to add value based on forecasts of the near-term returns of those asset classes, is the characteristic of tactical asset allocation. Both of capital market expectations and risk tolerance could be a factor to influence the result of strategic asset allocation.





> The following table shows data for the stock of AAPL and a market index.

| Expected return of market index | R _M | 10% |
|---|--------------------------|-------|
| Risk free rate | R_{f} | 6% |
| Standard deviation of market index returns | σ_{M} | 15% |
| Covariance coefficient between JKU and market index | Cov _(AAPL, M) | 0.027 |

What is the required rate of return of AAPL according to CAPM?

- A. 12.0%
- B. 13.4%
- C. 15.0%

> Solution: A.

$$\begin{split} \beta_{AAPL} &= Cov_{(AAPL,M)}/\sigma_{M}^{2} = 0.027/(0.15^{2}) = 1.2 \;; \\ E(R_{AAPL}) &= R_{f} + \beta_{AAPL} \times (R_{M} - R_{f}) = 6\% + 1.2 \times (10\% - 5\%) = 12.0\% \end{split}$$

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Portfolio (4)



| | Systematic Risk | Unsystematic Risk |
|-------------|-----------------|-------------------|
| Portfolio 1 | 7% | 3% |
| Portfolio 2 | 6% | 6% |
| Portfolio 3 | 9% | 1% |

- A. Portfolio 1.
- B. Portfolio 2.
- C. Portfolio 3.

> Solution: C.

The portfolio's expected return only compensates systematic risk. Therefore, Portfolio 3 would require the highest expected return.

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Portfolio (5)



- With respect to the capital asset pricing model, if the expected return for a security is equal to 15% and its β is 1.7, assuming the expected return is 10% of market and risk-free rate is 1%, the security is:
 - A. undervalued.
 - B. properly valued.
 - C. overvalued.

> Solution: C

The required rate of return of the security is $16.3\% = 1\% + 1.7 \times (10\% - 1\%)$ according to CAPM and the expected return is 15%, which is lower than its required return. Therefore, this security is overvalued relative to the Security Market Line (SML). The risk-return relationship lies below the SML.





- ➤ With respect to capital market theory, an investor's optimal portfolio is the combination of a risk–free asset and a risky asset with the highest:
 - A. expected return.
 - B. indifference curve.
 - C. capital allocation line slope.

> Solution: B.

Investors will have different optimal portfolios depending on their indifference curves. The optimal portfolio for each investor is the one with the highest utility; that is where the CAL is tangent to the individual investor's highest possible indifference curve.

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Portfolio (7)

- ➤ A portfolio on the capital market line with the returns greater than the returns on the market portfolio represents a(n):
 - A. lending portfolio.
 - B. borrowing portfolio.
 - C. unachievable portfolio.

Solution: B.

As one moves further to the right of point M on the capital market line, an increasing amount of borrowed money is being invested in the market portfolio. This means that there is negative investment in the risk–free asset, which is referred to as a leveraged position in the risky portfolio.

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Portfolio (8)



- In the context of capital market theory and the capital asset pricing model (CAPM), the average investor is least likely to be compensated for assuming risk that can be:
 - A. Reduced by diversification.
 - B. Related to interest rate volatility.
 - C. Related to changes in macroeconomic variables.

> Solution: A.

Unsystematic risk (risk that can be diversified away) is not rewarded. Systematic risk is the risk for which investors are compensated. Systematic risk is that part of total risk that is correlated with the market and related to changes in macroeconomic variables (such as changes in interest rate volatility). Standard deviation of returns of the market portfolio is a measurement of systematic risk.





- Stock X and Stock Y have the same level of total risk. Stock X has twice the systematic risk of Stock Y and half its non-systematic risk. Stock X's expected return will most likely be:
 - A. lower than the expected return of Stock Y.
 - B. the same as the expected return of Stock Y.
 - C. higher than the expected return of Stock Y.

> Solution: C.

Because Stock X has a higher systematic risk level compared with Stock Y, its expected return will be higher than that of Stock Y.

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Portfolio (10)



- ➤ There are plenty of measures to evaluate the performance of portfolios.

 Which of the following performance measures uses the same measure of risk as M-squared?
 - A. Jensen's alpha
 - B. Treynor ratio
 - C. Sharpe ratio

> Solution: C

M-squared and Sharpe ratio use total risk as the measure of risk. Treynor ratio and Jensen's alpha use systematic risk as the measure of risk.

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Portfolio (11)



- ➤ Which of the following is most likely associated with an investor's ability to take risk rather than the investor's willingness to take risk?
 - A. The investor has a long investment time horizon.
 - B. Safety of principal is very important to the investor.
 - C. The investor believes earning excess returns on stocks is a matter of luck.

> Solution: A.

Investment time horizon is an objective factor that measures the investor's ability to take risk.



Portfolio (12)

- ➤ In defining asset classes as part of the strategic asset allocation decision, pairwise correlations within asset classes should generally be:
 - A. equal to correlations among asset classes.
 - B. lower than correlations among asset classes.
 - C. higher than correlations among asset classes.

> Solution: C.

An asset class should contain homogeneous assets paired correlations of securities that would be high within an asset class, but should be lower versus securities in other asset classes.

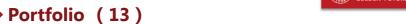
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- > If a company has a one-day 10% Value at Risk of \$10 million, this means:
 - A. 10% of the time the firm is expected to lose at least \$10 million in one day.
 - B. 90% of the time the firm is expected to lose at least \$10 million in one day.
 - C. 10% of the time the firm is expected to lose no more than \$10 million in one day.

> Solution: A.

The VaR measure indicates the probability of a loss of at least a certain level in a time period.

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Portfolio (14)



- ➤ A benefit of distributed ledger technology (DLT) favoring its use by the investment industry is its:
 - A. Scalability of underlying systems.
 - B. Ease of integration with existing systems.
 - C. Streamlining of current post-trade processes.

> Solution: C.

DLT has the potential to streamline the existing, often complex and labor intensive post-trade processes in securities markets by providing close to real-time trade verification, reconciliation, and settlement, thereby reducing related complexity, time, and costs.

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- > In the use of machine learning (ML):
 - A. Some techniques are termed "black box" due to data biases.
 - B. Human judgment is not needed because algorithms continuously learn from data.
 - C. Training data can be learned too precisely, resulting in inaccurate predictions when used with different datasets.

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> Solution: C.

Overfitting occurs when the ML model learns the input and target dataset too precisely. In this case, the model has been "over trained" on the data and is treating noise in the data as true parameters. An ML model that has been overfitted is not able to accurately predict outcomes using a different dataset and may be too complex.

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