2020 FRM Part II

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风险管理与投资管理

2020 年 2 月

4. Risk Management and Investment Management

4.1. Key Point: Factor Theory

4.1.1. 重要知识点

4.1.1.1. Factors and CAPM

- **Factors definition**
  - Factors are to assets what nutrients are to food.
  - Factor risks are driving force behind assets' risk premiums.
  - Factors matter, not assets.
  - Assets are bundles of factors.
  - Different investors need different risk factors.
- **Factor risks are bad.**
- **Factor theory specifies different types of underlying factor risk.**
- **CAPM and its assumptions**
  - Assumptions:
    - ✓ No transaction costs.
    - ✓ Assets are infinitely divisible.
    - ✓ The absence of personal income tax.
    - ✓ An individual can not affect the price of a stock by his trading.
    - ✓ Investors' decision making solely depend on terms of returns and standard deviations of the returns.
    - ✓ Unlimited short sales are allowed.
    - ✓ Unlimited lending and borrowing at the riskless rate.
    - ✓ All investors have identical expectations.
    - ✓ All assets are marketable.
  - CAPM risk premiums depend only on the assets' beta, which means only one factor – market portfolio.
  - Shortcomings of CAPM come from its assumptions.
  - Basic intuitions of the CAPM still holds true: risk premiums are compensation for investors' losses during bad times.
- Efficient Market Theory and how markets can be inefficient. Losses during bad times are compensated for by high returns.

4.1.2. 基础题

Q-1. Which of the following concepts most likely to be a factor?

A. US Treasury Bill.

B. Corporate Bonds.

C. Private Equity.

D. Hedge Fund.

Q-2. Andrew Ang develops an analogy, writing "factors are to assets what nutrients are to food." His theory of factor risk premiums includes each of the following three ideas EXCEPT which is not in the theory?

A. Assets are bundles of factors (just as most foods are combinations of nutrients)

B. Factors do matter but asset classes do not (just as healthy eating is about the nutrients not the labels)

C. Different investors prefer and/or need different factors (just as different people have different nutritional needs)

D. Because factors represent different good times, most investors should seek exposure to most investable factors (just as most people should seek a balanced diet of most nutrients)

Q-3. In regard to the capital asset pricing model (CAPM),which of the following assumptions (or implications) of the CAPM is a genuine success such that it is both true in practice and useful to us?

A. Information is costless and available to all investors: technology has reduced information friction to roughly zero

B. Risk is factor exposure: The risk of an individual asset is measured in terms of the factor exposure of that asset

C. Investors have mean-variance utility: asset owners care only about means (which they like) and variances (which they dislike)

D. Investors have homogeneous expectations: investors have identical expectations with respect to the necessary inputs into the portfolio decision

Q-4. Which of the following statements is a limitation of the capital asset pricing model (CAPM)?

A. Investors have a single period investment horizon.

B. The market is not transparent

C. Investors have heterogeneous expectations.

D. People need to pay a liquidity premium to do transaction.

Q-5. Assets that have big profits during periods of low market returns have:

A. Low betas and low risk premiums.

B. Low betas and high risk premiums.

C. High betas and low risk premiums.

D. High betas and high risk premiums.

Q-6. Which behavior does asset payoffs and "bad times" events would most likely perform?

A. The expected payoff of an asset in bad times is unrelated to the asset's expected return, because arbitrageurs eliminate any expected return potential.

B. The expected payoff of an asset in bad times is unrelated to the asset's expected return, because it depends on investor preferences.

C. The higher the expected payoff of an asset in bad times, the higher the asset's expected return.

D. The higher the expected payoff of an asset in bad times, the lower the asset's expected return

4.2. Key Point: Factors

4.2.1. 重要知识点

4.2.1.1. Factors

- **Factors Investing**
  - Value Investing and Value Premium
  - A value-growth strategy is long value growth stocks and short growth stocks.
  - A value stock has a high book-to-market ratio, a growth stock has a low book-to-market ratio.
- **Macroeconomic risk factors**
  - Economic growth, inflation, and volatility are the three most important macro factors that affect asset prices.
  - Rather than level of a factor, it is the unanticipated change to a risk factor that affects asset prices.
- **Mitigating volatility risk and Challenges**
  - Two basic approaches to mitigate volatility risk:
    - ✓ Invest in less-volatile assets like bonds.
    - ✓ Buy volatility protection in the derivatives market.
- **Dynamic risk factor**
  - The Fama-French model explains asset returns on three dynamic factors:
    - ✓ Traditional CAPM market risk factor.
    - ✓ A factor that captures size effect (SMB or small cap minus big cap)
    - ✓ A factor that captures value/growth effect (HML or high book-to-market value minus low book-to-market value.
- **Value and momentum investment strategies**

- A momentum strategy is long “winners” and short “losers”.
- Value strategy is a negative feedback strategy, momentum is a positive feedback strategy.
- Momentum strategies are subject to crashes.

➢ **Different strategy based on different situations and needs.**

4.2.2. 基础题

Q-7. A high book-to-market value ratio is indicative of a:

A. Small-cap stock.
B. Large-cap stock.
C. Value stock.
D. Growth stock

Q-8. Which of the following statements is TRUE about the momentum factor?

A. Momentum is a negative feedback strategy which is inherently stabilizing
B. The momentum factor is observed in equities but is NOT observed in bonds, commodities and real estate
C. Momentum investing by definition is an anti-value strategy; correlations between HML and WML are strongly negative
D. The cumulated profits on momentum strategies have been an order of magnitude larger than cumulated profits on either size or value

Q-9. Which of the following is a factor in the Fama-French three-factor model?

A. Investment Growth.
B. The small capitalization minus big capitalization risk factor.
C. The winners minus losers risk factor.
D. Inflation.

Q-10. Which of the following investment strategies destabilizes asset prices most?

A. A value strategy.
B. A size investment strategy.
C. A momentum investment strategy.
D. Value, momentum, and size strategies all stabilize asset prices.

4.3. Key Point: Alpha and the Low-Risk Anomaly

4.3.1. 重要知识点

4.3.1.1. Alpha and the Low-Risk Anomaly

- Alpha, tracking error, information ratio, Sharpe ratio.
  - Alpha is the average performance of an investor in excess of their benchmark.
  - The standard deviation of excess return is known as tracking error.
  - Information ratio is the ratio of alpha to its tracking error.

    $$\mathrm{IR} = \frac{\alpha}{\sigma_\alpha}$$
  - If an investor is using risk free rate as benchmark, Sharpe ratio is:

    $$\mathrm{SR} = \frac{\mathrm{E}(\mathrm{R_P}) - \mathrm{R_f}}{\sigma_\mathrm{P}}$$
- Ideal Benchmark should be:
  - Well defined.
  - Tradable.
  - Replicable
  - Adjusted for risk.
- Grinold's fundamental law of active management suggests a tradeoff between the number of investment bets placed(breadth) and the required degree of forecasting accuracy(information coefficient)

  $$\mathrm{IR} \approx \mathrm{IC} \times \sqrt{\mathrm{BR}}$$
- Factor Regression
  - Traditional CAPM, APT, Fama-French.
- Application of Factor Regression:
  - Style analysis
- Alphas for nonlinear strategies
- Risk Anomaly
  - Risk anomaly – the stocks with low betas and low volatilities have high returns.
  - Explanations:
    - ✓ Data mining
    - ✓ Leverage constraints
    - ✓ Agency Problems
    - ✓ Preferences
- A comprehensive explanation for risk anomaly is elusive.

4.3.2. 基础题

Q-11. Which of the following statements is incorrect concerning the low-risk anomaly?

A. The low-risk anomaly conflicts with the CAPM.

B. The firms with higher beta perform indifferently with the lower beta firms.

C. The low-risk anomaly point to a negative relationship between risk and reward.

D. The low-risk anomaly suggests that low-beta stocks will outperform high-beta stocks.

Q-12. Which of the following statements is not true regarding benchmark?

A. A benchmark should be well-defined.

B. A benchmark should be replicable.

C. A benchmark should be equally applied to all risky assets irrespective of their risk exposure.

D. A benchmark should be tradeable.

Q-13. Following Grinold's fundamental law of active management, one should find:

A. sector allocation is the most important factor in active management.

B. to maximize the information ratio, active investors need to either have high-quality predictions or place a large number of investment bets in a given year.

C. a small number of investment bets decreases the chances of making a mistake and, therefore, increases the expected investment performance.

D. investors should focus on increasing only their predictive ability relative to stock price movements.

Q-14. Why would an investor include multiple factors in a regression study?

I. To attempt to improve the adjusted R^2 measure.

II. To search for a benchmark that is more representative of a portfolio's investment style.

III. To increase the tests of statistical significance.

A. I only.

B. Both I and III.

C. Both I and II.

D. I, II, and III.

Q-15. Regarding of the risk anomaly, which of the following characteristics is a possible reason?

A. Investor preferences.

B. The presence of highly leveraged retail investors.

C. Lack of short selling constraints for institutional investments.

D. Lack of tracking error constraints for institutional investments.

4.4. Key Point: Portfolio Construction

4.4.1. 重要知识点

4.4.1.1. Portfolio Construction

- Portfolio Construction Techniques
  - Screens
  - Stratification
  - Linear Programming
  - Quadratic Programming

4.4.2. 基础题

Q-16. Which statement about risk control in portfolio construction is correct?

A. Quadratic programming allows for risk control through parameter estimation but generally requires many more inputs estimated from market data than other methods require.

B. The screening technique provides superior risk control by concentrating stocks in selected sectors based on expected alpha.

C. When using the stratification technique, risk control is implemented by overweighting the categories with lower risks and underweighting the categories with higher risk.

D. When using the linear programming technique, risk is controlled by selecting the portfolio with the lowest level of active risk.

4.5. Key Point: Portfolio Risk Measures

4.5.1. 重要知识点

4.5.1.1. Portfolio Risk Measures

- Portfolio VaR
  - VaR for uncorrelated positions (ρ=0):

$$\mathrm{VaR_p} = \sqrt{\mathrm{VaR_1^2} + \mathrm{VaR_2^2}}$$

  - Undiversified VaR (ρ=1)

$$\mathrm{VaR_p} = \mathrm{VaR_1} + \mathrm{VaR_2}$$

- Marginal VaR, Incremental VaR and Component VaR
  - $\mathrm{MVaR_A} = \frac{\partial \mathrm{VaR_P}}{\partial \mathrm{V_A}}$

$$= z_\alpha \times \frac{\mathrm{Cov}(R_A, R_P)}{\sigma_P}$$

$$= z_\alpha \times \rho_{A,P} \times \sigma_A$$

$$= z_\alpha \times \beta_{A,P} \times \sigma_P$$

$$= \frac{\text{VaR}_P}{V_P} \times \beta_{A,P}$$

- Incremental $\text{VaR}_A \approx \text{MVaR}_A \times W_A(\text{any amount})$

  Component $\text{VaR}_A = \text{MVaR}_A \times V_A$
- Global Minimum Portfolio: $\text{MVaR}_i = \text{MVaR}_j$
- Optimal Portfolio:

$$\frac{\text{Position i return} - \text{risk free rate}}{\text{MVaR}_i} = \frac{\text{Position j return} - \text{risk free rate}}{\text{MVaR}_j}$$

➢ Liquidity Duration: It is an approximation of the number of days necessary to dispose of a portfolio's holdings without a significant market impact.

$$\text{LD} = \frac{\text{number of shares of a security}}{\text{desired max daily volume}(\%) \times \text{daily volume}}$$

4.5.2. 基础题

Q-17. A wealth management firm has a portfolio consisting of USD 48 million invested in US equities and USD 35 million invested in emerging markets equities. The 1-day 95% VaR for each individual position is USD 1.2 million. The correlation between the returns of the U.S. equities and emerging markets equities is 0.36. While rebalancing the portfolio, the manager in charge decides to sell USD 8 million of the US equities to buy USD 8 million of the emerging markets equities. At the same time, the CRO of the firm advises the portfolio manager to change the risk measure from 1-day 95% VaR to 10-day 99% VaR. Assuming that returns are normally distributed and that the rebalancing does not affect the volatility of the individual equity positions, by how much will the portfolio VaR increase due to the combined effect of portfolio rebalancing and change in risk measure?

A. USD 4.529 million

B. USD 6.258 million

C. USD 7.144 million

D. USD 7.223 million

Q-18. The bank's trading book consists of the following two assets:

Asset	Annual Return	Volatility of Annual Return	Value
A	10%	25%	100
B	20%	20%	50

Correlation (A, B) = 0.2

How would the daily VaR at 99% level change if the bank sells 50 worth of asset A and buys 50 worth of asset B?

Assume there are 250 trading days in a year. ($\mu_{1-\text{day}} = 0$)

A. 0.2286
B. 0.4578
C. 0.7705
D. 0.7798

Q-19. A portfolio manager is evaluating the risk profile for a portfolio of stocks. Currently, the portfolio is valued at CAD 20 million and contains CAD 5 million in stock XYZ. The standard deviation of returns of stock XYZ is 15% annually and that of the overall portfolio is 12% annually. The correlation of returns between stock XYZ and the portfolio is 0.3. Assuming the portfolio manager uses a 1-year 99% VaR and that returns are normally distributed, what is the estimated component VaR of stock XYZ?

A. CAD 162,972
B. CAD 234,906
C. CAD 523,350
D. CAD 632,152

Q-20. Consider a USD 1 million portfolio with an equal investment in two funds, Alpha and Omega, with the following annual return distributions:

Fund	Expected Return	Volatility
Alpha	5%	20%
Omega	7%	25%

Assuming the returns follow the normal distribution and that there are 252 trading days per year, what is the maximum possible daily 95% Value-at-Risk (VaR) estimate for the portfolio?($\mu_{1-\text{day}} = 0$)

A. USD 16,587
B. USD 23,316
C. USD 23,459
D. USD 32,973

Q-21. A portfolio consists of two positions. The VaR of the two positions are $10 million and $20million. If the returns of the two positions are not correlated. The VaR of the portfolio would be closest to:

A. $5.48million
B. $15.00million
C. $22.36million
D. $25.00million

Q-22. A portfolio is composed of two securities and has the following characteristics:

Investment in X:	USD 1.8 million
Investment in Y:	USD 3.2 million
Volatility of X:	8%
Volatility of Y:	4%
Correlation between X and Y:	15%

The portfolio diversified VaR at the 95% confidence level is closest to:

A. $14,074

B. $206,500

C. $404,740

D. $340,725

Q-23. The manager of the Beta Balance fund, a balanced global equity and fixed-income portfolio, believes that globalization is causing the correlations of equity and fixed-income returns across different markets to rise over time. He decides to adjust the correlations in his VaR analysis for the coming year to reflect the higher correlations he expects. If his expectation turns out to be incorrect, what is the most likely result?

A. There will be no impact on the portfolio because VaR is only a prediction, and portfolio return depends on what actually happens.

B. The portfolio return will be lower than it should have been, given the expected risk level, because asset allocation will not have been optimal.

C. The risk of the portfolio will have been understated because of the incorrect estimate of correlation among global markets.

D. The portfolio return will be higher than it should have been, given the expected risk level, because of the higher correlation among asset classes

The next two questions are based on the following information.

A risk manager assumes that the joint distribution of returns is multivariate normal and calculates the following risk measures for a 2-asset portfolio:

Asset	Position	Individual VaR	Marginal VaR	VaR Contribution
1	USD 100	USD 23.3	0.176	USD 17.6
2	USD 100	USD 46.6	0.440	USD 44.0
Portfolio	USD 200	USD 61.6		USD 61.6

Q-24. If asset 1 is dropped from the portfolio, what will be the reduction in portfolio VaR?

A. USD 15.0

B. USD 38.3

C. USD 44.0

D. USD 46.6

Q-25. Let $\beta_i = \rho\sigma_i/\sigma_p$, where ρ denotes the correlation between the return of asset i and the return of the portfolio, σ_i is the volatility of the return of asset i and σ_p is the volatility of the return of the portfolio. What is β_2?

A. 0.714

B. 1.429

C. 1.513

D. Cannot determine from information provided.

Q-26. Consider the following two asset portfolios:

Asset	Position Value (In Thousands of USD)	Return Standard Deviation (%)	Beta
A	400	3.60	0.5
B	600	8.63	1.2
Portfolio	1,000	5.92	1

Calculate the component VaR of asset A and marginal VaR of asset B, respectively, at the 95% confidence level.

A. USD 21,773 and 0.1306

B. USD 21,773 and 0.1169

C. USD 19,477 and 0.1169

D. USD 19,477 and 0.1306

Q-27. A risk analyst is evaluating the risks of a portfolio of stocks. Currently, the portfolio is valued at EUR 200 million and contains EUR 15 million in stock A. The standard deviation of returns of stock A is 16% annually and that of the overall portfolio is 21% annually. The correlation of returns between stock A and the portfolio is 0.37. Assuming the risk analyst uses a 1-year 99% VaR and that returns are normally distributed, how much is the component VaR of stock A?

A. EUR 2.066 million

B. EUR 2.326 million

C. EUR 5.582 million

D. EUR 7.327 million

Q-28. A portfolio manager currently holds 8,000 shares of GF Inc. in a particular portfolio. The daily volume of GF shares traded on the stock exchange is 2,000. Additionally, on any

given day, the portfolio manager wishes to trade no more than 25% of the daily trading volume of GF. Which of the following amounts is closest to the liquidity duration of GF in this portfolio?

A. 0.06
B. 0.40
C. 6.50
D. 16.00

Q-29. A portfolio manager wants to invest a small amount of new money that has recently come into a fund. The fund is benchmarked to an index and, rather than adding a new holding, the manager is considering increasing the holdings of one of the four assets described in the following table:

Asset	Expected Return	Beta to the Index	Beta to the Portfolio
A	12%	1.2	0.90
B	10%	0.7	0.90
C	10%	0.6	0.85
D	8%	0.3	1.10

The portfolio manager wants to select the asset that has the lowest marginal VaR as long as its Treynor ratio is at least 0.1. Assuming the risk free rate is 2%, which asset should the portfolio manager select?

A. Asset A
B. Asset B
C. Asset C
D. Asset D

4.6. Key Point: Portfolio Risk Management

4.6.1. 重要知识点

4.6.1.1. tracking error

- Relevant return is the tracking error (TE), which is excess return of asset over benchmark.

$$TE = R_P - R_B$$

$$TEV = \sigma(e) = \sqrt{\sigma_P^2 - 2\rho\sigma_P\sigma_B + \sigma_B^2}$$

4.6.1.2. policy mixed VaR

- the policy mix risk is the risk of a dollar loss owing to the policy mix selected by the fund.

4.6.1.3. Surplus at Risk

- Surplus (S) is the difference between the value of the assets (A) and the liabilities (L). The change in the surplus (ΔS) is equal to the change in assets (ΔA) minus the change in liabilities (ΔL). If we normalize by the assets, the return on the surplus is given by:

  $$\text{Expected surplus} = A \times (1 + R_A) - L \times (1 + R_L)$$

  $$\sigma_{\text{Surplus}} = \sqrt{A^2\sigma_A{}^2 + L^2\sigma_L{}^2 - 2A\sigma_A L\sigma_L \rho}$$

  $$\text{Surplus at risk} = z_\alpha \times \sigma_{\text{Surplus}}$$

- Funding risk should be measured as the potential shortfall in surplus over the horizon, this is sometimes called surplus at risk.

4.6.1.4. Risk Budgeting

- **Budget Risk across Asset Classes**: Budgeting risk across asset classes means selecting assets whose combined VaRs are less than the total allowed. The budgeting process would examine the contribution each position makes to the portfolio VaR.
- **Budget Risk across Active Managers**: For allocating across active managers, if the tracking errors of the managers are independent of each other, it can be shown that the optimal allocation is achieved with the following formula:

$$\text{weight of portfolio managed by manager i} = \frac{IR_i \times (\text{Portfolio's tracking error volatility})}{IR_P \times (\text{Manager's tracking error volatility})}$$

  - For a given group of active managers, the weights may not sum to one. The remainder of the weight can be allocated to the benchmark, which has no tracking error.

4.6.2. 基础题

Q-30. You are evaluating the performance of Valance, an equity fund designed to mimic the performance of the Russell 2000 Index. Based upon the information provided below, what is the best estimate of the tracking error of Valance relative to the Russell 2000 Index?

Annual volatility of Valance:	35%
Annual volatility of the Russell 2000 Index:	40%
Correlation between Valance and the Russell 2000 Index:	0.90

A. 3.1%

B. 17.5%

C. 39.6%

D. 53.2%

Q-31. On January 1, 2006, a pension fund has assets of EUR 100 billion and is fully invested in the equity market. It has EUR 85 billion in liabilities. During 2006, the equity market declined by 15% and yields increases by 1.2%. If the modified duration of the liabilities is 12.5, what is the pension fund's surplus on December 31, 2006?

A. EUR 15.00 billion
B. EUR 12.93 billion
C. EUR 12.75 billion
D. EUR 12.57 billion

Q-32. At the end of 2007, Chad & Co.'s pension had USD 350 million worth of assets that were fully invested in equities and USD 180 million in fixed-income liabilities with a modified duration of 14. In 2008, the wide spread effects of the subprime crisis hit the pension fund, causing its investment in equities to loss 50% of their market value. In addition, the immediate response from the government – cutting interest rates – to salvage the situation, caused bond yields to decline by 2%. What was the change in the pension fund's surplus in 2008?

A. USD -55.4 million
B. USD -124.6 million
C. USD -225.4 million
D. USD -230.4 million

Q-33. An analyst reports the following fund information to the advisor of a pension fund that currently invests in government and corporate bonds and carries a surplus of USD 10 million.

Pension Assets	Assets	Liabilities
Amount (in USD million)	100	90
Expected Annual Growth	6%	7%
Modified Duration	12	10
Annual Volatility of Growth	10%	5%

To evaluate the sufficiency of the fund's surplus, the advisor estimates the possible surplus values at the end of one year. The advisor assumes that annual returns on assets and the annual growth of the liabilities are jointly normally distributed and their correlation coefficient is 0.8. The advisor can report that, with a confidence level of 95%, the surplus value will be greater than or equal to:

A. USD -11.4 million
B. USD -8.3 million
C. USD -1.7 million

D. USD 0 million

Q-34. Which of the following statements about risk management in the pension fund industry is correct?

A. A pension plan's total VaR is equal to the sum of its policy-mix VaR and active management VaR.

B. Pension fund risk analysis does not consider performance relative to a benchmark.

C. In most defined-benefit pension plans, if liabilities exceed assets, the shortfall does not create a risk for the plan sponsor.

D. From the plan sponsor's perspective, nominal pension obligations are similar to a short position in a bond.

Q-35. A company's pension fund is established as a defined benefit plan, and therefore the board must consider funding risk. Which of the following statements about the pension fund's funding risk is correct?

A. The longer the horizon for expected payouts, the lower the funding risk.

B. Decreases in interest rates will reduce funding risk.

C. The funding risk has been effectively transferred to the employees.

D. Funding risk represents the true long-term risk to the plan sponsor.

Q-36. The AT&T pension fund has an allocation of $60 million devoted to U.S. equities. Now the fund wants to allocate this $60 million to two managers. This is equivalent to a risk budget of $3.948 million. Each manager has a TEV of 6%. The fund managers have different capabilities, their IRs are 0.6(manager 1) and 0.4(manager 2).To achieve an exact TEV of 4% and information ratio of 0.725, the weight for each should be?

A. Manager1: 55.17%, Manager2: 36.78%

B. Manager1: 55.17%, Manager2: 44.83%

C. Manager1: 36.78%, Manager2: 55.17%

D. Insufficient information to calculate

4.7. Key Point: Performance Measurement and Evaluation

4.7.1. 重要知识点

4.7.1.1. Portfolio Performance Measurement

- Performance Analysis

$$SR = \frac{E(R_P) - R_f}{\sigma_P}$$

$$TR = \frac{E(R_P) - R_f}{\beta_P}$$

$$\alpha_P = E(R_P) - \{R_F + \beta_P[E(R_M) - R_F]\}$$

$$IR = \frac{E(R_P) - E(R_B)}{\sigma_{TE}}$$

$$\sigma_{TE}^2 = \sigma_{(P-B)}^2 = \sigma_P^2 + \sigma_B^2 - 2\rho\sigma_P\sigma_B$$

- Performance Attribution
  - Refers to the set of techniques used by performance analysts to identify the sources of value addition to the portfolio. For example, how much of the performance (excess returns above benchmark) is attributable to the selection of the right asset classes or how much is attributable to selection of right sector or security within an asset class.

4.7.2. 基础题

Q-37. A manager who obtains an average alpha of 2.5% with a tracking-error of 4%. If he wish the result to be significant to 95%, how many years it is necessary to observe the portfolio return?

A. 8.8 years
B. 9.8 years
C. 10.8 years
D. 11.8 years

Q-38. Based on 60 monthly returns, you estimate an actively managed portfolio alpha = 1.24% and standard error of alpha = 0.1278%. The portfolio manager wants to get due credit for producing positive alpha and believes that the probability of observing such a large alpha by chance is only 1%. Calculate the t-statistic, and based on the estimated t-value would you accept (or reject) the claim made by the portfolio manager.

A. t = 9.70, accept
B. t = 2.66, accept
C. t = 2.66, reject
D. t = 9.70, reject

Q-39. Consider the following performance date for a sample period:

	Portfolio (P)	Market (M)
Average return	15%	9%

Beta	1.6	1.0
Standard deviation	32%	24%
Tracking error	20%	0
Risk free rate	—	3%

If the Portfolio (P) is one sub-portfolio that is combined with several other portfolios into a large investment fund, which is the appropriate risk-adjusted performance measure (RAPM) and what is its value for Portfolio (P)?

A. Sharpe of 25.0%

B. Treynor of 6.0%

C. Treynor of 7.5%

D. Information ratio of 12.0%

Q-40. Consider the following performance date for a sample period:

	Portfolio (P)	Market (M)
Average return	15%	8%
Beta	0.9	1.0
Standard deviation	27%	15%
Tracking error	20%	0
Risk free rate	—	2%

If the Portfolio (P) represents the active portfolio to be optimally mixed with the passive portfolio, which is the appropriate risk-adjusted performance measure (RAPM) and what is its value for Portfolio (P)?

A. Sharpe of 0.4815

B. Jensen (alpha) of 0.0760

C. Treynor of 14.44%

D. Information ratio of 0.380

Q-41. Rick Masler is considering the performance of the managers of two funds, the HCM Fund and the GRT Fund. He uses a linear regression of each manager's excess returns (r_i) against the excess returns of a peer group (r_B):

$r_i = a_i + b_i \times r_B + e_i$

The information he compiles is as follows:

Fund	Initial Equity	Borrowed Funds	Total Investment Pool	a_i	b_i
HCM	USD 100	USD 0	USD 100	0.0150	0.9500
				(t = 4.40)	(t = 12.1)
GRT	USD 500	USD 3,000	USD 3,500	0.0025	3.4500
				(t = 0.002)	(t = 10.20)

Based on this information, which of the following statements is correct?

A. The regression suggests that both managers have greater skill than the peer group.

B. The a_i term measures the extent to which the manager employs greater or lesser amounts of leverage than do his/her peers.

C. If the GRT Fund were to lose 10% in the next period, the return on equity (ROE) would be -60%.

D. The sensitivity of the GRT fund to the benchmark return is much higher than that of the HCM fund.

Q-42. A portfolio has an average return over the last year of 13.2%. Its benchmark has provided an average return over the same period of 12.3%. The portfolio's standard deviation is 15.3%, its beta is 1.15, its tracking error volatility is 6.5% and its semi-standard deviation is 9.4%. Lastly, the risk-free rate is 4.5%. Calculate the portfolio's information Ratio (IR).

A. 0.569

B. 0.076

C. 0.138

D. 0.096

Q-43. Portfolio Q has a beta of 0.7 and an expected return of 12.8%. The market risk premium is 5.25%. The risk-free rate is 4.85%. Calculate Jensen's Alpha measure for Portfolio Q.

A. 7.67%

B. 2.70%

C. 5.73%

D. 4.27%

Q-44. A risk manager runs a performance attribution analysis on an actively managed portfolio using a selected benchmark. The weights and performance of the different market sectors within the portfolio and the benchmark are given below:

	Benchmark		Portfolio	
Market Sector	Weight	Annual Return	Weight	Annual Return
Equity	20%	8%	40%	6%
Fixed Income	50%	4%	55%	5%
Cash	30%	2%	5%	3%

What conclusion can be drawn from the data above by using common performance attribution analysis?

A. The portfolio outperforms the benchmark primarily because of the contribution of asset allocation.

B. The portfolio outperforms the benchmark primarily because of the contribution of security selection within market sectors.

C. The portfolio underperforms the benchmark primarily because of the contribution of asset allocation.

D. The portfolio underperforms the benchmark primarily because of the contribution of security selection within market sectors.

4.8. Key Point: Hedge Fund Strategy

4.8.1. 重要知识点

4.1.1.1. Hedge Fund Trading Strategy

- Equity long/short strategy: go long and short similar securities to exploit mispricing-decreases market risk and generates alpha.
- Global macro strategy: makes leveraged bets on anticipated price movements in broad equity and fixed-income markets, interest rates, foreign exchange, and commodities.
- Emerging markets strategy: invests in developing countries' securities or sovereign debt.
- Fixed-income arbitrage strategy: long/short strategy that looks for pricing inefficiencies between various fixed-income securities.
- Convertible arbitrage strategy: investor purchases a convertible bond and sells the underlying stock.
- Merger arbitrage strategy: involves purchasing shares in a target firm and selling short shares in the purchasing firm.
- Distressed investing strategy: purchase bonds of distressed company and sell short the stock, antic bating that the shares will eventually be worthless.
- Fund of hedge funds: perform screening and due diligence of other funds. Fees can be extensive, and the due diligence does not always identify fraud. A key advantage is diversification benefit without large capital commitment.

4.8.2. 基础题

Q-45. Which of the following statements about convertible arbitrage hedge fund strategies is correct?

A. Credit risk plays only a minor role in convertible arbitrage hedge funds.

B. Investing in convertible arbitrage does not require an understanding of liquidity considerations as the market for convertible securities is sufficiently liquid today.

C. Gamma trading entails significant directional exposure to the equity markets.

D. Re-hedging after significant moves of the underlying stock price is the essence of gamma trading.

Q-46. Identify the risks in a convertible arbitrage strategy that takes long positions in convertible bonds hedged with short positions in Treasuries and the underlying stock.

A. Short implied volatility

B. Long duration

C. Long stock delta

D. Positive gamma

Q-47. George Smith, a hedge fund manager, has just established a short position in short-term Swiss government bonds that are currently yielding 3.5% and a long position in short-term Italian government bonds that are yielding 4.2%. Smith believes the market has underestimated the probability that the Swiss Franc will appreciate relative to the euro. Which of the following hedge fund strategies is most similar to Smith's strategy?

A. Pair trading strategy.

B. Managed futures strategy.

C. Global macro strategy.

D. Event-driven strategy.

Q-48. A fund of hedge funds combines a mix of strategy sectors, managers, and styles, and therefore fund of funds risk managers need to understand the common attributes of hedge fund strategies. Which of the following statements is incorrect?

A. Equity market neutral funds aim to generate returns that have low correlation with the overall equity market and to insulate their portfolios from broad market risk factors.

B. Convertible arbitrage funds typically purchase securities that are convertible into the issuer's stock and simultaneously short the underlying stock. These funds earn returns in part form gamma trading on the stock's volatility.

C. Merger arbitrage funds buy the stock of an acquisition target company and simultaneously short the bidding company's stock. These funds have large exposure to deal risk.

D. Equity short-selling funds sell stocks not currently owned by the seller in order to take a directional bet that the stock price will decline. These funds tend to be uncorrelated with traditional long-only equity portfolios.

Q-49. EACH of the following makes it difficult to evaluate the performance of hedge funds EXCEPT for:

A. Liquidity risk: Hedge funds tend to hold more illiquid assets, such that compensation for illiquidity may mistakenly appear to be alpha

B. Tail risk: Some hedge fund strategies will earn consistent profits for a period, appearing to be high reward per unit of risk, but are exposed to tail risk; e.g., writing deep OTM puts

C. Incentive structure: carried interest fee creates a circularity in the evaluation model that is difficult to overcome

D. Instability of risk attributes: As hedge funds have greater leeway to invest opportunistically, their factor loading and risk profile changes rapidly

4.9. Key Point: Risk Management of Hedge Fund

4.9.1. 重要知识点

4.1.1.2. Hedge Fund Risk

- Liquidity Risk
  - More liquid assets should exhibit less serial autocorrelation than illiquid assets.
  - A Q-statistic is used as a summary measure of the overall statistical significance of autocorrelations.
  - This create two biases: Low correlations; Low volatility
- Style Drift
  - Changes in the risk factor exposures
  - Changes in the overall risk of the fund
- Phase-Locking Phenomenon

4.9.2. 基础题

Q-50. Every year Business Week reports the performance of a group of existing equity mutual funds, selected for their popularity. Taking the average performance of this group of funds will create

A. Survivorship bias only

B. Selection bias only

C. Both survivorship and selection bias

D. Instant-history bias only

Q-51. A factor analysis of returns for hedge funds employing a equity market-neutral strategy produces strongly positive performance information for the strategy (for example,

impressive Sharpe ratios). However, the analysis is guilty of neglecting the effects of survivorship bias. If the problem is survivorship bias, which of the following criticisms of the methodology is best?

A. The sample is too small
B. The historical window is too short
C. Risk metrics needs to be included along with return metrics
D. Past performance is no guarantee of future performance

Q-52. A risk analyst at an investment bank is reviewing the way performance analysis of hedge funds and real estate funds have been conducted. Each year, whenever a hedge fund stops trading, the hedge fund is removed from the database of hedge funds. Also, because of the addition of new assets to the real estate fund, the liquidity of that asset category has improved each year and trading has become more frequent. Which of the following best describes the impacts these changes have historically had on hedge fund and real estate fund analyses performed using these databases?

A. The average Sharpe ratio of hedge funds is understated and the average Sharpe ratio of real estate funds has increased.
B. The average Sharpe ratio of hedge funds is overstated and the average Sharpe ratio of real estate funds has decreased.
C. The average volatility of hedge funds is overstated and the average volatility of real estate funds has decreased.
D. The average volatility of hedge funds is understated and the average volatility of real estate funds has increased.

Q-53. Which of the following statements are true?

I. Hedge fund manager compensation is often symmetric (i.e., a dollar of gain has the opposite impact on compensation as a dollar of loss), while the compensation of mutual fund managers is almost always asymmetric.
II. Leverage obtained through lines of credit increases the risk of a hedge fund more than leverage obtained by issuing debt, because unexpected cancellation of a line of credit by a lender during troubled times can force a fund to liquidate its positions in illiquid markets.
III. A hedge fund investor should pay performance-based compensation to the manager for producing alpha, but should not pay performance-based compensation to a hedge fund manager who has done well because the fund invests in risk factors that mirror the performance of his style or strategy, and the style or strategy has performed well.

IV. The lack of hedge fund transparency is particularly Problematic for investors with fiduciary responsibilities such as pension fund managers, and to secure funding from these investors, hedge fund managers often have to provide more information to these investors.

A. I, II, and IV only.
B. II, III, and IV only.
C. II and IV only.
D. I and III only.

Q-54. For a portfolio of illiquid assets, hedge fund managers often have considerable discretion in portfolio valuation at the end of each month and may have incentives to smooth returns by marking values below actual in high-return months and above actual in low-return months. Which of the following is not a consequence of return smoothing over time?

A. Higher Sharpe ratio
B. Lower volatility
C. Higher serial correlation
D. Higher market beta

Q-55. In performing due diligence on a potential investment manager, which of the following factors is the least important for the investor to consider?

A. Risk controls
B. Business model
C. Past performance
D. Investment process

Q-56. A due diligence specialist is evaluating the risk management process of a hedge fund in which his company is considering making an investment. Which of the following statements best describes criteria used for such an evaluation?

A. Because of the overwhelming importance of tail risk, the company should not invest in the fund unless it fully accounts for fat tail using extreme value theory at the 99.99% level when estimating VaR.
B. Today's best practices in risk management require that a fund employ independent risk service providers and that these service providers play important roles in risk-related decisions.
C. When considering a leveraged fund, the specialist should assess how the fund estimates risks related to leverage, including funding liquidity risks during periods of

market stress.

D. It is crucial to assess the fund's valuation policy, and in general if more than 10% of asset prices are based on model prices or broker quotes, the specialist should recommend against investment in the fund regardless of other information available about the fund.

Q-57. A due diligence specialist at an asset management firm is evaluating the risk management process of a hedge fund in which the firm is considering making an investment. Which of the following statements best describes appropriate criteria the specialist should use for such an evaluation?

A. The firm should ensure that the hedge fund allows direct, in-person communications with the fund's senior management or key decision makers at the fund.

B. Today's best practices in risk management require that a fund employ independent risk service providers and that these service providers play important roles in risk-related decisions.

C. When considering investing in a leveraged fund, the company should not invest in the fund unless the fund's gross leverage ratio is above the peer group average.

D. It is crucial to assess the fund's valuation policy, and in general if more than 10% of asset prices are based on model prices or broker quotes, the specialist should recommend against investment in the fund.

Q-58. When measuring risk in hedge funds that hold illiquid assets using monthly data, certain biases can create a misleading picture. For example, these hedge funds might have the appearance of low systematic risk. Which of the following represents an appropriate means of correction?

A. Account for negative serial correlation of returns by first differencing the data when extrapolating risk to longer time horizons.

B. Account for positive serial correlation of returns by aggregating the data.

C. Use regressions with fewer lags of the market factors and sum the coefficients across lags.

D. Use regressions with additional lags of the market factors and sum the coefficients across lags.

SOLUTIONS

1. Solution: A

Assets, including corporate bonds, private equity, and hedge funds, are not considered factors themselves, but contain many factors, such as equity risk, interest rate risk, volatility risk, and default risk.

Some assets, like equities and government bonds, can be thought of as factors themselves. Factors may also include the market (a tradable investment factor), interest rates, or investing styles (including value/growth, low volatility, or momentum).

2. Solution: D

There are three similarities between food and assets:

1. Factors matter, not assets.
2. Assets are bundles of factors.
3. Different investors need different risk factors.

3. Solution: B

Here is a summary of the successes of CAPM ("ideas it gets right"):

1. Don't hold an individual asset, hold the factor.
2. Each investor has his own optimal exposure of factor risk.
3. The average investor holds the market.
4. The factor risk premium has an economic story.
5. Risk is factor exposure.
6. Assets paying off in bad times have low risk premiums.

4. Solution: A

The CAPM does not assume uniform taxes and transaction costs; it assumes there are no taxes or transaction costs (i.e., frictionless markets). The other limiting assumptions of the CAPM include:

1. Investors only have financial wealth.
2. Investors have mean-variance utility.
3. Investors have a single period investment horizon.
4. Investors have homogeneous (identical) expectations.
5. All investors are price takers.

5. Solution: A

Assets that have losses during periods of low market returns have high betas (high sensitivity to market movements), which indicates they are risky and, therefore, should have high risk premiums. Low beta assets have positive payoffs when the market performs poorly, making them valuable to investors. As a result, investors do not require high risk premiums to hold these assets.

6. Solution: D

The higher the expected payoff of an asset in bad times, the lower the assets expected return. Assets that have a positive payoff in bad times are valuable to hold, leading to high prices and, therefore, low expected returns.

7. Solution: C

A company's book value per share is equal to total assets minus total liabilities all divided by shares outstanding. It indicates, on a per-share basis, what a company would be worth if it liquidated its assets and paid off its liabilities. Value stocks have high book-to-market ratios while growth stocks have low book-to-market ratios.

8. Solution: D

Momentum is a positive feedback strategy

Momentum is observed in every asset class: we observe it in international equities, commodities, government bonds, corporate bonds, industries and sectors, and real estate.

Momentum returns are not the opposite of value returns: Value is a negative feedback strategy, where stocks with declining prices eventually fall far enough that they become value stocks. Then value investors buy them when they have fallen enough to have attractive high expected returns. Value investing is inherently stabilizing. Stocks with high past returns are attractive, momentum investors continue buying them, and they continue to go up! Positive feedback strategies are ultimately destabilizing and are thus subject to periodic crashes.

9. Solution: B

The Fama-French model includes the following three risk factors:

1. The traditional capital asset pricing model market risk factor.
2. A factor that captures the size effect (SMB).
3. A factor that captures the value/growth effect (HML).

The winners minus losers (WML) momentum factor was discovered by Jagadeesh and Titman in 1993 and was first put into use by Carhard to build a four-factor model.

10. Solution: C

Value and momentum are opposite each other in that value investing is inherently stabilizing. It is a negative feedback strategy where stocks that have fallen in value eventually are priced low enough to become value investments, pushing prices back up. Momentum is inherently destabilizing. It is a positive feedback strategy where stocks that have been increasing in value are attractive to investors, so investors buy them, and prices increase even more. Momentum can be

riskier than value or size investing in that it is more prone to crashes.

11. Solution: B

The low-risk anomaly violates the CAPM and suggests that low beta stocks will outperform high-beta stocks. This has been empirically proven with several studies. The CAPM points to a positive relationship between risk and reward, but the low-risk anomaly suggests an inverse relationship.

12. Solution: C

An appropriate benchmark should be well-defined, replicable, tradeable, and risk-adjusted. If the benchmark is not on the same risk scale as the assets under review, then there is an unfair comparison.

13. Solution: B

Grinold's fundamental law of active management focuses on the trade-off of high quality predictions relative to placing a large number of investment bets. Investors can focus on either action to maximize their information ratio, which is a measure of risk-adjusted performance. While sector allocation is a very important component of the asset allocation decision, Grinold focused only on the quality of predictions and the number of investment bets made.

14. Solution: D

An investor should consider adding multiple factors to the regression analysis to potentially improve the adjusted R^2 measurement, potentially increase the tests of statistical significance, and to search for a benchmark that is more representative of a portfolio's investment style.

15. Solution: A

Potential explanations for the risk anomaly include: the preferences of investors, leverage constraints on retail investors that drive them to buy pre-leveraged investments in the form of high-beta stocks, and institutional investor constraints like prohibitions against short selling and tracking error tolerance bands.

16. Solution: A

Quadratic programming requires many more inputs than other portfolio construction techniques because it entails estimating volatilities and pair-wise correlations between all assets in a portfolio. Quadratic programming is a powerful process, but given the large number of inputs it introduces the potential for noise and poor calibration given the less than perfect nature of most data.

On the other hand, the screening technique strives for risk control by including a sufficient number of stocks that meet the screening parameters and by weighting them to avoid concentrations in any particular stock. However, screening does not necessarily select stocks evenly across sectors and can ignore entire sectors or classes of stocks entirely if they do not pass the screen. Therefore, risk control in a screening process is fragmentary at best.

Stratification separates stocks into categories (for example, economic sectors) and implements risk control by ensuring that the weighting in each sector matches the benchmark weighting. Therefore, it does not allow for overweighting or underweighting specific categories.

Linear programming does not necessarily select the portfolio with the lowest level of active risk. Rather, it attempts to improve on stratification by introducing many more dimensions of risk control and ensuring that the portfolio approximates the benchmark for all these dimensions.

17. Solution: D

D is correct. The first step is to calculate the VaR of the original portfolio of two equities, U.S (u) and emerging markets (e). This can be derived by using the following equation:

$\mathrm{VaR_p} = \sqrt{\mathrm{VaR_u^2} + \mathrm{VaR_e^2} + 2\rho \times \mathrm{VaR_u} \times \mathrm{VaR_e}}$, where ρue is the correlation coefficient.

(i) Initial position: The portfolio 1-day 95% VaR (before the rebalancing) is therefore:

$$\mathrm{VaR_p} = \sqrt{1.2^2 + 1.2^2 + 2 \times 0.36 \times 1.2 \times 1.2} = \text{USD } 1.979\text{million}$$

(ii) Rebalanced position: 1-day 95% VaR: After the rebalance, the market value of the position in the U.S. equities is reduced by 8/48 = 0.1667, so VaR_u is now equal to (1 - 0.1667)×(USD 1.2 million) = USD 1.0 million. Meanwhile the market value for the position in the emerging market equities has increased by 8/35 = 0.2286 so that VaR_e is now (1 + 0.2286)× (USD 1.2 million) = USD 1.474 million. Hence the 1-day 95% VaR of the new portfolio (after rebalancing) = USD 2.058 million and is calculated as follows:

$$\mathrm{VaR_p} = \sqrt{1.474^2 + 1^2 + 2 \times 0.36 \times 1.474 \times 1} = \text{USD } 2.058\text{million}$$

(iii) Next, convert the 1-day 95% VaR to 10-day 95% VaR:

10-day 95% VaR = (1-day 95% VaR) × sqrt(10)/1 = 2.058 x 3.162278 = USD 6.508 million.

(iv) Finally, convert the 10-day 95% VaR to 10-day 99% VaR:

10-day 99% VaR = (10-day 95% VaR) × (2.326/1.645) = 6.508 x 1.4140 = USD 9.202 million. The question is to compare the original 1-day 95% VaR (USD 1.979m) to the new rebalanced 10-day 99% VaR (USD 9.202). Thus, VaR will increase by (9.202 – 1.979) million, or USD 7.223 million. Thus, D is correct.

18. Solution: B

$$\sigma_p = \sqrt{\omega_1^2\sigma_1^2 + \omega_2^2\sigma_2^2 + 2\rho\omega_1\sigma_1\omega_2\sigma_2}$$

$$\sigma_{previous}^{1-year} = \sqrt{(\frac{2}{3})^2 \times (25\%)^2 + (\frac{1}{3})^2 \times (20\%)^2 + 2 \times 0.2 \times \frac{1}{3} \times \frac{2}{3} \times 20\% \times 25\%} = 0.191485$$

$$\sigma_{now}^{1-year} = \sqrt{(\frac{1}{3})^2 \times (25\%)^2 + (\frac{2}{3})^2 \times (20\%)^2 + 2 \times 0.2 \times \frac{1}{3} \times \frac{2}{3} \times 20\% \times 25\%} = 0.170783$$

$$\sigma_{previous}^{1-year} = \sigma_{previous}^{1-day} \times \sqrt{250} \rightarrow \sigma_{previous}^{1-day} = \frac{0.191485}{\sqrt{250}} = 0.012111$$

$$\sigma_{now}^{1-year} = \sigma_{now}^{1-day} \times \sqrt{250} \rightarrow \sigma_{now}^{1-day} = \frac{0.170783}{\sqrt{250}} = 0.010801$$

$$VaR_{change} = z \times \sigma_{change} \times P = 2.33 \times (0.12111 - 0.010801) \times 150 = 0.4578$$

The trade will decrease the VaR by 0.4578.

19. Solution: C

Let Z(99%) represent the 99% confidence factor for the VaR estimate, which is 2.326, r_{XYZ} represent the correlation of stock XYZ with the portfolio, which is 0.3, and V_{XYZ} represent the value of stock XYZ, which is CAD 5 million.

Then, $MVaR_{XYZ} = Z(99\%) \times s_{XYZ} \times r_{XYZ} = 2.326 \times 15\% \times 0.3$

Component $VaR_{XYZ} = MVaR_{XYZ} \times V_{XYZ}$ = CAD 523,350

20. Solution: B

This question tests that the candidate understands correlation in calculating portfolio VaR. From the table, we can get daily volatility for each fund:

Fund Alpha volatility: $0.20 / 252^{0.5} = 1.260\%$

Fund Omega volatility: $0.25 / 252^{0.5} = 1.575\%$

Portfolio variance:

$0.5^2 \times 0.01259^2 + 0.5^2 \times 0.01574^2 + 2 \times 0.5 \times 0.5 \times 0.01259 \times 0.01574 \times \rho$

Portfolio volatility = (portfolio variance)$^{0.5}$

Portfolio volatility is least when $\rho = -1$ → portfolio volatility = 0.1575%

Portfolio volatility is greatest when $\rho = 1$ → portfolio volatility = 1.4175%

Therefore, 95% VaR maximum is 1.645 × 0.014175 × 1,000,000 = USD23, 316

21. Solution: C

For uncorrelated positions, the answer is the square root of the sum of the spread VaRs:

$$VaR_p = \sqrt{10^2 + 20^2} = \$22.36 \text{ million}$$

22. Solution: D

$$\text{VaR}_\text{p} = 1.65 \times \sqrt{(1.8 \times 0.08)^2 + (3.2 \times 0.04)^2 + 2 \times 15\% \times (1.8 \times 0.08) \times (3.2 \times 0.04)}$$
$$= 0.340754 \text{ Million}$$

23. Solution: B

An error in predicting correlation among asset classes will cause the calculation of optimal asset allocation to be in error as well. Thus, the asset allocation of the portfolio will be less than optimal. Any portfolio that does not have optimal asset allocation will, by definition, have returns that are too low for the expected level of risk. The risk of the portfolio will be overstated because the estimates of correlation among markets were too high.

24. Solution: A

A is correct: The new portfolio VaR is that of asset 2 alone (USD 46.6), which implies a reduction in portfolio VaR of USD 61.6 - USD 46.6 = USD 15.0

25. Solution: B

Marginal $\text{VaR}_i = \beta_i \times$ Portfolio VaR / Portfolio Value

So, β_i = Marginal $\text{VaR}_i \times$ Portfolio Value/Portfolio VaR

$\beta_2 = 0.44 \times 200 / 61.6 = 1.429$

26. Solution: C

$$\text{VaR}_\text{p} = \alpha \times \text{portfolio standard deviation} \times \text{portfolio value}$$
$$= 1.645 \times 0.0592 \times \text{USD1,000,000} = \text{USD97,384}$$
$$\text{Component VaR}_\text{A} = \text{USD97,384} \times 0.5 \times \frac{400}{1000} = \text{USD19,477}$$
$$\text{Marginal VaR}_\text{B} = \text{USD97,384} \times 1.2/\text{USD1,000,000} = 0.1169$$

27. Solution: A

$$\beta = \rho \frac{\sigma_\text{i}}{\sigma_\text{P}} = 0.37 \times \frac{16\%}{21\%} = 0.2819$$

$$\text{Component VaR} = 0.2819 \times 2.326 \times 21\% \times 15\text{million} = 2.066\text{million}$$

28. Solution: D

Liquidity duration is an approximation of the number of days necessary to dispose of a portfolio's holdings (of a particular share in this case) without a significant market impact. It is calculated as: $8{,}000 / (0.25 \times 2{,}000) = 16.$

29. Solution: C

$$\mathrm{TR_A} = \frac{12\% - 2\%}{1.2} = 0.0833$$

$$\mathrm{TR_B} = \frac{10\% - 2\%}{0.7} = 0.1143$$

$$\mathrm{TR_C} = \frac{10\% - 2\%}{0.6} = 0.1333$$

$$\mathrm{TR_D} = \frac{(8\% - 2\%)}{0.3} = 0.2$$

Asset B, C, D have Treynor measures greater than 0.1. Of these, C has the lowest marginal VaR as its Beta to the portfolio is the lowest.

30. Solution: B

$\sigma_{\mathrm{TE}}^2 = \sigma_{(R_p - R_B)}^2 = \sigma_{\mathrm{P}}^2 + \sigma_{\mathrm{B}}^2 - 2\rho\sigma_{\mathrm{P}}\sigma_{\mathrm{B}} = 0.35^2 + 0.4^2 - 2 \times 0.35 \times 0.4 \times 0.9 = 0.0305$

$\sigma_{\mathrm{TE}} = 17.5\%$

31. Solution: C

The surplus at the beginning of the year was 100 – 85 = 15 billion EUR. During the year, the equity portfolio declines 15%, or 15 billion EUR, to 85 billion EUR. Due to the increase in yields, the dollar value of the liabilities decrease by 12.5 × 1.2% × 85 billion EUR, or 12.75. Thus at the end of the year, the assets are worth (100-15)=85 billion EUR and the liabilities (85 - 12.75) = 72.25 billion. The surplus is the 12.75, a decrease of 2.25 billion EUR.

32. Solution: C

The change in the pension fund's surplus for the year 2008 is equal to the initial surplus S_0 at the end of 2007 less the ending surplus S_1 at the end of 2008.

The initial surplus is calculated as S_0 = 350 – 180 = 170.

Next we have to calculate the surplus at the end of 2008. Given the 50% decline in the equity market, the new level of assets A_1 at the end of 2008 is equal to:

(1 – 0.5) × 350 = 175

The new level of liabilities L_1 can be calculated as:

L_1 = (1 – 14 × (-0.02)) × 180 = 230.4

Therefore the 2008 surplus S_1 is equal to $A_1 – L_1$ = 175 – 230.4 = -55.4 (which implies the pension fund is actually in a deficit situation at the end of 2008). The change in surplus for 2008 is hence $S_1 – S_0$ = -55.4 – 170 = -225.4 million.

33. Solution: C

The lower bound of the 95% confidence interval is equal to: Expected Surplus – (95% confidence factor × Volatility of Surplus). The required variables can be calculated as follows:

Variance of the surplus = $100^2 \times 10\%^2 + 90^2 \times 5\%^2 - 2 \times 100 \times 90 \times 10\% \times 5\% \times 0.8 = 48.25$

Volatility of the surplus = 6.94

The expected surplus = 9.7

Therefore, the lower bound of the 95% confidence interval = 9.7 – 1.645 × 6.94 = -1.725

34. Solution: D

Explanation: Liabilities at a pension fund are typically composed of accumulated benefit obligations, measured by the present value of all pension benefits owed to employees discounted by an approximate interest rate. When liabilities consist mostly of nominal payments, their value in general will behave like a short position in a long-term bond.

35. Solution: D

Explanation: The time horizon of payouts does not eliminate funding risk. In fact it is the mismatch between assets and liabilities that creates funding risk. In an low interest rate environment the value of equities will rise, however the value of the liabilities are likely to increase more thereby exacerbating funding risk. Funding risk is transferred to employees with a defined contribution plan. Immunizing the portfolio, essentially matching duration of assets and liabilities, will reduce funding risk.

36. Solution: A

$$\omega_1 = \frac{IR_1/TEV_1}{IR_P/TEV_P} = \frac{0.6/6\%}{0.725/4\%} = 55.17\%$$

$$\omega_2 = \frac{IR_2/TEV_1}{IR_P/TEV_P} = \frac{0.4/6\%}{0.725/4\%} = 36.78\%$$

37. Solution: B

$$IR \approx \frac{t_{stat}}{\sqrt{T}} \rightarrow T = \left[\frac{t_{stat}}{IR}\right]^2 = \left[\frac{1.96}{2.5\%/4\%}\right]^2 = 9.8 year$$

38. Solution: A

$$t = \frac{alpha}{S.E(alpha)} = \frac{1.24\%}{0.1278\%} = 9.702$$

With 60 observations and such a large t value, you would have rejected H_0 (alpha = 0). The manager should receive credit for the statistically significant alpha.

39. Solution: C

$\text{Treynor(Portfolio)} = (15\% - 3\%)/1.6 = 7.5\%.$

40. Solution: D

$\text{Jensen (alpha)} = 15.0\% - [2.0\% + 0.90 \times (8.0\% - 2.0\%)] = 0.0760.$
$\text{Information ratio} = \text{alpha/tracking error} = 0.0760/20\% = 0.380$

41. Solution: D

Statement D is correct as can be seen from the b coefficient. It. is higher for GRT and lower for HCM. This indicates that the sensitivity of the GRT fund to the benchmark return is much higher than that of the HCM fund.

42. Solution: C

$$\text{IR}_\text{P} = \frac{13.2\% - 12.3\%}{6.5\%} = 0.138$$

43. Solution: D

Jensen's alpha is defined by:

$$\alpha_\text{P} = \text{E}(\text{R}_\text{P}) - \{\text{R}_\text{F} + \beta_\text{P}[\text{E}(\text{R}_\text{M}) - \text{R}_\text{F}]\} = 0.128 - [0.0485 + 0.7 \times 0.0525] = 4.27\%$$

44. Solution: A

$\text{R}_\text{P} = 40\% \times 6\% + 55\% \times 5\% + 5\% \times 3\% = 5.3\%$

$\text{R}_\text{B} = 20\% \times 8\% + 50\% \times 4\% + 30\% \times 2\% = 4.2\%$

Asset allocation:(40%-20%)×8%+(55%-50%)×4%+(5%-30%)×2%=1.3%

Security selection:(6%-8%)×40%+(5%-4%)×55%+(3%-2%)×5%=-0.2%

45. Solution: D

Since small movement of an underlying can be captured by delta, large movement should be captured by both delta and gamma. Therefore, re-hedging after significant moves of the underlying stock price is the essence of gamma trading. Credit risk plays an important role in the risk profile of convertible arbitrage hedge funds. Liquidity considerations are essential. Ignorance of this risk can lead to devastating losses as the 2008 financial crisis showed. Gamma trading means frequent re-hedging of directional exposure after market moves.

46. Solution: D

This position is hedged against interest rate risk, so B) is wrong. It is also hedged against directional

movements in the stock, so C) is wrong. The position is long an option (the option to convert the bond into the stock) and so is long implied volatility, so A) is wrong. Long options positions have positive gamma.

47. Solution: C

Global macro strategies take long and short positions based on expectations regarding fundamental changes in global capital markets. The manager in this scenario is engaging in a carry trade by taking a long position in a high-yielding currency (euros) and a short position in a low-yielding currency (Swiss Francs). The manager also expects a fundamental change in the exchange rate between the currencies. Managed futures strategies have a similar philosophy but use futures rather than the underlying assets to execute the strategy.

48. Solution: D

Equity short-selling funds sell stocks not currently owned by the seller in order to take a directional bet that the stock price will decline. However, traditional people who buy stock strategies believe that future stock prices are rising.These short-selling funds tend to be negatively correlated with traditional long-only equity portfolios.

49. Solution: C

In summary, the four difficulties are: 1. Illiquid assets; 2. Tail risk; 3. Unstable risk profiles; and 4. Survivorship bias

50. Solution: C

The publication lists existing funds, so it must be subject to survivorship bias, because dead funds are not considered. In addition, there is selection bias because the publication focuses on just the popular funds, which are large and likely to have done well. A and B are incomplete. D is also incomplete.

51. Solution: A

The sample is too small: survivorship bias implies that certain non-performing funds (e.g., funds that went out of business) are not included in the sample, it is an issue of the sample.

D is closely related and D is probably true, but D relates to interpretation and Ais more directly the implied methodological flaw. So, D is fine, but A is a little better.

52. Solution: B

As poor performers drop out of the database, the average performance increases. The removal of poor performers could actually reduce average volatility and the correlation of returns. The

Sharpe Ratio tends to get inflated due to survivorship bias. With infrequent trading, estimates of volatilities, correlations, and betas are too low when computed using reported returns. Thus, Sharpe ratios would be higher under the circumstances. When trading becomes more frequent, the Sharpe ratios will be lower in – due to higher volatilities – in comparison with those under infrequent trading condition.

53. Solution: B

Statements II, III, and IV are true. Statement I is false — the opposite is true.

54. Solution: D

Thus risk estimates are biased downward by smooth.volatilities, correlations, and betas—are too low when computed using reported returns.

55. Solution: C

Investors should assess potential managers and their investment strategies with an objective and unbiased mind. They should not be unduly concerned with a manager's past successes given that past performance is not always indicative of future performance. Risk controls, the business model, and the investment process are all fundamental parts of the due diligence process.

56. Solution: C

Generally speaking, with a leveraged fund, an investor will need to evaluate historical and current changes in leverage, as well as the level of liquidity of the portfolio, particularly during times of market stress. Certain strategies may in fact expose an investor to tail risk, so while an investor should inquire whether the manager believes that tail risk exists, and whether or not it is hedged, it is then up to the investor to decide whether to accept the risk unhedged or hedge it on their own. Many funds employ independent risk service providers to report risks to investors, but these firms do not get involved in risk related decision making. And finally, while it is important to know what percentage of the assets is exchange-traded and marked to market, what might be acceptable may differ depending on the strategy of the fund.

57. Solution: A

A is correct. Investors should make sure they have access to the people at the top of the firm; the actual risk takers and decision makers, so that they have a better sense of what is really going on at that firm. Direct access to founders or senior management is preferred as part of continuing due diligence but if they are not available then the fund should strive to communicate with managers who perform day-to-day investment tasks at the fund. Communication with investor relations is not sufficient.

B is incorrect. Many funds employ independent risk service providers to report risks to investors, but these firms do not get involved in risk related decision making.
C is incorrect. Investors should evaluate the considered fund's current and historical leverage figures but also understand how and why these figures might deviate from the fund's peers.
D is incorrect. While it is important to know what percentage of the assets is exchange- traded and marked to market, what might be acceptable may differ depending on the strategy of the fund.

58. Solution: D

D is correct. Artificially low asset class correlations leading to the appearance of low systematic risk is a bias faced by hedge funds with illiquid holdings that use monthly valuation data. One way to correct for this is to use enlarged regressions with additional lags of the market factors and to sum the coefficients across lags.

2020 FRM Part II

百题巅峰班

案例

2020 年 5 月

6. Current Issues in Financial Market

6.1. Key Point: The Impact of Blockchain Technology on Finance

6.1.1. 重要知识点

- Describe the challenges blockchain technology faces in gaining widespread adoption in
- economic applications.
- Explain and assess the questions to be considered prior to implementing a blockchain solution to any economic activity.
- Explain the concept of cost of trust when speaking about legacy fnancial systems and blockchain technology.
- Describe the current regulatory concerns surrounding crypto-fnance and assess the steps taken by regulators to address these issues

6.1.2. 基础题

Q-1. Which of the following statements is incorrect regarding the performance of blockchain？

A. Although processing speeds are stressed during high volume, for bitcoin, the blockchain transparency keeps prices current.

B. Bitcoin process 7-10 transactions per second, Ethereum processes about 20 transactions per second, while Visa processes about 20,000 transactions per second.

C. The proof-of-work verification model is a cause of slower performance for bitcoin.

D. Performance concerns have led to discussions about small transactions being redirected to separate blockchains or other software.

Q-2. Which of the following statements is not an example of solutions or improvements to mitigate privacy concerns in blockchain technology？

A. Zero-knowledge proofs allow a statement to be proven true without knowing exactly why it is true.

B. Zcash and JPMorgan's Quorum have both effectively used zero-knowledge proofs to improve privacy.

C. Privacy concerns are mitigated by using the same pseudonym for repeated transactions.

D. Blockchain has strong privacy characteristics; transactions that limit processes on supporting technology will have more privacy.

Q-3. Benefits provided by blockchain include all of the following except

A. the reduced costs of intermediation, secure, verifiable transactions can significantly reduce operational costs.

B. increased transaction security and speed, allowing more efficient execution.

C. the lower costs to reconcile transactions between different centrally maintained ledgers.

D. reduced counterparty risk as contracts are settled, in many cases, instantly.

6.2. Key Point: FinTech and market structure in financial services

6.2.1. 重要知识点

- Differentiate between the potential changes to market structure (lending, payments, insurance, trading) and fnancial stability risks resulting from fnancial innovation through traditional providers, Fintech providers, Big Tech and third-party tech servicers.
- Discuss the impact and risks of technological developments in the areas of APIs, mobile banking and cloud computing on payment systems along with the scope of the EU's Payment Services Directive.
- Analyze the market structure impact and risks of China's NPI's online MMFs in the areas of same day cash availability, deposit guarantee mechanisms and concentration risk along with the effort of Chinese.
- authorities to address these risks.

6.2.2. 基础题

Q-4. Which of the following statements is least accurate regarding the impact of technology companies on market structure?

A. Fintech firms have made their largest impact on lending delivery, but the impact is mostly in niche areas.

B. Fintech has strong customer relations, and its success has provided the necessary capital investment to scale

C. Bigtech firms have made their strongest contribution to payment systems across markets and regions

D. Bigtech firms have the greatest opportunity to impact financial market structure as they are generally characterized by strong customer bases, excess capital resources, and technological expertise.

Q-5. Which of the following features of Payment Services Directive (PSD2) is intended to protect customers from fraud, abuse, and payment problems?

A. Under PSD2, the customer may control what information various payment initiation services (PIS) share with each provider.

B. PSD2 mandates open access for specific types of customer data to account information services (AIS) and nonbank licensed providers of payment initiation services (PIS).

C. Account information services (AIS) firms can obtain personal information from online

bank accounts, but must have explicit customer approval

D. Banks must allow account information services (AIS) firms access rights.

Q-6. Which of the following statements regarding technological developments has the primary impact of increasing risk in our payment systems?

A. Financial institutions currently use the cloud for less sensitive data processes, including customer relationship management, human resources, and financial accounting.

B. Application programming interface (API) usage and automation of communication and data transfer for financial account information is increasing economies of scale should drive further increases in API use.

C. In some regions, smartphones integrate online shipping, wallet capabilities, and P2P money transfers directly in a dedicated payment system.

D. PSD2 mandates open access for specific types of customer data to account information services (AIS) and nonbank licensed providers of payment initiation services (PIS).

6.3. Key Point: Fintech credit markets around the world

6.3.1. 重要知识点

- Describe the difculties involved in measuring the size of the global Fintech credit market.
- Describe the factors that have driven the recent growth of the Fintech credit market.
- Examine the potential benefts and risks inherent in the Fintech credit market.
- Compare and evaluate how different jurisdictions have crafted policy and regulatory responses to the Fintech credit market.

6.3.2. 基础题

Q-7. Which of the following statements regarding the collection of data is least likely a factor that makes it difficult to measure the size of the fintech credit market?

A. The lack of demand deposits in the fintech credit market result in less required reporting to supervisory authorities.

B. Smaller platforms with limited turnover are not included.

C. Fintech credit activity is not included.

D. Fintech credit originations are not included.

Q-8. Which of the following countries did not have the consumer sector as the leading fintech credit based on volume?

A. China

B. Spain

C. United States

D. New Zealand

Q-9. Which of the following countries has not introduced specific new regulations and license requirements since 2015?

A. China

B. Mexico

C. United Kingdom

D. United States

6.4. Key Point: Implications of fintech developments for banks and bank supervisors

6.4.1. 重要知识点

- Differentiate between the fve Basel fntech scenarios and the roles participants (incumbent banks, new banks, Big Tech, fntech frms and service providers) perform and risks they are subject to in each.
- Discuss the Basel disintermediated bank scenario and its impact on incumbent banks' present business models. Identify areas of existing product and funding risks.
- Distinguish practical instances of Basel Committee's Principles for sound management of operational risk (PSMOR) as applied to fntech.
- Distinguish the implications for bank supervisors on regulatory frameworks as a result of fntech along with existing licensing regimes and regulatory responses.

6.4.2. 基础题

Q-10. From the BCBS scenarios regarding how fintech may affect the financial services industry, what is the key difference between the distributed bank and the relegated bank?

A. A key difference between the distributed and relegated bank is that the customer service interface for a relegated firm is independent of the product providers.

B. The distributed bank allows banks to maintain both the customer relationship and product offerings, while in the relegated bank these both fall under a single technology firm platform.

C. The relegated bank offers modularized products from banks, bigtech, and fintech.

D. The distributed bank scenario suggests that banks overhaul and fully integrate their digitized platform to manage the customer relationship and allow customers access to modularized products from various vendors.

Q-11. In reviewing the BCBS fintech scenarios, banks and supervisors monitoring and managing end-to-end product transactions are risks of which scenarios?

A. Better bank and distributed bank.
B. Better bank, distributed bank and disintermediated bank.
C. Distributed bank and relegated bank.
D. Relegated bank and disintermediated bank.

Q-12. The CEO of a regional bank has contracted fintech providers to improve access to retail loans through mobile applications. As this is a pilot with unclear performance, she increased loan loss provisions for the online loan portfolio. This is most likely an example of

A. effectively implementing risk policies, processes, and systems.
B. enhancing capacity to identify, assess, and mitigate risks arising from extended processes and systems in fintech migrations.
C. updating the frequency of monitoring and reporting with appropriate escalation according to the size and nature of the risks.
D. ensuring prompt reporting, assessment, and early risk mitigation for fintech risks.

6.5. Key Point: The Rise of Digital Money

6.5.1. 重要知识点

- Describe the characteristics of e-money that could propel a rapid global adoption of this type of money.
- Describe the risks faced by the banking sector as e-money adoption increases.
- Evaluate regulatory and policy actions that could be implemented in response to risks arising from increased adoption of e-money

6.5.2. 基础题

Q-13. Which of the following current attributes of e-money is least likely to contribute to the widespread adoption of e-money as a form of money?

A. Convenience.
B. Complementarity.
C. Stability.
D. Ubiquity.

Q-14. Suppose a large e-money provider capitalizes on network effects, leading to the rapid adoption of e-money, and regulators become concerned that this firm will monopolize the industry. Which of the following risks best describe this situation?

A. Monetary policy transmission.
B. Market contestability.

C. Financial integrity.

D. Policy making.

6.6. Key Point: Big Data

6.6.1. 重要知识点

- Describe the issues unique to big datasets.
- Explain and assess different tools and techniques for manipulating and analyzing big data.
- Examine the areas for collaboration between econometrics and machine learning.

6.6.2. 基础题

Q-15. Which of the following statements is not a problem common to the contemporary world of big data?

A. A researcher might find a strong in-sample prediction that does not produce good out-of-sample results.

B. Traditional spreadsheet analysis is not robust enough to capture relationships with multiple interactions and millions of data points.

C. Access to data is difficult.

D. The periodic presence of spurious correlations requires active variable selection.

Q-16. Which of the following statements is not involved in conducting a 10-fold cross validation?

A. Test your prediction on an out-of-sample dataset to validate accuracy.

B. Rotate which fold is the testing set.

C. Conduct at least 10 different tests and average the testing results.

D. Break a large dataset into 10 smaller subsets of data.

Q-17. Which of the following statements most accurately describes the process of growing a random forest?

A. Select a bootstrapped sample from a large dataset and grow a tree with random variables that were selected using a lambda (λ) tuning parameter. Average the results from a large number of trees that fill out the random forest

B. Break the full dataset into 10 identifiable subsets and build 10 different trees each having the same variables that were selected using a lambda (λ) tuning parameter.

C. Break the full dataset into a random number of small unique datasets. Grow trees and average the results.

D. Select a bootstrapped sample (with replacement) from a large dataset and grow a tree with random variables and no pruning Average the results from a large number of trees

that fill out the random forests.

Q-18. About the analysis of big data, Hal Varian says "Conventional statistical and econometric techniques such as regression often work well, but there are issues unique to big datasets that may require different tools. First, the sheer size of the data involved may require more powerful data manipulation tools. Second, we may have more potential predictors than appropriate for estimation, so we need to do some kind of variable selection. Third, large datasets may allow for more flexible relationships than simple linear models. Machine learning techniques such as decision trees, support vector machines, neural nets, deep learning, and so on may allow for more effective ways to model complex relationships." Further, according to Hal Varian, which of the following statements is TRUE?

A. Excel remains the best database for Big Data because it contains fully 2^18 rows
B. The goal of machine learning is to develop good in-sample predictions but such methods are not helpful if the data is "too fat" or "too tall"
C. NoSQL databases are table-based relational databases that are more sophisticated than (i.e., "less primitive than") structured query language
D. Data analysis includes four categories: prediction (a primary concern of machine learning), summarization, estimation, and hypothesis testing

Q-19. Hal Varian introduces "trees" as non-linear methods that are effective alternatives to linear or logistic regression for prediction. Classification trees such as binary trees (i.e., two branches at each node) are used for multiple outcomes, while regression trees handle continuous dependent variables. In regard to some of the different tools and techniques for manipulating and analyzing big data, each of the following statements is true EXCEPT which statement is inaccurate?

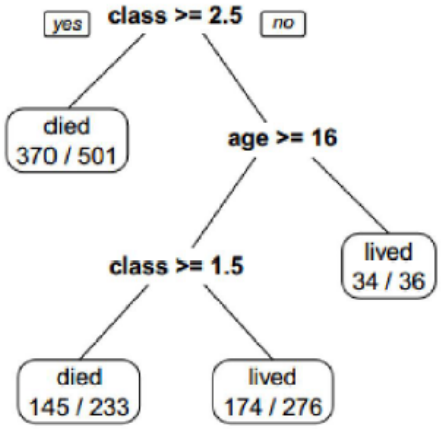
A. Random forests is a technique that uses multiple classification and/or regression trees
B. The primary drawback of trees is that, because they lack methods for coping with missing values, trees require all observations in the dataset to be complete cases
C. Trees sometimes do not work well when the underlying relationship is linear, but on the other hand they tend to thrive when there are important non-linear relationships and interactions
D. Elastic net regression adds a penalty term to the sum of squared residuals in a multivariate regression model such that it includes the special case of ordinary least squares (OLS) when the penalty term equals zero

Q-20. In regard to areas of potential collaboration between econometrics and machine

learning, according to Hal Varian each of the following statements is true EXCEPT which is inaccurate?

A. In big datasets, model uncertainty tend to be small but sampling uncertainty tends to be quite large
B. Machine learning tends to find that averaging over many small models tends to give better out-of-sample prediction than choosing a single model
C. In order to model the average treatment effect as a function of other variables, we typically need to model both the observed difference in outcome and the selection bias
D. Prediction methods can assist with the thorny problem of estimating causation; for example, Bayesian Structural Time Series (BSTS) is a machine learning technique that can be used to forecast a counterfactual and estimate the causal effect of certain variables

Q-21. Below is Hal Varian's simple classification tree that predicts Titanic survivors (Figure 1 in the reading).



According to the tree, each of the following statements is true EXCEPT which is inaccurate?

A. This testing set contain 1,046 observations and two features
B. The tree predicts that all passengers who are younger than 16 will live
C. The rules in this tree misclassify about 30.9% of the "in sample" (testing set) observations
D. The tree predicts that all First Class passengers live, but only some Second Class passengers live

Q-22. With respect to tools and techniques for manipulating and analyzing big data, each of the following statements is true EXCEPT which is false?

A. Classifier performance is often improved by adding randomness and examples of this include boosting, bagging and bootstrapping

B. When using a large data set (e.g., big data), the data should be parsed at least into separate training and testing sets; or even training, validation, and testing sets

C. Random forests have the advantage of intuitive usability by offering simple summaries of data relationships, but their disadvantage is inferior out-of-sample performance especially with nonlinear data

D. Pruning a tree is an example of regularization because it imposes a cost for tree complexity (e.g., number of terminal nodes) with the goal of simplifying the model and generating better out-of-sample predictions

6.7. Key Point: Machine Learning

6.7.1. 重要知识点

- Describe the process of machine learning and compare machine learning approaches.
- Describe the application of machine learning approaches within the fnancial services sector and the types of problems to which they can be applied.
- Analyze the application of machine learning in three use cases:
  - Credit risk and revenue modeling
  - Fraud
  - Surveillance of conduct and market abuse in trading

6.7.2. 基础题

Q-23. Which of the following classes of statistical problems typically cannot be solved through supervised machine learning?

A. Regression problems.

B. Penalized regression.

C. Classification problems.

D. Clustering.

Q-24. Which of the following concepts best identifies the problem where a highly complex model describes random error or noise rather than true underlying relationships in the data?

A. Bagging.

B. Boosting.

C. Overfitting.

D. Deep learning.

Q-25. Which data type is most characteristic of “big data”?

A. High-quality data.

B. Low frequency data.
C. Structured supervisory data.
D. Low-quality unstructured data.

Q-26. Peter is an analyst who is using Microsoft Azure to conduct drag-and-drop (that is, without coding!) machine learning analytics on his company's dataset of consumer loans. The dataset includes the response variable (aka, dependent variable) in a column that indicates the historical performance of the consumer loan as either "defaulted" or "repaid in full." Peter wants to use a training set to predict whether future loans will default and he expects the relationship is non-linear. Which of the following machine learning approaches is probably BEST?

A. Any unsupervised approach
B. Either ridge or LASSO non-penalized regression
C. Either principal components, or K- and X- means clustering
D. Either decision trees, support vector machines or deep learning

Q-27. Barbara has developed a model to detect fraudulent transactions at her bank. Her primary dataset consists of a table that contains millions of rows (aka, observations), one per each customer transaction, and several dozen columns; each column is already a "feature" (aka, attribute, parameter) in the model. Her goal is to increase the predictive power of the model, and the model does perform well when applied to the historical database (aka, insample), but she is greatly concerned specifically about overfitting the model. Each of the following techniques is a possible mitigant (or remedy) EXCEPT which of the following is unlikely to help or cure her overfitting problem?

A. Bootstrap aggregation; aka, bagging
B. Bootstrap aggregation; aka, bagging
C. Increase the number of features; ie, add parameters to the model
D. Boosting; ie., overweight scarcer observations in the training dataset

Q-28. Bart van Liebergen writes that "Financial institutions (FIs) are looking to more powerful analytical approaches in order to manage and mine increasing amounts of regulatory reporting data and unstructured data, for purposes of compliance and risk management (applying machine learning as RegTech) or in order to compete effectively with other FIs and FinTechs." He explains that machine learning approaches are well-positioned to deliver this analytical power due to their natural ability to cope with extremely large datasets while offering a high granularity and depth of predictive

analysis. He presents three use cases: Credit risk and revenue modeling; Fraud; and Surveillance of conduct and market abuse in trading.In regard to these three case studies, each of the following is true (according to Bart van Liebergen) EXCEPT which is inaccurate?

A. Clustering is an unsupervised learning method that is applicable to anti-money laundering and counter terrorism financing.
B. Machine learning has been more successful in credit card fraud than anti-money laundering and counter terrorism financing.
C. To facilitate the surveillance of conduct breaches by traders, supervisory learning approaches are difficult to apply because there is often no labeled training data
D. Widespread adoption of machine learning is limited by two practical constraints : regulations require supervised (i.e., national supervisor) learning; and machine learning's black box character implies that applications in the financial sector are not context dependent

Q-29. Peter the risk analyst is helping his international financial services client analyze their very big client transaction database. His immediate task is to conduct an anti-money laundering (AML) analysis. Unlike credit card fraud, however, money laundering is hard to define: there is no universally agreed definition of money laundering. Consequently the historical database contains no field indicating whether a transaction was fraudulent or not; put another way, there is no dependent variable. As such, Peter effectively only has input variables with which to work. If his goal is to yield insights from the data for his client, which of the following methods (among the choices given) in this situation is the MOST appropriate?

A. Clustering
B. Support vector machines
C. Classification decision tree
D. LASSO, a penalized regression

Q-30. Among these choices, which of the following machine learning models is the LEAST useful for the regulatory purpose of providing a system that can be audited and verified by the supervisor?

A. Logit regression
B. Linear regression approach
C. Machine learning ensemble
D. Behavioral science-based model

6.8. Key Point: Artificial intelligence and machine learning in financial services

6.8.1. 重要知识点

- Describe the drivers that have contributed to the growing use of FinTech and the supply and demand factors that have spurred adoption of AI and machine learning in fnancial services.
- Describe the use of AI and machine learning in the following cases:
  I. customer-focused uses
  II. operations-focused uses
  III. trading and portfolio management in fnancial markets
  IV. uses for regulatory compliance
- Describe the possible effects and potential benefts and risks of AI and machine learning on financial markets and how they may affect fnancial stability.

6.8.2. 基础题

Q-31. Which of the following is least likely a driver of demand for artificial intelligence (AI) and machine learning (ML) in financial services?

A. Benefits of AI and ML for risk management.
B. Increasing computing power and faster processors.
C. Improved data reporting and regulatory compliance.
D. The ability of financial services firms to offer new products and services.

Q-32. The primary factor driving the adoption of Fintech by financial services firms is

A. risk reduction.
B. product innovation.
C. increased profitability.
D. delivering more value to customers.

Q-33. Which of the following applications of AI has the greatest risk of raising consumer protection issues?

A. Trading by hedge funds.
B. Evaluation of credit quality.
C. Automating trades in securities markets.
D. Assessing the market impact of large trades.

Q-34. Currently, AI and ML are being used in the financial services industry

A. across many types of firms and services.
B. primarily to perform regulatory functions in financial markets.

C. primarily by hedge funds to fully automate portfolio decision-making.

D. primarily in the area of virtual assistants ("chatbots") for brokerage customers.

Q-35. The Financial Stability Board's Financial Innovation Network (FSB FIN, November 2017) observes that "artificial intelligence and machine learning (AI&ML) are being rapidly adopted for a range of applications in the financial services industry." Specific use cases of AI&ML include (i)customer-focused applications; (ii)operations-focused uses; (iii) trading and portfolio management; and (iv)regulatory compliance and supervision. Further, according to FSB FIN, each of the following statements is true EXCEPT which is inaccurate?

A. Deep learning can be used for supervised, unsupervised, or reinforcement learning

B. The key risk of artificial intelligence is that its ability to contextualize implies it will soon be able to fully replicate human intelligence and therefore eventually replace humans

C. Machine learning is a sub-category of artificial intelligence (AI) that extends familiar statistical methods and generally deals with optimization, prediction and categorization but not causal inference

D. Reinforcement learning falls in between supervised and unsupervised learning, and it feeds an unlabeled dataset to the algorithm which chooses an action and then receives human feedback that helps it learn

Q-36. In regard to the drivers that have contributed to the growing use of Fintech and the supply and demand factors that have spurred adoption of AI and machine learning in financial services, each of the following statements is true EXCEPT which is false?

A. A key supply factor is the declining cost of data storage and corresponding growth in datasets

B. Key demand factors include profitability (ie, cost reduction, risk management gains, productivity improvements), competition, and regulatory compliance

C. A key supply factor is weak-form efficient markets due to a lack of threshold structured data, a factor which is theoretically temporary because AI and machine learning should eventually arbitrage it away.

D. Regulatory compliance is a salient demand factor (i.e., RegTech) but legal frameworks will be a complicating--and possibly dampening--factor on several fronts such as liability, anti-discrimination and credit system interpretability

Q-37. The FSB FIN briefly discusses three customer-focused use cases: credit scoring applications, insurance-related technologies (aka, InsurTech including insurance policies), and client-facing chatbots. About the use of artificial intelligence and machine

learning (AI&ML) specifically in these customer-focused use cases, which of the following statements is TRUE?

A. The black box is good because it will reduce discrimination
B. Machine learning algorithms are likely to reduce access to credit
C. Machine learning-based credit scoring models decisively outperform traditional credit models in over 90.0% of cases
D. In the insurance industry, AI&ML can improve profitability (via risk-based pricing and reduced costs) and augment underwriting and claims processing functions

Q-38. The Financial Stability Board's Financial Innovation Network (FSB FIN, November 2017) says that "From a micro-financial point of view, the application of AI and machine learning to financial services may have an important impact on financial markets, institutions and consumers." Specifically, in regard to this micro-financial point of view, each of the following is true EXCEPT which statement is inaccurate?

A. In regard to consumers, AI&ML could enable wider access to financial services that are more personalized/customized
B. In regard to financial institutions, AI&ML can be used for risk management through earlier and more accurate estimation of risks
C. In regard to consumers, AI&ML guarantees the avoidance of discrimination by excluding sensitive features (e.g., race, religion, gender) from the dataset
D. In regard to financial markets, AI&ML is likely to enable participants to collect and analyze information on a greater scale which should (i) reduce information asymmetries and contribute to market efficiency; and (ii) lower trading costs

6.9. Key Point: Climate Change and Financial Risk

6.9.1. 重要知识点

- Discuss the history of climate change related risks for the fnancial sector including the Paris Agreement (2015) and distinguish the signifcance of Article 2.1 c as it pertains to the fnancial system.
- Distinguish the causes of potential mispricing of climate change risk and the impact of relevant history and data, non-normal probability distributions, kurtoses, skew, “black swan” events, and risk materialization time horizons on pricing as compared to traditional investment risk analysis.
- Discuss recent reporting and disclosure requirements under Article 173 of the French Energy Transition Act and the impact of The European Commission Sustainable Finance Action Plan on the allocation of capital towards sustainable investments and inclusion of climate and environmental factors in financial.

- institutions' risk management policies.

6.9.2. 基础题

Q-39. One of the first concerns with climate change is creating awareness for financial markets, regulators, industries, and consumers. Which event occurred in 2005 that brought climate change awareness to investment bankers and financial institutions who created a new product under energy trading platforms?

A. Article 173 of the Energy Transition Act is passed.
B. Financial carbon footprints are published by asset managers.
C. Paris Agreement Article 2.1(c) is adopted.
D. Unburnable Carbon Report defines carbon bubble.

Q-40. A risk manager at a large financial institution is concerned with pricing climate-related risks in the institutions asset pricing models. Currently, the financial institution does not have a pricing model for climate risk. The risk managers goal is to develop a model that does not underprice climate risk. Which of the following factors is least likely to cause mispricing of climate risk?

A. Bounded rationality.
B. Discrepancy in time horizons.
C. Nonnormal probability distributions.
D. Qualitative measures.

6.10. Key Point: Beyond LIBOR

6.10.1. 重要知识点

- Describe the features comprising an ideal benchmark.
- Examine the issues that led to the replacement of LIBOR as the reference rate.
- Examine the risks inherent in basing risk-free rates (RFR's) on transactions in the repo market.

6.10.2. 基础题

Q-41. Regulatory authorities and financial market participants are considering potential new reference rates to replace interbank offering rates (IBORs) that have been preferred since the 1980s. One possible reference rate is linked to overnight index swap (OIS) contracts. The OIS reference rate would satisfy all key desirable features of an ideal benchmark except

A. it is derived from actual data of active liquid market.
B. it is able to offer a reference rate for financial contracts outside of the money market.

C. it is derived for different tenors so that a term structure of interest rates is created.

D. it is able to serve financial intermediaries as a term lending and funding benchmark.

Q-42. Regulators across jurisdictions are contemplating replacing LIBOR with a more appropriate reference rate. While a major concern is the exposure to bank manipulation, there are also other issues which of the following is not a cause that led to the removal of LIBOR as a reference rate?

A. LIBORs are not widely accepted as a reference rate by most banks.

B. Interbank deposit markets became less active, especially following the global finance crisis of 2007-2009.

C. The increased variance of individual bank credit risk since 2007 erodes the effectiveness of benchmarks based on IBORs that try to capture average bank credit risk exposures.

D. Banks rely more on less risky wholesale funding in the form of repos in response to regulatory and market efforts to reduce counterparty risk.

Solutions

Q-1. Solution: A

Performance is a key challenge for blockchain as the verification process is costly and time consuming. Using proof of work, heavy trading volumes for bitcoin would exceed the verification speed choose transactions based on high fees instead of servicing the ay creating transaction delays and pricing lags. In addition, miners chronologically. There are some verification processes that improve upon proof of work, but none that solve the performance issue satisfactorily The higher speeds of transactions on the Visa network are consistent with a centralized system, but create other costs. Executing smaller transactions through a separate blockchain or trading system is a popular suggestion, but batching a small trade platform into the primary blockchain includes unsolved technical issues and adds security risk.

Q-2. Solution: C

Privacy is increased by zero-knowledge proofs, and zero-knowledge proofs are used in Zcash and Quorum. Repeated transactions with the same pseudonym enable hackers to narrow pseudonym identity or demographic. Approximately 90% of blockchain transactions take place in supporting processes and systems. The supporting systems are much more vulnerable to hackers than blockchain.

Q-3. Solution: B

Intermediation using blockchain is secure, verifiable, and low cost Transactions speeds using blockchain are often slower than competitive technology. Costs of reconciling decentralized ledgers outside of the blockchain can be very expensive. Cross-border payments are a very good application of blockchain to improve transparency, reduce settlement costs, reduce operating risk, and reduce counterparty risk.

Q-4. Solution: B

Fintech lenders generally gather customers online (often the underserved or those in niche markets), use unique credit analysis, and employ various business models, thereby increasing client exposure and satisfaction. Fintech firms have made their largest impact on lending delivery, but the impact is mostly in niche areas. Fintech currently lacks strong customer relations and lacks the necessary capital investment to scale. These are two key drivers for fintech to partner with traditional banks, Bigtech firms have a strong position in payment systems. In addition, bigtech firms have the greatest opportunity to impact financial market structure as they are generally characterized by strong customer s, excess capital resources, and technological expertise.

Q-5. Solution: A

The European Union, through the revised PSD2 in 2015, initiated regulation aimed at encouraging

competition in open banking. Its intent is to better protect customers against fraud, abuse, and payment problems, and to promote innovative mobile and payment services. The regulation also authorizes licensed PIS, with customer approval to access payment details and bypass login protocols. However, the customer may control what information he shares with each provider.

PSD2 also encourages competitive payment services by mandating open access for specific types of customer data to AIS and nonbank licensed PIS. AIS firms can obtain personal information from online banking accounts, but must have explicit customer approval. Banks must allow AIS firms access rights.

Q-6. Solution: B

Financial institutions currently use the cloud for less sensitive data processes, including customer relationship management, human resources, and financial accounting. This is to reduce risk until cloud computing is proven to be a secure process. API usage and automation of communication and data transfer for financial account information is increasing; economies of scale should drive further increases in API use.

The common use of APIs to manage or overlay on our payments systems may increase risk. Any defect in the software is amplified by high usage.

Additionally, the high usage may attract more sophisticated fraud. In some regions, smartphones integrate online shipping, wallet capabilities, and P2P money transfer directly into a dedicated payment system. This is primarily a cost savings and efficiency assertion. PSD2 mandates op access for specific types of customer data to AIS and nonbank licensed providers of PIS. This predominantly increases competition.

Q-7. Solution: D

The most detailed information regarding the fintech credit market is often limited to new credit originations. More detailed data on the amount of the total fintech credit in not disclosed, making it difficult to know the size of this market.

Q-8. Solution: B

In 2016, most fintech credit is in the consumer sector for New Zealand Germany, United States, and China. For the same year, the largest fintech credit segment was real estate lending in Spain.

Q-9. Solution: D

The following countries have implemented new licensing and regulatory regimes since 2015: Brazil, China, Finland, France, Mexico, New Zealand, Spain, Switzerland, and the United Kingdom.

Q-10. Solution: A

In the relegated bank, bigtech or fintech companies use front-end customer platforms to offer various financial services. Incumbent bank become commoditized service providers and give the direct customer relationship to other financial services providers (e.g., fintech or bigtech).
In the distributed bank scenario, both the customer relationship and product contracts could be managed by banks, but in this scenario, products are fragmented and offered by banks, fintech, and bigtech.

Q-11. Solution: C

In the distributed bank and the relegated bank scenarios, the customer relationship and product offerings are both managed by multiple providers that interact with each other. Regulators will have prudential oversight of the bank or licensed financial, but they may not have oversight over the entire product market or transaction.

Q-12. Solution: B

The CEO increased loan loss reserves to support the potential additional risk of fintech-related services.

Q-13. Solution: C

There are six characteristics of e-money that could encourage rapid widespread adoption of e-money: convenience, ubiquity complementarity low transaction costs trust, and network effects. Currently, e-money is not stable because it is not backed by governments.

Q-14. Solution: B

Strong network effects could create monopolies. Market contestability risk is concerned with the creation of large monopolies that extract rents and create barriers of entry to new competition.

Q-15. Solution: C

Our modern world is filled with computerized commerce. This trend has created a seemingly endless stream of information that can be dissected using machine learning. Overfitting and spurious correlations are two clear issues and traditional spreadsheet analysis is simply not robust enough to capture the interactions in very large pools of data.

Q-16. Solution: A

Cross validation is used to conduct testing within a dataset that attempts to create virtual out-of-sample subsets that are actually still in-sample.
In this example, the large dataset is broken into 10 folds and then 1 fold is selected for testing. Parameters from the other training sets are tested against the testing set and the testing set is

rotated so that each fold gets a turn as the testing set. Parameters from each test are then averaged to get a population parameter used for prediction.

Q-17. Solution: D

Growing a random forest involves a bootstrapped sample (with replacement) from a larger data set. Researchers will then grow a tree from this sample. They will construct a large number of trees using soon computerized assistance and average the results to find the population parameters.

Q-18. Solution: D

In regard to false (A) and (C): Economists have historically dealt with data that fits in a spreadsheet, but that is changing as new more-detailed data becomes available. If you have more than a million or so rows in a spreadsheet, you probably want to store it in a relational database, such as MySQL. Relational databases offer a flexible way to store, manipulate, and retrieve data using a Structured Query Language (SQL), which is easy to learn and very useful for dealing with medium-sized datasets. However, if you have several gigabytes of data or several million observations, standard relational databases become unwieldy. Databases to manage data of this size are generically known as “NoSQL” databases. The term is used rather loosely, but is sometimes interpreted as meaning “not only SQL.” NoSQL databases are more primitive than SQL databases in terms of data manipulation capabilities but can handle larger amounts of data.

In regard to false (B): In machine learning, the x-variables are usually called “predictors” or “features.” The focus of machine learning is to find some function that provides a good prediction of y as a function of x. Historically, most work in machine learning has involved cross-section data where it is natural to think of the data being independent and identically distributed (IID) or at least independently distributed. The data may be “fat,” which means lots of predictors relative to the number of observations, or “tall” which means lots of observations relative to the number of predictors ... Our goal with prediction is typically to get good out-of-sample predictions.

Q-19. Solution: B

B. is FALSE because classification and regression trees are good at handling incomplete case as there exists several methods for coping with missing values.

In regard to false (B) and true (C), "Trees tend to work well for problems where there are important nonlinearities and interactions ... Trees also handle missing data well ... Interestingly enough, trees tend not to work very well if the underlying relationship really is linear, but there are hybrid models such as RuleFit (Friedman and Popescu 2005) that can incorporate both tree and linear relationships among variables."

Q-20. Solution: A

A. False. Instead, say Hal Varian, "In this period of big data, it seems strange to focus on sampling uncertainty, which tends to be small with large datasets, while completely ignoring model uncertainty, which may be quite large. One way to address this is to be explicit about examining how parameter estimates vary with respect to choices of control variables and instruments."

Q-21. Solution: B

B. False. Passengers in First or Second Class (i.e., Class < 2.5) who are younger than 16 live, but all Third Class passengers (including the young) do not survive; although among Third class, this misclassifies 1 - 370/501 = 26.1% of this group.

Q-22. Solution: C

C is inaccurate. Rather, the inverse is true: random forests are something of a black box but their performance is generally superior!

Q-23. Solution: D

Clustering typically involves applying unsupervised learning to a dataset It involves observing input variables without knowing which dependent variable corresponds to them(e. g, detecting fraud without knowing which transactions are fraudulent).

Regression problems, including penalized regression, and classification problems involve predictions around a dependent variable. These statistical problems can be solved through machine learning.

Q-24. Solution: C

Overfitting is a concern where highly complex models describe noise or random error rather than true underlying relationships in the model Overfitting is a particular concern in non-parametric, nonlinear models.

Boosting overweights less frequent observations to train the model to detect these more easily. Bagging involves running a very large number of model subsets to improve its predictive ability. Deep learning differs from classical learning models in that it applies many layers of algorithms into the learning process to identify complex patterns.

Q-25. Solution: D

"Big data" is data that arises from large volumes of low-quality, high-frequency, unstructured data.

Q-26. Solution: D

This a supervised classification problem where a linear relationship could use support vector machines but a non-linear relationship could use (i) decision trees [classification trees, regression trees, or random forests], (ii) support vector machines, or deep learning.

Q-27. Solution: C

Tackling overfitting: bagging and ensembles: Excessively complex models can also lead to "overfitting," where they describe random error or noise instead of underlying relationships in the dataset. Model complexity can be due to having too many parameters relative to the number of observations [footnote 11: For example, R^2, a goodness-of-fit indicator, tends to increase (and cannot decrease) with any variable that is added to the model, whether or not it makes sense in the context. In machine learning, overfitting is particularly prevalent in nonparametric, non-linear models, which are also complex by design (and therefore also typically hard to interpret). When a model describes noise in a dataset, it will fit that one data sample very well, but will perform poorly when tested out-of-sample.

There are several ways to deal with overfitting and improve the forecast power of machine learning models, including "bootstrapping," "boosting" and "bootstrap aggregation" (also called bagging). Boosting concerns the overweighting of scarcer observations in a training dataset to ensure the model will train more intensively on them. For example, one may want to overweight the fraudulent observations due to their relative scarcity when training a model to detect fraudulent transactions in a dataset. In "bagging," a model is run hundreds or thousands of times, each on a different subsample of the dataset, to improve its predictive performance. The final model is then an average of each of the run models. Since this average model has been tested on a lot of different data samples, it should be more resilient to changes in the underlying data. A "random forest" is an example of a model consisting of many different decision treebased models. Econometricians can take this concept even further by combining the resulting model with a model based on another machine learning technique. The result is a so-called ensemble: a model consisting of a group of models whose outcomes are combined by weighted averaging or voting. It has been shown that averaging over many small models tends to give better out-ofsample prediction than choosing a single model.

Q-28. Solution: D

Both clauses are false. The first is nonsensical, and a key theme in the paper is that applications are context-dependent.

From the Conclusion: This article has given an introduction to the machine learning field and has discussed several cases of application within financial institutions,based on discussions with IIF members and technology vendors: credit risk modeling, detection of credit card fraud and money

laundering, and surveillance of conduct breaches at FIs. Two tentative conclusions emerge on the use of machine learning in the financial sector – tentative, because the field is developing fast and many FIs are still experimenting with machine learning in some spaces.

First, machine learning comprises a range of statistical learning tools that are generally able to analyze very large amounts of data while offering a high granularity and depth of analysis, mostly for predictive purposes.

Second, the application of machine learning approaches within the financial sector is highly context-dependent. Ample, high-quality data for training or analysis are not always available in FIs. More importantly, the predictive power and granularity of analysis of several approaches can come at the cost of increased model complexity and a lack of explanatory insight. This is an issue particularly where analytics are applied in a regulatory context, and a supervisor or compliance team will want to audit and understand the applied model. Fortunately, simpler machine learning approaches do exist, combining non-linear analysis with simplicity. Indeed, vendors of machine learning analytics in finance typically aim to combine machine learning's depth of insight with model simplicity, or add factor models to improve the auditability of their products. As it seems, there is an algorithm for every problem.

In regard to (A), (B) and (C), each is TRUE.

Q-29. Solution: A

van Liebergen: "The machine learning spectrum comprises many different analytical methods, whose applicability varies with the types of statistical problem one might want to address. Broadly speaking, machine learning can be applied to three classes of statistical problems: regression, classification, and clustering. Regression and classification problems both can be solved through supervised machine learning; clustering is an unsupervised machine learning approach.

Regression problems involve prediction of a quantitative, continuous dependent variable, such as GDP growth or inflation. Linear learning methods try to solve regression problems including partial least squares5 and principal component analysis; non-linear learning methods include penalized regression approaches, such as LASSO and elastic nets. In penalized approaches, a factor is typically added to penalize complexity in the model, which should improve its predictive performance.

Classification problems typically involve prediction of a qualitative (discrete) dependent variable, which takes on values in a class, such as blood type (A/B/AB/O). An example is filtering spam e-mail, where the dependent variable can take on the values SPAM/NO SPAM. Such problems can be solved by a decision tree, 'which aims to deliver a structured set of yes/no questions that can quickly sort through a wide set of features, and thus produce an accurate prediction of a particular outcome.' Support vector machines also classify observations, but by applying and

optimizing a margin that separates the different classes more efficiently.

In clustering, lastly, only input variables are observed while a corresponding dependent variable is lacking. An example is exploring data to detect fraud without knowing which observations are fraudulent and which not. An anti-money laundering (AML) analysis may nonetheless yield insights from the data by grouping them in clusters according to their observed characteristics. This may allow an analyst to understand which transactions are similar to others. In some instances, unsupervised learning is first applied to explore a dataset; the outputs of this approach are then used as inputs for supervised learning methods."

Q-30. Solution: C

For the use case of Credit Risk and Revenue Modeling, van Liebergen says: "Nonparametric and non-linear approaches (support vector machines, neural networks, and deep learning) and ensemblesare so complex that they are practically black boxes that are hard, if not impossible, for any human to understand and audit from the outside. That makes these models hardly useful for regulatory purposes, such as the development of internal models in the Basel Internal Ratings-Based approach. Financial supervisors typically require risk models to be clear and simple in order to be understandable and verifiable and appropriate for validation by them."

For the use case of Surveillance of conduct and market abuse in trading, van Liebergen says: "There are several challenges to applying machine learning in this space. First, there are typically no labeled data to train algorithms on, as it is legally complex for financial institutions to share the sensitive information on past breaches with developers. Supervisory learning approaches are, therefore, hard to apply. Second, a surveillance system needs to be auditable for supervisors and for compliance officers, and needs to be able to explain to a compliance officer why certain behavior has set off an alert. For systems that are entirely based on machine learning, that can be difficult due to the black box character of learning approaches. In order for an alert to be interpretable and actionable for compliance teams, it should ideally be linked to detection of a specific kind of behavior, rather than based solely on a statistical correlation in the data."

Q-31. Solution: B

Increases in computing power and the availability of faster processors have driven increases in the supply of AI and ML solutions to financial firms. The other answer choices are examples of demand drivers.

Q-32. Solution: C

Overall, increased profits are driving the adoption of Fintech. Product innovation, risk reduction, cost savings, and delivering more value to customers are all possible ways to increase profits.

Q-33. Solution: B

If credit evaluation depends on data about consumers that are highly correlated with such characteristics as gender or race, it is almost certain to raise consumer protection concerns.

Q-34. Solution: A

Fintech is being used for a wide variety of functions in the financial services industry, including estimating credit risk, supervision and regulation, capital optimization, estimating insurance risks, portfolio management, securities trading, and customer service.

Q-35. Solution: B

The authors say the trend is toward augmented intelligence, but not replacement of humans (we did not mean to scare you!); and the article asserts that AI cannot contextualize. Many applications tend more toward augmented intelligence, or an augmentation of human capabilities, rather than a replacement of humans. Even as advancements in AI and machine learning continue, including in the area of deep learning, most industries are not attempting to fully replicate human intelligence. As noted by one industry observer "… a human in the loop is essential: we are, unlike machines, able to take into account context and use general knowledge to put AI-drawn conclusions into perspective."

In regard to (A), (C) and (D), each is TRUE.

In regard to true (A) and (D), FSB FIN frames a typology: There are several categories of machine learning algorithms. These categories vary according to the level of human intervention required in labeling the data:

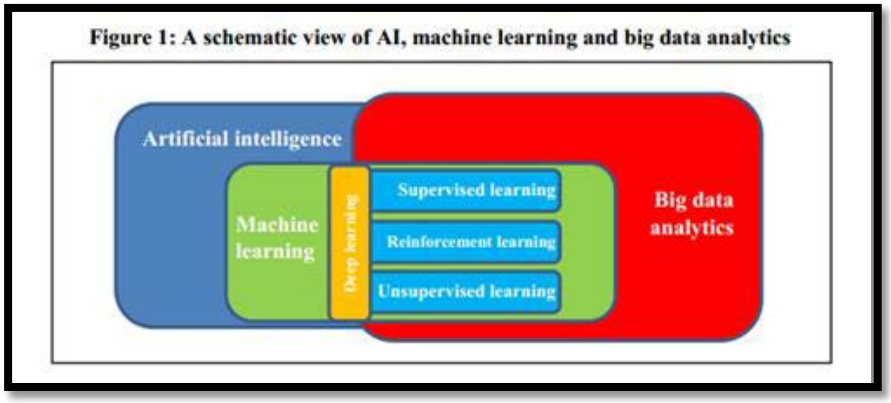
- In supervised learning, the algorithm is fed a set of 'training' data that contains labels on some portion of the observations. For instance, a data set of transactions may contain labels on some data points identifying those that are fraudulent and those that are not fraudulent. The algorithm will 'learn' a general rule of classification that it will use to predict the labels for the remaining observations in the data set.
- Unsupervised learning refers to situations where the data provided to the algorithm does not contain labels. The algorithm is asked to detect patterns in the data by identifying clusters of observations that depend on similar underlying characteristics. For example, an unsupervised machine learning algorithm could be set up to look for securities that have characteristics similar to an illiquid security that is hard to price. If it finds an appropriate cluster for the illiquid security, pricing of other securities in the cluster can be used to help price the illiquid security.
- Reinforcement learning falls in between supervised and unsupervised learning. In this case, the algorithm is fed an unlabelled set of data, chooses an action for each data point, and receives feedback (perhaps from a human) that helps the algorithm learn. For instance,

reinforcement learning can be used in robotics, game theory, and self-driving cars.

Deep learning is a form of machine learning that uses algorithms that work in 'layers' inspired by the structure and function of the brain. Deep learning algorithms, whose structure are called artificial neural networks, can be used for supervised, unsupervised, or reinforcement learning.

In regard to true (C), writes FSB FIN: This report defines AI as the theory and development of computer systems able to perform tasks that traditionally have required human intelligence. AI is a broad field, of which 'machine learning' is a sub-category [footnote 7: Examples of AI applications that are not machine learning include the computer science fields of ontology management, or the formal naming and defining of terms and relationships by computers, as well as inductive and deductive logic and knowledge representation. In this report, for completeness, we often refer to "AI and machine learning," with the understanding that many of the important recent advances are in the machine learning space].

Machine learning may be defined as a method of designing a sequence of actions to solve a problem, known as algorithms [footnote 8: An algorithm may be defined as a set of steps to be performed or rules to be followed to solve a mathematical problem. More recently, the term has been adopted to refer to a process to be followed, often by a computer], which optimizes automatically through experience and with limited or no human intervention.9 These techniques can be used to find patterns in large amounts of data (big data analytics) from increasingly

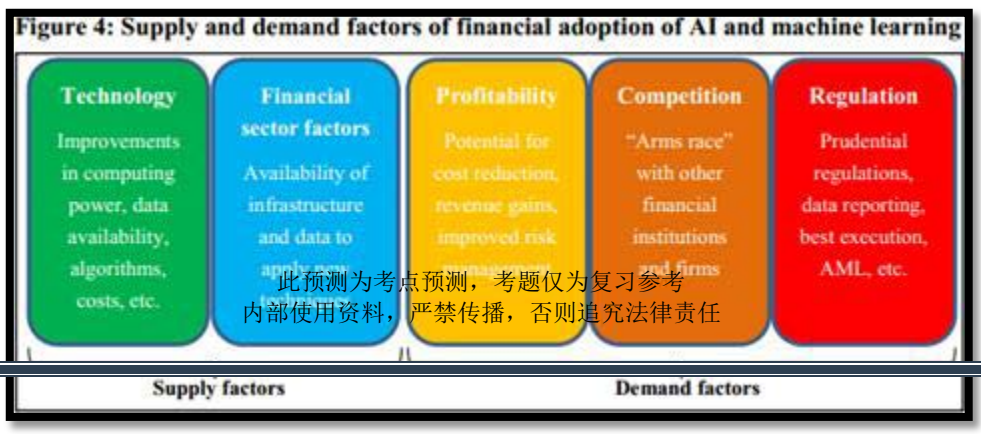


diverse and innovative sources. Figure 1 gives an overview.

Q-36. Solution: C

The sentence tries to sound reasonable but is mostly some manufactured mumbo-jumbo (sorry!).

In regard to (A), (B), and (D), each is TRUE. FSB FIN graphically summarizes the supply/demand



factors in their Figure 4 (below). Also see the reading's Annex A: Legal Issues Around AI and Machine Learning.

Q-37. Solution: D

In the insurance industry, AI&ML can improve profitability (via risk-based pricing and reduced costs) and augment underwriting and claims processing functions. See: Use for pricing, marketing and managing insurance policies.

In regard to (A), (B) and (C), each is FALSE.

In regard to false (A), says FSB FIN: However, the use of complex algorithms could result in a lack of transparency to consumers. This black box aspect of machine learning algorithms may in turn raise concerns. When using machine learning to assign credit scores make credit decisions, it is generally more difficult to provide consumers, auditors, and supervisors with an explanation of a credit score and resulting credit decision if challenged. Additionally, some argue that the use of new alternative data sources, such as online behaviour or non-traditional financial information, could introduce bias into the credit decision. Specifically, consumer advocacy groups point out that machine learning tools can yield combinations of borrower characteristics that simply predict race or gender, factors that fair lending laws prohibit considering in many jurisdictions (see annex B). These algorithms might rate a borrower from an ethnic minority at higher risk of default because similar borrowers have traditionally been given less favourable loan conditions.

In regard to false (B) and (C), the authors assert that an advantage of ML algorithms is their ability to enable greater access to credit, but their out-performance has not been established, In addition to facilitating a potentially more precise, segmented assessment of creditworthiness, the use of machine learning algorithms in credit scoring may help enable greater access to credit. In traditional credit scoring models used in some markets, a potential borrower must have a sufficient amount of historical credit information available to be considered scorable. In the absence of this information, a credit score cannot be generated, and a potentially creditworthy borrower is often unable to obtain credit and build a credit history. With the use of alternative data sources and the application of machine learning algorithms to help develop an assessment of ability and willingness to repay, lenders may be able to arrive at credit decisions that previously would have been impossible. While this trend may benefit economies with shallow credit markets, it could lead to non-sustainable increases in credit outstanding in countries with deep credit markets. More generally, it has not yet been proved that machine learning-based credit scoring models outperform traditional ones for assessing creditworthiness ... There are a number of advantages and disadvantages to using AI in credit scoring models. AI allows massive amounts of data to be analysed very quickly. As a result, it could yield credit scoring policies that can handle a broader range of credit inputs, lowering the cost of assessing credit risks for certain individuals, and increasing the number of individuals for whom firms can measure credit risk. An

example of the application of big data to credit scoring could include the assessment of non-credit bill payments, such as the timely payment of cell phone and other utility bills, in combination with other data. Additionally, people without a credit history or credit score may be able to get a loan or a credit card due to AI, where a lack of credit history has traditionally been a constraining factor as alternative indicators of the likelihood to repay have been lacking in conventional credit scoring models.

Q-38. Solution: C

This statement is currently too extreme, or at a minimum, it is imprecise; there is a concern (including among some experts) that AI&ML will not curb discrimination and might even create new types of discrimination. This is a non-trivial problem.

FSB FIN:Avoiding discrimination in credit scoring, credit provision, and insurance is also an important topic. Even where data on sensitive characteristics such as race, religion, gender, etc. are not collected, AI and machine learning algorithms may create outcomes that implicitly correlate with those indicators, for example, based on geography or other characteristics of individuals. There is ongoing research on how to address and mitigate these biases. This is a key area in the broader discussion on AI ethics.

In regard to (A), (B) and (D), each is TRUE, at least according to the reading.

- In regard to true (A), (emphasis ours): "4.3 Possible effects of AI and machine learning on consumers and investors: If AI and machine learning reduce the costs and enhance the efficiency of financial services, consumers could obtain a number of benefits: (a) Consumers and investors could enjoy lower fees and borrowing costs if AI and machine learning reduce the costs for various financial services; (b) Consumers and investors could have wider access to financial services. For example, applications of AI for robo-advice might facilitate people's use of various asset markets for their investments. Moreover, AI and machine learning, through advanced credit scoring for FinTech lending, might make wider sources of funds available to consumers and small and medium enterprises (SMEs); (c) AI and machine learning could facilitate more customized and personalized financial services through big data analytics. For example, AI and machine learning might facilitate the analysis of big data, thus clarifying the characteristics of each consumer and/or investor and allowing firms to design well-targeted services...
- In regard to true (B), "AI and machine learning can be used for risk management through earlier and more accurate estimation of risks. For example, to the extent that AI and machine learning enable decision making based on past correlations among prices of various assets, financial institutions could better manage these risks. Tools that mitigate tail risks could be especially beneficial for the overall system. Also, AI and machine learning could be used for anticipating and detecting fraud, suspicious transactions, default, and the

risk of cyber-attacks, which could result in better risk management."

- In regard to true (D), "4.1 Possible effects of AI and machine learning on financial markets: (a) AI and machine learning may enable certain market participants to collect and analyse information on a greater scale. In particular, these tools may help market participants to understand the relationship between the formulation of market prices and various factors, such as in sentiment analysis. This could reduce information asymmetries and thus contribute to the efficiency and stability of markets; (b) AI and machine learning may lower market participants' trading costs. Moreover, AI and machine learning may enable them to adjust their trading and investment strategies in accordance with a changing environment in a swift manner, thus improving price discovery and reducing overall transaction costs in the system."

Q-39. Solution: B

In 2005, financial carbon footprints were published in the financial portfolios for several asset managers.

Q-40. Solution: D

The following five factors are reasons climate change risk is mispriced unprecedented phenomena, radical uncertainty, nonnormal probability distributions, bounded rationality, and discrepancy in time horizons Radical uncertainty refers to the complexity and multiplicity resulting from climate risks that are uninsurable and unmeasurable in quantitative terms. Climate-related risks can only be measured in qualitative terms.

Q-41. Solution: D

Risk-free rate (RFR) benchmarks such as OIS are derived on active markets outside money markets and can create a term structure.

Conversely, they do not reflect the marginal costs of borrowing and lending for banks.

Q-42. Solution: A

Despite shortcomings in IBOR-linked reference rates, they are still widely used, and new securities are linked more often to LIBOR than alternative benchmarks. Problems with using LIBOR as a reference rate include the following: (1) rates are subject to manipulation, (2) there is inactivity in the interbank deposit markets, (3) there is an increased variance of individual bank credit risk, and (4) banks rely more on less risky wholesale funding in the form of repos.