GARP
FRM | Financial Risk Manager

2020

FRM®

PRE-STUDY

Practice Exam Part II

Updated 01/21/20

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Introduction

The FRM Exam is a practice-oriented examination. Its questions are derived from a combination of theory, as set forth in the core readings, and "real-world" work experience. Candidates are expected to understand risk management concepts and approaches and how they would apply to a risk manager's day-to-day activities.

The FRM Exam is also a comprehensive examination, testing a risk professional on a number of risk management concepts and approaches. It is very rare that a risk manager will be faced with an issue that can immediately be slotted into one category. In the real world, a risk manager must be able to identify any number of risk-related issues and be able to deal with them effectively.

The 2020 FRM Pre-Study Part I and Part II Practice Exams have been developed to aid candidates in their preparation for the FRM Exam in May and November 2020. These Practice Exams are based on a sample of questions from prior FRM Exams and are suggestive of the questions that will be on the 2020 FRM Exam.

The 2020 FRM Pre-Study Part I Practice Exam contains 25 multiple-choice questions and the 2020 FRM Pre-Study Part II Practice Exam contains 20 multiple-choice questions.

The 2020 FRM Practice Exams do not necessarily cover all topics to be tested in the 2020 FRM Exam as any test samples from the universe of testable possible knowledge points. However, the questions selected for inclusion in the Practice Exams were chosen to be broadly reflective of the material assigned for 2020 as well as to represent the style of question that the FRM Committee considers appropriate based on assigned material.

For a complete list of current topics, core readings, and key learning objectives, candidates should refer to the 2020 FRM Exam Study Guide and 2020 FRM Learning Objectives.

Core readings were selected by the FRM Committee to assist candidates in their review of the subjects covered by the Exam. Questions for the FRM Exam are derived from the core readings. It is strongly suggested that candidates study these readings in depth prior to sitting for the Exam.

Reference Table: Let Z be a standard normal random variable.

z	P(Z<z)	z	P(Z<z)	z	P(Z<z)	z	P(Z<z)	z	P(Z<z)	z	P(Z<z)
-3	0.0013	-2.50	0.0062	-2.00	0.0228	-1.50	0.0668	-1.00	0.1587	-0.50	0.3085
-2.99	0.0014	-2.49	0.0064	-1.99	0.0233	-1.49	0.0681	-0.99	0.1611	-0.49	0.3121
-2.98	0.0014	-2.48	0.0066	-1.98	0.0239	-1.48	0.0694	-0.98	0.1635	-0.48	0.3156
-2.97	0.0015	-2.47	0.0068	-1.97	0.0244	-1.47	0.0708	-0.97	0.1660	-0.47	0.3192
-2.96	0.0015	-2.46	0.0069	-1.96	0.0250	-1.46	0.0721	-0.96	0.1685	-0.46	0.3228
-2.95	0.0016	-2.45	0.0071	-1.95	0.0256	-1.45	0.0735	-0.95	0.1711	-0.45	0.3264
-2.94	0.0016	-2.44	0.0073	-1.94	0.0262	-1.44	0.0749	-0.94	0.1736	-0.44	0.3300
-2.93	0.0017	-2.43	0.0075	-1.93	0.0268	-1.43	0.0764	-0.93	0.1762	-0.43	0.3336
-2.92	0.0018	-2.42	0.0078	-1.92	0.0274	-1.42	0.0778	-0.92	0.1788	-0.42	0.3372
-2.91	0.0018	-2.41	0.0080	-1.91	0.0281	-1.41	0.0793	-0.91	0.1814	-0.41	0.3409
-2.9	0.0019	-2.40	0.0082	-1.90	0.0287	-1.40	0.0808	-0.90	0.1841	-0.40	0.3446
-2.89	0.0019	-2.39	0.0084	-1.89	0.0294	-1.39	0.0823	-0.89	0.1867	-0.39	0.3483
-2.88	0.0020	-2.38	0.0087	-1.88	0.0301	-1.38	0.0838	-0.88	0.1894	-0.38	0.3520
-2.87	0.0021	-2.37	0.0089	-1.87	0.0307	-1.37	0.0853	-0.87	0.1922	-0.37	0.3557
-2.86	0.0021	-2.36	0.0091	-1.86	0.0314	-1.36	0.0869	-0.86	0.1949	-0.36	0.3594
-2.85	0.0022	-2.35	0.0094	-1.85	0.0322	-1.35	0.0885	-0.85	0.1977	-0.35	0.3632
-2.84	0.0023	-2.34	0.0096	-1.84	0.0329	-1.34	0.0901	-0.84	0.2005	-0.34	0.3669
-2.83	0.0023	-2.33	0.0099	-1.83	0.0336	-1.33	0.0918	-0.83	0.2033	-0.33	0.3707
-2.82	0.0024	-2.32	0.0102	-1.82	0.0344	-1.32	0.0934	-0.82	0.2061	-0.32	0.3745
-2.81	0.0025	-2.31	0.0104	-1.81	0.0351	-1.31	0.0951	-0.81	0.2090	-0.31	0.3783
-2.8	0.0026	-2.30	0.0107	-1.80	0.0359	-1.30	0.0968	-0.80	0.2119	-0.30	0.3821
-2.79	0.0026	-2.29	0.0110	-1.79	0.0367	-1.29	0.0985	-0.79	0.2148	-0.29	0.3859
-2.78	0.0027	-2.28	0.0113	-1.78	0.0375	-1.28	0.1003	-0.78	0.2177	-0.28	0.3897
-2.77	0.0028	-2.27	0.0116	-1.77	0.0384	-1.27	0.1020	-0.77	0.2206	-0.27	0.3936
-2.76	0.0029	-2.26	0.0119	-1.76	0.0392	-1.26	0.1038	-0.76	0.2236	-0.26	0.3974
-2.75	0.0030	-2.25	0.0122	-1.75	0.0401	-1.25	0.1056	-0.75	0.2266	-0.25	0.4013
-2.74	0.0031	-2.24	0.0125	-1.74	0.0409	-1.24	0.1075	-0.74	0.2296	-0.24	0.4052
-2.73	0.0032	-2.23	0.0129	-1.73	0.0418	-1.23	0.1093	-0.73	0.2327	-0.23	0.4090
-2.72	0.0033	-2.22	0.0132	-1.72	0.0427	-1.22	0.1112	-0.72	0.2358	-0.22	0.4129
-2.71	0.0034	-2.21	0.0136	-1.71	0.0436	-1.21	0.1131	-0.71	0.2389	-0.21	0.4168
-2.7	0.0035	-2.20	0.0139	-1.70	0.0446	-1.20	0.1151	-0.70	0.2420	-0.20	0.4207
-2.69	0.0036	-2.19	0.0143	-1.69	0.0455	-1.19	0.1170	-0.69	0.2451	-0.19	0.4247
-2.68	0.0037	-2.18	0.0146	-1.68	0.0465	-1.18	0.1190	-0.68	0.2483	-0.18	0.4286
-2.67	0.0038	-2.17	0.0150	-1.67	0.0475	-1.17	0.1210	-0.67	0.2514	-0.17	0.4325
-2.66	0.0039	-2.16	0.0154	-1.66	0.0485	-1.16	0.1230	-0.66	0.2546	-0.16	0.4364
-2.65	0.0040	-2.15	0.0158	-1.65	0.0495	-1.15	0.1251	-0.65	0.2578	-0.15	0.4404
-2.64	0.0041	-2.14	0.0162	-1.64	0.0505	-1.14	0.1271	-0.64	0.2611	-0.14	0.4443
-2.63	0.0043	-2.13	0.0166	-1.63	0.0516	-1.13	0.1292	-0.63	0.2643	-0.13	0.4483
-2.62	0.0044	-2.12	0.0170	-1.62	0.0526	-1.12	0.1314	-0.62	0.2676	-0.12	0.4522
-2.61	0.0045	-2.11	0.0174	-1.61	0.0537	-1.11	0.1335	-0.61	0.2709	-0.11	0.4562
-2.6	0.0047	-2.10	0.0179	-1.60	0.0548	-1.10	0.1357	-0.60	0.2743	-0.10	0.4602
-2.59	0.0048	-2.09	0.0183	-1.59	0.0559	-1.09	0.1379	-0.59	0.2776	-0.09	0.4641
-2.58	0.0049	-2.08	0.0188	-1.58	0.0571	-1.08	0.1401	-0.58	0.2810	-0.08	0.4681
-2.57	0.0051	-2.07	0.0192	-1.57	0.0582	-1.07	0.1423	-0.57	0.2843	-0.07	0.4721
-2.56	0.0052	-2.06	0.0197	-1.56	0.0594	-1.06	0.1446	-0.56	0.2877	-0.06	0.4761
-2.55	0.0054	-2.05	0.0202	-1.55	0.0606	-1.05	0.1469	-0.55	0.2912	-0.05	0.4801
-2.54	0.0055	-2.04	0.0207	-1.54	0.0618	-1.04	0.1492	-0.54	0.2946	-0.04	0.4840
-2.53	0.0057	-2.03	0.0212	-1.53	0.0630	-1.03	0.1515	-0.53	0.2981	-0.03	0.4880
-2.52	0.0059	-2.02	0.0217	-1.52	0.0643	-1.02	0.1539	-0.52	0.3015	-0.02	0.4920
-2.51	0.0060	-2.01	0.0222	-1.51	0.0655	-1.01	0.1562	-0.51	0.3050	-0.01	0.4960

Special Instructions and Definitions

1. Unless otherwise indicated, interest rates are assumed to be continuously compounded.
2. Unless otherwise indicated, option contracts are assumed to be on one unit of the underlying asset.
3. bp(s) = basis point(s)
4. CAPM = capital asset pricing model
5. CCP = central counterparty or central clearing counterparty
6. CDO = collateralized debt obligation(s)
7. CDS = credit default swap(s)
8. CEO, CFO, CIO, and CRO are: chief executive, financial, investment, and risk officers, respectively
9. CVA = credit value adjustment
10. ERM = enterprise risk management
11. ES = expected shortfall
12. EWMA = exponentially weighted moving average
13. GARCH = generalized auto-regressive conditional heteroskedasticity
14. LIBOR = London interbank offered rate
15. MBS = mortgage-backed-security(securities)
16. OIS = overnight indexed swap
17. OTC = over-the-counter
18. RAROC = risk-adjusted return on capital
19. VaR = value-at-risk
20. The following acronyms are used for selected currencies:

Acronym	Currency
AUD	Australian dollar
BRL	Brazilian real
CAD	Canadian dollar
CNY	Chinese yuan
EUR	euro

Acronym	Currency
GBP	British pound sterling
INR	Indian rupee
JPY	Japanese yen
SGD	Singapore dollar
USD	US dollar

2020 FRM Part II Pre-Study Practice Exam – Candidate Answer Sheet

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1. 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.

2. A bank buys a bond on its coupon payment date. Three months later, in order to generate immediate liquidity, the bank decides to repo the bond. Details of the bond and repo transaction are as follows:

Notional (USD)	100,000
Coupon (semi-annual)	6%
Current bond price	97
Repo haircut	10%
Repo interest	4%

If the repo contract expires 6 months from now, what is the bank's expected cash outflow at the end of the repo transaction?

A. USD 89,046
B. USD 90,423
C. USD 93,177
D. USD 100,470

3. A market risk manager seeks to calculate the price of a 2-year zero-coupon bond. The 1-year interest rate today is 8.0%. There is a 50% probability that the 1-year interest rate will be 10.0% in 1 year and a 50% probability that it will be 6.0% in 1 year. Assuming the risk premium of duration risk is 40 bps each year, and the bond's face value is EUR 1,000, which of the following should be the price of the zero-coupon bond?

A. EUR 822.98
B. EUR 854.47
C. EUR 905.30
D. EUR 921.66

4. The CEO of a large bank has reported that the bank's tools and processes for managing operational risk are consistent with Basel II and Basel III guidelines for operational risk governance. Which of the following actions and principles of the bank is correct?

A. The bank uses outsourcing to mitigate the operational risk that should be addressed by the management.
B. As the highest-level executive of senior management, the CEO approves the bank's risk appetite and tolerance statement for operational risk.
C. The operational risk management framework established by the bank is subject to independent review.
D. Department managers monitor their departments' operational risk profiles and losses and enforce compliance with company risk policies.

5. A mid-sized investment bank conducts several trades. As part of its risk control, it has entered into netting agreements on 10 equity trade positions with an average correlation of 0.27. The firm believes that it can improve upon the diversification benefit of netting by revising the current agreement. Assuming values of future trade positions are normally distributed with zero mean and equal variance, which of the following trade combinations would increase the firm's expected netting benefit the most from the current level?

Trade Combination	Number of Positions	Average Correlation
L	5	0.29
M	8	0.20
P	12	-0.05
Q	14	-0.04

A. Trade combination L
B. Trade combination M
C. Trade combination P
D. Trade combination Q

6. A packaging materials manufacturer is considering a project that has an estimated RAROC of 12%. Suppose that the risk-free rate is 4% per year, the expected market rate of return is 10% per year, and the company's equity beta is 1.6. Using the criterion of adjusted RAROC for the risk of returns, the company should:

A. Reject the project because the adjusted RAROC is higher than the market expected excess return.
B. Accept the project because the adjusted RAROC is higher than the market expected excess return.
C. Reject the project because the adjusted RAROC is lower than the risk-free rate.
D. Accept the project because the adjusted RAROC is lower than the risk-free rate.

7. A credit manager who is well versed in lessons learned from the 2007–2009 subprime mortgage crisis in the US is overseeing the structured credit book of a bank in order to identify potential problems of information flow (frictions) among the parties involved in the securitization process. Which of the following is a correct combination of a potential friction in the securitization process and an appropriate mechanism to mitigate that friction?

A. Friction between the asset manager and the investor: Principal-Agent problem. This problem can be mitigated by establishing investment mandates and evaluating the asset manager’s performance.
B. Friction between the arranger and the originator: Model error problem. This problem can be mitigated by the arranger providing a credit enhancement to the securitized products with its own funding.
C. Friction between the investor and credit rating agencies: Moral hazard problem. This problem can be mitigated by requiring credit rating agencies to be paid by originators and not by investors for their rating services.
D. Friction between the servicer and the mortgagor: Adverse selection problem. This problem can be mitigated by the mortgagor applying due diligence on the servicer.

8. Large dealer banks have often financed significant fractions of their assets using short-term (overnight) repurchase agreements in which creditors hold bank securities as collateral against default losses. The table below shows the quarter-end financing of four A-rated broker-dealer banks (all values are in USD billion):

	Bank P	**Bank Q**	**Bank R**	**Bank S**
Financial Instruments Owned	339	656	835	750
Pledged as collateral	139	258	209	472
Not pledged	200	398	626	278

In the event that repo creditors become equally nervous about each bank's solvency, which bank is most vulnerable to a liquidity crisis?

A. Bank P
B. Bank Q
C. Bank R
D. Bank S

9. A gold mining company has outstanding optionless zero-coupon bonds with a face value of CAD 115 million and a current market value of CAD 100 million. The company's bonds mature in 2 years. Treasury notes with a 2-year maturity have a continuously compounded yield of 4.8% per year. What is the average credit spread of the company's bonds?

A. 1.37%
B. 2.07%
C. 2.19%
D. 3.43%

10. A hedge fund risk manager plans to adopt an interest rate term structure model whose risk neutral dynamics display mean reversion and a time-varying drift. The manager is considering the Vasicek model as one of the candidates. Which of the following best describes a feature of the Vasicek model?

A. Shocks to short-term rates give rise to a downward-sloping term structure of volatility and the model allows for a time dependent drift.
B. The short-term rates tend toward a long run equilibrium value and the expected value of the change in short-term rates is always zero over time.
C. Shocks to short-term rates affect all rates equally, giving rise to parallel shifts.
D. There is no mean reversion and the risk premium corresponds to a constant drift in the Vasicek model.

11. A risk manager is evaluating the risks of a portfolio of stocks. Currently, the portfolio is valued at CAD 248 million and contains CAD 15 million in stock T. The annualized standard deviations of returns of the overall portfolio and of stock T are 16% and 13%, respectively. The correlation of returns between the portfolio and stock T is 0.45. Assuming the risk analyst uses a 1-year 95% VaR and the returns are normally distributed, what is the component VaR of stock T?

A. CAD 0.096 million
B. CAD 1.444 million
C. CAD 2.041 million
D. CAD 3.948 million

12. A treasurer at a regional bank is assessing the bank's liquidity position. The treasurer estimates that the following cash inflows and outflows will occur in the next week:

Cash Flows	Amount (millions of USD)
Deposit withdrawals	50
Deposit inflows	80
Scheduled loan repayments	120
Acceptable loan requests	100
Borrowings from money market	80
Operating expenses	70
Stockholder dividend payments	40
Repayment of bank borrowings	60

Which of the following is the correct amount, at the week's end, for the bank's net liquidity position?

A. -200
B. -80
C. -40
D. 80

13. Pillar 1 of the Basel II framework allows banks to use various approaches to calculate the capital requirements for credit risk, operational risk, and market risk. Which of the following Basel II approaches allows a bank to use its own estimates of recovery rates?

A. The standardized measurement approach for operational risk
B. The advanced internal ratings-based approach for credit risk
C. The foundation internal ratings-based approach for credit risk
D. The fundamental review of the trading book (FRTB) approach for securitized products

14. A regional commercial bank is considering a loan to be fully funded by deposits, with the following parameters:

- Loan amount: CNY 3.8 billion
- Average annual interest rate paid on deposits: 0.6%
- Annual interest rate received on loan: 4.1%
- Expected loss: 3.0% of face value of loan
- Annual operating costs: 0.3% of face value of loan
- Economic capital required to support the loan: 15.0%
- Average pre-tax return on economic capital: 2.0%
- Effective tax rate: 38%
- Other transfer costs: CNY 0

What is the after-tax RAROC for this loan?

A. 0.31%
B. 2.07%
C. 3.33%
D. 10.07%

15. The CRO of a hedge fund asks the risk team to develop a term-structure model that is appropriate for fitting interest rates for use in the fund's options pricing practice. The risk team evaluates several interest rate models with drift and volatility functions. Which of the following is a correct description of the specified model?

A. In the Ho-Lee model, the drift of the interest rate process is presumed to be constant.
B. In the Ho-Lee model, short term rates are presumed to have a mean-reversion function.
C. In the Cox-Ingersoll-Ross model, short term rates are presumed to have a lognormal distribution.
D. In the Cox-Ingersoll-Ross model, the basis-point volatility of the short-term rate is presumed to be proportional to the square root of the rate.

16. The director of an equity mutual fund is reviewing a portfolio construction technique proposed by a new portfolio manager who has recently been allocated capital to manage. The fund typically grants its portfolio managers flexibility in selecting and implementing appropriate portfolio construction procedures but requires that any methodology adopted fulfills key risk control objectives set by the firm. Which of the following portfolio construction techniques and its capability for 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 portfolio construction techniques 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 risks.
D. When using the linear programming technique, risk is controlled by selecting the portfolio with the lowest level of active risk.

17. A risk manager has asked a junior analyst to estimate the implied default probability for a BBB-rated discount corporate bond. The continuously compounded annual yields of other fixed-income securities are given below:

- 3-year Treasury note (a risk-free bond): 2%
- 1-year BBB-rated discount bond: 4%
- 2-year BBB-rated discount bond: 7%
- 3-year BBB-rated discount bond: 10%

If the recovery rate on the 3-year BBB-rated discount bond is expected to be 0% in the event of default, which of the following is the best estimate of the risk-neutral probability that the BBB-rated discount bond defaults within the next 3 years?

A. 6.55%
B. 14.55%
C. 21.34%
D. 25.92%

18. A bank is using the VaR and stressed VaR market risk framework in line with the Basel II.5 guidelines. The bank's internal models for market risk have generated the following risk measures (in USD million) for the current trading book positions:

Confidence Level	Latest Available 10-day VaR	Latest Available 10-day Stressed VaR	Average 10-day VaR of Previous 60 Days	Average 10-day Stressed VaR of Previous 60 Days
95.0%	289	501	271	572
99.0%	513	993	489	1,187
99.9%	607	1,347	564	1,412

Assuming the supervisory authority has set the multiplication factors for both the VaR and the stressed VaR values to 3, what is the correct capital requirement for general market risk for the bank under Basel II.5?

A. USD 1,248 million
B. USD 1,533 million
C. USD 4,557 million
D. USD 5,028 million

19. Bank HJK has written puts on Bank PQR stock to a hedge fund and sold CDS protection on Bank PQR to a manufacturer. Bank HJK and Bank PQR operate in several of the same businesses and geographies and their performances are highly correlated. Many in the market are concerned that rising interest rates could negatively impact the credit quality of Bank HJK's numerous borrowers, which in turn would increase the credit spread of Bank HJK. From the perspectives of the hedge fund and the manufacturer, which of the following is correct with respect to their counterparty risk exposure to Bank HJK?

	Hedge Fund	Manufacturer
A.	Right-way risk	Right-way risk
B.	Right-way risk	Wrong-way risk
C.	Wrong-way risk	Right-way risk
D.	Wrong-way risk	Wrong-way risk

20. A wealth management firm has JPY 86 billion in assets under management. The portfolio manager computes the daily VaR at various confidence levels as follows:

Confidence Level	VaR (JPY)
95.0%	397,463,000
95.5%	401,682,500
96.0%	406,224,500
96.5%	418,453,000
97.0%	428,934,000
97.5%	439,415,500
98.0%	451,993,000
98.5%	468,763,000
99.0%	490,773,000
99.5%	524,663,000

What is the closest estimate of the daily ES at the 97.5% confidence level?

A. JPY 398 million
B. JPY 400 million
C. JPY 484 million
D. JPY 497 million

2020 FRM Part II Pre-Study Practice Exam – Answer Key

1.	A
2.	B
3.	B
4.	C
5.	D
6.	C
7.	A
8.	D
9.	C
10.	A
11.	B
12.	C
13.	B
14.	B
15.	D
16.	A
17.	C
18.	D
19.	D
20.	C

1. 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.

Correct Answer: A

Explanation: 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.

Section: Risk Management and Investment Management

Reference: Kevin R. Mirabile, Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance, 2nd Edition (Hoboken, NJ: Wiley Finance, 2016). Chapter 12 - Performing Due Diligence on Specific Managers and Funds

Learning Objective: Describe criteria that can be evaluated in assessing a fund's risk management process.

2. A bank buys a bond on its coupon payment date. Three months later, in order to generate immediate liquidity, the bank decides to repo the bond. Details of the bond and repo transaction are as follows:

Notional (USD)	100,000
Coupon (semi-annual)	6%
Current bond price	97
Repo haircut	10%
Repo interest	4%

If the repo contract expires 6 months from now, what is the bank's expected cash outflow at the end of the repo transaction?

A. USD 89,046
B. USD 90,423
C. USD 93,177
D. USD 100,470

Correct Answer: B

Explanation: A. Incorrect. Left out the accrued interest of 6%*0.25 in the correct equation for cash inflow.

B. Correct. Cash inflow at beginning of repo: (100,000)*(97%+6%*0.25)*(1-10%) = 88,650; Cash outflow at end of repo: 88,650*(1+4%*0.5)=90,423

C. Incorrect. Used 1 instead of 97% for price in the correct equation for cash inflow.

D. Incorrect. Left out haircut of 10% in the correct equation for cash inflow.

Section: Liquidity and Treasury Risk

Reference: Bruce Tuckman and Angel Serrat, "Fixed Income Securities: Tools for Today's Markets, 3rd Edition". Chapter 12. Repurchase Agreements and Financing

Learning Objective: Discuss the mechanics of repurchase agreements (repos) and calculate the settlement for a repo transaction.

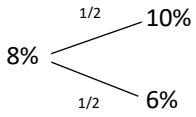
3. A market risk manager seeks to calculate the price of a 2-year zero-coupon bond. The 1-year interest rate today is 8.0%. There is a 50% probability that the 1-year interest rate will be 10.0% in 1 year and a 50% probability that it will be 6.0% in 1 year. Assuming the risk premium of duration risk is 40 bps each year, and the bond's face value is EUR 1,000, which of the following should be the price of the zero-coupon bond?

A. EUR 822.98
B. EUR 854.47
C. EUR 905.30
D. EUR 921.66

Correct Answer: B

Explanation: B is correct.

We can find the price of the 2-year zero-coupon bond by using a binomial tree as follows:



To find the value at date 0, we must first find the expected value of the price on date 1:

$$\frac{1}{2}\left(\frac{1000}{1.104}+\frac{1000}{1.064}\right) = \text{EUR } 922.8234,$$

and then discount this by the rate at date 0:

$$\frac{\frac{1}{2}\left(\frac{1000}{1.104}+\frac{1000}{1.064}\right)}{1.08} = \text{EUR } 854.4661.$$

Section: Market Risk Measurement and Management

Reference: Bruce Tuckman and Angel Serrat, Fixed Income Securities, 3rd Edition (Hoboken, NJ: John Wiley & Sons, 2011), Chapter 8 - The Evolution of Short Rates and the Shape of the Term Structure

Learning Objective: Calculate the price and return of a zero coupon bond incorporating a risk premium.

4. The CEO of a large bank has reported that the bank's tools and processes for managing operational risk are consistent with Basel II and Basel III guidelines for operational risk governance. Which of the following actions and principles of the bank is correct?

A. The bank uses outsourcing to mitigate the operational risk that should be addressed by management.
B. As the highest-level executive of senior management, the CEO approves the bank's risk appetite and tolerance statement for operational risk.
C. The operational risk management framework established by the bank is subject to independent review.
D. Department managers monitor their departments' operational risk profiles and losses and enforce compliance with company risk policies.

Correct Answer: C

Explanation: C is correct. The board of directors of a bank should ensure that the bank's framework is subject to independent review by audit or other appropriately trained parties.

A is incorrect. "Banks should view risk transfer tools as complementary to, rather than a replacement for, thorough internal operational risk control." Risk transfer via outsourcing should not be used to relieve management of their responsibility to manage operational risk, and outsourcing can actually introduce additional operational risks to the bank.

B is incorrect. The board of directors should approve and review the risk appetite of the bank.

D is incorrect. Staff responsible for monitoring and enforcing compliance with the institution's risk policy should have authority independent from the units they oversee.

Section: Operational Risk and Resiliency

Reference: Principles for the Sound Management of Operational Risk, (Basel Committee on Banking Supervision Publication, June 2011).

Learning Objective: Summarize the fundamental principles of operational risk management as suggested by the Basel committee.

5. A mid-size investment bank conducts several trades. As part of its risk control, it has entered into netting agreements on 10 equity trade positions with an average correlation of 0.27. The firm believes that it can improve upon the diversification benefit of netting by revising the current agreement. Assuming values of future trade positions are normally distributed with zero mean and equal variance, which of the following trade combinations would increase the firm's expected netting benefit the most from the current level?

Trade Combination	Number of Positions	Average Correlation
L	5	0.29
M	8	0.20
P	12	-0.05
Q	14	-0.04

A. Trade combination L
B. Trade combination M
C. Trade combination P
D. Trade combination Q

Correct Answer: D

Explanation: D is correct. The netting factor represents the ratio of net to gross exposure and is expressed as: $Netting\ Factor = \frac{\sqrt{n + n(n-1)\rho}}{n}$

where n represents the number of exposures and ρ represents the average correlation.

Therefore, a lower netting factor implies higher netting benefits.

For the current position, when n = 10 and ρ = 0.27:

$$Netting\ Factor = \frac{\sqrt{n + n(n-1)\rho}}{n} = \frac{\sqrt{10 + 10(10-1)(0.27)}}{10} = 0.5857 = 58.57\%$$

When n = 14 and ρ = -0.04, there is the most reduction in netting factor (the most increase in netting benefit for combination Q):

$$Netting\ Factor = \frac{\sqrt{n + n(n-1)\rho}}{n} = \frac{\sqrt{14 + 14(14-1)(-0.04)}}{14} = 0.1852 = 18.52\%$$

A is incorrect. When n = 5 and ρ = 0.29, there is deterioration in netting benefit:

$$Netting\ Factor = \frac{\sqrt{n + n(n-1)\rho}}{n} = \frac{\sqrt{5 + 5(5-1)(0.29)}}{5} = 0.6573 = 65.73\%$$

B is incorrect. When n = 8 and ρ = 0.20, there is a modest improvement in netting benefit but not as much as for trade combination Q:

$$Netting\ Factor = \frac{\sqrt{n + n(n-1)\rho}}{n} = \frac{\sqrt{8 + 8(8-1)(0.20)}}{8} = 0.5477 = 54.77\%$$

C is incorrect. When n = 12 and ρ = –0.05, there is a reasonable increase in netting benefit but not as large as for trade combination Q:

$$Netting\ Factor = \frac{\sqrt{n + n(n-1)\rho}}{n} = \frac{\sqrt{12 + 12(12-1)(-0.05)}}{12} = 0.1936 = 19.36\%$$

Section: Credit Risk Measurement and Management

Reference: Jon Gregory, The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 3rd Edition (West Sussex, UK: John Wiley & Sons, 2015). Chapter 7 - Credit Exposure and Funding

Learning Objective: Explain the impact of netting on exposure, the benefit of correlation, and calculate the netting factor.

6. A packaging materials manufacturer is considering a project that has an estimated RAROC of 12%. Suppose that the risk-free rate is 4% per year, the expected market rate of return is 10% per year, and the company's equity beta is 1.6. Using the criterion of adjusted RAROC for the risk of returns, the company should:

A. Reject the project because the adjusted RAROC is higher than the market expected excess return.
B. Accept the project because the adjusted RAROC is higher than the market expected excess return.
C. Reject the project because the adjusted RAROC is lower than the risk-free rate.
D. Accept the project because the adjusted RAROC is lower than the risk-free rate.

Correct Answer: C

Explanation: C is correct. Consider the adjusted RAROC for the risk of returns:

Adjusted RAROC = RAROC - $\beta_E*(R_m - R_f)$,

where:

β_E = Beta of the equity of the firm

R_m = Expected market rate of return

R_f = Risk-free rate of interest

$\beta_E*(R_m - R_f)$ = Risk premium of the project.

Adjusted RAROC is simply "RAROC adjusted for the systematic riskiness of the returns." Adjusted RAROC can be used in evaluating the project in the following way: if the project's "RAROC less the project's risk premium" is greater than the risk-free rate, then the firm's shareholders are compensated for the non-diversifiable systematic risk they bear when investing in the activity, assuming the investors hold a well-diversified portfolio (i.e., the project adds value). That is, if the project's adjusted RAROC exceeds the risk-free rate, it should be accepted by the firm. Otherwise, if it is less than the risk-free rate, the project should be rejected.

Given RAROC = 12%, β_E = 1.6, R_m = 10% and R_f = 4%, one can compute Adjusted RAROC = 0.12-1.6*(0.10- 0.04) = 0.024 = 2.4% and is less that R_f = 4%. Thus, the project is rejected.

Section: Operational Risk and Resiliency

Reference: Michel Crouhy, Dan Galai and Robert Mark, The Essentials of Risk Management, 2nd edition (New York: McGraw-Hill, 2014). Chapter 17 - Risk Capital Attribution and Risk-Adjusted Performance Measurement.

Learning Objective: Compute the adjusted RAROC for a project to determine its viability.

7. A credit manager who is well versed in lessons learned from the 2007–2009 subprime mortgage crisis in the US is overseeing the structured credit book of a bank in order to identify potential problems of information flow (frictions) among the parties involved in the securitization process. Which of the following is a correct combination of a potential friction in the securitization process and an appropriate mechanism to mitigate that friction?

A. Friction between the asset manager and the investor: Principal-Agent problem. This problem can be mitigated by establishing investment mandates and evaluating the asset manager's performance.
B. Friction between the arranger and the originator: Model error problem. This problem can be mitigated by the arranger providing a credit enhancement to the securitized products with its own funding.
C. Friction between the investor and credit rating agencies: Moral hazard problem. This problem can be mitigated by requiring credit rating agencies to be paid by originators and not by investors for their rating services.
D. Friction between the servicer and the mortgagor: Adverse selection problem. This problem can be mitigated by the mortgagor applying due diligence on the servicer.

Correct Answer: A

Explanation: A is correct. Friction between the asset manager and the investor is a principal-agent problem. The investor is less sophisticated than the asset manager, does not fully understand the investment strategy of the asset manager, has uncertainty about the manager's ability, and does not observe any effort that the manager makes to conduct due diligence. Some of the ways to mitigate this friction is through the use of investment mandate, and the evaluation of manager performance relative to its peers or a peer benchmark.

B is incorrect. Friction between the arranger and originator is a predatory borrowing and lending problem.

C is incorrect. Friction between the investor and credit rating agencies is a model error problem.

D is incorrect. Friction between the servicer and the mortgagor is a moral hazard problem.

Section: Credit Risk Measurement and Management

Reference: Adam Ashcraft and Til Schuermann, "Understanding the Securitization of Subprime Mortgage Credit," Federal Bank of New York Staff Reports, No. 318 (March 2008).

Learning Objective: Identify and describe key frictions in subprime mortgage securitization, and assess the relative contribution of each factor to the subprime mortgage problems.

8. Large dealer banks have often financed significant fractions of their assets using short-term (overnight) repurchase agreements in which creditors hold bank securities as collateral against default losses. The table below shows the quarter-end financing of four A-rated broker-dealer banks (all values are in USD billion):

	Bank P	Bank Q	Bank R	Bank S
Financial Instruments Owned	339	656	835	750
Pledged as collateral	139	258	209	472
Not pledged	200	398	626	278

In the event that repo creditors become equally nervous about each bank's solvency, which bank is most vulnerable to a liquidity crisis?

A. Bank P
B. Bank Q
C. Bank R
D. Bank S

Correct Answer: D

Explanation:

	Bank P	Bank Q	Bank R	Bank S
Financial Instruments Owned	339	656	835	750
Pledged as collateral	139	258	209	472
Not pledged	200	398	626	278
Fraction Pledged	41%	39%	25%	63%

D is correct. A liquidity crisis could materialize if repo creditors become nervous about a bank's solvency and choose not to renew their positions. If enough creditors choose not to renew, the bank could likely be unable to raise sufficient cash by other means on such short notice, thereby precipitating a crisis. The bank may therefore be forced to sell its assets in a hurry to buyers that know it needs to sell quickly. This leads to the potential for a fire sale and supports using the proportion of assets covered by repos as a signal of liquidity risk. Also, low prices recorded in a fire sale could lower the market valuation of securities not sold, and thus reduce the amount of cash that could be raised through repurchase agreements collateralized by those securities. Overall, this vulnerability is directly related to the proportion of assets a bank has pledged as collateral.

Bank S is most vulnerable since it has the largest dependence on short-term repo financing (i.e. the highest percentage of its assets out of the four banks is pledged as collateral (see additional discussions in the 2018 FRM Reading [OR-19], pages 353-358).

Section: Liquidity and Treasury Risk

Reference: Darrell Duffie, "The Failure Mechanics of Dealer Banks," Journal of Economic Perspectives (2010), Volume 24, Number 1) pp. 51-72.

Learning Objective: Identify situations that can cause a liquidity crisis at a dealer bank and explain responses that can mitigate these risks.

9. A gold mining company has outstanding optionless zero-coupon bonds with a face value of CAD 115 million and a current market value of CAD 100 million. The company's bonds mature in 2 years. Treasury notes with a 2-year maturity have a continuously compounded yield of 4.8% per year. What is the average credit spread of the company's bonds?

A. 1.37%
B. 2.07%
C. 2.19%
D. 3.43%

Correct Answer: C

Explanation: Credit spread = RD – Rf = –(1/T)*ln(D/F) – Rf

where D is value of debt, F is Face value, T = maturity, Rf = risk free rate, RD = yield of the debt (Average maturity should be applied).

In this case the credit spread = – (1/2)*ln(100/115) – 0.048 = 6.99% – 4.80% = 2.19%.

A is incorrect. 1.37% is the difference between the bond's semi-annual yield (= 3.43%, as calculated in B below) and 2.4%, the semi-annual yield of the Treasury note (=4.8%/2).

B is incorrect. It uses a wrong procedure of not making continuous compounding. Without continuous compounding the average yield on the bond is 6.87% (Calculator: PV = -115, FV = 100, N = 2*2=4, PMT = 0, then I/Y = 6.87%). And 2.07% is the difference between 6.87% and the yield of the Treasury note of 4.8%.

D is incorrect. 3.43% is the semi-annual yield of the company's zero-coupon using the bond-pricing formula (Calculator: PV = -115, FV = 100, N = 2*2=4, PMT = 0).

Section: Credit Risk Measurement and Management

Reference: René Stulz, Risk Management & Derivatives (Florence, KY: Thomson South-Western, 2002). Chapter 18, Credit Risks and Credit Derivatives [CR-5].

Learning Objective: Explain the relationship between credit spreads, time to maturity, and interest rates, and calculate credit spread.

10. A hedge fund risk manager plans to adopt an interest rate term structure model whose risk neutral dynamics display mean reversion and a time-varying drift. The manager is considering the Vasicek model as one of the candidates. Which of the following best describes a feature of the Vasicek model?

A. Shocks to short-term rates give rise to a downward-sloping term structure of volatility and the model allows for a time dependent drift.
B. Short-term rates tend toward a long run equilibrium value and the expected value of the change in short-term rates is always zero over time.
C. Shocks to short-term rates affect all rates equally, giving rise to parallel shifts.
D. There is no mean reversion and the risk premium corresponds to a constant drift in the Vasicek model.

Correct Answer: A

Explanation: A is correct. The Vasicek model incorporates mean reversion. The flexibility of the model also allows for risk premium, which enters into the model as constant drift or a drift that changes over time. In a model with mean reversion, shocks to the short rate affect short-term rates more than longer-term rates and give rise to a downward-sloping term structure of volatility.

B is incorrect as the drift of Vasicek model is not always zero.

C is incorrect because shocks to the short rate affect short-term rates more than longer-term rates as Vasicek model comes with mean reversion.

D is incorrect. The Vasicek model incorporates mean reversion. The flexibility of the model also allows for risk premium, which enters into the model as a constant drift or a drift that changes over time.

Section: Market Risk Measurement and Management

Reference: Bruce Tuckman and Angel Serrat, Fixed Income Securities: Tools for Today's Markets, 3rd Edition (Hoboken, NJ: John Wiley & Sons, 2011). Chapter 9 - The Art of Term Structure Models: Drift.

Learning Objective: Describe the process of constructing a simple and recombining tree for a short term rate under the Vasicek Model with mean reversion.

11. A risk manager is evaluating the risks of a portfolio of stocks. Currently, the portfolio is valued at CAD 248 million and contains CAD 15 million in stock T. The annualized standard deviations of returns of the overall portfolio and of stock T are 16% and 13%, respectively. The correlation of returns between the portfolio and stock T is 0.45. Assuming the risk analyst uses a 1-year 95% VaR and the returns are normally distributed, what is the component VaR of stock T?

A. CAD 0.096 million
B. CAD 1.444 million
C. CAD 2.041 million
D. CAD 3.948 million

Correct Answer: B

Explanation: B is correct. The component VaR for stock T ($CVaR_T$) can be presented as:

$CVaR_T = \rho_{T,p} * VaR_T$,

where VaR_T = VaR of stock T and $\rho_{T,p}$= correlation coefficient between stock T and the portfolio.

Let w_T represent the value of stock T,

σ_T represent the standard deviation of stock T returns, and

$\alpha(95\%)$ represent the 95% confidence factor for the VaR estimate, which is 1.645.

Hence,

$VaR_T = w_T * \sigma_T * \alpha(95\%)$ = CAD 15 million x 0.13 x 1.645 = CAD 3.2078 million.

Therefore,

$CVaR_T = \rho_{T,p} * VaR_T$ = 0.45 x 3.2078 = CAD 1.4435 million.

A is incorrect. 0.096 is the marginal VaR of stock T, calculated as follows: (0.45*0.13/0.16)*1.645*0.16. Marginal VaR measure is unitless.

C is incorrect. CAD 2.041 million is the component VaR of stock T if the manager incorrectly uses the 99% VaR, i.e. 15*0.13*2.326*0.45.

D is incorrect. CAD 3.948 million is the incremental VaR of stock T (assuming that the volatility of the portfolio without stock T remains 16% and the correlation of returns between stock T and the portfolio without stock T is 0.45). It is simply the weight of stock T in the portfolio multiplied by the portfolio VaR, i.e. (15/248)*(248*1.645*0.16).

Section: Risk Management and Investment Management

Reference: Philippe Jorion, Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition. (New York, NY: McGraw-Hill, 2007). Chapter 7 - Portfolio Risk: Analytical Methods.

Learning Objective: Define, calculate, and distinguish between the following portfolio VaR measures: individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR, and diversified portfolio VaR.

12. A treasurer at a regional bank is assessing the bank's liquidity position. The treasurer estimates that the following cash inflows and outflows will occur in the next week:

Cash Flows	Amount (millions of USD)
Deposit withdrawals	50
Deposit inflows	80
Scheduled loan repayments	120
Acceptable loan requests	100
Borrowings from money market	80
Operating expenses	70
Stockholder dividend payments	40
Repayment of bank borrowings	60

Which of the following is the correct amount, at the week's end, for the bank's net liquidity position?

A. -200
B. -80
C. -40
D. 80

Correct Answer: C

Explanation: C is correct. -50+80+120-100+80-70-40-60= -40
A is incorrect. Flips the sign for borrowings from money market.
B is incorrect. Flips the sign for scheduled loan repayments and acceptable loan requests.
D is incorrect. Flips the sign for repayment of bank borrowings.

Section: Liquidity and Treasury Risk

Reference: Peter Rose, Sylvia Hudgins, "Bank Management & Financial Services, Ninth Edition", Chapter 11. Liquidity and Reserve Management: Strategies and Policies

Learning Objective: Calculate a bank's net liquidity position and explain factors that affect the supply and demand of liquidity at a bank

13. Pillar 1 of the Basel II framework allows banks to use various approaches to calculate the capital requirements for credit risk, operational risk, and market risk. Which of the following Basel II approaches allows a bank to use its own estimates of recovery rates?

A. The standardized measurement approach for operational risk
B. The advanced internal ratings-based approach for credit risk
C. The foundation internal ratings-based approach for credit risk
D. The fundamental review of the trading book (FRTB) approach for securitized products

Correct Answer: B

Explanation: B is correct. Under the advanced internal ratings-based (Advanced IRB) approach banks supply their own estimates of probability of default (PD), loss given default (LGD) and exposure at default (EAD). Since LGD is dependent on recovery rates, this also implies that the recovery rates are modelled. On the other hand, under the foundation ratings-based approach, they supply only PD, while LGD and EAD are set by the Basel Committee. So, C is incorrect.

A is incorrect. The standardized measurement approach for operational risk has eliminated the use of internal models for modelling operational risk.

D is incorrect. Basel II.5 introduced a Comprehensive Risk Measure for credit sensitive instruments dependent on credit correlation. Banks could use their internal models to calculate the CRM, with supervisory approval, and these models included the estimation of recovery rates. However, the FRTB withdrew the use of the CRM for securitized products due to there being too much volatility between different banks' models in modeling securitizations. Banks are now required to use the standardized approach for these products.

Section: Operational Risk and Resiliency

Reference: John Hull, Risk Management and Financial Institutions, 5th Edition, (Hoboken, NJ: John Wiley & Sons, 2018). Chapter 15 - Basel I, Basel II, and Solvency II and Chapter 18 - Fundamental Review of the Trading Book.

Learning Objective: Describe and contrast the major elements—including a description of the risks covered—of the two options available for the calculation of market risk capital: Standardized Measurement Method and Internal Models Approach.

Describe the changes to the Basel framework for calculating market risk capital under the Fundamental Review of the Trading Book (FRTB), and motivations for these changes

14. A regional commercial bank is considering a loan to be fully funded by deposits, with the following parameters:

- Loan amount: CNY 3.8 billion
- Average annual interest rate paid on deposits: 0.6%
- Annual interest rate received on loan: 4.1%
- Expected loss: 3.0% of face value of loan
- Annual operating costs: 0.3% of face value of loan
- Economic capital required to support the loan: 15.0%
- Average pre-tax return on economic capital: 2.0%
- Effective tax rate: 38%
- Other transfer costs: CNY 0

What is the after-tax RAROC for this loan?

A. 0.31%
B. 2.07%
C. 3.33%
D. 10.07%

Correct Answer: B

Explanation: B is correct. The risk-adjusted after-tax return on capital (RAROC) is computed by:

$$RAROC = \frac{After\_tax\ expected\ risk - adjusted\ net\ income}{Economic\ capital}$$

$$= \frac{ER + ROEC - IC - OC - EL - Taxes \pm Transfers}{Economic\ capital}$$

where,

Economic capital = CNY 3,800,000,000 x 0.15 = CNY 570,000,000,

ER = expected revenue = CNY 3,800,000,000 x 0.041 = CNY 155,800,000,

ROEC = pre-tax return on invested economic capital =

= Economic capital x 0.02 = CNY 570,000,000 x 0.02 = CNY 11,400,000,

IC = interest expense = CNY 3,800,000,000 x 0.006 = CNY 22,800,000,

OC = Operating Cost = CNY 3,800,000,000 x 0.003 = CNY 11,400,000,

EL = expected loss = CNY 3,800,000,000 x 0.03 = CNY 114,000,000,

Taxes = (Revenue + Income – Interest – Operating Cost – Loss)*(Tax rate)

= (155,800,000 + 11,400,000 – 22,800,000 – 11,400,000 – 114,000,000)*(0.38)

= (CNY 19,000,000)*(0.38) = CNY 7,220,000.

Therefore, numerator = 155,800,000 + 11,400,000 – 22,800,000 – 11,400,000 – 114,000,000 – 7,220,000 = CNY 11,780,000.

Thus,

$$RAROC = \frac{11{,}780{,}000}{570{,}000{,}000} = 0.0207 = 2.07\%$$

A is incorrect. 0.31% is the result obtained when the denominator is incorrectly taken to be CNY 3.8 billion instead of being 15% of the loan amount.

C is incorrect. 3.33% is the result obtained when taxes are ignored.

D is incorrect. 10.07% is the result obtained when IC is added instead of subtracting in the numerator.

Section: Operational Risk and Resiliency

Reference: Michel Crouhy, Dan Galai and Robert Mark, The Essentials of Risk Management, 2nd Edition (New York, NY: McGraw-Hill, 2014). Chapter 17, Risk Capital Attribution and Risk-Adjusted Performance Measurement.

Learning Objective: Compute and interpret the RAROC for a project, loan, or loan portfolio, and use RAROC to compare business unit performance.

15. The CRO of a hedge fund asks the risk team to develop a term-structure model that is appropriate for fitting interest rates for use in the fund's options pricing practice. The risk team evaluates several interest rate models with drift and volatility functions. Which of the following is a correct description of the specified model?

A. In the Ho-Lee model, the drift of the interest rate process is presumed to be constant.
B. In the Ho-Lee model, short term rates are presumed to have a mean-reversion function.
C. In the Cox-Ingersoll-Ross model, short term rates are presumed to have a lognormal distribution.
D. In the Cox-Ingersoll-Ross model, the basis-point volatility of the short-term rate is presumed to be proportional to the square root of the rate.

Correct Answer: D

Explanation: D is correct. In the CIR model, the basis-point volatility of the short rate equals σ*sqrt(r) and therefore increases as a function of the square root of the rate.

A is incorrect. In the Ho-Lee model, the drift of the interest rate process is presumed to be time-varying.

B is incorrect. The Ho-Lee model does not incorporate mean reversion

C is incorrect. The distribution of the short rate in the Cox-Ingersoll-Ross model is not lognormal.

Section: Market Risk Measurement and Management

Reference: Bruce Tuckman and Angel Serrat, Fixed Income Securities, 3rd Edition (Hoboken, NJ: John Wiley & Sons, 2011). Chapter 9 - The Art of Term Structure Models: Drift.

Bruce Tuckman and Angel Serrat, Fixed Income Securities, 3rd Edition (Hoboken, NJ: John Wiley & Sons, 2011). Chapter 10 - The Art of Term Structure Models: Volatility and Distribution.

Learning Objective: Describe methods for addressing the possibility of negative short-term rates in term structure models.

Construct a short-term rate tree under the Ho-Lee Model with time-dependent drift.

Describe the short-term rate process under the Cox-Ingersoll-Ross (CIR) and lognormal models.

16. The director of an equity mutual fund is reviewing a portfolio construction technique proposed by a new portfolio manager who has recently been allocated capital to manage. The fund typically grants its portfolio managers flexibility in selecting and implementing appropriate portfolio construction procedures but requires that any methodology adopted fulfills key risk control objectives set by the firm. Which of the following portfolio construction techniques and its capability for 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 portfolio construction techniques 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 risks.
D. When using the linear programming technique, risk is controlled by selecting the portfolio with the lowest level of active risk.

Correct Answer: A

Explanation: A is correct. 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 and the less than perfect nature of most data, it introduces the potential for noise and poor calibration.

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 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.

Section: Risk Management and Investment Management

Reference: Richard Grinold and Ronald Kahn, Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, 2nd Edition (New York, NY: McGraw-Hill, 2000). Chapter 14 - Portfolio Construction.

Learning Objective: Evaluate the strengths and weaknesses of the following portfolio construction techniques: screens, stratification, linear programming, and quadratic programming.

17. A risk manager has asked a junior analyst to estimate the implied default probability for a BBB-rated discount corporate bond. The continuously compounded annual yields of other fixed-income securities are given below:

- 3-year Treasury note (a risk-free bond): 2%
- 1-year BBB-rated discount bond: 4%
- 2-year BBB-rated discount bond: 7%
- 3-year BBB-rated discount bond: 10%

If the recovery rate on the 3-year BBB-rated discount bond is expected to be 0% in the event of default, which of the following is the best estimate of the risk-neutral probability that the BBB-rated discount bond defaults within the next 3 years?

A. 6.55%
B. 14.55%
C. 21.34%
D. 25.92%

Correct Answer: C

Explanation: C is correct. The continuously compounded 3-year spread for the BBB-rated discount bond is 0.10 - 0.02 = 0.08 per year. Note that hazard rate = λ = spread/(1 – recovery rate) = spread = 8% per year (given that recovery rate is zero).

Thus, the risk-neutral probability that the corporate bond will default within the next 3 years is: 1 – exp(-λ*t) = 1 - exp(-0.08*3) = 21.34%.

A is incorrect. 6.55% is the marginal probability of default in year 3 for the 3-year BBB-rated bond: 1 - exp(-0.08*3) – 1 - exp(-0.08*2) = 6.55%

B is incorrect. 14.55% is the 3-year cumulative probability of default of the 3-year BBB-rated bond while incorrectly using the credit spreads of the 1-year, 2-year, and 3-year BBB-rated bonds, and also failing to scale the hazard rates (credit spreads) by the factor of time, i.e., 1-exp(-0.02) + 1-exp(-0.05) + 1 – exp(-0.08).

D is incorrect. 25.92% is the result obtained if the hazard rate for the 3-year BBB-rated bond is taken as equal to its annual yield of 10%.

Section: Credit Risk Measurement and Management

Reference: Allan Malz, Financial Risk Management: Models, History, and Institutions (Hoboken, NJ: John Wiley & Sons, 2011)

Learning Objective: Calculate risk-neutral default rates from spreads.

18. A bank is using the VaR and stressed VaR market risk framework in line with the Basel II.5 guidelines. The bank's internal models for market risk have generated the following risk measures (in USD million) for the current trading book positions:

Confidence Level	Latest Available 10-day VaR	Latest Available 10-day Stressed VaR	Average 10-day VaR of Previous 60 Days	Average 10-day Stressed VaR of Previous 60 Days
95.0%	289	501	271	572
99.0%	513	993	489	1,187
99.9%	607	1,347	564	1,412

Assuming the supervisory authority has set the multiplication factors for both the VaR and the stressed VaR values to 3, what is the correct capital requirement for general market risk for the bank under Basel II.5?

A. USD 1,248 million
B. USD 1,533 million
C. USD 4,557 million
D. USD 5,028 million

Correct Answer: D

Explanation: D is correct. The revised market risk capital requirement (at 99.0% level) is:

Market Risk Capital

$= \max(VaR_{t-1}, m_c * VaR_{60\text{-day Avg}}) + \max(sVaR_{t-1}, m_s * sVaR_{60\text{-day Avg}})$

= max(513, 3*489) + max(993, 3*1,187)
= USD 1,467 million + USD 3,561 million
= USD 5,028 million

Section: Operational Risk and Resiliency

Reference: John Hull, Risk Management and Financial Institutions, 5th Edition (New York, NY: John Wiley & Sons, 2018). Chapter 16 - Basel II.5, Basel III, and Other Post-Crisis Changes.

Learning Objective: Describe and calculate the stressed VaR introduced in Basel 2.5, and calculate the market risk capital charge.

19. Bank HJK has written puts on Bank PQR stock to a hedge fund and sold CDS protection on Bank PQR to a manufacturer. Bank HJK and Bank PQR operate in several of the same businesses and geographies and their performances are highly correlated. Many in the market are concerned that rising interest rates could negatively impact the credit quality of Bank HJK's numerous borrowers, which in turn would increase the credit spread of Bank HJK. From the perspectives of the hedge fund and the manufacturer, which of the following is correct with respect to their counterparty risk exposure to Bank HJK?

	Hedge Fund	Manufacturer
A.	Right-way risk	Right-way risk
B.	Right-way risk	Wrong-way risk
C.	Wrong-way risk	Right-way risk
D.	Wrong-way risk	Wrong-way risk

Correct Answer: D

Explanation: The hedge fund has wrong-way risk. As interest rates rise, both Bank HJK's and Bank PQR's equity value would decline since the performances of the two banks are highly correlated. Therefore, the value of the long put option on PQR would increase, resulting in a higher exposure to bank HJK for the hedge fund. This is a wrong-way risk since the hedge fund's exposure to HJK would be increasing as the credit quality of HJK is declining.

The manufacturer also has wrong-way risk. Since the credit spread of Bank HJK is increasing and credit spreads of different banks in the same market tend to be positively correlated, the credit spread of Bank PQR should also increase. Therefore, the value of the manufacturer's long CDS position on Bank PQR is increasing at the same time the credit quality of Bank HJK is decreasing; thus, that is wrong-way risk.

Section: Credit Risk Measurement and Management

Reference: Jon Gregory, The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 3rd Edition (West Sussex, UK: John Wiley & Sons, 2015). Chapter 17 - Wrong-way Risk.

Learning Objective: Identify examples of wrong-way risk and examples of right-way risk.

Describe wrong-way risk and contrast it with right-way risk.

20. A wealth management firm has JPY 86 billion in assets under management. The portfolio manager computes the daily VaR at various confidence levels as follows:

Confidence Level	VaR (JPY)
95.0%	397,463,000
95.5%	401,682,500
96.0%	406,224,500
96.5%	418,453,000
97.0%	428,934,000
97.5%	439,415,500
98.0%	451,993,000
98.5%	468,763,000
99.0%	490,773,000
99.5%	524,663,000

What is the closest estimate of the daily ES at the 97.5% confidence level?

A. JPY 398 million
B. JPY 400 million
C. JPY 484 million
D. JPY 497 million

Correct Answer: C

Explanation: C is correct. An estimate of the expected shortfall (ES) can be obtained by taking the average of the VaRs for the various confidence levels that are greater than 97.5%. Therefore,

ES = (451,993,000+468,763,000+490,773,000+524,663,000)/4 = JPY 484,048,000

Section: Market Risk Measurement and Management

Reference: Kevin Dowd, Measuring Market Risk, 2nd Edition (West Sussex, UK: John Wiley & Sons, 2005). Chapter 3 -Estimating Market Risk Measures: An Introduction and Overview.

Learning Objective: Estimate the expected shortfall given P/L or return data.

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