

Performing Due Diligence

Reasons For The Failures Of Funds

- Poor investment decisions.
- Fraud
- Extreme events
- Excess leverage
- Lack of liquidity
- Poor controls
- Insufficient questioning
- Insufficient attention to returns.

Due Diligence

- Questions To Evaluate A Manager
- Criteria To Assess Risk Management Process
- Operational Due Diligence
- Business Model Risk And Fraud Risk

尽职调查四大方面，了解

3.1 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

Answer: 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.

3.2 A due diligence specialist at a company is evaluating the risk management process of a hedge fund in which the company is considering making an investment. Which of the following statements best describes criteria used for such an evaluation? (Practice Exam)

- A. Because of the overwhelming importance of tail risk, the company should not invest in the fund unless it fully accounts for fat tails 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.

Correct answer: c

Explanation: 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.



目录

Credit Risk Measurement and Management.....	3
Section 1-2 The Credit Decision & The Credit Analyst	3
1 Key Point: Credit Decision and Credit Analysis	3
Section 3 Introduction of Credit Risk	5
1 Default and Recovery.....	5
Section 4 Credit VaR.....	6
1 Key Point: Expected Loss and Credit VaR.....	6
Section 5 Binomial Trees of PD	8
1 Key Point: Binomial Trees of PD	8
Section 6 Credit Ratings	11
1 Credit Transition Matrices.....	11
Section 7 Credit Scoring Models	11
1 Credit Scoring Models	11
Section 8 Infer Credit Risk from Corporate Bond Prices	12
1 Infer Credit Risk from Corporate Bond Prices & Spread Risk.....	12
Section 9 Infer Credit Risk from Equity Prices.....	15
1 Key Point: Merton Model.....	15
2 Key Point: The KMV Approach	18
Section 10 Default Intensity Models.....	23
1 Key Point: Poisson distribution and Exponential distribution.....	23
2 Hazard Rates	24
Section 12-13 Credit Exposure & Counterparty Risk	26
1 Key Point: Credit Exposure Metrics and Counterparty Risk.....	26
2 Key Point: Exposure Profiles of Different Security Types.....	30
3 Key Point: Risk Mitigation Techniques	33
4 Managing and Mitigating Counterparty Risk	41
5 Key Point: Credit Value Adjustment (CVA).....	43
6 Key Point: Wrong-Way Risk.....	46

Section 14 Portfolio Credit Risk.....	48
1 Credit Risk Portfolio Models	48
2 Default Correlation for Credit Portfolios.....	49
3 Key Point: Single-Factor Model.....	51
Section 15 Credit Derivatives	52
1 Credit Default Swaps (CDS)	52
2 Total return swaps (TRS)	57
3 Credit-Linked Notes.....	58
Section 16-18 Structured Credit Risk and Securitization, The Securitization of Subprime Mortgage Credit, CDOs	61
1 Structured Products & CDO	61
2 Structured Credit Risk	69
3 The Securitization of Subprime Mortgage Credit	71
Section 19 Risk Mitigation Techniques	75
1 Risk Mitigation Techniques	75



Credit Risk Measurement and Management

Section 1-2 The Credit Decision & The Credit Analyst

1 Key Point: Credit Decision and Credit Analysis

Credit Risk & Credit Risk Evaluation		了解		
Credit Risk definition		Credit risk is the probability that a borrower will not pay back a loan in accordance with the terms of the credit agreement.		
Credit Risk Evaluation		<ul style="list-style-type: none"> • The capacity and willingness of the obligor (borrower, counterparty, issuer, etc.) • The external environment (operating conditions, country risk, business climate, etc.) • The characteristics of the relevant credit instrument (product, facility, issue, debt security, loan, etc.) • The quality and sufficiency of any credit risk mitigants (collateral, guarantees, credit enhancements, etc.) 		
Credit Analysis Comparison		了解		
	Consumers	Corporations	Financial Institutions	Sovereigns
Capacity	Wealth, salary, or incoming cash, expenses, assets, net cash	Liquidity, cash flow combined with earnings capacity and profitability	Similar to nonfinancial firms but bank specific.	Financial factors including the country's external debt load; tax receipts.
Willingness	Reputation of individual, payment history.	Quality of management, historical debt service.	Quality of management; qualitative analysis is even more important for financial firms.	Credit analysis for sovereigns is often more subjective than for financial and nonfinancial firms.
Methods of evaluation	Credit scoring models	Detailed manual analysis including financial statement analysis, interviews with management.	Similar to nonfinancial firms.	Similar to financial and nonfinancial firms but with increased subjective analysis of the political environment.
Loan size/type	Large exposures: secured (e.g., mortgage). Smaller exposures: unsecured (e.g., credit card loans).	Typically larger exposures	Similar to nonfinancial firms (i.e., large).	Similar to financial and nonfinancial firms (i.e., large)

1.1 Golin and Delhaise divide credit analysis into four areas according to borrower type:

- I. Consumer credit analysis is the evaluation of the creditworthiness of individual consumers;
- II. Corporate credit analysis is the evaluation of nonfinancial companies such as manufacturers, and nonfinancial service providers;
- III. Financial institution credit analysis is the evaluation of financial companies including banks and nonbank financial institutions, such as insurance companies and investment funds;
- IV. Sovereign/municipal credit analysis is the evaluation of the credit risk associated with the financial obligations of nations, subnational governments, and public authorities, as well as the impact of such risks on obligations of nonstate entities operating in specific jurisdictions.

According to Golin and Delhaise, each of the following is true about key features of credit analysis with respect to borrower type, except which is not true?

- A. Individuals (consumers): Credit analysis is amenable to automation and the use of scoring models and statistical tools to correlate risk to limited number of variables
- B. Non-financial corporations: Compared to consumers, tends to be more detailed and "hands-on" (i.e. less automated); key variables are likely to include liquidity, cash flow, near-term earnings capacity and profitability, solvency or capital position
- C. Financial Companies: In contrast to corporate (non-financial) credit analysis, qualitative analysis and asset quality are not important, but cash flow is a highly important (a "key indicator")
- D. Sovereigns: Includes analysis of country risk, which is primarily political dynamics and state of the economy; and systematic risk, which includes the regulatory regime and the financial system

Answer: C

Credit analysis of financial companies has much in common with corporate credit analysis, but the authors cite two key differences: With respect to financial companies, "The differences are: The importance of asset quality; The omission of cash flow as a key indicator."

1.2 A company that is domiciled in a country with a strong legal system is applying for a USD 1,000,000 loan with an annual interest rate of 5% to be used exclusively on expanding its business and not to repay current debt. The loan will be secured by the company's factory buildings, which have an appraised value of USD 2,000,000. The company views loans as an integral component of its working and long-term capital, and it has an annual operating profit of USD 30,000. Which of the following statements relating to the credit risk of this company can most likely be inferred from the given data? (Important)

- A. The company's capacity to pay is low.
- B. The company's willingness to pay is low.
- C. The loan exhibits a high loss given default.
- D. The loan's exposure at default will increase.

Answer: A

1.3 An analyst is reviewing the minutes of a recent credit review meeting at a bank. Listed below are four comments made at the meeting pertaining to the credit analysis of consumers, non-financial institutions, and sovereigns. Which of these statements is correct? (Important)

- A. Due to the relatively small amount of credit advanced to individual consumers, scoring models are typically used as the only factor in determining the creditworthiness of consumers.
- B. Due to publicly available information on consumers and the lack of information on non-financial institutions, credit analysis for non-financial institutions tends to be less detailed than that for consumers.

- C. Due to the similarity of institutions that comprise the financial sector, the credit analysis of financial institutions tends to be more straightforward than the credit analysis of other institutions.
- D. Due to there being fewer sovereigns than non-financial institutions, the credit analysis of sovereigns tends to include fewer factors than that of non-financial institutions.

Answer: C

Section 3 Introduction of Credit Risk

1 Default and Recovery

Default and Recovery ★

Expected loss (EL)

$$EL = PD \times LGD \times \text{exposure}$$

$$E[\text{loss}|\text{default}] = LGD = \frac{EL}{P[\text{default}]} = \frac{EL}{PD}$$

Compare Risk-free bonds with Risky bond

The investor may **prefer the risky bond**:

- $(1 - PD)(I + r + z) + (PD)(RR) > I + r$

expected loss = $PD(1 - RR)$

unexpected loss at default = $(1 - PD)(I - RR)$

- 1.1** An analyst is reviewing a bond for investment purposes. The bond is expected to have a default probability of 2%, with an expected loss of 80 bps in the event of default. If the current risk-free rate is 4%, what is the minimum coupon spread needed on the bond for its expected return to match the risk-free rate? (Practice Exam)

- A. 90 bps
 B. 120 bps
 C. 200 bps
 D. 280 bps

Answer: A

The credit risky bond is preferable when:

$$(1 - PD) \times (1 + r + z) + PD \times RR > 1 + r$$

$$RR = 1 - EL / PD = 0.6$$

$$(1 - 2\%) \times (1 + 4\% + z) + 2\% \times 60\% = 1 + 4\%$$

$$z > 0.00897$$

- 1.2** Suppose that you want to estimate the implied default probability for a BB-rated discount corporate bond.

- ✓ The T-bond (a risk-free bond) yields 12% per year.
- ✓ The one-year BB-rated discount bond yields 15.8% per year.
- ✓ The two-year BB-rated discount bond yields 18% per year.

If the recovery rate on a BB-rated bond is expected to be 0%, and the marginal default probability in year one is 5%, which of the following is the best estimate of the risk-neutral probability that the BB-rated discount bond defaults within the next two years? (Practice Exam)

- A. 6.85%
- B. 3.28%
- C. 9.91%
- D. 10.14%

Answer: C

$$(1 + 0.12)^2 = (1 - PD) \times (1 + 0.18)^2 \rightarrow PD = 9.91\%$$

Section 4 Credit VaR

1 Key Point: Expected Loss and Credit VaR

Credit VaR ★★		名词掌握
Type of credit loss	Description	Formula
Expected credit loss (credit provision)	Represent the average credit loss. Pricing of the portfolio covers expected loss.	$ECL_i = PD_i \times (1 - f_i) \times CE_i$ $ECL = \sum_{i=1}^N PD_i \times (1 - f_i) \times CE_i$
Worst credit loss	Represent the loss that will not be exceeded at some level of confidence.	$1 - c = \int_{WCL}^{\infty} f(x) dx$
Unexpected credit loss	Deviation from the expected loss like VAR Economic capital covers the unexpected loss	$UCL = CVAR = WCL - ECL$

Frequency distribution

Highly skewed to the left

Worst credit loss

Unexpected credit loss at 99% level

Expected credit loss

Credit loss

	Market Risk	Credit Risk
Definition	compares a future value with a current value	compares two future values
Distributions	Symmetric	Skewed to the left
Time Horizon	Short Term (Days)	Long Term (Years)

1.1 Use the following table to answer the question below. Which loan below has the highest expected credit loss? (Assume that all of the loans are due at maturity without amortization and recovery rate is zero).

Default Probabilities		
Rating	3 year	5 year
AAA	0.05%	0.15%
AA	0.22%	0.48%
A	0.30%	0.72%
BBB	0.92%	1.98%
BB	6.91%	11.83%
B	20.37%	28.00%

CCC	31.63%	40.15%
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- A. A 3-year loan of \$50,000,000 to a counterparty with a credit rating of “A”.
- B. A 5-year loan of \$1,500,000 to a counterparty with a credit rating of “BB”.
- C. A 5-year loan of \$40,000,000 to a counterparty with a credit rating of “AA”.
- D. A 3-year loan of \$20,000,000 to a counterparty with a credit rating of “BBB”.

Answer: C

1.2 A credit analyst at a bank has been asked to produce an exposure analysis for three of the loans in the bank’s portfolio. Loan information assembled by the analyst as well as the bank’s internal default.

Loan	Tenor (Years)	Notional (USD)	Loss Given Default	S&P Rating
1	2	30,000,000	0.75	BB-
2	3	100,000,000	0.90	A
3	1	100,000,000	0.70	B+

Probability of Default (PD)			
		Tenor(years)	
Loan Quality		1	2
Investment Grade		0.01	0.02
Non- Investment Grade		0.05	0.10

There is no collateral provided by the borrower for these loans, so the analyst uses the notional amount provided above as the Exposure at Default. Which of the following correctly orders the expected loss for each loan from lowest to highest? (Important)

- A. Loan 1 < Loan 2 < Loan 3
- B. Loan 1 < Loan 3 < Loan 2
- C. Loan 2 < Loan 3 < Loan 1
- D. Loan 2 < Loan 1 < Loan 3

Answer: A

1.3 Becky the Risk Analyst is trying to estimate the credit value at risk (CVaR) of a three-bond portfolio, where the CVaR is defined as the maximum unexpected loss at 99.0% confidence over a one-month horizon. The bonds are independent (i.e., no default correlation) and identical with a one-month forward value of \$1.0 million each, a one-year cumulative default probability of 4.0%, and an assumed zero recovery rate. Which is nearest to the one-month 99.0% CVaR?

- A. \$989,812
- B. \$1.0 million

- C. \$1.7 million
D. \$2.3 million

Answer: A

The one-month PD = $1 - (100\% - 4\%)^{(1/12)} = 0.3396\%$.

Expected loss = $98.9846\% \times 0 + 1.0119\% \times \$1.0 \text{ million} + 0.0034\% \times \$2.0 \text{ million} + 0\% \times \$3.0 \text{ million} = \$10,188$

The probability of zero defaults = $(1 - 0.3396\%)^3 = 98.98464\%$.

Therefore, the 99.0% WCL is one default or \$1.0 million, and

the 99.0% CVaR = \$1.0 million - \$10,188 = \$989,812.

Section 5 Binomial Trees of PD

1 Key Point: Binomial Trees of PD

Binomial Trees of PD ★★★	
Marginal default probability	the probability that a borrower will default in <i>any given year</i> .
Survival Rate	a borrower will not default <i>over a specified multi-year period</i> . • Survival Rate at end of two years: $S_2 = (1-d_1)(1-d_2)$ • Survival Rate at end of three years: $S_3 = (1-d_1)(1-d_2)(1-d_3)$
Cumulative default probability	a borrower will default <i>over a specified multi-year period</i> . • Cumulative default probability at end of two years: $C_2 = 1 - S_2 = d_1 + (1 - d_1)d_2$ • Cumulative default probability at end of three years: $C_3 = 1 - S_3 = d_1 + (1 - d_1)d_2 + (1 - d_1)(1 - d_2)d_3$ 计算
Average survival rate and average default rate	$S_3 = (S^a)^3 \Rightarrow S^a = 1 - d^a \Rightarrow d^a$
↓ Change on probability of default ★★ 对比	
<ul style="list-style-type: none"> For <i>investment-grade credits</i>, the increase of cumulative default probability is <i>more</i> than proportional with the horizon. For <i>speculative-grade credits</i>, the increase of cumulative default probability is <i>less</i> than proportional with the horizon. The marginal probability of default <i>increases</i> with maturity for initial <i>high</i> credit ratings, but <i>decreases</i> for initial <i>low</i> credit ratings. (Reasons: <i>mean reversion effect</i>) 	

1.1 A corporate bond will mature in three years. The marginal probability of default in year one is 3%. The marginal probability of default in year two is 4%. The marginal probability of default in year three is 6%. What is the cumulative probability that default will occur during the three-year period?

- A. 12.47%
B. 12.76%
C. 13%
D. 13.55%

Answer: A

This is one minus the survival rate over three years: $S_3(R) = (1 - d_1)(1 - d_2)(1 - d_3) = (1 - 0.03)(1 - 0.04)(1 - 0.06) = 0.8753$. Hence, the cumulative default rate is 0.1247.

1.2 You are the risk manager at Vision, a small fixed-income hedge fund that specializes in bank debt. Vision's strategy utilizes both relative value and long-only trades using credit default swaps (CDS) and bonds. One of the new traders has the positions described in the table below.

Bank	Position	Credit Rating
SBU	Long USD 10 million CDS	A
Stanos	Long USD 5 million bond	BB+
CAB	Short USD 10 million CDS	A

Some of Vision's newest clients are restricted from withdrawing their funds for three years. You are currently evaluating the impact of various default scenarios to estimate future asset liquidity. You have estimated that the marginal probability of default of the Stanos bond is 5% in Year 1, 10% in Year 2, and 15% in Year 3. What is the probability that the bond makes coupon payments for 3 years and then defaults at the end of Year 3?

- A. 13%
- B. 15%
- C. 27%
- D. 73%

Answer: A

The probability that the bond defaults in year 3 can be modeled as a Bernoulli trial given by the following equation where MP stands for marginal probability:

$$\begin{aligned} P(\text{Default at end of year 3}) &= (1 - \text{MP}_{\text{year 1 default}}) \times (1 - \text{MP}_{\text{year 2 default}}) \times \text{MP}_{\text{year 3 default}} \\ &= (1 - 0.05) \times (1 - 0.10) \times 0.15 = 0.1283 \text{ or } 12.83\%. \end{aligned}$$

1.3 An analyst has noted that the default frequency in the pharmaceutical industry has been constant at 8% for an extended period of time. Based on this information, which of the following statements is most likely correct for a randomly selected firm following a Bernoulli distribution?

- I. The cumulative probability that a randomly selected firm in the pharmaceutical industry will default is constant.
 - II. The probability that the firm survives for the next 6 years without default is approximately 60%.
- A. I only
 - B. II only
 - C. Both I and II
 - D. Neither I nor II

Answer: B

Statement I is false because the cumulative probability of default increases (i.e., even the highest rated companies will eventually fail over a long enough period). Statement II is true since the probability the firm survives over the next 6 years without default is: $(1-0.08)^6 = 60.6\%$

1.4 A risk manager at a small fixed-income hedge fund is evaluating the default conditions of several trade positions. The hedge fund specializes in bank debt and runs a strategy that utilizes both relative value and long-only trades using credit default swaps (CDS) and bonds. One of the new traders at the hedge fund has the positions described in the table below:

Bank	Position	Credit
ABC	Long USD 12 million CDS	AA
LTM	Long USD 6 million bond	BBB
XYZ	Short USD 12 million CDS	A

Some of the hedge fund's newest clients are restricted from withdrawing their funds for three years. The manager is currently evaluating the impact of various default scenarios to estimate future asset liquidity. The manager has estimated that the marginal probability of default of the LTM Bank bond is 4% in Year 1, 7% in Year 2, and 16% in Year 3. What is the probability that the LTM bond makes coupon payments for 3 years and then defaults at the end of Year 3? (Practice Exam)

- A. 12.0%
- B. 12.6%
- C. 14.3%
- D. 14.9%

Answer: C

Explanation: The probability that the bond defaults in year 3 can be modeled as a Bernoulli trial given by the following equation, where MP stands for marginal probability:

$$P(\text{Default at end of year 3}) = (1 - \text{MP year 1 default}) * (1 - \text{MP year 2 default}) * (\text{MP year 3 default}) = (1 - 0.04) * (1 - 0.07) * (0.16) = 0.1429 = 14.29\% = 14.3\%.$$

1.5 A major regional bank has determined that counterparty has a constant default probability of 5.5% per year. What is the probability of this counterparty defaulting in the fourth year? (Practice Exam)

- A. 4.39%
- B. 4.64%
- C. 4.91%
- D. 5.50%

Answer: B

The probability of default in year 4 = $(1-0.055)(1-0.055)(1-0.055)(0.055) = 0.06054 = 4.64\%$.
 Choice a is incorrect. It is the probability of default in year five = $(1-0.055)(1-0.055)(1-0.055)(1-0.055)(0.055) = 0.0439 = 4.39\%$.

Choice c is incorrect. It is the probability of default in year three = $(1-0.055)(1-0.055)(0.055) = 0.0491 = 4.91\%$. Choice d is incorrect. It is simply the default probability per year, which equals 5.5%.

Section 6 Credit Ratings

1 Credit Transition Matrices

1.1 As a result of the credit crunch, a small retail bank wants to better predict and model the likelihood that its larger commercial loans might default. It is developing an internal ratings-based approach to assess its commercial customers. Given this one-year transition matrix, what is the probability that a loan currently rated at B will default over a two-year period?

Rating at Beginning of Period	Rating at End of Period			
	A	B	C	D
A	0.90	0.10	0.00	0.00
B	0.00	0.75	0.15	0.10
C	0.00	0.05	0.55	0.40

- A. 17.50%
- B. 20.0%
- C. 21.1%
- D. 23.5%

Answer: D

Section 7 Credit Scoring Models

1 Credit Scoring Models

Quantitative methodologies for credit analysis and scoring ★★ 概念对比

Type of credit scoring models	Feature	Example
Fisher Linear discriminant analysis	<ul style="list-style-type: none"> • Parametric technique • A process that segregates <i>a larger group into homogeneous subgroups.</i> 	z-score model
Parametric discrimination	<ul style="list-style-type: none"> • Parametric technique • Use a score function to determine the members of the subgroups. Whether the value of the score falls above or below a certain threshold determines which subgroup the observation is placed in 	logit and probit model
K-nearest neighbor approach	<ul style="list-style-type: none"> • Non-parametric technique • Use the properties of firms that have already fallen into the categories of interest (e.g., default or not default) and categorizes a new entrant by how closely it resembles the members already in each of the groups. 	
Support vector machines	<ul style="list-style-type: none"> • Parametric technique • Use the characteristics of observations (firms) to create an equation that does the best job of dividing the larger group into two subgroups. 	Linear and nonlinear

Decision Rules in Credit Analysis ★ 概念对比

Type	Feature
Minimum error	<ul style="list-style-type: none"> • uses Bayes' theorem to determine a conditional probability • $p(C \text{ given default}) \times p(\text{default}) > p(C \text{ given not default}) \times p(\text{not default})$
Minimum risk	<ul style="list-style-type: none"> • a class of rules that try to either minimize the probability of misclassification (incorrectly lending to risky firm) or minimize the loss associated with that error.
Neyman-Pearson	<ul style="list-style-type: none"> use the statistical concept of Type I and Type II errors. • A Type I error is lending to a risky firm because it was incorrectly accepted as a non-risky firm. • A Type II error is not lending to a non-risky firm because it incorrectly rejected as being risky. $\frac{p(\text{"conditions" given default})}{p(\text{"conditions" not given default})} > \text{threshold value}$
Minimax	<ul style="list-style-type: none"> • minimizing the maximum error or risk.

The **minimum error rule** makes a decision based on calculated **probabilities**.
The **other three** methods use **optimization** techniques

1.1 A risk officer of a bank is evaluating the four rules for credit scoring model performance measurement. Which of the following is correct? (Practice Exam)

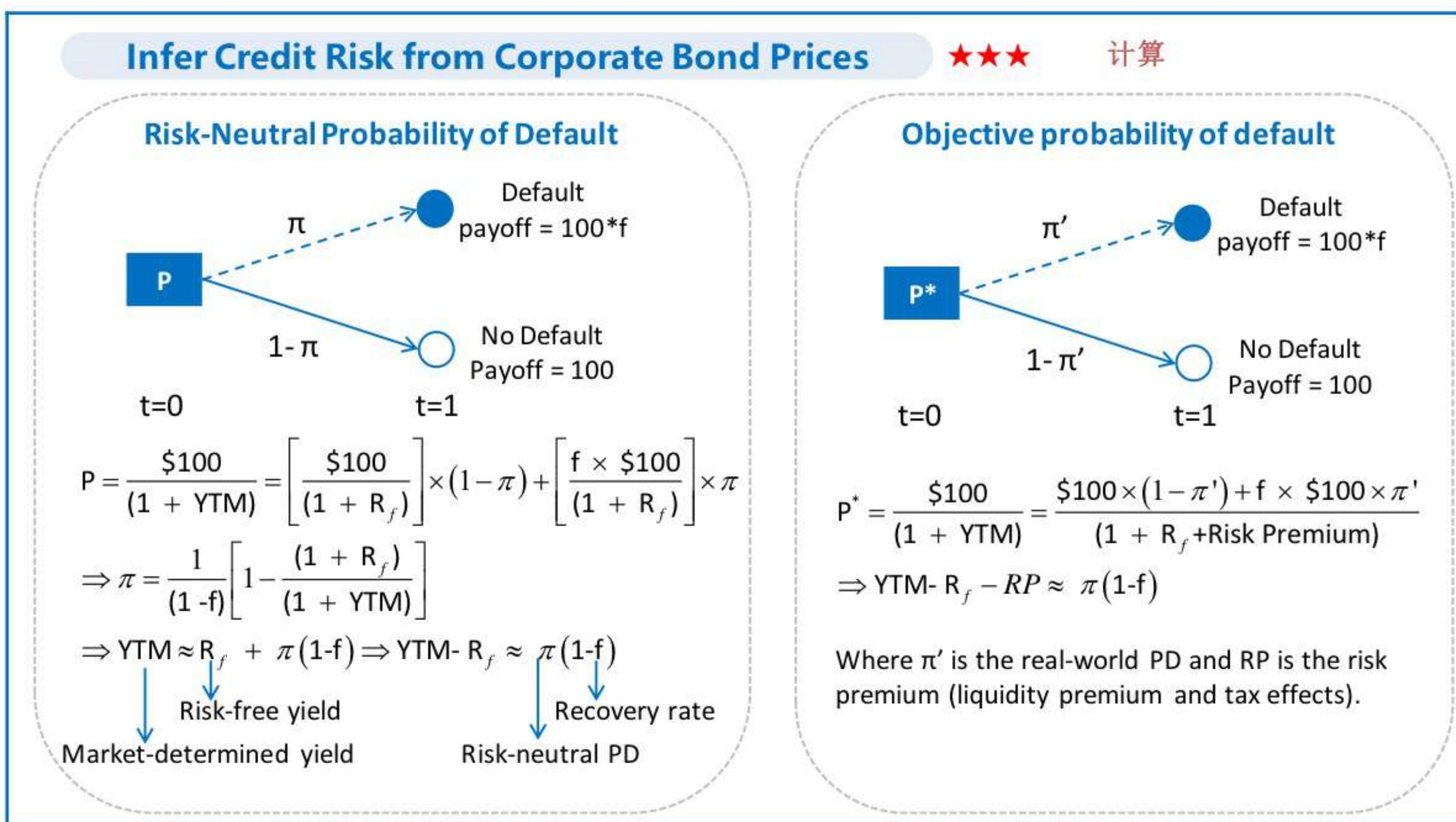
- A. The “Minimum-Risk” decision rule tries to minimize both type I and type II errors.
- B. The Neyman-Pearson rule minimizes type II error with type I error remaining constant.
- C. The Neyman-Pearson rule minimizes type I error with type II error remaining constant.
- D. The “Minimum-Risk” decision rule tries to minimize both credit and market risks.

Answer: C

The Neyman-Pearson rule minimizes type I error with type II error remaining constant. There are four rules “Minimum-Error”, “Minimum-Risk”, Neyman-Pearson, and Minimax. The “Minimum-Risk” decision rule tries to minimize the risk of misclassification. It has nothing to do with market risk. Hence d is wrong.

Section 8 Infer Credit Risk from Corporate Bond Prices

1 Infer Credit Risk from Corporate Bond Prices & Spread Risk



1.1 Consider a 1-year maturity zero-coupon bond with a face value of USD 1,000,000 and a 0% recovery rate issued by Company A. The bond is currently trading at 80% of face value. Assuming the excess spread only captures credit risk and that the risk-free rate is 5% per annum, the risk-neutral 1-year probability of default on Company A is closest to which of the following? (Practice Exam)

- A. 2%
- B. 14%
- C. 16%
- D. 20%

Answer: C

This can be calculated by using the formula which equates the future value of a risky bond with yield (y) and default probability (π) to a risk free asset with yield (r):

$$1 + r = (1 - \pi) \times (1 + y) + \pi R$$

π = Probability of default; R = Recovery rate

In the situation where the recovery rate is assumed to be zero, the risk-neutral probability of default can be derived from the following equation: $1 + r = (1 - \pi) \times (1 + y) = (1 - \pi) \times (FV/MV)$
Where MV = market value and FV = face value.

Inputting the data into this equation yield $\pi = 1 - (800,000 \times 1.05)/1,000,000 = 0.16$.

1.2 Given the following information, what is the probability of default for this zero-coupon bond that matures in one year?

Face value of bond	\$100
Market price of bond	\$86
Risk-free rate	5%

- A. 9.70%.
- B. 30.71%.
- C. 10.74%.
- D. 35.21%.

Answer: A

First back out the yield for the bond:

$$\frac{\$100}{\$86} - 1 = 16.28\%$$

The probability of default is then calculated as:

$$1 - \left(\frac{1.05}{1.1628} \right) = 9.70\%$$

Alternatively, it can be calculated as:

$$1 - \frac{\$86 \times 1.05}{\$100} = 9.70\%$$

1.3 Suppose XYZ Corp. has two bonds paying semiannually according to the following table. The recovery rate for each in the event of default is 50%. For simplicity, assume that each bond will default only at the end of a coupon period. The market-implied risk-neutral probability of default for XYZ Corp. is

Remaining Maturity	Coupon(30/360)	Price	T-bill rate
6 months	8%	99	5.5%
1 year	9%	100	6%

- A. Greater in the first six-month period than in the second
- B. Equal between the two coupon periods
- C. Greater in the second six-month period than in the first
- D. Cannot be determined from the information provided

Answer: A

First, we compute the current yield on the six-month bond, which is selling at a discount. We solve for y^* such that $99 = 104/(1 + y^*/2)$ and find $y^* = 10.10\%$. Thus, the yield spread for the first bond is $10.1 - 5.5 = 4.6\%$. The second bond is at par, so the yield is $y^* = 9\%$. The spread for the second bond is $9 - 6 = 3\%$. The default rate for the first period must be greater. The recovery rate is the same for the two periods, so it does not matter for this problem.

1.4 The spread on a one-year BBB rated bond relative to the risk-free treasury of similar maturity is 2%. It is estimated that the contribution to this spread by all non-credit factors (e.g., liquidity risk, taxes) is 0.8%. Assuming the loss given default rate for the underlying credit is 60%, what is approximately the implied default probability for this bond?

- A. 3.33%
- B. 5.00%
- C. 3.00%
- D. 2.00%

Answer: D

The probability of default equals the credit risk spread divided by the loss given default. $PD = \text{spread}/\text{LGD}$. Here, the spread due to credit risk equals $2.0\% - 0.8\% = 1.2\%$ and the loss given default is 60%. The probability of default is then 2%.

1.5 The risk-neutral default probability of a one-year corporate BB-rated bond is 5% with an estimated loss given default (LGD) of 65% while the risk-free rate is 2%. If we assume an annual compound frequency, which is nearest to the yield of the corporate bond?

- A. 3.57%
- B. 4.29%
- C. 5.43%
- D. 6.60%

Answer: C

$$\text{Implied yield} = (1 + R_f)[(1 - PD) + PD \times (1 - LGD)] - 1 = 1.02/[0.95 + 0.05 \times 0.35] - 1 = 1.02/0.96750 - 1 = 5.4264\%$$

Section 9 Infer Credit Risk from Equity Prices

1 Key Point: Merton Model

Merton Model ★★

- Value of **equity** = Call option on firm = value of firm's asset (V) – value of risky debt
- Value of risky **debt** = Risk-free debt – **put** option on firm

Equity: Call Option

- Equity can be viewed as a call option on the firm value with strike price equal to the face value of debt.

Firm value	Face value of debt
\downarrow	\downarrow
$\text{Stock}_t = \text{Call} = [VN(d_1) - Fe^{-r(T-t)}N(d_2)]$	
$\frac{\ln(V/Fe^{-r(T-t)}) + \sigma\sqrt{T-t}}{\sigma\sqrt{T-t}} = d_1$	$d_2 = d_1 - \sigma\sqrt{T-t}$

- $N(-d_2)$ is the risk-neutral probability of default.

Corporate debt

- Long corporate bond = Long free-risk bond + Short put option on the firm value (or Short CDS)
- $Bond = Fe^{-r(T-t)} - Put = VN(-d_1) + Fe^{-r(T-t)}N(d_2)$
- $ECL_T = Put \times e^{r(T-t)} = -Ve^{r(T-t)}N(-d_1) + FN(-d_2)$
- $A_t = E_t + D_t = (\text{European call with strike at } F) + Fe^{-rT} - (\text{European put with strike at } F)$

Determining Firm Value and Volatility

- $\sigma_S * S = \Delta * \sigma_V * V$
- The distribution of equity values is not constant (**volatility smirk**). The non-constant volatility of equity is a **violation of the Black-Scholes-Merton model**.

Credit spread

$$\text{credit spread} = \left[\frac{1}{T-t} \right] * \ln \left(\frac{D}{F} \right) - R_F$$

$$y_t - r = \frac{1}{T-t} \log \left[(1 - e^{-r(T-t)}) F + \text{European put option with strike at } F \right] - r$$

- As time increases there is greater probability that the value received will be less than par.
 - Studies have shown that *as time to maturity increases, credit spreads tend to widen* (i.e., increase).
 - For *very risky debt*, it may be the case that *credit spreads narrow*.
- As the *risk-free rate increases*, the expected value of the firm at maturity increases, which in turn *decreases the risk of default*.

Subordinate Debt in Merton Model

- Subordinate debt can be valued in a portfolio as a *long position in a call option on the firm with an exercise price equal to the face value of senior debt, F, and a short position on a call option on the firm with an exercise price equal to the total principal due on all debt, U + F.*
- Subordinate debt values behave like *equity* when the *firm has low values*, as during periods of financial distress, and they behave like *senior debt* when the *firm is not in financial distress*.

Calculate PD and LGD

$$PD = N \left[\frac{\ln(F) - \ln(V) - (\mu)(T-t) + 0.5\sigma^2(T-t)}{\sigma\sqrt{T-t}} \right]$$

$$EL = F * PD - V e^{\mu(T-t)} * N \left[\frac{\ln(F) - \ln(V) - (\mu)(T-t) + 0.5\sigma^2(T-t)}{\sigma\sqrt{T-t}} \right]$$

$$\text{expected LGD} = \frac{[e^{r(T-t)} (\text{European put option with strike at } D)]}{PD}$$

The Merton model rests on a number of assumptions:

- The market value of assets, A_t , and expected return, μ , are related.
- The value of the firm is observable* and follows a *lognormal* diffusion process (geometric Brownian motion).
- The *risk-free interest rate is constant* through time.
- Debt consists of a *single zero-coupon bond* with a nominal payment of maturing at time T. The model assumes that the firm *can default only on the maturity date* of the bond.
- Equity consists of *common shares only*.
- Debt-holders have *limited liability and have no recourse* to any other assets once equity is eliminated.
- Trading in markets* occurs not only for the firm's equity and debt securities, but also for its *assets*.
- There are *no cash flows prior to the maturity* of the debt (including dividends).

The drawbacks of Merton Model

- The Merton model makes some *unrealistic assumptions*.
- It could result in *low default probability values and high recovery rates* for firms with high leverage. *Firms with high leverage in reality would typically have higher default probabilities* and lower recovery rates.

1.1 A firm has an asset value of \$110 million with asset volatility of 30% per annum. Its only debt is a zero-coupon bond with face value of \$80 million that matures in five years. The risk-free rate is 4%. The Black-Scholes Merton price of a put option on the firm's assets with strike price equal to the face value of the bond is \$6.95 million. Which is nears to the current value of the firm's debt.

- A. \$6.95 million
- B. \$41.30 million
- C. \$58.55 million
- D. \$65.50 million

Answer: C

$$PV(\text{risk-free debt}) - \text{put} = 80 \times \exp(-0.04 \times 5) - 6.95 = 58.55$$

1.2 Suppose a firm has two debt issues outstanding. One is a senior debt issue that matures in three years with a principal amount of \$100 million. The other is a subordinate debt issue that also matures in three years with a principal amount of \$50 million. The annual interest rate is 5%, and the volatility of the firm value is estimated to be 15%. If interest rates decline in the Merton model, then which of the following is true?

- A. If the firm is experiencing financial distress (low firm value), then the value of senior debt will increase while the values of subordinate debt and equity will both decline.
- B. If the firm is not experiencing financial distress (high firm value), then the value of senior debt and subordinate debt and equity will increase.
- C. If the firm is experiencing financial distress (low firm value), then the value of senior debt and subordinate debt will increase while equity values will decline.
- D. If the firm is not experiencing financial distress (high firm value), then the value of senior debt will increase while the values of subordinate debt and equity will both decline.

Answer: A

When firms with subordinate debt are experiencing financial distress (low firm values), changes in the value of subordinate debt will react to changes in the model parameters in the same way as equity. Since equity is valued as a call option in the Merton model, a decline in interest rates will reduce the value of equity (and subordinate debt). When firms with subordinate debt are not experiencing financial distress (high firm values), changes in the value of subordinate debt will react to changes in the model parameters in the same way as senior debt. Since senior debt is valued as the difference in firm value less equity valued as a call option in the Merton model, a decline in interest rates will increase the value of senior debt and subordinate debt.

1.3 In the following things about Merton model, which of the statement is true?

- A. In Merton model the payment to debt holder can be seen as the payoff of a riskless bond plus a put on the value of the firm.
- B. The sudden surprise (a jump), leading to an unexpected default can be captured by the by this model.
- C. The model can take into account the default prior to the maturity of debt, when a borrower claims so.
- D. The value of the firm is difficult to pin down cause the market-to-market value of debt is often unknown..

Answer: D

A is wrong; the payoff of a bond holder is equivalent to a riskless bond minus a put on the value on the value of a firm. B is wrong, the firm follows lognormal diffusion process, it doesn't allow

for sudden change. C is wrong, because in this model default can only occur at the debt maturity.

1.4 Analyst Greg is employing the Merton model to both value a firm's equity and estimate a physical default probability. He has collected the following information:

- The firm's default threshold one year forward is \$10 million; e.g., face value of short-term debt is \$10 million.
- The firm current asset value is \$12.75 million with an expected return of 8% per annum with continuous compounding
- The volatility of the firm's assets is 9.6%
- The risk-free rate is 2%

His exercise includes two components: one, valuation of the firm's equity market value by treating equity as a call option on the firm's assets; two, estimate of default probability by calculation of a forward distance to default. Greg makes two assumptions:

- I. An increase in the risk-free rate will increase an estimate of the firm's current equity market value, and
- II. An increase in the risk-free rate will decrease the estimated default probability.

Which of Greg's two assumptions is correct?

- A. Neither
- B. I only
- C. II only
- D. Both

Answer: B

Just as an increase in the risk-free rate increases the value of a call option, an increase in the risk-free rate increases the equity value under Merton. However, the risk-free rate has no impact on the Merton PD; the physical drift of 8% is used in that application.

2 Key Point: The KMV Approach

The KMV Approach ★★

First step: calculate the distance to default (DD)

$$DD = \frac{\text{expected asset return} - \text{default threshold}}{\sigma_{\text{expected asset returns}}} = \frac{A-K}{\sigma_A}$$

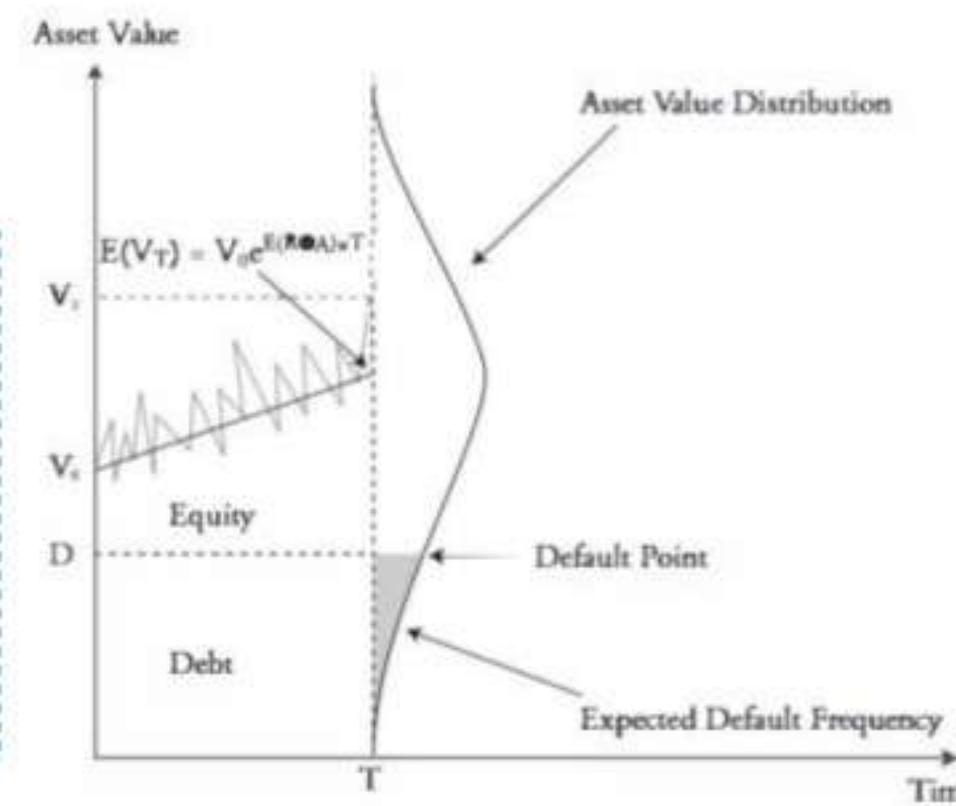
Determining the default point (i.e., default threshold) is:

- If the ratio of long-term-liabilities-to-short-term-liabilities is less than 1.5:
 - short-term liabilities + 0.5 × long-term liabilities

- If this ratio is greater than 1.5:

$$\text{short-term liabilities} + \left(0.7 - \frac{0.3 \times \text{short-term liabilities}}{\text{long-term liabilities}} \right) \times \text{long-term liabilities}$$

$$DD = \frac{\log(V) - \log(\text{default threshold}) + \left[E(\text{ROA}) - \frac{\sigma_V^2}{2} \right] \times \text{maturity}}{\sigma_V \times \sqrt{\text{maturity}}}$$



Final step: Report estimated default frequency (EDF)

- Once the distance to default is computed, the expected default frequency can be found.
- The EDF will be associated with a particular credit rating (e.g., BBB).

2.1 An analyst is using Moody's KMV model to estimate the distance to default of a large public firm, Shoos Inc., a firm that designs, manufactures and sells athletic shoes. The firm's capital structure consists of USD 40 million in short-term debt, USD 20 million in long-term debt, and there are one million shares of stock currently trading at USD 10 per share. The asset volatility is 20% per year. What is the normalized distance to default for Shoos Inc.?

- A. 0.714
- B. 1.430
- C. 2.240
- D. 5.000

Answer: B

Moody's KMV model is a model for predicting private company defaults. It covers many geographic specific models, and each model reflects the unique lending, regulatory, and accounting practices of that region. Moody's KMV computes the normalized distance to default as:

$$DD = \frac{A - K}{A\sigma_A}$$

where: "K" (floor) is defined as the value of all short term liabilities (one year and under) plus one half of the book value of all long term debt: $40 \text{ million} + 0.5 \times 20 \text{ million} = 50 \text{ million}$. "A" is the value of assets: Market value of equity ($1 \text{ million shares} \times 10/\text{share} = 10 \text{ million}$) plus the book value of all debt (60 million) = 70 million . Thus $A\sigma_A = 20\% \times 70 \text{ million} = 14 \text{ million}$. $DD = (70 \text{ million} - 50 \text{ million}) / 14 \text{ million} = 1.429$ standard deviations

2.2 You are given the following information about firm A:

Market value of asset at time 0 = 1000

Market value of asset at time 1 = 1200

Short-term debt = 500

Long-term debt = 300

Annualized asset volatility = 10%

According to KMV model, what are the default point and the distance to default at time 1?

Default Point	Distance to Default
A. 800	3.33
B. 650	7.50
C. 650	4.58
D. 500	5.83

Answer: C

Default Point:

$$\left(500 + \frac{1}{2} \times 300 \right) = 650$$

Distant to Default

$$\frac{1200 - \left(500 + \frac{1}{2} \times 300 \right)}{1200 \times 10\%} = 4.58$$

2.3 Each of the following is true about the KMV model except which if false?

- A. Unlike Merton, which assume the default threshold is total debt, KMV's default threshold falls between short-term and total (short-term + long-term) debt.
- B. Similar to the Merton model, the KMV approach requires an estimate of asset volatility and future asset value in order to calculate distance to default as a number of standard deviations.
- C. Similar to the Merton model, the KMV approach models distance to default (DD) = $(\text{asset market value} - \text{default threshold}) / (\text{asset market value} \times \text{asset volatility})$
- D. Similar to the Merton model, the KMV approach assumes the future asset value is lognormal such that asset (log) returns are normal with $\text{EDF} = N(\text{DD})$

Answer: D

While KMV computes the forward DD as a standard deviation, it does not assume normal returns/lognormal asset value. This is explicitly considered insufficient to model empirically heavy tails. Rather KMV first measures the distance-to-default as the number of standard deviations the asset value is away from default and then uses empirical data to determine the corresponding default probability.

2.4 A credit risk analyst has estimated the probability of a particular firm defaulting in the next

year to be 1.25% using the Merton model. The risk analyst used his bank's definition of the default threshold, namely that default occurs when the firm's value falls below the value of its short term debt plus half the value of its long term debt. Suppose the bank switched from using the Merton model to using the KMV approach to estimate default risk with the following historical expected default frequency buckets: ($N(-2.24) = 1.25\%$)

Distance-to-Default	Expected Default Frequency
< -4	0.3%
-4 to -3	0.3%
-3 to -2.5	0.6%
-2.5 to -2.0	1.6%
-2.0 to -1.6	3.8%
-1.6 to -1.2	8.3%
-1.2 to -0.9	14.9%
-0.9 to -0.6	22.7%

What would the new default probability be? (Important)

- A. 0.3%
- B. 1.6%
- C. 2.8%
- D. 3.8%

Answer: B



2.5 Pricing instruments usually requires first determining whether to use real-world or risk-neutral parameters. Which of the following statements about real-world and risk-neutral values is correct? (Important)

- A. The KMV expected default frequency is a risk-neutral measure because it is based on the Merton model for debt pricing.
- B. Risk-neutral values are more suitable for risk management applications than real-world values.
- C. Risk-neutral values are based on no-arbitrage conditions in the market.
- D. Risk-neutral default probabilities are usually equal to or lower than corresponding real-world default probabilities.

Answer: C

2.6 A firm has a value of \$400 million with expected return of 14% per annum and volatility of 36% per annum. The firm's only debt is a short-term zero-coupon bond with face value of \$300 million due in one year. The riskless rate is 4%. Which is nearest to the firm's (normal returns-based) distance to default when deriving the physical PD?

- A. 1.0

- B. 2.7
- C. 3.3
- D. 8.5

Answer: A

The normal returns-based distance to default (DD) = $[\ln(400/300) + (14\% - 36\%^2/2) \times 1] / [36\% \times \text{sqrt}(1)] = 1.0080$

2.7 Consider a firm with current asset value of \$20 billion, asset volatility of 35% per annum, short-term liabilities of \$12 billion and long-term liabilities of \$6 billion. The expected return on the firm's assets is 12% and the risk-free rate is 1%. Finally, the firm does not pay dividends and the credit horizon is 1 year. If the strike price default point is the sum of short-term debt plus one-half of long-term debt, what is the Merton physical probability of default in one year?

z	P(Z < z)	z	P(Z < z)	z	P(Z < z)
-1.50	0.0668	-1.00	0.1587	-0.50	0.3085
-1.49	0.0681	-0.99	0.1611	-0.49	0.3121
-1.48	0.0694	-0.98	0.1635	-0.48	0.3156
-1.47	0.0708	-0.97	0.1660	-0.47	0.3192
-1.46	0.0721	-0.96	0.1685	-0.46	0.3228
-1.45	0.0735	-0.95	0.1711	-0.45	0.3264
-1.44	0.0749	-0.94	0.1736	-0.44	0.3300
-1.43	0.0764	-0.93	0.1762	-0.43	0.3336
-1.42	0.0778	-0.92	0.1788	-0.42	0.3372

- A. 10.11%
- B. 12.11%
- C. 14.11%
- D. 16.11%

Answer: D

PD = N(-d₂) where d₂ is the distance to default.

$$d_2 = [\ln(20/15) + 12\% \times 1 - 0.5 \times 35\%^2 \times 1] / (35\% \times \text{SQRT}[1]) = 0.99$$

Such that N(-d₂) = 16.11%

Please note we use the asset drift (12%) not the risk free rate, this is not option pricing!

2.8 The capital structure of HighGear Corporation consists of two parts: one 5-year zero-coupon bond with a face value of USD 100 million and the rest is equity. The current market value of the firm's asset (MVA) is USD 130 million and the risk-free rate is 25%. The firm's assets have an annual volatility of 30%. Assume that firm value is log-normally distributed with constant volatility. The firm's risk management division estimates the distance to default (in terms of

number of standard deviations) using the Merton Model, or

$$\frac{\ln\left(\frac{FV_B}{MV_A}\right) - \left(\delta - \frac{1}{2}\sigma_A^2\right)T}{\sigma_A T^{0.5}}$$

Given the distance to default, the estimated risk-neutral default probability is: $N(1.9191) = 0.9724$

- A. 2.74%
- B. 12.78%
- C. 12.79%
- D. 30.56%

Answer: A

$$N[\ln(100/130) - (25\% - (30\%_2)/2) \times 5]/(30\% \times \sqrt{5}) = 2.74\%$$

Section 10 Default Intensity Models

1 Key Point: Poisson distribution and Exponential distribution

Poisson Distribution & Exponential Distribution ★ 结论	
Bernoulli trial	<ul style="list-style-type: none"> Default risk for a single company can be represented as a Bernoulli trial. An important property of the Bernoulli distribution is that each trial is conditionally independent. (memoryless property)
Binomial Distribution	This series of independent and identically (i.e., same probability of default) distributed Bernoulli trials is characterized by a binomial distribution.
Poisson random variable	<ul style="list-style-type: none"> $p(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$ The mean and variance of a Poisson distributed random variable is equal to λ and, as it turns out, the mean of the exponential distribution is equal to $1/\lambda$ and the variance is equal to $1/\lambda^2$
Exponential Distribution	<ul style="list-style-type: none"> The exponential distribution is often used to model waiting times such as how long it takes an employee to serve a customer or the time it takes a company to default. $f(x) = \frac{1}{\beta} \times e^{-x/\beta}, x > 0$ The scale parameter, β, is greater than zero and is the reciprocal of the "rate" parameter (i.e., $\lambda=1/\beta$) The rate parameter measures the rate at which it will take an event to occur. In the context of waiting for a company to default, the rate parameter is known as the hazard rate and indicates the rate at which default will arrive.

1.1 Mike Merton is the head of credit derivatives trading at an investment bank. He is monitoring a new credit default swap basket that is made up of 20 bonds, each with a 1% annual probability of default. Assuming the probability of any one bond defaulting is completely independent of what happens to other bonds in the basket, what is the probability that exactly one bond defaults in the first year?

- A. 2.06%

- B. 3.01%
 C. 16.5%
 D. 30.1%

Answer: C

$$C_{20}^1 p^1 (1-p)^{19} = 20 \times 0.01 \times (1-0.01)^{19} = 0.1652$$

1.2 A portfolio consists of 10 independent bonds. There will be one default on average in 5 years. What is the probability that only exactly one default in a year.

- A. 16.37%
 B. 26.84%
 C. 36.96%
 D. 45.28%

Answer: A

$$P(X=x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

We first need to realize that the expected number of default in one year, which is $\lambda = 1/5 = 0.2$; Using the Poisson distribution, we solve for the probability that x will be 1.

$$P(X=1) = \frac{0.2^1 e^{-0.2}}{1!} = 16.37\%$$

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2 Hazard Rates

Hazard Rates ★★

名词掌握、计算

The **hazard rate** (i.e., default intensity) is represented by the (constant) parameter λ and **the probability of default over the next, small time interval, dt , is λdt** .

Survival rate & cumulative PD	<ul style="list-style-type: none"> The survival distribution: $P(t^* \geq t) = 1 - F(t) = e^{(-\lambda t)}$. The cumulative default time distribution $F(t)$ represents the probability of default over $(0, t)$: $P(t^* < t) = F(t) = 1 - e^{-\lambda t}$ As t increases, the cumulative default probability approaches 1 and the survival probability approaches 0.
Marginal default probability	$\lambda e^{-\lambda t}$

2.1 Peter the municipal bond analyst observes that in recent years there have occurred only about 6 U.S. municipal defaults per year. If he makes the highly simplifying assumption that 6 defaults per year is the average in a Poisson process (distribution), what is the probability that the next municipal default will occur within one month?

- A. 8.42%
 B. 17%
 C. 39.35%

- D. 60.65%

Answer: C

$\lambda = 6 \text{ defaults}/12 \text{ month} = 0.5 \text{ defaults per month.}$

$$P = 1 - \exp(-0.5) = 39.35\%$$

2.2 Given a hazard rate of 0.15, find the probability when a company defaults in year two after surviving the first year.

- A. 0.1393
- B. 0.2592
- C. 0.7408
- D. 0.8607

Answer: A

T	Cumulative PD	Survival Probability	PD (t, t+1)	Conditional PD Given Survival Until Time t
1	$1 - e^{-0.15} = 0.1393$	$1 - 0.1393 = 0.8607$	0.1393	
2	$1 - e^{-0.15(2)} = 0.2592$	$1 - 0.2592 = 0.7408$	$0.2592 - 0.1393 = 0.1199$	$0.1199/0.8607 = 0.1393$

2.3 Suppose the hazard rate is constant and equal to 0.090. In this case, each of the following is true except which is false?

- A. The unconditional one-year default probability is 8.6%
- B. The unconditional two-year default probability is 16.5%
- C. The probability of joint event of survival through the first year and default in the second year is 7.9%
- D. The conditional one-year default probability, given survival through the first year, is 17.3%

Answer: D

The conditional one-year PD is equal to 8.6%, same as the unconditional one-year default probability.

2.4 An analyst estimates that the hazard rate for a company is 0.16 per year. The probability of survival in the first year followed by a default in the second year is closest to: (Practice Exam)

- A. 11.62%.
- B. 13.63%.
- C. 14.79%.

D. 27.39%.

Answer: C

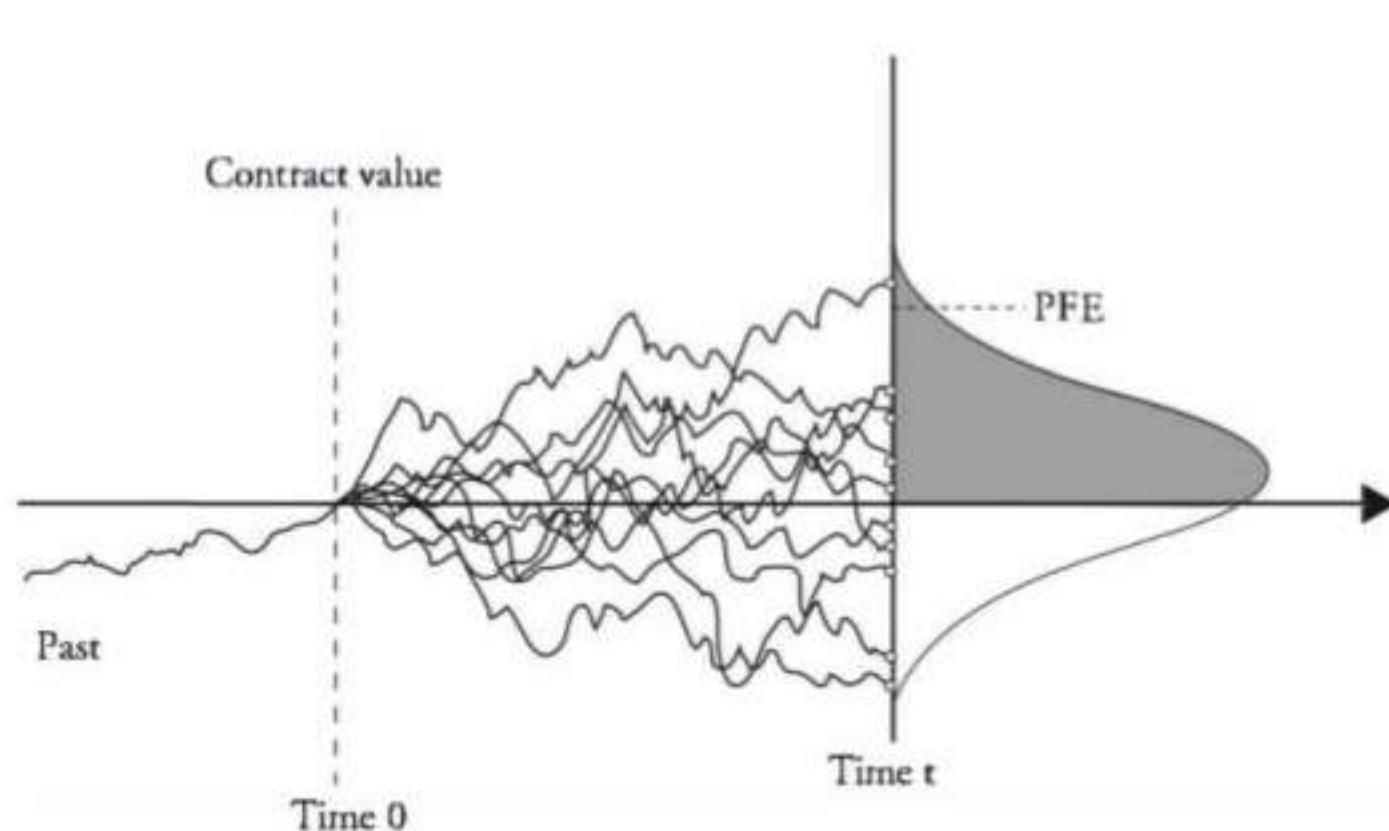
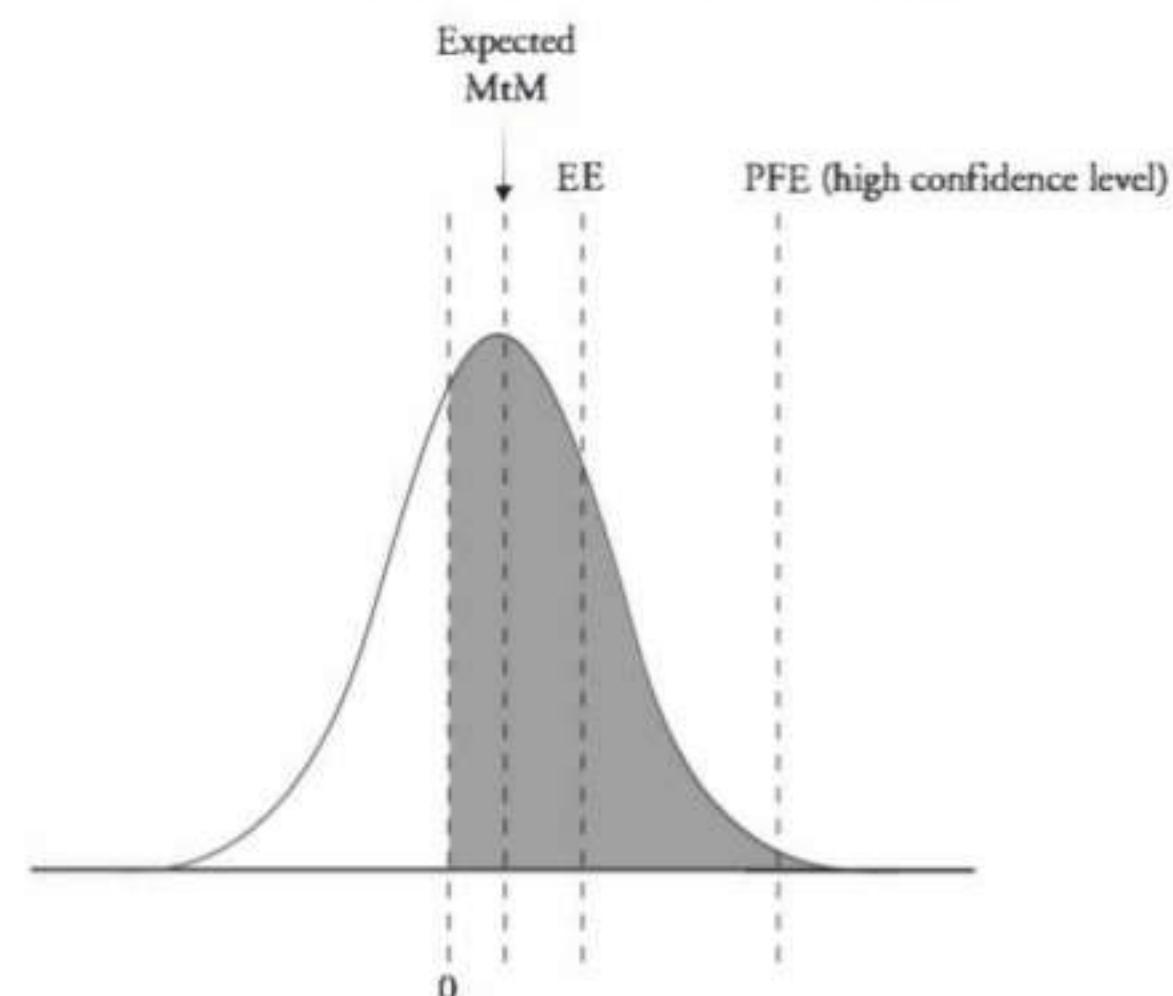
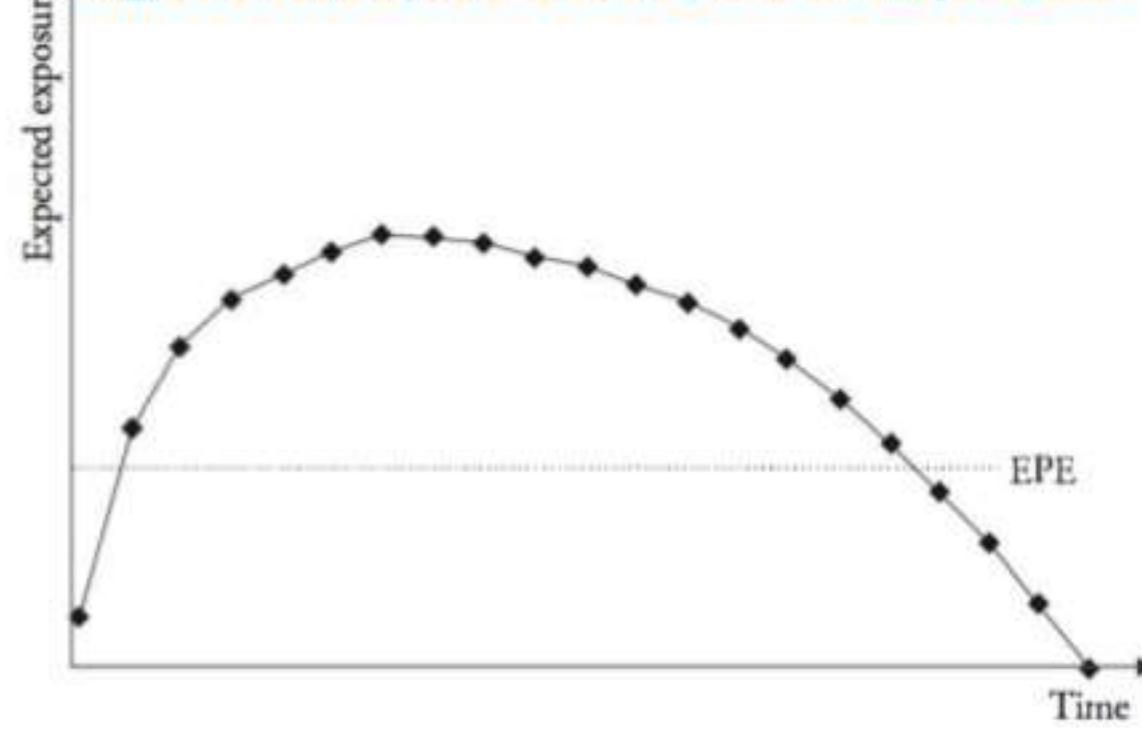
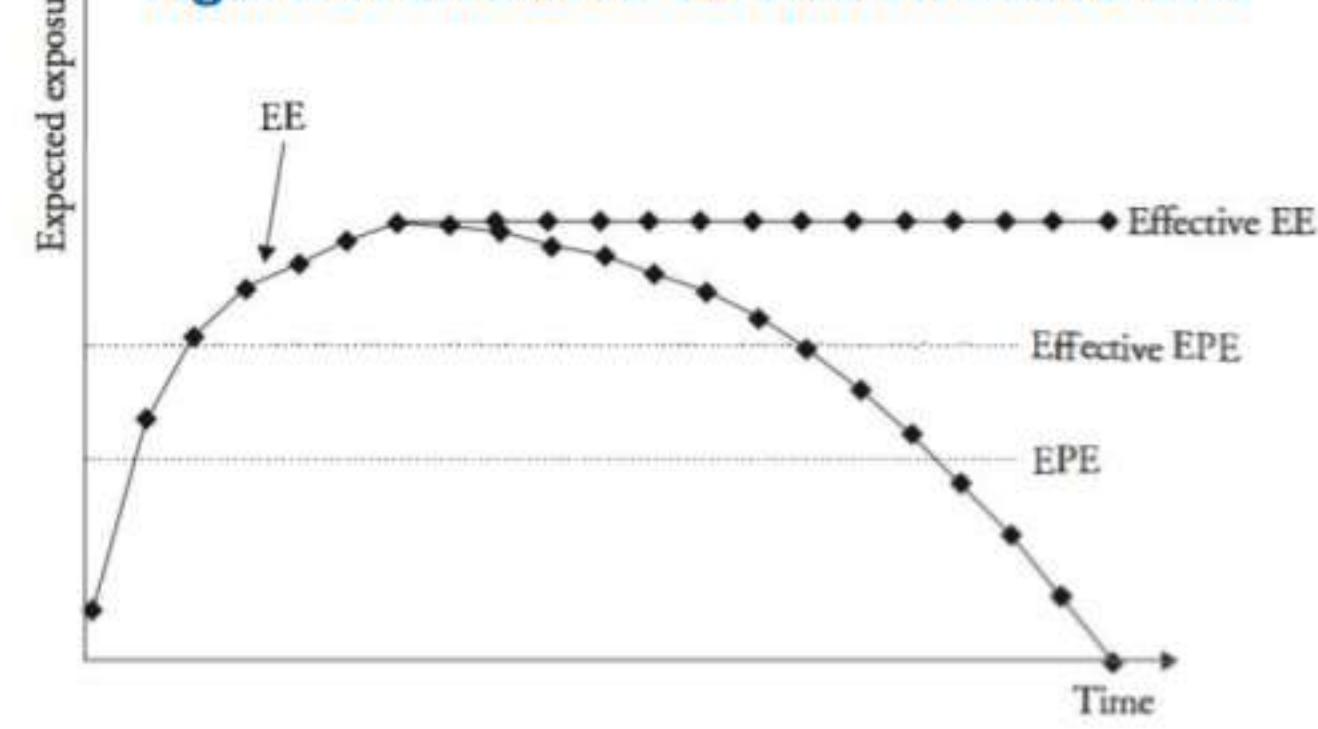
Explanation: The probability that the firm defaults in the second year is conditional on its surviving the first year. Using λ to represent the given hazard rate, we can calculate the cumulative probability of default in the first year using the formula $1 - \exp(-1 * \lambda) = 1 - \exp(-0.16) = 0.14786$. Thus, probability of survival in the first year = $1 - 0.14786 = 0.85214$.

Then, the cumulative probability that the firm defaults in the second year = $1 - \exp(-2 * \lambda) = 1 - \exp(-2 * 0.16) = 0.27385$, and the conditional one year default probability given that the firm survived the first year is the difference between the two year cumulative probability of default and the one year probability divided by the probability of survival in the first year = $(0.27385 - 0.14786) / 0.85214 = 0.14785 = 14.79\%$.

Section 12-13 Credit Exposure & Counterparty Risk

1 Key Point: Credit Exposure Metrics and Counterparty Risk

Credit Exposure Metrics ★★★ 概念对比	
Key terms	Definition
Expected mark to market (MtM)	The <i>expected value</i> of a transaction at a <i>given point</i> in the future.
Expected exposure (EE)	The amount that is <i>expected to be lost</i> if there is positive MtM and the counterparty defaults. It is <i>larger than expected MtM</i>
Potential future exposure (PFE)	The <i>worst exposure</i> that could occur at a <i>given time</i> in the future at a given confidence level.
Maximum PFE	The <i>highest PFE</i> value over a stated time frame
Expected positive exposure (EPE)	The <i>average EE</i> through time
Negative exposure	The exposure from the <i>counterparty's point of view</i> , is represented by negative future values. The <i>expected negative exposure (ENE)</i> and the negative expected exposure (NEE) are the exact opposite of EPE and EE.
Effective EE & Effective EPE	<i>Effective EE</i> is equal to <i>nondecreasing EE</i> . Effective EPE is the average of the effective EE.

Figure 1: Potential Future Exposure**Figure 2: Credit Exposures****Figure 3: Expected Positive Exposure****Figure 4: Effective EE and Effective EPE**

Introduction of Counterparty Risk

★★★ 概念对比

A type of credit risk that one of the parties to a transaction will *not fulfill its obligations*. Counterparty risk is typically a *two-way transaction*.

Counterparty Risk & Market Risk

- Market risk** is the risk that the value of an underlying position will move against the trader due to adverse market factors, which may result in a *negative NPV* of the investment.
- Counterparty risk is the conditional risk that the *NPV is positive*, however, the *counterparty fails to perform its obligations*.

Counterparty Risk & Lending Risk

Lending risk has two notable characteristics

- The *principal* amount at risk is usually *known*.
 - Only one party* takes on risk.
- Counterparty risk
- the value of the underlying instrument is *uncertain*
 - Counterparty risk is *bilateral* in that each party takes on the risk that the counterparty will default

Counterparty Risk Terminology

Credit exposure	Credit exposure is the loss that is "conditional" on the counterparty defaulting.
Credit migration	There is <i>mean reversion in credit quality</i> , so the implication is that counterparties with strong credit ratings tend to deteriorate and those with weak credit ratings tend to improve.
Recovery	$LGD = 1 - \text{recovery rate}$
Mark-to-market	$MtM = \text{present value of all expected inflows less the present value of expected payments}$

1.1 If a counterparty defaults before maturity, which of the following situations will cause a credit loss?

- You are short Euros in a one-year euro/USD forward FX contract, and the euro has appreciated.
- You are short Euros in a one-year euro/USD forward FX contract, and the euro has depreciated.
- You sold a one-year OTC euro call option, and the euro has appreciated.
- You sold a one-year OTC euro call option, and the euro has depreciated.

Answer: B

1.2 Suppose a mark-to-market (MtM) is defined by a normal distribution with mean of 2% and standard deviation of 5%. Each of the following is true about the expected exposure except which is false?

- A. The EE is greater than 2%
- B. The EE is greater than the 95% confident potential future exposure (PFE)
- C. An increase in the mean assumption will increase the EE.
- D. An increase in the standard deviation assumption will increase the EE.

Answer: B

The EE will be less than the 95% PFE.

1.3 Each of the following is true except:

- A. At any point in time, effective EE cannot be less than EE
- B. (effective) EPE is average (effective) EE over time
- C. Effective EPE cannot be less than EPE
- D. For each point in time, there is a different maximum PFE such that maximum PFE does not represent a single value

Answer: D

Maximum PFE is a single value. Maximum PFE simply represents the highest (peak) PFE value over a given time interval.

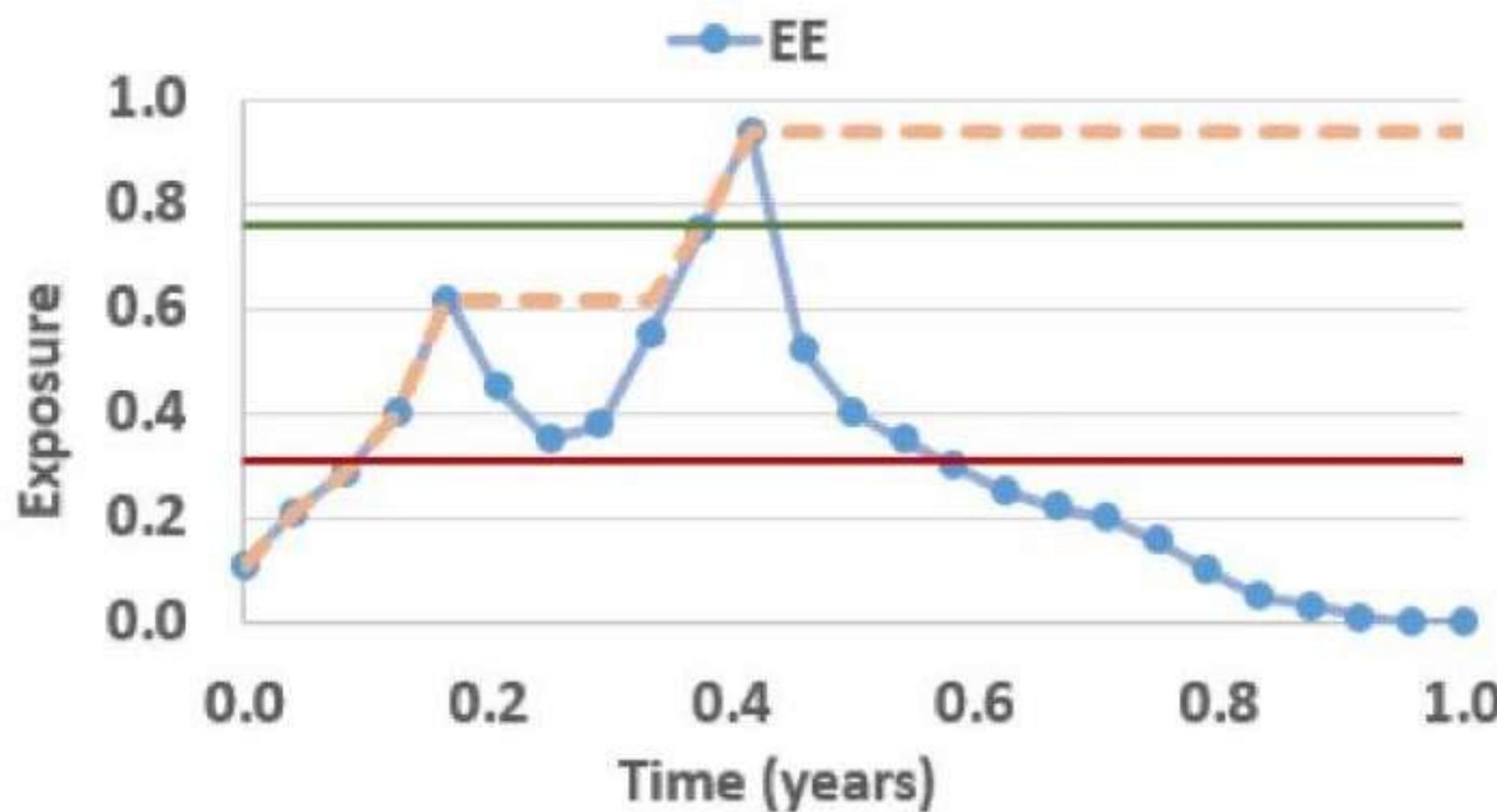
1.4 A financial firm sells a put option on ABC stock with a time to expiration of six months, a strike price of USD 105, an underlying asset price of USD 85, implied volatility of 24% and a risk-free rate of 3%. What is the firm's counterparty credit exposure from this transaction? (Practice Exam)

- A. USD 0.00
- B. USD 0.68
- C. USD 2.38
- D. USD 32.40

Answer: A

Explanation: Selling a put option exposes the firm to zero counterparty credit risk as the premium is paid up front. The correct answer is therefore (a). All the information necessary to price the option is provided but it is not necessary.

1.5 Refer to the chart below, which plots four lines over time.



Which of the following does the uppermost line most likely represent?

- A. Effective expected exposure.
- B. Expected positive exposure.
- C. Potential future exposure.
- D. Maximum potential future exposure.

Answer: A

Measures such as EE and EPE may underestimate exposure for short-dated transactions (since capital measurement horizons are typically 1-year) and not capture properly rollover risk (Chapter 3). For these reasons, the terms effective EE and effective EPE were introduced by the Basel Committee on Banking Supervision (2005). Effective EE is simply a non-decreasing EE. Effective EPE is the average of the effective EE.

1.6 Which of the following two transactions increases counterparty credit exposure?

- I. Selling a forward contract to the counterparty
 - II. Selling a call option to the counterparty
- A. I only
 - B. II only
 - C. Both
 - D. Neither

Answer: A

- I. Selling of forward contract creates credit risk exposure to the counterparty as it is subject to the performance of the counterparty, which may default to pay at expiry date,
- II. Selling an option (for both call and put) does not create credit risk as it is not subject to the performance of the counterparty. The option premium has already been collected when the transaction is made and default of the counterparty will have no negative impact on the seller.

1.7 A bank is the fixed rate payer in a 4-year interest rate swap. The probability distribution for

the portfolio mark-to-market (MTM) is shown in the following table. (Important)

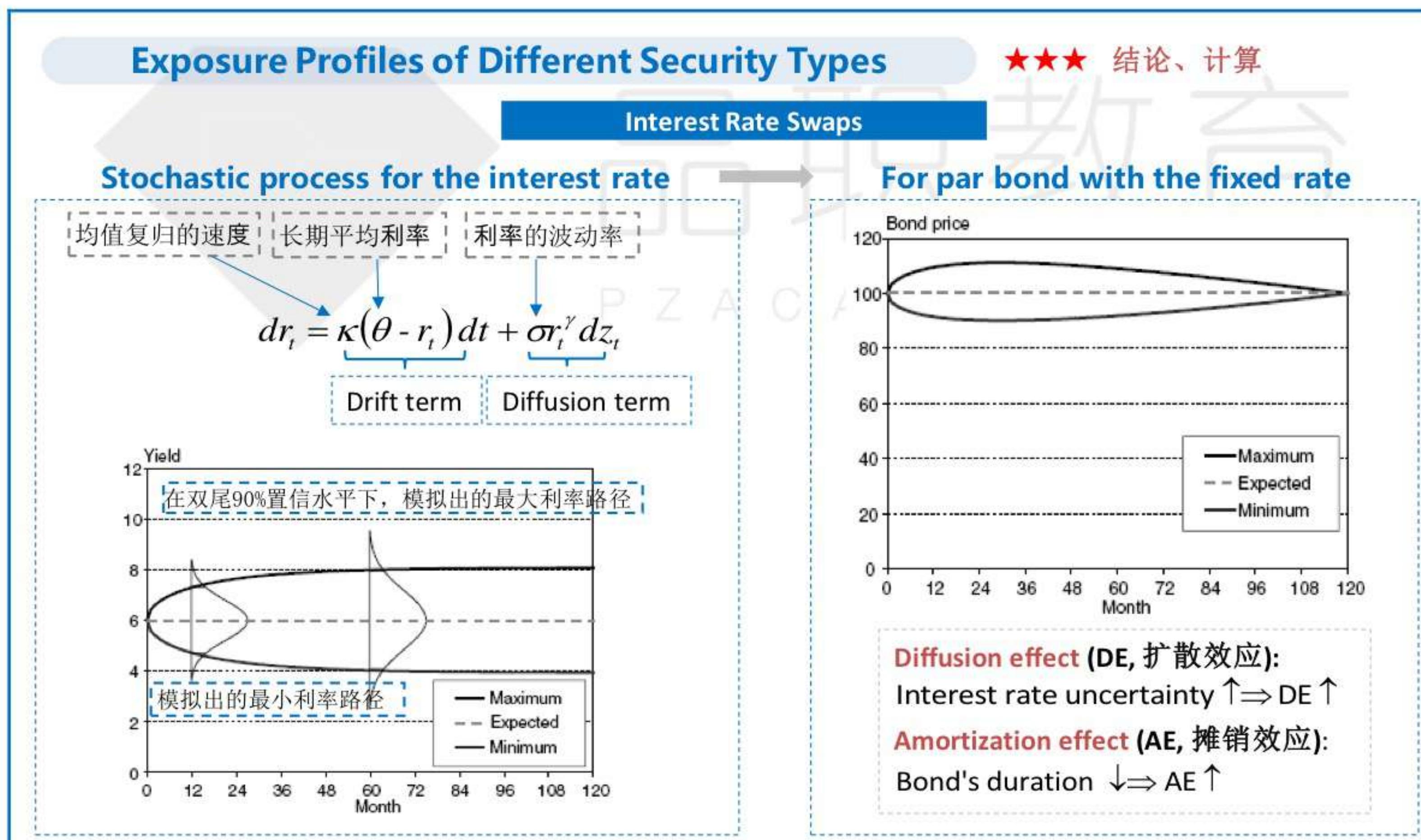
Portfolio MTM (USD)	Probability
-4,000,000	10%
-1,500,000	20%
400,000	35%
2,500,000	20%
4,500,000	15%

The counterparty risk expected exposure of this swap is: (Important)

- A. USD -700,000
- B. USD 615,000
- C. USD 1,315,000
- D. USD 4,500,000

Answer: C

2 Key Point: Exposure Profiles of Different Security Types



Exposure of interest rate swap

- Assume that the bond's (modified) duration is proportional to the remaining life, $D = k(T - t)$ at any date t .
- The volatility from 0 to time t : $\sigma_{r_t - r_0} = \sigma\sqrt{t}$
- Hence the swap volatility: $\sigma(V) = [k(T - t)] \times \sigma\sqrt{t}$
- Thus peak exposure occurs: $t_{MAX} = \frac{1}{3}T \Leftrightarrow \frac{d\sigma(V)}{dt} = 0$

Currency Swaps

Other Security Types

Types	Description
Loans, Bonds and Repos	<ul style="list-style-type: none"> The exposures of bonds, loans and repos can usually be considered almost deterministic and approximately equal to the notional value. Bonds typically pay a fixed rate and therefore will have some additional uncertainty since, if interest rates decline, the exposure may increase.
Options	The general exposure profile of a long option position tends to increase until exercise due to the increased possibility that the option can be highly in the money
Credit Derivatives	The increase in exposures in early years is the result of the CDS premium (or credit spread) widening . The maximum exposure for the CDS occurs at a credit event where the notional value is paid less the recovery value.

2.1 Assume that swap rates are identical for all swap tenors. A swap dealer entered into a plain-vanilla swap one year ago as the receive-fixed party, when the price of the swap was 7%. Today, this swap dealer will face credit risk exposure from this swap only if the value of the swap for the dealer is

- Negative, which will occur if new swaps are being priced at 6%
- Negative, which will occur if new swaps are being priced at 8%
- Positive, which will occur if new swaps are being priced at 6%
- Positive, which will occur if new swaps are being priced at 8%

Answer: C

2.2 Which one of the following deals would have the greatest credit exposure for a \$1,000,000 deal size (assume the counterparty in each deal is an AAA-rated bank and has no settlement risk)?

- Pay fixed in an Australian dollar (AUD) interest rate swap for one year.
- Sell USD against AUD in a one-year forward foreign exchange contract.

- C. Sell a one-year AUD cap.
- D. Purchase a one-year certificate of deposit.

Answer: D

The CD has the whole notional at risk. Otherwise, the next greatest exposure is for the forward currency contract and the interest rate swap. The short cap position has no exposure if the premium has been collected. Note that the question eliminates settlement risk for the forward contract.

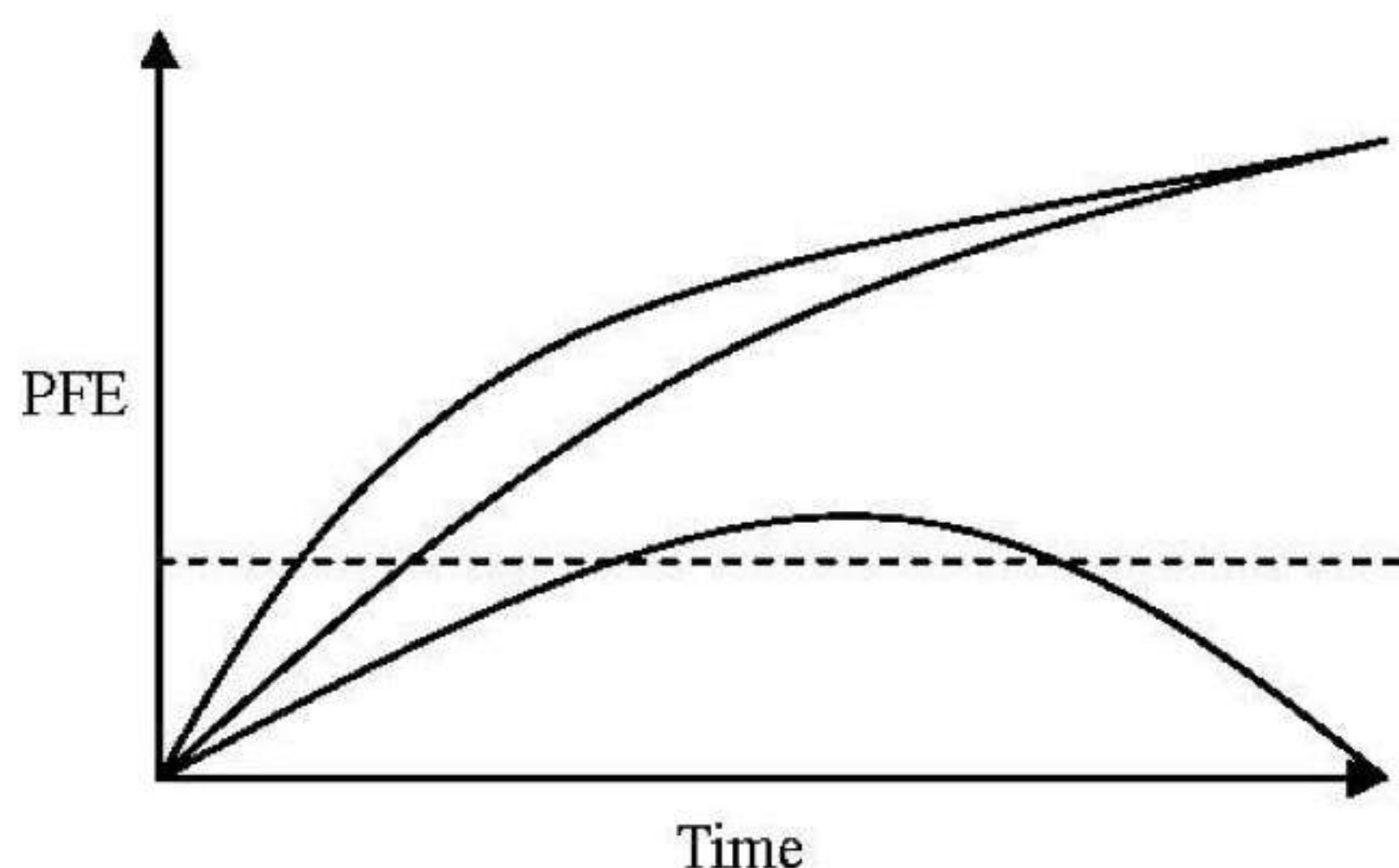
2.3 BNP Paribas has just entered into a plain-vanilla interest-rate swap as a pay-fixed counterparty. Credit Agricole is the receive-fixed counterparty in the same swap. The forward spot curve is upward-sloping. If LIBOR starts trending down and the forward spot curve flattens, the credit risk from the swap will:

- A. Increase only for BNP Paribas
- B. Increase only for Credit Agricole
- C. Decrease for both BNP Paribas and Credit Agricole
- D. Increase for both BNP Paribas and Credit Agricole

Answer: B

With an upward-sloping term structure, the fixed payer has greater credit exposure. He receives less initially, but receives more lately. This back-loading of payments increases credit exposure. Conversely, if the forward curve flattens, the fixed payer (i.e., BNP Paribas) has less credit exposure. Credit Agricole must have greater credit exposure. Alternatively, if LIBOR drifts down, BNP will have to pay more, and its counterparty will have greater credit exposure.

2.4 The chart below shows three exposure profiles, where the exposure metric is the potential future exposure (PFE): PFE of an interest rate swap (IRS), PFE of a foreign exchange (FX) forward contract, and PFE of a cross-currency swap. Also plotted is the average PFE of the interest rate swap, where "average PFE" is what Jorion calls the average worst credit exposure (AWCE). Which position's (instrument's) exposure profile is most likely the uppermost, concave plot line?



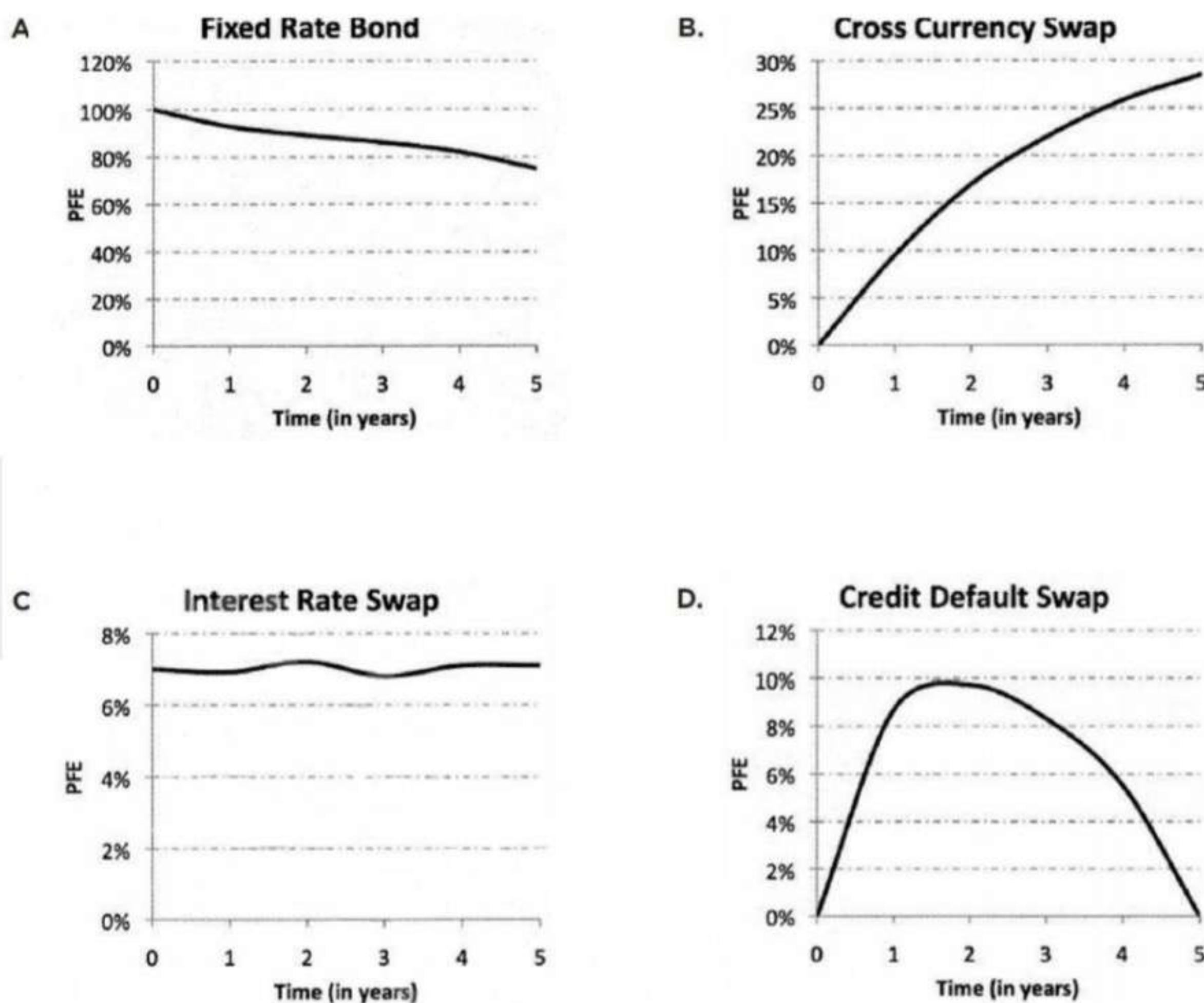
- A. PFE of interest rate swap

- B. PFE of foreign exchange (FX) contract
- C. PFE of cross-currency swap
- D. Average PFE of interest rate swap

Answer: C

PFE of cross-currency swap, which combines the exposure of an interest rate swap and the FX forward. The dotted must be the average PFE (aka, AWCE) since it is a flat line.

2.5 Which of the following graphs is an accurate representation of a typical potential future exposure (PFE) profile for the corresponding instrument? (Practice Exam)



Answer: B

The risk of cross-currency swaps is driven by a large final payoff, and thus the profile increases monotonically until the maturity of the trade. The FX risk of the notional exchange dominates the small contribution due to interest rate exposure.

3 Key Point: Risk Mitigation Techniques

Risk Mitigation Techniques ★★ 结论

Modeling Netting Agreements

The benefit of correlation

- Positive correlations have lower netting benefits than negative correlations, with perfect positive correlation providing the least netting benefit.
- Negative correlations provide stronger netting benefits, with perfect negative correlation leading to the greatest netting benefit.

Netting factor

$$\text{netting factor} = \frac{\sqrt{n+n(n-1)\bar{\rho}}}{n}$$

- Netting benefit improves (i.e., netting factor declines) with a larger number of exposures and a lower correlation.
- It is important to note that the netting benefit also depends on the initial MtM of transactions.

Impact of Collateral on Credit Exposure

Certain parameters impact the effectiveness of collateral

- Remargin period:** the time between the call for collateral and its receipt.
- Threshold:** exposure level below which collateral is not called. It represents an amount of uncollateralized exposure.
- Minimum transfer amount:** the minimum quantity or block in which collateral may be transferred. Quantities below this amount represent uncollateralized exposure as well.
- Independent amount:** an amount posted independently of any subsequent collateralization. This is also referred to as the *initial margin*.
- Rounding:** the process by which a collateral call amount will be adjusted (rounded) to a certain increment.

Impact of Collateral on Credit Exposure

Remargin Period	<p>The remargin period, also known as the margin call frequency, is <i>the period from which a collateral call takes place to when collateral is actually delivered</i>.</p> <p>Expected exposure (EE): $EE = \frac{1}{\sqrt{2\pi}} \times \sigma_E \times \sqrt{T_M} \approx 0.4 \times \sigma_E \times \sqrt{T_M}$</p> <p>Potential future exposure (PFE): $PFE = k \times \sigma_E \times \sqrt{T_M}$</p>
Imperfect collateralization	<ul style="list-style-type: none"> Collateralization may be deficient due to terms in the collateral agreement, such as <i>threshold, minimum transfer amount, and rounding</i>. $\text{exposure}_{t-\Delta} > \text{collateral}_{t-\Delta}$ Exposure could increase <i>between margin calls</i>. $\text{exposure}_t > \text{collateral}_{t-\Delta}$

3.1 Which of the following are methods of credit risk mitigation?

I. Collateral agreements

II. Netting

- A. I only
- B. II only
- C. Both
- D. Neither

Answer: C

Both collateral and netting agreements are methods of mitigation credit risk.

3.2 Sacks Bank has many open derivative positions with Lake Investments. A description and current market values are displayed in the table below:

Positions	Market Price (USD)
Long Swaptions	10 million
Long Credit Default Swaps	-25 million
Short Currency Derivatives	25 million

In the event that Lake defaults, what would be the loss to Sacks if netting is used?

- A. USD 5 million
- B. USD 10 million
- C. USD 25 million
- D. USD 35 million

Answer: B

Netting means that the payments between the two counterparties are netted out, so that only a net payment has to be made. With netting, Sacks is not required to make the payout of 25 million. Hence the loss will be reduced to: 35 million -25 million = 10 million

3.3 The exhibit below presents a summary of bilateral mark-to-market (MtM) trades for four counterparties. If netting agreements exist between all pairs of counterparties shown, what is the correct order of net exposure per counterparty, from lowest to highest? (Practice Exam)

MtM Trades for Four Counterparties (USD million)		Opposing Counterparty		
		B	C	D
Counterparty A	Trades with positive MtM	10	10	1
	Trades with negative MtM	-10	-5	-10
Counterparty B	Trades with positive MtM	10	0	10
	Trades with negative MtM	-10	-5	-2
Counterparty C	Trades with positive MtM	5	5	2
	Trades with negative MtM	-10	0	-1
Counterparty D	Trades with positive MtM	10	2	1
	Trades with negative MtM	-1	-10	-2

- A. A – C – B – D
- B. A – D – C – B
- C. D – B – C – A
- D. B – C – D – A

Answer: A

The properly netted amounts are: For A: B = \$0, C = \$5, D = \$0, for a sum of \$5. For B: A = \$0, C =

\$0, D = \$8, for a sum of \$8. For C: A = \$0, B = \$5, D = \$1, for a sum of \$6. For D: A = \$9, B = \$0, C = \$0, for a sum of \$9.

3.4 Miven Corp. has two trades outstanding with one of its counterparties. Which of the following scenarios would result in the greatest netting advantage for Miven?

- A. The two trades have strong positive correlation.
- B. The two trades have weak positive correlation.
- C. The two trades are uncorrelated with each other.
- D. The two trades have strong negative correlation.

Answer: D

The greatest netting benefit among the scenarios presented occurs when the two trades have a strong negative correlation. In this case, a large portion of the negative exposures will offset positive exposures.

3.5 The table below illustrates exposures for scenarios involving two trades:

	MtM	
	Trade 1	Trade 2
Scenario 1	25	15
Scenario 2	15	-10
Scenario 3	10	-5
Scenario 4	5	-5
Scenario 5	-5	-10

Which is nearest to the netting factor?

- A. 9.92%
- B. 37.50%
- C. 60.88%
- D. 71.43%

Answer: D

	MtM		Total Exposure		Netting Factor
	Trade 1	Trade 2	No netting	Netting	
Scenario 1	25	15	40	40	
Scenario 2	15	-10	15	5	
Scenario 3	10	-5	10	5	
Scenario 4	5	-5	5	0	
Scenario 5	-5	-10	0	0	
EE			70	50	71.43%

3.6 A diversified portfolio of OTC derivatives with a single counterparty currently has a net mark-to-market value of USD 20,000,000 and a gross absolute mark-to-market value (the sum of the value of all positive-value positions minus the value of all negative-value positions) of USD 80,000,000. Assuming there are no netting agreements in place with the counterparty, determine the current credit exposure to the counterparty.

- A. Less than or equal to USD 19,000,000
- B. Greater than USD 19,000,000 but less than or equal to USD 40,000,000
- C. Greater than USD 40,000,000 but less than USD 60,000,000
- D. Greater than USD 60,000,000

Answer: C

Define X and Y as the absolute values of the positive and negative positions. The net value is $X - Y = 20$ million. The absolute gross value is $X + Y = 80$. Solving, we get $X = 50$ million. This is the positive part of the positions, or exposure.

3.7 You are the credit risk manager for a bank and are looking to mitigate counterparty credit risk exposure to ZTM, an A-rated firm. Currently your bank has the following derivatives contracts with ZTM:

Contract	Contract Value (HKD)
A	40,000,000
B	60,000,000
C	28,000,000
D	2,000,000

With the information provided, what is the most appropriate credit risk mitigation technique in this case? (Practice Exam)

- A. Implement a netting scheme
- B. Use credit triggers.
- C. Sell credit default swaps on ABCO
- D. Increase collateral.

Answer: D

Increasing collateral would effectively reduce current credit exposure depending on the contract parameters, mainly minimum transfer amount and threshold.

3.8 An underlying exposure with an effective annual price volatility of 6% is collateralized by a 10-year U.S. Treasury note with an effective price volatility of 8%. The correlation between the exposure and the U.S. Treasury note is zero. Changes in the value of the overall position (the exposure plus collateral) are calculated for a 10-day horizon at a 95% confidence interval. Which of the following would one expect to observe from this analysis? (Practice Exam)

- A. The presence of collateral increases the current exposure and increases the volatility of the exposure between remargining periods.
- B. The presence of collateral decreases the current exposure, but increases the volatility of the exposure between remargining periods.
- C. The presence of collateral increase the current exposure, but decreases the volatility of the exposure between remargining periods.
- D. The presence of collateral decreases the current exposure and decreases the volatility of the exposure between remargining periods.

Answer: B

Explanation: Worst case change for the value of the collateral is: $-1.96 \times 8\% \times (10/250)^{0.5} = -3.136\%$.
 The overall volatility of the position: $(0.06^2 + 0.08^2)^{0.5} = 0.10 = 10\%$

Thus the worst case change in the value of this position (exposure + collateral) = $-1.96 \times 10\% \times (10/250)^{0.5} = -3.920\%$

Thus, the collateral mitigates the exposure today while increasing the volatility of the position in the future.

3.9 Rarecom is a specialist company that only trades derivatives on rare commodities. Rarecom and a handful of other firms, all of whom have large notional outstanding contracts with Rarecom, dominate the market for such derivatives. Rarecom management would like to mitigate its overall counterparty exposure, with the goal of reducing it to almost zero. Which of the following methods, if implemented, could best achieve this goal? (Practice Exam)

- A. Ensuring that sufficient collateral is posted by counterparties.
- B. Diversifying among counterparties.
- C. Cross-product netting on a single counterparty basis.
- D. Purchasing credit derivatives, such as credit default swaps.

Answer: A

Counterparty exposure, in theory, can be almost completely neutralized as long as a sufficient amount of high quality collateral, such as cash or short-term investment grade government bonds, is held against it. If the counterparty were to default, the holder of an open derivative contract with exposure to that counterparty would be allowed to receive the collateral. Cross-product netting would only reduce the exposure to one of the counterparties, and purchasing credit derivatives would replace the counterparty risk from the individual counterparties with counterparty risk from the institution who wrote the CDS.

3.10 A financial firm 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 0.35. The firm believes that it can improve upon the diversification benefit of netting by a judicious choice of number of exposures with a favorable correlation coefficient. Which of the following trade combinations

would increase the firm's expected netting benefit the most from the current level? (Practice Exam)

Trade Combination	Number of Positions	Average Correlation
A	5	0.22
B	7	0.11
C	11	-0.07
D	14	-0.03

- A. Trade combination A
- B. Trade combination B
- C. Trade combination C
- D. Trade combination D

Answer: C

Explanation: Trade combination c is the correct answer. Netting factor is expressed as:

$$\text{Netting factor} = \frac{\sqrt{n+n(n-1)\rho}}{n}$$

When n (number of positions) = 10 and ρ (correlation coefficient) = 0.35 (current position),

$$\text{Netting factor} = \frac{\sqrt{n+n(n-1)\rho}}{n} = \frac{\sqrt{10+10*(10-1)(0.35)}}{10} = 64.42\%$$

When $n = 11$ and $\rho = -0.07$, there is the most reduction in netting factor,

$$\text{Netting factor} = \frac{\sqrt{n+n(n-1)\rho}}{n} = \frac{\sqrt{11+11*(11-1)(-0.07)}}{11} = 16.52\%$$

a is incorrect. When $n = 5$ and $\rho = 0.22$, there is only a modest netting benefit:

$$\text{Netting factor} = \frac{\sqrt{n+n(n-1)\rho}}{n} = \frac{\sqrt{5+5*(5-1)(0.22)}}{5} = 61.32\%$$

b is incorrect. When $n = 7$ and $\rho = 0.10$, there is reduction in netting factor but not as much as in c,

$$\text{Netting factor} = \frac{\sqrt{n+n(n-1)\rho}}{n} = \frac{\sqrt{7+7*(7-1)(0.10)}}{7} = 47.81\%$$

d is incorrect. When $n = 14$ and $\rho = -0.03$, there is a reasonable reduction in netting factor but not

$$\text{Netting factor} = \frac{\sqrt{n+n(n-1)\rho}}{n} = \frac{\sqrt{14+14*(14-1)(-0.03)}}{14} = 20.87\%$$

3.11 A bank has many open derivative positions with an investment firm. A description and current market values are displayed in the table below:

Positions Market	Price (USD)
Long swaptions	21 million
Long credit default swaps	-33 million
Short currency derivatives	33 million

In the event that the investment firm defaults, what would be the loss to the bank if netting is

used? (Practice Exam)

- A. USD 0 million
- B. USD 12 million
- C. USD 21 million
- D. USD 33 million

Answer: C

Explanation: Netting means that the payments between the two counterparties are netted out, so that only a net payment has to be made. With netting, the investment firm is not required to make the payout of 33 million. Hence the loss will be reduced to: USD 21 million + USD 33 million – USD 33 million = USD 21 million.

3.12 Assume a two-way CSA with the following identical parameters for both counterparties:

- Threshold is equal to \$1,000,000.
- Independent amount is equal to zero for both.
- Minimum transfer amount is equal to \$100,000
- Rounding up equal to \$25,000, and
- Initial collateral held equal to zero.

As noted, the initial collateral held is zero for both counterparties. Consider the next two days, from the perspective of Party A.

- 1) The portfolio mark to market increases to \$1,430,000 (1.430 million) on the first day, T(1)
- 2) The portfolio mark to market decreases to \$1,030,000 (1.030 million) on the second day, T(2)

Which of the following is the correct sequence of collateral calls (returns) from the perspective of Party A?

- A. On first day \$450,000 collateral called (received) by Party A; on second day \$400,000 collateral returned by Party A.
- B. On first day \$225,000 collateral posted by Party A; on second day additional \$100,000 collateral posted by Party A.
- C. On first day \$175,000 collateral called (received) by Party A; on second day \$200,000 collateral returned by Party A.
- D. Neither call nor post (return) collateral on either the first or second day.

Answer: A

On the first day, the portfolio value minus the threshold (which is not collateralized) is equal to \$1.430 million minus \$1.0 million or \$430,000. Because this is above the minimum transfer amount, there is a collateral call, and it is rounded up to \$450,000.

On the second day, the portfolio value minus the collateral held equals \$1.030 million minus \$450,000 equals \$580,000 which is \$420,000 below the threshold, such that (rounded) \$400,000

is returned.

3.13 Risk managers in a medium sized bank are trying to implement new tools to measure and manage counterparty credit risk. Most exposure to the bank's counterparties is through derivative contracts, but only some of the derivative counterparties have posted collateral. The risk managers are debating how the margined and non-margined counterparty exposure should be treated when calculating the exposure at default. Which of the following statement is correct? (Important)

- A. The forecasting period should be as long as the life of the contract for both margined counterparties as well as non-margined counterparties.
- B. The forecasting period should be no smaller than half the life of the contract for non-margined counterparties and can be chosen at any length for margined counterparties given the presence of collateral.
- C. An identical forecasting period which is shorter than the life of the contract should be chosen for margined and non-margined counterparties in order to be able to aggregate the risk exposures.
- D. A short forecasting period can be used for margined counterparties, while for non-margined counterparties it should correspond to the contract lifetime.

Answer: A

4 Managing and Mitigating Counterparty Risk

Managing and Mitigating Counterparty Risk ★★★ 概念对比

Approaches	Description
Close-out	The <i>immediate closing of all contracts</i> with the defaulted counterparty.
Collateralization (i.e., margining)	Occur in the form of a collateral agreement between two counterparties that reduces exposure by requiring sufficient collateral to be posted.
Walkaway feature	A <i>walkaway feature</i> allows a party to <i>cancel the transaction if the counterparty defaults</i> . It is advantageous if a party has a <i>negative MtM</i> and the counterparty defaults.
Mark-to-market	MtM = present value of all expected inflows less the present value of expected payments
Diversification	Limit credit exposure to any given counterparty
Exchange and centralized clearinghouses	<i>Exchange and centralized clearinghouses take on the role of the counterparty</i> and guarantee all trades by removing all counterparty risk from trades.
Netting	commonly used to mitigate counterparty risk
Hedging	Using credit derivatives allows an organization to reduce counterparty exposure to its own clients

4.1 What are the benefits of novation?

- A. Allows both party to walk away from the contract in case of default.
- B. A bilateral contract specifying that upon default, the non-defaulting party nets gains and losses with the defaulting counterparty to a single payment for all covered transactions

- C. Financial market contracts can be terminated upon an event of default prior to the bankruptcy process.
- D. Obligations are amalgamated with others

Answer: D

“a” is a walk-away clause.

“b” is a close-out netting.

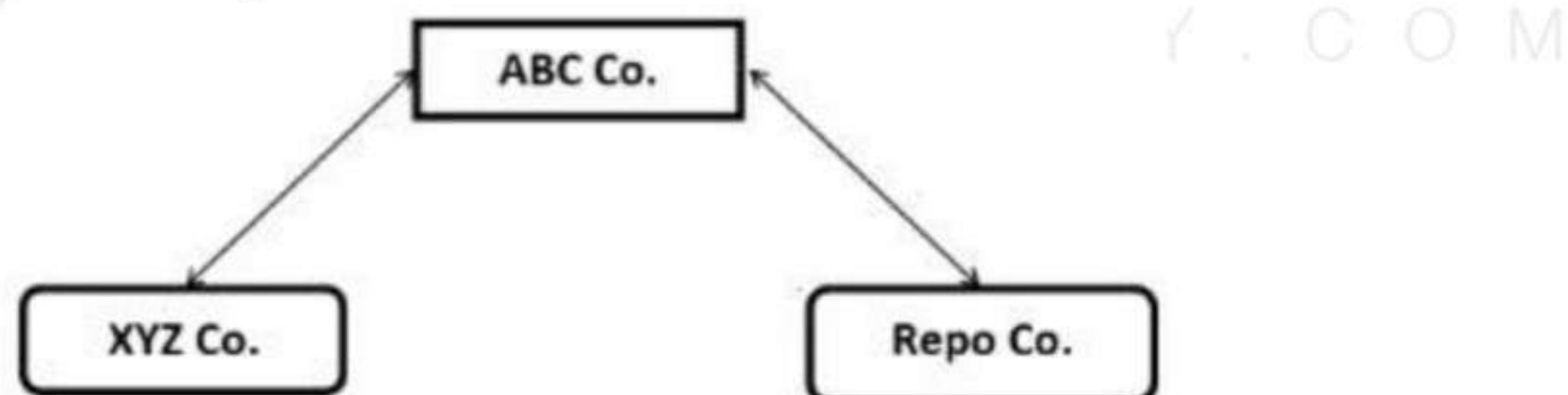
“c” is Termination.

4.2 QUESTIONS (1) AND (2) REFER TO THE FOLLOWING INFORMATION (Practice Exam)

XYZ, a small investment management firm, specializes in structuring small business loans and selling the government guaranteed portion to other institutional investors while retaining the riskier portions for high net worth investors. XYZ funds its operations by engaging in overnight repurchase agreements (repos) with three firms, but primarily with ABC, a firm that specializes in pooling funds from community banks and local government agencies and investing them in short-term, high-quality, government-secured investments.

Last week, XYZ was informed by ABC that its line had been frozen. XYZ learned that ABC had been defrauded by Repo Co., another repo borrower, who had provided false documentation of non-existent collateral of government- guaranteed loans. ABC feared a run by its investors as news of the fraud spread.

The diagram below illustrates the parties involved:



(1) The use of a central clearinghouse to handle the transactions executed between XYZ's main funding source, ABC and ABC's client, Repo Co., would likely have resulted in a reduction in:

- A. ABC's funding liquidity risk.
- B. Repo Co.'s default risk.
- C. XYZ's lending risk.
- D. ABC's operational risk.

Answer: D

Explanation: If it uses a clearinghouse and the clearinghouse makes a mistake (operational risk) like that made by ABC, ABC will have recourse to the clearinghouse and it would have, therefore, reduced its operational risk exposure.

- A. Incorrect. ABC is not funding from Repo Co.

B. Incorrect. The use of a clearinghouse does not change Repo Co.'s default risk – just ABC's exposure to Repo Co. defaults.

C. Incorrect. The use of a clearinghouse in this situation does not reduce XYZ's lending risk.

(2) By using a clearinghouse to handle the repo transactions between ABC and Repo Co., obligations owed between the two could have been netted once the fraudulent documentation was discovered. Which of the following is the most appropriate type of netting to use in this situation and what would be a likely additional impact from using this netting?

- A. Payment netting would be used, which would reduce ABC's counterparty risk, but this risk would be transferred to other creditors outside the clearinghouse.
- B. Payment netting would be used, which would reduce Repo Co.'s counterparty risk, but ABC's counterparty risk would be increased.
- C. Closeout netting would be used, which would reduce ABC's counterparty risk, but this risk would be transferred to other creditors outside the clearinghouse.
- D. Closeout netting would be used, which would reduce Repo Co.'s counterparty risk, but ABC's counterparty risk would be increased.

Answer: C

Payment netting per the reading is the simple netting of cash flows due on the same day. Closeout netting occurs if there is an event of default, which would include an incidence of fraud. One of the shortcomings of clearinghouses, and closeout netting as well, is that the other party, in this case ABC Bank, jumps to the head of the queue with its claim on Repo Co. to the possible detriment of others, particularly those outside the clearinghouse in general.

5 Key Point: Credit Value Adjustment (CVA)

Credit Value Adjustment (CVA)

★★★ 名词掌握、结论

- The credit value adjustment (CVA) is defined as *the expected value or price of counterparty credit risk*. A positive value represents a *cost* to the counterparty that bears a greater propensity to default.
- *Risky value = risk-free value - CVA*

CVA as a spread

- This would be a charge to the weaker counterparty.

$$\text{CVA as a spread} = X^{\text{CDS}} \times \text{EPE}$$

Impact of Changes in Credit Spread assumptions on CVA

Credit Spread:

- The CVA will most often *increase* given an *increase in the credit spread*.
- However, the impact will not be linear because default probabilities are limited to 100%. If a counterparty is very close to default, the CVA will actually decrease slightly, and in default the CVA will fall to zero.

Credit spread curve

- The CVA will be *lower* for an *upward-sloping curve* compared to a flat and a downward-sloping curve, and the CVA will be *higher* for a *downward-sloping curve* compared to a flat and an upward-sloping curve.

Incremental CVA	Change (or increment) in CVA that a <i>new trade will create, taking netting into account</i> .
Marginal CVA	<ul style="list-style-type: none"> • By using a marginal CVA measure, it will be possible to <i>break down a CVA for any number of netted trades into trade level contributions</i> that sum to the total CVA. • This metric allows for more rigorous analysis as it is <i>useful for better understanding which trades have the greatest impact</i> on a counterparty's CVA.

5.1 With respect to the CVA calculation, which of the following statement is correct when a risk manager wishes to understand which trades have the greatest impact on a counterparty's CVA? The manager would use:

- A. Incremental CVA because it accounts for the change in CVA once the new trade is priced, accounting for netting.
- B. Marginal CVA because he could break down netted trades into trade level contributions.
- C. Incremental CVA because he could break down netted trades into trade level contributions.
- D. Marginal CVA because it accounts for the change in CVA once the new trade is priced, accounting for netting.

Answer: B

Understanding which trades have the greatest impact on a counterparty's credit value adjustment requires use of the marginal CVA. Incremental CVA, by contrast, is useful for pricing a new trade with respect to an existing one.

5.2 A bank enters into a swap agreement with a counterparty. The swap has no collateral requirements, and no netting agreements are present between the bank and the counterparty. The following data is available for the swap position:

- The counterparty expected exposure is 0.40% and approximately constant from month to month.
- The credit spread for a five year credit default swap on the counterparty is 500 bps.
- The counterparty's probability of default within five years is 10%.
- The 5-year effective duration of the swap is 4.0.

Assuming no wrong-way risk on the position, which value is the closest approximation of the credit value adjustment expressed as a running spread? (Important)

- A. 2 bps
- B. 4 bps
- C. 5 bps
- D. 8 bps

Answer: A

5.3 Mary assigns to John a long position in an at-the-money (ATM) call option with a one year term and strike a price of \$100.00. The current stock price is \$100.00 with volatility of 60.0%. The risk-free rate is 3.0% with continuous compounding. $N(d_1) = 0.64$ and $N(d_2) = 0.40$. The present-valued expected exposure (EE) to the counterparty, who holds the short option position, is \$23.00 with a probability of counterparty default of 5.0% and loss given default (LGD) of 75.0%. Which is nearest to John's payment for the long option position, if his cost includes a credit

valuation adjustment (CVA)?

- A. \$6.15
- B. \$19.37
- C. \$24.32
- D. \$26.04

Answer: C

The BSM call option price = $100 \times 0.64 - 100 \times \exp(-3\%) \times 0.40 = \25.182 , which does not include counterparty risk incurred by the long option position (the short has no counterparty risk). The CVA-adjusted value = $\$25.182 - \$23.00 \times 5\% \times 75\% = \24.32

5.4 Sam prices a put option on an asset with the Black-Scholes-Merton option pricing model and calculates a model premium of \$25. This \$25 also coincidentally equals the present-valued expected exposure faced by Sam with respect to the short option position. Sam estimates the probability of counterparty default by the option writer to be 10% with loss given default of 40%, such that the expected loss = \$25 EE (writer) \times 10% PD \times 40% LGD = \$1. He concludes that the CVA-adjusted (net of counterparty risk) option price is \$24. His colleague Jane observes that this calculation assumes no wrong-way risk. But there is a high, positive correlation between underlying asset price and the credit quality of the option writer counterparty: both the counterparty and underlying share a sector that reacts to the same common factors such that adverse economic regimes depress sector asset prices while lowering sector credit quality (and increasing credit spreads). Is Jane correct that the CVA-adjusted option value deserves further adjustment?

- A. As the correlation is positive, this is instead right-way risk; but the true CVA-adjusted value remains \$24 as there is no adjustment for right-way risk.
- B. As the correlation is positive, this is instead right-way risk; therefore, the true CVA-adjusted value will be higher than \$24.
- C. Jane is correct that this is wrong-way risk; therefore, true CVA-adjusted value will be lower than \$24.
- D. Jane is correct that this is wrong-way risk but expected loss is not impacted by correlation, so Sam correctly has the CVA-adjusted value at \$24.

Answer: C

We refer to wrong-way risk as the adverse (negative) correlation between the exposure to the counterparty and its credit quality. Alternatively, it can be stated as the positive correlation between exposure and credit spread.

5.5 Local Company, a frequent user of swaps, often enters into transactions with Global Bank, a major provider of swaps. Recently, Global Bank was downgraded from a rating of AA+ to a rating of A, while Local Company was downgraded from a rating of A to a rating of A-. During this time,

the credit spread for Global Bank increased from 20 bps to 150 bps. While the credit spread for Local Company increased from 130 bps to 170 bps. Which of the following is the most likely action that the counterparties will request on their credit value adjustment (CVA)? (Important)

- A. The credit qualities of the counterparties have changed, but not enough to justify amending existing CVA arrangements.
- B. Global Bank requests an increase in the CVA charge it receives.
- C. Local Company requests a reduction in the CVA charge it pays.
- D. CVA is no longer a relevant factor, and the counterparties will use other mitigants of counterparty risk.

Answer: C

5.6 LEM Banking Corporation, a frequent user of swaps, often enters into transactions with GXT Bank, a major provider of swaps. Recently, GXT Bank was downgraded from a rating of AA to a rating of A, while LEM Banking Corporation was downgraded from a rating of A to a rating of A-. During this time, the credit spread for GXT Bank has increased from 25 bps to 155 bps, while the credit spread for LEM Banking has increased from 120 bps to 160 bps. Which of the following is the most likely action that the counterparties will request on their credit value adjustment (CVA)? (Practice Exam)

- A. The credit qualities of the counterparties have migrated, but not significantly enough to justify amending existing CVA arrangements.
- B. GXT Bank requests an increase in the CVA charge it receives.
- C. LEM Banking Corporation requests a reduction in the CVA charge it pays.
- D. CVA is no longer a relevant factor, and the counterparties should migrate to using other mitigants of counterparty risk.

Answer: C

Explanation: Because LEM Banking Corporation has a lower credit rating than GXT Bank, it would typically pay a CVA charge to GXT Bank which would be a function of the relative credit spread between the two banks.

After the downgrades of both GXT Bank and LEM Banking Corporation y, the credit spread between the two firms narrowed from 95 bps initially to only 5 bps after the downgrades. Therefore, with the spread much lower between the two banks, LEM Banking Corporation would be in a position to request a reduction in the CVA charge that it pays.

6 Key Point: Wrong-Way Risk

Wrong-Way Risk Vs. Right-Way Risk ★★★ 名词掌握、结论

Wrong-Way Risk

- An outcome of any association, dependence, linkage, or interrelationship between **exposure and counterparty creditworthiness** that generates an overall **increase in counterparty risk**.
- An increase in the amount of the credit value adjustment (CVA).

Right-Way Risk

- Any dependence, linkage, or interrelationship between the **exposure and default probability of a counterparty** producing an overall **decrease in counterparty risk** is described as right-way risk.
- RWR decreases the CVA and increases the DVA

Examples of Wrong-Way Risk and Right-Way Risk

Over-the-Counter Put Option	WWR (Assume the counterparty and the underlying issuer are the same .)
Over-the-Counter Call Option	RWR
Credit Default Swaps (CDSs)	WWR (The 2007-2009 credit crisis offers a classic example)
Foreign Currency Transactions	WWR (for the financial institution in the developed economy)
Interest rate swaps	WWR (The decline in the euro swap rate also increased the counterparty risk exposure . Deteriorating economic conditions also increased the default probability of Italian financial institutions)
Commodities	WWR

6.1 A Mexican retailer buys its goods from global suppliers. The contracts are priced in U.S. dollars. The retailer sells its goods to Mexican consumers and receives pesos from the sales. The firm enters a currency swap in which they will pay dollars and receive Brazilian real. They use Monte Carlo simulation to model their potential future exposure (PFE) to the real. Which of the following is most consistent with the retailer's circumstances?

- The retailer has wrong-way exposure in the swap and should use a lognormal distribution to model the PFE to the real.
- The retailer has right-way exposure in the swap and should use a distribution that allows for jumps to model the PFE to the real.
- The retailer has right-way exposure in the swap and should use a lognormal distribution to model the PFE to the real.
- The retailer has wrong-way exposure in the swap and should use a distribution that allows for jumps to model the PFE to the real.

Answer: D

The retailer has wrong-way exposure in the swap. They are paying dollars in their underlying business and paying dollars in the swap. If the dollar increases in value, their losses increase in both their business and the swap (i.e., the swap increases their expected losses).

The retailer should use a distribution that allows for jumps to model the PFE to the real because emerging country currencies are subject to extreme volatility.

A lognormal distribution would be used for major currencies, so choices A and C are incorrect.

6.2 Which of the following activities or transactions would most likely result in right-way risk with counterparty? (Important)

- Purchasing a put option from an A-rated company on that company's stock.

- B. Entering Into a forward contract to buy West Texas Intermediate (WTI) crude oil from an airline company at a fixed price
- C. Entering into a forward contract to buy WTI crude oil from a large oil producer at a fixed price.
- D. Selling a put option to an A-rated company on that company's stock.

Answer: C

Section 14 Portfolio Credit Risk

1 Credit Risk Portfolio Models

Credit Risk Portfolio Models ★★ 概念对比	
Models	Description
CreditRisk+ (Credit Suisse)	<ul style="list-style-type: none"> Each obligor has its own sensitivity to each of the <i>common risk factors</i>. The model allows for <i>only two outcomes (default or non-default)</i> for a loss of a fixed size. The model assumes that defaults are <i>uncorrelated across obligors</i>.
CreditMetrics (J.P. Morgan)	<p>Steps in calculating credit VaR using CreditMetrics:</p> <ol style="list-style-type: none"> Determine rating class for debt claim. Use historical rating transition matrix to determine the probability that claim will migrate. Estimate the distribution of value for claim by computing the expected values for one year. Use the 1-year forward zero curves rates to get current price of zero-coupon bond. Assume annual coupons to compute value of bond for each possible rating for next year. Compute the expected bond value $E(BV_p) = \sum p_i BV_i$. Then compute the credit value at risk (VaR) for a given confidence level.
Moody's KMV	<ul style="list-style-type: none"> Use of <i>current equity values</i> in the model. This allows for the impact of a current event to immediately affect the probability of default. Ratings changes occur with a considerable lag. The use of equity values allows for <i>probabilities of default to change continuously</i> as equity values change. In the <i>CreditMetrics</i> approach, <i>the value of the firm change without any impact</i> on the probability of default.
CreditPortfolioView	<ul style="list-style-type: none"> Model the transition matrices <i>using macroeconomic or economic cycle data</i>. CreditPortfolioView estimates an <i>econometric model for an index that drives the default rates of an industrial sector</i>.

1.1 At the beginning of the year, a firm bought an AA-rated corporate bond at USD 110 per USD 100 face value. Using market data, the risk manager estimates the following year-end values for the bond based on interest rate simulations informed by the economics team:

Rating	Year-End Bonds Value
AAA	112
AA	109
A	105
BBB	101
BB	92
B	83
CCC	73
Default	50

In addition, the risk manager estimates the 1-year transition probabilities on the AA-rated corporate bond:

Rating	Probability of State
AAA	3.00%
AA	85.00%
A	7.00%
BBB	4.00%
BB	0.35%
B	0.25%
CCC	0.15%
Default	0.25%

What is the 1-year 95% credit VaR per USD 100 of face value closest to? (Practice Exam)

- A. USD 9
- B. USD 18
- C. USD 30
- D. USD 36

Answer: A

The 95% credit VaR corresponds to the unexpected loss at the 95th percentile minus the expected loss, or the expected future value at the 95% loss percentile minus the current value. Using the probabilities in the given ratings transition matrix, the 95% percentile corresponds to a downgrade to BBB, at which the value of the bond would be estimated at 101. Since cash flows for the bond are not provided, we cannot derive the precise expected and unexpected losses, but the credit VaR (the difference) is easily derived by subtracting the estimated value given a BBB rating from the current value. 95% credit VaR = 110 – 101 = 9.

2 Default Correlation for Credit Portfolios

Default Correlation for Credit Portfolios ★★

$$\text{Default correlation: } \rho_{12} = \frac{\pi_{12} - \pi_1\pi_2}{\sqrt{\pi_1(1-\pi_1)}\sqrt{\pi_2(1-\pi_2)}}$$

计算

结论

Drawbacks in Credit Portfolio Framework

- **The number of required calculations:** There are 2^n event outcomes. The number of correlations is equal to $n(n-1)$.
- **Certain characteristics of credit positions do not fit well in the default correlation** credit portfolio model.
- **The limited data for estimating defaults:** Firm defaults are relatively rare events.

Credit VaR & Default Correlation (看基础班讲义例题)

- **Default correlation impacts the volatility and extreme quantiles of loss rather than the expected loss.**
 - If default correlation is 1, then there are **no credit diversification benefits**, and the portfolio behaves as if there were just one credit position.
 - A default correlation equal to 0 implies the portfolio is a **binomial-distributed** random variable because there is no correlation with other firms/ credits.
- “Granular”: **reducing the weight** of each credit as a proportion of the total portfolio by **increasing the number of credits**.
 - As a credit portfolio becomes **more granular, the credit VaR decreases**. However, **when the default probability is low, the credit VaR is not impacted as much** when the portfolio becomes more granular

2.1 Consider a pair of two speculative credits, rated BB and BB-, with default probabilities respectively of 2% and 3%. If their joint default probability is 0.4%, which is nearest to the implied default correlation?

- A. Zero
- B. 0.083
- C. 0.1424
- D. 0.3750

Answer: C

$$\text{Default correlation} = (0.4\% - 2\% \times 3\%) / [\sqrt{2\% \times 98\%} \times \sqrt{3\% \times 97\%}] = 0.142365$$

2.2 Suppose there is a \$1,000,000 portfolio with $n = 50$ credits that each has a default probability of $\pi = 0.02$ percent and a zero recovery rate, the default correlation is 0. In addition, each credit is equally weighted and has a terminal value of \$20,000 if there is no default. The number of defaults is binomially distributed with parameters of $n = 50$ and $\pi = 0.02$, and the 95th percentile of the number of defaults based on this distribution is 3. What is the credit VaR at the 95% confidence level based on these parameters? (Important)

- A. \$30,000
- B. \$40,000
- C. \$50,000
- D. \$60,000



Answer: B

The expected loss is \$20,000 ($\$1,000,000 \times 0.02$). If there are three defaults, the credit loss is \$60,000 ($3 \times \$20,000$). The credit VaR at the 95% confidence level is \$40,000 (calculated by taking the credit loss of \$60,000 and subtracting the expected loss of \$20,000).

2.3 Suppose there is a \$1,000,000 portfolio with n credits that each have a default probability, $\pi = 2\%$ and a zero recovery rate. The default correlation is 0 and $n = 1,000$. There is a probability of 28 defaults at the 95th percentile based on the binomial distribution with the parameters of $n = 1,000$ and $\pi = 0.02$. What is the credit VaR at the 95% confidence level based on these parameters?

- A. \$7,000
- B. \$8,000
- C. \$9,000
- D. \$10,000

Answer: B

The 95th percentile of the credit loss distribution is \$28,000 ($28 \times \$1,000,000/1,000$). The expected loss is \$20,000 ($\$1,000,000 \times 0.02$). The credit VaR is then \$8,000 ($\$28,000 - \$20,000$).

3 Key Point: Single-Factor Model

Single Factor Model ★
结论

Firm i's individual asset return is defined as:

- (1) the return on a market factor m that denotes the correlation between default and the state of the economy, and (2) a shock ε_i that captures idiosyncratic risk.

$$\alpha_i = \beta_i m + \sqrt{1 - \beta_i^2} \varepsilon_i$$

- Assuming that **each ε_i is not correlated with other credits**, each return on asset, a_i , is a standard normal variate. The correlation between pairs of individual asset returns between two firm's i and j is $\beta_i \beta_j$

Conditional Independence

- The **unconditional default distribution** is a standard normal distribution.
- The **conditional distribution** is a normal distribution with a mean of $\bar{\beta}_i m$ and a standard deviation of $\sqrt{1 - \beta_i^2}$.

Credit VaR with a single-factor model

The unconditional distribution used to calculate credit VaR

- The default loss level is assumed to be a random variable X with realized values of x .
- The market factor return, \bar{m} , for a given loss level, \bar{x} , is determined based on the following relationship
$$\Phi^{-1}(\bar{x}) = \left(\frac{\bar{k} - \bar{\beta} \bar{m}}{\sqrt{1 - \bar{\beta}^2}} \right)$$
- The market factor is assumed to be standard normal, and therefore, a loss level of 0.01 (99% confidence level) is equal to a value of -2.33 based on the standard normal distribution.
- These steps are repeated for each individual credit to **determine the loss probability distribution**.

3.1 Under single-factor model, a firm has a beta of 0.40 and an unconditional default probability of 1%. If we enter a modest economic downturn, such that the value of $m = -1.0$, what is the conditional default probability?

- A. 1.0%
- B. 1.8%
- C. 2.5%
- D. 2.8%

Answer: B

Conditional default has a mean of $0.40 \times (-1) = -0.40$ and a volatility of . The loss threshold is -2.33. Therefore the conditional default probability is: $\sqrt{1 - 0.4^2} = 0.92$

$$\Phi\left(\frac{-2.33 + 0.4}{0.92}\right) = 1.8\%$$

3.2 The default correlation under a single-factor credit model is 4.9%. Both credits have the same individual default probabilities of 2%. The joint default probability is characterized by a bivariate standard normal distribution. Below listed the asset correlations implied by various joint default probabilities. What is the implied asset correlation?

Asset Correlation	Joint Default Probability
-	0.040%

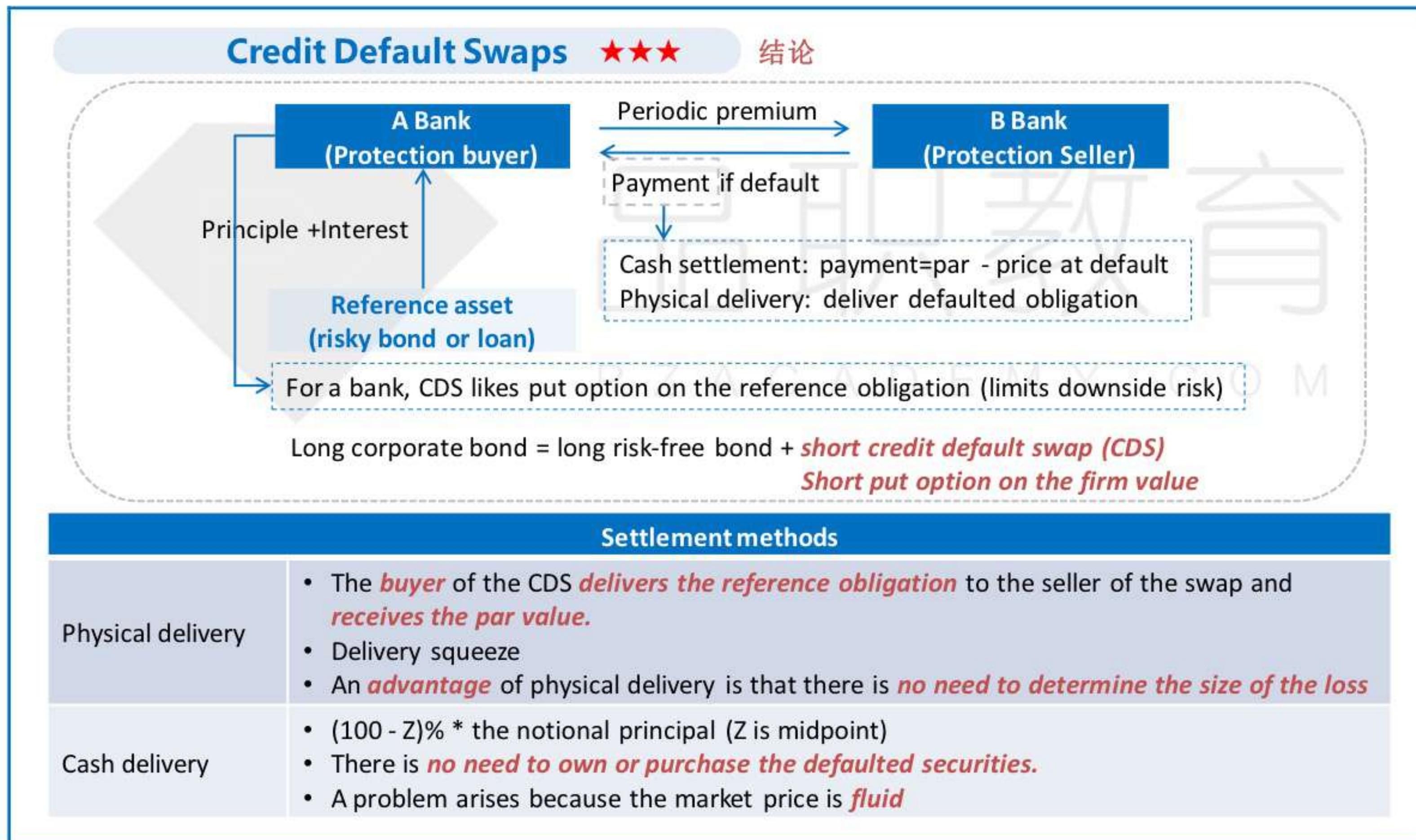
0.05	0.053%
0.10	0.069%
0.15	0.040%
0.20	0.110%
0.25	0.136%

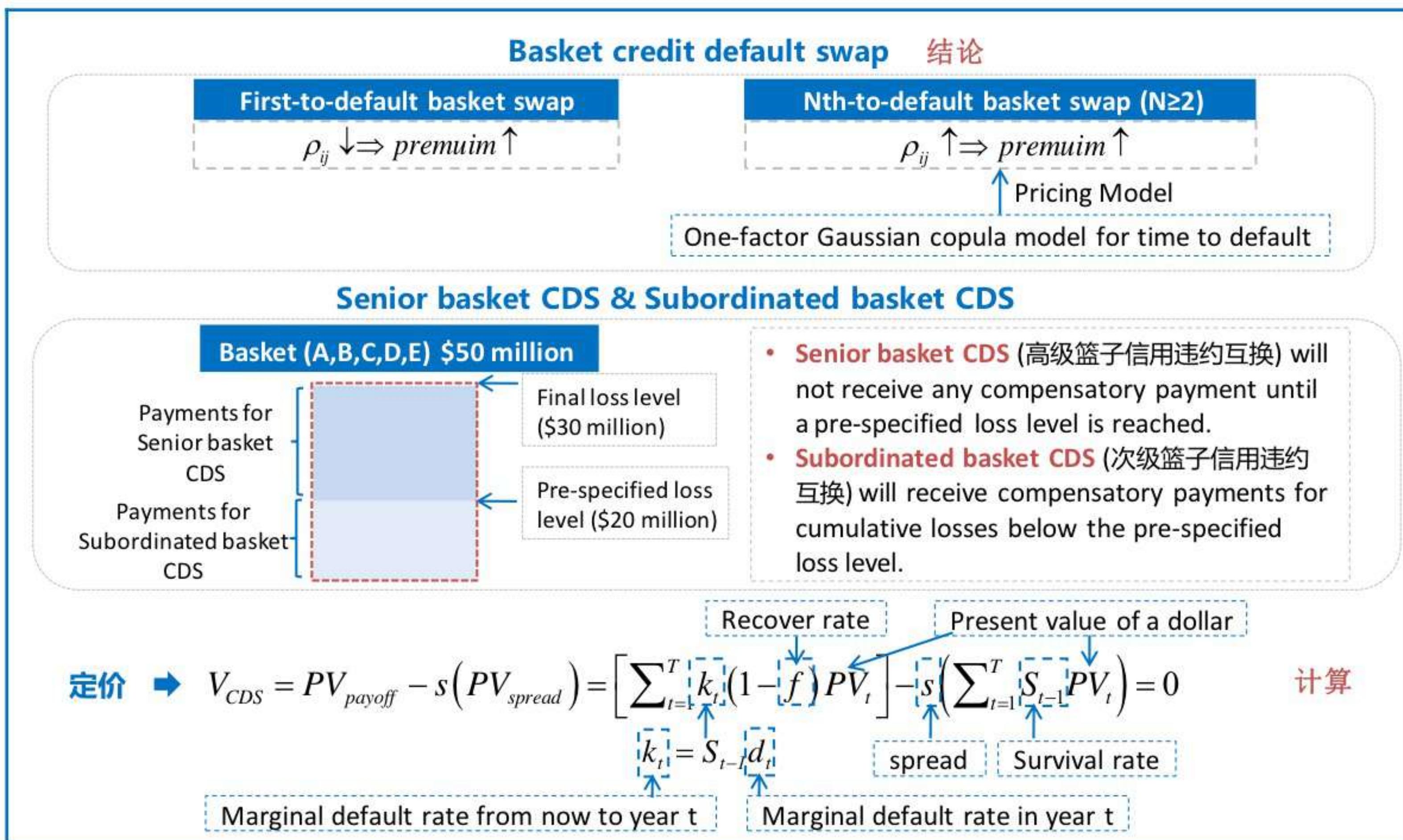
- A. 0.1
- B. 0.15
- C. 0.2
- D. 0.25

Answer: D

Section 15 Credit Derivatives

1 Credit Default Swaps (CDS)





1.1 You are currently long \$10,000,000 par value, 8% XYZ bonds. To hedge your position, you must decide between credit protection via a 5-year CDS with 60bp annual premiums or digital swap with 50% payout with 50bp annual premiums. After one year, XYZ has defaulted on its debt obligations and currently trades at 60% of par. Which of the following statements is true?

- A. The contingent payment from the protection buyer to the protection seller is greater under the single-name CDS than the digital swap.
- B. The contingent payment from the protection buyer to the protection seller is less under the single-name CDS than the digital swap.
- C. The contingent payment from the protection seller to the protection buyer is greater under the single-name CDS than the digital swap.
- D. The contingent payment from the protection seller to the protection buyer is less under the single-name CDS than the digital swap.

Answer: C

Choices A and B can be eliminated because payments in default are made from protection seller to protection buyer. The payoff from the digital swap will be 50% of par value while the payoff from the single name will be 40% (i.e., $1 - 0.6$) of par value.

1.2 When an institution has sold exposure to another institution (i.e., purchased protection) in a CDS, it has exchanged the risk of default on the underlying asset for which of the following?

- A. Default risk of the counterparty
- B. Default risk of a credit exposure identified by the counterparty
- C. Joint risk of default by the counterparty and of the credit exposure identified by the counterparty

- D. Joint risk of default by the counterparty and the underlying asset

Answer: D

The protection buyer is exposed to the joint risk of default by the counterparty and underlying credit. If only one defaults, there is no credit risk.

1.3 A risk manager is advising the trading desk about entering into a digital credit default swap as a way to obtain credit protection. Which cash flow and delivery requirement will the desk most likely experience in the event of a default of the underlying reference asset? (Important)

- A. Receive the pre-agreed cash payment; delivering nothing.
- B. Receive [(Par Value) – (Market Value of Reference Asset)]; deliver the reference asset.
- C. Receive [(Par Value) – (Market Value of Reference Asset)]; deliver nothing.
- D. Receive the pre-agreed cash payment; deliver the reference asset.

Answer: A

A digital CDS will pay off a pre-determined fixed amount in the event of a default. Digital CDS are often used against highly illiquid reference assets that would be difficult to price.

1.4 A six-year CDS on a AA-rated issuer is offered at 150bp with semiannual payments while the yield on a six-year annual coupon bond of this issuer is 8%. There is no counterparty risk on the CDS. The annualized LIBOR rate paid every six months is 4.6% for all maturities. Which strategy would exploit the arbitrage opportunity? How much would your return exceed LIBOR?

- A. Buy the bond and the CDS with a risk-free gain of 1.9%.
- B. Buy the bond and the CDS with a risk-free gain of 0.32%.
- C. Short the bond and sell CDS protection with a risk-free gain of 4.97%.
- D. There is no arbitrage opportunity as any apparent risk-free profit is necessarily compensation for being exposed to the credit risk of the issuer.

Answer: A

Because LIBOR is flat, the fixed-coupon yield is also 4.6%, creating a spread of $800 - 460 = 340\text{bp}$ on the bond. Going long the bond and short credit via buying the CDS yields an annual profit of $340 - 150 = 190\text{bp}$.

1.5 A risk analyst is valuing a 1-year credit default swap (CDS) contract that will pay the buyer 80% of the face value of a bond issued by a corporation immediately after a default by the corporation. To purchase this CDS, the buyer will pay the CDS spread, which is a percentage of the face value, once at the end of the year. The analyst estimates that the risk-neutral default probability for the corporation is 7% per year. The risk-free rate is 2.5% per year. Assuming defaults can only occur halfway through the year and that the accrued premium is paid immediately after a default, what is the estimate for the CDS spread? (Practice Exam)

- A. 560 basis points
- B. 570 basis points
- C. 580 basis points
- D. 590 basis points

Answer: D

Explanation: The key to CDS valuation is to equate the present value (PV) of payments to the PV of expected payoff in the event of default. Let:

$$r = \text{risk-free rate} = 2.5\%$$

$$s = \text{CDS spread.}$$

$$\pi = \text{probability of default during year 1} = 7\%$$

$$C = \text{contingent payment in case of default} = 80\%$$

$$d_{0.5} = \text{discount factor for half-year} = e^{-0.5 \cdot r} = e^{-0.5 \cdot 0.025} = 0.987578, d_{1.0} = \text{discount factor for 1-year} = e^{-1.0 \cdot r} = e^{-0.025} = 0.975310$$

Therefore, to solve for the CDS spread (s):

The PV of payments (premium leg, which includes the spread payment and accrual) is:

$$s * [0.5 * d_{0.5} * \pi + d_{1.0} * (1 - \pi)] = s * [0.034565 + 0.907038] = s * 0.941603$$

$$\text{The payoff leg (in the event of default)} = C * d_{0.5} * \pi = 0.8 * 0.987578 * 0.07 = 0.055304$$

$$\text{Equating the two PVs and solving for the spread: } s * 0.941603 = 0.055304$$

Thus, $s = 0.058734$ or a spread of approximately 587 basis points.

1.6 The market quoted credit default swap spreads for an A-rated counterparty are 325 bps per annum for all maturities out to five years. Assuming a loss given default rate of 40%, which of the following is closest to the implied risk-neutral probability that the counterparty will default at some point with the next two years? (Important)

- A. 5%
- B. 8%
- C. 10%
- D. 15%

Answer: D

1.7 Historical credit default swap (CDS) spreads are always available to be used to estimate VaR using historical simulation. Assume a firm requires two years of historical market data to compute its historical simulation VaR on a specific issuer but the first year of market data is not available. What is the best method to address the missing data issue? (Important)

- A. Substitute the missing data with historical spreads on a market index such as CDX or ITraxx.
- B. Extrapolate the missing data from data on the issuer's historical equity returns.

- C. Calculate the historical simulation VaR for one year and scale the result by the square root of two.
- D. Use available historical CDS spread data for another issuer in the same industry sector and credit rating.

Answer: D

1.8 QUESTIONS (1) AND (2) REFER TO THE FOLLOWING INFORMATION (Important)

You are a risk manager at a bank that has a large exposure as a protection seller in single-name credit default swaps (CDS). To value the positions, the trading desk collects bid and ask quotes from several dealers at the end of the day and uses these as guidance for determining a fair price for each position. Typically, the traders use a price near the bid price (the bid price being the premium someone will pay to buy protection) and have told you that they do this in order to be conservative. Recently, as bid/ask spreads have widened in the CDS market, the chief risk officer (CRO), who is under a lot of pressure to assist the bank through a difficult market period, has begun to push internally for pricing to be done using the mid-point between the bid and the ask quotes for all over-the-counter (OTC) derivatives.

(1) What consequences might arise from the CRO's proposed switch for the CDS desk?

- A. The bank will post a one-time gain related to the CDS positions which might help the bank's profitability but could cause unwanted scrutiny from regulators.
- B. The bank will have to post more collateral related to the CDS positions and this could cause a liquidity problem.
- C. The bank will not be in compliance with Basel requirements to use a conservative approach to pricing OTC instruments.
- D. The bank will effectively reduce the periodic premium payments it must make on the CDS and this will help its liquidity position.

Answer: B

(2) The treasury department of the bank has recently proposed becoming a protection buyer via single-name CDS for hedging purposes. Many of these CDS are on the same firms that the bank currently is a derivative-market contacts, it will use a standard CDS valuation model to price the contracts. To ensure accuracy, however, the model inputs and assumptions will be independently verified by the traders in the bank's CDS dealer function on a weekly basis. Which statement regarding this proposal is most accurate?

- A. In pricing illiquid instruments that are used only for hedging purposes, banks should mark-to-model whenever possible.
- B. In order to be in compliance with Basel regulations, the traders must verify the inputs and assumptions daily, not weekly.
- C. Any change in the value of the CDS positions used for financial reporting purposes may have to be adjusted for regulatory reporting purposes.

- D. The valuation model used by the treasury department, if determined to be useful, should be adopted by the trading desk.

Answer: D

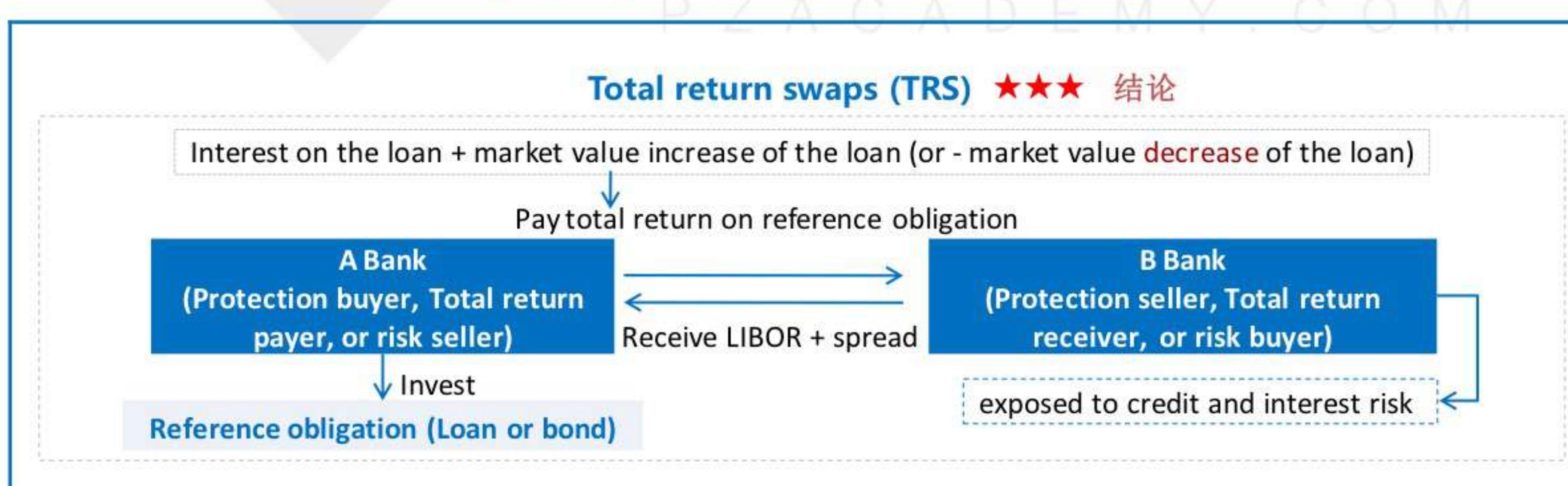
1.9 The Big Bank Corp has securitized a large pool of 100 mortgages as follows: \$75 million in senior AAA notes, \$20 million in mezzanine BB notes, and \$5 million in equity tranche. Big Bank Corp would like to provide a credit enhancement to the issue. Which of the following strategies would most effectively reinforce the credit rating of the AAA notes?

- A. 26th-to-default basket.
- B. Standard basket.
- C. Senior basket with \$25 million loss level.
- D. Subordinated basket with \$25 million loss level.

Answer: C

The senior basket provides compensatory payouts after \$25 million in loss is suffered by the pool. Because the goal is to enhance the AAA notes, \$25 million can be absorbed by the mezzanine and equity investors without impairing the AAA notes. Assuming all credits are of equal size, the 26th-to-default basket would provide minimal protection since all defaults above 26 would directly impair AAA claims. The standard basket would provide protection starting with the first default and thus would be very expensive if used to protect the AAA

2 Total return swaps (TRS)



2.1 Risk Averse Bank (RAB) has made a loan of USD 100 million at 8% per annum. RAB wants to enter into a total return swap under which it will pay the interest on the loan plus the change in the mark-to-market value of the loan, and in exchange, RAB will get LIBOR + 30 basis points. Settlement payments are made annually. What is the cash flow for RAB on the first settlement date if the mark-to-market value of the loan falls by 2% and LIBOR is 6%?

- A. Net inflow of USD 0.3 million
- B. Net outflow of USD 0.3 million
- C. Net inflow of USD1.7 million
- D. Net outflow of USD 1.7 million

Answer: A

2.2 A firm has entered into a USD 20 million total return swap on the NASDAQ 100 index as the index payer with ABC Corporation, which will pay 1-year LIBOR + 2.5%. The contract will last 1 year, and cash flows will be exchanged annually. Suppose the NASDAQ 100 Index is currently at 2,900 and LIBOR is 1.25%. The firm conducts a stress test on this total return swap using the following scenario:

NASDAQ 100 in 1 year: 3,625

LIBOR in 1 year: 0.50%

For this scenario, what is the firm's net cash flow in year 1?

- A. A net cash outflow of USD 4.40 million.
- B. A net cash outflow of USD 4.25 million.
- C. A new cash inflow of USD 4.25 million.
- D. A new cash inflow of USD 4.40 million.

Answer: B

The NASDAQ will increase 25%, or $(3625/2900) - 1$, over the next year, so the index payer will pay USD 5 million ($0.25 \times 20 \text{ million}$) to ABC Corp. Since ABC Corp's payments depend on today's LIBOR, it will pay 3.75% ($1.25\% + 2.5\%$) or USD 0.75($0.0375 \times 20\text{million}$). So the firm's net cash flow would be $0.75 \text{ million} - 5 \text{ million} = -\text{USD } 4.25 \text{ million}$.

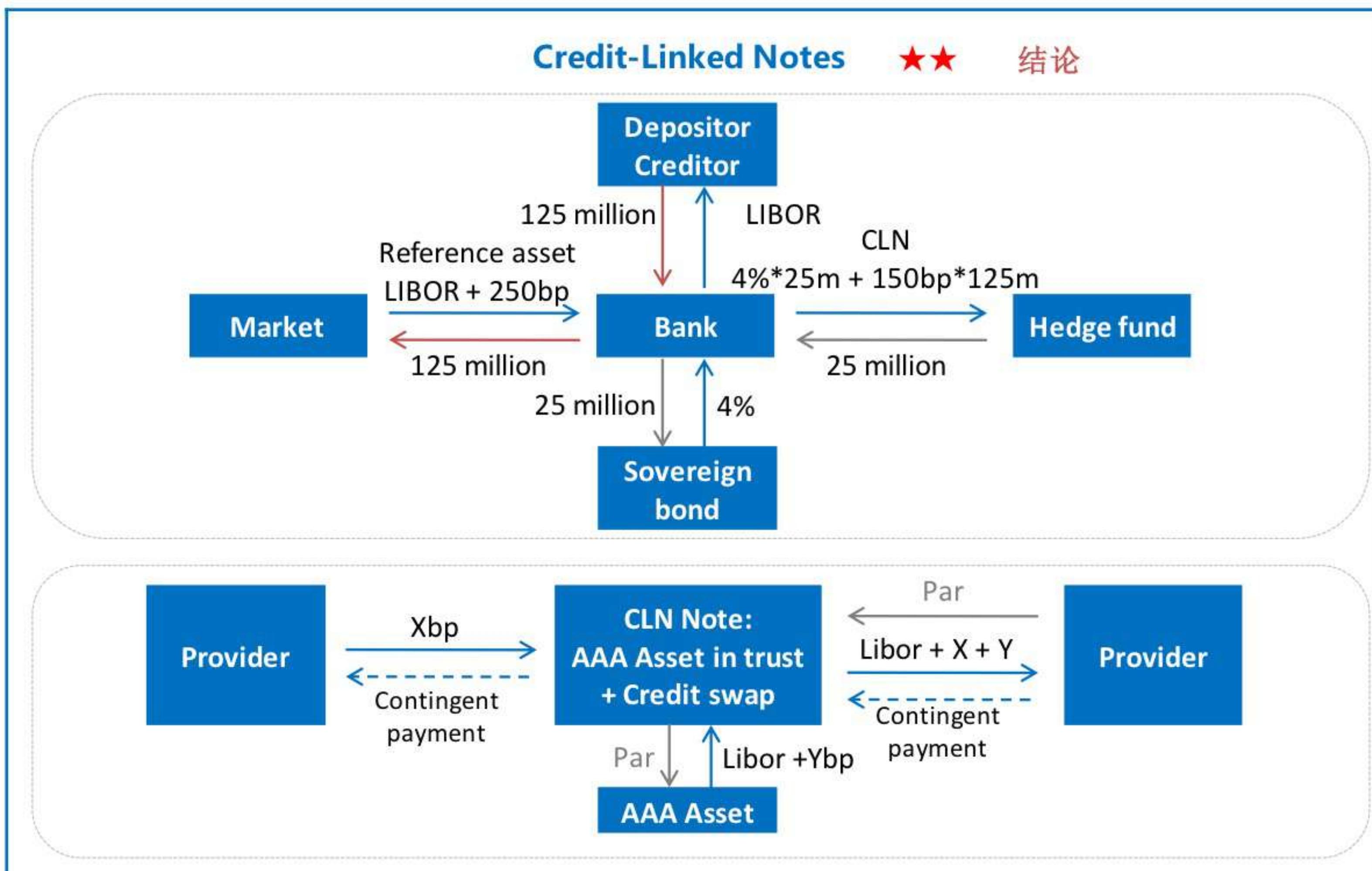
2.3 The credit protection buyer in a total return swap, where the protection seller pays LIBOR plus a spread, is hedged against each of the following risks except for:

- A. Credit deterioration in the reference.
- B. Spread risk in the reference.
- C. General level of interest rates.
- D. Counterparty exposure to the protection seller.

Answer: D

The TRS provides a hedge against credit and market risk. In the case of LIBOR, a higher interest rate implies a loss on the reference, however this is hedged by the protection sellers higher payments.

3 Credit-Linked Notes



3.1 Which of the following statements about credit-linked notes is true?

- A. The borrower receives an enhanced coupon.
- B. The borrower receives a reduced coupon.
- C. The lender receives an enhanced coupon.
- D. The lender receives a reduced coupon.

Answer: C

In a credit-linked note, the lender (note holder) receives an enhanced coupon as compensation for bearing the credit risk of the issuer.

3.2 Investors in a credit-linked note (CLN) are most similar to:

- A. Credit default swap (CDS) protection buyers who have funded (prepaid) the contingent credit loss.
- B. Credit default swap (CDS) protection buyers who own (have an insurable interest in) the reference entity.
- C. Credit default swap (CDS) protection sellers who have funded (prepaid) the contingent credit loss.
- D. Credit default swap (CDS) protection sellers who own (have an insurable interest in) the reference entity.

Answer: C

A CLN is like a funded CDS; the investors are selling protection (synthetically short the reference)

In regard to (d), neither counterparty needs to own the reference.

3.3 A three-year, credit-linked note (CLN) with underlying company Z has a LIBOR + 60bps semi-annual coupon. The face value of the CLN is USD 100. LIBOR is 5% for all maturities. The current three-year CDS spread for company Z is 90bps. The fair value of the CLN is closest to

- A. USD 100.00
- B. USD 111.05
- C. USD 101.65
- D. USD 99.19

Answer: D

Because the current CDS spread is greater than the coupon, the CLN must be selling at a discount. The only solution is D.

3.4 Which of the following types of credit derivatives creates the least counterparty credit exposure for the protection buyer? (Important)

- A. Total return swap
- B. Equity default swap
- C. Credit-linked note
- D. Senior basket credit default swap

Answer: C

3.5 XYZ Hedge Fund wants to get exposure to a high-yield pool of commercial loans without actually investing in the loans. It wants a leverage ratio of 7.5. If the hedge fund is willing to invest \$35 million in this investment, which credit derivative is best for them and what is their expected return given that the reference asset earns LIBOR plus 285 basis points, the counterparty earns LIBOR plus 150 basis points, and the required collateral earns 3.5%?

- A. Total return swap with a 13.63% return.
- B. Asset-backed credit-linked note with an 11.34% return.
- C. Total return swap with an 11.34% return.
- D. Asset-backed credit-linked note with a 13.63% return.

Answer: D

The best credit derivative for this hedge fund is an asset-backed credit-linked note. With leverage of 7.5 and an investment of \$35 million, we know that the notional value of the pool of commercial loans is \$262.5 million. The hedge fund will earn 3.5% on their \$35 million in collateral. This translates into \$1.225 million. They will also earn the 135 basis point spread on the entire \$262.5 million. This translates into \$3.54375 million. The hedge fund's percentage

return is 13.63% [(\$1.225 million + \$3.54375 million)/\$35 million]).

Section 16-18 Structured Credit Risk and Securitization, The Securitization of Subprime Mortgage Credit, CDOs

1 Structured Products & CDO

Types of Structured Products ★ 概念对比	
Types of Structured Products	
Covered bonds	<ul style="list-style-type: none"> • <i>Principal and interest is paid and guaranteed by the originator</i> and is not based on the performance of the underlying assets themselves. Covered bonds are not true securitizations since the assets are <i>not part of a bankruptcy-remote structure</i>
MPS	<ul style="list-style-type: none"> • MBS are <i>true off-balance sheet</i> securitizations. • Most pass-throughs are <i>agency MBS</i> that carry implicit or explicit government guarantee. The <i>primary risk is due to prepayment</i> of principal by the homeowner.
CMOs	<ul style="list-style-type: none"> • <i>CMOs are MBSs that tranche</i> cash flows into different securities. • The most basic structure is the <i>waterfall or sequential pay</i> structure. Tranche 1 will have a very low prepayment risk
Structured credit products	<p>The difference is that structured credit products create <i>tranches that have different amounts of credit risk</i>.</p>
ABS	<p>MBS is a special case of the more general ABS.</p>

Securitization Process and Participants

```

graph LR
    Customers[Customers] -- "Make a loan" --> Originator[Originator]
    Originator -- "Sell the loan" --> SPV[SPV]
    SPV -- "Sell ABS" --> ABSInvestors[ABS Investors]
    SPV -- "Pay I&P" --> Originator
    SPV -- "Pay I&P" --> ABSInvestors
  
```

Waterfall Structure

- The most *senior* tranches at the top of the capital structure will have the *highest priority* to receive principal and interest and earns a relatively low fixed coupon
- The *equity* tranche is the slice of the cash flow distribution with the *lowest priority and will absorb the first losses up to a prespecified level*.
- Between the senior and equity tranches is the *mezzanine* tranche (i.e., the junior tranche). The mezzanine tranches will *absorb losses only after the equity tranche* is completely written down.

Three-Tiered Securitization Structure

- *Inflows prior to maturity* = interest on the collateral (L_t) + the recovery from the sale of any defaulted assets in the current period (R_t)
- The *terminal cash flows in the final year* = last interest payment + principal and recovery of defaulted assets.
- The *outflows* (B) = the coupon payments paid to senior + mezzanine note holder.

To determine the cash flow to equity, the following steps must be performed:

- Is the current period interest sufficient to cover the promised coupons: $L_t - B \geq 0$?
 - *If yes*, then the following overcollateralization test must be performed to see: $L_t - B \geq K$?
 - If yes, then K is diverted to trust, and $L_t - B - K$ flows to equity holders: $OC_t = K$.
 - If no, then $L_t - B$ is diverted to trust, and nothing flows to equity holders: $OC_t = L_t - B$
 - *If no*, then the interest is not sufficient to pay bondholders and all L_t flows to bondholders. Therefore, the shortfall is $B - L_t$.

Credit Enhancements		
External credit enhancement	insurance or wraps purchased from a <i>third party</i>	
Internal credit enhancement	Overcollateralization (hard credit enhancement)	
	Excess spread (soft credit enhancement): the difference between the cash flows collected and the payments made to all bondholders	
	Subordinating note classes (tranches)	
SPV Structures		
Amortizing structure	<ul style="list-style-type: none"> Principal and interest payments are made on an <i>amortizing schedule</i> to investors over the life of the product (residential mortgages, commercial mortgages, and consumer loans). Because payments are made as coupons are received, this type of structure is referred to as a <i>pass-through structure</i>. 	
Revolving structures	<ul style="list-style-type: none"> <i>Principal payments of the assets are paid in large lump sums</i> rather than a pre-specified amortization schedule. (Credit card debt and auto loans) Under a revolving structure, <i>payments are not simply passed through</i>. Rather, <i>principal payments are often used to purchase new receivables</i> 	
Master trust structure	<ul style="list-style-type: none"> A master trust structure <i>allows an SPV to make frequent issues or multiple securitizations</i>. <i>the master trust structure enables the SPV to issue multiple ABS through the single trust</i>. The ability of SPV master trust structures to sell multiple issues to investors that <i>share excess spreads over these multiple series</i> 	
ABS and MBS Performance Tools		
Performance Analysis Tools	Asset Type	Calculation
loss curves	auto loans	expected cumulative losses
absolute prepayment speed (APS)	auto loans	Prepayments/pool balance
delinquency ratio	credit cards	past due receivables/pool balance
default ratio	credit cards	Defaults/pool balance
monthly payment rate (MPR)	credit cards	receivables collected/pool balance
debt service coverage ratio (DSCR)	commercial mortgages	NOI / debt payments
weighted average coupon (WAC)	mortgages	weighted pool coupon payment
weighted average maturity (WAM)	mortgages	weighted pool maturity
weighted average life (WAL)	mortgages	$\sum(a/365) \times PF(t)$
single monthly mortality (SMM)	mortgages, home-equity, student loans	prepayment / pool balance
constant prepayment rate (CPR)	mortgages, home-equity, student loans	$1 - (1 - SMM)^{12}$
Public Securities Association (PSA)	mortgages, home-equity, student loans	100PSA: [CPR/(0.2)(months)] x 100

1.1 Which of the following structured credit products does not allow its issuer to segregate the pool of underlying assets from its balance sheet? (Important)

- A. Mortgage backed security
- B. Collateralized debt obligation
- C. Collateralized loan obligation
- D. Coverd bond

Answer: D

1.2 National united bank has recently increased the bank's liquidity through securitization of existing credit card receivables. The proposed securitization includes tranches with multiple internal credit enhancements as shown in Exhibit 1 below. The total value of the collateral for

the structure is USD 600 million, no lockout period, and the subordinated tranche B bond is the first loss piece:

Exhibit 1: Proposed ABS Structure

Bond Class	par value
Senior tranche	USD 250 million
Junior tranche A	USD 200 million
Junior tranche B	USD 70 million
Subordinated tranche A	USD 50 million
Subordinated tranche B	USD 30 million
Total	USD 600 million

At the end of the fourteenth month after the securities were issued, the underlying credit card accounts have prepaid USD 300 million in principal in addition to regularly scheduled principal and interest payments. What is the amount of the prepaid principal paid out to the holders of the junior tranche A bond class?

- A. USD 0 million
- B. USD 50 million
- C. USD 120 million
- D. USD 230 million

Answer: B

USD 50 million is calculated by $USD300 - USD250 = USD50$, since prepayments are first distributed to the senior tranches.

1.3 King Motors Acceptance Corporation (KMAC), the finance arm of King Motors, issues an auto-loan asset-backed security that consists of a senior tranche, denoted Tranche A in the amount of \$50 million and an interest payment of 5 percent, and two subordinated tranches, denoted Tranches X and Z respectively, each with a face amount of \$35 million. Tranche X pays investors annual interest at a rate of 6.5 percent while Tranche Z pays investors annual interest at a rate of 7.5 percent. Which of the following methods of credit support would NOT affect the credit quality of subordinated Tranche X?

- A. The total amount of the auto loans that make up the asset-backed issue is \$125 million.
- B. The weighted average interest rate on the auto loans making up the pool is 6.4 percent.
- C. Any defaults on the part of King Motor's customers will be first absorbed by Tranche Z.
- D. KMAC has a reserve in the amount of \$10 million that will remain on KMAC's balance sheet.

Answer: D

An investor's claim when purchasing an ABS is solely with the ABS and no longer with the originator. The fact that KMAC has \$10 million set aside means nothing for the ABS issue if it

remains on KMAC's balance sheet and is not part of the ABS issue. The other answer choices all describe forms of credit support that will support at least Tranches X and A, if not all 3 tranches. By having Tranche Z be subordinate to Tranche X, Tranche X has additional support. Also, loans of \$125 million are used to back asset-backed securities worth $(\$50 + \$35 + \$35) = \120 million, which means the issue, is over-collateralized. The weighted average interest rate paid on the securities is approximately 6.2%. If the weighted average interest rate on the loans that make up the pool is 6.4% that means there is an excess spread between the loans and securities that also provides support for the entire issue.

1.4 Assume the originator securitizes a \$100 million loan portfolio that pays LIBOR plus 200 bps. Senior expenses of the SPE amount to 20 bps. The SPE issues only two classes of securities: senior debt with face value of \$90 million and subordinated debt with face value of \$10 million, such that the subordinated debt "functions as equity". The coupon on the senior debt is LIBOR plus 100 bps. The subordinated debt (equity) gets an interest rate equal to the realized net excess spread. What is the net excess spread?

- A. \$10 million × (LIBOR + 3%)
- B. \$10 million × (LIBOR + 5%)
- C. \$10 million × (LIBOR + 7%)
- D. \$10 million × (LIBOR + 9%)

Answer: D

$$\text{Excess spread} = 100 \text{ million} \times (\text{LIBOR} + 200 \text{ bps} - 20 \text{ bps}) - 90 \text{ million} \times (\text{LIBOR} + 100 \text{ bps}) = 10 \text{ million} \times (\text{LIBOR} + 9\%)$$

1.5 In which of the below the assets remain on the balance sheet of the institution (Important)

- A. CMO
- B. CLO
- C. MBS
- D. Covered Bond

Answer: D

1.6 Each of the following is a valid difference between a covered bond and a true securitization except which is not true?

- A. In a covered bond, the cover pool remains on the balance sheet, but in a true securitization, loans (assets) are removed from the balance sheet.
- B. In a covered bond, principal and interest are paid from issuer's general cash flows, but in a securitization, principal and interest are paid from the collateral pool directly.
- C. Unlike a true securitization, there is not a "true sale" of assets to a bankruptcy-remote

- special purpose vehicle in the case of covered bond.
- D. Unlike a true securitization, a covered bond neither creates securities nor is a genuine method for raising funds (i.e., borrowing) in capital markets.

Answer: D

Covered bond and securitization are similar in the sense that both methods do issue securities, which are backed by assets, as a means to raise funds (borrow) in capital markets

- 1.7** A collateralized mortgage obligation (CMO) has the characteristics below. Which of the following are most accurate regarding its credit enhancement?

Return on assets	8.75%
Senior tranche	\$400,000,000
Subordinated tranche A	\$120,000,000
Subordinated tranche B	\$50,000,000
Value of collateral	\$600,000,000
Interest paid on liabilities of SPE	7.50%
Fees and expenses	0.60%

- I. There is overcollateralization.
- II. The investors gain credit enhancement through the excess spread.
- A. I only.
- B. II only.
- C. Both I and II.
- D. Neither I nor II.

Answer: C

The total value of the tranches is: $\$400 + \$120 + \$50 = \570 million. The value of the collateral is \$600 million, so the CMO is over collateralized by \$30 million.

The net excess spread is $8.75\% - 7.50\% - 0.60\% = 0.65\%$, so there is positive excess spread. This provides credit enhancement for the CMO investors.

- 1.8** Which of the following is an internal enhancement?

- A. Overcollateralization
- B. CDS
- C. Put options on assets
- D. Letters of credit

Answer: A

Internal enhancements include: overcollateralization, direct equity issue, holdback, cash

collateral account (CCA), excess spread.

External credit enhancement include, insurance, warps, and guaranties, letters of credit, CDS, put options on assets.

1.9 In assessing the key variables associated with a potential mortgage loan, a bank will charge a higher interest rate if the borrower has a relatively:

- A. High FICO score.
- B. High loan-to-value ratio.
- C. Low debt-to-assets ratio.
- D. Low debt-to-income ratio.

Answer: B

The loan-to-value ratio represents the amount of the mortgage versus the appraised value of the property. The higher this ratio is for a property and an associated borrower, the more risk there is to the lender. In order to protect their position, a lender will charge a higher interest rate. Each of the other scenarios will result in a lower interest rate.

1.10 Which of the following statements describe part of the risk mitigation process for a collateralized debt obligation (CDO)?

- I. Default risk is restructured in such a way that previously lower-rated issues can be re-formulated into highly rated debt instruments.
 - II. The equity tranche has no certain return and bears the highest level of default risk.
- A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.

Answer: C

The default risk in a CDO is structured through various tranches in such a way that a pool of assets that were once lower rated could be AAA rated after the securitization process. The equity tranche is the most junior tranche. Therefore, it offers the highest return potential but with no certain return. The equity tranche also bears the highest level of default risk.

1.11 A major benefit of securitization for a financial institution is the ability to remove assets from the balance sheet, which lowers risk and the required regulatory capital. While a large portion of the risk is removed from the balance sheet, the originating financial institution often maintains a portion of the risk. Which of the following terms best identify the risk that is maintained by the originator?

- A. Correlation.
- B. Excess spread.
- C. First-loss piece.
- D. Guarantor of collateral value

Answer: C

The originator often maintains ownership of the first-loss piece, which is the class of assets with the lowest credit quality and is the most junior level where losses are first absorbed in the event of a default.

1.12 Securitized products are often customized to meet the needs of the investor as well as the originator. What type of asset-backed securities (ABSs) typically uses a revolving structure?

- A. Residential mortgage.
- B. Credit card debt.
- C. Commercial mortgage.
- D. Commercial paper.

Answer: B

Revolving structures are used with products that are paid back on a revolving basis, such as credit card debt or auto loans. Credit card debt does not have a pre-specified amortization schedule; therefore the principal paid back to investors is in large lump sums rather than amortizing schedules.

1.13 Which of the following measures are most likely to be used by a securitized product backed by student loans?

- A. Single monthly mortality (SMM), constant prepayment rate (CPR), and Public Securities Association (PSA).
- B. Loss curves and absolute prepayment speed (APS).
- C. Weighted average life (WAL), weighted average maturity (WAM), and weighted average coupon (WAC).
- D. Debt service coverage ratio (DSCR) and monthly payment rate (MPR).

Answer: A

The constant prepayment rate (CPR) and the Public Securities Association (PSA) method are common methodologies used to estimate prepayments for student loans and mortgages.

1.14 Assume an MBS is composed of the following four different pools of mortgages:

- \$2 million of mortgages that have a maturity of 90 days.

- \$3 million of mortgages that have a maturity of 180 days.
- \$5 million of mortgages that have a maturity of 270 days.
- \$10 million of mortgages that have a maturity of 360 days.

What is the weighted average maturity (WAM) of these mortgage pools?

- 167 days.
- 225 days.
- 252 days.
- 284 days.

Answer: D

The WAM is calculated as follows:

$$\text{WAC} = [90(2 \text{ million}) + 180(3 \text{ million}) + 270(5 \text{ million}) + 360(10 \text{ million})]/(2 \text{ million} + 3 \text{ million} + 5 \text{ million} + 10 \text{ million}) = (180 \text{ million} + 540 \text{ million} + 1,350 \text{ million} + 3,600 \text{ million})/20 \text{ million} = 5,670 \text{ million}/20 \text{ million} = 284 \text{ days}$$

1.15 An underwriter structures a collateralized loan obligation(CLO) composed of 100 identical loans, each with a notional value of GBP 800,000 to be repaid in one year with an interest rate of LIBOR + 3%.The CLO has one planned payment at maturity and its capital structure is given by:

Tranche	Face Value	Coupon
Equity	GBP 5 million	
Mezzanine debt	GBP 10 million	LIBOR + 5.0%
Senior debt	GBP 65 million	LIBOR + 0.5%

At maturity the CLO accumulates GBP 6,625,000 of losses from defaults and unpaid interest. If LIBOR was flat at 1% over the 1-year period, and assuming no recovery on the defaults, how would the losses be absorbed by the capital structure? (Important)

- The equity tranche will lose some of its value, and the other tranches will not be affected.
- The equity tranche will lose all of its value, and the other tranches will not be affected.
- The equity tranche will lose some of its value, and the mezzanine tranches will lose some of its value.
- The equity tranche will lose all of its value, and the mezzanine tranche will lose some of its value.

Answer: B

1.16 A mortgage analyst is reviewing a refinancing event. A New York City apartment building was originally purchased for USD 5,000,000 and financed with an interest-only hybrid adjustable rate mortgage (With a loan-to-value ratio, or LTV- of 80%) al an initial annual fixed rate of 2.75%. Before the interest-only period elapses, the building's appraised value drops to USD 4,000,000.

The owner decides to refinance the existing mortgage with a 15-year fixed mortgage at an annual rate of 4.5% (LTV 80%) and uses cash to pay off the remainder of the original mortgage's principal balance. Assuming standard payments, which of the following is the best estimate of the immediate change in monthly payments as a result of the refinancing? (Important)

- A. USD 15,000
- B. USD 20,000
- C. USD 25,000
- D. USD 30,000

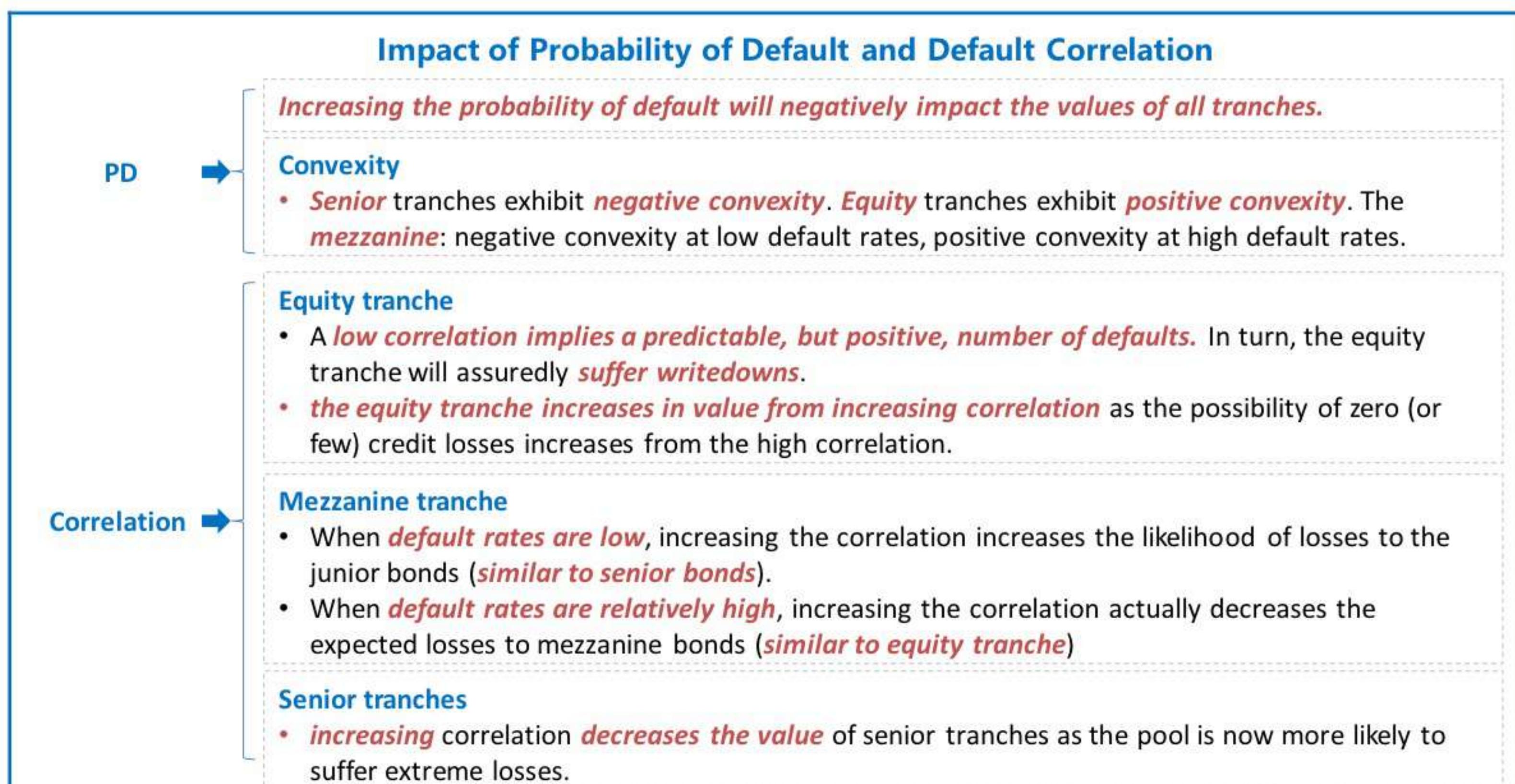
Answer: A

1.17 In reviewing the risk of the mortgage products held on the bank's balance sheet, the risk group starts by re-categorizing the various products held on the books. What distinguishes pass-through mortgage backed securities (MBS) from collateralized mortgage obligations (CMOs)? (Important)

- A. pass-through MBS can only be issued by government agencies and CMOs can be issued by government agencies and private issuers.
- B. pass-through MBS can be issued by government agencies and private issuers and CMOs can only be issued by government agencies.
- C. all investors in pass-through MBS are exposed to prepayment risk equally and in a CMO the prepayment risk may differ among the investor.
- D. all investors in a CMO are exposed to prepayment risk equally and in a pass-through MBS the prepayment risk may differ among the investors.

Answer: C

2 Structured Credit Risk



Increasing Default Probability (Holding Correlation Constant)		Increasing Correlation (Holding Default Probability Constant)			
	Mean Value	Credit VaR		Mean Value	Credit VaR
Equity tranche	↓	↓	Equity tranche	↑	↑
Mezzanine tranche	↓	↑ then ↓	Mezzanine tranche	↓(at low default rates) ↑(at high default rates)	↑
Senior tranche	↓	↑	Senior tranche	↓	↑

Measuring Default Sensitivities: $1/20[(\text{mean value/loss based on } \pi+0.001) - (\text{mean value/loss based on } \pi - 0.001)]$

Implied Correlation

- For securitized tranches, *starting with observed market prices and a pricing function for the tranches, it is possible to back out the unique implied correlation* to calibrate the model price with the market price.

2.1 An investor has sold default protection on the most senior tranche of a CDO. If the default correlation between assets held in the CDO decreases sharply, assuming everything else is unchanged, the investor's position: (Practice Exam)

- A. Will gain significant value, since the probability of exercising the protection falls.
- B. Will lose significant value, since the protection will gain value.
- C. Will neither gain nor lose value, since only expected default losses matter and correlation does not affect expected default losses.
- D. Can either increase or decrease, depending on the pricing model used and the market conditions.

Answer: A

Explanation: The senior tranche will gain value if the default correlation decreases. High correlation implies that if one name defaults, a large number of other names in the CDO will also default. Low correlation implies that if one name defaults, there would be little impact on the default probability of the other names.

Therefore, as the correlation decreases, the cumulative probability of enough defaults occurring to exceed the credit enhancement on the senior tranche will also decrease. Hence the investor who has sold protection on the senior tranche will see a gain.

2.2 Which of the following statements about portfolio losses and default correlation are most likely correct?

- I. Increasing default correlation decreases senior tranche values but increases equity tranche values.
 - II. At high default rates, increasing default correlation decreases mezzanine bond prices.
- A. I only
 - B. II only
 - C. Both I and II
 - D. Neither I nor II

Answer: A

2.3 A hedge fund is considering taking positions in various tranches of a collateralized debt obligation (CDO). The fund's chief economist predicts that the default probability will decrease significantly and that the default correlation will increase. Based on this prediction, which of the following is a good strategy to pursue? (Practice Exam)

- A. Buy the senior tranche and buy the equity tranche.
- B. Buy the senior tranche and sell the equity tranche.
- C. Sell the senior tranche and sell the equity tranche.
- D. Sell the senior tranche and buy the equity tranche.

Answer: D

The decrease in probability of default would increase the value of the equity tranche. Also, a default of the equity tranche would increase the probability of default of the senior tranche, due to increased correlation, reducing its value. Thus, it is better to go long the equity tranche and short the senior tranche.

2.4 A standard synthetic CDO references a portfolio of 10 corporate names. Assume the following. The total reference notional is X , and the term is Y years. The reference notional per individual reference credit name is $X/10$. The default correlations between the individual credit names are all equal to one. The single-name CDS spread for each individual name is 100 bp, for a term of Y years. The assumed recovery rate on default for all individual reference credits is zero in all cases. The synthetic CDO comprises two tranches, a 50% junior tranche priced at a spread J , and a 50% senior tranche priced at spread S . All else constant, if the default correlations between the individual reference credit names are reduced from 1.0 to 0.7, what is the effect on the relationship between the junior tranche spread J and the senior tranche spread S ?

- A. The relationship remains the same
- B. S increases relative to J
- C. J increases relative to S
- D. The effect cannot be determined given the data supplied

Answer: C

If the correlation is one, all names will default at the same time, and the junior and senior tranche will be equally affected. Hence, their spread should be 100bp, which is the same as for the collateral. With lower correlations, the losses will be absorbed first by the junior tranche. Therefore, the spread on the junior tranche should be higher, which is offset by a lower spread for the senior tranches.

3 The Securitization of Subprime Mortgage Credit

The Subprime Securitization Process

Prime loans that meet conforming standards are sold to government sponsored enterprises (GSEs).

The remaining loans are increasingly being sold and taken off the originators' balance sheet.

Frictions in Subprime Securitization	
Friction 1: mortgagor & originator	The lender may steer the borrower to products that are not suitable.
Friction 2: Originator and arranger	The arranger operates at an information disadvantage to the originator.
Friction 3: Arranger and third-parties	The arranger of the pool of mortgages will possess better information about the borrower than third parties (Resolution: Due diligence)
Friction 4: Servicer and mortgagor	The homeowner in financial difficulty does not have the incentive to upkeep tax payments, insurance, or maintenance on the property.
Friction 5: Servicer and third-parties	Moral hazard: Between servicer & asset manager; Between servicer & credit rating agencies
Friction 6: Asset manager and investor	It is difficult for the investor to comprehend the investment strategy (same moral hazard problem as shareholder-manager)
Friction 7: Investor and credit rating agencies	Rating agencies are compensated by the arranger. (conflict of interest)

Characteristic of The Subprime Mortgage Market

Protection to Investors

- **Subordination:** creating tranches of differing priority levels.
- **Excess spread:** the weighted average coupon (less servicing expenses) exceeds the weighted average payout.
- **Shifting interest:** senior investors receive all principal in the pool while mezzanine investors receive only interest.
- **Performance triggers:** release of overcollateralization which is applied from the bottom of the capital structure up
- **Interest rate swaps:** Since the first few years of the pool are fixed, the pool faces interest rate risk. As protection, interest rate swaps are used where the pool will pay a fixed rate and receive a floating rate.

The Credit Ratings Process

Credit ratings for subprime securities differ from corporate ratings

- First, **corporate bond ratings are based on the firm-specific characteristics** of the issuer. **Systematic risk** and degree of correlation between assets is **important** in the **latter** but not the former.
- In addition, **the forecasts for ABS incorporate future economic conditions** since the cash flow stream is tied to the macro environment.
- Finally, while corporates and ABSs with the same rating may indicate similar default probabilities, the **ABS will exhibit much wider variation in losses**.

Predatory Lending and Borrowing

- lying on the mortgage application allows the borrower to buy the house with the expectation that continued appreciation will allow a favorable refinancing.

Flaws in The Securitization of Subprime Mortgages

- **Originate-to-distribute model:** OTD models have produced **three primary benefits**.
 - The first benefit is that loan originators enjoy **increased capital efficiency and decreased earnings volatility**
 - The second benefit is that **investors have a wider array of diversification options for the fixed income portion** of their portfolios
 - The third benefit is that **borrowers have expanded access to credit and lowered borrowing costs**.
- Under the **traditional originate-to-hold (OTH) lending model**, credit assets are retained at the business unit level.

3.1 Which of the following statements regarding frictions in the securitization of subprime mortgages is correct? (Practice Exam)

- A. The arranger will typically have an information advantage over the originator with regard to the quality of the loans securitized.
- B. The originator will typically have an information advantage over the arranger, which can create an incentive for the originator to collaborate with the borrower in filing false

- loan applications.
- C. The major credit rating agencies are paid by investors for their rating service of mortgage-backed securities, and this creates a potential conflict of interest.
 - D. The use of escrow accounts for insurance and tax payments eliminates the risk of foreclosure.

Answer: B

One of the key frictions in the process of securitization involves an information problem between the originator and arranger. In particular, the originator has an information advantage over the arranger with regard to the quality of the borrower. Without adequate safeguards in place, an originator can have the incentive to collaborate with a borrower in order to make significant misrepresentations on the loan application. Depending on the situation, this could be either construed as predatory lending (where the lender convinces the borrower to borrow too large of a sum given the borrower's financial situation) or predatory borrowing (the borrower convinces the lender to lend too large a sum).

The major rating agencies are not paid by the investors. Escrow accounts can forestall but not eliminate the risk of foreclosure.

3.2 EACH of the following is an example or element of predatory lending except for:

- A. Lender makes unaffordable loans based on borrower assets rather than ability to repay
- B. Lender induces borrower to repeatedly refinance ("loan flipping") in order to collect fees and charge high points
- C. Borrower misrepresents income or employment in mortgage application
- D. Lender engages in deception to conceal true nature of loan; e.g., deceives borrower into thinking loan is fixed-rate (FRM) when mortgage is actually an adjustable-rate (ARM)

Answer: C**3.3 Each of the following is an example or element of predatory borrowing except for:**

- A. Borrower colludes with appraiser to inflate the appraised value of home.
- B. Borrower makes misrepresentations in regard to income, employment, credit history.
- C. Use of "nominee loans" that concealing the true identity of the true borrower.
- D. Borrower is required to pay a prepayment penalty for more than three years, or in an amount larger than six months interest.

Answer: D

In regard to (D), this is an example or sign of predatory lending. Ashcraft: "Predatory borrowing is defined as the willful misrepresentation of material facts about a real estate transaction by a

borrower to the ultimate purchaser of the loan. This financial fraud might also involve cooperation of other insiders – realtors, mortgage brokers, appraisers, notaries, attorneys. The victims of this fraud include the ultimate purchaser of the loan (for example a public pension), but also include honest borrowers who have to pay higher interest rates for mortgage loans and prices for residential real estate.”

3.4 A credit manager overseeing the structured credit book of a bank works on identifying the frictions in the securitization process that caused the recent subprime mortgage crisis in the United States. Of the following frictions in the securitization process, which one was not a cause of the subprime crisis? (Practice Exam)

- A. Frictions between the mortgagor and the originator: predatory lending.
- B. Frictions between the originator and the arranger: predatory borrowing and lending.
- C. Frictions between the servicer and asset manager: moral hazard.
- D. Frictions between the asset manager and investor: principal-agent conflict.

Answer: C

a is incorrect; frictions between the mortgagor and the originator: predatory lending have been identified as key frictions that caused the subprime mortgage crisis. b is incorrect; frictions between the originator and the arranger: predatory borrowing and lending, have been identified as key frictions that caused the subprime mortgage crisis. c is correct; frictions between the servicer and asset manager or credit ratings agency: moral hazard, although important, these frictions have not been identified as key frictions that caused the subprime mortgage crisis. d is incorrect; frictions between the asset manager and investor: principal–agent, have been identified as key frictions that caused the subprime mortgage crisis.

3.5 Which of the following is a fundamental difference that must be understood and accounted for when comparing an AA-rated corporate bond and a private label AA-rated mortgage-backed security (MBS) pass-through? (Important)

- A. Corporate bonds are exposed to systemic risk because a single corporate bond is undiversified, while MBS pools are immune to systemic risk because they consist of many mortgages.
- B. Corporations have a dynamic capital structure because they can undergo restructuring by issuing more debt, while MBS pools have a relatively static capital structure.
- C. Corporate ratings are based on default probabilities that are driven by quantitative models, while MBS ratings rely heavily on analyst judgment and qualitative factors.
- D. Corporate ratings rely heavily on forecasts of economic conditions, while MBS ratings are based on the assumption of neural economic conditions.

Answer: B

3.6 A bank is considering the acquisition of a smaller rival bank. As part of due diligence, a risk

manager is investigating claims that the target bank had engaged in “predatory lending” during the housing bubble. Which of the following behaviors is evidence that predatory lending took place? (Important)

- A. Granting an Alt-A loan based on unverified income and employment.
- B. Inducing a borrower to refinance repeatedly in order to collect fees.
- C. Steering borrowers into prime loans when they could only qualify for subprime loans.
- D. Concealing the true identity of the borrower from the lender.

Answer: B

Section 19 Risk Mitigation Techniques

1 Risk Mitigation Techniques

<p>Netting and Close-Out</p> <p>Netting and Close-Out Between Two Counterparties</p> <ul style="list-style-type: none"> • Payment netting: combining the cash flows from different contracts with a counterparty into a single net amount • Close-out netting: the netting of contract values with a counterparty in the event of the counterparty's default <p>Netting and Close-Out Between Multiple Counterparties</p> <ul style="list-style-type: none"> • Netting arrangements would involve multiple counterparties to mitigate counterparty and operational risk. <p>Typically, multilateral netting is achieved with a central entity, such as an exchange or clearinghouse.</p>	<p>Termination Features</p> <p>Termination provisions</p> <ul style="list-style-type: none"> • Termination events allow institutions to terminate a trade before their counterparties become bankrupt. <p>Walkaway clauses</p> <ul style="list-style-type: none"> • Under these clauses an entity can walk away from, or avoid, its net liabilities to a counterparty that is in default, while still being able to claim in the event of a positive MtM exposure. <p>Trade compression</p> <ul style="list-style-type: none"> • An approach for utilizing multilateral netting without the need for a membership organization. • Compression aims to reduce the gross notional amount and the number of trades (e.g., OTC derivatives transactions). <p>Collateral Management</p> <ul style="list-style-type: none"> • Collateral management has been highly standardized through the introduction of ISDA documentation. (CSA) • There are three key parameters established with any CSA: Threshold, Minimum transfer amount, Independent amount <p>Central Counterparties (CCP)</p> <p>引入CCP</p> <p>OTC市场容易违约 →</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; vertical-align: top; padding: 5px;"> <p>Strengths of a CCP</p> <ul style="list-style-type: none"> • Multilateral netting: Mitigate counterparty risk and reduces total credit exposures. • Liquidity. values are set daily to adjust variation margins. • Transparency. The process of daily valuation greatly enhances the transparency • Legal and operational efficiency. A CCP can work directly with regulators • Loss mutualization. This process reduces systemic risk as losses are distributed through a network of members. • Default management through auction process. The defaulted positions are auctioned off to surviving members </td> <td style="width: 85%; vertical-align: top; padding: 5px;"> <p>Weaknesses of a CCP</p> <ul style="list-style-type: none"> • Inability to eliminate counterparty risk. A CCP only reduces counterparty risk • Undesirable consequences of CCP features and roles. moral hazard and adverse selection • CCPs can potentially increase systemic risk. if a CCP defaults the result could be severe systemic problems. </td> </tr> </table>	<p>Strengths of a CCP</p> <ul style="list-style-type: none"> • Multilateral netting: Mitigate counterparty risk and reduces total credit exposures. • Liquidity. values are set daily to adjust variation margins. • Transparency. The process of daily valuation greatly enhances the transparency • Legal and operational efficiency. A CCP can work directly with regulators • Loss mutualization. This process reduces systemic risk as losses are distributed through a network of members. • Default management through auction process. The defaulted positions are auctioned off to surviving members 	<p>Weaknesses of a CCP</p> <ul style="list-style-type: none"> • Inability to eliminate counterparty risk. A CCP only reduces counterparty risk • Undesirable consequences of CCP features and roles. moral hazard and adverse selection • CCPs can potentially increase systemic risk. if a CCP defaults the result could be severe systemic problems.
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1.1 Which of the following Credit Support Annex (CSA) features would best mitigate the risk of a volatile market value of the posted collateral in a bilateral agreement? (Important)

- A. Permission to rehypothecate the securities.
- B. Specification of a high threshold amount.
- C. Using a two-way CSA.
- D. Requirement to post an independent amount.

Answer: D

1.2 Assume three counterparties (A, B and C) are entered into bilateral derivative trades with the following net current replacement values: replacement value for A with respect to B = \$10 million (i.e., if closed out immediately, B would owe \$10 million to A); replacement value for B with respect to C = \$10 million; replacement value for C with respect to A = \$10 million. If these positions were immediately novated to central counterparty with multilateral netting, which of the following is implied?

- A. Counterparty exposures among A, B and C are each eliminated to zero; but each will have a \$10 million exposure to the central counterparty.
- B. Counterparty exposures among A, B and C are each eliminated to zero; and each will have zero exposure to the central counterparty.
- C. Counterparty exposures among A, B and C are, in total, reduced from \$30 million to \$10 million; and the central counterparty assumes \$20 million in exposure.
- D. The total exposure is not reduced from \$30 million; it is effectively transferred to the central counterparty.

Answer: B

1.3 There are a number of challenges for clearing over-the-counter (OTC) derivative products through a centralized counterparty (CCP). Which of the following statements best summarizes the key challenges for central clearing of OTC derivative products?

- A. Jurisdictional fragmentation, increased counterparty risk, less transparency, and standardization.
- B. Product complexity, illiquid products, presence of wrong-way risk, and lack of standardization.
- C. Illiquid products, jurisdictional fragmentation, presence of wrong-way risk, and legal concerns.
- D. Lack of standardization, increased counterparty risk, increased dependency risk, and less transparency.

Answer: B

Lack of standardized products, complexity, illiquid products, and presence of wrong-way risk are characteristics of OTC derivative products that make CCP clearing challenging. OTC derivative products need to be standardized before they can be cleared through a CCP. More complex and illiquid derivative products are problematic for CCPs because their unique features make them difficult to value. Products with wrong-way risk are also more complex and create additional concerns for the added risk to CCPs in the event of default.

1.4 Setting margin levels and loss reserves are important aspects of mitigating systemic risk through the use of a central counterparty (CCP). Which of the following statements most accurately reflects the calculation of initial margins?

- A. The value at risk (VaR) approach sets appropriate initial margins at the 99% confidence level.
- B. The Standard Portfolio Analysis of Risk (SPAN) is considered the most advanced methodology today in calculating initial margins.
- C. The calculation of the initial margin should be based on volatility, tail risk, and dependency.
- D. Initial margins depend solely on the credit quality of the clearing member.

Answer: C

The calculation of the initial margin should be based on volatility, tail risk, and dependency. The value at risk (VaR) approach is a more advanced method than the SPAN approach for calculating initial margins. Studies suggest that the VaR approach does a good job of setting initial margins at the 95% confidence level, but at the 99% confidence level initial margins are not sufficient. The initial margin depends primarily on market risk and not the credit quality of the clearing member.

1.5 A bank has the following single name credit default swap contracts with a counterparty, with each contract maturing on March 31 of the maturity year.

Notional (USD)	Long/Short	Maturity Year	Coupon (bps)
40,000,000	Long Protection	2020	200
25,000,000	Short Protection	2020	150
10,000,000	Short Protection	2017	325

The bank is concerned with the counterparty's default risk and wants to reduce its exposure. It uses trade compression for all possible trades, what is the resulting coupon of the compressed trades in basis points? (Important)

- A. 200
- B. 250
- C. 375
- D. 650

Answer: A



目录

Operational and Integrated Risk Management	3
Section 1 Operational Risk	3
1 Defining Operational Risk.....	3
2 Loss Distribution Approach	4
3 Data Elements in an AMA Framework and Modeling Dependence.....	8
4 Managing operational risk	10
Section 2 Model Risk	11
1 Sources of Model Risk	11
2 Mitigating Model Risk	12
3 Case Studies: LTCM, London Whale, The 2005 Credit Correlation Episode and Subprime Default Models	14
4 VaR Model.....	17
Section 3 Liquidity Risks	20
1 Definition of Liquidity Risk	20
2 Transaction Liquidity Risk Measurement.....	21
3 Funding Liquidity Risk Measurement.....	27
4 Repurchase Agreements and Financing.....	28
Section 4 Principles for the Sound Management of Operational Risk.....	31
1 Principles for the Sound Management of Operational Risk.....	31
Section 5 Risk Capital Attribution and Risk-Adjusted Performance Measurement.....	32
1 RAROC and Adjusted RAROC.....	32
Section 7 Enterprise Risk Management: Theory and Practice	39
1 Enterprise Risk Management (ERM) and Firm-wide VaR.....	39
Section 9 The Failure Mechanics of Dealer Banks.....	42
1 The Failure Mechanics of Dealer Banks	42
Section 10 Stress Testing Banks	44
1 Stress Testing Banks	44
Section 11 Capital Planning at Large Bank Holding Companies.....	44

1 Capital Planning at Large Bank Holding Companies.....	44
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Operational and Integrated Risk Management

Section 1 Operational Risk

1 Defining Operational Risk

Defining Operational Risk ★★		名词掌握
Basel Definition ➔	Definition approach	Cause impact
	What cause operational risk	People (human factor) Internal processes Systems External events.
	Excluding	Strategic risk and Reputational risk
	Including	Legal risk

Basel Loss Event Types	Operational Risk Events
<ul style="list-style-type: none"> • Clients, products, and business practices • Internal fraud • External fraud • Damage to physical assets • Execution, delivery, and process management • Business disruption and system failures • Employment practices and workplace safety 	<ul style="list-style-type: none"> • <i>High Frequency/Low Severity(HFLS)</i>: occur regularly, but low-level losses • <i>Low Frequency/High Severity(LFHS)</i>: rare but devastating

1.1 All the following are operational risk loss events, except: (Practice Exam)

- A. An individual shows up at a branch presenting a check written by a customer for an amount substantially exceeding the customer's low checking account balance. When the bank calls the customer to ask him for the funds, the phone is disconnected and the bank cannot recover the funds.
- B. A bank, acting as a trustee for a loan pool, receives less than the projected funds due to delayed repayment of certain loans.
- C. During an adverse market movement, the computer network system becomes overwhelmed, and only intermittent pricing information is available to the bank's trading desk, leading to large losses as traders become unable to alter their hedges in response to falling prices.
- D. A loan officer inaccurately enters client financial information into the bank's proprietary credit risk model.

Answer: B

Statement a. represents external fraud, which is included in operational risk.

Statement c. represents a systems failure. Statement d. is a failure in internal processes.

1.2 Which of the following is an example of an operational risk loss by Firm A?

- A. After a surprise announcement by the central bank that interest rates would increase,

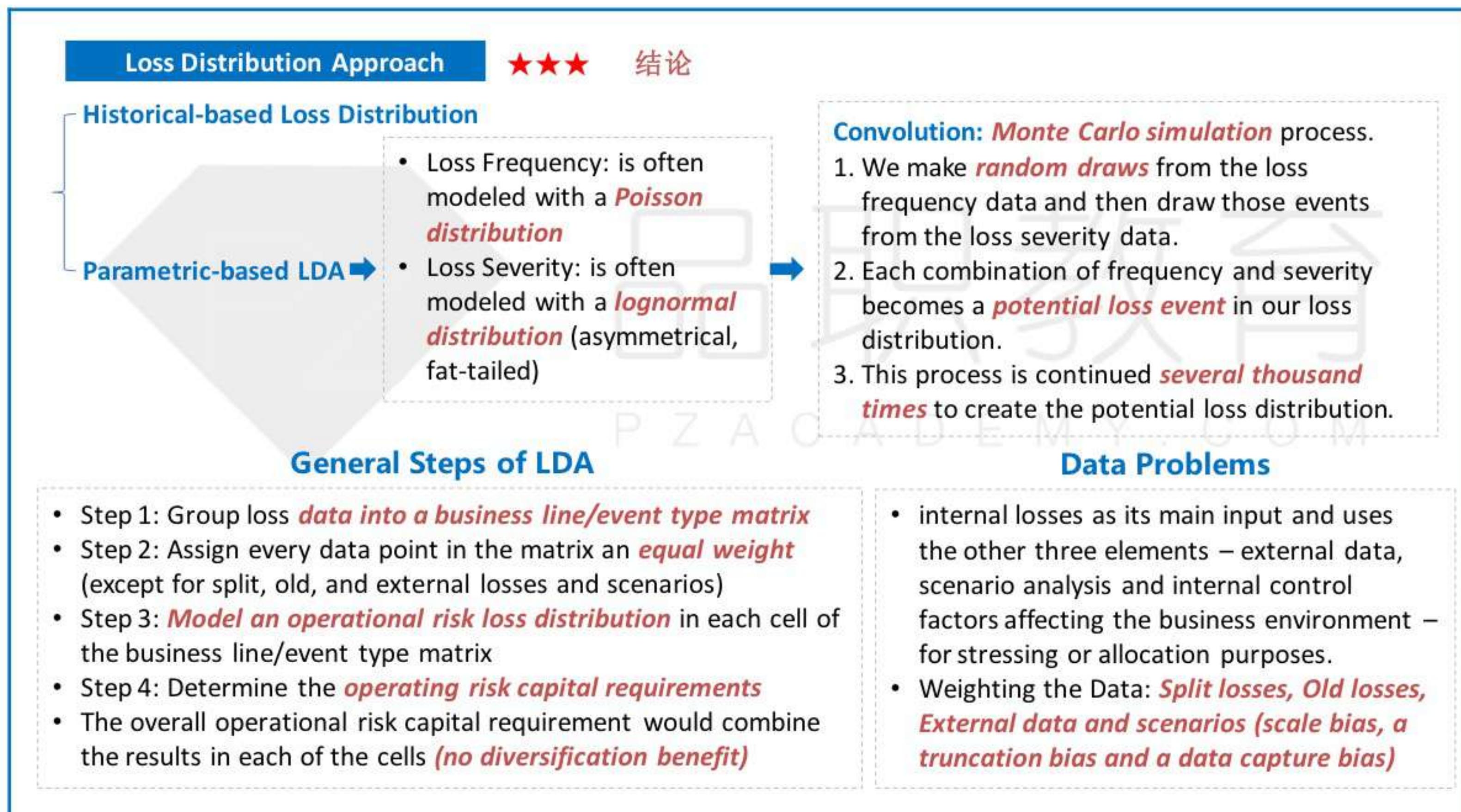
bond prices fall, and Firm A incurs a significant loss on its bond portfolio.

- B. The data capture system of Firm A fails to capture the correct market rates causing derivative trades to be done at incorrect prices, leading to significant losses.
- C. As a result of an increase in commodity prices, the share price of a company that Firm A invested in falls significantly causing major investment losses.
- D. A counterparty of Firm A fails to settle their debt to Firm A, and in doing this, they are in breach of a legal agreement to pay for services rendered.

Answer: B

In (B), systems failure or incorrect systems caused the problem. The losses are directly due to an operational risk exposure, (A) and (C), an increase in interest rates and the fall in the value of an investment, are both examples of market risk exposure, (D), failure to repay debt, is an example of credit risk exposure.

2 Loss Distribution Approach



2.1 Please find the right order of LDA structure process.

- 1) Assign every data point in the matrix an equal weight except for split losses, old loss and external losses.
 - 2) Model a loss distribution in each cell of the business line/event type matrix.
 - 3) Organize and group loss data into a business line/event type matrix.
 - 4) Determine the operating risk capital requirement for each business line by combining empirical distributions and parametric tail distributions.
- A. (4) (2) (3) (1)
 - B. (3) (1) (4) (2)

- C. (3) (1) (2) (4)
 D. (4) (1) (3) (2)

Answer: C

2.2 The Chief Risk Officer of your bank has put you in charge of operational risk management. As a first step, you collect internal data to estimate the frequency and severity of operational-risk-related losses. The table below summarizes your findings:

Frequency Distribution		Severity Distribution	
Number of Occurrences	Probability	Loss (USD)	Probability
0	0.6	1,000	0.5
1	0.3	100,000	0.4
2	0.1	1,000,000	0.1

Based on this information, what is your estimate of the expected loss due to operational risk?

- A. USD 20,000
 B. USD 70,250
 C. USD 130,600
 D. USD 140,500

Answer: B

The expected loss can be calculated by multiplying the expected frequency and the expected severity. Expected frequency is equal to: $(0 \times 0.6) + (1 \times 0.3) + (2 \times 0.1) = 0.5$,

Expected severity is equal to: $(1000 \times 0.5) + (100,000 \times 0.4) + (1,000,000 \times 0.1) = 140,500$

The expected loss is therefore: $0.5 \times 140,500 = 70,250$

2.3 Suppose you are given the following information about the operational risk losses at your bank.

Frequency distribution		Severity Distribution	
Probability	Frequency	Probability	Severity
0.5	0	0.6	USD 1000
0.3	1	0.3	USD 10,000
0.2	2	0.1	USD 100,000

What is the estimate of the VaR at the 95% confidence level (including expected loss), assuming that the frequency and severity distributions are independent?

- A. USD 100,000
 B. USD 101,000
 C. USD 200,000
 D. USD 110,000

Answer: A

Loss	Prob.
0	$0.5 = 0.5$
1,000	$0.3 \times 0.6 = 0.18$
2,000	$0.2 \times 0.6 \times 0.6 = 0.072$
10,000	$0.3 \times 0.3 = 0.09$
11,000	$0.2 \times 0.6 \times 0.3 + 0.2 \times 0.3 \times 0.6 = 0.072$
20,000	$0.2 \times 0.3 \times 0.3 = 0.018$
100,000	$0.3 \times 0.1 = 0.03$
101,000	$0.2 \times 0.6 \times 0.1 + 0.2 \times 0.1 \times 0.6 = 0.024$
110,000	$0.2 \times 0.1 \times 0.3 + 0.2 \times 0.3 \times 0.1 = 0.012$
200,000	$0.2 \times 0.1 \times 0.1 = 0.002$

2.4 Gerard Kuper is modeling the number of operational risk loss events that could adversely impact Bank ABC in 2010. He expects the number of operational risk loss events for the year to be relatively small. Which type of distribution is the least likely to use?

- A. Normal distribution
- B. Binomial distribution
- C. Negative binomial distribution
- D. Poisson distribution

Answer: A

The last three distributions require the number n to be positive, which is not the case for the normal distribution.

2.5 Consider a bank that wants to model processing errors in its retail banking business. The number of such errors in a given year is denoted by random variable N . The dollar loss amount when a processing error occurs is denoted by random variable S . Which of the following procedures is the most likely implementation of the first step of the loss distribution approach?

- A. Convolute a marginal Poisson distribution (to characterize N) with a Weibull (to characterize S)
- B. Convolute a marginal Poisson distribution (to characterize S) with a Weibull (to characterize N)
- C. Convolute a marginal lognormal distribution (to characterize N) with a Weibull (to characterize S)
- D. Convolute a marginal Poisson distribution (to characterize N) with a negative binomial (to Characterize S)

Answer: A

Poisson is a popular discrete distribution used to model frequency; Weibull is a typical

continuous distribution, which generalizes the exponential distribution and has a positive domain, used to model severity.

2.6 Which of the following is true about modeling the severity distribution(s) of operational losses?

- A. A single parametric distribution is generally inadequate to capture the probabilistic behavior of severity over its range.
- B. The specification of the severity distribution(s) is less consequential than the specification of the frequency distribution(s).
- C. Due to the importance and firm-specific nature of loss severity data, empirical distributions are almost always recommended, especially for the “tail”.
- D. Most banks can (and should) rely on internal dataset(s) for the estimation of their severity distribution.

Answer: A

2.7 A risk team in the investment banking subsidiary of a bank holding company is setting up a Monte Carlo simulation methodology to estimate the subsidiary's aggregate loss distribution. Which of the following loss severity and loss frequency distribution pairs is the most appropriate to use? (Practice Exam)

- A. Binomial distribution for severity, lognormal distribution for frequency.
- B. Binomial distribution for frequency, normal distribution for severity.
- C. Poisson distribution for severity, normal distribution for frequency.
- D. Poisson distribution for frequency, lognormal distribution for severity.

Answer: D

Rationale: Pareto and lognormal distributions (fat-tailed) are generally used for loss severity, Poisson and Negative Binomial distributions are appropriate for loss frequency.

2.8 Which of the following statements about the process of estimating operational risk is correct? (Important)

- A. When operational losses from two or more business units are combined, the unit with the heaviest-tailed distribution dominates the tail of the distribution of total losses.
- B. An incidence of an extreme loss at a bank will usually result in changes to the bank's internal controls and processes which increase the likelihood of a similar loss event in the future.
- C. The high excess kurtosis in typical operational loss distributions allows accurate quantile estimates to be made with a relatively small sample.
- D. A bank with 10 years of historical loss data will have sufficient internal loss data to

accurately estimate the 99.9th percentile of its annual operational loss distribution.

Answer: A

2.9 A bank's risk analyst has completed an inventory of firm-wide risks and has classified these risks as market, credit, or operational. Which of the following observations from the bank's data would be most consistent with typical features of industry data? (Important)

- A. The operational risk distribution has a large number of small losses.
- B. The credit risk distribution is symmetric and has relatively thin tails compared to a normal distribution.
- C. The market risk distribution has a large negative skew and very high kurtosis.
- D. The firm-wide risk distribution is very similar to a normal distribution.

Answer: A

3 Data Elements in an AMA Framework and Modeling Dependence

Modeling Dependence	
Dependencies in LDA Models	
<ul style="list-style-type: none"> • There are several types of dependencies: <i>Within-cell dependencies & Between-cell dependencies</i> • <i>Copula functions</i> can model the dependency of frequency distributions and. <i>Gaussian copulas are often used.</i> 	
Data Elements in an AMA Framework ★★ 结论	
Data Elements in an AMA Framework	
Internal Loss Data	select a <i>loss threshold</i> for loss data collection <ul style="list-style-type: none"> • <i>too low</i>: require a <i>very high amount of reporting</i>; <i>too high</i>: bias the total losses Selecting Internal Loss Reference Date
External Loss Data	<ul style="list-style-type: none"> • <i>Subscription Databases (Internal development)</i>: the firm gathers and collates information from <i>media such as news or magazines</i>. (<i>reporting bias</i>) • <i>Consortium Data: Operational Riskdata eXchange Association (ORX)</i> • <i>Vendors</i>
Scenario Analysis	These scenarios estimates are usually gathered through <i>expert opinions</i> Biases and Challenges: <i>Presentation bias, Availability bias, Confidence bias, Huddle bias, Gaming and Inexpert opinion</i>
Business Environment and Internal Control Factors	Risk Control Self-Assessment (RCSA) Business and Control Environment Programs

3.1 Each of the following is a key issue related to external datasets in modeling operational losses except:

- A. The lack of any vendors with centralized database necessitates the manual collection of peer data.
- B. The relevance question of whether past loss events at other institutions seem likely or even plausible for the user bank going forward.
- C. The quantity question: there may not be enough data points in the external dataset that can supplement the internal loss data.
- D. The under-reporting problem that not all loss events reach the public domain.

Answer: A

3.2 Operational risk loss data is not easy to collect within an institution, especially for extreme loss data. Therefore, financial institutions usually attempt to obtain external data, but doing so may create biases in estimating loss distributions. Which of the following statements regarding characteristics of external loss data is incorrect?

- A. External loss data often exhibits scale bias as operational risk losses tend to be positively related to the size of the institution (i.e., scale of its operations).
- B. External loss data often exhibits truncation bias as minimum loss thresholds for collecting loss data are not uniform across all institutions.
- C. External loss data often exhibits data capture bias as the likelihood that an operational risk loss is reported is positively related to the size of the loss.
- D. The biases associated with external loss data are more important for large losses in relation to a bank's assets or revenue than for small losses.

Answer: D

The biases associated with external loss data are important for all losses in relation to a bank's assets or revenue.

3.3 There are typically four steps used in designing the risk control self-assessment (RCSA) program for a large firm. Which of the following statements is least likely to be a step in the design of that program?

- A. Identify and assess risks associated with each business unit's activities.
- B. Controls are added to the RCSA program to mitigate risks identified for the firm.
- C. Risk metrics and all other OpRisk Initiatives are linked to the RCSA program.
- D. Reports to regulators are prepared that summarize the degree of OpRisk.

Answer: D

The last step in the design of a risk control self-assessment (RCSA) program involves control tests to assess how well the controls in place mitigate potential risks.

3.4 Analysts at a global bank are developing risk reporting systems to comply with the Basel Advanced Measurement Approaches. In setting a threshold for losses to be considered material for data collection purpose, which of the following is a prudent approach for the bank to use? (Important)

- A. Use statistical evidence to justify that losses below the threshold would have an immaterial impact of capital calculations.
- B. Use cost-benefit analysis to justify a threshold that would minimize the bank's operational risk charge.

- C. Select a single loss data threshold for all global subsidiaries which is equal to the appropriate threshold for the largest operation.
- D. Select a threshold based on the 99th percentile of the frequency distribution of its operational loss.

Answer: A

3.5 A German bank uses the loss distribution approach to estimate its operational risk. Which of the following decisions will most likely cause the bank to significantly overestimate its operational risk capital? (Important)

- A. Establishing a minimum threshold of EUR 10,000 for internal and external operational loss events to be included in the dataset
- B. Using a Gaussian copula to model dependence between several marginal loss distributions representing different business units at the bank
- C. Assuming that operational loss events and severity across the bank's business units are perfectly dependent
- D. Relying solely upon historical internal loss events and severity collected over the past five years

Answer: C

4 Managing operational risk

4.1 Which of the following strategies can contribute to minimizing operational risk?

- I. Individuals responsible for committing to transactions should perform clearance and accounting functions.
 - II. To value current positions, price information should be obtained from external sources.
 - III. Compensation schemes for traders should be directly linked to calendar revenues.
 - IV. Trade tickets need to be confirmed with the counterparty.
- A. I and II
 - B. II and IV
 - C. III and IV
 - D. I, II, and III

Answer: B

Answer I violates the principle of separation of functions. Answer III. may create problems of traders taking too much risk. Answer II. advises the use of external sources for valuing positions, as traders may affect internal price data.

Section 2 Model Risk

1 Sources of Model Risk

Sources of Model Risk ★★ 概念对比	
Common Model Errors	<ul style="list-style-type: none"> Assuming constant volatility. Assuming a normal distribution of returns. Underestimating the number of risk factors. Assuming perfect capital markets. Assuming adequate liquidity. Misapplying a model.
Common Model Implementation Errors	<ul style="list-style-type: none"> When models that require complex simulations are not allowed to run a sufficient number of runs. (<i>Monte Carlo simulations</i>) Frequency of refreshing model parameters. Correctly estimating parameters
Common Valuation and Estimation Errors	<ul style="list-style-type: none"> Inaccurate data. Incorrect sampling period length. Liquidity and valuation problems.

1.1 Which of the following scenarios is the best example of a model error?

- A. Assuming a non-normal distribution of returns.
- B. Assuming perfectly liquid markets.
- C. Assuming variable distribution of asset price.
- D. Assuming imperfect capital markets.

Answer: B



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Six common model errors include: (1) assuming constant volatility, (2) assuming a normal distribution of returns, (3) underestimating the number of risk factors, (4) assuming perfect capital markets, (5) assuming adequate liquidity, and (6) misapplying a model.

1.2 You are the head of the Independent Risk Oversight (IRO) unit of XYZ bank. Your first task is to review the following existing policies relating to model implementation.

- I. The remuneration of the staff of the IRO unit is dependent on how frequently the traders of XYZ bank use models vetted by the IRO.
- II. Model specifications assume that markets are perfectly liquid.

Which of the existing policies are sources of model risk?

- A. Statement I only
- B. Statement II only
- C. Both statements are correct
- D. Both statements are incorrect

Answer: B

I. Incorrect. Even though this is a risk that can increase exposure to model risk, the policy itself is regarding compensation and not the model itself.

II. Correct. This assumption can lead to major error where market liquidity is limited.

1.3 An important source of model risk is incorrect model specification. Which of the following is not an example of model specification error?

- A. Omitting an important risk factor from the model.
- B. Assuming that variables are independent when significant correlations exist.
- C. Assuming data is from a particular distribution when a more accurate distribution is available.
- D. Estimating the model using data from an inappropriate sample period.

Answer: D

Using data from an inappropriate sample period is an example of calibration error.

2 Mitigating Model Risk

Mitigating Model Risk ★ 结论

Mitigating Model Risk

- Investing in research to improve the model
- Independent vetting process
- Models need to be **periodically reevaluated** for relevance and accuracy.
- Empirical evidence suggests that **simple**, robust models work better than more complex and less robust models.

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2.1 The role of senior managers in managing model risk includes all of the following except

- A. Becoming expert modelers.
- B. Establishing an organizational framework that implements sound risk management procedures.
- C. Questioning model features.
- D. Understanding the fundamentals of model risk.

Answer: A

Senior managers need not be expert modelers, but they do need to understand the fundamentals of model risk so that they can ask the right questions and implement sound risk management procedures.

2.2 Which of the following actions could worsen rather than reduce model risk?

- A. Require documentation of the model so that the risk manager can produce the same prices as the user of the model.
- B. Use a simulation benchmark model to assess a model that has a closed-form solution.

- C. Make the model for the dynamics of the underlying fit past data better by making the price of the underlying depend on additional variables.
- D. Plot model prices against parameter values.

Answer: C

The other three are procedures that help to monitor the model and can help to reduce model risk.

2.3 Even though risk managers cannot eliminate model risk, there are many ways managers can protect themselves against model risk. Which of the following statement about managing model risk is correct?

- A. Models should be test against known problems.
- B. It is not advisable to estimate model risk using simulations.
- C. Complex models are generally preferable to simple models.
- D. Small discrepancies in model outputs are always acceptable.

Answer: A

One way to protect against model risk is to test a model against known problems. It is always a good idea to check a model against simple problems to which one already knows the answer, and many problems can be distilled to simple special cases that have known answers. If the model fails to give the correct answer to a problem whose solution is already known, then this indicates that there is something wrong with it.

2.4 As a risk practitioner. Leo realizes that model risk can never be eliminated, although he may find some ways to protect against it. Which of the following measures help reduce model risk?

- I. All else equal, choose the model with the fewest parameters.
 - II. Have regularly scheduled model reviews that involve careful back-testing and stress-testing.
 - III. Identify and evaluate key model assumptions, and ignore small but persistent problems.
 - IV. Validate the model using simple Problems for which answers are independently known.
- A. II only
 - B. I, II, and III
 - C. I, II, and IV
 - D. III and IV

Answer: C

I. is correct. First and foremost, practitioners should simply be aware of the model risk: It is true that unnecessary complexity is never a virtue in model selection.

II. is correct. Practitioners should evaluate model adequacy using stress tests and backtests: models should be recalibrated and re-estimated on a regular basis and the methods used should be kept up to date.

III. is incorrect. Users should explicitly set out the key assumptions on which a model is based. Evaluate the extent to which the model's results depend on these assumptions: But he should never ignore the small problems because small discrepancies are often good warning signals of larger Problems.

II. is correct. It is always a good idea to check a model on simple Problems to which one already knows the answer and many Problems can be distilled to simple special cases that have known answers.

2.5 Gamma Investments, LLC (Gamma) uses monthly model vetting to mitigate potential model risk. Gamma's managers recently accepted the use of a model for valuing short-term option on 30-year corporate bonds, but rejected the same model to value short-term options on three-year government bonds. The managers also frequently test proposed analytical models against a simulation approach. These model vetting techniques are examples of which of the following vetting phases?

Accepting/rejecting a model Testing models against simulation

A. Health check of the model Stress testing

B. Soundness of a model Stress testing.

C. Health check of the model Benchmark modeling

D. Soundness of a model Benchmark modeling

Answer: D

Accepting the model for one use but rejecting it for another (inappropriate) use is an example of vetting the soundness of the model. In other words, the model vetter (in this case the risk manager) should ensure that the mathematical model reasonably represents the asset being valued.

Testing a proposed analytical model against a simulation approach or a numerical approximation technique is an example of benchmark modeling.

Health check of the model ensures that the model contains all of the necessary properties.

Stress testing a model uses simulations to check the model's reaction to different situations.

3 Case Studies: LTCM, London Whale, The 2005 Credit Correlation Episode and Subprime Default Models

Case Studies ★ 结论	
Long-Term Capital Management	
Incident & Results	<ul style="list-style-type: none"> LTCM's trading strategy relied on <i>arbitrage positions based on market-neutral and relative-value trading</i>. Use <i>extensive leverage</i>
Key Factors	<ul style="list-style-type: none"> Failure to supplement VaR with a full set of <i>stress test scenarios</i> Failure to account for <i>illiquidity</i> of positions during stress <i>Leverage too was high</i> Too much faith in models; i.e., <i>model risk</i>
Lessons	<p>LTCM's collapse highlighted several flaws in its regulatory value at risk (VaR) calculations</p> <ul style="list-style-type: none"> <i>The fund's calculated 10-day VaR period was too short.</i> The fund's VaR models <i>did not incorporate liquidity assumptions</i>. The fund's risk models <i>did not incorporate correlation and volatility risks</i>.
London Whale	
<p>Risk Culture, Model Risk, and Operational Risk</p> <ul style="list-style-type: none"> The London trading desk belonged to JPM's Chief Investment Office (CIO), which was responsible for managing the bank's excess deposits. The CIO used the deposits to engage in high- profit potential, high-risk derivatives trading strategies. JPM garnered international headlines when in the first half of 2012 it sustained losses in excess of \$6 billion due to <i>risky synthetic credit derivatives trades</i> executed by a trader, called the "London Whale", in its London office. The CIO <i>adopted a new VaR model</i> which lowered its calculated VaR by 50%. <i>The losses from the London Whale trade and the subsequent investigations revealed a poor risk culture at JPM.</i> 	
The 2005 Credit Correlation Episode	
The Trade	<p>The Trade</p> <ul style="list-style-type: none"> <i>Sell protection on the equity tranche</i> of the CDX.NA.IG; i.e., long credit and credit spread risk <i>Buy protection on the junior mezzanine tranche</i> of the CDX.NA.IG; i.e., short credit and credit-spread risk through the mezzanine <p>The motivation</p> <ul style="list-style-type: none"> The trade was intended to achieve a <i>positively convex payoff profile</i> The trade was designed to be <i>default-risk-neutral</i> at initiation The portfolio also had <i>positive carry</i>; i.e., it earned a positive net spread.
The Critical Error	<ul style="list-style-type: none"> The critical error of the trade was that it's setup <i>at a particular value of implied correlation</i>. The critical flaw was that the <i>correlation assumption was static</i>. <i>Stress testing correlation</i> would have revealed the risk.
Subprime Default Models	
Two key Assumption	<ul style="list-style-type: none"> <i>House price appreciation assumption</i>: The models assumed <i>positive future house price appreciation rates</i>. <i>Low (geographical) correlation assumption</i>
Additional points	<ul style="list-style-type: none"> The model errors, and/or inappropriate parameters, led to a substantial <i>underestimation of the degree of systematic risk</i> in subprime RMBS returns. The <i>inaccuracy of rating agency models</i> for subprime RMBS is a complex phenomenon

3.1 Which of the following two model errors in the RMBS valuation and risk models are considered to have contributed the most to a significant underestimation of systematic risk in subprime RMBS returns during 2008-2009?

- The assumption of future house price appreciation and the assumption of high correlations among regional housing markets.
- The assumption of future house price declines and the assumption of high correlations among regional housing markets.
- The assumption of future house price appreciation and the assumption of low correlations among regional housing markets.
- The assumption of future house price declines and the assumption of low correlations among regional housing markets.

Answer: C

The two model errors considered to have contributed the most to a significant underestimation of systematic risk were (1) the assumption of future house price appreciation, and (2) the assumption of low correlations among regional housing markets.

3.2 About the long-equity tranche, short-mezzanine credit trade in 2005, Malz writes "A widespread trade among hedge funds, as well as proprietary trading desks of banks and brokerages, was to sell protection on the equity tranche and buy protection on the junior mezzanine tranche of the CDX.NA.IG. The trade was thus long credit and credit-spread risk through the equity tranche and short credit and credit-spread risk through the mezzanine. It was executed using several CDX.NA.IG series, particularly the IG3 introduced in September 2004 and the IG4 introduced in March 2005.

The trade was designed to be default-risk-neutral at initiation; by sizing the two legs of the trade so that their credit spread sensitivities were equal. The motivation of the trade was not to profit from a view on credit or credit spreads, though it was primarily oriented toward market risk. Rather, it was intended to achieve a positively convex payoff profile. The portfolio of two positions would then benefit from credit spread volatility. In addition, the portfolio had positive carry; that is, it earned a positive net spread. Such trades are highly prized by traders, for whom they are akin to delta-hedged long option portfolios in which the trader receives rather than paying away time value."

But, of course, many of these traders suffered large losses. According to Malz, which of the following was the critical error in the trade?

- A. The model ignored correlation altogether
- B. The model failed to adequately capture and anticipate individual defaults
- C. The model assumed a static implied correlation: deltas were partial derivatives that did not account for changing correlation, which drastically altered the hedge ratio
- D. The recovery amount was at risk; in the event of a default on one or more of the names in the index, the recovery amount was not fixed but a random variable

Answer: C

Malz: "The relative value trade was set up in the framework of the standard copula model, using the analytics described in Chapter 9. These analytics were simulation-based, using riskneutral default probabilities or hazard-rate curves derived from single-name CDS. The timing of individual defaults was well modeled. Traders generally used a normal copula. The correlation assumption might have been based on the relative frequencies of different numbers of joint defaults, or, more likely, on equity return correlations or prevailing equity implied correlations, as described at the end of Chapter 10.

In any event, the correlation assumption was static. This was the critical flaw, rather than using the 'wrong' copula function, or even the 'wrong' value of the correlation. The deltas used to set the proportions of the trade were partial derivatives that did not account for changing

correlation. Changing correlation drastically altered the hedge ratio between the equity and mezzanine tranches, which more or less doubled to nearly 4 by July 2005. In other words, traders needed to sell protection on nearly twice the notional value of the mezzanine tranche in order to maintain spread neutrality in the portfolio.... The model did not ignore correlation, but the trade thesis focused on anticipated gains from convexity. The flaw in the model could have been readily corrected if it had been recognized. The trade was put on at a time when copula models and the concept of implied correlation generally had only recently been introduced into discussions among traders, who had not yet become sensitized to the potential losses from changes in correlation. Stress testing correlation would have revealed the risk. The trade could also have been hedged against correlation risk by employing an overlay hedge: that is, by going long single-name protection in high default-probability names. In this sense, the 'arbitrage' could not be captured via a two-leg trade, but required more components."

3.3 Which of the following flaws in Long-Term Capital Management's (LTCM) value at risk (VaR) calculations were most evident following its collapse in 1998?

- I. The calculated 10-day VaR period was too short.
 - II. The fund's VaR model assumed strong positive correlation.
- A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.

Answer: A

LTCM's collapse highlighted several flaws in its regulatory VaR calculations. The fund relied on a VaR model that: (1) used a 10-day horizon, which proved to be too short to sufficiently model the time to raise new capital, (2) did not factor in liquidity risk (in other words, it assumed markets were perfectly liquid), and (3) did not incorporate correlation and volatility risks, where in fact markets exhibited strong positive correlation during periods of stress in 1997 and 1998.

4 VaR Model

VaR Model

Variability of VaR Estimates

The risk manager has a great deal of discretion in actually computing a VaR

- On the **positive** side, the risk manager has the **flexibility to adapt the way**
- On the **negative** side, the flexibility leads to two problems with the use of VaR in practice:
 - **Lack of standardization of VaR parameters.**
 - **Differences in VaR measurements.**

Risk Factor Mapping for VaR Calculations

Problems with Mapping

- Some decisions about mapping are pragmatic trade-offs with **pros and cons: Cash flow mappings & duration-convexity mapping**
- It may be **difficult to find data** that address certain risk factors.

Impact of Improper Mapping

- **Basis Risk:** The result, however, will be a measured VaR of zero, even though there is a significant basis risk
- **Liquidity Risk:** convertible bond trading

4.1 A profitable derivatives trading desk at a bank decides that its existing VaR model, which has been used broadly across the firm for several years, is too conservative. The existing VaR model uses a historical simulation over a three-year look-back period, weighting each day equally. A quantitative analyst in the group quickly develops a new VaR model, which uses the delta normal approach. The new model uses volatilities and correlations estimated over the past four years using the RiskMetrics EWMA method.

For testing purposes, the new model is used in parallel with the existing model for four weeks to estimate the 1-day 95% VaR. After four weeks, the new VaR model has no exceedances despite consistently estimating VaR to be considerably lower than the existing model's estimates. The analyst argues that the lack of exceedances shows that the new model is unbiased and pressures the bank's model evaluation team to agree. Following an overnight examination of the new model by one junior analyst instead of the customary evaluation that takes several weeks and involves a senior member of the team, the model evaluation team agrees to accept the new model for use by the desk.

Which of the following statements about the risk management implications of this replacement is correct? (Practice Exam)

- A. Delta-normal VaR is more appropriate than historical simulation VaR for assets with non-linear payoffs.
- B. Changing the look-back period and weighting scheme from three years, equally weighted, to four years, exponentially weighted, will underestimate the risk in the portfolio.
- C. The desk increased its exposure to model risk due to the potential for incorrect calibration and programming errors related to the new model.
- D. A 95% VaR model that generates no exceedances in four weeks is necessarily conservative.

Answer: C

Given the quick implementation of the new VaR model and the insufficient amount of testing

that was done, the desk has increased its exposure to model risk due to the increased potential for incorrect calibration and programming errors. This situation is similar to the JP Morgan London Whale case in 2012, where a new VaR model was very quickly introduced for its Synthetic Credit Portfolio response to increasing losses and multiple exceedances of the earlier VaR model limit in the portfolio.

4.2 Consider the following four statements about value at risk (VaR):

- I. If there were standardization of both the confidence interval and the time horizon, VaR estimates would be highly consistent across users.
- II. There is not much uniformity of practice as to confidence interval and time horizon; as a result, intuition on what constitutes a large or small VaR is underdeveloped.
- III. There are a number of computational and modeling decisions that can greatly influence VaR results, such as the length of time series used for historical simulation or to estimate moments; and the technique used for estimating moments.
- IV. There are a number of computational and modeling decisions that can greatly influence VaR results, such as mapping techniques and the choice of risk factors.

Which of the above statements is/are true?

- A. None are true.
- B. I and II are true.
- C. II, III, and IV are true.
- D. All are true.

Answer: C

Malz: "The risk manager has a great deal of discretion in actually computing a VaR. The VaR techniques we described in Chapter 3—modes of computation and the user-defined parameters—can be mixed and matched in different ways. Within each mode of computation, there are major variants, for example, the so-called "hybrid" approach of using historical simulation with exponentially weighted return observations. This freedom is a mixed blessing. On the one hand, the risk manager has the flexibility to adapt the way he is calculating VaR to the needs of the firm, its investors, or the nature of the portfolio.

On the other hand, it leads to two problems with the use of VaR in practice:

1. There is not much uniformity of practice as to confidence interval and time horizon; as a result, intuition on what constitutes a large or small VaR is underdeveloped.
2. Different ways of measuring VaR would lead to different results, even if there were standardization of confidence interval and time horizon. There are a number of computational and modeling decisions that can greatly influence VaR results, such as:
 - Length of time series used for historical simulation or to estimate moments
 - Technique for estimating moments

- Mapping techniques and the choice of risk factors, for example, maturity bucketing
- Decay factor if applying EWMA
- In Monte Carlo simulation, randomization technique and the number of simulations"

4.3 The risk management group estimates the 1-day 99% VaR on a long-only, large-cap equity portfolio using a variety of approaches. A daily risk report shows the following information:

1-day 99% VaR Estimates (by approach):

- Delta-Normal VaR: USD 441,940
- Monte Carlo Simulation VaR: USD 473,906
- Historical Simulation VaR: 495,584

Which of the following is the most likely explanation for the variation in VaR estimates? (Practice Exam)

- Data problems
- Differences in model assumptions
- Endogenous model risk
- Programming errors

Answer: B

Explanation: VaR measures will vary according to the approach (delta-normal, historical simulation, Monte Carlo simulation). The variation in these values does not suggest bigger problems with data or programming/implementation nor is there any reason to suspect endogenous model risk (e.g., traders gaming the system to lower risk values).

Section 3 Liquidity Risks

1 Definition of Liquidity Risk

Definition of Liquidity Risk ★★★ 概念对比

Transaction liquidity risk	<ul style="list-style-type: none"> Risk of moving the price of an asset adversely in the act of buying or selling it. <p>Transaction liquidity risk is low if assets can be liquidated or a position can be covered quickly, cheaply, and without moving the price too much.</p>
Balance Sheet Risk or Funding Liquidity Risk	<ul style="list-style-type: none"> Risk that creditors either withdraw credit or change the terms that the positions have to be unwound and/or are no longer profitable.
Systemic Risk: In situations of severe financial stress	

1.1 Which of the following statements regarding liquidity risk is correct?

- Asset liquidity risk arises when a financial institution cannot meet payment obligations.
- Flight to quality is usually reflected in a decrease in the yield spread between corporate and government issues.
- Yield spread between on-the-run and off-the-run securities mainly captures the liquidity premium, and not the market and credit risk premium.