

## 1. Question

Consider an exposure with a value of \$30.0 million. In L(+)/P(-) format, its expected loss is 4.0% with volatility of 15.0%; i.e.,  $\mu(L/P) = +4.0\%$ ,  $\sigma = 15.0\%$ . Conveniently, the exposure happens to have a normal distribution. Which is **nearest** to the single-period 97.5% expected shortfall (ES)?

a) 6.60 million

b) 9.38 million

c) 11.72 million

d) 14.50 million

Correct

C. True: 11.72 million

If the distribution is normal, the 97.5% ES is approximated by the 99.0% VaR.

In this case, we can use  $\$30.0 * (4.0\% + 15\% * 2.33) = \$30.0 * 38.950\% = \$11.69$ .

The exact 97.5% ES is given by \$11.7210, so that is given as the correct choice.

## 2. Question

Among its financial positions, Zapex Financial Corporation has written a call, entered into an interest rate swap, and written a credit default swap. Among these (the following) four positions, which is the **BEST** example of wrong-way risk?

- a) Zapex has written (aka, sold) a call option to a counterparty in the same industry
- b) Zapex is the fixed-rate payer in an interest rate swap during an economic recovery
- c) Zapex has written (aka, sold) a credit default swap (CDS) to counterparty whose credit quality is positively correlated with the reference entity
- d) Zapex has a position in a forward currency contract where its mark-to-market gain is positively correlated with the counterparty's default probability

Correct

**D. TRUE. Zapex has a position in a forward currency contract where its mark-to-market gain is positively correlated with the counterparty's default probability**

Wrong-way (credit) risk is adverse correlation between the exposure and the credit quality, so wrong-way risk is a positive (negative) correlation between exposure and default probability (credit quality). This is wrong-way risk because greater exposure is associated with a lower likelihood of payment. Algebraically, wrong-way (or right-way) risk is some dependence between exposure/EAD and PD. We normally write  $EL\% = PD * EAD$  but that assumes independence between PD and EAD, so a way to think about WWR is simply when  $EL > PD * EAD$ , because  $EL <> PD * EAD$  is also a condition for non-independence.

In regard to (A), (B) and (C), each is an example of RIGHT-WAY risk.

### 3. Question

In December 2017, the Basel Committee (BCBS) made several revisions to the Basel III framework. This included revisions to both the standardized approach to credit risk (“Credit risk accounts for the bulk of most banks’ risk-taking activities and hence their regulatory capital requirements. The standardized approach is used by the majority of banks around the world, including in non-Basel Committee jurisdictions,” wrote the Committee) and the internal ratings-based (IRB) approaches to credit risk (“The financial crisis highlighted a number of shortcomings related to the use of internally modeled approaches for regulatory capital, including the IRB approaches to credit risk. These shortcomings include the excessive complexity of the IRB approaches, the lack of comparability in banks’ internally modeled IRB capital requirements and the lack of robustness in modelling certain asset classes,” wrote the Committee).<sup>1</sup>

In regard to these December 2017 revisions to credit risk approaches in Basel III, which of the following statements is **TRUE**?

<sup>1</sup> “High-level summary of Basel III reforms,” (Basel Committee on Banking Supervision Publication, December 2017)

- a) In the standardized approach (SA) for residential real estate exposures, the risk weights are lower if the loan-to-value (LTV) falls into a lower band
- b) The standardized approach (SA) eliminated the treatment of unrated exposures because all exposures are required to have an external credit rating
- c) The internal ratings-based (IRB) approach removed the option to use the foundation IRB (F-IRB) because the advanced IRB (A-IRB) must be used for all asset classes
- d) The internal ratings-based (IRB) approach removed the parameter input floors (in the case of PD, LGD, and EAD) to increase RWA variability across different banks

Correct

A. True: In the standardized approach (SA) for residential real estate exposures, the risk weights is lower if the loan-to-value (LTV) falls into a lower band.

See below. Writes BCBS (High-level summary of Basel III reforms, December 2017): “For residential real estate exposures, more risk-sensitive approaches have been developed, whereby risk weights vary based on the LTV ratio of the mortgage (instead of the existing single risk weight) and in ways that better reflect differences in market structures.”

Residential real estate exposures								
LTV bands	Below 50%	50% to 60%	60% to 70%	70% to 80%	80% to 90%	90% to 100%	above 100%	Criteria not met
<i>General RRE</i>								
Whole loan approach RW	20%	25%	30%	40%	50%	70%		RW of counterparty
Loan-splitting approach <sup>2</sup> RW	20%		RW of counterparty					RW of counterparty
<i>Income-producing residential real estate (IPRRE)</i>								
Whole loan approach RW	30%	35%	45%	60%	75%	105%		150%

In regard to (B), (C) and (D), each is FALSE. Instead, the following are true:

- The Basel III reforms included a more granular approach to unrated exposures and reduced the “mechanistic reliance on credit ratings”
- In regard to the internal ratings-based approaches, GARP writes, “the financial crisis highlighted a number of shortcomings related to the use of internally modelled approaches for regulatory capital, including the IRB approaches to credit risk. These shortcomings include the excessive complexity of the IRB approaches, the lack of comparability in banks’ internally modelled IRB capital requirements and the lack of robustness in modelling certain asset classes. To address these shortcomings, the Committee has made the following revisions to the IRB approaches: (i) removed the option to use the advanced IRB (A-IRB) approach for certain asset classes; (ii) adopted “input” floors (for metrics such as probabilities of default (PD) and loss-given-default (LGD)) to ensure a minimum level of conservatism in model parameters for asset classes where the IRB approaches remain available; and (iii) provided greater specification of parameter estimation practices to reduce RWA variability.” — Source: 2020 FRM Part II: Operational Risk and Resiliency, 10th Edition.
- In regard to the Specification of Input Floors: “The revised IRB framework also introduces minimum floor values for bank-estimated IRB parameters that are used as inputs to the calculation of RWA. These include PD floors for both the F-IRB and A-IRB approaches, and LGD and EAD floors for the A-IRB approach. In some cases, these floors consist of

recalibrated values of the existing Basel II floors. In other cases, the floors represent new constraints for banks' IRB models." — Source: 2020 FRM Part II: Operational Risk and Resiliency, 10th Edition.

#### 4. Question

An asset that is not very liquid is quoted bid \$89.00, offer \$96.00. Which is **nearest** to the proportional bid-offer spread?

a) 0.0378

b) 0.0757

c) 0.1538

d) 7.000

**Correct**

**B. True: 0.0757.** Because  $(96.00 - 89.00)/92.50 = 0.075676$

According to Hull (24.1.2. Measuring Market Liquidity), the two measures of bid-offer spread are:

- Dollar bid-offer spread =  $p = \text{Offer price} - \text{Bid price}$
- Proportional bid-offer spread =  $s = (\text{Offer price} - \text{Bid price}) / \text{Mid-market price}$

*(Source: John C. Hull, Risk Management and Financial Institutions, 5th Edition (Hoboken, NJ: John Wiley & Sons, 2018))*

## 5. Question

Richard conducted a factor regression for his firm's Flagship Portfolio. He used the three-factor Fama-French specification where the factors are MKT (the market), SMB (small stocks minus big stocks), and HML (value stocks minus growth stocks). His factor regression results are displayed below.

<i>Flagship excess returns, <math>R(p) - R_f</math>, Fama-French benchmark (monthly)</i>		
	<b>Coeffi- cient</b>	<b>Standard Error (SE)</b>
<b>Alpha, <math>\alpha</math></b>	<b>0.300%</b>	<b>0.033%</b>
<b>MKT Loading</b>	<b>1.250</b>	<b>0.096</b>
<b>SMB Loading</b>	<b>0.640</b>	<b>0.043</b>
<b>HML Loading</b>	<b>-0.920</b>	<b>0.066</b>
<b>Adjusted <math>R^2</math></b>	<b>0.290</b>	

Please note the regression is based on monthly returns. Each of the following statements is **TRUE** about these factor regression results EXCEPT which is false?

- a) The portfolio's style appears to growth-oriented, small-cap
- b) This portfolio manager(s) appear to be skillful; that is, the alpha is significant
- c) The low adjusted  $R^2$  and low standard errors imply these factors are not appropriate to this portfolio
- d) The implied CAPM benchmark is leveraged as it borrows cash (i.e., T-bills) to invest

more than 100% (i.e., > \$1.0) in the market portfolio

Correct

C. FALSE: The factors are each significant and the adjusted  $R^2$  is relatively high for empirical finance  
In regard to (A), (B) and (D), each is true.

## 6. Question

The riskfree rate is 5.0% while the current stock price is \$80.00. Two most liquid options both have a strike price of \$70.00 such that the ratio  $K/S(0) = 0.90$ . In addition to the same strike price, both options have the same maturity of three months,  $T = 0.25$  years. The implied volatility of the call is 30.0%, and the implied volatility of the put is 38.0%. What is the trade that exploits this scenario, if any?

- a) Buy call, sell put, and short the stock
- b) Buy put, sell call, and buy the stock
- c) Buy the call, buy the put, and short a straddle
- d) Sell the call, sell the put, and buy a straddle

Correct

A. True: Buy call, sell put, and short the stock

## 7. Question

Consider a netting set with two derivative positions: an interest rate swap (IRS) with a marginal CVA of -1.450 and a cross-currency swap (CCS) with a marginal CVA of -1.550. If the first transaction is the cross-currency swap (CCS) and its incremental CVA is -2.100, then what is the incremental CVA of the IRS?

a) -0.900

b) -1.100

c) -1.550

d) -2.220

Correct

A. True: -0.900

The total CVA is the sum of marginal CVAs and therefore must be  $-1.450 + (-1.550) = -3.000$ . The incremental CVAs must sum to the total (netted) CVA such that, if the CCS is second in sequence, its incremental CVA is equal to  $-3.000 - (-2.100) = -0.900$ .

## 8. Question

The central feature of Basel III's first pillar is the regulatory capital (i.e., CET1, Tier 1, and total capital) requirements which require minimum fractions of risk-weighted assets (RWA). In addition to these minimums, as of early 2019 (when the buffers were fully phased in), Basel specifies three buffers: the capital conservation buffer (CCB), the G-SIB buffer, and the countercyclical buffer (CCyB). This is all very confusing, so you ask your colleague Mary to summarize these additional buffers and their motivations. She makes the following five points:

- I. For all three, the additional buffer must be CET1
- II. For all three, breach of the buffer requirements implies the bank's ability to pay dividends will be restricted
- III. The CCB requires an additional 2.5% of CET1 capital and is meant to ensure that banks have an additional layer of usable capital that can be drawn down when losses are incurred.
- IV. The additional G-SIB requirement includes five buckets {1.0%, 1.5%, 2.0%, 2.5%, or 3.5%} [https://www.bis.org/fsi/fsisummaries/g-sib\\_framework.htm](https://www.bis.org/fsi/fsisummaries/g-sib_framework.htm) and is meant to reduce the likelihood and severity of the failure of a global systemically important financial institution
- V. The CCyB requirement varies between zero and 2.5% and is meant to protect the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risks

Is Mary correct in her summary?

- a) No, unfortunately, none of her statements is correct
- b) I. and II. are correct, but the others (III., IV., and V.) are wrong
- c) III., IV., and V. are correct, but the others (I. and II.) are wrong
- d) Yes, all five statements are correct

## Correct

### D. True: Yes, all five statements are correct

- In regard to true statements (I.) and (II.), the capital conservation buffer (CCB), the G-SIB buffer, and the countercyclical buffer (CCyB) each require common equity Tier 1 (CET1) which is a buffer of the highest quality. Further, breach of any of them implies restrictions on dividend payments (in addition to other supervisor tools such as restriction on executive bonuses)
- In regard to true statement (III.), the BCBS says that “the capital conservation buffer [CCB] was introduced to ensure that banks have an additional layer of usable capital that can be drawn down when losses are incurred” (see [https://www.bis.org/fsi/fsisummaries/b3\\_capital.htm](https://www.bis.org/fsi/fsisummaries/b3_capital.htm)) and GARP says “In the case of the CCB, the rationale roughly follows that for the Prompt Corrective Action (PCA) system built into U.S. capital regulation beginning in 199; i.e., a bank with ratios that begin to approach the minimums should be subject to increasingly stringent supervisory intervention in order to induce a return to well-capitalized status.”– 2020 FRM Part II: Operational Risk and Resiliency, 10th Edition.
- In regard to true statement (IV.), the G-SIB requirement includes five buckets {1.0%, 1.5%, 2.0%, 2.5%, or 3.5%} and, explains GARP, “In the case of the G-SIB buffer, the rationale is similar to that for the CCB but also recognizes the very large costs to society of distress at G-SIBs (and the higher volatility of losses at some of them). Thus, larger buffers are specified to further reduce the chance of failure.”
- In regard to true statement (V.), “The CCyB [countercyclical capital buffer] has two rationales. One is to provide an instrument for macroprudential restraint of overheating; the other is attentive to the cost of capital,” says GARP. Further, explains BCBS, “The countercyclical capital buffer [CCyB] aims to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate. Its primary objective is to use a buffer of capital to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk. Due to its countercyclical nature, the countercyclical capital buffer regime may also help to lean against the build-up phase of the credit cycle in the first place. In downturns, the regime should help to reduce the risk that the supply of credit will be constrained by regulatory capital requirements that could undermine the performance of the real economy and result in additional credit losses in the banking system.” See <https://www.bis.org/bcbs/ccyb/>

Keep in mind the basic requirements of these three additional buffers: the CCB requires +2.5% CET1; the G-SIB requires either {+1.0%, +1.5%, +2.0%, +2.5%, or +3.5%} depending on the bank’s score (see <https://trtl.bz/fsb-g-sibs>); and the CCyB requires between zero and 2.5%.

## 9. Question

A portfolio holds 100,000 shares of a stock and this single position has a value of \$3.0 million. The stock is quoted bid \$29.00, offer \$31.00. The stock's daily volatility is 1.43% or 143 basis points. For purposes of value at risk (VaR), we will assume the stock's arithmetic returns are normally distributed (aka, normal VaR) and the expected daily return rounds to zero (under these assumptions absolute VaR is identical to relative VaR). Which is **NEAREST** to the position's one-day 99.0% confident liquidity-adjusted value at risk (LVaR)?

a) \$15,000

b) \$80,000

c) \$200,000

d) \$1.0 million

Correct

C. True: \$200,000

The one-day 99.0% VaR is given by  $-0 + 1.43\% * 2.326 * \$3.0 \text{ million} = \$99,800$ .

The liquidity cost (LC) is given by  $(31.00 - 29.00)/30.00 * 0.5 * \$3.0 \text{ million} = \$100,000$ .

The one-day 99.0% VaR is therefore  $99,800 + 100,000 = 199,800$

## 10. Question

According to Grinold, typical or illustrative information ratios (IR) include: 0.500 is good, 0.750 is very good and 1.00 is exceptional. In regard to risk aversion,  $\lambda$ , 0.150 is restrained, 0.100 is moderate, and 0.050 is aggressive. Patricia is a manager with a “very good” information ratio of 0.750 and a “moderate” risk aversion of 0.10. If she shifts from this moderate risk aversion to an aggressive risk aversion of 0.050, what is the impact on the optimal level of active risk?

- a) No effect
- b) Optimal active risk reduces by one-half
- c) Optimal active risk Increases by about +41%
- d) Optimal active risk doubles

Correct

D. True: Optimal active risk doubles

As the optimal level of active risk is given by  $IR/(2*\lambda)$ , Patricia doubles her optimal level when she goes from  $0.750/(2*0.10) = 3.750$  to  $0.750/(2*0.050) = 7.500$

## 11. Question

For his term structure model, Peter considered the Vasicek model, but on reflection, he prefers the Cox-Ingersoll-Ross (CIR). In regard to the CIR, which of the following statements is **TRUE**?

- a) A drawback of the CIR is that it does not mean revert to a long-term rate
- b) In the CIR, the drift is time-dependent such that CIR is a no-arbitrage model
- c) An advantage of the CIR is that the terminal distribution of the short rate is eventually (e.g., >10 years) normally distributed
- d) Unlike the Vasicek model's constant volatility, the CIR's basis point volatility is not constant, and this ensures the short rate cannot become negative

Correct

D. True: Unlike the Vasicek model's constant volatility, the CIR's basis point volatility is not constant, and this ensures the short rate cannot become negative.

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

## 12. Question

Jason is a small business owner specializing in the wholesale of steel. Jason worked hard on his business, so he purchased insurance to help safeguard his company on January 4th, 2023. Later that month, on January 31st, he made a significant payment to secure a shipment of steel that will arrive on February 2nd, 2023. Jason delivered the steel to two clients on February 8th and 9th; however, he did not receive payment from the clients until February 13th. After receiving the proceeds Jason deposited the money at ABC bank.

Among these transaction dates, on which did Jason increase his credit risk?

- a) None of the transactions increase his credit risk
- b) His credit risk increased on the Jan dates (Jan 4th and 31st) but was unchanged on Feb dates (Feb 8th, 9th and 13th)
- c) His credit risk increased on the Feb dates (Feb 8th, 9th, and 13th) but was unchanged on Jan dates (Jan 4th and 31st)
- d) His credit risk increased on all of the cited transaction dates; i.e., both Jan dates (4th and 31st) and all Feb dates (8th, 9th, and 13th)

Correct

D. True: His credit risk increased on all of the cited transaction dates; i.e., both Jan dates (4th and 31st) and all Feb dates (8th, 9th, and 13th)

- Jan 4th: Purchasing insurance increases credit risk because Jason is buying a policy that will not be delivered if ever once an event occurs. *Contingent claims* are a type of credit risk. According to the text, "A sixth type of transaction is a special case of a claim on an asset—a contingent claim. The claim is contingent on certain events occurring, such as a

loss covered by an insurance policy. At policy inception, the policyholder has no claim on the insurer. However, once the insured suffers a covered loss, the insured has a claim. If the insurer fails to pay the claim, this would constitute a credit loss.” (†)

- Jan 31st: He prepays for an order and thus has the possibility of his counterpart not delivering on their obligation. According to the text, “*Prepayment of goods and services* is a fourth type of transaction that involves credit risk. Delivery is expected at a certain time and of a certain quality and/or performance, and the failure of the counterparty may lead to the loss of the advanced payments and also generates business interruption costs.” (†)
- February 8th and 9th: Jason delivered an order of steel to his clients. Either of his clients could have not delivered on their obligation to pay him, and thus, Jason increased his credit risk. According to the text, “The third type is the sale of a product or a service without immediate cash payment. The seller sends an invoice to the buyer after the product has been shipped or the service performed, and the buyer has a few weeks to pay. This is known as an *account receivable*.” (†)
- February 13th: He deposited the proceeds of his sale and his earnings from last quarter at ABC Bank. Jason granted a third-party custody over his assets, and thus, he has the risk of the bank not being able to repay his assets. Per the text, “A fifth type of transaction that creates credit risk involves a party’s claim on an asset in the custody of or under the management of another party, such as a bank deposit.” (†)  
Credit risk can be generated in myriad ways. The text (†) lists seven:
  1. Lending: Risk of non-repayment from the borrower to the lender.
  2. Leases: Risk that the lessee will fail to make future payments for the use of an asset.
  3. Accounts Receivable (Sale of Product/Service without Immediate Payment): Risk that the buyer will not pay after receiving the product or service.
  4. Prepayment of Goods and Services: Risk that the counterparty will not deliver or meet the quality/performance after receiving payment.
  5. Deposits and Bank Balances: Risk that the financial institution holding deposits or managing assets will default.
  6. Contingent Claims (e.g., Insurance, Pension Fund Claims): Risk that the insurer or sponsor will not be able to pay out the claim or pension liabilities.
  7. Derivative Exposures: Risk from future payment obligations in derivative transactions like swaps or futures, which are dependent on the underlying asset’s market value.

(†) Sylvain Bouteille and Diane Coogan-Pushner, **The Handbook of Credit Risk Management: Originating, Assessing, and Managing Credit Exposures (2nd Edition, Hoboken, NJ: John Wiley & Sons, 2022).**

### 13. Question

Peter is studying for the Financial Risk Manager (FRM) exam, and he thinks the historical evolution of the Basel regulations is confusing. In particular, he wants to better understand the difference between the original Basel I accord (aka, the 1988 Basel Accord that was implemented by 1992) and Basel II, which was finally published over ten years later in 2004. His colleague Mary explains that, in comparison to the original accord, Basel II contained four significant innovations. Specifically, in comparison to the original Basel I accord (which do include the 1995/1996 Amendments) that came before, Mary says that significant innovations in Basel II included the following:

- I. In addition to credit risk and market risk, Basel II required capital for operational risk
- II. Basel II eliminated risk weights and risk-weighted assets (RWA) and replaced them with direct calculation of risk charges
- III. Basel II contained specific requirements for supervision related to capital and risk management (Pillar 2) and required public disclosures (Pillar 3)
- IV. To fine-tune the accord's design, Basel II made repeated use of Quantitative Impact Studies (QIS) to which banks contributed data (i.e., feedback) that was analyzed by supervisors

Is Mary correct?

- a) Yes, all four statements are correct
- b) I. and II. are correct but III and IV are inaccurate
- c) Only II. is inaccurate but I, III, and IV are correct
- d) Unfortunately, none of her statements are correct

Correct

C. True: Only II. is inaccurate but I, III and IV are correct

Basel II did NOT eliminate risk-weighted assets (or risk weights); risk-weighted assets (RWA) do continue in Basel III/IV. According to GARP's Mark Carey, the four significant innovations of Basel II (as an improvement over the original Basel I accord) were: more sophisticated risk weight formulas; the addition of an operational risk capital charge; Pillars 2 and 4; and the repeated use of the Quantitative Impact Studies (QIS). Many experts consider the additional Pillars to be a highly significant development. As Carey explains, "The three pillars represented a push toward convergence of national practices [especially in the context of the "rules versus principles" disparity]. Specifically, Pillar 2 mandated that supervisors require banks to have more than the minimum amount of capital as well as internal capital adequacy and assessment processes (ICAAP) that take their risk profile into account ... National discretion regarding enforcement of the accord's provisions was reduced, and national regulators were to be transparent about their implementation efforts, including those concerning the requirements in excess of the minimums. Pillar 3 required more qualitative and quantitative disclosures, in the hope that pressure from market participants would help improve banks' practices [aka, market discipline]." *(Source: 2020 FRM Part II: Operational Risk and Resiliency, 10th Edition. Pearson Learning Solutions)*

## 14. Question

Assume the spot foreign exchange (FX) rate between the US dollar and the Japanese Yen is 110.00 which can be represented as USDJPY 110.00 or JPY 110.00 where USD is the base currency and JPY is the quote currency; aka, quote 110.00 yen per one dollar of the base or “per unit” currency. The USD interest rate is 2.50% and the JPY interest rate is 0.450%. The period is one year, and the compound frequency is annual. If the covered interest rate (CIP) arbitrage framework enforces a perfectly accurate one-year forward exchange rate, then what is the implied one-year “swap rate” which is here simply defined as the difference between the forward FX rate and the spot FX rate; put simply, what is the difference,  $F(\text{USDJYP}) - S(\text{USDJPY})$ , or  $F(\text{USDJPY}) - 110.00$ ?

a) -2.20 JPY (or -2.20 USDJPY)

b) Zero

c) + 5.80 JPY

d) + 13.70 JPY

Correct

A. True:  $F - S = -2.20$  USDJPY

If CIP is enforced, then  $F - S = S * [(1 + R_{f\_JPY}) / (1 + R_{f\_USD}) - 1] = 110.00 * [(1 + 0.45\%) / (1 + 2.50\%) - 1] = -2.20$ .