CHARTA LEARNING · LESSON NOTES

Counterparty Risk and Beyond

FRM Part II

1 A story: Harbourline Bank and Meridian Power

- Loan: Harbourline lends $20m; only the lender can lose
- Swap: its value moves up and down with markets
- When the swap is negative, Harbourline owes Meridian
- Counterparty risk: the other side defaults first

IN THE LESSON

- Meet Harbourline Bank, our running example.
- Harbourline lends twenty million dollars to Meridian Power, a utility.
- The risk is easy to see.
- If Meridian fails, Harbourline loses part of the twenty million, and only Harbourline can lose.
- Now suppose instead that they sign a long-dated interest rate swap.
- A swap is a contract to exchange payments, and its value rises and falls as markets move.
- Some years it favours Harbourline, other years it favours Meridian.
- If Meridian fails when the swap favours Harbourline, Harbourline loses.
- If it fails when the swap favours Meridian, Harbourline still owes.
- That shifting, two-sided problem is counterparty risk.

2 Lending versus a derivative

Same borrower, two very different risks

	Loan	Derivative
Exposure	Known	Uncertain
Sign	Always owed	Plus or minus
Who is exposed	Lender only	Either side
Loss on default	Amount × LGD	max(V, 0) × LGD
Nature	Credit	Market and credit

IN THE LESSON

- Counterparty risk is the risk that the other side defaults before the final cash flows are settled, so that you lose value you were still owed.
- Compare it with lending, which is the simple case.
- On a loan the exposure is the known amount advanced, and the loss is that amount times the loss given default.
- A derivative differs in three ways.
- First, the exposure is uncertain, because the contract value moves with market prices.
- Second, it can be positive or negative, so either party may turn out to be the creditor, and the risk is two sided.
- Third, only a positive value is at risk.
- Because the exposure comes from markets and the default from credit quality, counterparty risk blends market risk and credit risk.

3 Exposure at default

Exposure at default = max(V , 0)

V, value at default	Contract value on the default date
Exposure	What is truly at risk
Notional	Never the exposure

IN THE LESSON

- Now the formal idea.
- Let V be the value of the contract on the default date.
- If V is positive, the defaulter owes you that amount, and you will queue with other creditors to recover part of it.
- If V is negative, you owe the defaulter.
- You are not excused.
- The negative value is still owed in full to the defaulted estate, the pool of assets the liquidators manage for creditors.
- So you cannot offset a loss against it by pretending it is not there.
- The exposure at default is therefore the larger of V and zero.
- One more point.
- The notional, the face amount on which payments are calculated, is never the exposure.
- It only scales the payments.

4 Example 1: the swap and the default date

Swap notional $200m. Meridian defaults on a day when V is +6m, then −4m. LGD 60%

Notional	never the exposure	**$200m**
V = +6m: exposure	max(6, 0)	**$6m**
V = −4m: exposure	max(−4, 0)	**$0**
Loss when V = +6m	6m × 60%	**$3.6m**
V = −4m: still owed	to the estate	**$4m**

Compare a $20m loan: 20m × 60% = $12m loss

IN THE LESSON

- Harbourline and Meridian have a swap with a notional of two hundred million dollars.
- Suppose Meridian defaults on a day when the swap is worth plus six million dollars to Harbourline.
- The exposure is the larger of six and zero, so six million.
- If Harbourline expects to lose sixty per cent of that, the loss is three point six million.
- Now suppose Meridian defaults on a day when the swap is worth minus four million.
- The exposure is the larger of minus four and zero, which is zero.
- Harbourline loses nothing on the swap, but it must still pay four million to the estate.
- Compare the loan, where the loss would be twelve million.
- The trap is quoting the notional.
- It is two hundred million, and it is irrelevant here.

5 Which transactions bear counterparty risk

Counterparty risk wherever future cash flows are owed

Transaction	Where the exposure arises
OTC derivatives	Positive mark-to-market
Repo, reverse repo	Collateral short of the cash
Securities lending	Securities exceed collateral
Settlement	Pay your leg first
Cleared contracts	Exposure moves to the CCP

IN THE LESSON

- Counterparty risk arises wherever a deal leaves one party owing the other something that depends on future events.
- Here are the main cases.
- In over the counter derivatives, called O T C derivatives, it is the positive mark to market of the contract.
- For example, a fixed rate payer holds a claim after rates rise.
- In repos, reverse repos and securities lending, the exposure is the gap between the collateral and what was lent.
- In settlement, the risk is paying away your leg before the other party delivers theirs.
- And in exchange traded and cleared contracts, the exposure moves to a central counterparty, a single hub that stands in the middle of the trades.
- In each case, ask which side is in the money.

6 Example 2: repo and securities lending

Cash lent $50m against bonds worth $50m. Securities lent $50m, collateral $52m

Cash lender, bonds at 46m	50m − 46m	**$4m**
Cash lender, bonds at 54m	max(50 − 54, 0)	**$0**
Sec. lender, securities 57m	57m − 52m collateral	**$5m**
Sec. lender, securities 47m	max(47 − 52, 0)	**$0**

IN THE LESSON

- Let's see who is exposed.
- Harbourline lends fifty million dollars of cash and holds bonds worth fifty million as collateral.
- This is a reverse repo.
- If the bonds fall to forty six million, a borrower default leaves Harbourline holding bonds worth less than the cash, so its exposure is four million.
- If the bonds rise to fifty four million, the exposure is zero, because the collateral covers the cash.
- Now Harbourline lends securities worth fifty million and holds fifty two million of collateral.
- If the securities rise to fifty seven million, the exposure is five million.
- If they fall to forty seven million, it is zero.
- The cash lender is hurt when collateral falls.
- The securities lender is hurt when what it lent rises.

7 Example 3: settlement risk

Harbourline sells $30m against another currency, with no payment-versus-payment

Harbourline pays its leg	sent in the morning	**$30m**
Other bank fails	its leg never arrives	**no receipt**
Loss with no PvP	up to the full principal	**$30m**
Loss with PvP	both legs or neither	**$0**

IN THE LESSON

- The third source is settlement.
- Suppose Harbourline agrees to sell thirty million dollars against an equal value of another currency.
- The payments leave on different systems at different times.
- Harbourline sends its thirty million in the morning, and then the other bank fails before sending its leg.
- Harbourline has paid and received nothing, so the loss is up to the whole principal, thirty million, not just a gain or loss from price moves.
- The cure is payment versus payment, where both legs are exchanged together or neither is.
- With that arrangement the exposure is zero.
- The exam point for this whole outcome is to always locate the party whose position is in the money, because only that party is exposed.

8 Who carries substantial counterparty risk

Where the risk sits and why

Institution	Position
Dealer banks	Huge books, hedge each other
Monoline insurers	Sold protection, no collateral
Insurers, hedge funds	Collateral calls in stress
Sovereigns, corporates	Often post no collateral
Central counterparty	Concentrates risk

IN THE LESSON

- Counterparty risk concentrates in institutions that sit on many derivative trades or sell credit protection.
- Dealer banks face it on a huge scale, and they hedge with each other.
- Monoline insurers sold large amounts of credit protection on structured credit without posting collateral, relying on a high rating.
- Insurers and hedge funds can face collateral calls when markets move or ratings fall.
- Sovereigns, supranationals and many corporates often do not post collateral, which leaves dealers with uncollateralised exposure.
- A central counterparty concentrates risk and relies on margin, a default fund and its own capital.
- The exam point is that the biggest concerns are one sided collateral, wrong way risk and concentration, not mere trading volume.

9 Example 4: protection from a monoline

Protection on $100m of structured credit, uncollateralised. Recovery 25%

Value in calm times	max(2, 0)	**$2m**
Value in the crisis	max(35, 0)	**$35m**
Collateral held	none posted	**$0**
Loss if the monoline fails	35m × (1 − 25%)	**$26.25m**

Wrong-way risk: exposure is highest as default nears

IN THE LESSON

- Here is wrong way risk, using Harbourline.
- It buys protection on one hundred million dollars of structured credit from a monoline insurer that posts no collateral.
- In calm times the protection is worth only two million dollars to Harbourline.
- Then the structured credit starts to suffer losses, and the protection becomes worth thirty five million.
- This is exactly when the monoline is under strain, because it sold the same kind of protection to many others.
- Suppose it fails and pays only twenty five per cent of the claim.
- The loss given default is seventy five per cent, so Harbourline loses about twenty six point two five million.
- The claim grows as the seller weakens, and with no collateral there is nothing to cushion it.

10 The vocabulary of counterparty risk

- Mark-to-market: current fair value of a contract
- Replacement cost: price of an identical contract today
- Credit exposure: max(MtM, 0), for each netting set
- Credit migration: a change in credit quality, no default
- Recovery: amount received; recovery rate = share of claim

IN THE LESSON

- Now the vocabulary, one term at a time.
- Mark to market is the current fair value of a contract.
- Replacement cost is what it would cost to replace the contract with an identical one at today's market.
- This matters only if the value is positive to you.
- Credit exposure is therefore the larger of the mark to market value and zero, taken for each netting set, which is a group of trades that can be netted against one another.
- Negative values are not at risk.
- Credit migration is a change in a counterparty's credit quality, such as a downgrade, without default.
- Recovery is what is actually received after default, and the recovery rate is that amount as a fraction of the claim.

11 Expected loss from counterparty risk

EL = Exposure × PD × LGD
LGD = 1 − recovery rate

Exposure	max(MtM, 0) for the netting set
Default probability	Chance of default in the horizon
Loss given default	Share of the claim lost
Recovery rate	Share of the claim recovered

IN THE LESSON

- Two more terms complete the set.
- Default probability, written P D, is the chance of default over a horizon.
- Loss given default, written L G D, is the share of the claim that is lost.
- Because recovery and loss are two sides of one coin, loss given default equals one minus the recovery rate.
- Expected loss combines the three ingredients.
- It is the exposure, times the default probability, times the loss given default.
- Notice that the exposure carries the floor at zero that we met earlier.
- The exam point has two parts.
- L G D and the recovery rate are complements, so they add to one, and exposure is floored at zero.

12 Example 5: expected loss on a netting set

Trades +10m, −4m and +1m in one netting set. PD 1.5%, recovery 35%

Net mark-to-market	10 − 4 + 1	**$7m**
Credit exposure	max(7, 0)	**$7m**
Loss given default	1 − 35%	**65%**
Expected loss	7m × 1.5% × 65%	**$68,250**
Wrong: recovery as LGD	7m × 1.5% × 35%	**$36,750**

IN THE LESSON

- Harbourline has three trades with Meridian under one netting agreement, worth plus ten, minus four and plus one million dollars.
- Together they make a net mark to market of seven million.
- Seven is positive, so the credit exposure is seven million.
- If it had been negative, the exposure would have been zero.
- Suppose Meridian's one year default probability is one point five per cent and the recovery rate is thirty five per cent.
- Loss given default is sixty five per cent.
- Expected loss is seven million, times point zero one five, times point six five, which is sixty eight thousand two hundred and fifty dollars.
- The common mistake is to use the recovery rate in place of loss given default.
- That would give thirty six thousand seven hundred and fifty, far too low.

13 Credit value adjustment: the price of the risk

- CVA = risk-free value − value allowing for default
- It is the market price of counterparty risk
- Probabilities are risk-neutral, implied by credit spreads
- It enters deal pricing and the accounts
- It can be hedged with credit default swaps (CDS)

IN THE LESSON

- Expected loss tells us the size of the risk.
- Credit value adjustment, called C V A, puts a price on it.
- It is the market price of counterparty risk, and it is the difference between the risk free value of a portfolio and its value allowing for the counterparty's possible default.
- Because it is a price, it enters the pricing of the deal and the accounts of the bank, and it can be hedged with credit default swaps, called C D S, contracts that pay out if a named borrower defaults.
- The default probabilities in C V A are market implied, also called risk neutral, and are taken from credit spreads, the extra yield investors demand for credit risk.
- They are not the historical default frequencies.

14 Calculating CVA

CVA ≈ LGD × Σ DF × EPE × PD

Loss given default	Share of the claim lost
Discount factor	Brings each date to today
Expected positive exposure	Average positive exposure
Marginal default probability	Default chance in that period

IN THE LESSON

- Here is the approximate formula.
- Split the life of the trade into periods.
- In each period, take the discount factor, which converts a future amount into today's money.
- Multiply by the expected positive exposure, called E P E, the average of the positive exposures at that date.
- Multiply by the marginal default probability, the probability today that the counterparty defaults during that period.
- Add these up over the periods, using the sigma sign, and multiply by the loss given default.
- Each term is an expected loss in that period, valued today.
- Only the positive exposure appears, because only a positive value is at risk, exactly as before.

15 Example 6: Harbourline's CVA on Meridian

Three years. LGD 60%. Risk-neutral PDs from Meridian's spread

Year 1	0.97 × 4m × 1.0%	**$38,800**
Year 2	0.94 × 6m × 1.2%	**$67,680**
Year 3	0.91 × 5m × 1.4%	**$63,700**
Sum, then × 60% LGD	170,180 × 60%	**$102,108**

IN THE LESSON

- Let's price Harbourline's exposure to Meridian over three years.
- In year one, the discount factor is point nine seven, the expected positive exposure is four million dollars, and the marginal default probability is one per cent.
- Multiply them to get thirty eight thousand eight hundred dollars.
- Year two is point nine four, times six million, times one point two per cent, which is sixty seven thousand six hundred and eighty.
- Year three is point nine one, times five million, times one point four per cent, which is sixty three thousand seven hundred.
- The sum is one hundred and seventy thousand one hundred and eighty.
- Multiply by a loss given default of sixty per cent, and C V A is one hundred and two thousand one hundred and eight dollars.

16 CVA versus credit limits

Two tools with two jobs

	CVA	Credit limit
What it is	A price	A cap on a quantity
Measures	Expected loss	Future exposure
Spreads widen	CVA rises	No response
Cost of the risk	Charged	Ignored
Main job	Pricing	Concentration

IN THE LESSON

- Credit limits are the older tool, and they work differently.
- A credit limit caps the potential future exposure, called P F E, a high percentile of the possible exposure, such as the ninety ninth.
- It sets a quantity rather than a price.
- It ignores the cost of the risk, and it does not respond to credit spreads.
- Limits control concentration, so that no single name can hurt the bank too much.
- C V A, by contrast, prices the expected loss.
- It rises when spreads widen and falls when they narrow, and it can be hedged.
- A bank needs both.
- A limit says how much risk to take with Meridian.
- C V A says what to charge for it.

17 Example 7: when Meridian's spread widens

Limit $15m on PFE; PFE is $12m. Meridian's default probabilities double

CVA before	from Example 6	**$102,108**
CVA after, PDs doubled	2 × 102,108	**$204,216**
PFE against limit	12m vs 15m	**inside**
Limit after the widening	still 12m vs 15m	**unchanged**

IN THE LESSON

- Now see the difference at work.
- Harbourline's limit on Meridian is fifteen million dollars of potential future exposure, and the current figure is twelve million.
- Suppose Meridian's spread widens so that its default probabilities double.
- The potential future exposure has not changed, so the limit still says twelve against fifteen, comfortably inside.
- A limit would not notice.
- But C V A doubles, from about one hundred and two thousand to about two hundred and four thousand dollars, because every probability in the sum has doubled.
- The price reacts.
- That is why the exam point matters.
- Use risk neutral probabilities for C V A that will be hedged, and historical ones for capital or reserves.

18 Measuring and managing the risk

- Measure: expected positive exposure, high-percentile PFE
- Close-out netting: one net amount replaces all trades
- Collateral: variation margin, threshold, minimum transfer
- Residual exposure remains over the margin period of risk
- Netting is legal, collateral operational; both need law

IN THE LESSON

- How do institutions measure and reduce counterparty risk?
- They measure it with exposure metrics, such as expected positive exposure and potential future exposure at a high percentile.
- They manage it with several tools.
- The first is close out netting.
- On default, all trades under one master agreement are terminated and replaced by a single net amount, so gains offset losses.
- The second is collateral.
- Counterparties transfer variation margin, often with a threshold below which nothing moves and a minimum transfer amount below which no call is made.
- That leaves some residual exposure over the margin period of risk, the days needed to close out and re-hedge after a default.
- Exam point: netting lowers exposure legally, collateral lowers it operationally.

19 The other tools

Five more ways to cut or move the risk

Tool	What it does
Central clearing	Exposure to a CCP; margin, fund
Credit limits	Cap exposure per name
Buying CDS protection	Transfers default risk
Break clauses, triggers	Early termination
Diversification	Spreads exposure across names

IN THE LESSON

- There are five more tools.
- Central clearing replaces bilateral exposures with exposure to a central counterparty, which collects margin and holds a default fund.
- Credit limits cap exposure to each name.
- Buying credit default swap protection transfers default risk to someone else, although it creates a new exposure to the seller.
- Break clauses and downgrade triggers allow early termination of a trade at an agreed date, or if a counterparty's rating falls, which stops the exposure from lasting for years.
- Diversification spreads the exposure across many names, so that one failure matters less.
- Notice the exam point once more.
- Netting and collateral both fail if the legal enforceability is doubtful, so legal opinions matter.

20 Example 8: netting and collateral at work

Trades +15m, −6m, +3m. Threshold $2m. Daily volatility $0.4m, ten-day MPOR

Net value	15 − 6 + 3; gross is 18m	**$12m**
Collateral held	12m − 2m threshold	**$10m**
Exposure today	12m − 10m	**$2m**
Move in 10 days, 99%	2.33 × 0.4m × √10	**$2.95m**
Exposure at the 99% level	2m + 2.95m	**$4.95m**

IN THE LESSON

- Harbourline now has three trades with Meridian worth plus fifteen, minus six and plus three million dollars.
- Counting only the positive trades gives eighteen million.
- With enforceable netting the net value is twelve million.
- The collateral agreement has a threshold of two million, so Meridian posts twelve minus two, which is ten million, and the exposure today is two million.
- But Meridian could default several days after the last call.
- If the margin period of risk is ten days, and the daily volatility of the net value is four hundred thousand dollars, a ninety nine per cent move is two point three three times four hundred thousand times the square root of ten, about two point nine five million.
- That is how much the net value could rise before new collateral arrives, so exposure at that level is two plus two point nine five, about four point nine five million.
- This simple model assumes no minimum transfer amount, zero drift and normal moves.

21 The costs inside an OTC derivative

A dealer prices five costs into one trade

Cost	What it covers
CVA	Loss if the client defaults
FVA	Funding for hedge collateral
KVA	Return on regulatory capital
MVA	Funding initial margin posted
Hedging, transaction	Ordinary dealing costs

IN THE LESSON

- An O T C derivative carries costs beyond its risk free value, and a dealer builds them into the price.
- The counterparty credit cost is C V A, the expected loss from the client's default.
- The funding cost, F V A, arises because an uncollateralised client trade is hedged with collateralised market trades that require cash to be posted.
- The capital cost, K V A, is the return required on regulatory capital held for the position over its life.
- The margin cost, M V A, is the cost of funding initial margin posted on margined or cleared trades.
- A price also reflects ordinary hedging and transaction costs.
- Each charge has its own driver, namely credit quality, funding rates, capital rules and margin requirements.

22 The price of an OTC derivative

Price = risk-free value + CVA + FVA + KVA + MVA
plus ordinary hedging and transaction costs

Risk-free value	Value with no frictions
CVA	Expected loss from default
FVA	Funding of hedge collateral
KVA	Return on required capital
MVA	Funding of initial margin

IN THE LESSON

- Putting it together, the dealer quotes a price equal to the risk free value plus the four charges.
- Risk free value is what the contract is worth with no default, funding, capital or margin effects.
- Then add C V A, F V A, K V A and M V A.
- Ordinary hedging and transaction costs sit on top as well.
- The crucial point is that each charge is estimated over the whole life of the trade.
- They are expected values over many years, not one year amounts, so a ten year trade carries ten years of capital cost, funding cost and expected credit loss.
- That is why long-dated, uncollateralised trades are the expensive ones.

23 Example 9: quoting Harbourline's price

Risk-free value $400,000. CVA from Example 6. FVA $55,000, KVA $70,000, MVA $18,000

Risk-free value	no frictions	**$400,000**
CVA	from Example 6	**$102,108**
FVA + KVA	55,000 + 70,000	**$125,000**
MVA	funding initial margin	**$18,000**
Price to quote	400,000 + 245,108 charges	**$645,108**

IN THE LESSON

- Harbourline wants to quote Meridian a price.
- Suppose the risk free value of the trade, what it would have to charge if there were no credit, funding, capital or margin costs, is four hundred thousand dollars.
- Take the C V A from Example six, one hundred and two thousand one hundred and eight dollars.
- Add a funding charge of fifty five thousand and a capital charge of seventy thousand, which together make one hundred and twenty five thousand.
- Add eighteen thousand for margin funding.
- The quoted price is four hundred thousand, plus one hundred and two thousand one hundred and eight, plus one hundred and twenty five thousand, plus eighteen thousand, which is six hundred and forty five thousand one hundred and eight dollars.
- Meridian is paying about two hundred and forty five thousand dollars for credit, funding, capital and margin.

24 xVA: the umbrella term

- CVA: cost of the counterparty's possible default
- DVA: benefit of the dealer's own possible default
- FVA: net of funding cost and funding benefit adjustments
- ColVA: collateral terms (eligible assets, interest)
- MVA funds initial margin; KVA is the cost of capital

IN THE LESSON

- X value adjustment, X V A, is the umbrella term for the adjustments that move a derivative's price away from its risk free value.
- Meet each piece.
- C V A is the cost of the counterparty's possible default.
- D V A, debit value adjustment, is the benefit from the dealer's own possible default, because it would not pay its liabilities in full.
- Bilateral C V A is C V A minus D V A.
- F V A is the cost or benefit of funding uncollateralised positions, split into a funding cost adjustment and a funding benefit adjustment, and the formula uses their net.
- Col V A, collateral value adjustment, arises from collateral terms such as eligible assets and the interest paid on collateral.
- M V A funds initial margin, and K V A is the cost of capital.

25 The dealer's value with every adjustment

Value = Risk-free − CVA + DVA − FVA − ColVA − MVA − KVA
Bilateral CVA = CVA − DVA

CVA	Counterparty's default cost
DVA	The dealer's own default benefit
FVA	Net funding cost
ColVA	Collateral terms
MVA and KVA	Margin funding and capital

IN THE LESSON

- Seen from the dealer, the portfolio is worth the risk free value, minus C V A, plus D V A, minus F V A, minus Col V A, minus M V A, minus K V A.
- Equivalently, subtract the bilateral C V A, which is C V A less D V A, and then subtract the others.
- Now look at the signs, because that is where marks are lost.
- D V A is the only item that adds value.
- All the others reduce it.
- This is the textbook additive convention.
- In practice, D V A and F V A overlap and are debated, and gains from D V A are excluded from regulatory capital, so treat this formula as the standard exam convention, not as a statement of accounting.

26 Example 10: the dealer's value after xVA

CVA 102,108; DVA 30,000; funding cost 80,000, benefit 25,000

Risk-free value	starting point	**$400,000**
Less bilateral CVA	102,108 − 30,000	**− $72,108**
Less net FVA	80,000 − 25,000	**− $55,000**
Less ColVA, MVA, KVA	8,000 + 18,000 + 70,000	**− $96,000**
Value to the dealer	400,000 − 223,108	**$176,892**

Risk-free 400,000; ColVA 8,000; MVA 18,000; KVA 70,000

IN THE LESSON

- Let us apply the signs.
- The risk free value is four hundred thousand dollars.
- The C V A is one hundred and two thousand one hundred and eight, and the D V A is thirty thousand, so the bilateral C V A is seventy two thousand one hundred and eight.
- The funding cost adjustment is eighty thousand and the funding benefit adjustment is twenty five thousand, so the net F V A is fifty five thousand.
- Col V A is eight thousand, M V A is eighteen thousand and K V A is seventy thousand, a total of ninety six thousand.
- The value is four hundred thousand, minus seventy two thousand one hundred and eight, minus fifty five thousand, minus ninety six thousand, which is one hundred and seventy six thousand eight hundred and ninety two dollars.

27 Mistakes to avoid with xVA

Check each one before answering

Check	Rule
DVA	Adds value; all others subtract
Bilateral CVA	CVA − DVA
FVA in the formula	Net of cost and benefit
MVA versus FVA	MVA funds initial margin
All the charges	Whole life, not one year

IN THE LESSON

- Here are the mistakes to avoid.
- Watch the signs first.
- D V A adds value and the rest subtract.
- Next, remember that bilateral C V A is C V A minus D V A, not the other way round.
- Use the net of funding cost and funding benefit adjustments in F V A, not just the cost.
- Do not confuse M V A with F V A.
- M V A funds initial margin, while F V A funds the cash for variation margin and uncollateralised hedges.
- And do not treat any of these as a one year charge.
- Every one is an expected value across the whole life of the trade.
- Last, remember that the grouping and names of these adjustments vary across texts, so read the definition given in the question.

28 Recap: the main ideas

- Exposure = max(V, 0), never the notional
- EL = Exposure × PD × LGD; LGD = 1 − recovery rate
- CVA = LGD × sum of DF × EPE × PD, risk-neutral PDs
- Limits cap a quantity; CVA is a hedgeable price
- Price adds CVA, FVA, KVA, MVA; DVA adds value in xVA

IN THE LESSON

- Let us pull it together.
- Counterparty risk is the chance the other side defaults while you are still owed value.
- On a derivative the exposure is uncertain, two sided, and equal to the larger of V and zero, never the notional.
- It arises in derivatives, repos, securities lending and settlement, and it concentrates in dealers, monolines and central counterparties.
- Expected loss is exposure times default probability times loss given default.
- C V A prices that risk with risk neutral probabilities, while credit limits cap a quantity.
- Netting and collateral reduce it, if enforceable.
- A dealer's price adds C V A, F V A, K V A and M V A, and X V A adds D V A, with its sign.

29 Try three quick questions

1. Trades +20m, −8m, −5m, netted, no collateral. LGD 70%. Loss if it defaults?
   Answer: Net 7m = exposure. 7m × 70% = $4.9m.
2. DF 0.95, EPE $8m, marginal PD 2%, LGD 50%. One-period CVA?
   Answer: 0.5 × 0.95 × 8m × 0.02 = $76,000.
3. RFV 500k; CVA 90k; DVA 20k; FVA 30k; ColVA 0; MVA 10k; KVA 40k. Value?
   Answer: 500 − 90 + 20 − 30 − 10 − 40 = $350,000.

IN THE LESSON

- Now try three quick questions.
- Pause, think, then listen to the answers.
- Question one.
- Client trades are worth plus twenty, minus eight and minus five million dollars, under enforceable netting, no collateral, loss given default seventy per cent.
- What is the loss if the client defaults?
- The net value is seven million, which is the exposure, so the loss is four point nine million dollars.
- Question two.
- Discount factor point nine five, expected positive exposure eight million, marginal default probability two per cent, loss given default fifty per cent.
- What is the C V A?
- Point five times point nine five times eight million times point zero two is seventy six thousand dollars.
- Question three.
- Risk free value is five hundred thousand, C V A ninety, D V A twenty, net F V A thirty, Col V A zero, M V A ten and K V A forty, all in thousands.
- What is the dealer's value?
- Five hundred minus ninety plus twenty minus thirty minus ten minus forty is three hundred and fifty thousand dollars.