Monitoring Liquidity

FRM Part II

1 A story: the month the dates moved

- Larkfield plans its cash straight from the contracts
- A quiet month: every flow arrives on schedule
- A stress: clients draw lines, depositors leave early
- Customers held choices the plan ignored
- Some flows are fixed; others depend on choices

IN THE LESSON

- Imagine Larkfield Bank, a mid sized lender.
- Its treasurer plans the month's cash straight from the contracts: which bonds pay coupons, which deposits mature, which loans repay.
- In a quiet month the plan works, because every flow arrives on schedule.
- Then a stress comes.
- Corporate clients draw on their credit lines all at once, and depositors take their money early.
- The contract dates were never the real dates, because customers held choices the plan ignored.
- The lesson for Larkfield is that some cash flows are fixed, while others depend on someone's decision or on the market.
- Telling them apart is the first step in monitoring liquidity.

2 Deterministic cash flows

- Deterministic: amount and timing fixed by contract
- No dependence on future events or anyone's choice
- Coupons and redemption of fixed-rate, non-callable bonds
- Instalments on a fixed-rate loan with no early repayment
- A term deposit with no early exit, repaid at maturity

IN THE LESSON

- A cash flow is deterministic when both its amount and its timing are fixed by contract.
- It does not depend on future events, and it does not depend on anyone's discretion.
- Here are the standard examples.
- The coupons and redemption of a fixed rate bond with no call feature, whether the bank holds it or has issued it.
- The scheduled instalments on a fixed rate loan, where the borrower has no right to repay early.
- And the repayment of a term deposit with no early withdrawal right, on its stated maturity date.
- Because the amount and the date are both known today, Larkfield can write these flows straight into its plan with confidence.
- That plan is a maturity ladder, which we build later in the lesson.

3 Stochastic cash flows

- Stochastic: amount, timing or both are uncertain
- Driven by market variables or customer behaviour
- Drawdowns on committed credit lines
- Withdrawals from non-maturity deposits
- Loan prepayments; margin and collateral calls

IN THE LESSON

- A cash flow is stochastic when its amount, its timing, or both, depend on random market variables or on the behaviour of customers.
- Stochastic simply means random.
- The drivers are of two kinds: the market, such as interest rates and prices, and customer behaviour.
- The examples you must know are these.
- Drawdowns on committed credit lines, where the client chooses when and how much to borrow.
- Withdrawals from non maturity deposits, such as current accounts, which have no fixed date at all.
- Loan prepayments, where a borrower repays early.
- And margin or collateral calls on derivatives, which grow or shrink as market prices move.

4 Sorting Larkfield's cash flows

Can anything but the calendar change the amount or the date?

Larkfield's flow	Type	Why
Coupon on a fixed-rate bond held	Deterministic	Fixed by contract
Term deposit, no early exit	Deterministic	Date and amount set
Draw on a committed line	Stochastic	Client decides
Current account withdrawals	Stochastic	Customer behaviour
Margin call on a swap	Stochastic	Market moves

IN THE LESSON

- Let us sort some of Larkfield's flows, row by row.
- A coupon on a fixed rate bond Larkfield holds is deterministic, because it is fixed by contract.
- The repayment of a term deposit with no early exit is deterministic, because the date and amount are set.
- A draw on a committed line is stochastic, because the client decides.
- Withdrawals from current accounts are stochastic, because they depend on customer behaviour.
- And a margin call on an interest rate swap is stochastic, because it depends on how the market moves.
- Notice the test.
- Ask whether anything other than the calendar can change the amount or the date.
- If the answer is yes, the flow is stochastic.

5 Example 1: a schedule that is not certain

Fixed-rate mortgages $1,000m: contract repays $50m this year; borrowers may prepay

Contractual principal	the schedule	**$50m**
Expected prepayments	8% × (1,000 − 50)	**$76m**
Expected inflow	50 + 76	**$126m**
If rates fall: prepay 20%	50 + 20% × 950 = 50 + 190	**$240m**

Not certain: borrowers hold an option; prepaying cuts later inflows

IN THE LESSON

- Here is the classic trap.
- Larkfield holds one thousand million dollars of fixed rate mortgages.
- The contract schedule repays fifty million of principal this year.
- But the borrowers may prepay.
- On the schedule alone, the treasurer would plan for fifty million.
- Larkfield's behavioural model expects eight per cent of the remaining nine hundred and fifty million to be prepaid, which is seventy six million.
- So the expected inflow is fifty plus seventy six, one hundred and twenty six million.
- If rates fall, borrowers refinance, and prepayments may jump to twenty per cent, which is one hundred and ninety million, for a total of two hundred and forty million.
- Each prepaid dollar also removes later inflows.
- The contract schedule is not certain, because the borrowers hold an option.

6 How each kind is handled

- Deterministic: place directly on the maturity ladder
- Stochastic: distributions, behaviour, scenarios
- Plus a buffer of liquid assets sized for the uncertainty
- Trap: a schedule is not certain if someone holds an option

IN THE LESSON

- So how does a bank treat the two kinds?
- Deterministic flows can be placed directly on the maturity ladder, in the time bucket where they fall.
- Stochastic flows cannot simply be written in.
- They need a distribution, which says how likely each amount is, or behavioural assumptions, such as the prepayment rate we just used, or scenarios, which ask what happens in a named stress.
- On top of that, the bank holds a buffer of liquid assets sized for the uncertainty.
- The usual mistake is to treat a contractual schedule as certain when the counterparty holds an option that can change it.
- The mortgage schedule looked certain, but it was not.

7 Liquidity options

- A right to decide whether and when a cash flow occurs
- Embedded in a contract or granted to a client
- The holder decides; the writer must deliver
- A bank that writes the option is short it

IN THE LESSON

- That leads to the idea of a liquidity option.
- A liquidity option is a right that lets the holder decide whether and when a cash flow occurs.
- It may be embedded in a contract, such as a prepayment clause in a loan, or granted to a client, such as a credit line.
- The holder decides, and the writer, the party who granted the right, must deliver the cash when asked.
- When a bank is the writer, we say the bank is short the option.
- That means it carries the risk and has no say over timing.
- Most liquidity options in banking are written by the bank, so most of them work against it.

8 Options a bank typically writes

In every row the holder, not the bank, picks the moment

Option the bank writes	Holder exercises when
Committed credit line	The client needs cash
Deposit withdrawable early	Depositor wants funds back
Loan prepayment right	Rates fall: refinance
Downgrade collateral clause	The bank is downgraded

IN THE LESSON

- Here are the options a bank typically writes, with the moment each is used.
- A committed credit line lets the client borrow up to a limit, and the client draws when it needs cash.
- A deposit that can be withdrawn early lets the depositor take the money back before maturity, and the depositor does so when it wants its funds.
- A loan prepayment right lets the borrower repay early, which it does when rates fall and it can refinance more cheaply.
- And a collateral clause triggered by a rating downgrade obliges the bank to post more collateral, exactly when the bank itself is downgraded.
- In every row the holder, not the bank, picks the moment.

9 Why a short option hurts

- The holder exercises when it suits the holder
- Often just when the bank is under stress
- So the cash flow becomes stochastic
- Expected-value planning understates the need
- Hold liquid assets or limits against exercise

IN THE LESSON

- Why does being short these options hurt?
- The holder exercises when it suits the holder.
- That is often just when the bank is under stress and funding is hardest to find.
- A client in trouble draws its line.
- A depositor who reads bad news about the bank takes money out.
- A downgrade brings a collateral call at the worst moment.
- So the cash flow becomes stochastic, and worse, it is largest in the bad states.
- Planning on the expected value therefore understates the need, because the average blends calm months with stressed ones.
- The answer is to hold liquid assets, or set limits, against the exercise amount.

10 Example 2: committed lines, average and stressed

Larkfield: $2,000m of undrawn committed lines. Normal draw 5%; stressed draw 30%

Normal drawdown	5% × 2,000	**$100m**
Stressed drawdown	30% × 2,000	**$600m**
Shortfall vs plan	600 − 100	**$500m**

Size the buffer for stressed exercise, not average

IN THE LESSON

- Let us put numbers on it.
- Larkfield has two thousand million dollars of undrawn committed credit lines.
- In a normal month, clients draw about five per cent, which is one hundred million.
- In a stress, Larkfield assumes they draw thirty per cent, which is six hundred million.
- If the treasurer plans on the normal draw, the bank is short by six hundred minus one hundred, five hundred million dollars, exactly when funding is scarce.
- The lesson is to size the buffer for the stressed exercise, and not for the average exercise.
- That is the exam point to remember for any option the bank has written.

11 Example 3: adding up the written options

Normal and stressed exercise of Larkfield's written options, $m

Committed lines	2,000 × 5%, then × 30%	**100 → 600**
Early deposit withdrawals	1,000 × 2%, then × 15%	**20 → 150**
Downgrade collateral	only if downgraded	**0 → 120**
Total	100+20+0 → 600+150+120	**120 → 870**

Stressed total is 7.25 times normal: plan for 870, not 120

IN THE LESSON

- Now add Larkfield's other written options.
- The committed lines we have seen: one hundred million normally, six hundred in stress.
- Larkfield also has one thousand million of term deposits that can be withdrawn early.
- Unlike the term deposits we sorted earlier, these carry an early exit right, so they are an option Larkfield has written.
- Normally two per cent leave early, twenty million.
- In stress, fifteen per cent leave, one hundred and fifty million.
- And a downgrade clause in its derivative contracts would require one hundred and twenty million of extra collateral, but only if Larkfield is downgraded, so nothing in a normal month.
- The normal total is one hundred plus twenty plus zero, one hundred and twenty million.
- The stressed total is six hundred plus one hundred and fifty plus one hundred and twenty, eight hundred and seventy million.
- The stressed figure is seven point two five times the normal one.
- So plan for eight hundred and seventy, not one hundred and twenty.

12 When the bank holds the option

- Suppose Larkfield buys a $300m standby facility
- Now Larkfield holds the option: it adds capacity
- Exam habit: first ask who holds the option
- Writer: short, needs a buffer for stressed exercise
- Holder: long, gains extra capacity

IN THE LESSON

- Options can also work for the bank.
- Suppose Larkfield buys a committed standby facility of three hundred million dollars from another bank.
- Now Larkfield holds the option.
- It can draw the cash when it chooses, so the facility adds to its capacity to raise liquidity.
- The exam habit is to ask first who holds the option.
- If the bank is the writer, it is short, and it needs a buffer sized for stressed exercise.
- If the bank is the holder, it is long, and the option is a source of extra capacity.
- The same contract is a drain on one side and a reserve on the other.

13 How written options change liquidity management

- Model behaviour, not just contracts
- Limits on committed lines and downgrade clauses
- Liquid assets for stressed exercise: 870, not 120
- Watch rising drawdowns and rating reviews

IN THE LESSON

- Written options change how Larkfield manages liquidity day to day.
- First, it models behaviour, not just contracts, because the contract dates are not the real dates.
- Second, it sets limits, for example on the total of committed lines it grants and on clauses that are triggered by a downgrade.
- Third, it holds liquid assets sized for the stressed exercise of all its options together, the eight hundred and seventy million rather than the one hundred and twenty.
- Fourth, it watches the signs that exercise is coming, such as rising drawdowns or a rating under review.
- A bank that ignores its written options looks liquid until the moment they are exercised.

14 Five ideas that describe liquidity

- Expected liquidity: expected cumulative net cash flow
- Cash flow at risk: shortfall below expected, at a confidence
- Capacity: cash from unencumbered assets, after haircuts
- Funding cost risk: refinancing costs rise
- Liquidity risk: outflows beyond expectation exceed capacity

IN THE LESSON

- Now we describe Larkfield's liquidity with numbers, using five ideas.
- Expected liquidity is the expected cumulative net cash flow over a horizon, meaning expected inflows minus expected outflows, added up from today.
- Cash flow at risk is the shortfall of net cash flow below its expected value that is not exceeded at a stated confidence level.
- Liquidity generation capacity is the cash the bank can raise by selling or pledging assets, after haircuts, and excluding assets already encumbered, meaning already pledged.
- A haircut is the cut in value a lender applies to an asset.
- Funding cost risk is the risk that refinancing costs rise.
- And liquidity risk is the possibility that outflows beyond expectation exceed capacity, so that cash is lacking.

15 Cash flow at risk

If normal: CFaR ≈ z × σ
Stressed flow = expected liquidity − CFaR

Standard normal value, z	From the confidence level
SD of net cash flow, σ	How widely net flow swings
Cash flow at risk	Shortfall below expected
Expected liquidity	Expected cumulative net flow

IN THE LESSON

- Here is cash flow at risk in its simplest form.
- Suppose net cash flow over the horizon is normally distributed.
- Then cash flow at risk is approximately zee times sigma.
- Zee is the standard normal value for the chosen confidence level.
- Sigma is the standard deviation of net cash flow, which measures how widely it swings.
- It is a shortfall measured from the expected value, not from zero.
- So the stressed net cash flow, the level that is not breached at that confidence, is the expected liquidity, the expected cumulative net flow, minus the cash flow at risk.
- Definitions of cash flow at risk vary between sources, so always check that it is measured below the expected value.

16 Example 4: Larkfield's cash flow at risk

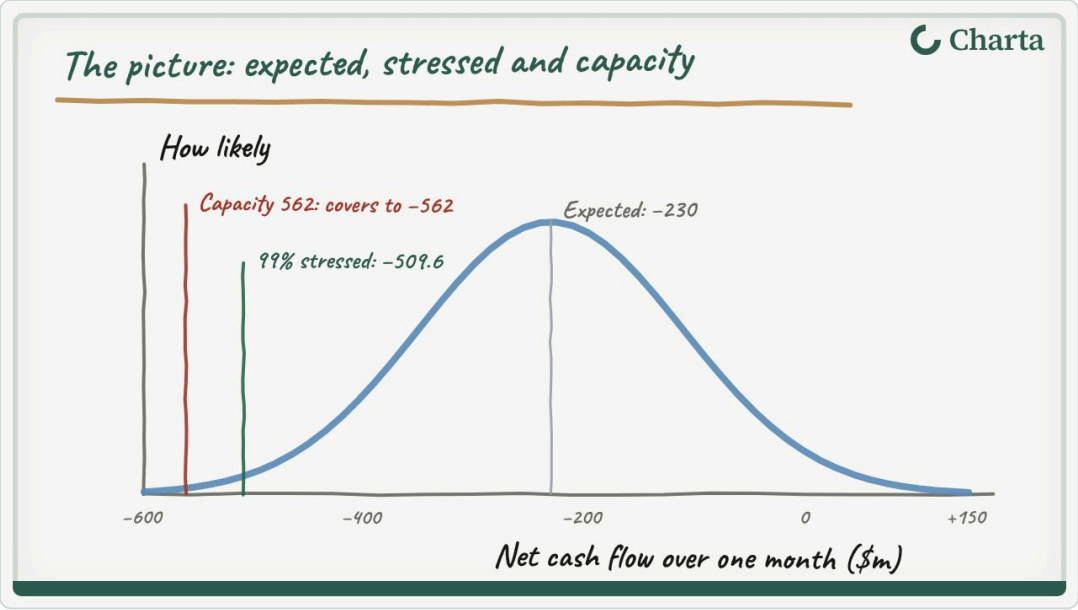
Larkfield, one-month horizon, 99% confidence. Net cash flow taken as normal

Expected liquidity, 1 month	expected cumulative net flow	**−$230m**
σ of net cash flow	from Larkfield's model	**$120m**
z at 99% confidence	standard normal value	**2.33**
Cash flow at risk	2.33 × 120	**$279.6m**
Stressed net flow	−230 − 279.6	**−$509.6m**

IN THE LESSON

- Let us compute it for Larkfield over a horizon of one month.
- Its expected liquidity, the expected cumulative net cash flow to one month, is a deficit of two hundred and thirty million dollars.
- We will see this figure again on the maturity ladder.
- Larkfield's model gives a standard deviation of net cash flow of one hundred and twenty million.
- At ninety nine per cent confidence, zee is about two point three three.
- Cash flow at risk is two point three three times one hundred and twenty, which is two hundred and seventy nine point six million.
- The stressed net cash flow is minus two hundred and thirty, minus two hundred and seventy nine point six, a deficit of five hundred and nine point six million dollars.

17 The picture: expected, stressed and capacity



IN THE LESSON

- Here is the same idea as a picture.
- Along the bottom is Larkfield's net cash flow over one month, in millions of dollars, from minus six hundred on the left up to plus one hundred and fifty on the right.
- The curve shows how likely each outcome is.
- Its peak sits at the expected liquidity, minus two hundred and thirty.
- The green line marks the stressed flow at ninety nine per cent, minus five hundred and nine point six.
- Only one month in a hundred should be worse.
- The red line marks Larkfield's capacity to generate liquidity, which we compute next: five hundred and sixty two million, so it covers a net outflow down to minus five hundred and sixty two.
- The gap between the green and red lines is the headroom.

18 Example 5: liquidity generation capacity

Government bonds $500m ($100m pledged), haircut 2%; corporates $200m, 15%

Government bonds held	of which 100 already pledged	**$500m**
Government: unencumbered	(500 − 100) × 98%	**$392m**
Corporate bonds	200 × 85%	**$170m**
Capacity	392 + 170	**$562m**
Wrong: include pledged	500 × 98% + 170	**$660m**

IN THE LESSON

- How much cash can Larkfield raise?
- It holds five hundred million dollars of government bonds, but one hundred million are already pledged to other lenders.
- Those are encumbered, so they cannot be used again.
- The unencumbered four hundred million carry a haircut of two per cent, so they raise four hundred times ninety eight per cent, three hundred and ninety two million.
- Larkfield also holds two hundred million of corporate bonds with a haircut of fifteen per cent, which raise one hundred and seventy million.
- Capacity is three hundred and ninety two plus one hundred and seventy, five hundred and sixty two million.
- The common error is to include the pledged bonds, giving six hundred and sixty million, which is ninety eight million too much.
- We leave out the standby facility, which was only a what if.

19 Example 6: funding cost risk

Horizon 1 year. $800m of funding rolls after 3 months; its spread widens 0.5%

Amount that rolls	at the end of month 3	**$800m**
Spread widening	on the new funding	**0.5%**
Time left in the horizon	12 − 3 months	**9 months**
Extra funding cost	800 × 0.5% × 9 ÷ 12	**$3.0m**
Wrong: a full year	800 × 0.5%	**$4.0m**

IN THE LESSON

- Funding cost risk asks what happens to the cost of funding, not to its availability.
- Take a horizon of one year.
- Eight hundred million dollars of Larkfield's funding matures at the end of month three and must be rolled over, meaning replaced with new funding.
- Suppose Larkfield's credit spread widens by half of one per cent when it rolls.
- The extra cost applies to the amount that rolls over, for the time remaining after the roll, which is twelve minus three, nine months.
- The extra cost is eight hundred times half of one per cent times nine twelfths, three million dollars.
- Charging a full year would give four million, which overstates the cost for this horizon.

20 Example 7: is there liquidity risk?

Compare the stressed flow, not the expected flow, with capacity

Stressed net flow, 99%	from Example 4	**−$509.6m**
Capacity	from Example 5	**$562m**
Headroom	562 − 509.6	**$52.4m**
Wrong: expected flow only	562 − 230	**$332m**

Liquidity risk: outflows beyond expectation exceed capacity

IN THE LESSON

- Now bring the pieces together.
- Compare the stressed cash flow with capacity, not just the expected flow.
- Larkfield's stressed net flow at ninety nine per cent is a deficit of five hundred and nine point six million.
- Its capacity is five hundred and sixty two million.
- The headroom is five hundred and sixty two minus five hundred and nine point six, only fifty two point four million.
- That is thin.
- A treasurer who compared the expected deficit of two hundred and thirty with capacity would see three hundred and thirty two million of headroom, and feel far safer than the bank really is.
- That is liquidity risk: the chance that outflows beyond expectation exceed capacity.

21 The liquidity maturity ladder

- Ladder: expected inflows and outflows by time bucket
- Net flow: inflows minus outflows within the bucket
- Cumulative: running sum of net flows from today
- It is the funding or surplus built up by that date

IN THE LESSON

- Where did the expected deficit of two hundred and thirty million come from?
- From Larkfield's liquidity maturity ladder.
- A maturity ladder allocates expected cash inflows and outflows to time buckets, such as overnight to one week, one week to one month, one to three months, and so on.
- The net flow of a bucket is inflows minus outflows within that bucket only.
- The cumulative figure is the running sum of net flows, from today through the end of that bucket.
- It is the amount of funding the bank needs, or the surplus it has built up, by that date.
- A negative cumulative figure is a funding gap that must be filled.

22 Example 8: net flow in each bucket

Larkfield's expected flows, $m. Net = inflows − outflows within each bucket

Overnight to 1 week	120 − 200	**−80**
1 week to 1 month	150 − 300	**−150**
1 to 3 months	200 − 270	**−70**
3 to 12 months	560 − 310	**+250**
Over 1 year	400 − 250	**+150**

IN THE LESSON

- Here is Larkfield's ladder in millions of dollars, bucket by bucket.
- Overnight to one week, inflows are one hundred and twenty and outflows two hundred, a net flow of minus eighty.
- One week to one month, one hundred and fifty in and three hundred out, minus one hundred and fifty.
- One to three months, two hundred in and two hundred and seventy out, minus seventy.
- Three to twelve months, five hundred and sixty in and three hundred and ten out, plus two hundred and fifty.
- Over one year, four hundred in and two hundred and fifty out, plus one hundred and fifty.
- Each net flow uses only that bucket's own inflows and outflows.

23 Example 9: the cumulative gap

Cumulative = running sum of the net flows from today, $m

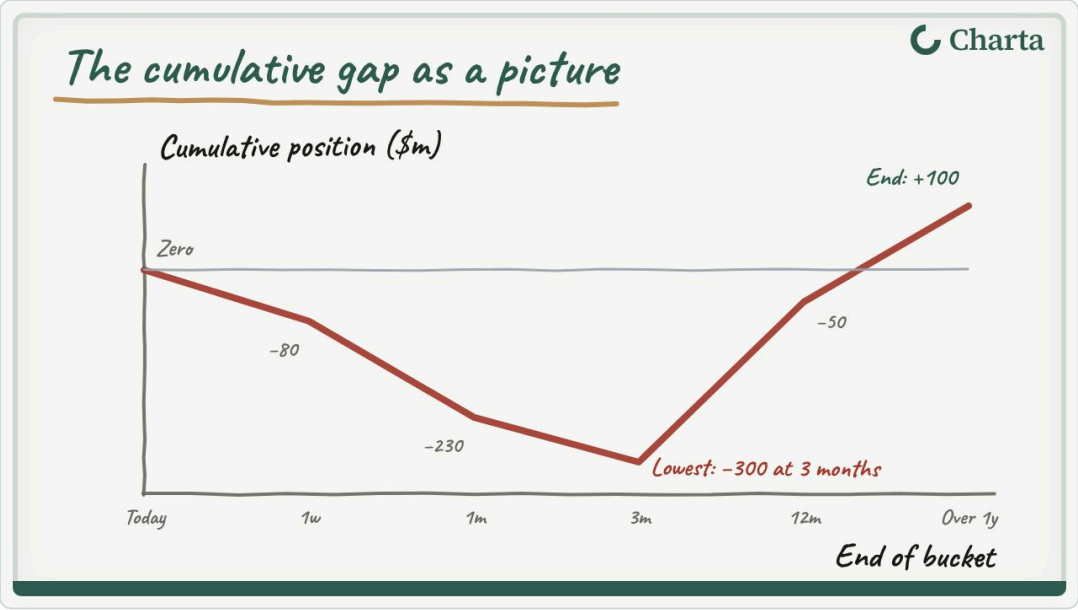
To 1 week	−80	**−80**
To 1 month	−80 − 150	**−230**
To 3 months	−230 − 70	**−300**
To 12 months	−300 + 250	**−50**
Over 1 year	−50 + 150	**+100**

Funding needed: the largest deficit, $300m, not the final +$100m

IN THE LESSON

- Now run the cumulative total.
- To one week it is minus eighty.
- To one month, minus eighty minus one hundred and fifty, minus two hundred and thirty.
- That is the expected liquidity we used for cash flow at risk.
- To three months, minus two hundred and thirty minus seventy, minus three hundred.
- To twelve months, minus three hundred plus two hundred and fifty, minus fifty.
- And over one year, minus fifty plus one hundred and fifty, plus one hundred.
- The final figure is a surplus of one hundred million, which looks comfortable.
- But the funding Larkfield must have available is set by the largest cumulative deficit, three hundred million at three months, and not by the last figure.

24 The cumulative gap as a picture



IN THE LESSON

- Here is the cumulative gap as a picture.
- Along the bottom are the ends of Larkfield's buckets, from today to one week, one month, three months, twelve months and over one year.
- The buckets are drawn evenly spaced, though they differ in length.
- Up the side is the cumulative position in millions of dollars.
- The red line starts at zero today and falls to minus eighty, then to minus two hundred and thirty, then to its lowest point, minus three hundred, at three months.
- After that, the later surpluses pull it back up, to minus fifty at twelve months and plus one hundred over one year.
- The grey line marks zero, so everything below it is a funding gap.
- The bank must survive the bottom of this valley, not just reach the end of it.

25 Reading the ladder

- The largest cumulative deficit sets the funding needed
- The bank must survive every intermediate date
- A later surplus repays the gap gradually; it does not cure it
- Short-end deficits: long assets funded with short liabilities

IN THE LESSON

- Four rules for reading any ladder.
- First, the largest cumulative deficit, not the last cumulative value, sets the funding that must be available.
- Second, that is because the bank must survive every intermediate date.
- A bank that runs out of cash at three months never reaches its surplus at one year.
- Third, a positive flow in a later bucket only repays the deficit gradually.
- It does not cure the earlier gap.
- Fourth, look at the shape.
- Consistent negative cumulative flows at the short end signal that the bank is funding long assets with short liabilities.
- Larkfield's ladder, negative for the first year, shows exactly that pattern.

26 Transactions in available assets

- Available assets can be sold or pledged for cash
- Each deal changes the cash flows and the capacity
- Sale: cash today; later coupons and principal gone
- Repo: cash = value less haircut; repay it with interest
- Pledged assets are encumbered: no second use

IN THE LESSON

- How can Larkfield close its gap?
- By using its available assets, the unencumbered bonds we counted in its capacity.
- It can sell them or pledge them.
- Each transaction changes two things: the cash flow profile on the ladder, and the capacity to generate liquidity.
- A sale brings cash in today, but the asset's later coupons and principal disappear from the ladder.
- A repurchase agreement, or repo, is a sale with a promise to buy back.
- It brings in cash equal to market value less the haircut today, and creates an outflow of that cash plus interest at the repo maturity.
- The pledged asset is encumbered and cannot be used again.

27 Example 10: a sale moves cash forward

Sell a $100m corporate bond at a 1% discount. It would pay $5m coupon, then $100m

Cash today, to 1 week	100 × 99%	**+$99m**
Coupon lost, 3 to 12 months	no longer held	**−$5m**
Principal lost, over 1 year	no longer held	**−$100m**
Net over the whole ladder	99 − 5 − 100	**−$6m**

IN THE LESSON

- Larkfield sells one hundred million dollars of its corporate bonds at a discount of one per cent to their value.
- Cash arrives now, in the first bucket: one hundred times ninety nine per cent, ninety nine million.
- But the bond would have paid a coupon of five million in the three to twelve month bucket, and its principal of one hundred million over one year.
- Both are now gone from the ladder.
- Across the whole ladder the net effect is ninety nine minus five minus one hundred, minus six million.
- So a sale does not create cash.
- It brings cash forward, at the price of the discount and the lost coupon.

28 Example 11: the ladder after the sale

Cumulative ladder after the sale, $m

To 1 week	−80 + 99	**+19**
To 1 month	19 − 150	**−131**
To 3 months	−131 − 70	**−201**
To 12 months	−201 + (250 − 5)	**+44**
Over 1 year	44 + (150 − 100)	**+94**

Largest deficit 300 → 201; final 100 → 94: cash brought forward

IN THE LESSON

- Here is the cumulative ladder after the sale.
- To one week, minus eighty plus ninety nine, plus nineteen.
- To one month, nineteen minus one hundred and fifty, minus one hundred and thirty one.
- To three months, minus one hundred and thirty one minus seventy, minus two hundred and one.
- The three to twelve month net flow is now two hundred and fifty minus the lost coupon of five, two hundred and forty five, so the cumulative is plus forty four.
- Over one year the net flow is one hundred and fifty minus one hundred, fifty, giving plus ninety four.
- The largest deficit falls from three hundred to two hundred and one, while the final figure falls from one hundred to ninety four.
- The sale has brought cash forward.

29 Example 12: the sale and capacity

Capacity counts the bond after its 15% haircut and cash at face value, $m

Bond in capacity before	100 × 85%	**$85m**
Cash after the sale	at face value	**$99m**
Change in capacity	99 − 85 = (15% − 1%) × 100	**+$14m**
New capacity	562 + 14	**$576m**
Wrong: count both	562 + 99	**$661m**

Wrong, dropping the cash: 562 − 85 = $477m

IN THE LESSON

- What did the sale do to capacity?
- Before the sale, the bond counted in capacity at one hundred times eighty five per cent, eighty five million, after its fifteen per cent haircut.
- After the sale, Larkfield holds ninety nine million of cash, which counts at face value.
- So capacity rises by ninety nine minus eighty five, fourteen million, which is the fifteen per cent haircut less the one per cent discount, on one hundred million.
- New capacity is five hundred and sixty two plus fourteen, five hundred and seventy six million.
- Converting an asset to cash does not cut capacity by the asset's full value.
- One mistake is to count both the bond and the cash, giving six hundred and sixty one.
- The other is to drop the cash, giving four hundred and seventy seven.

30 Example 13: a one-month repo

Repo $200m of government bonds for 1 month: haircut 2%, rate 6% a year

Cash today	200 × 98%	**+$196m**
Repay at 1 month	196 + 196 × 6% ÷ 12	**−$196.98m**
Cumulative to 1 week	−80 + 196	**+$116m**
Cumulative to 1 month	116 − 150 − 196.98	**−$230.98m**
Largest deficit, 3 months	−230.98 − 70	**−$300.98m**

The repo bridges the first week; it does not cure the 3-month gap

IN THE LESSON

- Instead of selling, Larkfield could repo two hundred million dollars of its government bonds for one month, at a haircut of two per cent and a repo rate of six per cent a year.
- Cash today is two hundred times ninety eight per cent, one hundred and ninety six million.
- At one month it must repay that plus one month's interest, one hundred and ninety six times six per cent divided by twelve, which is zero point nine eight, so one hundred and ninety six point nine eight million.
- The cumulative position to one week becomes minus eighty plus one hundred and ninety six, plus one hundred and sixteen.
- To one month it is one hundred and sixteen minus one hundred and fifty minus one hundred and ninety six point nine eight, minus two hundred and thirty point nine eight.
- The deepest point, at three months, is minus three hundred point nine eight, slightly worse than before.
- So the repo bridges the first week, but it does not cure the three month gap.

31 Example 14: the repo and capacity

Starting capacity $562m. The repo pledges $200m of government bonds

Bonds pledged: capacity lost	200 × 98%	**−$196m**
Cash received	at face value	**+$196m**
Capacity after the repo	562 − 196 + 196	**$562m**
Wrong: bonds still counted	562 + 196	**$758m**

Same haircut, so capacity is unchanged; the bonds cannot be used again

IN THE LESSON

- And capacity?
- The two hundred million of government bonds are now pledged, so they are encumbered and leave capacity.
- They had counted at two hundred times ninety eight per cent, one hundred and ninety six million.
- In their place Larkfield holds one hundred and ninety six million of cash, which counts at face value.
- Capacity is five hundred and sixty two minus one hundred and ninety six plus one hundred and ninety six, still five hundred and sixty two.
- Because the repo haircut equals the haircut used in capacity, nothing changes.
- The usual error is to keep counting the pledged bonds as well as the cash, which would show seven hundred and fifty eight million.

32 Mistakes to avoid

- Treating a contract schedule as certain
- Planning on average, not stressed, option exercise
- Comparing expected flow, not stressed flow, with capacity
- Reading the last cumulative figure, not the worst
- Counting both an asset and its cash, or dropping the cash

IN THE LESSON

- Let us gather the traps from the whole lesson.
- First, treating a contractual schedule as certain when a customer holds an option, like the mortgage prepayments.
- Second, planning on the average exercise of a written option rather than the stressed exercise, one hundred and twenty instead of eight hundred and seventy.
- Third, comparing the expected flow with capacity, rather than the stressed flow.
- Fourth, reading the last cumulative figure on the ladder rather than the largest deficit, plus one hundred instead of minus three hundred.
- And fifth, when an asset is sold or pledged, double counting both the asset and the cash, or dropping the cash altogether.

33 Try three quick questions

1. Net cash flow σ = $50m; z = 1.645 at 95%. Cash flow at risk?
   Answer: 1.645 × 50 = $82.25m.
2. Net flows by bucket: −40, −60, +30, +90 ($m). Funding needed?
   Answer: Cumulative −40, −100, −70, +20: $100m.
3. $80m bond counts at 90%; sold at a 2% discount. Capacity change?
   Answer: Cash 78.4 replaces 72: up $6.4m.

IN THE LESSON

- Now try three quick questions.
- Pause the video, think, then listen to the answers.
- Question one.
- A bank's net cash flow over one month has a standard deviation of fifty million dollars.
- At ninety five per cent confidence, zee is one point six four five.
- What is the cash flow at risk?
- It is one point six four five times fifty, eighty two point two five million dollars.
- Question two.
- A ladder's net flows by bucket are minus forty, minus sixty, plus thirty and plus ninety million.
- How much funding must be available?
- The cumulative figures are minus forty, minus one hundred, minus seventy and plus twenty, so one hundred million, the largest deficit.
- Question three.
- A bond of eighty million counts at ninety per cent in capacity, and is sold at a two per cent discount.
- How does capacity change?
- Cash of eighty times ninety eight per cent, seventy eight point four, replaces eighty times ninety per cent, seventy two, so capacity rises by six point four million.