CHARTA LEARNING · LESSON NOTES

Key terms: fixed income

Key terminology

1 A bond, and how to use this lesson

- A bond is a loan sold in pieces to many lenders
- Coupon: the regular interest. Face value: repaid at the end
- Example: face value 100, coupon 5 a year, for 3 years
- Each term: plain meaning, small example, where you meet it

IN THE LESSON

- Every term here belongs to one picture, so let us draw it first.
- A bond is a loan that is cut into pieces and sold to many lenders.
- The borrower promises a regular payment of interest, called the coupon, and then repays the face value on a set date.
- Say a bond has a face value of one hundred and pays a coupon of five a year for three years.
- Lenders pay a price today, and the payments arrive later.
- Most terms here describe something about the gap between the price today and the payments later.
- For each term you will get the plain meaning, a small example, and where you will meet it in the course.

2 Yield to maturity: the rate hidden in the price

Price = C ÷ (1+y) + C ÷ (1+y)² + … + (C+F) ÷ (1+y)ⁿ

Price today	Today's price: 100.18
Coupon (C)	Coupon: 5 each year
Face value (F)	Repaid at the end: 100
Yield (y)	The yearly rate we solve for
Years (n)	Years left: 3

IN THE LESSON

- Start with the most quoted number in bond markets.
- Imagine you are offered our bond at a price of one hundred point one eight.
- What return is that?
- The yield to maturity is the single yearly rate that, used to discount every remaining payment, makes their total value equal the price.
- In the formula, the price equals the first coupon over one plus the yield, plus the second coupon over one plus the yield squared, and so on, until the last coupon and the face value arrive together.
- You meet it in Corporate Issuers, where it sets the cost of debt, and in Fixed Income.

3 Hunting for the yield

Price 100.18. Coupon 5, face value 100, 3 years

Try 5.00%	worth less than 100.18	**100.00**
Try 4.50%	worth more: too high	**101.37**
Try 4.90%	still a little high	**100.27**
Solved yield	value settles at 100.18	**4.93%**

Price above 100 means yield below the 5% coupon rate

IN THE LESSON

- Here is how the hunt goes, which is exactly what a calculator does.
- Higher yields mean lower prices.
- Try a yield of five per cent.
- The three payments are worth one hundred exactly.
- That is below the price of one hundred point one eight, so the yield must be lower.
- Try four and a half per cent.
- The value is one hundred and one point three seven, now too high.
- Try four point nine per cent.
- The value is one hundred point two seven, only a little high.
- Keep narrowing, and at four point nine three per cent, to two places, the value settles at one hundred point one eight.
- A quick check on direction: a price above face value means a yield below the coupon rate of five per cent,, which is a handy check.

4 What the yield quietly assumes

Bought at 100.18; two coupons of 5 are reinvested

Reinvest coupons at 4.93%	wealth at year 3	**115.75**
Realised return	(115.75 ÷ 100.18)^⅓ − 1	**4.93%**
Reinvest coupons at 2%	wealth at year 3	**115.30**
Realised return	(115.30 ÷ 100.18)^⅓ − 1	**4.80%**

Promised only if held, paid in full, and reinvested at the yield

IN THE LESSON

- A yield to maturity sounds like a promise, but it comes with fine print.
- You earn exactly the quoted yield only if three things happen.
- You hold the bond until it matures.
- The borrower pays every coupon and the face value in full.
- And every coupon you receive is reinvested at the yield itself.
- If you can reinvest the coupons at four point nine three per cent, you finish with one hundred and fifteen point seven five, and your realised return is exactly the yield.
- If you can only reinvest at two per cent, you finish with one hundred and fifteen point three zero, and you earn four point eight zero.
- So the yield is a promised return, not an expected one.

5 Spot rate: one payment, one date

- Spot rate: the yield on ONE payment at ONE date
- Like a voucher paying 100 on a single day
- Every date has its own spot rate
- Our market: 1 year 3%, 2 years 4%, 3 years 5%

IN THE LESSON

- Real markets are not as tidy as one rate.
- Money locked away for one year earns one rate, for two years another, for three years another again.
- Picture a voucher that pays exactly one hundred on one single date and nothing else.
- It sells today for less than one hundred, and the yearly return from buying it and waiting is the spot rate for that date.
- Spot means the rate for money lent today, in return for one payment on one chosen date.
- In our market the one-year spot rate is three per cent, the two-year rate is four per cent, and the three-year rate is five per cent.
- You meet spot rates in Quantitative Methods, Economics, Fixed Income and Derivatives.

6 Pricing a bond one payment at a time

Spot rates 3%, 4%, 5%. Bond: coupon 5, face value 100

Year 1 payment of 5	5 ÷ 1.03	**4.85**
Year 2 payment of 5	5 ÷ 1.04^2	**4.62**
Year 3 payment of 105	105 ÷ 1.05^3	**90.70**
Bond price	sum, unrounded	**100.18**

One rate that fits all three payments: the yield, 4.93%

IN THE LESSON

- Here is where that price came from.
- The fair way to value the bond is to treat it as three separate vouchers, and discount each one at its own spot rate.
- The five paid in one year is discounted at three per cent, and is worth four point eight five.
- The next five, paid in two years, is discounted at four per cent, and is worth four point six two.
- The last payment, one hundred and five, is discounted at five per cent over three years, and is worth ninety point seven zero.
- Add them and the bond is worth one hundred point one eight.
- The yield to maturity of four point nine three per cent is just one single rate that squeezes those three spot rates into one number.
- Spot rates come first, and the yield is a summary.

7 Forward rate: two routes to the same date

Route one: a two-year voucher at 4%

Pay 100 today → Earn 4% a year, twice → Receive 108.16

Route two: 3% for a year, then a forward deal

Pay 100 today → 3% for a year, then the forward rate → Receive 103 × (1 + f)

IN THE LESSON

- Now a third rate.
- Think of booking a hotel room today for next summer, at a price agreed now.
- A forward rate is the same idea for money: the interest rate, fixed today, for a loan that starts at a future date.
- You have one hundred to invest for two years.
- Route one is a two-year voucher at the four per cent spot rate, which grows to one hundred and eight point one six.
- Route two is a one-year voucher at three per cent, which gives one hundred and three, followed by a second year lent at a rate agreed today.
- If the routes ended apart, traders would profit from the gap until it closed, so the rate for that second year is forced.
- We call it the forward rate.
- You meet it in Quantitative Methods, Economics, Fixed Income and Derivatives.

8 Solving for the forward rate

$$(1 + z_2)^2 = (1 + z_1) \times (1 + f)$$
$$f = (1 + z_2)^2 \div (1 + z_1) - 1$$

One-year spot (z_1)	Rate for one year lent
Two-year spot (z_2)	Rate for two years lent
Forward rate (f)	Year-two rate, set today

IN THE LESSON

- Set the two routes equal.
- Route one grows one dollar to one plus the two-year spot rate, squared.
- Route two grows it to one plus the one-year spot rate, times one plus the forward rate.
- Write z one and z two for the two spot rates, and f for the forward rate.
- To find f, divide the two-year growth by the one-year growth, then take away the one.
- Notice what it never uses: any opinion about the future.
- Everything comes from prices that exist today.
- That is why a forward rate is a breakeven, not a prediction.

9 Forward rates, worked

Spot rates: 1 year 3%, 2 years 4%, 3 years 5%

Two-year growth	1.04^2	**1.0816**
Divide by one-year growth	1.0816 ÷ 1.03	**1.0501**
Forward, year two (1y1y)	1.0501 − 1	**5.01%**
Forward, year three (2y1y)	$1.05^3 \div 1.04^2 - 1$	**7.03%**

IN THE LESSON

- Same method on our numbers.
- The two-year spot rate is four per cent, so one dollar grows by one point zero four squared, which is one point zero eight one six.
- Divide by the one-year growth of one point zero three, and you get one point zero five zero one.
- Take away the one, and the forward rate for the second year is five point zero one per cent.
- People write that as one y one: the first number is how long until the loan starts, and the second is how long it lasts.
- Three-year growth is one point zero five cubed.
- Divide it by the two-year growth, and the rate for the third year, two y one, is seven point zero three per cent, higher again.

10 A breakeven, not a forecast

Start with 100. Two-year voucher against rolling

Two-year voucher grows to	100×1.04^2	**108.16**
Roll, next year's rate 6%	103×1.06	**109.18**
Roll, next year's rate 4%	103×1.04	**107.12**
Roll, next year's rate 5.01%	103×1.0501	**108.16**

Forward rate = the rate at which both routes tie

IN THE LESSON

- Go back to the two routes.
- The two-year voucher turns one hundred into one hundred and eight point one six.
- The rolling route earns three per cent in the first year, so you hold one hundred and three, and then it depends on the rate next year.
- If next year's rate turns out to be six per cent, rolling gives one hundred and nine point one eight, and rolling wins.
- If it turns out to be four per cent, rolling gives one hundred and seven point one two, and the voucher wins.
- At five point zero one per cent the two tie exactly.
- So the forward rate is the rate that next year must beat for rolling to come out ahead.
- Nobody promises that next year's rate will match it.

11 Covenants: rules written into the loan

- Covenant: a rule in the loan that binds the borrower
- Indenture: the contract. Trustee: enforces it for all lenders
- Affirmative covenant: what the borrower MUST do
- Negative covenant: what the borrower must NOT do

IN THE LESSON

- Suppose you lend a large sum to a friend.
- Before handing it over, you want rules in writing.
- Do not borrow elsewhere first.
- Show me your accounts each year.
- A bond has many lenders, so the rules go into one legal contract, the indenture, and a trustee enforces it for everyone.
- Each rule is called a covenant: a term written into the loan agreement that constrains the borrower after the money is lent.
- Its job is to stop value leaking to shareholders once the lenders have paid.
- There are two kinds.
- An affirmative covenant says what the borrower must do.
- A negative covenant says what it must not do.
- You meet covenants in Financial Statement Analysis, Corporate Issuers and Fixed Income.

12 Affirmative or negative?

Sort each covenant by kind

Covenant	Kind
Deliver audited accounts each year	Affirmative
Keep the factory insured	Affirmative
Do not pledge assets to other lenders	Negative
Cap dividends at a set level	Negative

IN THE LESSON

- Sort these for yourself.
- Delivering audited accounts each year says what the borrower must do, so it is affirmative.
- Keeping the factory insured is also affirmative.
- Affirmative covenants are good housekeeping, and they cost the borrower very little.
- Now the other side.
- Do not pledge assets to other lenders.
- Cap dividends at a set level.
- These are negative covenants, also called restrictive ones.
- They are the ones that really protect lenders, because they stop the borrower from moving value to shareholders, or to rival lenders, after your money has gone out.
- So when you are asked which covenants actually protect recovery, the answer is the negative ones.

13 A negative covenant in numbers

Wexford Mills ($ millions): debt 300, EBITDA 100, limit 3.5x

Ratio today	300 ÷ 100	**3.0x**
Debt allowed at the limit	3.5 × 100	**350**
Room to borrow	350 − 300	**50**
Borrow 80 for a dividend	380 ÷ 100	**3.8x**
EBITDA falls to 80, no new debt	300 ÷ 80	**3.75x**

A breach is a technical default, even if every payment is made

IN THE LESSON

- Negative covenants are often written as a ratio.
- A common one is debt divided by E B I T D A.
- E B I T D A is earnings before interest, tax, depreciation and amortisation, a rough yearly cash profit.
- Take Wexford Mills, with debt of three hundred million and E B I T D A of one hundred million.
- The ratio is three times.
- The covenant limit is three and a half times, which allows debt of three hundred and fifty million, so Wexford has room to borrow fifty million more.
- Suppose it wants to borrow eighty million for a big dividend.
- Debt would be three hundred and eighty, the ratio three point eight times, and the covenant says no.
- And if profit falls to eighty with no new borrowing, the ratio is three point seven five times, a breach without a missed payment.

14 Convertible bonds and conversion value

Conversion value = Share price × Ratio
Worth ≥ the higher of straight and conversion value

Conversion value	Worth if swapped today
Share price	Market price of one share
Conversion ratio	Shares received per bond
Straight value	Value as an ordinary bond

IN THE LESSON

- Now a bond with a bonus.
- A convertible bond lets the holder swap it for a fixed number of the issuer's shares.
- That number is the conversion ratio.
- The conversion value is what you would get if you swapped today: the share price times the conversion ratio.
- The straight value is what it would be worth as an ordinary bond with no swap right.
- A convertible is worth at least the higher of the two.
- If the shares soar, the conversion value takes over.
- If they collapse, the straight value is a floor.
- That is equity upside with a bond's downside protection, so investors accept a lower coupon.
- You meet the convertible in Financial Statement Analysis, Fixed Income and Alternative Investments, and conversion value also in Equity Investments.

15 A convertible, worked

Pellam Tools convertible: 5 shares per 100 of face value

Conversion price	100 ÷ 5	**20**
Conversion value, shares at 24	24 × 5	**120**
Floor: higher of 92 and 120	straight value is 92	**120**
Market price	4 above the floor	**124**
Shares fall to 15	15 × 5 = 75, so floor is	**92**

IN THE LESSON

- Example.
- Pellam Tools has a convertible that can be swapped for five shares per hundred of face value.
- Divide one hundred by five and the conversion price is twenty dollars a share.
- The shares trade at twenty-four, so the conversion value is twenty-four times five, one hundred and twenty.
- As an ordinary bond it would only be worth ninety-two.
- The floor is the higher of the two, one hundred and twenty.
- The convertible trades at one hundred and twenty-four, four above the floor, a small price for the extra safety.
- Now suppose the shares fall to fifteen.
- The conversion value shrinks to seventy-five, below the straight value of ninety-two, so the bond value becomes the floor.
- The holder keeps a protection that a plain shareholder never has.

16 Mistakes and look-alikes so far

- YTM: one rate for a bond. Spot rate: one payment
- A forward rate is a breakeven, not a forecast
- Affirmative: must do. Negative: must not do, protects more
- A breach is a technical default, not a missed payment
- Conversion value is not the price; price sits above it

IN THE LESSON

- Time to pause and sort the look-alikes.
- One.
- Yield to maturity and spot rate are both yields, but the yield to maturity is one rate for a whole bond, while a spot rate belongs to a single payment at one date.
- Two.
- A forward rate is a breakeven worked out from today's prices.
- It is not a forecast of where rates will go.
- Three.
- Affirmative covenants say must do, negative covenants say must not do, and the negative ones are what protect value.
- Four.
- A covenant breach is a technical default, not a missed payment, and lenders usually negotiate a waiver.
- Five.
- Conversion value is what the shares are worth if you swap, not what the bond costs.
- The price usually sits a little above the floor.

17 Recovery rate: what comes back after default

- Recovery rate: the share of the amount owed you get back
- Friend owes 100, their car sells for 40: recovery 40%
- Loss given default = 1 − recovery = 60%
- Secured lenders recover more; recessions cut recovery

IN THE LESSON

- Now the credit words.
- If a borrower fails, how much do you get back?
- Picture a friend who cannot repay a loan of one hundred dollars, so they sell their car, and the buyer pays forty.
- You get forty back.
- The recovery rate is that share of the amount owed which you recover after a default, here forty per cent.
- The part you lose is the loss given default, which is one minus the recovery rate, here sixty per cent.
- Recovery depends on your place in the queue: a secured lender, backed by pledged assets, recovers more than one that ranks behind everyone else.
- And it tends to fall in the same recessions that cause defaults, so losses cluster.
- You meet it in Fixed Income, Derivatives and Alternative Investments.

18 Expected loss: the questions multiplied

Expected loss = Exposure × PD × LGD
LGD = 1 − Recovery rate

Exposure	Amount lent, at risk
Default chance (PD)	Chance of default in the year
Loss given default	Share lost, e.g. 60%
Recovery rate	Share got back, e.g. 40%

IN THE LESSON

- Put the two questions together.
- Expected loss is the average amount you expect to lose in a year on a loan.
- Work it out in three steps.
- Start with the exposure, the amount at risk.
- Multiply by the probability of default, the chance the borrower defaults in the year, written P D.
- Then multiply by the loss given default, written L G D, which is one minus the recovery rate.
- So if you would recover forty per cent, the loss given default is sixty.
- It is an average over many loans, not what happens in any one case.
- You meet expected loss in Fixed Income and Alternative Investments.

19 Expected loss, worked

Loan 2,000,000. Default chance 2% a year. Recovery 40%

Exposure	amount at risk	**2,000,000**
Probability of default	chance in the year	**2.00%**
Loss given default	1 − 0.40	**60%**
Expected loss	2,000,000 × 0.02 × 0.60	**24,000**

= 1.2% of the loan. Recovery 70%: 12,000; recovery 10%: 36,000

IN THE LESSON

- Worked example.
- A lender has two million dollars out to a company.
- The chance of default in a year is two per cent.
- If it defaults, the lender recovers forty per cent, so the loss given default is sixty per cent.
- Multiply: two million times point zero two times point six gives twenty-four thousand dollars.
- That is one point two per cent of the loan.
- Now see how much recovery matters while the odds stay the same.
- With recovery of seventy per cent, secured on good assets, expected loss falls to twelve thousand.
- With recovery of only ten per cent, expected loss rises to thirty-six thousand.
- Same company, same chance of default, three times the loss.
- The common slip is to multiply by the recovery rate instead of the loss.

20 Averages understate the bad year

Loss, % of loan (recession 1 year in 5)

Benign year	**0.50**	PD 1%, LGD 50%
Recession year	**4.20**	PD 6%, LGD 70%
Product of averages	**1.08**	2% × 54%
True average	**1.24**	weighted 4 : 1

IN THE LESSON

- The side axis is the loss as a per cent of the loan.
- Take a lender whose world has a recession one year in five.
- In a benign year the chance of default is one per cent and the loss given default is fifty per cent, so the expected loss is zero point five per cent.
- In a recession the chance of default jumps to six per cent and the loss given default rises to seventy per cent, so the loss is four point two per cent.
- Now average each input first: a default chance of two per cent and a loss of fifty-four per cent multiply to one point zero eight.
- But the true average, weighing the two kinds of year, is one point two four.
- Defaults and low recoveries arrive together, so multiplying averages understates the bad year.

21 Credit spread: the extra yield for credit risk

- Credit spread = bond yield − safe benchmark yield
- Basis point = one hundredth of 1%
- Example: 4.5% − 3.0% = 1.5% = 150 basis points
- Benchmark: a government bond, or the swap curve

IN THE LESSON

- Why does a company pay more to borrow than a government?
- A credit spread is the extra yield a borrower pays over a safe benchmark of the same life, usually a government bond, though the swap curve is also used.
- It is quoted in basis points, and one basis point is one hundredth of one per cent.
- If the government yield is three per cent and the company's bond yields four and a half, the spread is one point five per cent, or one hundred and fifty basis points.
- The spread must pay for expected loss, but as the next picture shows, for far more than that.
- You meet it in Economics and Fixed Income.

22 What a 150 basis point spread pays for

Basis points (total 150)

Expected loss	**40**	0.8% × 50%
Credit risk premium	**45**	uncertainty
Liquidity	**40**	hard to sell
Other	**25**	spread risk

IN THE LESSON

- Here is that spread of one hundred and fifty basis points taken apart, with made-up numbers.
- The side axis is basis points.
- The first bar is expected loss.
- With a default chance of eight tenths of one per cent and a loss given default of fifty per cent, it is forty basis points.
- The second bar, forty-five, is a premium for uncertainty, because a real loss is a lump, not an average.
- The third, forty, pays for the cost of selling the bond in a hurry.
- The last, twenty-five, covers other items, such as the risk that the spread itself widens.
- So expected loss is only about a quarter of the spread, and the rest is not free profit.
- It is pay for real risks.

23 Credit default swap: insurance on a loan

- CDS: the buyer of protection pays a regular premium
- The seller pays if the reference entity has a credit event
- Credit event: bankruptcy, failure to pay, restructuring
- Credit risk moves without trading the loan or bonds

IN THE LESSON

- A bank has lent money and worries, but does not want to sell the loan.
- It can buy insurance.
- A credit default swap, or C D S, is a contract in which the protection buyer pays a regular premium, and the protection seller pays out if the reference entity, the borrower being covered, suffers a credit event.
- A credit event is something like bankruptcy, failure to pay, or a restructuring of the debt.
- The premium is quoted as a spread in basis points on the notional, the amount covered.
- The point is that credit risk moves from one party to another without anybody trading the loan or the bonds.
- You meet the credit default swap in Fixed Income and Derivatives.

24 The two cash flows of a credit default swap

Premium = spread × notional
Payment = notional × (1 − recovery rate)

CDS spread	Premium rate, in basis points
Notional	Amount of debt covered
Recovery rate	Share recovered, e.g. 40%
Protection payment	What the seller pays out

IN THE LESSON

- Two small formulas cover the money.
- The yearly premium equals the C D S spread times the notional.
- The payment on a credit event equals the notional times one minus the recovery rate.
- Notice that the seller does not pay the whole notional, because the lender still recovers something from the failed borrower.
- The swap pays the shortfall.
- If recovery is forty per cent, the lender gets that share from the borrower, and the seller pays the rest of the notional.
- Together they restore the lender to the full amount it was owed.
- The common mistake is to pay out the whole notional and forget about recovery.

25 A credit default swap, worked

Notional 5,000,000. Spread 200bp. Default at year 2, recovery 40%

Premium each year	2% × 5,000,000	**100,000**
Premiums paid in 2 years	2 × 100,000	**200,000**
Loan recovers	40% × 5,000,000	**2,000,000**
Seller pays	5,000,000 × (1 − 0.40)	**3,000,000**
Bank ends with	2.0m + 3.0m − 0.2m	**4,800,000**

IN THE LESSON

- Worked example.
- Roswell Bank has lent five million dollars and buys protection on that amount at a spread of two hundred basis points.
- That is two per cent of five million, a premium of one hundred thousand a year.
- The borrower defaults at the end of the second year, so the bank has paid two hundred thousand in premiums.
- Recovery turns out to be forty per cent, so the loan brings back two million.
- The seller pays the notional times one minus the recovery rate, which is three million.
- The bank now holds two million plus three million, less the premiums of two hundred thousand, which is four million eight hundred thousand.
- It is out only the cost of the insurance.

26 Tranche: a slice with its own place in the queue

Pool of 100 million: losses are absorbed in this order

Equity 6: first losses → Mezzanine 14: next → Senior 80: last

Cash is paid in the opposite order

Senior paid first → Mezzanine paid next → Equity gets the rest

IN THE LESSON

- One last credit word.
- Imagine a stack of champagne glasses, filled from the top.
- A securitisation pools many loans, then sells slices of the pool, and each slice is a tranche.
- What makes the slices different is their place in the queue.
- Losses fill the stack from the bottom.
- In our pool of one hundred million, the equity tranche of six million takes the first losses, the mezzanine of fourteen is next, and the senior of eighty is hit last.
- Cash flows the other way: the senior is paid first, the mezzanine next, and the equity gets whatever is left.
- This ranking is called subordination, and it lets ordinary loans support a very safe senior slice.
- You meet tranches in Fixed Income, and in Financial Statement Analysis the word also names the instalments in which a share award vests.

27 Losses climb the tranches

Tranches in $ millions: equity 6, mezzanine 14, senior 80

Pool loses 4	equity takes 4, keeps 2	**senior 0**
Pool loses 15	equity 6, mezzanine 9	**senior 0**
Pool loses 30	equity and mezzanine wiped out	**senior 10**

Senior loses 10 of 80 = 12.5%

IN THE LESSON

- Watch losses arrive.
- If the pool loses four million, the equity tranche absorbs all of it and has two left.
- Nothing reaches the others.
- If the pool loses fifteen, equity loses all six and the mezzanine takes the other nine.
- The senior still loses nothing.
- If the pool loses thirty, equity is gone, the mezzanine is gone, and the last ten lands on the senior tranche, which is twelve and a half per cent of its eighty.
- The order never changes.
- That only works if the loans do not all fail together, which is why a deep recession can hurt even a senior slice.

28 Commercial paper: IOUs sold to investors

- Commercial paper: unsecured short-term IOU for investors
- Issued by large, highly rated companies; matures in months
- Cheaper than a bank loan, but it must be rolled over
- Risk: if the market shuts, no new buyers (rollover risk)

IN THE LESSON

- Big companies sometimes skip the bank.
- A restaurant chain needs cash for a few months.
- Instead of a bank loan, it writes a short IOU and sells it to investors.
- That IOU is commercial paper: unsecured short-term debt, sold directly to investors by large, highly rated issuers, usually maturing within months.
- Unsecured means no assets are pledged, so only strong names can sell it.
- It is usually cheaper than a bank loan.
- The catch is that it must be sold again, rolled over, when it matures.
- If the market shuts, the company still owes the money and cannot find new buyers.
- That is rollover risk, and companies usually guard against it with a committed backup credit line from a bank.
- You meet commercial paper in Corporate Issuers and Fixed Income.

29 Paper or a bank loan?

Verano Foods borrows 50 for a year ($ millions)

Bank loan	6.0% × 50	**3.00**
Commercial paper	5.0% × 50	**2.50**
Backup line fee	0.2% × 50	**0.10**
Paper, all in	2.50 + 0.10	**2.60**
Saving against the loan	3.00 − 2.60	**0.40**

IN THE LESSON

- Example.
- Verano Foods needs fifty million dollars for a year.
- A bank loan would cost six per cent, which is three million dollars.
- Commercial paper costs five per cent, which is two and a half million.
- But Verano buys a committed backup line from its bank, in case the paper cannot be rolled over, for a fee of two tenths of one per cent, which is one tenth of a million.
- All in, the paper costs two point six million.
- That is still cheaper than the loan, a saving of four tenths of a million.
- The backup fee is the price of sleeping at night.

30 Bond ladder: a staircase of maturities

One year of the ladder

Five equal rungs, 20 invested in each →
The shortest rung matures →
Reinvest in a new 5-year bond

What the ladder gives you

A rung of cash every year →
Reinvesting in small pieces →
Rate risk still remains

IN THE LESSON

- Last term, and a picture of a staircase.
- A bond ladder is a portfolio with roughly equal amounts maturing at regular intervals.
- Say an investor puts twenty million into each of five bonds, maturing in one, two, three, four and five years.
- Each year the shortest rung matures.
- The cash comes back, and the investor buys a new five-year bond with it, so the ladder keeps its shape.
- Cash comes due regularly, and reinvestment happens bit by bit, in different market conditions, not all at once.
- That spreads reinvestment risk, the risk that rates are low on the day you must reinvest.
- But a ladder is not safe from rates.
- It still carries duration.
- You meet the portfolio in Fixed Income, and the staircase picture in Economics and Corporate Issuers, where it describes a series of steps.

31 A ladder and its duration

Five zero-coupon rungs, 20 invested in each, flat 5% yields, years 1 to 5

Total invested	5 × 20	**100**
Cash back each year	20×1.05^{t}, one rung	**21 to 26**
Average maturity	(1+2+3+4+5) ÷ 5	**3.0 years**
Duration	3.0 ÷ 1.05	**2.86**
Yields rise 1 point: price falls	duration × 1%, roughly	**2.86%**

IN THE LESSON

- The numbers.
- Take five rungs of twenty, a total of one hundred, with all yields at five per cent.
- One rung matures every year, and each twenty grows at five per cent, so the cash back rises from about twenty-one in year one to about twenty-six in year five.
- The average maturity is one plus two plus three plus four plus five, over five, which is three years.
- Duration measures how sensitive a price is to yields, and for these bonds it is three divided by one point zero five, about two point eight six.
- So if every yield rises by one percentage point, the portfolio's price falls by about two point eight six per cent.
- The ladder does not remove rate risk.
- It spreads the reinvestment risk over many dates and gives steady cash.

32 Recap: the key relationships

Price = Σ CF ÷ (1+y)^t (1+z_2)^2 = (1+z_1)(1+f)
EL = Exposure × PD × (1 − R) Conv. value = Price × Ratio

Rates	Yield, spot, forward
Credit	Recovery, loss, spread
Protection	Swap, tranche
Contracts	Covenant, convertible
Funding	Paper, ladder

IN THE LESSON

- Let us pull it together.
- The yield to maturity is the one rate that makes a bond's payments worth its price, but it is promised, not expected.
- A spot rate belongs to one payment, and a forward rate comes from dividing growth factors, as a breakeven.
- Expected loss is exposure times the chance of default times one minus the recovery rate.
- A credit spread holds expected loss plus other premiums.
- A credit default swap pays the notional times one minus the recovery rate.
- A covenant tells the borrower what it must or must not do.
- A convertible is worth at least the higher of its straight value and its conversion value, which is share price times ratio.
- Tranches take losses from the bottom up.
- Commercial paper must be rolled over, and a ladder spreads reinvestment dates but still carries duration.

33 Try three quick questions

1. Keep assets insured; do not pledge assets to others. Which is affirmative, which negative?
   Answer: Insured = affirmative (must do). No pledging = negative (must not).
2. Loan 500,000, default chance 4%, recovery 40%. Expected loss?
   Answer: 500,000 × 0.04 × 0.60 = 12,000.
3. Spot rates: 1 year 2%, 2 years 3%. Forward rate for year 2?
   Answer: $1.03^2 \div 1.02 - 1 = 4.01\%$.

IN THE LESSON

- Now try three quick questions yourself.
- Pause after each one.
- Question one.
- Which is affirmative and which is negative: keep the assets insured, and do not pledge assets to other lenders?
- Keeping the assets insured is affirmative, a must do.
- Not pledging assets is negative, a must not do.
- Question two.
- A lender has five hundred thousand dollars out, the chance of default is four per cent, and recovery would be forty per cent.
- What is the expected loss?
- Loss given default is sixty per cent, so five hundred thousand times point zero four times point six is twelve thousand dollars.
- Question three.
- The one-year spot rate is two per cent and the two-year spot rate is three per cent.
- What is the forward rate for the second year?
- One point zero three squared, divided by one point zero two, minus one, is four point zero one per cent.
- Well done.