Building equity portfolios and funding a liability

Portfolio Management

1 A story: the crowded door

- Same recipe, bigger crowd, narrower door
- Market impact: your own trade moves the price
- Size, liquidity and turnover set what is possible
- Capacity: the size where costs eat the edge

IN THE LESSON

- Picture a small cafe with a narrow door.
- A handful of customers can slip in and out without anyone noticing.
- Now a whole coach party arrives, and the same door becomes a jam.
- The recipe has not changed, but the cost of getting through the door has.
- An equity fund is just like that.
- Tessa Rowan at Hawkmoor Capital runs a small company fund with ideas that work.
- As the fund grows, each trade becomes a bigger slice of what the market trades in a day, and the price moves against her as she buys or sells.
- That price move is called market impact, and today we measure it.

2 Two ways to adapt as assets grow

Hold more names

Add stocks → Smaller trades → Weaker ideas

Trade more slowly

Spread over days → Smaller slices → Edge may fade

IN THE LESSON

- As assets grow, Tessa has two ways to cope.
- The top row is the first.
- She can hold more names, so each position is a smaller weight.
- Smaller trades mean less impact.
- But her last idea is rarely as good as her first, so her best ideas now carry less weight.
- We call that diluted conviction.
- The bottom row is the second way.
- She can trade over more days, so each day is a smaller slice of the stock's volume.
- Impact falls, but she acts later, and the edge may have faded before the trade is finished.
- Neither fix is free.
- Each gives back some alpha, the extra return that skill adds above the benchmark.

3 Days to exit and cost drag

Days to exit = position ÷ (limit × daily volume)
Cost drag = turnover × round-trip cost

Position size	Weight times assets
Volume limit	Share of a day's volume
Daily volume	Money traded in a typical day
Turnover	Share of fund replaced a year
Round-trip cost	Buying then selling one holding

IN THE LESSON

- Two small formulas turn this into numbers.
- The first is about liquidity, which means how easily a stock trades without the price moving.
- Daily volume is the money value that trades in a typical day.
- Hawkmoor's rules cap its trading at a share of that volume, and demand that any position can be sold within a set number of days.
- So days to exit equals the position, divided by the volume limit times the daily volume.
- The second is about turnover, the share of the portfolio replaced in a year.
- Cost drag equals turnover times the round trip cost, the price of buying and then selling a holding.
- Busy funds pay that price again and again.

4 Example 1: when does the rule bind?

50 stocks at 2%; daily volume 20m; trade at most 20% of it; exit in 5 days

Largest position the rules allow	20m × 20% × 5 days	**$20m**
Days to exit at $500m	10m ÷ (20% × 20m)	**2.5 days**
Days to exit at $2bn	40m ÷ (20% × 20m)	**10 days**
Assets at which the rule binds	20m ÷ 2%	**$1bn**

IN THE LESSON

- Hawkmoor's small company fund holds fifty stocks at about two per cent each.
- A typical stock trades twenty million dollars a day.
- The rules say trade no more than twenty per cent of daily volume, and be able to exit in five days.
- So the largest position allowed is twenty million times twenty per cent times five days, which is twenty million.
- At five hundred million of assets, a two per cent position is ten million.
- At twenty per cent of daily volume, the exit takes two and a half days.
- At two billion, the position is forty million, and the exit takes ten days.
- The rule binds where two per cent of assets reaches twenty million, at one billion dollars.

5 Days to exit as the fund grows

Days to exit one position

$500m	**2.5**
$1bn	**5**
$1.5bn	**7.5**
$2bn	**10**

Rule: exit within 5 days

IN THE LESSON

- Here is the same story as a picture.
- The vertical axis is days to exit one position, and every bar is the fund at a different size with two per cent positions.
- At five hundred million dollars, the exit takes two and a half days, which is comfortable.
- At one billion, it takes five days, exactly on the line.
- At one and a half billion, seven and a half days, and at two billion, ten.
- Nothing about Tessa's ideas changed.
- Only size did.
- So when the client offers enough new money to take the fund to two billion, the responsible answer is to take part of it and close the fund to new money at about one billion.
- A back test, a trial on past prices, would never warn her, because it never moves the price.

6 Example 2: more names, weaker ideas

At $2bn: 100 stocks at 1% instead of 50 at 2%

Position with 100 names	1% × $2bn	**$20m**
Days to exit	20m ÷ (20% × 20m)	**5 days**
Alpha of the top 50 ideas	assumed	**3.0%**
Alpha of the next 50 ideas	assumed	**1.0%**
Alpha of the 100-name fund	(3.0% + 1.0%) ÷ 2	**2.0%**

IN THE LESSON

- Could Tessa take the money by holding more stocks?
- At two billion, suppose she doubles the count to one hundred names at one per cent each.
- Each position is twenty million dollars, and the exit takes five days, so the liquidity rule is met again.
- Now the price of that choice.
- Suppose her best fifty ideas are expected to add three per cent a year, and the next fifty only one per cent.
- Equal weights give her an average of two per cent.
- A third of the alpha has gone, even though every position now passes the liquidity test.
- This is the trade off behind the note: more names cuts impact, but it dilutes conviction, and the client gets less skill per dollar.

7 Example 3: turnover and trading cost

Alpha 4%; turnover 150%; trade cost 0.4% at $500m, 1.6% at $2bn

Cost drag at $500m	150% × 0.4%	**0.6%**
Net alpha at $500m	4.0% − 0.6%	**3.4%**
Cost drag at $2bn	150% × 1.6%	**2.4%**
Net alpha at $2bn	4.0% − 2.4%	**1.6%**
Net alpha is zero at	4.0 ÷ 0.0012 per $m	**$3.3bn**

IN THE LESSON

- Now turnover.
- Suppose the strategy adds four per cent a year before trading costs, and turns over one hundred and fifty per cent of the fund a year.
- The cost of a round trip grows with size, because impact does.
- Say it is point four per cent at five hundred million and one point six per cent at two billion.
- At five hundred million, the drag is one and a half times point four, which is point six per cent, leaving net alpha of three point four.
- At two billion, the drag is two point four per cent, and net alpha is down to one point six.
- Keep that cost line rising and net alpha reaches zero at about three point three billion.
- A slower strategy pays far less, which is why busy funds hit their limit first.

8 Capacity: where costs meet alpha

Chart: % a year vs Assets under management

- Expected alpha 4%
- Cost drag
- Capacity $3.3bn

IN THE LESSON

- This picture shows capacity.
- The horizontal axis is assets under management.
- The vertical axis is per cent a year.
- The flat green line is expected alpha, four per cent.
- It does not depend on how much money follows the ideas.
- The rising red line is the cost drag.
- It starts near zero when the fund is small, and climbs as every trade pushes the price harder.
- Where the red line meets the green line, net alpha is nothing.
- That is capacity, here about three point three billion dollars.
- A careful manager stops well before that, because the client wants alpha left after costs, not an alpha of zero.

9 The trap, and the responsible answer

- Paper returns ignore the cost of size
- Liquidity limit: days of volume, not hope
- Small caps and high turnover hit capacity first
- Take part of the money, then close the fund

IN THE LESSON

- Here is the trap the exam sets.
- A back test looks wonderful, so a manager promises the same returns at many times the size.
- But the back test never paid market impact, and it never had to sell into a falling market.
- Judge a strategy on paper returns, without scaling for impact, and you are judging a fund that does not exist.
- Small company stocks reach their limit first, because their daily volume is thin, and so do busy funds, because they trade so often.
- The responsible manager writes a limit in days of volume, takes only part of an offer of new money, and closes the fund to new money before capacity is breached.

10 A story: paying for the bread

- Hired for stock picking, paid active fees
- Risk report: tracking error 5%, limit 4%
- Where does the risk actually come from?
- Match the risks to the skill and the mandate

IN THE LESSON

- Imagine hiring a chef famous for her sauces, then finding that most of your bill is for bread.
- Glenarris Pension Scheme hired Hawkmoor's Select Fund for one skill, picking individual stocks, and pays active fees for it.
- Its risk report shows a tracking error of five per cent, which is the volatility of its return relative to the benchmark.
- The mandate allows only four.
- Worse, much of that risk comes from something Hawkmoor never claimed to be good at.
- A portfolio is efficiently structured when its risks line up with the skills the manager claims, and with the limits in the mandate.
- So the first job is to look inside the risk.

11 Where the active risk comes from

Share of active variance, by source

Source of active risk	Share
Stock selection (hired for)	30%
Value tilt (unintended)	45%
Beta of 1.15 (unintended)	15%
Sector bets (unintended)	10%

IN THE LESSON

- The first test is to decompose the active risk.
- Active variance is the square of tracking error, and a risk model can split it by source.
- Here is its answer for the Select Fund.
- Stock selection, the intended source, is thirty per cent.
- The rest is unintended.
- A value tilt, a lean toward cheap stocks as a group, makes up forty five per cent.
- A beta of one point one five, which is more sensitive to the market than the benchmark, adds fifteen per cent.
- Sector bets add ten.
- So seventy per cent of the risk the client pays active fees for is not stock picking.
- The value tilt and the extra beta could be bought cheaply through index products.
- That is the inefficiency.

12 Splitting and resizing active risk

TE² = sum of source variances (unrelated)
Resize bets by k: variance × k²

Tracking error	Square it to get variance
One risk source	One part of the active risk
Resize factor	Variance grows with k squared

IN THE LESSON

- Two rules make the arithmetic work.
- First, variance is the square of tracking error.
- If the sources are unrelated, which we assume here, total active variance is just the sum of each source's variance, and a source's share is its variance divided by the total.
- Second, and this is the key to resizing, if you multiply a set of active positions by a factor, their variance is multiplied by the factor squared.
- Variance grows with the square.
- So making the stock bets bigger raises their variance by more than the same proportion.
- Keep both rules in mind, because the next example uses them to rebuild the portfolio.

13 Example 4: fixing the Select Fund

Tracking error 5% against a 4% limit; active variance split as shown

Active variance now	5 × 5	**25**
Stock selection's part	30% × 25	**7.5**
Drop value and beta	7.5 + 2.5 sector	**10.0**
Enlarge stock bets by 1.34	7.5 × 1.8 + 2.5	**16.0**
Stock selection's share	13.5 ÷ 16	**84%**

IN THE LESSON

- Let us rebuild the Select Fund.
- Tracking error is five, so active variance is twenty five.
- Stock selection holds thirty per cent of that, seven and a half.
- Step one: neutralise the value tilt and the extra beta, which removes them from the optimiser's choices.
- What is left is seven and a half of stock picking plus two and a half of sector bets, a total of ten.
- Tracking error is now well under the limit, but we are not using the risk budget on the skill we are paying for.
- Step two: enlarge the stock bets by one point three four, which raises their variance by one point eight.
- Seven and a half times one point eight, plus two and a half, is sixteen, a tracking error of exactly four.
- Stock selection is now thirteen and a half of sixteen, eighty four per cent.
- That is a far better use of the budget.

14 Where the risk is spent, before and after

Share of active risk (%)

Picks now	**30%**
Picks after	**84%**
Other now	**70%**
Other after	**16%**

Active variance: 25 now, 16 after

IN THE LESSON

- Here is the result as a picture.
- The vertical axis is the share of active risk, in per cent.
- The first green bar shows stock picking now, at thirty per cent.
- After the rebuild it is eighty four.
- The red bars show everything else, the risk the manager never claimed skill in.
- It starts at seventy per cent and ends at sixteen, which is just the sector bets that remain.
- The fund still takes the same tracking error budget, but now the client is paying active fees for risk that matches the manager's claimed skill.
- That is the test of efficiency: not how much risk, but whether it is the right risk, inside the limit the mandate sets.

15 Example 5: does the trading pay?

Turnover 120%; round-trip cost 0.5%; the trading adds 0.40% of alpha

Cost drag now	120% × 0.5%	**0.6%**
Net value of the trading	0.40% − 0.6%	**−0.2%**
Cost drag at 60% turnover	60% × 0.5%	**0.3%**
Alpha kept from the best trades	assumed	**0.38%**
Net value after the cut	0.38% − 0.3%	**+0.08%**

IN THE LESSON

- The mandate also sets cost limits, so check turnover.
- The Select Fund turns over one hundred and twenty per cent of its portfolio a year, at a round trip cost of half a per cent.
- The cost drag is one point two times half a per cent, which is point six per cent.
- Suppose its trading adds point four per cent of alpha.
- Then the trading loses point two per cent net.
- Now suppose Tessa halves the turnover to sixty per cent, keeping only the best trades, which still add point three eight.
- The drag falls to point three, and the net contribution turns positive, plus point oh eight.
- Cutting trades that only cost money saves the client fees, and gives up almost none of the alpha.
- So the recommendation has three parts: neutralise, resize and trim turnover.

16 A story: the one-way door

- Long-only: own a stock or not, never short it
- A disliked tiny stock can only be cut to zero
- Shorting lets negative views count
- It also changes the risk, cost and kind of return

IN THE LESSON

- Think of a door that only opens one way.
- A long only manager can back a stock she likes as heavily as she wishes, but she can only cut a stock she dislikes down to zero.
- A short position works in reverse.
- The manager borrows shares, sells them, and buys them back later, hoping to pay less.
- She gains if the price falls.
- For a stock that is a tiny slice of the benchmark, selling the whole holding is hardly an underweight at all.
- Tessa has negative views she cannot use.
- Glenarris wants to keep its market exposure near one.
- So let us compare four ways to build the portfolio, and what each costs.

17 Four structures and their market exposure

Net exposure to the equity market

Structure	Net exposure
Long-only	100%
Long extension, 130/30	100%
Market-neutral long/short	0%
Equitised market-neutral	100%

IN THE LESSON

- Here are the four structures.
- Long only is the familiar one: all the money is invested in shares, and net market exposure is one hundred per cent.
- Long extension, for example one hundred thirty, thirty, shorts stocks worth thirty per cent of capital and uses the proceeds to buy thirty per cent more on the long side.
- Net exposure stays at one hundred per cent, so beta stays near one.
- A market neutral long short portfolio holds longs and shorts in balance, so its market exposure is about zero.
- Last, an equitised market neutral portfolio adds index futures to put the market exposure back, to one hundred per cent.
- Same skill, four packages.

18 Example 6: what shorting buys

Stock X is 0.2% of the index; the fund may short 1.5% of capital

Long-only: largest underweight	0% − 0.2%	**0.2 pts**
130/30: short 1.5% of capital	0.2 + 1.5	**1.7 pts**
130/30 net exposure	130% − 30%	**100%**
130/30 gross exposure	130% + 30%	**160%**
Cost of the freedom	borrow, margin, squeeze	**Higher**

IN THE LESSON

- Take a stock that Tessa dislikes, which is only point two per cent of the index.
- A long only fund can underweight it by at most point two points, by owning none.
- In a one hundred thirty, thirty fund she can short one and a half per cent of capital in it, so the underweight is point two plus one and a half, one point seven points.
- Her negative view now really counts.
- Look at the exposure.
- Net exposure is one thirty minus thirty, one hundred per cent, so the market exposure is unchanged.
- But gross exposure, longs plus shorts, is one sixty per cent.
- That gap is the leverage she takes on, and it brings borrowing fees, margin requirements and the risk of a short squeeze, a sudden jump in price that forces shorts to buy back at a loss.

19 Returns of neutral and equitised books

Neutral = (Long − Short) + Cash − Borrowing
Equitised = Neutral + (Market − Cash)

Longs less shorts	Longs' return minus shorts'
Cash interest	Interest on the cash held
Borrowing cost	Fee to borrow the shares
Market return	Added by index futures

IN THE LESSON

- A market neutral book has no beta, so its return is not the market's return.
- It is the spread between what the longs earn and what the shorts earn, plus interest on the cash the short sales raise, less the cost of borrowing the shares.
- Now equitise it.
- Buy index futures, and the book earns the market's return as well.
- A futures position needs little cash, so the money earns interest anyway.
- The extra return is therefore the market return minus the cash rate.
- That is why an equitised book earns neutral alpha on top of market exposure.
- It is a way to choose how much market to take, separately from the stock picking.

20 Example 7: neutral against equitised

Longs +9%, shorts +4%, market +6%, cash 3%, borrowing 0.5%

Spread, longs less shorts	9% − 4%	**5.0%**
Add cash, less borrowing	5.0% + 3% − 0.5%	**7.5%**
Futures overlay adds	6% − 3%	**3.0%**
Equitised return	7.5% + 3.0%	**10.5%**

IN THE LESSON

- Now a year's numbers for Tessa's market neutral idea.
- Her longs return nine per cent and the stocks she shorts return four per cent, so the spread is five per cent.
- Cash earns three per cent, so interest adds three, and borrowing the shares costs half a per cent.
- The market neutral return is five plus three minus point five, seven and a half per cent.
- Now the client buys index futures.
- The market returned six per cent and cash three, so the futures add three.
- The equitised return is ten and a half.
- Shorting lets the negative views count, and the client chooses how much market to take beside them: none, for seven and a half, or all of it, for ten and a half.
- That is the real choice on offer.

21 What a short position can do to you

Chart: Profit or loss ($) vs Share price ($)

- Entry price 40
- Long: worst loss is 40
- Short: no floor
- Loss 60 at 100

IN THE LESSON

- Now the risk everyone forgets.
- The horizontal axis is the share price, up to one hundred dollars.
- The vertical axis is profit or loss.
- Suppose you trade at an entry price of forty dollars.
- The rising green line is owning the share.
- The worst that can happen is the price goes to zero, and you lose forty.
- Your loss has a floor.
- The falling red line is the short position.
- It gains if the price falls, but if the price rises there is no floor.
- At one hundred dollars the loss is already sixty, and the line keeps on falling as the price climbs.
- In theory the loss is unlimited, and the lender can also recall the shares at a bad moment.

22 More shorting, more exposure to manage

Gross exposure (% of capital)

Long-only	**100%**
130/30	**160%**
Neutral 100/100	**200%**
Equitised	**300%**

Futures counted at full size

IN THE LESSON

- Alpha potential and cost move together.
- The vertical axis is gross exposure, longs plus shorts, as a share of capital.
- Long only has a bar of one hundred per cent.
- The one hundred thirty, thirty fund is at one hundred sixty.
- A market neutral book with one hundred per cent long and one hundred per cent short is at two hundred.
- Equitise it, counting the futures at full size, and it reaches three hundred.
- More shorting gives the manager more room to act on negative views, so more alpha potential.
- But every step right adds borrowing fees, margin and financing costs, more complexity, and more ways for a mistake to hurt.
- Long only stays the simplest, cheapest, and highest capacity of the four.

23 Which structure for which client

If the client wants ... choose

If the client wants ...	Choose
Low cost, big capacity, market return	Long-only
Beta near one, room for alpha	130/30
Returns that ignore the equity market	Neutral
Neutral alpha plus the market	Equitised

IN THE LESSON

- Now the decision.
- A good answer matches the structure to what the client wants, and names the costs.
- If Glenarris wants low cost, a big capacity and the market's return, long only fits.
- If it wants market exposure near one but needs room to act on negative views, long extension is the answer.
- If it wants returns that ignore the equity market, a market neutral book gives that.
- If it wants market neutral alpha on top of a market return, it equitises.
- Here, Glenarris needs beta close to one, so Tessa should propose the one hundred thirty, thirty fund.
- The defence is clear: shorts add alpha room.
- The warning is plain too: borrowing fees, margin, and squeeze risk.

24 Mistakes to avoid so far

- Trusting a back test run at a size never traded
- Counting any active risk as skill
- Cutting risk without resizing the bets that earn the fee
- Calling 130/30 leveraged beta: net exposure is 100%
- Forgetting a short has no ceiling and can be recalled

IN THE LESSON

- Let us collect the traps from the first three topics.
- One: judging a strategy on a back test at a size it has never run at, when market impact grows with size.
- Two: counting any active risk as skill, when only the risk from the manager's claimed skills deserves an active fee.
- Three: cutting risk without resizing the bets that earn the fee, which leaves the budget unspent.
- Four: calling a one hundred thirty, thirty fund leveraged beta, when its net exposure is still one hundred per cent.
- And five: forgetting that a short position has no ceiling on its loss, and that the lender can recall the shares.

25 A story: a bill due on one day

- Glenarris owes $10m in exactly 5 years
- 1. Market value at least the liability's present value
- 2. Macaulay duration equals the time to payment
- 3. Lowest convexity that still beats the liability's
- Duration drifts, so rebalance

IN THE LESSON

- Glenarris owes one lump sum of ten million dollars in exactly five years, to settle a court award.
- It could simply wait, but it would rather lock the payment in today with a bond portfolio.
- The classic method is immunisation, and it has three conditions.
- First, the portfolio's market value must at least equal the present value of the payment.
- Second, its Macaulay duration, the weighted average time to its cash flows, must equal the time to the payment.
- Third, its convexity, the curvature of its price against yield, should be as low as possible while still exceeding the liability's.
- Because duration drifts, the match also needs rebalancing as time passes.

26 Why matching duration works

Rates rise

Prices fall → Reinvest higher → Payment still met

Rates fall

Prices rise → Reinvest lower → Payment still met

IN THE LESSON

- Why does matching duration work?
- Follow the two rows.
- In the top row, rates rise.
- The bonds fall in price, and that hurts.
- But the coupons and maturing bonds are reinvested at the higher rate, and that helps.
- When duration equals the time to the payment, the two effects offset, and the portfolio still reaches the amount owed.
- In the bottom row, rates fall.
- Prices rise, but reinvestment earns less, and again the two offset.
- This locks in the portfolio's yield.
- The offset holds for a parallel move in yields, where every maturity shifts together.
- Price risk and reinvestment risk work against each other, and duration is how we balance them.

27 Duration and convexity of the portfolio

Duration = sum of weight × duration
Zero convexity = $T \times (T + 1) \div (1 + y)^2$

Weight	Share of portfolio value
Macaulay duration	Years; zero: its maturity
Years to maturity	Time until the bond pays
Yield	Annual yield, as a decimal

IN THE LESSON

- Two formulas do the matching.
- A portfolio's Macaulay duration is the weighted average of its bonds' durations, with weights equal to each bond's share of the portfolio's value.
- For a zero coupon bond, duration is simply its years to maturity.
- Convexity of an annual zero is the years to maturity times that number plus one, divided by one plus the yield, squared.
- Convexity grows quickly with maturity, so a mix of short and long bonds has much more convexity than a single bond at the middle date.
- That extra convexity is not a gain here.
- It measures how far the cash flows are spread away from the payment date, and we want them close.

28 Example 8: two portfolios that fit

Pay $10m in 5 years; flat yield 4%; zero versus 2-year and 8-year barbell

Value needed today	10m ÷ 1.04^5	**$8.22m**
Barbell duration	0.5 × 2 + 0.5 × 8	**5 years**
Liability and zero convexity	5 × 6 ÷ 1.04²	**27.7**
Barbell convexity	avg of 5.5 and 66.6	**36.1**

IN THE LESSON

- Glenarris can fund the payment two ways, with the yield curve flat at four per cent.
- The value needed today is ten million over one point oh four to the fifth, eight point two two million dollars.
- Portfolio one is a five year zero coupon bond, a bullet.
- Portfolio two is a barbell, half in a two year zero and half in an eight year zero.
- Its duration is half of two plus half of eight, five years, the same as the bullet.
- Both pass the first two tests.
- Now convexity.
- The zero, like the liability, has five times six over one point oh four squared, twenty seven point seven.
- The barbell averages five point five and sixty six point six, thirty six point one.
- That extra curvature is the warning sign.

29 Example 9: the yield curve twists

2-year yield 3%, 8-year 5%, 5-year stays 4%; half of $8.22m in each

Two-year half	4.11m × (1.04/1.03)^2	**$4.19m**
Eight-year half	4.11m × (1.04/1.05)^8	**$3.81m**
Barbell after the twist	4.19m + 3.81m	**$8.00m**
Liability and the zero	5-year yield unchanged	**$8.22m**
Barbell less liability	8.00m − 8.22m	**– $0.22m**

IN THE LESSON

- Now the curve twists, not shifts.
- The two year yield falls to three per cent, the eight year rises to five, and the five year stays at four.
- The liability, priced off the five year yield, is still worth eight point two two million.
- The five year zero is untouched.
- But look at the barbell.
- Its two year half is now worth four point one nine million, and its eight year half is worth three point eight one.
- Together they come to eight million, short of the eight point two two million owed by point two two million dollars.
- Same duration, same starting cost, and the barbell is short.
- It was exposed to yields at maturities the liability does not care about.

30 A bet the client never chose

Gap to liability ($m)

Zero	**0.00**
Steepens	**−0.22**
Flattens	**+0.25**

Barbell gap after a twist; the zero has none

IN THE LESSON

- Here is the gap between the portfolio and the liability after a twist.
- The vertical axis is the size of the gap in millions of dollars.
- The first bar is the zero coupon bullet.
- It has no gap at all, whichever way the curve twists.
- The red bar is the barbell when the curve steepens, as we just saw.
- It is short by point two two million.
- The green bar is the barbell if the curve flattens instead, with the two year yield rising and the eight year falling.
- Then it is ahead by point two five million.
- The barbell can win or lose, depending on a twist nobody can predict.
- That is structural risk, and the client never chose to take it.

31 Structural risk by portfolio shape

All matched on value and duration; ranked by risk

Portfolio shape	Structural risk
Zero maturing on the date	Lowest
Bullet near the date	Low
Ladder around the date	Higher
Barbell, short and long	Highest

IN THE LESSON

- So here is the ranking, and the trap.
- The exam may suggest that any mix with the right duration works equally well.
- It does not.
- The lowest structural risk comes from a zero coupon bond that matures on the payment date, because its cash flow lands exactly on the date.
- A bullet of coupon bonds clustered near that date is close behind.
- A ladder, with maturities spread evenly around the date, carries more.
- A barbell, with short and long bonds at the two extremes, carries the most.
- Remember too that coupon bond durations drift as time passes and rates move, so those portfolios need rebalancing.
- A zero does not, because its duration falls exactly as fast as the time to the payment.

32 Recap: the lesson in five lines

- Capacity: days to exit, and turnover times cost
- Match active risk to skill; neutralise, resize, trim
- Shorts add alpha room, and leverage, cost and risk
- Neutral = spread + cash − borrowing; futures add market
- Immunise: value, duration, low convexity; bullet wins

IN THE LESSON

- Let us pull the lesson together.
- First, size, liquidity and turnover set capacity.
- Days to exit equals the position over the volume limit times daily volume, and cost drag equals turnover times round trip cost.
- Second, an efficient structure spends its active risk on the manager's claimed skill.
- Decompose the risk, neutralise unintended exposures, resize the bets and trim turnover that does not pay.
- Third, long extension keeps net exposure near one while shorts add alpha room.
- Market neutral earns the spread plus cash less borrowing, and futures add the market back.
- Fourth, immunise one liability with matched value and duration and the lowest convexity above the liability's.
- A bullet beats a barbell.

33 Try three quick questions

1. Position 2% of $800m; stock trades $10m a day; limit 25%. Days to exit?
   Answer: 16m ÷ (25% × 10m) = 16 ÷ 2.5 = 6.4 days.
2. Longs 8%, shorts 3%, cash 2%, borrowing 0.4%. Market-neutral return?
   Answer: (8 − 3) + 2 − 0.4 = 6.6%.
3. Pay $5m in 4 years; flat yield 5%. Value and duration needed?
   Answer: 5m ÷ 1.05^4 = $4.11m at least; duration 4 years.

IN THE LESSON

- Now try three quick questions yourself.
- Pause after each one.
- Question one.
- A fund holds a two per cent position with eight hundred million dollars of assets.
- The stock trades ten million a day, and the fund may trade twenty five per cent of that.
- How many days to exit?
- The position is sixteen million, the daily allowance is two and a half million, so it takes six point four days.
- Question two.
- Longs earn eight per cent, the shorts earn three, cash earns two and borrowing costs point four.
- What is the market neutral return?
- Eight minus three plus two minus point four is six point six per cent.
- Question three.
- A payment of five million is due in four years, with a flat yield of five per cent.
- What value and duration must the bond portfolio have?
- Five million over one point oh five to the fourth is about four point one one million, with a duration of four years, and the lowest convexity above the liability's.