

The four numbers, and the fifth, on one page

Chapters 4, 9 and 12 to 14. The front page of the risk report: four numbers in money on one set of inputs, and the one that is not in money, which no risk report carries.

Fund		Prepared by	
As at		Date	

#	The number	How it is computed	Halverton	Share	Your fund
1	Value at risk, one day, 99 per cent	Quantile x daily volatility x net assets	7,242,456	0.862% of NAV	
2	Stress loss, the spread scenario	Market value x spread duration x shock	93,277,800	11.10% of NAV	
3a	Cost of getting out: 25 per cent redemption, vertical slice	Half-spread x 4 + impact x 3 x 2 x fraction sold	5,101,785	2.733% of redemption	
3b	The same redemption, liquid-first	Same formula, cheapest sleeve first	2,016,532	1.080% of redemption	
4	Transfer to the investors who stay, per unit	Cost over the units remaining	0.8098 / 0.3201	0.91% / 0.36%	
5	One-week liquidity, before and after liquid-first	Seven-day assets over the portfolio	31.2% / 8.3%		

Question the front page must answer	Answered?	Figure
Three lines that decide how the four are read		
Which selling policy does line 3 assume, and who chose it? (chapter 14: "whoever is on the desk that morning")		
What is left inside a week after that policy, and what does the next redemption take? (workbook 4: 23.6, 15.1, 5.7 per cent)		
Does the collateral call land on the same morning, from the same sleeve? (chapter 16: 14,860,681)		

A report that carries lines 1 to 4 and not line 5 has priced the exit and left out what the exit spends. Read line 5 after the decision, not before it.

Value at risk, one visible step at a time

Chapter 4. Every step on its own row, so that the number can be argued with rather than accepted. The sleeves first, then the construction.

Fund		Prepared by	
As at		Date	

Sleeve	Market value	Weight	Volatility	Days to sell	Half-spread
Investment-grade credit	252,000,000	30.0%	4.5%	2	0.15%
High yield	294,000,000	35.0%	8.0%	8	0.45%
Leveraged loans	210,000,000	25.0%	6.0%	20	0.80%
Structured credit	84,000,000	10.0%	10.0%	30	1.40%

Your sleeves					

Step	Halverton	Yours
Volatility if every correlation were 1: weights x volatilities, summed	6.650%	
Portfolio variance: the sixteen cells of weight x vol x correlation x weight x vol	0.0034615	
Portfolio volatility, annual: its square root	5.883%	
Diversification benefit: the difference, in points and as a reduction	0.767 pts, 11.5%	
Daily volatility: over the root of 252 trading days	0.3706%	
Confidence multiplier: the normal quantile at 99 per cent	2.326348	
One-day value at risk: multiplier x daily volatility x net assets of 840,000,000	7,242,456	
Expected shortfall at 97.5 per cent, one day: 1.005 times it	7,278,117	
Twenty days by the root of time (chapter 7 objects: see the horizon note)	32,389,246	

Expected shortfall at 97.5 over value at risk at 99 is 1.005 on a normal distribution: switching measures changes almost nothing. What changes the answer is the tail, which is not in these rows.

The correlation memo: reported against crisis

Chapter 4. Four asset classes, four labels, one risk factor. The memo states both matrices and how much of the benefit survives the months that produce redemptions.

Fund		Prepared by	
As at		Date	

Reported	IG	HY	Loans	Struct.	Crisis	IG	HY	Loans	Struct.
IG	1.00	0.75	0.55	0.45	IG	1.00	0.92	0.88	0.82
HY	0.75	1.00	0.80	0.70	HY	0.92	1.00	0.95	0.90
Loans	0.55	0.80	1.00	0.65	Loans	0.88	0.95	1.00	0.93
Struct.	0.45	0.70	0.65	1.00	Struct.	0.82	0.90	0.93	1.00

Your matrices: reported, and the one you would use in a crisis

Line of the memo	Reported	Crisis	Yours, reported	Yours, crisis
Portfolio volatility, annual	5.883%	6.439%		
Volatility at correlation 1	6.650%	6.650%		
Diversification benefit, points	0.767	0.211		
as a reduction	11.5%	3.2%		
One-day value at risk, 99 per cent	7,242,456	7,925,849		
Crisis over reported		1.094 times		
Share of the benefit that survives		27.6%		

Statement	Checked?	Note
Three statements the memo should carry		
Where the crisis matrix comes from: which months, which markets, how many observations		
What the benefit is worth in money at each matrix (here 7,242,456 and 7,925,849)		
Which decisions assume the reported matrix: limits, capital, the leverage of the fund		

The benefit is small to begin with, and most of what there is disappears in the months that produce redemptions. A limit set on the reported matrix is a limit that loosens when it is needed.

The backtest log

Chapter 6. A 99 per cent measure promises exceptions, not their absence, and it promises that they arrive independently. The count tests the first promise; the log tests the second.

Fund		Prepared by	
As at		Date	

Observations	Expected	Green ends at	Amber ends at	Red from	Observed	Zone
250 (the published table)	2.5	4	9	10		
500 (Halverton, two years)	5	8	14	15	6	green
Yours						

#	Date	Loss that day	VaR that day	Excess	Days since the last	Cause	After an exception?

Line the report should carry	Pattern A (case two)	Pattern B (case two)	Yours
Exceptions, against 5 expected	6	6	
Count test (Kupiec), p-value	0.66	0.66	
Largest number in any five consecutive days	1	5	
Share of exceptions that followed an exception	0%	67%	
Independence test (Christoffersen), likelihood ratio	0.00	31.27	
p-value	0.98	0.00000002	

On 500 observations the green zone ends at 8, not 9: nine or fewer has a probability of 96.9 per cent from a correct model. Five exceptions over two years is a working model; five in one week is a model that stopped working, and the count is identical.

The horizon note

Chapter 7 and case one. The scaling assumes you can trade. State how long each sleeve takes to sell, give each its own horizon, and say what the model should have used.

Fund		Prepared by	
As at		Date	

Sleeve	Days to sell	Scale, own days	Equal slices, days	Yours: days to sell	Yours: why
Investment-grade credit	2	$\text{root}(2/252)$	1.25		
High yield	8	$\text{root}(8/252)$	3.19		
Leveraged loans	20	$\text{root}(20/252)$	7.18		
Structured credit	30	$\text{root}(30/252)$	10.51		

Result	Halverton	Days equivalent	Share of the stress	Yours
One-day value at risk	7,242,456	1	7.8%	
Twenty days, root of time	32,389,246	20	34.7%	
Each sleeve held to its own days to sell	24,029,172	11.0	25.8%	
Each sleeve sold in equal daily slices	14,978,648	4.3	16.1%	
Root of time over the average days to sell (11.3)	24,326,301	11.3	26.1%	
Stressed half-spread on the whole book	18,228,000		19.5%	
Own days plus the stressed half-spread	42,257,172		45.3%	
Stress loss, the chapter 9 scenario	93,277,800		100%	

Statement	Checked?	Note
What the note concludes		
The horizon the book implies, and whether the reported horizon covers it (here: 11.0 days; twenty covers it)		
What the horizon cannot supply: the cost of getting out, and the tail		

On this book the objection of chapter 7 is right in principle and small in size. The gap to the stress is the shape of the tail and the cost of exit, and no horizon closes it.

Before you run the stress: three outcome levels

Chapters 8 and 9. Write down what you will do differently at each of three outcome levels before the scenario is run. If the answer is the same at all three, the scenario is a report rather than a control.

Fund		Prepared by	
As at		Date	

Sleeve	Market value	Spread duration	Loss per 100 bp	Share of the fund	Yours: loss per 100 bp
Investment-grade credit	252,000,000	6.20	15,624,000	30%	
High yield	294,000,000	3.80	11,172,000	35%	
Leveraged loans	210,000,000	0.25	525,000	25%	
Structured credit	84,000,000	4.50	3,780,000	10%	
Total	840,000,000		31,101,000	100%	

Outcome level	Loss, share of net assets	What we will do	Who decides	By when
Level 1				
Level 2				
Level 3				

For comparison: where Halverton's scenario lands

The spread scenario of chapter 9	11.10%			
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Test	Yes / no	Note
Is the action different at each of the three levels?		
Is each action something the fund can do before the redemption arrives?		
Does the scenario reach financing as well as prices (the collateral call)?		

The leveraged loan sleeve is a quarter of the fund and 1.7 per cent of the stress loss. Floating rate is not a detail; it changes what the position is.

The scenario calibration sheet

Chapter 9. One shock per sleeve, each with its reason written beside it. On your calibration the total is whatever your calibration says; the sheet makes the calibration visible.

Fund				Prepared by		
As at				Date		

Sleeve	Market value	Spread duration	Shock, bp	Loss	Share of sleeve	Why this shock
Investment-grade credit	252,000,000	6.20	120	18,748,800	7.44%	
High yield	294,000,000	3.80	450	50,274,000	17.10%	
Leveraged loans	210,000,000	0.25	300	1,575,000	0.75%	
Structured credit	84,000,000	4.50	600	22,680,000	27.00%	
Total	840,000,000			93,277,800	11.10%	

Your scenario						

After the shock	Halverton	Yours
Net assets after the shock	746,722,200	
Net asset value per unit (from 100.00)	88.8955	
Stress over one-day value at risk	12.9 times	
Stress over twenty-day value at risk	2.9 times	
One-week liquidity after the shock	31.2%	

Root of time understates the event that matters by a factor of nearly three. The value at risk is not wrong; the distribution it was fitted to does not contain this.

Financing: the second door

Chapter 16. The scenario does not stop at the mark-to-market. Every financing line, its haircut calm and stressed, and the call that arrives on the same morning as the redemption.

Fund		Prepared by	
As at		Date	

Line	Borrowed	Haircut, calm	Haircut, stressed	Collateral, calm	Collateral, stressed	Call
Halverton repo	120,000,000	5%	15%	126,315,789	141,176,471	14,860,681

Your financing lines

The same morning	Halverton	Yours
Seven-day assets after the shock (investment-grade credit)	233,251,200	
Collateral call, met from the same sleeve	14,860,681	
Seven-day assets left for the redemption	218,390,519	
Net assets after the shock	746,722,200	
Largest redemption meetable inside a week, after the call	29.2%	
without the call	31.2%	
The chapter 13 redemption, 25 per cent	186,680,550	

Question for the financing counterparty	Answered?	Note
Can the haircut change without notice, and by how much in the last stress?		
Which assets are eligible, and are they the same ones the redemption needs?		

The call takes two points off the redemption the fund can meet inside a week. It appears nowhere in the mark-to-market loss.

The reverse stress worksheet

Chapter 10. Run the engine backwards: not what a scenario costs, but what would have to happen for the fund to fail at the dealing desk.

Fund		Prepared by	
As at		Date	

What would have to happen	Halverton	Yours
One redemption larger than this share of post-shock net assets, no call	31.2%	
The same, with the collateral call met first	29.2%	
Successive 10 per cent redemptions met inside a week, liquid-first	3	
The redemption that breaks it, liquid-first	the 4th: 54,436,048 against 30,889,484	
Of which posted against the repo	14,860,681	
Successive 10 per cent redemptions met inside a week, vertical slice	all 6	
The same, liquid-first with a floor at the next redemption plus the call (case three)	all 6	

Lever	Moves the breaking point by	Can be changed before the event?	Owner
Selling policy			
Financing terms (haircut, eligibility)			
Dealing frequency and notice			
Redemption gate or swing			

A fund fails at the dealing desk, not on the balance sheet. Reverse stress turns that into an observable you can put on the report.

The selling-policy decision record

Chapters 12 to 14. The decision nobody logs as a risk decision. One line per redemption: what was sold, what it cost, what was left inside a week, and who chose.

Fund		Prepared by	
As at		Date	

Date	Redemption	Policy	Cost	One-week before	One-week after	Next redemption meetable?	Decided by
Chapter 13	186,680,550	Vertical slice	5,101,785	31.2%	31.2%	yes	
Chapter 13	186,680,550	Liquid-first	2,016,532	31.2%	8.3%	yes, once	

Your redemptions

Six redemptions of 10 per cent	Vertical slice	Liquid-first	With a floor (case three)
Cost over six rounds	8,292,048	4,753,970	6,795,363
One-week liquidity after round 3	31.2%	5.7%	12.7%
One-week liquidity after round 6	31.2%	0.0%	13.7%
Redemptions not met inside a week	0	3	0

The cheap policy costs less money and leaves a quarter of the one-week liquidity. That is the trade, and it is made by whoever is on the desk that morning unless this record makes it somebody's decision.

The cost of the exit, and who pays it

Chapters 12 and 13. The cost of a 25 per cent redemption split sleeve by sleeve into its spread part and its impact part, and the transfer it makes to the investors who stay.

Fund		Prepared by	
As at		Date	

Sleeve	Sold, vertical	Spread part	Impact part	Sold, liquid-first	Spread part	Impact part
Investment-grade credit	58,312,800	349,877	87,469	186,680,550	1,120,083	896,449
High yield	60,931,500	1,096,767	319,890	0	0	0
Leveraged loans	52,106,250	1,667,400	468,956	0	0	0
Structured credit	15,330,000	858,480	252,945	0	0	0
Total	186,680,550	3,972,524	1,129,261	186,680,550	1,120,083	896,449

Impact coefficients scaled by	Vertical slice	Change	Liquid-first	Change	Yours
0.5	4,537,154	-11.1%	1,568,308	-22.2%	
1 (the book)	5,101,785		2,016,532		
2	6,231,045	22.1%	2,912,981	44.5%	
3	7,360,306	44.3%	3,809,430	88.9%	

Who pays	Vertical slice	Liquid-first	Yours
Net asset value per unit after, from 88.8955	88.0857	88.5754	
Loss per remaining unit	0.8098	0.3201	
as a percentage	0.91%	0.36%	
Selling-policy choice, per unit	0.4897		

Being wrong by a factor of three moves the answer 44 per cent; the choice of selling policy moves it 153. The parameter everybody argues about is not the one that decides.

The swing pricing memo, and the queue

Chapters 13 and 15. The swing that makes the investors who leave bear the cost of their own exit, and what the queue is worth to whoever is first out when there is none.

Fund		Prepared by	
As at		Date	

Swing	Vertical slice	Liquid-first	Yours
Redemption	186,680,550	186,680,550	
Cost of selling	5,101,785	2,016,532	
Neutralising swing factor	2.733%	1.080%	
Net asset value paid to the investor who leaves, swung	86.4661	87.9352	
Loss per remaining unit, once swung	0.0000	0.0000	

The queue, no swing	Portfolio before	Cost	NAV after	Units after
Redemption 1, 10 per cent	746,722,200	591,465	88.8173	7,560,000
Redemption 2	672,049,980	574,117	88.7329	6,803,334
Redemption 3	604,844,982	603,131	88.6344	6,121,687

The two decisions, per unit	Halverton	Yours
First out is served at	88.8955	
Last in is left with	88.6344	
First-mover advantage (revised: 0.0804 in the first edition of the workbook)	0.2611	
Selling-policy choice	0.4897	
Ratio	1.88	

The first edition of the workbook carried each redemption forward from the portfolio before costs, and understated the queue by more than two-thirds. The selling-policy choice is still the larger of the two; the industry writes its rules about the one with a villain.

The liquidity report: the fifth number, after the next decision

Chapter 14. What the fund can turn into cash inside a week, before the redemption and after each policy. The number you need is not the one before the event.

Fund		Prepared by	
As at		Date	

Sleeve	Days to sell	Before	After vertical slice	After liquid-first	Yours
Investment-grade credit	2	233,251,200	174,938,400	46,570,650	
High yield	8	243,726,000	182,794,500	243,726,000	
Leveraged loans	20	208,425,000	156,318,750	208,425,000	
Structured credit	30	61,320,000	45,990,000	61,320,000	
Portfolio		746,722,200	560,041,650	560,041,650	
One-week liquidity		31.2%	31.2%	8.3%	
Weighted average days to sell		11.3	11.3	14.4	

After round	Vertical slice	Liquid-first	With a floor	Yours
1	31.2%	23.6%	23.6%	
2	31.2%	15.1%	15.1%	
3	31.2%	5.7%	12.7%	
4	31.2%	0.0%	13.0%	
5	31.2%	0.0%	13.4%	
6	31.2%	0.0%	13.7%	
Cumulative cost, six rounds	8,292,048	4,753,970	6,795,363	

Do not read the one-week figure as a comfortable 31.2 per cent and move on. Run the redemption first, then read it again.