

Market assumption at 31.12.12

Bond	Maturity 31.12. ...	Face value	Coupon	Average yield annual
1	2 013	100.00	5.00 %	7.945607 %
2	2 014	100.00	5.00 %	7.616424 %
3	2 015	100.00	5.00 %	7.333579 %
4	2 016	100.00	5.00 %	7.091740 %
5	2 017	100.00	5.00 %	6.885408 %
6	2 018	100.00	5.00 %	6.709395 %
7	2 019	100.00	5.00 %	6.559044 %
8	2 020	100.00	5.00 %	6.430306 %
9	2 021	100.00	5.00 %	6.319723 %
10	2 022	100.00	5.00 %	6.224383 %

Payment matrix C

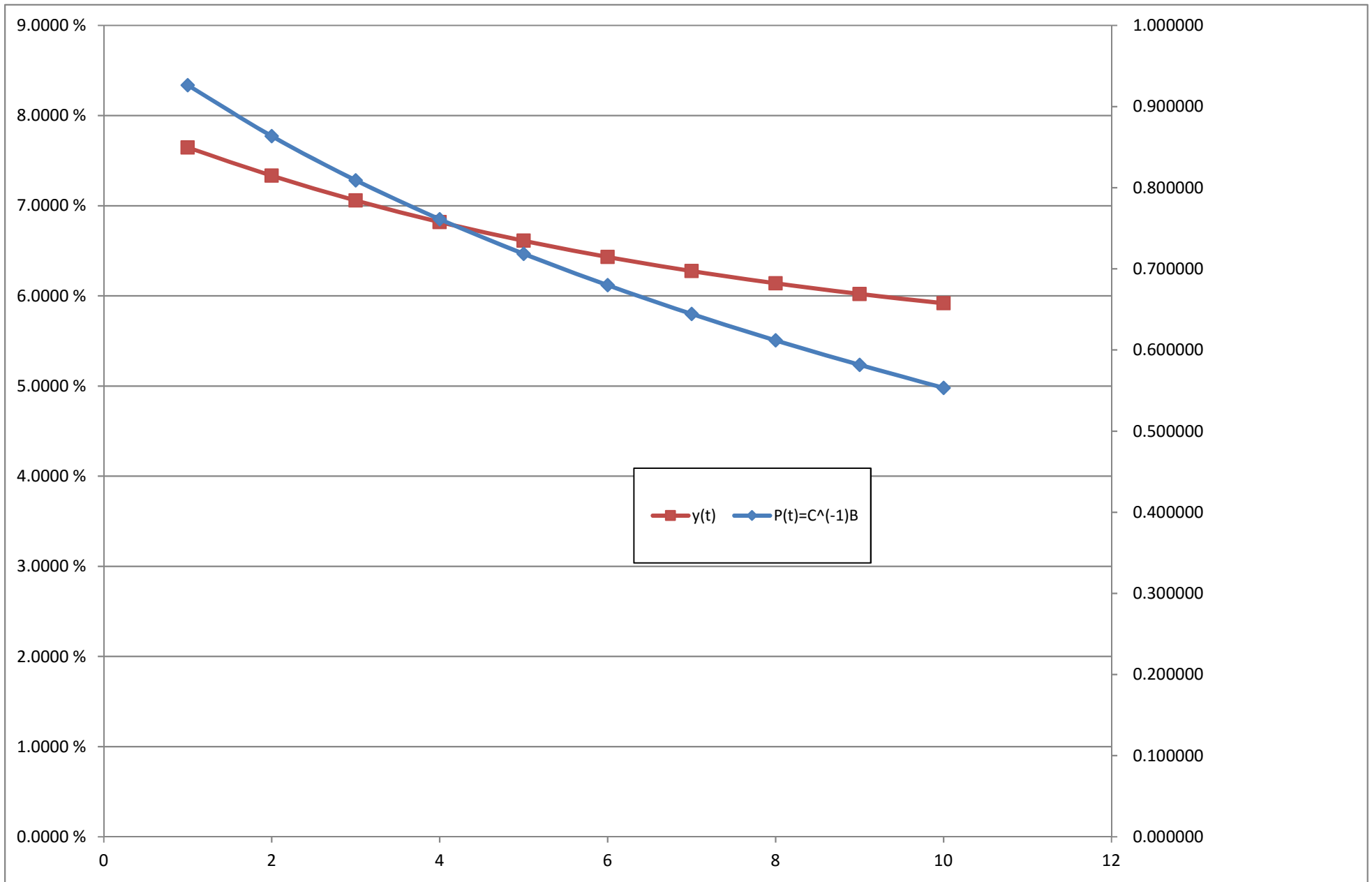
	2 013	2 014	2 015	2 016	2 017	2 018	2 019	2 020	2 021	2 022
	1	2	3	4	5	6	7	8	9	10
1	105.00	-	-	-	-	-	-	-	-	-
2	5.00	105.00	-	-	-	-	-	-	-	-
3	5.00	5.00	105.00	-	-	-	-	-	-	-
4	5.00	5.00	5.00	105.00	-	-	-	-	-	-
5	5.00	5.00	5.00	5.00	105.00	-	-	-	-	-
6	5.00	5.00	5.00	5.00	5.00	105.00	-	-	-	-
7	5.00	5.00	5.00	5.00	5.00	5.00	105.00	-	-	-
8	5.00	5.00	5.00	5.00	5.00	5.00	5.00	105.00	-	-
9	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	105.00	-
10	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	105.00

The clean market price

Bond	Maturity	Face value	Coupon	Average yield annual	Market price B NPV
1	2 013	100.00	5.00 %	7.945607 %	97.271212
2	2 014	100.00	5.00 %	7.616424 %	95.309569
3	2 015	100.00	5.00 %	7.333579 %	93.913084
4	2 016	100.00	5.00 %	7.091740 %	92.929484
5	2 017	100.00	5.00 %	6.885408 %	92.245678
6	2 018	100.00	5.00 %	6.709395 %	91.778486
7	2 019	100.00	5.00 %	6.559044 %	91.467136
8	2 020	100.00	5.00 %	6.430306 %	91.267403
9	2 021	100.00	5.00 %	6.319723 %	91.147242
10	2 022	100.00	5.00 %	6.224383 %	91.083464

The yield curve (continuous compounding)

Payment time t	$P(t)=C^{(-1)B}$	y(t)	Forward	Forward
1	0.926392	7.6457 %	7.6457 %	7.6457 %
2	0.863596	7.3325 %	7.0193 %	7.0193 %
3	0.809173	7.0581 %	6.5093 %	6.5093 %
4	0.761273	6.8191 %	6.1020 %	6.1020 %
5	0.718510	6.6115 %	5.7813 %	5.7813 %
6	0.679845	6.4315 %	5.5314 %	5.5314 %
7	0.644507	6.2753 %	5.3380 %	5.3380 %
8	0.611914	6.1396 %	5.1894 %	5.1894 %
9	0.581630	6.0213 %	5.0756 %	5.0756 %
10	0.553326	5.9181 %	4.9887 %	4.9887 %



An assumed liability cash flow

Actuarial predictions	
Year	Payments
2 013	1 000 000
2 014	1 000 000
2 015	1 000 000
2 016	1 000 000
2 017	1 000 000
2 018	1 000 000
2 019	1 000 000
2 020	1 000 000
2 021	1 000 000
2 022	1 000 000
Total	10 000 000

Time t	Yield curve					
	spot rate y(t)	P(0,t)	PV	t x PV	t^2 x PV	
1	7.6457 %	0.9263925	926 392	926 392	926 392	
2	7.3325 %	0.8635963	863 596	1 727 193	3 454 385	
3	7.0581 %	0.8091728	809 173	2 427 518	7 282 555	
4	6.8191 %	0.7612731	761 273	3 045 092	12 180 370	
5	6.6115 %	0.7185096	718 510	3 592 548	17 962 739	
6	6.4315 %	0.6798454	679 845	4 079 072	24 474 434	
7	6.2753 %	0.6445065	644 507	4 511 546	31 580 821	
8	6.1396 %	0.6119136	611 914	4 895 308	39 162 467	
9	6.0213 %	0.5816304	581 630	5 234 674	47 112 063	
10	5.9181 %	0.5533263	553 326	5 533 263	55 332 632	
			<u>7 150 166</u>	<u>35 972 607</u>	<u>239 468 859</u>	

Duration Convexity
5.0310168 33.49136865

Dispersion
8.180238963

Parallel shift
1.00 %

New yield curve		
spot rate y(t)	P(0,t)	PV
8.645728 %	0.9171747	917 175
8.332496 %	0.8464959	846 496
8.058094 %	0.7852581	785 258
7.819078 %	0.7314232	731 423
7.611525 %	0.6834674	683 467
7.431498 %	0.6402543	640 254
7.275290 %	0.6009339	600 934
7.139553 %	0.5648674	564 867
7.021334 %	0.5315702	531 570
6.918074 %	0.5006704	500 670
	<u>Exact new PV</u>	<u>6 802 115</u>
		-348 051

Estimated by
Duration only 6 790 440 -359 726
Duration and convexity 6 802 414 -347 753

The bonds you use

Maturity	3	5	10
Coupon	5.00 %	5.00 %	5.00 %
Face value	100.00	100.00	100.00

Bond investments (number of bonds)		
Maturity: 3	Maturity: 5	Maturity: 10
28 767	23 256	25 289

Time t	Yield curve	Price of €1	Liability cash flow	Bond payments per face value		
				Maturity: 3	Maturity: 5	Maturity: 10
1	7.645728 %	0.9264	1 000 000	5.00	5.00	5.00
2	7.332496 %	0.8636	1 000 000	5.00	5.00	5.00
3	7.058094 %	0.8092	1 000 000	105.00	5.00	5.00
4	6.819078 %	0.7613	1 000 000	-	5.00	5.00
5	6.611525 %	0.7185	1 000 000	-	105.00	5.00
6	6.431498 %	0.6798	1 000 000	-	-	5.00
7	6.275290 %	0.6445	1 000 000	-	-	5.00
8	6.139553 %	0.6119	1 000 000	-	-	5.00
9	6.021334 %	0.5816	1 000 000	-	-	5.00
10	5.918074 %	0.5533	1 000 000	-	-	105.00
Total			10 000 000	115.00	125.00	150.00

Bond payments in absolute values			Asset cash flow
Maturity: 3	Maturity: 5	Maturity: 10	Total
143 833.38	116 278.25	126 442.59	386 554.23
143 833.38	116 278.25	126 442.59	386 554.23
3 020 500.97	116 278.25	126 442.59	3 263 221.82
-	116 278.25	126 442.59	242 720.85
-	2 441 843.33	126 442.59	2 568 285.92
-	-	126 442.59	126 442.59
-	-	126 442.59	126 442.59
-	-	126 442.59	126 442.59
-	-	126 442.59	126 442.59
-	-	2 655 294.45	2 655 294.45
3 308 167.73	2 906 956.35	3 793 277.79	10 008 401.87

Present value	7 150 166	93.91	92.25	91.08
Duration	5.0310	2.86	4.53	8.05
Convexity	33.4914	8.38	21.74	73.89
Dispersion	8.1802	0.22	1.22	9.10

2 701 567	2 145 233	2 303 366	7 150 166
2.8554	4.5297	8.0496	5.0310
8.3755	21.7388	73.8949	33.4914
0.2224	1.2203	9.0982	8.1802

Finding the immunising portfolio

Solve	Liability	Maturity: 3	Maturity: 5	Maturity: 10	Weights w1--w3
PV	7 150 166	93.91	92.25	91.08	28 767
PV x D	35 972 607	268.16	417.85	733.19	23 256
PV x C	239 468 859	786.57	2 005.31	6 730.61	25 289