Fixed Income
Team Assignment-2

Team 12

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Question 1

1a

md	convexity
1.365414	2.547628
4.267179	21.183365
7.328469	61.567296
11.937371	179.723990

1b

Modified duration of the bond portfolio: 7.023
Convexity of the bond portfolio: 79.768

1c

First order approximation of the percentage change: -0.702%

1d

Second order approximation of the percentage change: -0.698 %

1e

Actual percentage change: -0.698%

1f

First Order Approximation of Percentage Change in Market Value: 0.725 %
Second Order Approximation of Percentage Change in Market Value: -0.721 %
Percentage change of the market value of this portfolio: -0.721 %

We can clearly see that the Second Order Approximation simulate better in this case with the exact same result -0.721% as we had discussed in the class.

Question 2

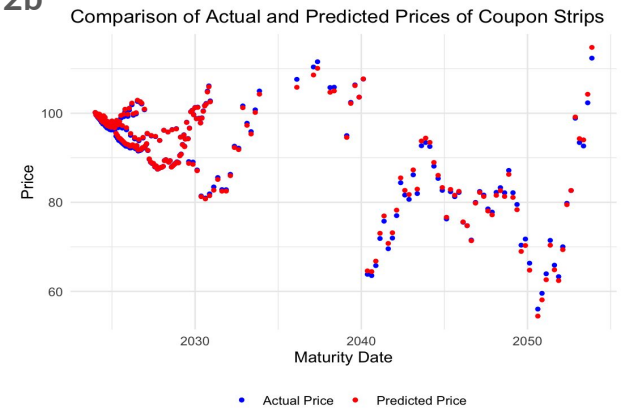
	p1	p2	p3	p4	p5	p6	value	fevals	gevals	niter
BFGS	0.01000000	1.993374e-44	6.391927e-16	1.700052e-29	1.700052e-29	1.700052e-29	221150.65303	76	1	NA
Nelder-Mead	0.04434334	-2.301289e-03	4.067661e-04	-3.228110e-05	1.218913e-06	-1.729954e-08	84.28756	971	NA	NA
L-BFGS-B	0.01000000	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	221150.65306	21	21	NA
nlm	0.01000000	2.514191e-08	5.608710e-07	8.356844e-06	7.941266e-06	-4.073486e-08	212510.44334	NA	NA	2
nlminb	0.01000000	3.052684e-11	6.941450e-10	1.665749e-08	3.359806e-07	8.854855e-07	218577.13508	53	12	2
Rvmmin	0.01000000	2.195157e-06	1.721878e-06	-5.255214e-08	7.258296e-07	-2.352549e-08	26499.12213	3061	96	NA

	convcode	kkt1	kkt2	xtime
BFGS	0	FALSE	FALSE	11.366
Nelder-Mead	0	FALSE	FALSE	129.108
L-BFGS-B	52	FALSE	FALSE	36.272
nlm	0	FALSE	FALSE	11.959
nlminb	1	FALSE	FALSE	8.713
Rvmmin	1	FALSE	FALSE	498.005

2e

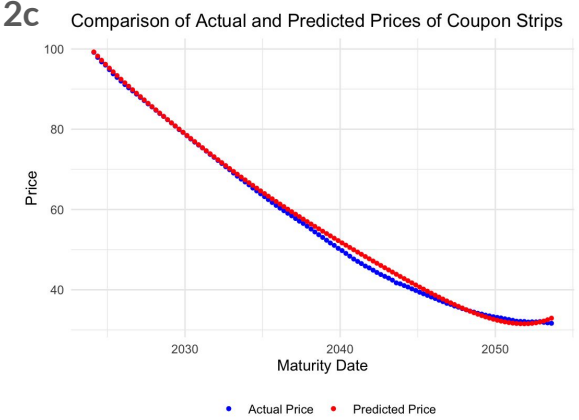
The model's prediction errors for coupon and principal strips (SSR of 2156.06) contrast with its lower error (SSR of 84.29) for regular bonds. This suggests it's better suited for bonds' complex structures, while the simpler, single-payment strips pose a challenge. Though reasonably effective for strips, as seen in the graphs, the model needs adjustments for these distinct financial instruments.

2b



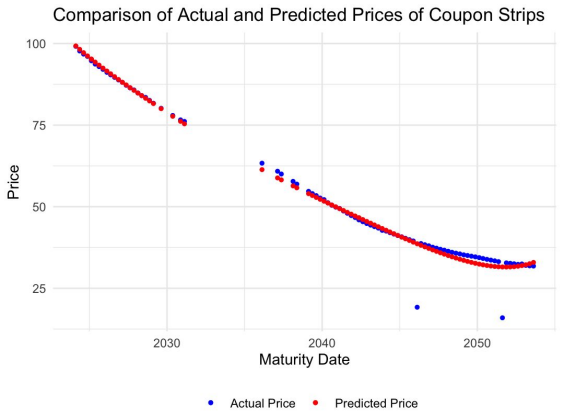
The actual and estimated bond prices presents similar patterns over various maturity dates. Although the patterns are closely aligned for bonds maturing around 2040 to 2050, there is a clear difference, especially near the year 2030, where the estimated prices are often greater than the actual prices.

2c



The actual and predicted prices of the coupon strips closely track each other across the entire maturity spectrum, with both sets of prices declining as maturity increases.

2d



The actual and predicted prices of the coupon strips initially align closely for earlier maturities but begin to diverge for maturities beyond approximately 2035. The predicted prices tend to be lower than the actual prices as maturity dates extend,

Question 3

3 A

	maturity	par.rate	ttm	disfac	spot
1	2022-12-30	0.003524	1.000000	0.9964884	0.003520901
2	2023-12-30	0.007097	2.000000	0.9859308	0.007097132
3	2024-12-30	0.009603	3.002740	0.9716322	0.009606879
4	2025-12-30	0.011592	4.002740	0.9546899	0.011617862
5	2026-12-30	0.013155	5.002740	0.9362640	0.013207774
6	2027-12-30	0.014330	6.002740	0.9174244	0.014409289
7	2028-12-30	0.015139	7.005479	0.8991503	0.015232267
8	2029-12-30	0.015675	8.005479	0.8817582	0.015780847
9	2030-12-30	0.016172	9.005479	0.8640359	0.016294014
10	2031-12-30	0.016712	10.005479	0.8453682	0.016859771

3 B

Answer: 957,691.69

We took the spot rates and the time to maturity and used to the slime function to make predictions on the CFs of the 10 yr annuity. This answer makes sense since the total CFs are 1,000,000 and the 957,000,000 shows a discount rate of about a 11% discount rate. Seems reasonable.