



Subject: Fixed Income Products

Chapter: Unit 4

Category: Practice questions

1. a. Given the information below for a 6.2% 18-year bond compute the price value of a basis point:
price = 114.1338 yield = 5% price if yield is 5.01% = 114.0051
- b. If the duration of the 6.2% 18-year bond is 11.28, what is the estimated price change for a 1 basis point change in yield.

2. Consider price information for four bonds and assuming that all four bonds are trading to yield 5%:

Yield	Coupon Maturity	5.0% 4	5.0% 25	8.0% 4	8.0% 25
3.00%		107.4859	134.9997	118.7148	187.4992
4.00%		103.6627	115.7118	114.6510	162.8472
4.50%		101.8118	107.4586	112.6826	152.2102
4.75%		100.9011	103.6355	111.7138	147.2621
4.90%		100.3593	101.4324	111.1374	144.4042
5.00%		100.0000	100.0000	110.7552	142.5435
5.10%		99.6423	98.5959	110.3746	140.7175
5.25%		99.1085	96.5416	109.8066	138.0421
5.50%		98.2264	93.2507	108.8679	133.7465
6.00%		96.4902	87.1351	107.0197	125.7298
7.00%		93.1260	76.5444	103.4370	111.7278

Percentage price change based on an initial yield of 5%

Yield	Coupon Maturity	5.0% 4	5.0% 25	8.0% 4	8.0% 25
3.00%		7.49%	35.00%	7.19%	31.54%
4.00%		3.66%	15.71%	3.52%	14.24%
4.50%		1.81%	7.46%	1.74%	6.78%
4.75%		0.90%	3.64%	0.87%	3.31%
4.90%		0.36%	1.43%	0.35%	1.31%
5.00%		0.00%	0.00%	0.00%	0.00%
5.10%		-0.36%	-1.40%	-0.34%	-1.28%
5.25%		-0.89%	-3.46%	-0.86%	-3.16%
5.50%		-1.77%	-6.75%	-1.70%	-6.17%
6.00%		-3.51%	-12.86%	-3.37%	-11.80%
7.00%		-6.87%	-23.46%	-6.61%	-21.62%

Assuming all four bonds are selling to yield 5%, compute the following for each bond:

- a. duration based on a 25 basis point rate shock ($\Delta y = 0.0025$)
- b. duration based on a 50 basis point rate shock ($\Delta y = 0.0050$)

3. a. Using the duration computed in question 2a, compute the approximate percentage price change using duration for the two 8% coupon bonds assuming that the yield changes by 10 basis points ($\Delta y = 0.0010$).
- b. How does the estimated percentage price change compare to the actual percentage price change?

4. a. Using the duration computed in question 2a, compute the approximate percentage price change using duration for the two 8% coupon bonds assuming that the yield changes by 200 basis points ($\Delta y * = 0.02$).
- b. How does the estimated percentage price change compare to the actual percentage price change?
5. a. Using the value for C computed in question 12, compute the convexity adjustment for the two 25-year bonds assuming that the yield changes by 200 basis points ($\Delta y * = 0.02$).
- b. Compute the estimated percentage price change using duration (as computed in question 2a) and convexity adjustment if yield changes by 200 basis points.
- c. How does the estimated percentage price change using duration and convexity adjustment compare to the actual percentage price change for a 200 basis point change in yield?

6. CT1 April 2018 Q8

An investment fund has liabilities of £20 million due in 8 years' time and £15 million due in 12 years' time. The manager wishes to immunise the fund against small changes in the rate of interest and seeks to achieve this by purchasing two zero-coupon bonds. One bond is for a term of exactly 7 years and the other bond is for a term of exactly 14 years. The current interest rate is 4.5% per annum effective.

- (i) Calculate the amount that should be invested in each bond, demonstrating that all three Redington conditions are met. [9]
- (ii) Explain, without performing any further calculations, how the relative values of the assets and the liabilities will change if the interest rate changes immediately to 4.7% per annum effective. [2] [Total 11]

7. CT1 September 2018 Q10 (part)

- (i) Describe the characteristics of a repayment mortgage. [3]

A bank has just granted a loan of \$10,000 to a business to be repaid in ten equal instalments, annually in arrears. The rate of interest is 4% per annum effective.

- (ii) (a) Calculate the amount of the annual repayment.
- (b) Calculate the duration (discounted mean term) of the repayments. [5]

The bank wishes to immunise itself from changes in interest rates in relation to this particular asset. For this purpose, the bank has issued two zero-coupon bonds. The first bond is of nominal amount \$5,000 and has a term to redemption of two years.

- (iii) Determine the nominal amount of the second zero-coupon bond and its term to redemption such that the present value and durations of the assets and liabilities are equal.

8. CT1 April 2017 Q5

An investment fund has liabilities of £11 million due in 7 years' time and £8.084 million in 11 years' time. The manager of the fund will meet the liabilities by investing in zero-coupon bonds.

The manager is able to buy zero-coupon bonds for whatever term is required and there are adequate funds at the manager's disposal.

(i) Explain whether it is possible for the manager to immunise the fund against small changes in the rate of interest by purchasing a single zero-coupon bond. [2]

The manager decides to purchase two zero-coupon bonds, one paying £15.363 million in 7.5 years' time and the other paying £3.787 million in 14.25 years' time. The current interest rate is 5.5% per annum effective.

(ii) Determine whether the investment fund satisfies the necessary conditions to be immunised against small changes in the rate of interest. [7] [Total 9]

9. CT1 September 2017 Q10

An insurance company has liabilities of £100 million due in 10 years' time and £200 million due in 20 years' time.

The company's assets consist of a zero-coupon bond and a level annuity paid annually in arrear. The zero coupon bond will pay £144.054 million in 15 years' time. The current interest rate is 3% per annum effective at all terms to redemption.

Redington's first two conditions for immunisation against small changes in the rate of interest have been satisfied for this insurance company.

(i) (a) Calculate the present value of the liabilities.

(b) Calculate the discounted mean term of the liabilities. [4]

(ii) Show that the term of the annuity is 41 years. [6]

(iii) Determine the annual rate of payment of the annuity. [1]

(iv) State Redington's third condition for immunisation, explaining whether you think it is fulfilled. [2]

The insurance company decides to sell the zero-coupon bond it holds and invest the proceeds in another zero-coupon bond with a shorter term to maturity.

(v) Explain the risks of implementing this decision. [2] [Total 15]

10. CT1 April 2016 Q2

An insurance company has liabilities of £6 million due in exactly 8 years' time and a further £11 million due in exactly 15 years' time.

The assets held by the insurance company consist of:

a 5-year zero-coupon bond of nominal amount £5.5088 million; and

a 20-year zero-coupon bond of nominal amount £13.7969 million.

The current rate of interest is 8% per annum effective at all durations.

(i) Show that the first two conditions of Redington's theory for immunisation against small changes in the rate of interest are satisfied. [5]

(ii) Explain, without doing any further calculations, whether the insurance company will be immunised against small changes in the rate of interest. [2] [Total 7]