MFE 408 Fixed Income Markets

Homework 3

Group #9 of Cohort #2

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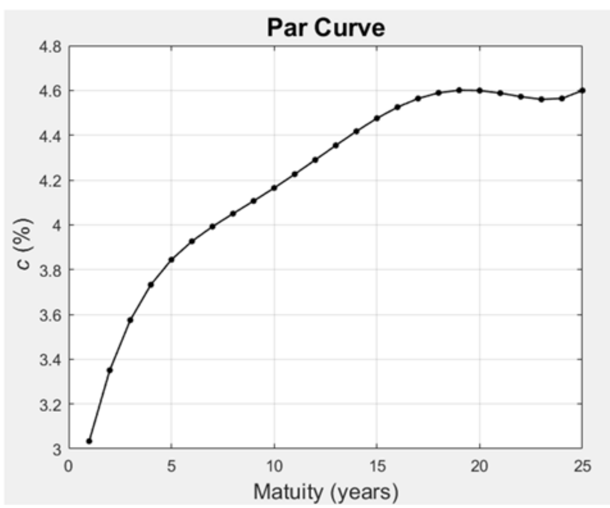
Problem 1

Use the zero-coupon curve to compute the par rates for semiannual pay bonds with maturities ranging from 1 year to 25 years.

For par bond, par rate equals coupon rate

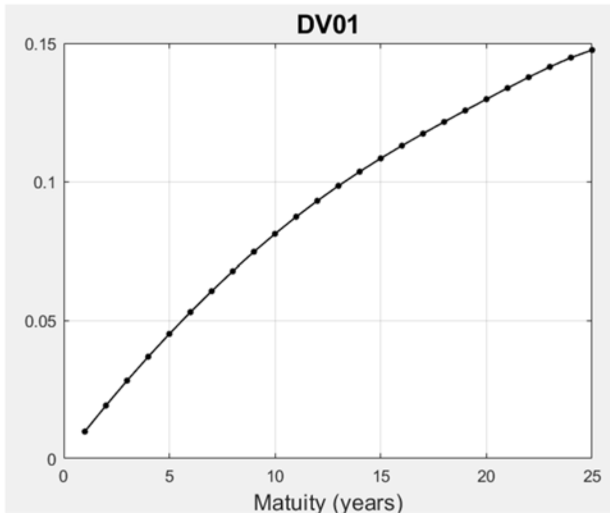
$$c = 2\left[\frac{100 - 100D(T)}{\sum_{i=1}^{2T} D(i/2)}\right]$$



Problem 2

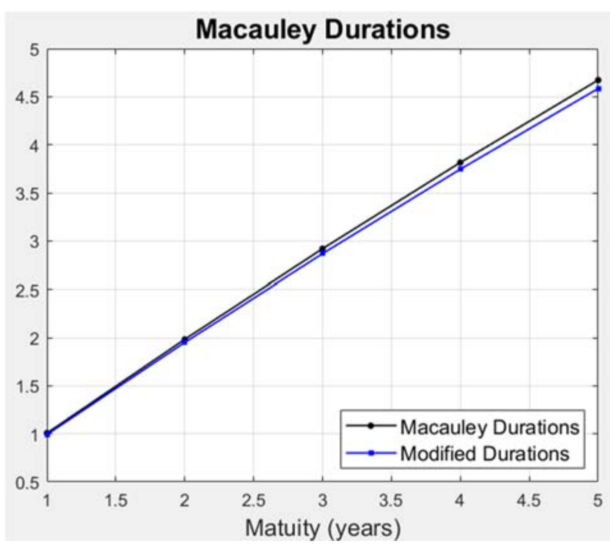
For each of these bonds, compute their DV01.

DV01 is defined as the price change resulting from a one-basis point change in yield.



Problem 3

Compute the Macauley and modified durations for the 1, 2, 3, 4, and 5 year bonds in Question 1 above.



Problem 4

You have a $5,000,000 liability due in 3 years. How much do you need to invest in a 3 year zero-coupon bond to defease the liability? Use the same zero-coupon curve as in Question 1.

In order to defease the liability of $5,000,000, we can invest $4.49 million in a 3-year ZCB.

$$\text{MarketValue} = \frac{\$5,000,000}{(1+r_3/2)^6} = \$4.49 \text{ m}$$

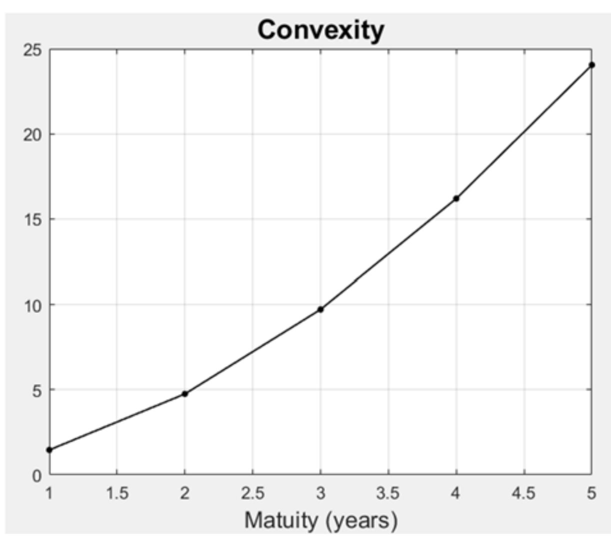
Problem 5

Using the data in Question 1, compute the convexities of the 1, 2, 3, 4, and 5 year bonds.

The convexity is defined as

$$\text{Convexity} = \frac{\sum_{i=1}^{N} i \times (i+1) CF(i) D(i)}{(1+y/k)^2 \times k^2 \times \text{Price}}$$

where k is the number of periods in a year and $N = k * T$ is the total number of payments within the maturity T.



Problem 6

Use the computed dollar durations and convexities for the 1, 2, 3, 4, and 5 year bonds, compute the price change of a 100 basis point upward and downward parallel shift in the zero-curve. Compare the price changes with the actual price change obtained by recomputing the price of the bond from the shifted spot curve.

The percentage change in bond prices can be calculated from duration and convexity as

$$\frac{\Delta P}{P} = -\mathrm{MD} \times \Delta y \times 100 + \frac{1}{2} \times \mathrm{Convexity} \times \Delta y^2 \times 100$$