Bond Value with Annual Interest

$$P = \sum_{t=1}^{n} \frac{C}{(1 + r)^t} + \frac{M}{(1+r)^n} \text{ where}$$

P = value in rupees
n = number of years
C = annual coupon payment in rupees
r = periodic required return
M = maturity value
t = time period when payment is received

Bond Value with Annual Interest

- Since the stream of coupon payments is an ordinary annuity, we can apply the formula for the present value of an ordinary annuity, i.e.
- $P = C \times PVIFA_{r,n} + M \times PVIF_{r,n}$
- Example: Compute the value of a 10 year bond with a par value of Rs.1000, coupon of 11 per cent, when the required yield is 12 per cent.
- The cash flows for the bond are 10 annual coupon payments of Rs.110 and Rs. 1000 principal repayment 10 years from now. The value of the bond is:
- $P = 110 \times PVIFA_{12\%,10yr} + 1000 \times PVIF_{12\%,10yr}$
  $=110 \times 5.650 + 1000 \times 0.322 = 621.50 + 322$
  $=$ Rs.943.50

Duration

$$D = \frac{\sum_{n=1}^{N} (n)(C_n) / (1 + i)^n}{\sum_{n=1}^{N} (C_n) / (1 + i)^n}$$

Where, N is the life of the bond in years, C is the cash receipt at the end of year n – equal to the annual coupon except for the last year, when it is equal to the annual coupon plus the maturity value, and i is the yield-to-maturity.

The numerator is the weighted present value of cash receipts, while the denominator is the sum of all these present values, which is equal to the total present value of the bond.

Example of Duration of a Bond

- Let us consider a 7 per cent coupon bond (annual interest payments) with three years to maturity that is priced at par (Rs.1000).
- $$D = \frac{(1)[(70)/(1.07)] + (2)[(70)/(1.07)^2] + (3)[(1070)/(1.07)^3]}{70/1.07 + 70/(1.07)^2 + 1070/(1.07)^3}$$

  = 2.81 years