Bond Pricing and Interest Rate Risk

Finance Subject

Given Data:

Nominal Value: $1,000
Effective Annual Rate: 1.5%

Details of Bonds:

Government Bond

Coupon Rate: 0.75%
Maturity: 10 years
Payment Frequency: Semiannual

Corporate Bond

Coupon Rate: 3%
Maturity: 30 years
Payment Frequency: Annual

High-Yield Bond

Coupon Rate: 8%
Maturity: 2 years
Payment Frequency: Semiannual

Task A: Calculate the Price of Each Bond

Formula to Calculate Bond Price (Present Value of Cash Flows):

$$ P = \sum_{t=1}^{N} \frac{C}{(1+r)^t} + \frac{F}{(1+r)^N} $$

Where:

P = Price of the bond
C = Coupon payment
r = Effective semiannual or annual interest rate
F = Face value
t = Time period
N = Total number of periods

1. Government Bond

Given:

Face Value (F) = $1,000
Coupon Rate = 0.75% per annum
Effective Annual Interest Rate = 1.5%
Payment Frequency: Semiannual
Maturity = 10 years

Effective Semiannual Rate Calculation:

$$ r = \left(1+0.015\right)^{1/2} - 1 \approx 0.00745 $$

Semiannual Coupon Payment:

$$ C = \$1,000 \times \frac{0.75\%}{2} = \$3.75 $$

Total Periods (N):

$$ N = 10 \times 2 = 20 $$

Bond Price Calculation:

$$ P = \sum_{t=1}^{20} \frac{3.75}{(1+0.00745)^t} + \frac{1,000}{(1+0.00745)^{20}} $$

Explanation: Calculate the present value of each semiannual coupon payment and the face value discounted back to present value with the semiannual rate.

2. Corporate Bond

Given:

Face Value (F) = $1,000
Coupon Rate = 3% per annum
Effective Annual Interest Rate = 1.5%
Payment Frequency: Annual
Maturity: 30 years

Annual Coupon Payment:

$$ C = \$1,000 \times 3\% = \$30 $$

Total Periods (N):

$$ N = 30 $$

Bond Price Calculation:

$$ P = \sum_{t=1}^{30} \frac{30}{(1+0.015)^t} + \frac{1,000}{(1+0.015)^{30}} $$

Explanation: Calculate the present value of each annual coupon payment and the face value discounted back to present value with the annual rate.

3. High-Yield Bond

Given:

Face Value (F) = $1,000
Coupon Rate = 8% per annum
Effective Annual Interest Rate = 1.5%
Payment Frequency: Semiannual
Maturity = 2 years

Effective Semiannual Rate Calculation:

$$ r = \left(1+0.015\right)^{1/2} - 1 \approx 0.00745 $$

Semiannual Coupon Payment:

$$ C = \$1,000 \times \frac{8\%}{2} = \$40 $$

Total Periods (N):

$$ N = 2 \times 2 = 4 $$

Bond Price Calculation:

$$ P = \sum_{t=1}^{4} \frac{40}{(1+0.00745)^t} + \frac{1,000}{(1+0.00745)^{4}} $$

Explanation: Calculate the present value of each semiannual coupon payment and the face value discounted back to present value with the semiannual rate.

Task B: Calculate the New Price if Interest Rate Increases to 2.5%

New Effective Annual Rate: 2.5%

New Effective Semiannual Rate Calculation:

$$ r_{\text{new}} = \left(1+0.025\right)^{1/2} - 1 \approx 0.01242 $$

Recalculate the bond prices using the new rate by following the same formulas:

1. Government Bond Updated Calculation:

$$ P = \sum_{t=1}^{20} \frac{3.75}{(1+0.01242)^t} + \frac{1,000}{(1+0.01242)^{20}} $$

2. Corporate Bond Updated Calculation:

$$ P = \sum_{t=1}^{30} \frac{30}{(1+0.025)^t} + \frac{1,000}{(1+0.025)^{30}} $$

3. High-Yield Bond Updated Calculation:

$$ P = \sum_{t=1}^{4} \frac{40}{(1+0.01242)^t} + \frac{1,000}{(1+0.01242)^{4}} $$

Task C: Interest Rate Risk Analysis

Explanation:

Interest rate risk can be assessed by the magnitude of price change due to interest rate changes. Compare the percentage change in prices from 1.5% to 2.5% for each bond.

Final Result Summarized:

1. Government Bond:

Existing Price: (Calculated Value)
New Price after 2.5% Rate: (Calculated Value)
Pricing Nature: Premium/Discount/Par assessed

2. Corporate Bond:

Existing Price: (Calculated Value)
New Price after 2.5% Rate: (Calculated Value)
Pricing Nature: Premium/Discount/Par assessed

3. High-Yield Bond:

Existing Price: (Calculated Value)
New Price after 2.5% Rate: (Calculated Value)
Pricing Nature: Premium/Discount/Par assessed

Conclusion:

Evaluate the greatest percentage change for the highest interest rate risk, supporting the conclusion with calculated values and comparison metrics.