FINANCIAL ENGINEERING

IME611A

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SESSION OBJECTIVES

- Fixed income instrument: Credit Rating
- Yield to maturity
- Pricing of a Bond
- Price-Yield curve

QUALITY RATING (CREDIT RATING) (1/2)

- Bonds offer fixed-income stream, yet they may be **subject to default** if the issuer faces financial difficulties or falls into bankruptcy.
- **Default:** Failure to pay the coupons or the face value

- **Credit Rating Agencies (CRAs)**
  - Assess financial health of issuer and issue some rating
  - **Example:** Moody's, Standard and Poor (S&P), CRISIL, ICRA
  - Rating schemes
    - AAA, AA, A, BBB, BB, B etc. (S&P)
    - Aaa, Aa, A, Baa, Ba, B, etc. (Moody's)

QUALITY RATING (CREDIT RATING) (2/2)

	Moody's	S&P
High grade (least risky)	Aaa	AAA
-do-	Aa	AA
Medium grade	A	A
-do-	Baa	BBB
Speculative grade	Ba	BB
-do-	B	B
Default grade (highly risky)	Caa	CCC
-do-	Ca	CC
-do-	C	C
		D

Additional reading:
https://www.crisil.com/en/home/our-businesses/ratings/credit-ratings-scale.html

YIELD

- **A bond's yield** is the interest rate implied by the payment structure.

- **Yield:** The interest rate at which present value of the stream of payments is equal to the current price. [Similar to the concept of **IRR** earlier discussed!]

PRICING OF A BOND (1/2)

- Consider, a bond with **face value F** paying **m coupon payments** of **C/m each year** and there are **n periods remaining.**

- $$P = \frac{F}{[1 + (\lambda/m)]^n} + \sum_{k=1}^{n} \frac{C/m}{[1 + (\lambda/m)]^k}$$

- Where,
  - P = price of the bond
  - F = face value of the bond
  - C = coupon amount of the bond per year
  - λ = yield to maturity of the bond
  - m = number of coupon payments per year
  - n = number of periods remaining

PRICING OF A BOND (2/2)

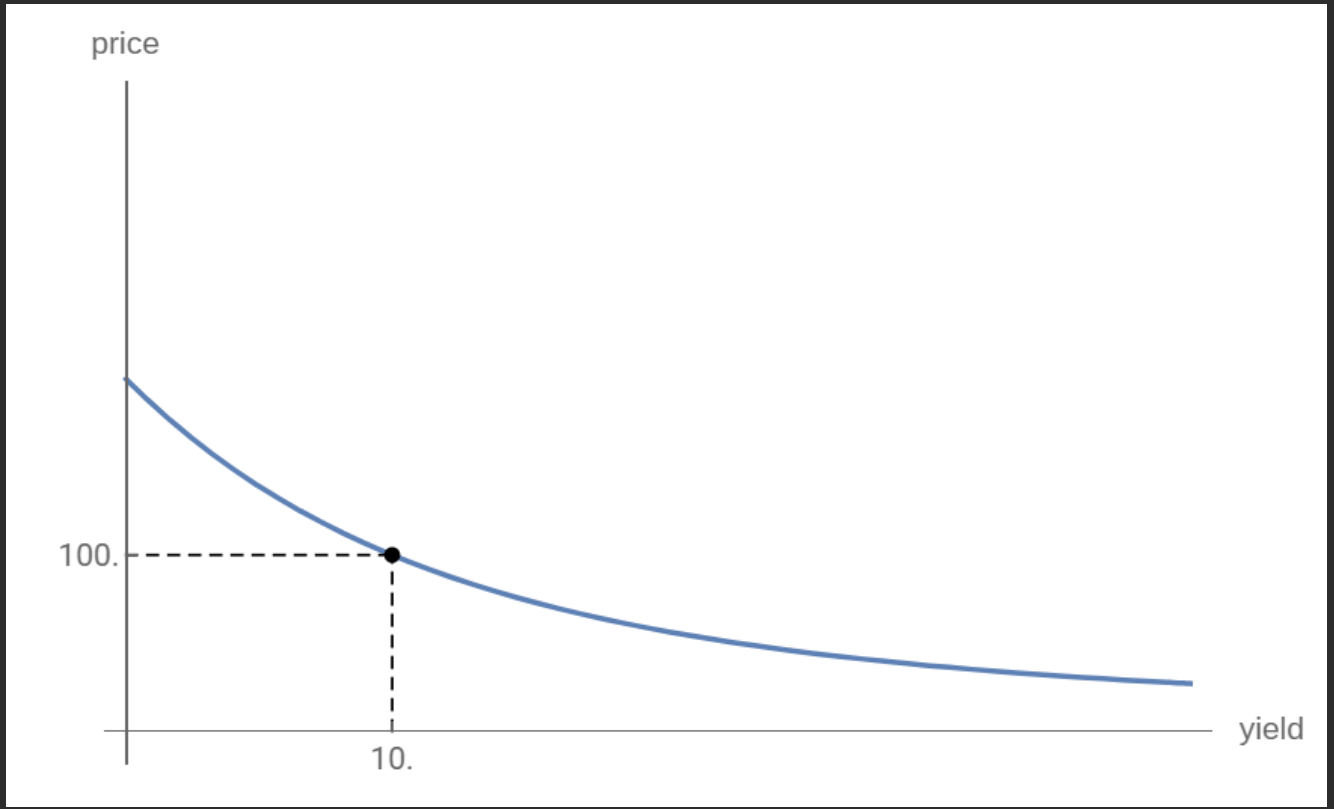
- ***Bond price formula:*** The price of a bond, having exactly **n coupon periods** remaining to maturity and a **yield to maturity of λ**, satisfies

- $$P = \frac{F}{[1 + (\lambda/m)]^n} + \frac{C}{\lambda}\{1 - \frac{1}{[1 + (\lambda/m)]^n}\}$$

- Where, **F** is the face value of the bond, **C** is the yearly coupon payment, and **m** is the number of coupons per year.

PRICE-YIELD CURVE

- Price and yield have an **inverse** relation.
- Curvature is an important idea.
- Useful tools (*Duration, Convexity*) for analysis of the risk (sensitivity of price to yield)
- **An illustration** [Wolfram Demonstrations Project]
  - Source: https://www.wolframcloud.com/objects/demonstrations/PriceYieldCurve-source.nb



PRICE YIELD CURVES

- **Practice Problem - 1**: A bond with FV of 100 offers **6% annual coupon**. Calculate its price for following scenarios.

- i) Time to maturity = 1 year, Yield to maturity = a) 4%, b) 6%, c) 8%

- ii) Time to maturity = 5 years, Yield to maturity = a) 4%, b) 6%, c) 8%

- iii) Time to maturity = 20 years, Yield to maturity = a) 4%, b) 6%, c) 8%

PRICE YIELD CURVES

- **Practice Problem - 1**:
- Q1) Construct a table as below (showing prices in each cell)

Time to maturity	Yield		
	4%	6%	8%
1 year			
5 years			
20 years			

- Q2) What can you comment about the price and yield relationship?

- Q3) Draw the charts similar to Fig. 3.3 and 3.4.

DISCLAIMER

- The information in this presentation has been compiled from the following textbook which has been mentioned as a reference text for this course on **Financial Engineering.**

- **Reference Text:**
  - Investment Science, 2nd Edition, Oxford University Press, David G. Luenberger