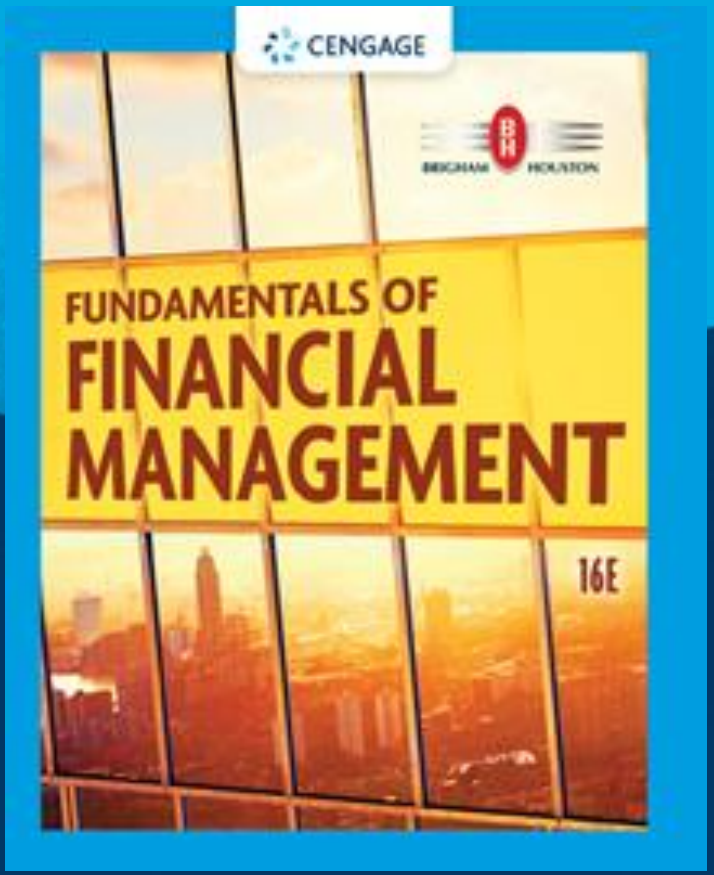
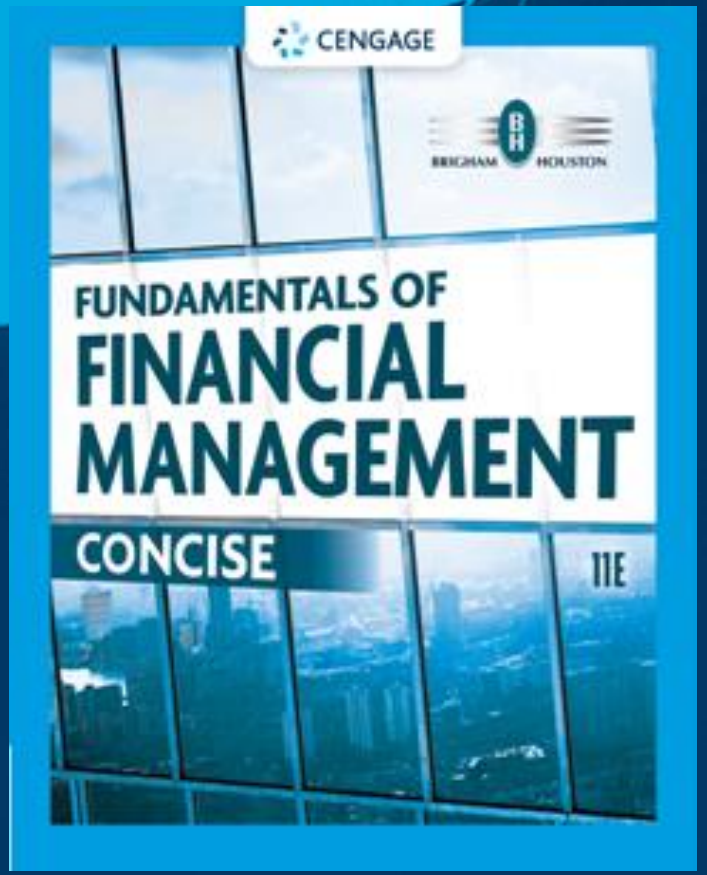



# Chapter 7

## Bonds and Their Valuation

# Overview

- Key Features of Bonds
- Bond Valuation
- Measuring Yield
- Assessing Risk

# What is a bond?

- A long-term debt instrument in which a borrower agrees to make payments of principal and interest, on specific dates, to the holders of the bond.

# Key Features of a Bond

- Par value: face amount of the bond, which is paid at maturity (assume $1,000).
- Coupon interest rate: stated interest rate (generally fixed) paid by the issuer. Multiply by par value to get dollar payment of interest.
- Maturity date: years until the bond must be repaid.
- Issue date: when the bond was issued.
- Yield to maturity: rate of return earned on a bond held until maturity (also called the “promised yield”).

# Other Types (Features) of Bonds

- Convertible bond: may be exchanged for common stock of the firm, at the holder's option.
- Warrant: long-term option to buy a stated number of shares of common stock at a specified price.
- Putable bond: allows holder to sell the bond back to the company prior to maturity.
- Income bond: pays interest only when interest is earned by the firm.
- Indexed bond: interest rate paid is based upon the rate of inflation.

# Effect of a Call Provision

- Allows issuer to refund the bond issue if rates decline (helps the issuer, but hurts the investor).
- Bond investors require higher yields on callable bonds.
- In many cases, callable bonds include a deferred call provision and a declining call premium.

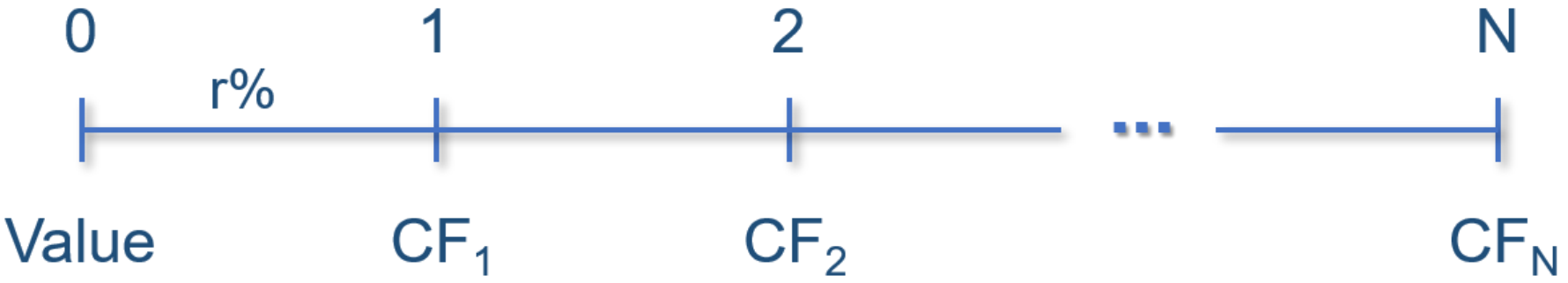
# What is a sinking fund?

- Provision to pay off a loan over its life rather than all at maturity.
- Similar to amortization on a term loan.
- Reduces risk to investor, shortens average maturity.
- But not good for investors if rates decline after issuance.

# How are sinking funds executed?

- Call x% of the issue at par, for sinking fund purposes.
  - Likely to be used if $r_d$ is below the coupon rate and the bond sells at a premium.
- Buy bonds in the open market.
  - Likely to be used if $r_d$ is above the coupon rate and the bond sells at a discount.

# The Value of Financial Assets



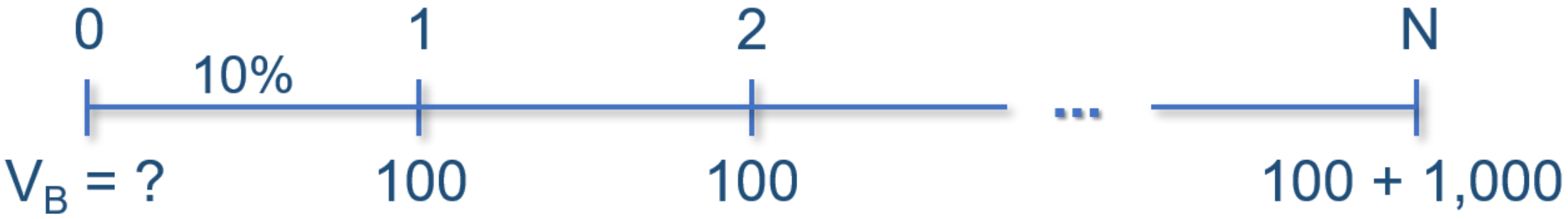

$$\text{Value} = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_N}{(1+r)^N}$$

# What is the opportunity cost of debt capital?

- The discount rate ($r_i$) is the opportunity cost of capital, and is the rate that could be earned on alternative investments of equal risk.

$$r_i = r^* + IP + MRP + DRP + LP$$

# What is the value of a 10-year, 10% annual coupon bond, if $r_d$ = 10%?



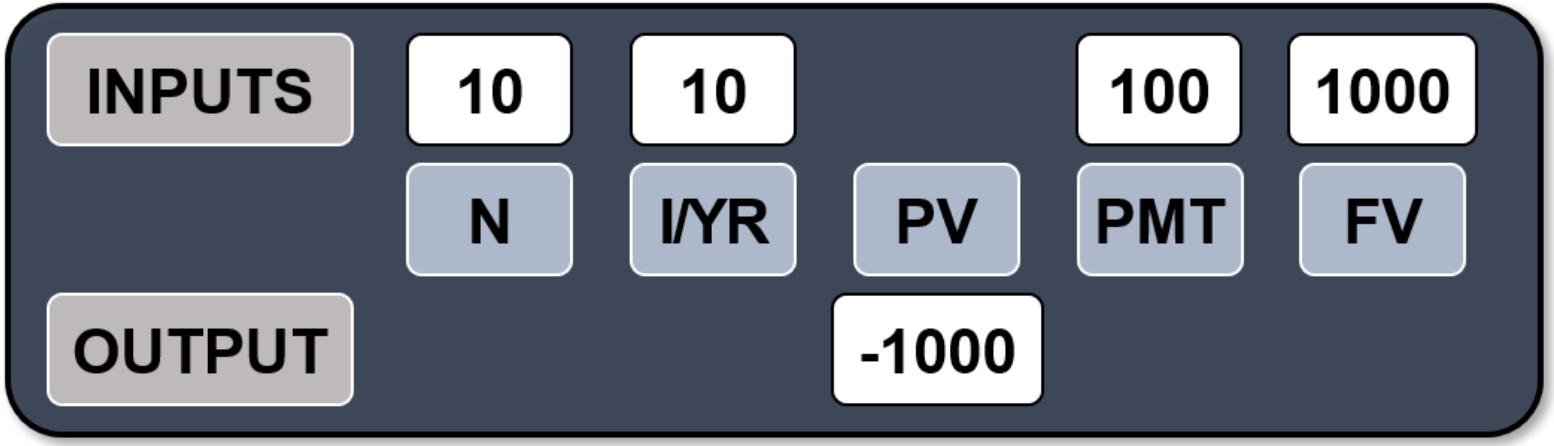

$$V_B = \frac{\$100}{(1.10)^1} + \cdots + \frac{\$100}{(1.10)^{10}} + \frac{\$1{,}000}{(1.10)^{10}}$$

$$V_B = \$90.91 + \cdots + \$38.55 + \$385.54$$

$$V_B = \$1{,}000$$

# Calculating the Value of a Bond

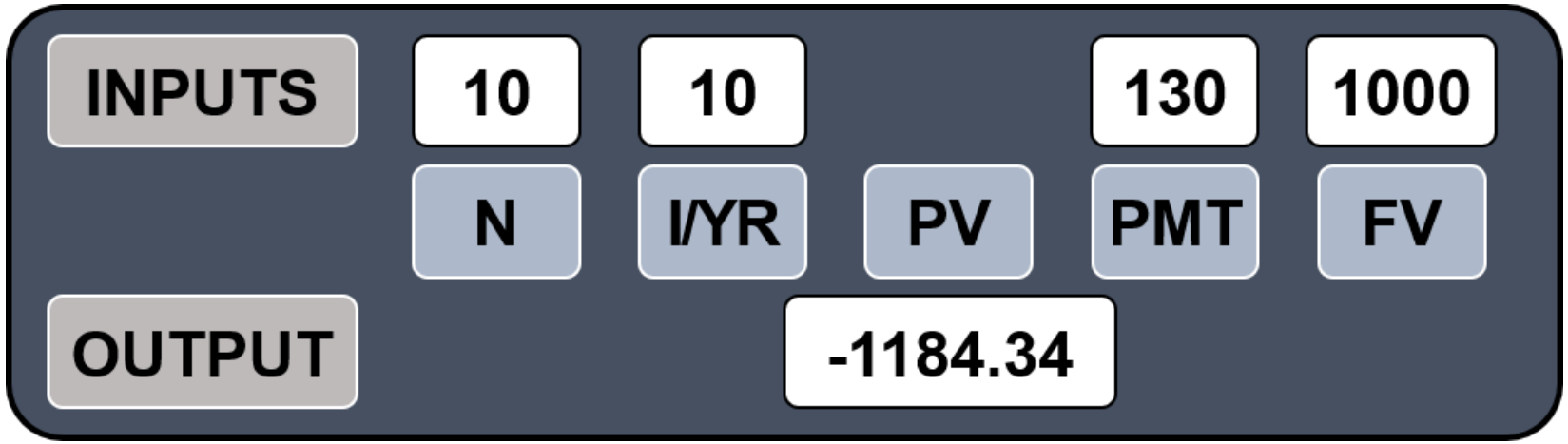
- This bond has a $1,000 lump sum (the par value) due at maturity (t = 10), and annual $100 coupon payments beginning at t = 1 and continuing through t = 10. The price of the bond can be found by solving for the PV of these cash flows.




Excel: =PV(.10,10,100,1000)

# What's the value of a 10-year bond outstanding with the same risk but a 13% annual coupon rate?

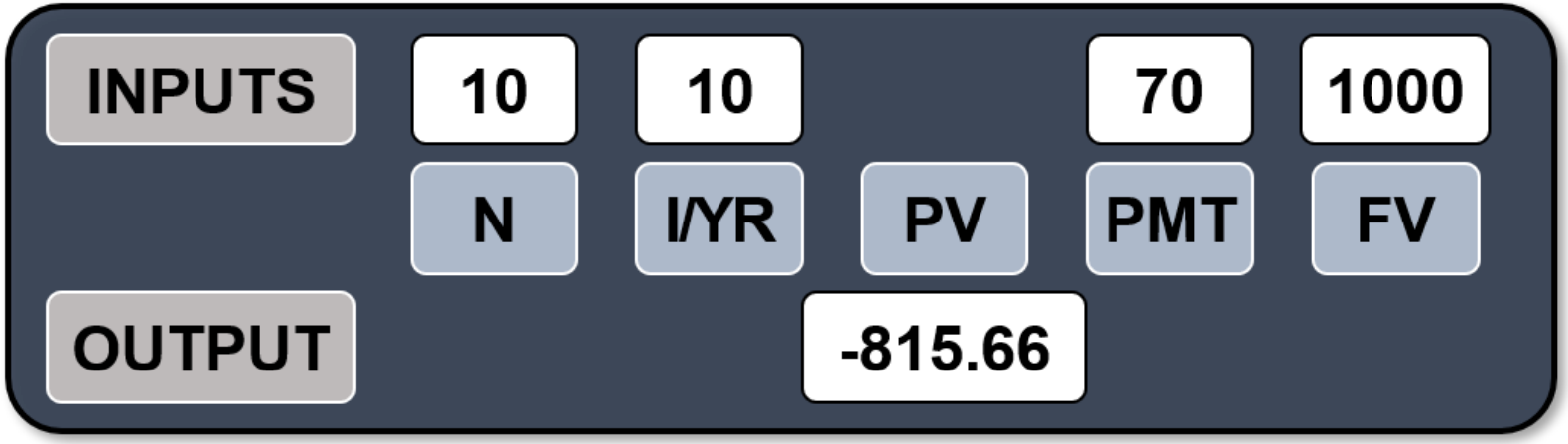
- The annual coupon payment is $130. Since the risk is the same it has the same yield to maturity as the previous bond (10%). This bond sells at a premium because the coupon rate > the yield to maturity.




Excel: =PV(.10,10,130,1000)

# What's the value of a 10-year bond outstanding with the same risk but a 7% annual coupon rate?

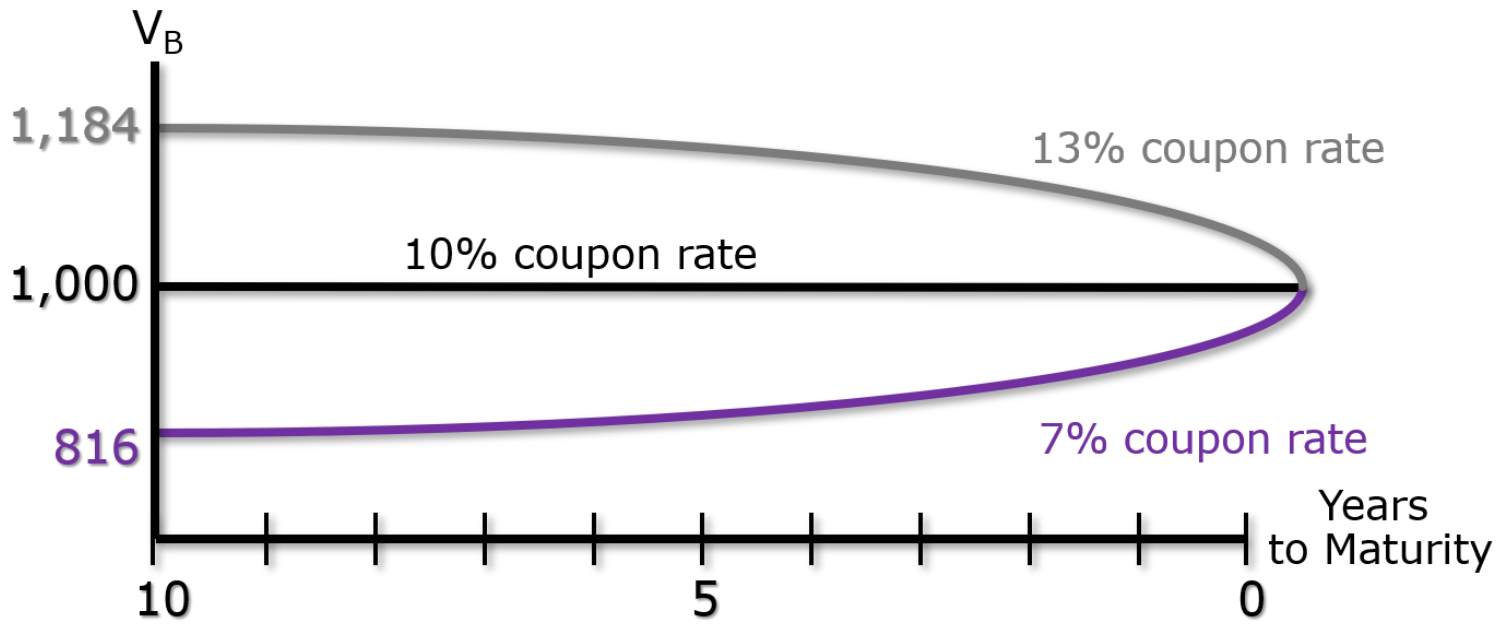
- The annual coupon payment is $70.  Since the risk is the same it has the same yield to maturity as the previous bonds (10%). This  bond sells at a discount because the coupon rate < the yield to maturity.




Excel:  =PV(.10,10,70,1000)

# Changes in Bond Value over Time

- What would happen to the value of these three bonds if the required rate of return remained at 10%?



# Bond Values over Time

- At maturity, the value of any bond must equal its par value.
- If $r_d$ remains constant:
  - The value of a premium bond would decrease over time, until it reached $1,000.
  - The value of a discount bond would increase over time, until it reached $1,000.
  - The value of a par bond stays at $1,000.

# What is the YTM on the following bond?

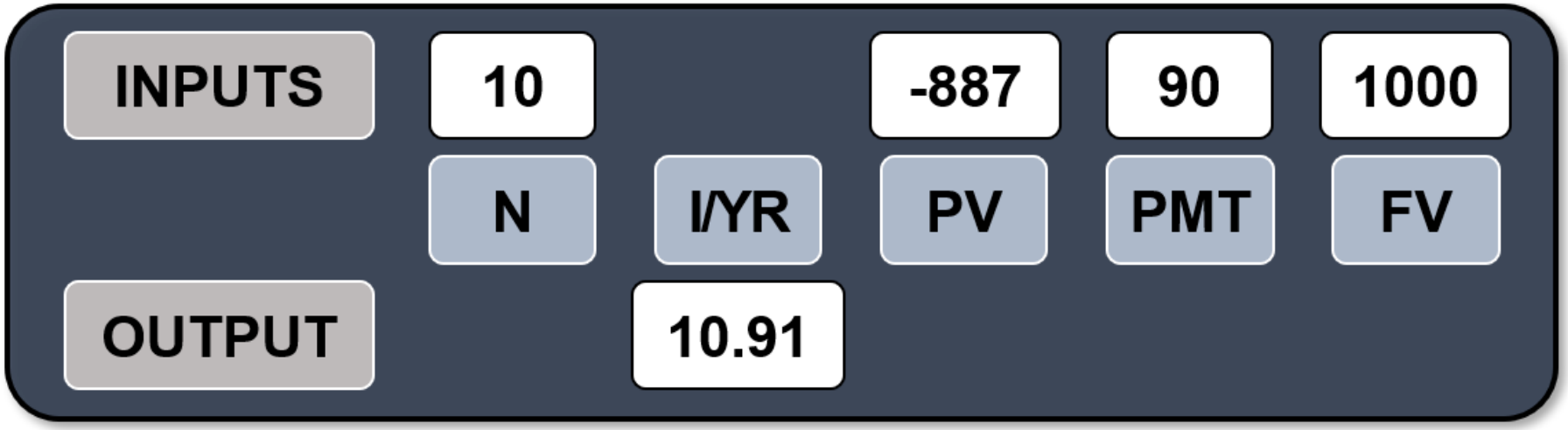
- 10-year; 9% annual coupon; $1,000 par value; selling for $887.
- Must find the $r_d$ that solves this equation.

$$V_B = \frac{INT}{(1+r_d)^1} + \cdots + \frac{INT}{(1+r_d)^N} + \frac{M}{(1+r_d)^N}$$

$$\$887 = \frac{90}{(1+r_d)^1} + \cdots + \frac{90}{(1+r_d)^{10}} + \frac{1,000}{(1+r_d)^{10}}$$

# Solving for the YTM

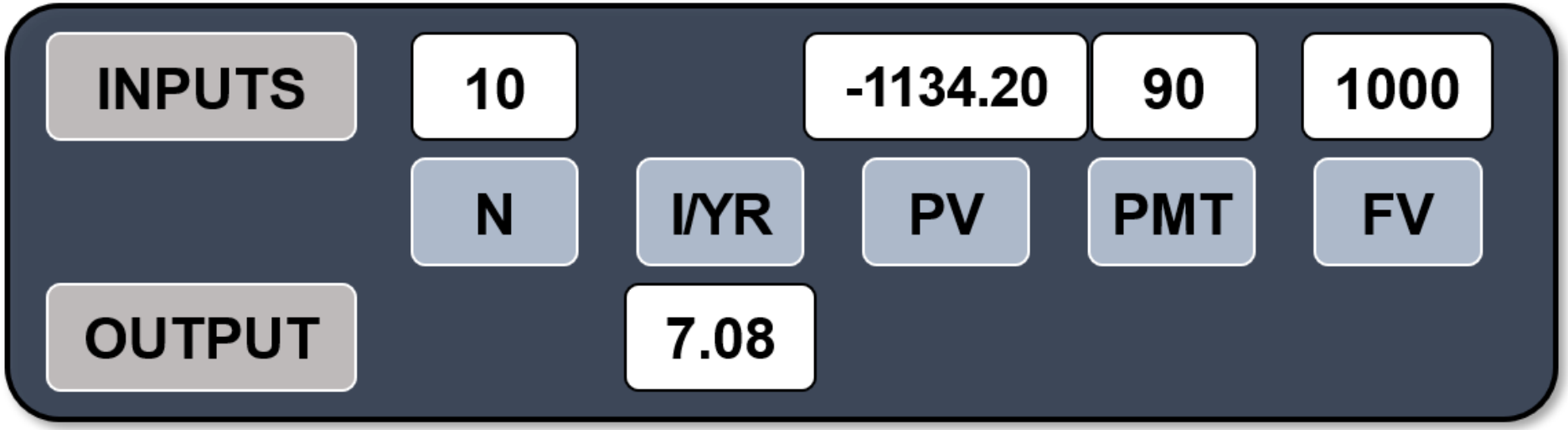
- Solving for I/YR, the YTM of this bond is 10.91%. This bond sells at a discount, because YTM > coupon rate.




Excel: =RATE(10,90,-887,1000)

# Find YTM If the Bond Price is $1,134.20

- Solving for I/YR, the YTM of this bond is 7.08%. This bond sells at a premium, because YTM < coupon rate.




Excel: =RATE(10,90,-1134.20,1000)

# Definitions

$$\text{Current yield (CY)} = \frac{\text{Annual coupon payment}}{\text{Current price}}$$

$$\text{Capital gains yield (CGY)} = \frac{\text{Change in price}}{\text{Beginning price}}$$

$$\text{Expected total return} = \text{YTM} = \text{Expected CY} + \text{Expected CGY}$$

# An Example: Current and Capital Gains Yields

Find the current yield and the capital gains yield for a 10-year, 9% annual coupon bond that sells for $887, and has a face value of $1,000.

$$\text{Current yield} = \frac{\$90}{\$887}$$

$$= 0.1015 = 10.15\%$$

# Calculating Capital Gains Yield

YTM = Current yield + Capital gains yield

$$\begin{aligned} CGY &= YTM - CY \\ &= 10.91\% - 10.15\% \\ &= 0.76\% \end{aligned}$$

Could also find the expected price one year from now and divide the change in price by the beginning price, which gives the same answer.

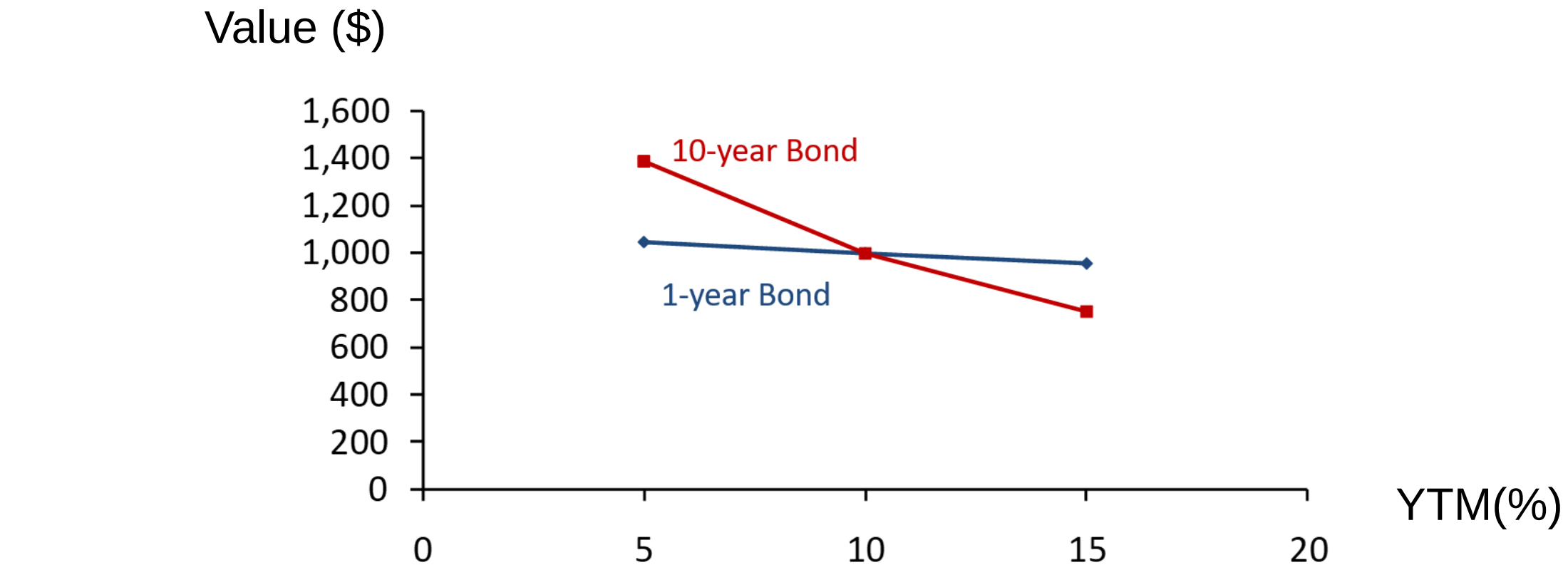
# What is price risk? Does a 1-year or 10-year bond have more price risk?

- Price risk is the concern that rising $r_d$ will cause the value of a bond to fall.

| $r_d$ | 1-year | Change | 10-year | Change |
|---|---|---|---|---|
| 5% | $1,048 | | $1,386 | |
| 10% | 1,000 | + 4.8% | 1,000 | +38.6% |
| 15% | 956 | – 4.4% | 749 | –25.1% |

- The 10-year bond is more sensitive to interest rate changes, and hence has more price risk.

# Illustrating Price Risk



# What is reinvestment risk?

- Reinvestment risk is the concern that $r_d$ will fall, and future CFs will have to be reinvested at lower rates, hence reducing income.

  *EXAMPLE: Suppose you just won $500,000 playing the lottery. You intend to invest the money and live off the interest.*

# Reinvestment Risk Example

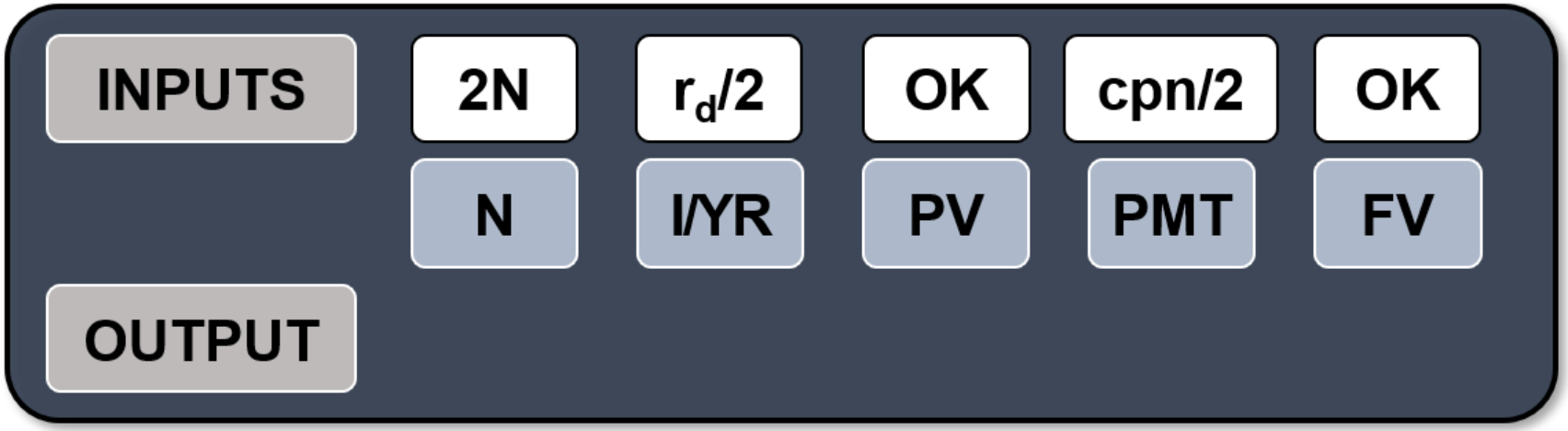
- You may invest in either a 10-year bond or a series of ten 1-year bonds. Both 10-year and 1-year bonds currently yield 10%.
- If you choose the 1-year bond strategy:
  - After Year 1, you receive $50,000 in income and have $500,000 to reinvest. But, if 1-year rates fall to 3%, your annual income would fall to $15,000.
- If you choose the 10-year bond strategy:
  - You can lock in a 10% interest rate, and $50,000 annual income for 10 years, assuming the bond is not callable.

# Conclusions about Price Risk and Reinvestment Risk

| | Short term AND/OR High coupon Bonds | Long term AND/OR Low coupon Bonds |
|---|---|---|
| Price risk | Low | High |
| Reinvestment risk | High | Low |

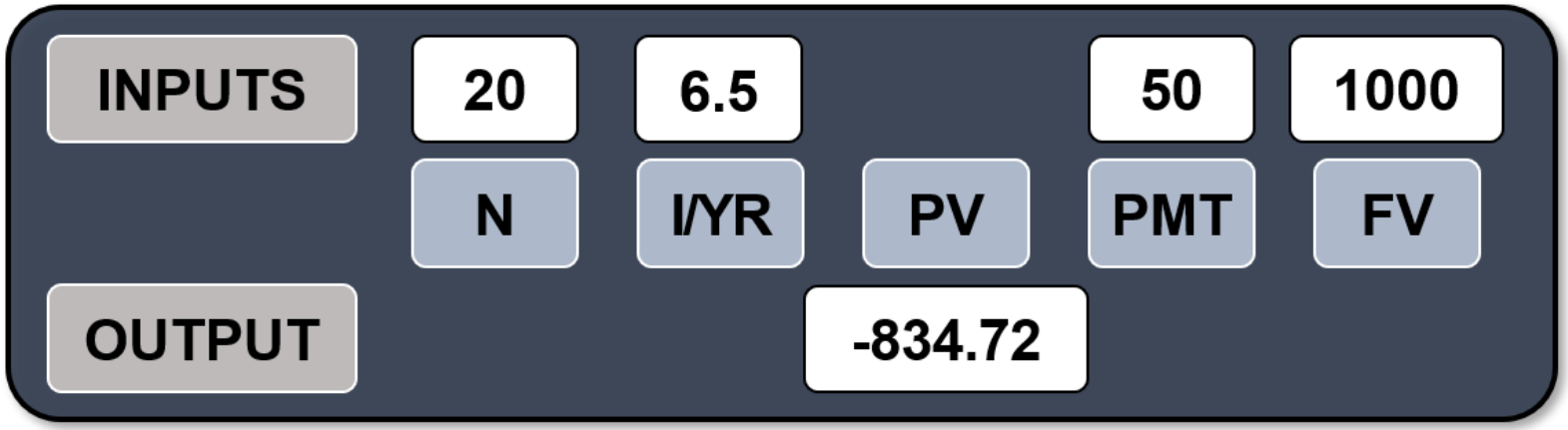
# Semiannual Bonds

1. Multiply years by 2: Number of periods = 2N
2. Divide nominal rate by 2: Periodic rate (I/YR) = $r_d/2$
3. Divide annual coupon by 2: PMT = Annual coupon/2



# What is the value of a 10-year, 10% semiannual coupon bond, if $r_d$ = 13%?

1. Multiply years by 2: N = 2 × 10 = 20
2. Divide nominal rate by 2: I/YR = 13/2 = 6.5
3. Divide annual coupon by 2: PMT = 100/2 = 50




Excel: =PV(.065,20,50,1000)

# Would you prefer to buy a 10-year, 10% annual coupon bond or a 10-year, 10% semiannual coupon bond, all else equal?

The semiannual bond's effective rate is:

$$EFF\% = \left(1 + \frac{r_{NOM}}{M}\right)^{M} - 1 = \left(1 + \frac{0.10}{2}\right)^{2} - 1 = 10.25\%$$

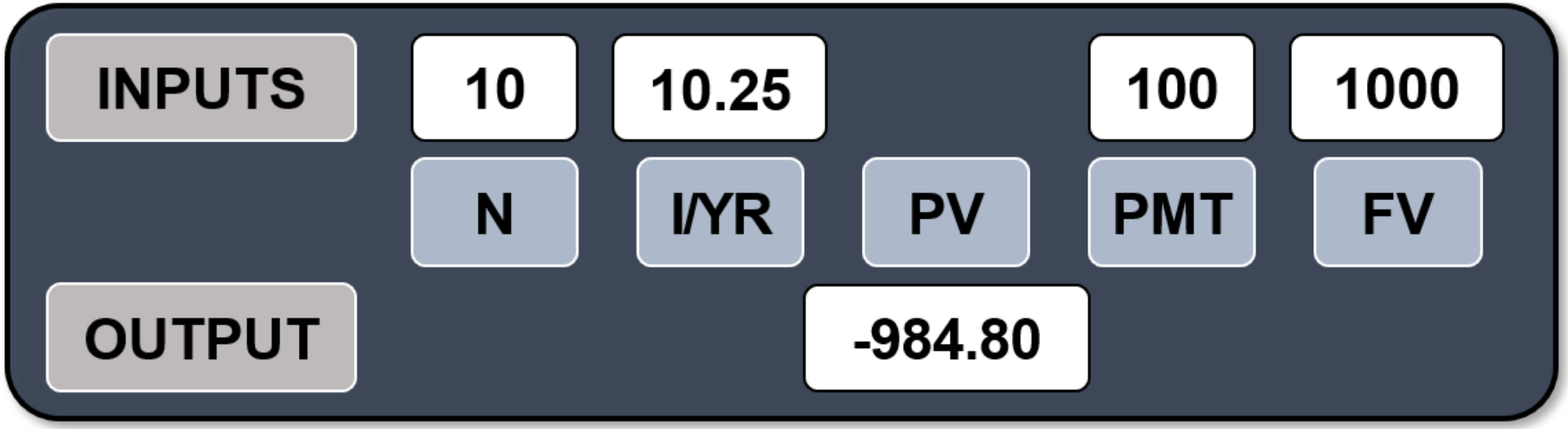
Excel: =EFFECT(.10,2)

= 10.25%

10.25% > 10% (the annual bond's effective rate), so you would prefer the semiannual bond.

# If the proper price for this semiannual bond is $1,000, what would be the proper price for the annual coupon bond?

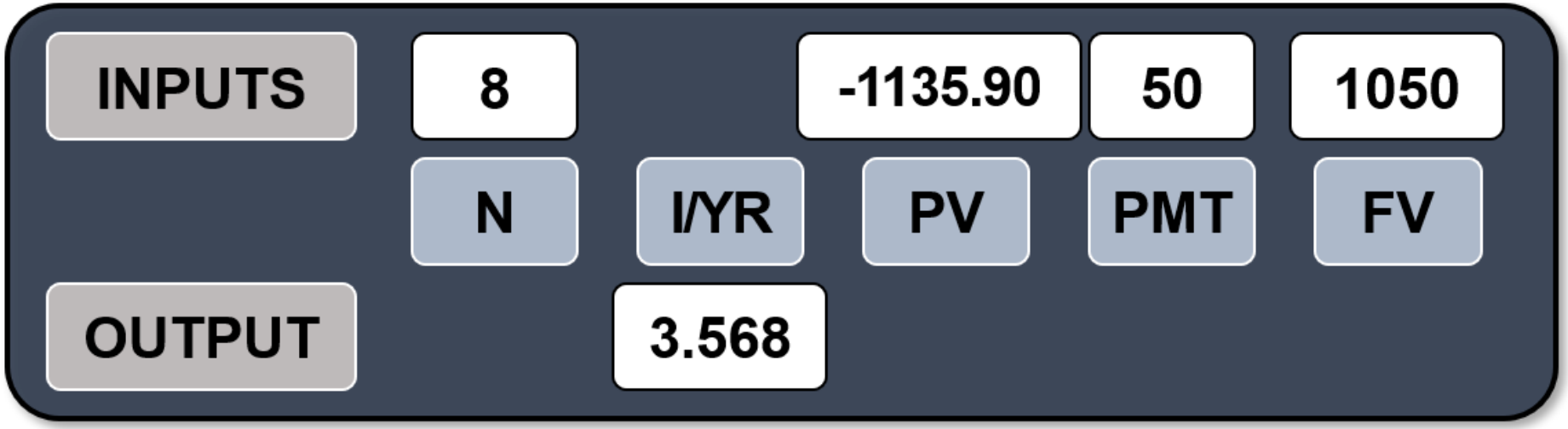
- The semiannual bond has a 10.25% effective rate, so the annual bond should earn the same EAR. At these prices, the annual and semiannual bonds are in equilibrium.




Excel: =PV(.1025,10,100,1000)

# A 10-year, 10% semiannual coupon bond selling for $1,135.90 can be called in 4 years for $1,050, what is its yield to call (YTC)?

- The bond's yield to maturity is 8%. Solving for the YTC is identical to solving for YTM, except the time to call is used for N and the call premium is FV.




Excel: =RATE(8,50,-1135.90,1050)

# Yield to Call

- 3.568% represents the periodic semiannual yield to call.
- $YTC_{NOM} = r_{NOM} = 3.568\% \times 2 = 7.137\%$ is the rate that a broker would quote.
- The effective yield to call can be calculated.
  - $YTC_{EFF} = (1.03568)^2 - 1 = 7.26\%$
  - Excel: =EFFECT(.07137,2) = 7.26%

# If you bought these callable bonds, would you be more likely to earn the YTM or YTC?

- The coupon rate = 10% compared to YTC = 7.137%.  The firm could raise money by selling new bonds which pay 7.137%.
- Could replace bonds paying $100 per year with bonds paying only $71.37 per year.
- Investors should expect a call, and to earn the YTC of 7.137%, rather than the YTM of 8%.

# When is a call more likely to occur?

- In general, if a bond sells at a premium, then (1) coupon > $r_d$, so (2) a call is more likely.
- So, expect to earn:
  - YTC on premium bonds.
  - YTM on par and discount bonds.

# Default Risk

- If an issuer defaults, investors receive less than the promised return. Therefore, the expected return on corporate and municipal bonds is less than the promised return.
- Influenced by the issuer's financial strength and the terms of the bond contract.

# Evaluating Default Risk: Bond Ratings

| | Investment Grade | | | | Junk Bonds | | | |
|---|---|---|---|---|---|---|---|---|
| Moody's | Aaa | Aa | A | Baa | Ba | B | Caa | C |
| S & P | AAA | AA | A | BBB | BB | B | CCC | C |

Bond ratings are designed to reflect the probability of a bond issue going into default.

# Factors Affecting Default Risk and Bond Ratings

- Financial performance
  - Debt ratio
  - TIE ratio
  - Current ratio
- Qualitative factors: Bond contract terms
  - Secured vs. unsecured debt
  - Senior vs. subordinated debt
  - Guarantee and sinking fund provisions
  - Debt maturity

# Other Factors Affecting Default Risk

- Miscellaneous qualitative factors
  - Earnings stability
  - Regulatory environment
  - Potential antitrust or product liabilities
  - Pension liabilities
  - Potential labor problems

# Chapter 11 Bankruptcy

- If company can't meet its obligations…
  - It files under Chapter 11 to stop creditors from foreclosing, taking assets, and closing the business and it has 120 days to file a reorganization plan.
  - Court appoints a "trustee" to supervise reorganization.
  - Management usually stays in control.
- Company must demonstrate in its reorganization plan that it is "worth more alive than dead."
  - If not, judge will order liquidation under Chapter 7.

# Priority of Claims in Liquidation

1. Secured creditors from sales of secured assets
2. Trustee’s costs
3. Wages, subject to limits
4. Taxes
5. Unfunded pension liabilities
6. Unsecured creditors
7. Preferred stock
8. Common stock

# Reorganization

- In a liquidation, unsecured creditors generally receive nothing. This makes them more willing to participate in reorganization even though their claims are greatly scaled back.
- Various groups of creditors vote on the reorganization plan. If both the majority of the creditors and the judge approve, the company “emerges” from bankruptcy with lower debts, reduced interest charges, and a chance for success.