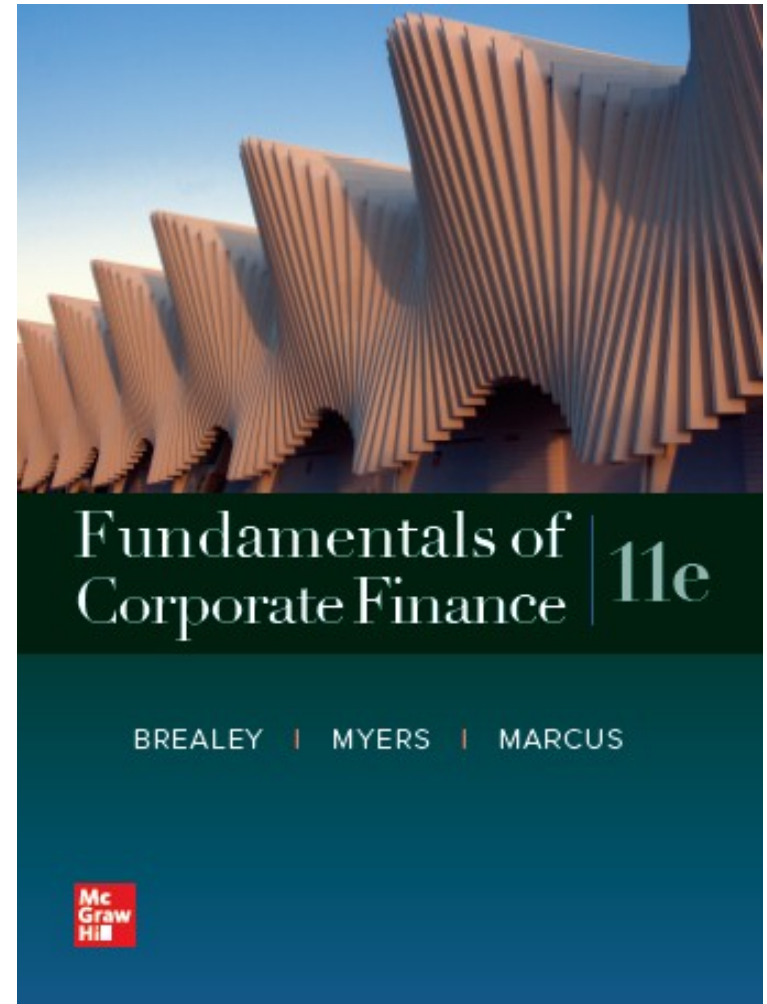# Fundamentals of Corporate Finance, 11th Edition

CHAPTER 5: The Time Value Of Money

Perpetuities and Annuities

- Perpetuity
  - A stream of level cash payments that never ends

  - Difficult: an infinite stream of payments that nevertheless has a finite value

Perpetuities and Annuities

- PV of Perpetuity Formula

$$PV = \frac{PMT}{r}$$

PMT = cash payment

r = interest rate

Perpetuities and Annuities

Example

In order to create an endowment, which pays $100,000 per year forever, how much money must be set aside today in the rate of interest is 10%?

$$;$$

$$\$1,000,000 \times .10 = \$100,000$$

Perpetuities and Annuities

Example (continued)

If the first perpetuity payment will not be received until three years from today, how much money needs to be set a side today? (see timeline) **Excel**

$$= PV \times 1/$$

See textbook section 5.5

- Timelines for two perpetuities:

- Perp A $1 $1 $1 $1 $1 $1 ..... PV= $1/r

- Perp B $1 $1 $1 .....PV =$1/r(1 + r)^t

- What is PV Perp A – PV Perp B? The PV of a 3-year annuity **Excel**

- So, PV annuity formula is

$$1/r - 1/r(1+r)^t$$

Perpetuities and Annuities

- PV of Annuity Formula

$$PV = PMT\left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]$$

PMT = cash payment

r = interest rate

t = Number of years cash payment is received
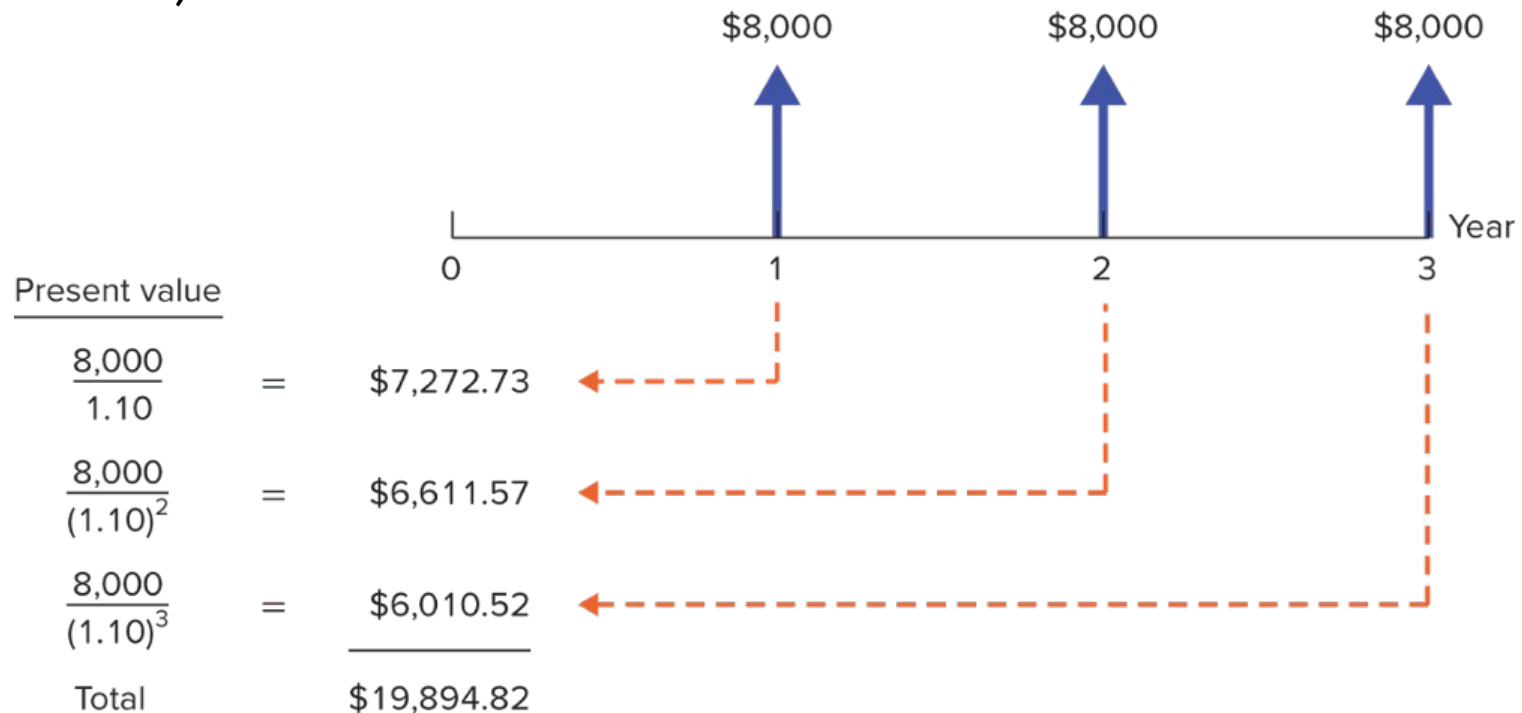
Perpetuities and Annuities

Example

You are purchasing a car. You are scheduled to make 3 annual installments of $8,000 per year. Given a rate of interest of 10%, what is the price you are paying for the car (i.e., what is the PV)?

Perpetuities and Annuities

Example (continued)

You are purchasing a car. You are scheduled to make 3 annual installments of $8,000 per year. Given a rate of interest of 10%, what is the price you are paying for the car (i.e. what is the PV)?

Present value

$$\frac{8,000}{1.10} = \$7,272.73$$

$$\frac{8,000}{(1.10)^2} = \$6,611.57$$

$$\frac{8,000}{(1.10)^3} = \$6,010.52$$

Total $19,894.82

Perpetuities and Annuities

- Applications
  - Value of payments (for a Bond investment)
  - Implied interest rate for an annuity
  - Calculation of periodic payments
    - Mortgage payment
    - Annual income from an investment payout
    - Future Value of annual payments

    - **Excel**

Perpetuities and Annuities

Example — Future value of annual payments

FV of $1 Annuity = PV of $1 Annuity x $(1+r)^t$ **Excel**

$$= \ x \ (1+r)^t$$

FV of $1 Annuity   =

To get to your savings goal, you won't have a "$1" Annuity but you will have a "PMT" Annuity; so multiply by the PMT: FV of Annuity   =   PMT X

Perpetuities and Annuities

Example — Future value of annual payments

You plan to save for 50 years and then retire. Given a 10% rate of interest, if you desire to have $500,000 at retirement, how much must you save each year?

$FV\ of\ Annuity\quad =\quad PMT\ x$

$\$500,000 = PMT\ x\ ;$

PMT or Annual Savings

Now see Excel for shortcuts

Annuities Due

- Annuity Due   *(See Lecture 3 discussion)*
  - Level stream of cash flows starting immediately
- How does it differ from an ordinary annuity?

$$\text{PV Annuity Due} = \text{PV Annuity} \times (1 + r)$$

- ***One year more (one extra r) (1+r)***

- How does the future value differ from an ordinary annuity?

$$\text{FV Annuity Due} = \text{FV Annuity} \times (1 + r)$$

Annuities Due

Example

Suppose you invest $429.59 annually at the beginning of each year at 10% interest. After 50 years, how much would your investment be worth?

$$FV \; AD \; = \; FV \; Annuity \; \times \; (1 + r)$$

=

(effectively one more year of earning 10%)

Excel