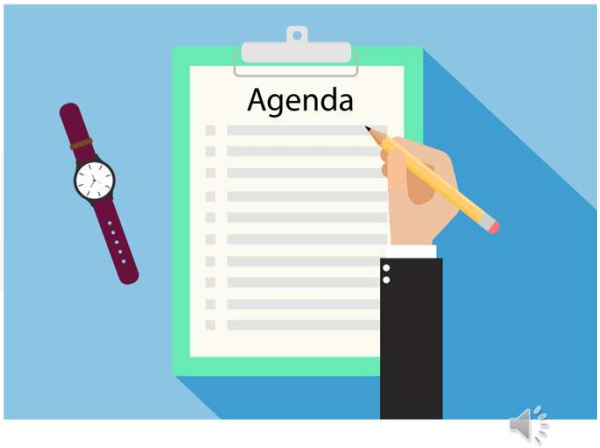
Time Value of Money-Foundational concept in Finance

In this session, we'll be discussing the time Value of Money covering the concepts of Present Value, Future Value, Annuity, Types of Annuities, Conversion of PV factor of Ordinary Annuity to Annuity Due

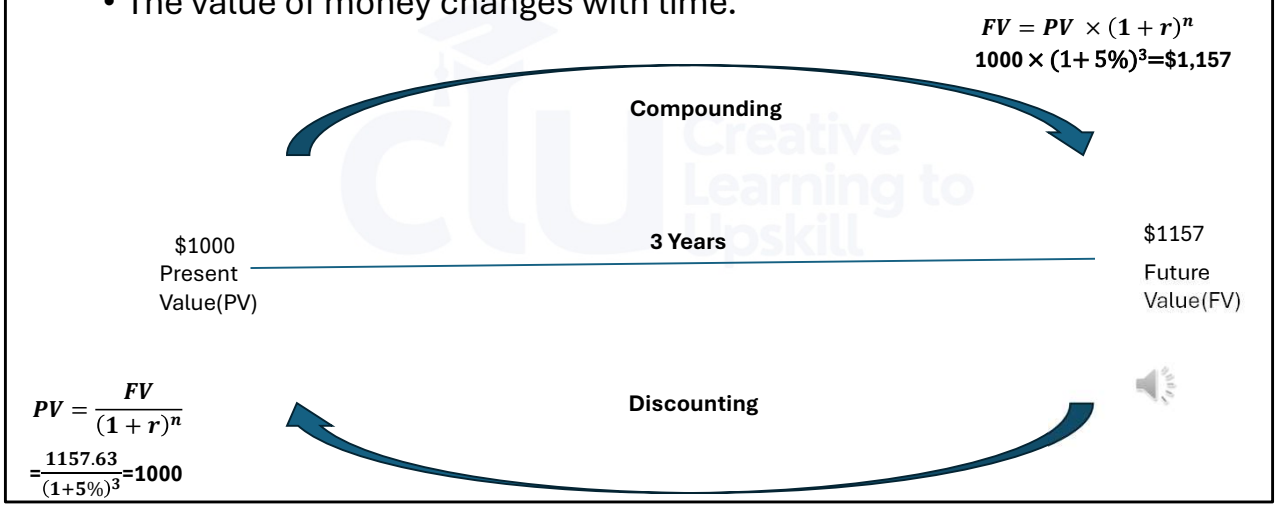
Agenda

- What is Time Value of Money?
- Concept of Present Value and Future Value
- Annuity
- Types of Annuities
- PV Factor conversion



What is Time Value of Money?

- The value of money changes with time.



Time Value of Money (TVM) is a fundamental principle in finance which states that money available today is worth more than the same amount in the future due to its potential earning capacity. This is based on the idea that money can earn interest or investment returns over time.

Present Value(PV) represents the current worth of a future amount of money, discounted at a given interest rate.

$$PV = \frac{FV}{(1+r)^n}$$

Future Value(FV) is the value of a current amount of money after it grows over time at a specified rate.

$$FV = PV \times (1+r)^n$$

Where:
r= Rate of interest per period
n= number of interest periods

Example: If you invest **$1000** today at **5% interest** per year, the future value after **3 years** will be 1157.63. This means **$1000 today** will grow to **$1157.63 in three years** if left to compound at **5% interest**.
Hence, Future Value(FV) of $1000 in 3 years is $1,157.63
Or
Present Value of $1,157.63 that will be received in 3 years is $1000
Assuming @5 % interest rate.

Why does TVM matter?

- Helps in **investment decisions** (should you invest now or later?).
- Determines **loan repayment values**.
- Used in **retirement planning** to estimate savings needed.
- Essential for valuing **bonds, stocks, and other financial instruments**.

Market Rate: 6%

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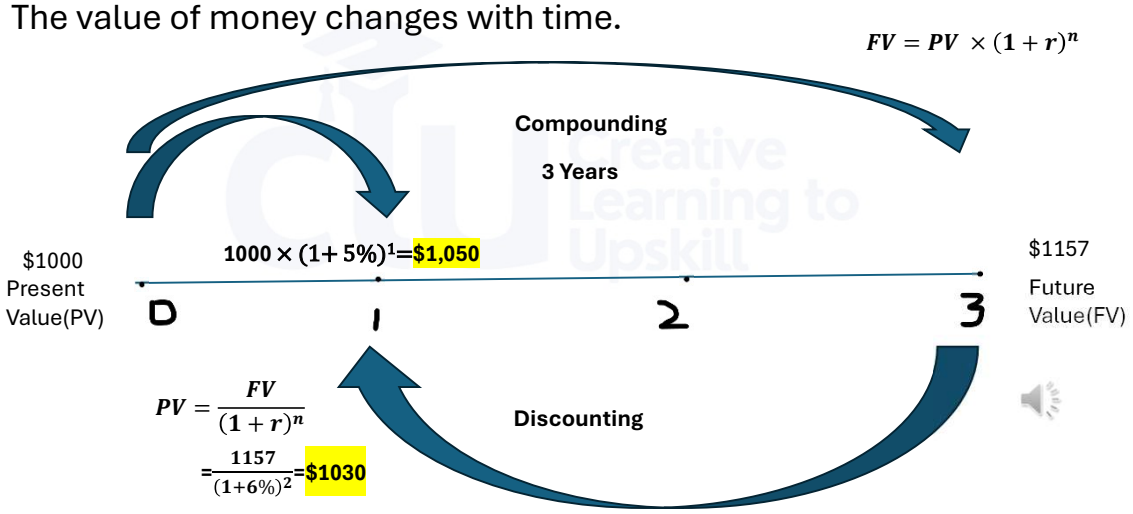
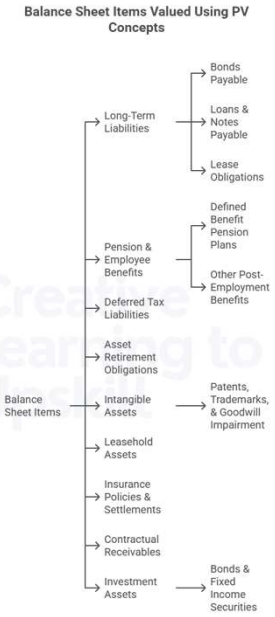


After one year, an initial investment of $1000 at a 5% interest rate grows to $1050. However, the current market rate stands at 6%, which exceeds the original investment rate of 5%.
To determine the present value (PV) of the investment, $1157.63 is discounted over two years at the market rate of 6%:
$\frac{1157.63}{(1+6\%)^2}$=1030.

Thus, based on current market rates, the investment is valued at **$1030**. Money compounds at the agreed-upon rate, whereas discounting is done using the prevailing market rate.



A balance sheet includes various assets and liabilities, all of which must be accurately valued and fairly represented. Different valuation methods are applied based on the nature of the asset or liability, applicable accounting standards, and industry practices. **The Present Value (PV) method is primarily used for valuing assets and liabilities that involve future cash flows**, ensuring a more precise reflection of their economic worth.

Compounding

- Compounding means earning interest on both your original amount and on the interest you've already earned
- You invest **$1,000** at an interest rate of **5% per year**, compounded **annually**, for **5 years**.

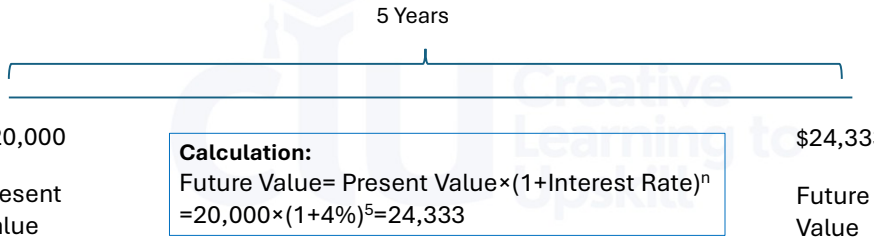
Year	Starting Amount	Interest (5%)	Ending Amount
1	$1,000.00	$50.00	$1,050.00
2	$1,050.00	$52.50	$1,102.50
3	$1,102.50	$55.13	$1,157.63

- Formula for Compounding: $FV=PV\times(1+r)^n= \$1000 \times (1 + 5\%)^3= \$1157.63$

Refer the above table to identify how money compounds over the interest periods.

Example of Time Value of Money

$20,000 deposited today with a bank @ 4% interest for 5 years . Interest is cumulative



Calculation:
Future Value= Present Value×(1+Interest Rate)^n
=20,000×(1+4%)^5=24,333

- $20,000 is called the Present Value, ie, Value at time 0.
- 4 % is the interest rate or the yield
- 5 years is the time to maturity or 'n'
- $24,333 is called the Future Value or the value at maturity.

Future Value is the amount of money you will have in the future if you invest a certain amount today at a given interest rate.
Future Value=Present Value×(1+Interest Rate)^n

Present Value is how much a future amount of money is worth today, discounted by an interest rate.
Present Value= Future Value/(1+Interest Rate)^n

Annuity

- Series of equal payments made at regular intervals—like getting or paying the same amount of money every month or year.
- Examples:
  - Paying lease periodically
  - Employer making fixed periodic pension or retirement contribution
  - Loan Liability
- Types of annuities:
  - ➢Ordinary Annuity(Annuity in Arrears
  - ➢Annuity Due(Annuity in Advance)

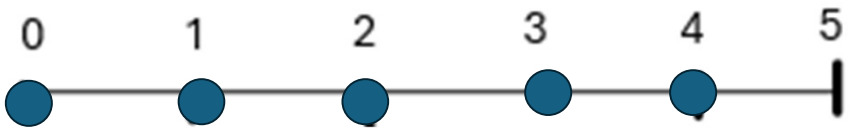
- Present Value (PV) of annuities is calculated to determine the worth of a stream of future payments in today's terms.
- This is done using discounting, which adjusts for the time value of money.

Importance of PV of Annuities:
Investment Decisions
Loan Structuring.
Retirement Planning: Assesses how much **pension funds** or savings will be worth in today's terms.
Business Valuations: Companies use it to analyze **long-term contracts** and **lease agreements** to understand their real value.
Insurance & Settlements: Helps insurers set fair values for **structured payouts** (e.g., life insurance, legal settlements).

Types of Annuities

- Ordinary Annuity(Annuity in Arrears): Payments happen at the end of each period. Examples: Car Loan EMI, Home Loan EMI, Bond Interest Payments etc.

- Annuity Due(Annuity in Advance): Payments happen at the beginning of each period. Examples: Insurance Premiums, Lease Payments etc.



The difference between Ordinary Annuity(Annuity in Arrears) and Annuity Due(Annuity in Advance) is the timing of the cash flow: Ordinary Annuity: Payments happen at the **end** of each period.
Annuity Due: Payments happen at the **beginning** of each period

Present Value of Ordinary Annuity table

Interest Rate6% **6%**

Time(in years) **5**

Year	Calculation	PV Factor
1	$\frac{1}{(1+6\%)^1}$	**0.943**
2	$\frac{1}{(1+6\%)^2}$	**0.890**
3	$\frac{1}{(1+6\%)^3}$	**0.840**
4	$\frac{1}{(1+6\%)^4}$	**0.792**
5	$\frac{1}{(1+6\%)^5}$	**0.747**
Total		4.212

$$PV\ Factor = \frac{1}{(1+r)^n}$$

Present Value of Ordinary Annuity table			
Year	**5%**	**6%**	**7%**
1	0.952	0.943	0.935
2	1.859	1.833	1.808
3	2.723	2.673	2.624
4	3.546	3.465	3.387
5	4.329	4.212	4.1

- **Annuity table** (on the right side)provides **annuity factors** that simplify calculations without needing complex formulas.
- The table contains **multipliers** based on the number of periods (**n**) and the discount rate (**r%**).
  - For annuities, the **Present Value (PV)** is calculated by multiplying the annuity payment by the pre-calculated annuity factor from the table.

Example: Receipt of $1,000 at year end, every year for 5 years, and the interest rate is 6%.

Interest Rate 6%
Time(in years) 5

Year	PV Factor
1	0.943
2	0.890
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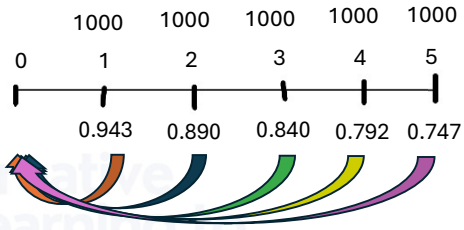
4	0.792
5	0.747
Total	4.212



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Year	Discount Factor	PMT	Present Value
1	0.943	1000	943
2	0.890	1000	890
3	0.840	1000	840
4	0.792	1000	792
5	0.747	1000	747
		Total	**4212**

Present Value (PV) is calculated by multiplying the annuity payment of $1000 by the pre-calculated annuity factor from the table(4.212)
PV= 1000×4.212= $4212

Present Value of Annuity Due table

Interest Rate 6%
Time(in years) 5

Year	PV Factor
0	1
1	0.943
2	0.890
3	0.840
4	0.792
Total	4.465

$$PV\ Factor = \frac{1}{(1+r)^n} \times (1+r)$$

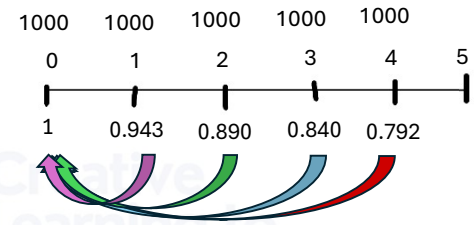
Present Value of Annuity Due table			
Year	**6%**	**8%**	**10%**
1	1	1	1
2	1.942	1.926	1.909
3	2.833	2.783	2.735
4	3.673	3.53	3.487
5	4.465	4.312	4.169

The PV at the beginning of the first period is the value itself. Hence, the discount factor is 1. Individual PV factors add up to the PV of Annuity Due for 5 years @ 6%.

Example: Receipt of $1,000 at year beginning, every year for 5 years, and the interest rate is 6%

Interest Rate 6%
Time(in years) 5

Year	PV Factor
0	1
1	0.943
2	0.890
3	0.840
4	0.792
Total	4.465



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Year	Discount Factor	PMT	PV
0	1	1000	1000
1	0.943	1000	943
2	0.890	1000	890
3	0.840	1000	840
4	0.792	1000	792
		Total	4465

The above tables represent how each cash flow is discounted to the Present Value using individual PV factor.

It also represents how the Present Value factor can be directly taken from the PV of Annuity Due table and multiple with the Annuity Amount to get the same Present Value.

Converting PV factor of Ordinary Annuity to PV factor of Annuity Due- Method 1

- Step1: In the Ordinary Annuity Table, refer the PV factor for (n-1) period
- Step 2: To the above factor, add 1
- To determine the PV Annuity Due factor for 5 years at 6%

Present Value of Ordinary Annuity table			
Year	5%	6%	7%
1	0.952	0.943	0.935
2	1.859	1.833	1.808
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5	4.465	4.312	4.169

3.465+1=4.465

Converting PV factor of Ordinary Annuity to PV factor of Annuity Due- Method 2

- Step1: In the Ordinary Annuity Table, refer the PV factor for n period
- Step 2: To the above factor, multiply (1+r)
- To determine the PV Annuity Due factor for 5 years at 6%

Present Value of Ordinary Annuity table			
Year	5%	6%	7%
1	0.952	0.943	0.935
2	1.859	1.833	1.808
3	2.723	2.673	2.624
4	3.546	3.465	3.387
5	4.329	4.212	4.1

Present Value of Annuity Due table			
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5	4.465	4.312	4.169

4.212 ×(1+6%)=4.465

Thank You!