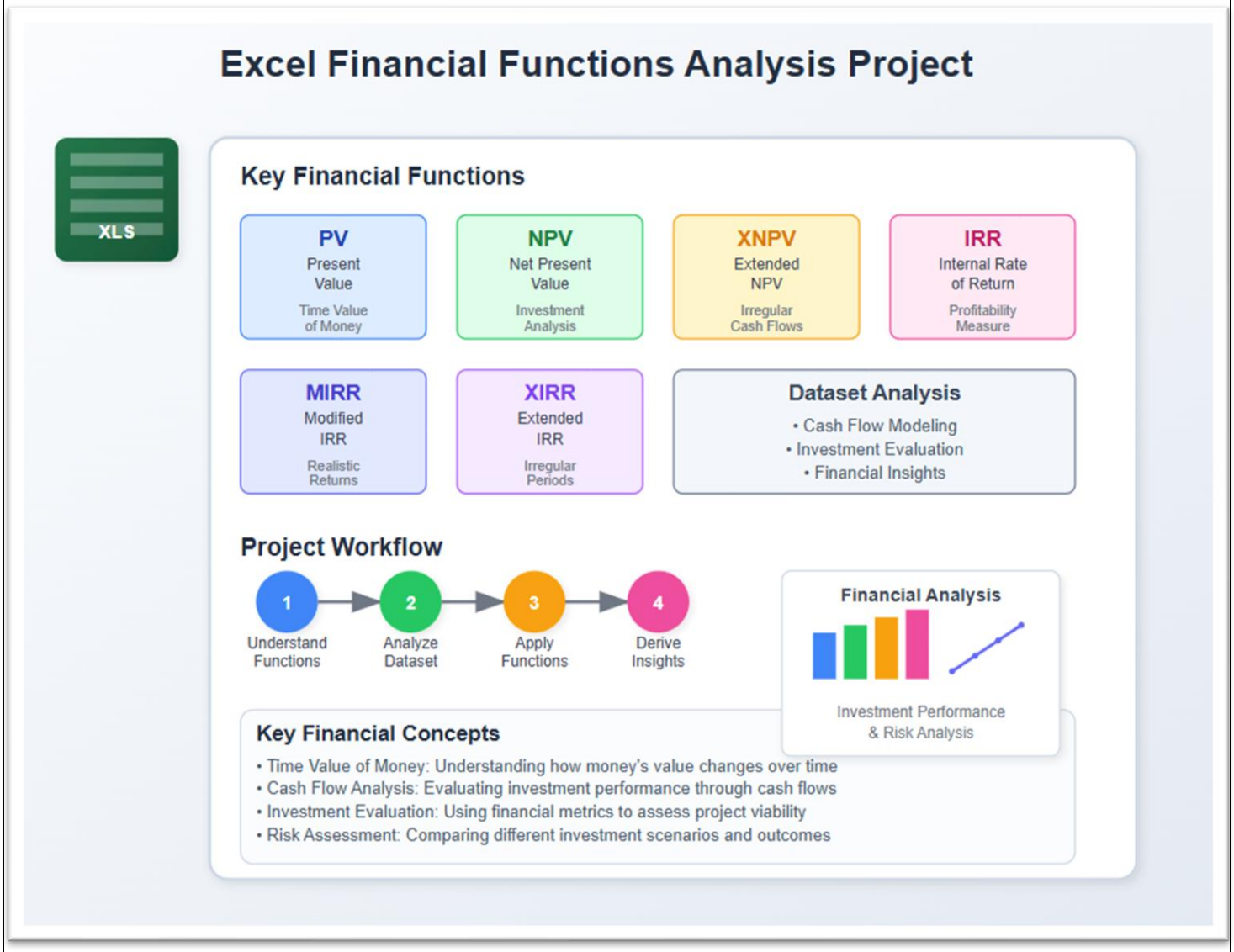
Financial Analysis: Understanding key concepts for effective decision making

Introduction

The purpose of this project is to provide fundamental insights into how financial functions and terminologies work in Excel. It is essential to thoroughly understand the provided documentation and terms to efficiently utilize Excel's financial functions such as PV, NPV, XNPV, IRR, MIRR, and XIRR. This project involves analysing a prepared dataset and applying these financial functions to derive meaningful financial insights.



Project Scope and Objectives

SCOPE:

- Utilize Excel to perform financial analysis.
- Apply various financial functions to solve real-world financial problems.
- Create a summary report based on the analysis conducted.

OBJECTIVES:

- Understand and use Excel functions for financial analysis.
- Calculate present value, net present value, and internal rate of return for different scenarios.
- Determine the effective interest rate, loan term, and EMI for given financial data.
- Generate a detailed summary report of insights and analysis.

Key Financial Concepts and Functions

1. **ANNUITY:**

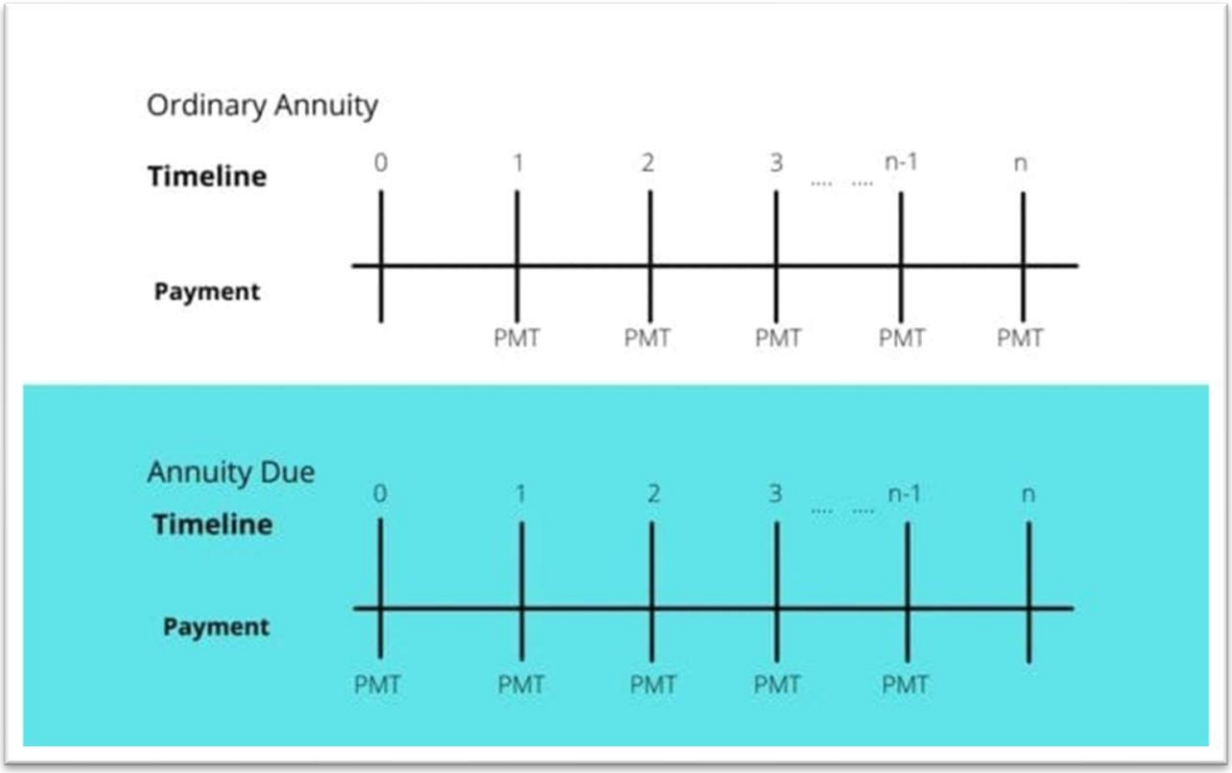
An annuity is a series of constant cash payments made over a continuous period, such as retirement savings, insurance payments, or mortgage payments.

In annuity functions:

- A positive number represents cash received.
- A negative number represents cash paid out.

- TYPES:
  - Ordinary Annuity: Payments are made at the end of each period.
  - Annuity Due: Payments are made at the beginning of each period.

- REAL LIFE APPLICATION:
  Commonly used in retirement savings plans, insurance payouts, and mortgage payments.



2. PRESENT VALUE (PV):

The present value is the total amount that a series of future payments is worth now.

- FORMULA:

  PV= FV (1+r) n

  Where, FV = Future Value, R = interest rate, N = number of periods.

- EXCEL FUNCTION:

  PV =PV (rate, nper, pmt, [fv], [type])

  - rate: Interest rate per period.
  - nper: Total number of payment periods.
  - pmt: Payment made each period.
  - fv: Future value (optional).
  - type: Payment type (0 for end of period, 1 for beginning of period).

Annuity				
Price	32000		**Price**	32000
Interest Rate	0.13		**Interest Rate**	0.13
No. of payments	8		**No. of payments**	8
Payment	-6000		**Payment**	-6000
Payments at end of the year			**Payments at beginning of the year**	
PV	**₹ 28,793**		**PV**	**₹ 32,536**

- SIGNIFICANCE:

  Helps investors and individuals understand how much future cash flows are worth today.

3. NET PRESENT VALUE (NPV):

NPV calculates the net present value of an investment based on a discount rate and a series of future payments and incomes.

- FORMULA:

$$NPV = \sum \frac{C_t}{(1+r)^t} - C_0$$

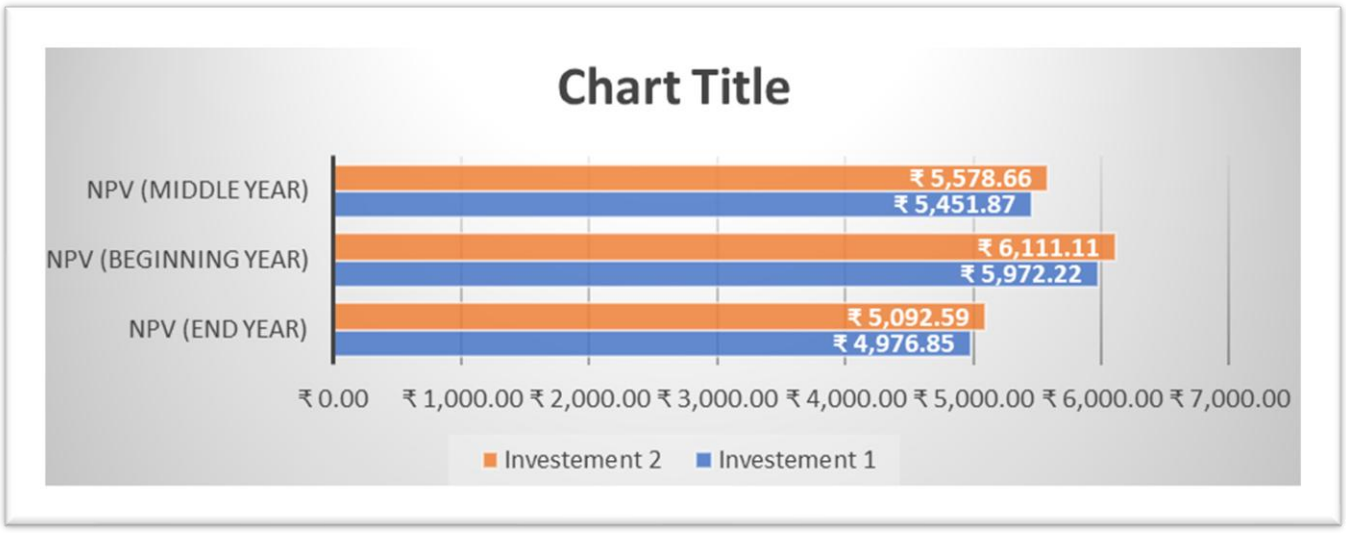
where C_t = Cash Inflow During the Period, R = Discount Rate,
T = Number of Periods, and C_0= Initial Investment.

- EXCEL FUNCTION: NPV
  =NPV (rate, value1, [value2], ...)
  - rate: Discount rate.
  - value1, value2, ...: Cash flows.

Interest Rate	0.2	
	Cash Flow	
Time	Investement 1	Investement 2
1	-10000	-5000
2	25000	20000
3	-7000	-8000
Total	8000	7000

NPV (End Year)	₹ 4,976.85	₹ 5,092.59
NPV (Beginning Year)	₹ 5,972.22	₹ 6,111.11
NPV (Middle Year)	₹ 5,451.87	₹ 5,578.66

At face value, Investment 1 looks better than Investment 2. However, you can decide on which investment is better only when you know the true worth of the investment as of today. You can use the NPV function to calculate the returns. The cash flows can occur at the end of every year, At the beginning of every year, In the middle of every year.



- IMPORTANCE:
  A positive NPV indicates that the investment is expected to generate profit, while a negative NPV suggests a loss.

4. **CASH FLOWS AT IRREGULAR INTERVALS (XNPV):**

If you want to calculate the net present value with irregular cash flows, i.e. cash flows occurring at random times, the calculation is a bit complex. However, in Excel, you can easily do such a calculation with XNPV function.

The XNPV function in Excel is a function that allows you to calculate the net present value of a series of cash flows at irregular intervals. Unlike the standard NPV function, the XNPV function allows the user to input specific dates that correspond to discounted cash flows in the series. Where the NPV formula assumes that all time periods are equal, the XNPV function offers more flexibility with inputting dates, resulting in a more precise calculation. When using the XNPV function, the user selects a discount rate, a series of cash flows and their corresponding dates.

- FORMULA:

$$\sum \frac{C_t}{(1+r)^{(dt-d0)/365 C_t}}$$

where Dt is the date of cash flow and d0 is the starting date.

- EXCEL FORMULA:

=XNPV (rate, values, dates)

  - rate: Discount rate.
  - values: Cash flows.
  - dates: Corresponding dates of the cash flows.

Arrange your data with the dates and the cash flows.

- Note − The first date in your data should be the earliest of all the dates. The other dates can occur in any order.

Use the XNPV function to calculate the net present value.

Interest Rate	0.2
Date	Cash Flow
15/Jun/2016	5000
14/Oct/2016	5143
30/Apr/2017	8838
10/Nov/2016	-4893
16/Sep/2016	-2134
18/Apr/2017	8047
27/Aug/2016	3908
17/Jul/2016	-4007

NPV	17523.65

Interest Rate	0.2
Date	Cash Flow
15/Mar/2015	0
15/Jun/2016	5000
14/Oct/2016	5143
30/Apr/2017	8838
10/Nov/2016	-4893
16/Sep/2016	-2134
18/Apr/2017	8047
27/Aug/2016	3908
17/Jul/2016	-4007
NPV	13940.18

Suppose today's date is 15th March 2015. As you observe, all the dates of cash flows are of later dates. If you want to find the net present value as of today, include it in the data at the top and specify 0 for the cash flow.

- APPLICATION:
  Useful in real estate and project financing where cash flows do not occur at regular intervals.

5. **EQUATED MONTHLY INSTALLMENT (EMI):**
   An equated monthly installment (EMI) is a fixed payment amount made by a borrower to a lender at a specified date each calendar month. Equated monthly installments are applied to both interest and principal each month so that over a specified number of years, the loan is paid off in full. In the most common types of loans—such as real estate mortgages, auto loans, and student loans—the borrower makes fixed periodic payments to the lender over several years to retire the loan.
   The benefit of an EMI for borrowers is that they know precisely how much money they will need to pay toward their loan each month, which can make personal budgeting easier.
   The benefit to lenders (or investors the loan is sold to) is that they can count on a steady, predictable income stream from the loan interest.
   The EMI can be calculated using either the flat-rate method or the reducing balance (ask the reduce-balance) method.

- FORMULA:

  The EMI reducing-balance method is calculated using this formula.

  EMI = P * [(r * (1 + r)^n)) / ((1 + r)^n - 1)]

  Where,

  - P = Principal amount borrowed
  - R= Periodic monthly interest rate
  - N = Total number of monthly payments

- EXCEL FUNCTION:

  =PMT (rate, nper, pv, [fv], [type])

  Where,

  - rate: Interest rate per period.
  - nper: Total number of payment periods.
  - pv: Present value or loan amount.
  - fv: Future value (optional).
  - type: Payment type (0 for end of period, 1 for beginning of period).

Rate per annum	0.12
Rate per month	0.01
Term	25
No. of monthly payments	300
Loan Amount (PV)	-5000000
FV	0
Type	1
EMI	**₹ 52,139.81**

Rate per annum	0.16
Rate per month	0.013333333
Term	8
Loan Amount (PV)	-100000
FV	0
Type	0
EMI	**₹ 13,261.59**

- As you can observe, Present Value (PV) is the loan amount.
- Future Value (FV) is 0 as at the end of the term the loan amount should be 0.
- Type is 1 as the EMIs are paid at the **beginning of each month.**
- Type is 0 as the EMIs are paid at the **end of each month.**

- INTEREST AND PRINCIPAL COMPONENTS OF EMI COMPONENTS:
  - Principal: The original sum of money borrowed.
  - Interest: The cost of borrowing the principal, usually expressed as an annual percentage rate (APR).

  EMI includes both-interest and a part payment of principal. As the time increases, these two components of EMI will vary, reducing the balance.

  To get the interest part of your monthly payments, you can use the Excel **IPMT function.**

  The payment of principal part of your monthly payments, you can use the Excel **PPMT function.**

- EXCEL FUNCTION:
  - Interest Component:
    IPMT =IPMT(rate, per, nper, pv, [fv], [type])
  - Principal Component:
    PPMT =PPMT(rate, per, nper, pv, [fv], [type])
- IMPORTANCE:
  Understanding these components helps borrowers comprehend their repayment structure.

For example, if you have taken a loan of 1,000,000 for a term of 8 months at the rate of 16% per annum. You can get values for the EMI, the decreasing interest amounts, the increasing payment of principal amounts and the diminishing loan balance over the 8 months. At the end of 8 months, loan balance will be 0.

Rate per month	0.013
No. of monthly payment	8
Loan Amount (PV)	100000
FV	0
Type	0
EMI	**₹ 13,242.27**

Next calculate the interest and principal parts of the EMI for the 8 months as shown below

Month	Beginning Balance	EMI	Interest	Principal	Ending Balance
1	₹ 1,00,000.00	₹ -13,242.27	₹ 1,300.00	₹ 11,942.27	₹ 88,057.73
2	₹ 88,057.73	₹ -13,242.27	₹ 1,144.75	₹ 12,097.52	₹ 75,960.22
3	₹ 75,960.22	₹ -13,242.27	₹ 987.48	₹ 12,254.78	₹ 63,705.43
4	₹ 63,705.43	₹ -13,242.27	₹ 828.17	₹ 12,414.10	₹ 51,291.34
5	₹ 51,291.34	₹ -13,242.27	₹ 666.79	₹ 12,575.48	₹ 38,715.86
6	₹ 38,715.86	₹ -13,242.27	₹ 503.31	₹ 12,738.96	₹ 25,976.89
7	₹ 25,976.89	₹ -13,242.27	₹ 337.70	₹ 12,904.57	₹ 13,072.33
8	₹ 13,072.33	₹ -13,242.27	₹ 169.94	₹ 13,072.33	₹ 0.00

- INTEREST AND PRINCIPAL PAID BETWEEN TWO PERIODS:

You can compute the interest and principal paid between two periods, inclusive.

- Compute the cumulative interest paid between 2nd and 3rd months using the CUMIPMT function.
- Compute the cumulative principal paid between 2nd and 3rd months using the CUMPRINC function.

Interest paid between 2nd and 3rd months
₹ 2,132.23

Principal paid between 2nd and 3rd months
₹ 24,352.30

6. CALCULATING INTEREST RATE:

The interest rate is the percentage of the principal charged as interest for a loan or earned on an investment.

- EXCEL FUNCTION:

=RATE (nper, pmt, pv, [fv], [type], [guess])

Loan Amount	100000
No.of monthly payment	15
EMI	-12000
Interest	8%

7. LOAN TERM:

The loan term is the duration over which the borrower agrees to pay back the loan.

- FACTORS AFFECTING LOAN TERM:
  Interest rates, loan type, and borrower's financial condition.

- EXCEL FUNCTION:
  =NPER (rate, pmt, pv, [fv], [type])

Term Loan	
Loan Amount	100000
Interest	0.1
EMI	-15000
No.of monthly payment	12

8. INTERNAL RATE OF RETURN (IRR):

The Internal Rate of Return (IRR) is a financial metric used to assess the profitability of potential investments. It represents the discount rate at which the Net Present Value (NPV) of all projected cash flows equals zero in a discounted cash flow analysis. Although IRR uses the same underlying formula as NPV, it is expressed as a percentage rather than a monetary value. This percentage reflects the annual rate of return expected from the investment. It's important to note that IRR does not provide the actual dollar gain but indicates the efficiency or yield of an investment over time.

In general, a higher IRR signifies a more attractive investment opportunity. Because IRR standardizes the return metric across different projects, it can be used to compare investments of several types and scales on a similar basis. When evaluating options with

comparable risks and characteristics, the project with the highest IRR is typically considered the most favourable. This makes IRR a useful tool for ranking and selecting among multiple investment opportunities.

- EXCEL FUNCTION:

  =IRR(values, [guess])

  Where,
  - values: Cash flows.
  - guess: Initial guess (optional)

Cash Flows
10000
-5000
-8500
2000

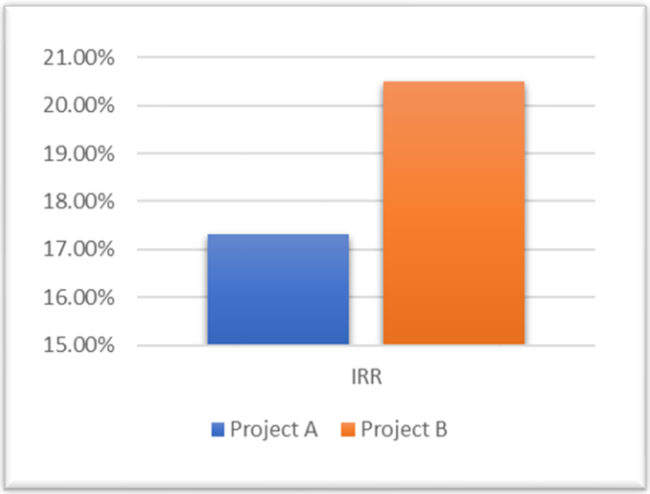
IRR
10.53%

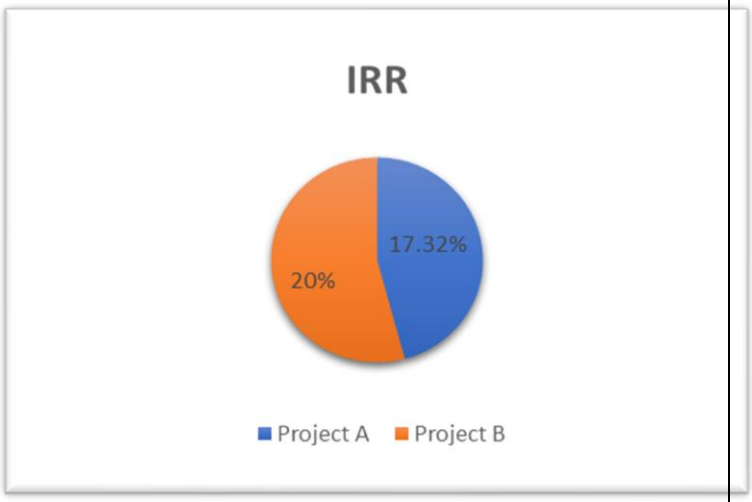
The IRR is 10.53% as you had seen in the previous section.

- APPLICATION:

  Commonly used in capital budgeting to compare the profitability of investments.

Year	Project A	Project B
0	-1000	-1000
1	0	400
2	200	400
3	300	300
4	500	300
5	900	200
IRR	17.32%	20%
NPV	₹ 815.89	₹ 552.40





For the given cash flows, IRR may

- exist and unique
- exist and multiple

- UNIQUE IRR:
  If IRR exists and is unique, it can be used to choose the best investment among several possibilities.
  When the first cash flow is negative, it indicates that the investor is putting in money, essentially making an investment. So, a higher IRR is more favourable, as it reflects the return they are earning. Conversely, if the first cash flow is positive, it suggests the investor is borrowing money, in which case a lower IRR is preferred, as it represents the cost of borrowing. To determine whether the IRR is unique, one can vary the initial guess value; if the calculated IRR stays consistent, it indicates the IRR is unique.

Cash Flows	Guess	IRR
10000		10.53%
-5000	0.05	10.53%
-8500	0.15	10.53%
2000	0.2	10.53%
	0.25	10.53%
	0.3	10.53%
	0.35	10.53%
	0.4	10.53%
	0.45	10.53%
	0.5	10.53%
	0.55	10.53%

As you can observe, the IRR has a unique value for the different guess values.

- MULTIPLE IRR:
  In certain cases, you may have multiple IRRs. Consider the following cash flows. Calculate IRR with different guess values.

Cash Flows	Guess	IRR
-20000		-9.59%
82000	15.00%	-9.59%
-60000	20.00%	-9.59%
2000	25.00%	-9.59%
	30.00%	-9.59%
	35.00%	-9.59%
	40.00%	-9.59%
	45.00%	216.09%
	50.00%	216.09%
	55.00%	216.09%
	60.00%	216.09%

You can observe that there are two IRRs - -9.59% and 216.09%. You can verify these two IRRs calculating NPV.

- NO IRR:
  In certain cases, you may not have IRR. Consider the following cash flows. Calculate IRR with different guess values.

  You will get the result as #NUM for all the guess values.

Cash Flows	Guess	IRR
10000		#NUM!
-5000	0.05	#NUM!
8500	0.15	#NUM!
2000	0.2	#NUM!
	0.25	#NUM!
	0.3	#NUM!
	0.35	#NUM!
	0.4	#NUM!
	0.45	#NUM!
	0.5	#NUM!
	0.55	#NUM!

The result #NUM means that there is no IRR for the cash flows considered.

9. IRR OF IRREGULARLY SPACED CASH FLOWS (XIRR):

XIRR - Extended Internal Rate of Return

XIRR, or Extended Internal Rate of Return, is a financial function used to calculate the internal rate of return for cash flows that occur on irregular dates. Unlike the standard IRR, which assumes cash flows happen at consistent intervals (e.g., annually), XIRR incorporates the actual dates of each cash flow. This allows for a more precise and realistic assessment of an investment's profitability.

- FORMULA:

The XIRR function does not have a simple mathematical formula like traditional IRR because it involves solving for a discount rate that equates the present value of cash inflows and outflows to zero. However, the mathematical concept behind XIRR can be understood as

$$XNVP = \frac{C_t}{(1+r)^{\frac{(d_t - d_0)}{365}}}$$

Where,

- C_t = Cash flow at time t
- r = The internal rate of return (which the XIRR function seeks to calculate)
- d_t = Date of cash flow t
- d_0 = Initial date of investment

- APPLICATION:

  XIRR is particularly useful in scenarios where cash flows occur at irregular intervals.
  - **Private Equity and Venture Capital**: Investments in startups or emerging businesses often involve inconsistent capital injections, making XIRR an effective method for evaluating returns.
  - **Real Estate Investments**: Income from real estate—such as rent payments, renovations, and property sales—typically happens at non-uniform intervals, where XIRR helps measure true profitability.
  - **Project Financing**: Large-scale projects usually require significant upfront investments and generate revenue unevenly over time, making XIRR valuable for assessing overall financial performance.

- EXCEL FUNCTION:

  =XIRR (values, dates, [guess])

Date	Cash Flow
04/08/2015	-10000
8/15/2015	4000
3/15/2016	3000
4/25/2016	5000

XIRR	26.42%

The Internal Rate of Return that results in is 26.42%

10.MODIFIED INTERNAL RATE OF RETURN (MIRR):

The Modified Internal Rate of Return (MIRR) provides a more precise evaluation of an investment's profitability compared to the traditional Internal Rate of Return (IRR). Unlike IRR, MIRR considers both the financing cost (finance rate) and the reinvestment of interim cash flows (reinvestment rate). It is commonly used in capital budgeting and project finance to evaluate projects with uneven or irregular cash flows.

- FORMULA:

$$MIRR = \left[\frac{FV\ (Possitive\ Cash\ Flows)}{PV(Negative\ Cash\ Flows)}\right]^{\frac{N}{1}} - 1$$

Where,

- FV = Future Value of positive cash flows (reinvested at the reinvestment rate).
- PV = Present Value of negative cash flows (discounted at the finance rate).
- N= Number of periods.

- EXCEL FUNCTION:

=MIRR (values, finance rate, reinvest rate)

Finance rate	10%
Reinvestment Rate	12%

Year	Cash Flow
0	-1.6
1	10
2	-10

Discount	NPV
10%	-$0.70
25%	$0.00
110%	$0.43
400%	$0.00
500%	-$0.04

MIRR	7%

As you can see the MIRR is 7%

Key Findings and Insights

This section will present the results and insights gained from the analysis of financial concepts.

- **KEY FINDINGS:**

i. **Annuities and Present Value:**
Grasping the concept of the time value of money is essential when evaluating long-term financial instruments like annuities. For instance, a deferred annuity typically has a higher present value than an immediate one when discounted appropriately.

ii. **NPV vs. IRR:**
Although both NPV and IRR are valuable tools for project evaluation, NPV provides a clearer picture of actual profitability. IRR can be misleading, particularly when its reinvestment assumptions do not align with real-world scenarios.

iii. **MIRR Provides Realistic Profitability Measures:**
MIRR rectifies the overestimation that traditional IRR might offer by assuming a more realistic reinvestment rate. This makes MIRR a better metric for long-term projects or investments with varying cash flows.

iv. **EMI and Loan Repayments:**
Borrowers often underestimate how much of their initial payments are used for interest rather than principal. Amortization schedules help visualize how the composition of payments changes over time, showing when the borrower starts reducing the loan's principal balance significantly.

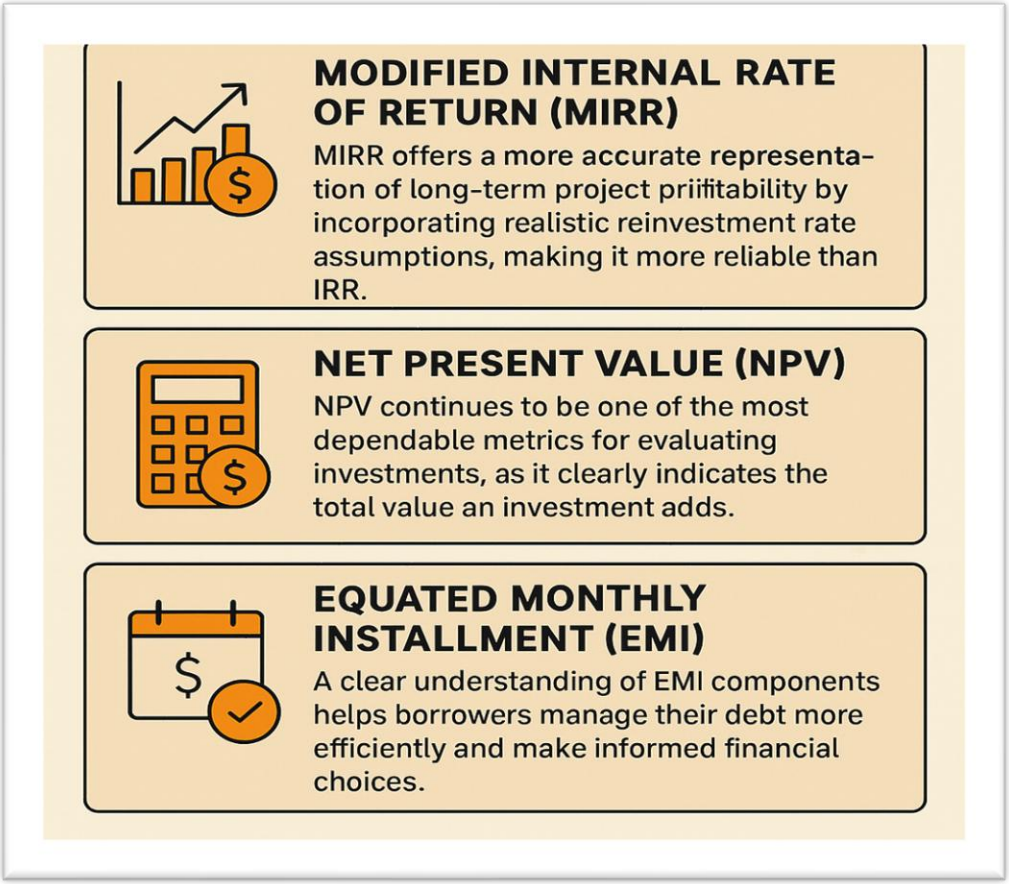
- **INSIGHTS:**

- Companies should rely more on MIRR and NPV for capital budgeting decisions as these are more accurate in reflecting the real profitability of long-term projects.
- Personal financial decisions, such as choosing between different loan products, can benefit from an understanding of EMI calculations and amortization schedules.

Conclusions

This project highlights the significance of understanding fundamental financial concepts such as NPV, IRR, EMI, and MIRR to make well-informed financial decisions. Whether applied in corporate or personal finance, these tools are essential for assessing profitability, risk, and repayment structures of various financial products and investment options.

- **Key Takeaways:**
  - MIRR offers a more accurate representation of long-term project profitability by incorporating realistic reinvestment rate assumptions, making it more reliable than IRR.
  - NPV continues to be one of the most dependable metrics for evaluating investments, as it clearly indicates the total value an investment adds.
  - A clear understanding of EMI components helps borrowers manage their debt more efficiently and make informed financial choices.



Actionable Recommendations

Actionable Recommendations Based on the Findings:

i. For Corporate Finance:

- Companies should prioritize using MIRR for long-term projects, especially those with non-conventional cash flows, as it offers a more accurate measure of profitability than IRR.
- When evaluating investments, always validate IRR results with NPV analysis to prevent inflated return expectations caused by unrealistic reinvestment rate assumptions.

ii. For Personal Finance:

- When exploring loan options, individuals should assess both the EMI and the total interest payable over the loan's duration to make well-informed borrowing decisions.
- Understanding the time value of money concepts, such as Present Value (PV) and Net Present Value (NPV), is essential for effective retirement planning, particularly when evaluating annuity options.

iii. For Investors:

- When making investment decisions, evaluating both NPV and IRR offers a more comprehensive view of potential returns. The XNPV and XIRR functions are especially valuable when cash flows occur at irregular intervals.