Q Internal Rate of Return Method

The discount rate which equates the aggregate present value of the cash inflows with the aggregate present value of cash outflows of a project, is called **Internal Rate of Return (IRR)**. Thus the value of the 'r' for which—

$$C = \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \frac{R_3}{(1+r)^3} + \ldots + \frac{R_n}{(1+r)^n}$$ is called Internal Rate of Return,

where —

C = Initial Investment ;

$R_1, R_2, R_3, \ldots R_n$ are the inflows of cash for the 1st, 2nd, 3rd .....nth year respectively ;

r = Internal rate of return.

❑ **Example 22 :** The initial outlay of a project is ₹ 50,000 with a working life of 2 years. Annual cash inflows of ₹ 36,000 and ₹ 28,800 are to be received from the project at the end of 1st and 2nd year respectively. Calculate the IRR of the project.

• **Solution** ⇒ Let the IRR is r%.

$$\therefore \quad 50{,}000 = \frac{36{,}000}{(1+r)} + \frac{28{,}800}{(1+r)^2}$$

Let $1 + r = x$

$$\therefore \quad 50{,}000 = \frac{36{,}000}{x} + \frac{28{,}800}{x^2}$$

$$\text{or,} \quad 50{,}000 = \frac{36{,}000\,x + 28{,}800}{x^2}$$

$$\text{or,} \quad 50{,}000\,x^2 = 36{,}000\,x + 28{,}800$$

$$\text{or,} \quad 50{,}000\,x^2 - 36{,}000\,x - 28{,}800 = 0$$

$$\text{or,} \quad 500\,x^2 - 360\,x - 288 = 0$$

$$\text{or,} \quad 5\,(100\,x^2 - 72x - 57.6) = 0$$

$$\text{or,} \quad 100\,x^2 - 72\,x - 57.6 = 0$$

$$\text{or,} \quad 100\,x^2 - 120\,x + 48\,x - 57.6 = 0$$

$$\text{or,} \quad 100\,x\,(x - 1.2) + 48\,(x - 1.2) = 0$$

$$\text{or,} \quad (x - 1.2)\,(100\,x + 48) = 0$$

$\therefore$ either $(100\,x + 48) = 0$ or, $(x - 1.2) = 0$

If $100\,x + 48 = 0$, then —

$$x = -\frac{48}{100}$$

But, $x = 1 + r > 0$

$$\therefore \quad x \neq \frac{48}{100}$$

Again, if $x - 1.2 = 0$, then —

$x = 1.2$

$\therefore \quad 1 + r = 1.2 \quad [\because x = 1 + r]$

or, $r = 1.2 - 1$

or, $r = 0.20$ or, 20%.

Hence, required IRR is 20%.

❑ **Example 23 :** A project costs ₹ 3,20,000 and is expected to generate annual net cash inflow of ₹ 2,00,000 and ₹ 2,80,000 over its life of 2 years. Calculate the internal rate of return of the project.

• **Solution** ⇒ Let the IRR is *r*%.

$$\therefore \quad 3{,}20{,}000 = \frac{2{,}00{,}000}{(1+r)} + \frac{2{,}80{,}000}{(1+r)^2}$$

$$\text{or,} \quad 3{,}20{,}000 = 40{,}000\left[\frac{5}{(1+r)} + \frac{7}{(1+r)^2}\right]$$

$$\text{or,} \quad 8 = \frac{5}{(1+r)} + \frac{7}{(1+r)^2}$$

$$\text{or,} \quad 8 = \frac{5\,(1+r) + 7}{(1+r)^2}$$

or, $8\,(1 + r)^2 = 5 + 5r + 7$

or, $8 + 16r + 8r^2 - 5 - 5r - 7 = 0$

or, $8r^2 + 11r - 4 = 0$

By applying Sridhar Acharya's formula, we get —

$$r = \frac{-11 \pm \sqrt{(11)^2 - 4(8)(-4)}}{2(8)}$$

or, $$r = \frac{-11 \pm \sqrt{121 + 128}}{16}$$

or, $$r = \frac{-11 \pm 15.78}{16}$$

Thus, $$r = \frac{-11 - 15.78}{16} \text{ or, } \frac{-11 + 15.78}{16}$$

If, $$r = \frac{-11 - 15.78}{16}$$, then —

$$r = \frac{-26.78}{16}$$

But $r > 0$

$$\therefore r \neq \frac{-26.78}{16}$$

If $$r = \frac{-11 + 15.78}{16}$$

or, $$r = \frac{4.78}{16}$$

or, $r = 0.29875$ or, 29.88%

Hence, required IRR is 29.88%.

■ **Technique of determining the IRR of a given series of incomes :** If cash flows are given for one or two years, then there is not much problem in determining the value of **r** under the above method. But when cash flows are given for three, four or more years, it is very difficult to determine the value of **r** in that very method. In such a case, the value of **r** can be determined easily by the following four steps —

Step - I ⇒ At first, the factor is to be determined with the help of the following formula in order to find out the trial rate.

$$\textbf{Factor (F)} = \frac{\textbf{Initial Investment}}{\textbf{Annual Average cash inflow}}.$$

Step - II ⇒ The rate which is equal to the value of **F** for that number of years which is equivalent to the estimated useful life of the project, will be found out from the **'PVF'** table. The rate which is equal to the value of **'F'** will be the **IRR**.

But, generally, there is no exact rate which is equal to the value of **F**. So, a lower rate and a higher rate nearest to the value of **F** are to be selected. It can be mentioned in this regard that the more the variance of the inflows of cash, the wider should be the higher and lower rates.

Step - III ⇒ The Net Present values are to be determined both at a higher and lower rates.

Step - IV ⇒ The exact value of **r** is to be determined with the help of the following formula :

$$r = \text{Lower rate} + \frac{\text{NPV at the lower rate}}{\text{NPV at the lower rate} - \text{NPV at the higher rate}} \times \text{Difference between higher and lower rates.}$$

❑ **Example 24 :** A project requires an initial investment of ₹ 12,000. The annual cashflow is estimated at ₹ 4,000 for 5 years. Calculate the internal rate of return.

• **Solution ⇒** Let 'F' be the factor.

$$\therefore F = \frac{12,000}{4,000} = 3.$$

We get from the 'PVF' table —

Present value of annuity of Re. 1 at 19% for 5 years = ₹ 3,058 and

Present value of annuity of Re. 1 at 20% for 5 years = ₹ 2,991.

Computation of NPV at 20% :

Present value of cash inflow : ₹ 4,000 × 2.991	= ₹	11,964
Less : Initial investment	= ₹	12,000
Net Present Value (NPV)	(–) ₹	36

Computation of NPV at 19% :

Present value of cash inflow : (₹ 4,000 × 3.058)	= ₹	12,232
Less : Initial investment	= ₹	12,000
Net Present Value (NPV)	₹	232

Now, Let IRR = r

$$\therefore r = 19 + \frac{232}{232 - (-36)} \times (20 - 19)$$

$$= 19 + \frac{232}{232 + 36} \times 1$$

$$= 19 + \frac{232}{268}$$

$$= 19 + 0.87 = 19.87.$$

Hence, required IRR is 19.87.

Q.1. Accept-Reject Principles

The following principles are to be followed for taking decision whether a proposed project is to be accepted or rejected under Internal Rate of Return (IRR) Method —

(i) **In case of only one project :** If the IRR of a project is equal to or more than the minimum expected rate of return to the investors, then the project is accepted otherwise not.

(ii) **In case of two projects :** When one project has to be selected out of two given projects, the project with higher IRR is accepted.

(iii) **In case of mutually exclusive projects :** In case of mutually exclusive projects, the projects are arranged according to the ranks on the basis of their IRR. The project which has highest IRR will be given rank 1, the second highest IRR will be given rank 2 and next to second highest will be given rank 3 and so on. The project with rank 1 will be accepted.

□ **Example 25 :** A project requires an initial investment of ₹ 3,00,000. The life of the project is 5 years and it can generate cash inflows of ₹ 60,000, ₹ 80,000, ₹ 1,00,000, ₹ 1,20,000 and ₹ 40,000 at the end of each year for next 5 years. If the required rate of return is 10%, should the project be accepted ?

Solution ⇒ Total cash inflows in 5 years = ₹ (60,000 + 80,000 + 1,00,000 + 1,20,000 + 40,000)

= ₹ 4,00,000.

∴ Annual average cash inflow = ₹ $\frac{4,00,000}{5}$ = ₹ 80,000

$$\text{Factor (F)} = \frac{\text{Initial investment}}{\text{Annual average cash inflow}}$$

$$= \frac{3,00,000}{80,000} = 3.75.$$

The present value of annuity of Re. 1 at 10% discount rate for 5 years is ₹ 3.791 and the present value of annuity of Re. 1 at 12% discount rate for 5 years is ₹ 3.605.

Statement showing the NPV

At a discount @ 10%				*At a discount @ 12%*			
Year	*Cash inflows (₹)*	*PV of (₹) 1*	*PV (₹)*	*Year*	*Cash inflows (₹)*	*PV of (₹) 1*	*PV (₹)*
1	60,000	0.909	54,540	1	60,000	0.893	53,580
2	80,000	0.826	66,080	2	80,000	0.797	63,760
3	1,00,000	0.751	75,100	3	1,00,000	0.712	71,200
4	1,20,000	0.683	81,960	4	1,20,000	0.636	76,320
5	40,000	0.621	24,840	5	40,000	0.567	22,680
	Total present value		3,02,520		Total present value		2,87,540
	Less : Initial investment		3,00,000		*Less :* Initial investment		3,00,000
	NPV		2,520		**NPV**		(–) 12,460

Now, Let IRR = r%

$$\therefore \quad r = 10 + \frac{2,520}{2,520 - (-12,460)} \times (12 - 10)$$

$$= 10 + \frac{2,520}{2,520 + 12,460} \times (12 - 10)$$

$$= 10 + \frac{2,520}{14,980} \times 2 = 10 + \frac{5,040}{14,980}$$

$$= 10 + 0.34 = 10.34.$$

Hence, the internal rate of return is 10.34%.

Comment : The required rate of return is 10%. But the internal rate of return of the project is 10.34%. So, the project should be accepted.

❑ **Example 26 :** Modern Electronic Ltd. wants to select one of the following two projects.

Particulars	*Project—A (₹)*	*Project—B (₹)*
Initial Investment	44,000	40,000
Cash inflows :		
1st year	24,000	4,000
2nd year	8,000	4,000
3rd year	4,000	8,000
4th year	20,000	40,000

Using the internal rate of return method suggest which project is preferable.

A. Computation of IRR of Project "A".

Total cash inflows in 4 years = ₹ (24,000 + 8,000 + 4,000 + 20,000)

= ₹ 56,000

Annual average cash inflow = $\frac{56,000}{4}$ = ₹ 14,000

$\therefore$ Factor (F) = $\frac{\text{Initial investment}}{\text{Annual average cash inflow}} = \frac{44,000}{14,000}$ = 3.14 (Approx.)

The present value of annuity of ₹ 1 at a discount @ 10% for 4 years = ₹ 3.17 and the present value of annuity of ₹ 1 at a discount @ 12% for 4 years = ₹ 3.037.

Statement showing the NPV

At a discount @ 10%				*At a discount @ 12%*			
Year	*Cash inflows (₹)*	*PV of (₹) 1 (₹)*	*PV (₹)*	*Year*	*Cash inflows (₹)*	*PV of (₹) 1 (₹)*	*PV (₹)*
1	24,000	0.909	21,816	1	24,000	0.893	21,432
2	8,000	0.826	6,608	2	8,000	0.797	6,376
3	4,000	0.751	3,004	3	4,000	0.712	2,848
4	20,000	0.683	13,660	4	20,000	0.636	12,720
Total present value			45,088	Total present value			43,376
Less : Initial investment			44,000	*Less :* Initial investment			44,000
NPV			1,088	**NPV**			(–) 624

Now, Let IRR = r %

$\therefore$ r = $10 + \frac{1,088}{1,088 - (-624)} \times (12 - 10)$

= $10 + \frac{1,088}{1,712} \times 2$

= $10 + \frac{2,176}{1,712}$

= 10 + 1.27 = 11.27

$\therefore$ ***The internal rate of return of project A is 11.27%.***

B. Computation of IRR of Project "B".

Total cash inflows in 4 years = ₹ (4,000 + 4,000 + 8,000 + 40,000)
= ₹ 56,000

Annual average cash inflows = $\frac{56,000}{4}$ = ₹ 14,000

∴ Factor (F) = $\frac{\text{Initial investment}}{\text{Annual average cash inflow}} = \frac{40,000}{14,000} = 2.86.$

The present value of annuity of ₹ 1 at a discount @ 14% for 4 years = ₹ 2.914 and the present value of annuity of ₹ 1 at a discount @ 10% for 4 years = ₹ 3.17.

Statement showing the NPV

At a discount @ 10%				*At a discount @ 14%*			
Year	*Cash inflows (₹)*	*PV of ₹ 1 (₹)*	*PV (₹)*	*Year*	*Cash inflows (₹)*	*PV of ₹ 1 (₹)*	*PV (₹)*
1	4,000	0.909	3,636	1	4,000	0.877	3,508
2	4,000	0.826	3,304	2	4,000	0.769	3,076
3	8,000	0.751	6,008	3	8,000	0.675	5,400
4	40,000	0.680	27,200	4	40,000	0.592	23,680
Total present value			40,148	Total present value			35,664
Less : Initial investment			40,000	*Less :* Initial investment			40,000
NPV			148	NPV			(–) 4,336

Let, IRR = r %

$$\therefore r = 10 + \frac{148}{148 - (-4,336)} \times (14 - 10)$$

$$\text{or, } r = 10 + \frac{148 \times 4}{4,484}$$

or, r = 10 + 0.13

or, r = 10.13.

∴ *The internal rate of return of Project B is 10.13%.*

Comment : The IRR of Project A is 11.27% and of Project B is 10.13%. The IRR of Project A is more than the IRR of Project B. So, the Project A is to be preferred.

Q.2. Advantages and Disadvantages of IRR Method

■ Advantages : The advantages of IRR method are —

Firstly, the time value of money is considered in this method.

Secondly, the inflows and outflows of cash of the entire life of a project are considered here.

Thirdly, this method does not use the concept of the cost of capital but itself provides a rate of return which is indicative of the profitability of the investment proposal.

Fourthly, this method is consistent with the objective of maximisation of wealth, the primary objective of the financial management.

■ **Disadvantages :** The disadvantages of IRR method are —

Firstly, it is very difficult to determine the IRR, because different rates of discount have to be used in this method for determining the IRR through trial and error.

Secondly, it takes a long-time to calculate the IRR by the method of trial and error.

Thirdly, it is assumed in this method that the returns which are obtained in different years are reinvested at the internal rate of return. On the other hand, it is assumed in NPV method that the reinvestment is made at the rate of cost of capital. So, the concept of NPV method is more realistic than that of IRR method.