Discounted Cash Flow Techniques:

The discounted cash flow methods provide a more objective basis for evaluating and selecting an investment project. These methods consider the magnitude and timing of cash-flows in each period of a project's life. Discounted cash-flow methods enable us to isolate the differences in the timing of cash-flows of the project by discounting them to know the present value. The present value can be analysed to determine the desirability of the project. These techniques adjust the cash-flows over the life of a project for the *time value of money*.

Time Value of Money:

Sound decision making demands logical comparability of cash-flows, which differ in timing and risk. Recognition of time value of money and risk by adjusting cash-flows for their differences in timing and risk is extremely vital in financial decision making. Most financial decisions, such as buying assets or borrowing funds involve cash-flows at different periods of time. For example, if a firm purchases any machinery which will be used to produce a certain type of product; the firm will have an immediate cash outflow; and a series of cash inflows will be there for many future periods as the finished products will be sold. Similarly, if an individual borrows money, she will have an immediate cash inflow and a series of cash outflows as she will commit an obligation to service the debt for many future periods. These cash-flows which differ in timing are not directly comparable. And, sound decision making demands logical comparability of cash-flows.

If an individual behaves rationally, she would not value the opportunity to receive an amount now equally with the same amount at a future date. Most of them will value the opportunity to receive the amount now, higher than receiving the same in future. This preference of an individual for possession of an amount now, rather than in future is *'time preference for money'.* The reasons attributed to time preference for money are:

1. Risk: Uncertainty about future cash receipts leads an individual to prefer receiving cash now as *"a bird in hand is worth two in the bush"*.

2. Preference for Present Consumption: Individuals has subjective preference for present consumption over future consumption of goods and services. The reason for the same may be its urgency of present want, not being in a position to enjoy future consumption due to illness, death or inflation.

3. Investment Opportunity: Individuals has preference for present cash to future cash because of the available investment opportunities. If the cash is received at present, it could be invested to reap returns in future.

To determine the desirability of the project, these techniques adjust the cash-flows over the life of a project for the *time value of money*.

a) Net Present Value (NPV)

b) Internal Rate of Return (IRR)

c) Profitability Index (PI)

Net Present Value Method:

The net present value method is a classic method of evaluating the investment proposals. It is one of the methods of discounted cash flow techniques. It recognises the importance of time value of money. It correctly postulates that cash flows arising at different time periods differs in value and are comparable only with their equivalents i.e., present values are found out.

"It is a present value of future returns, discounted at the required rate of return minus the present value of the cost of the investment." ----Ezra Solomon

NPV is the difference between the present value of cash inflows of a project and the initial cost of the project.

Steps for computing net present value:

1. An appropriate rate of interest should be selected to discount the cash flows. Generally, this will be the "Cost of Capital" of the company, or required rate of return

2. The present value of inflows and outflows of an investment proposal has to be computed by discounting them with an appropriate cost of capital

3. The net present value is the difference between the present value of cash inflows and the present value of cash outflows

Decision Criteria: According the NPV technique, for accept-reject type of decision, if the project has a positive NPV, the project is acceptable. If a project(s) NPV is less than 'Zero'. It gives negative NPV. Hence, it must be rejected. For mutually exclusive projects (i.e., only one project will be selected) the project with highest positive NPV should be selected.

Merits:

1. It recognizes the time value of money.

2. It is based on the entire cash flows generated during the useful life of the asset.

3. It is consistent with the objective of maximization of wealth of the owners.

4. The ranking of projects is independent of the discount rate used for determining the present value.

Demerits:

1. It is difficult to understand and use.

2. The NPV is calculated by using the cost of capital as a discount rate. But, the concept of cost of capital itself is difficult to understood and determine.

3. It does not give solutions when the comparable projects are involved in different amounts of investment.

4. It does not give correct answer to a question whether alternative projects or limited funds are available with unequal lines.

Example 5: The Alfa Company limited considering the purchase of a new machine. Two alternative machines X and Y have been suggested, each having an initial cost of Rs. 40,000/- and requiring Rs. 2,000/- as additional working capital at the end of the 1st year. Cash flows after taxes are as follows

Year	Cash Flows	
	Machine X (Rs.)	Machine Y (Rs.)
1	4,000	12,000
2	12,000	16,000
3	16,000	20,000
4	24,000	12,000
5	16,000	8,000

The company has a target return on capital of 10% and on this basis you are required to compare the profitability of the machines and state which alternative you consider as financially preferable.

Solution:

Present Value of Cash Outflow = Initial investment + Present Value of Additional Working Capital

= Initial investment + (Additional Working Capital x Discounting Factor)

= Rs. 40,000 + (2,000 x *0.9091)

= Rs. 40,000 + 1,818 = Rs. 41,818

Statement showing the NPV of two machines

Year	Cash Flows		*Discounting Factor @ 10% (c)	Present Value of Cash Flows	
	Machine X (Rs.) (a)	Machine Y (Rs.) (b)		Machine X (Rs.) (a)x(c)	Machine Y (Rs.) (b)x(c)
1	4,000	12,000	0.9091	3,636	10,909
2	12,000	16,000	0.8265	9,918	13,224
3	16,000	20,000	0.7513	12,021	15,026
4	24,000	12,000	0.6830	16,392	8,196
5	16,000	8,000	0.6209	9,934	4,967
Total	72,000	68,000		51,901	52,322
Less: Present Value of Cash Outflow (Initial Investment + PV of additional working capital)				(41,818)	(41,818)
Net Present Value of cash flows				10,083	10,504

**Discounting Factor @ 10% accessed from present value table.

Interpretation: Machine Y is preferable to Machine X. Though total cash inflow of machine X is more than the of machine Y by 4,000/- the net present value of cash flows of Machine Y is more than that of Machine X. Moreover, in case of Machine Y, cash inflow in the earlier years is comparatively higher than that of machine X

Example 6: A choice is to be made between the two competing proposals which require an equal investment of Rs 50,000/- and are expected to generate net cash flows as under

Year	Cash Flows	
	Project A (Rs.)	Project B (Rs.)
1	25,000	10,000
2	15,000	12,000
3	10,000	18,000
4	NIL	25,000
5	12,000	8,000
6	6,000	4,000

Cost of capital of the company is 10%. The following are the present factor at 10% P.A. Which proposal should be selected using NPV method? Suggest the best project.

Solution:

Present Value of Cash Outflow = Initial investment + Present Value of Additional Working Capital

= Initial investment + (Additional Working Capital x Discounting Factor)

= Rs. 50,000 + NIL

= Rs. 50,000

Statement showing the NPV of two projects

Year	Cash Flows		*Discounting Factor @ 10% (c)	Present Value of Cash Flows	
	Project A (Rs.) (a)	Project B (Rs.) (b)		Project A (Rs.) (a)x(c)	Project B (Rs.) (b)x(c)
1	25,000	10,000	0.9091	22,725	9,090
2	15,000	12,000	0.8265	12,390	9,912
3	10,000	18,000	0.7513	7,510	13,518
4	NIL	25,000	0.6830	NIL	17,075
5	12,000	8,000	0.6209	7,452	4,968
6	6,000	4,000	0.5645	3,384	2,256
Total	68,000	77,000		53,461	56,819
Less: Present Value of Cash Outflow (Initial Investment + PV of additional working capital)				(50,000)	(50,000)
Net Present Value of cash flows				3,461	6,819

**Discounting Factor @ 10% accessed from present value table.

Interpretation: Since project B has the highest NPV, hence project B should be accepted.

Internal Rate of Return:

This method advocated by Joel Dean, takes into account the magnitude and timing of cash flows. This is another important discounted cash flow technique of capital budgeting decisions. IRR can be defined as that rate which equates the present value of cash inflows with the present value of cash outflows of an investment proposal. It is the rate at which the net present value of the investment proposal is zero.

"The internal rate as the rate that equates the present value of the expected future receipts to the investment outlay" ----Weston and Brigham

If the IRR is greater than the cost of capital the funds invested will earn more than their cost, when IRR of a project equal the cost of capital, the management would be indifferent to the project as it would be expected to change the value of the firm. It is computed by the formula

Internal Rate of Return (IRR) = L + [(P1 - C) x D/(P1 - P2) x 100]

Where; L=Lower rate of interest

P1=Present value at lower rate of interest

P2=Present value at higher rate of interest

C= Capital Investment

D= Difference in rate of interest

Computation: The internal rate of return is to be determined by trail and error method. The following steps can be used for its computation:

1. Compute the present value of the cash flows from an investment, by using an arbitrary selected interest rate

2. Then compare the present value so obtained with capital outlay

3. If the present value is higher than the cost, then the present value of inflows is to be determined by using higher rate

4. This procedure is to be continued until the present value of the inflows from the investment is approximately equal to its outflow

5. The interest rate that brings about this equality is the internal rate of return.

If the internal rate of return exceeds the required rate of return, then the project is accepted. If the project's IRR is lower that the required rate of return, it will be rejected. In case of ranking the proposals, the technique of IRR is significantly used. The projects with higher rate of return will be ranked as first compared to the lowest rate of return projects. Thus, the IRR acceptance rules are

Accept if r>k

Reject if r<k

May accept or reject if r=k

Where; r = internal rate of return

k=cost of capital

Merits:

1. It considers the time value of money

2. It takes into account the cash flows over the entire useful life of the asset.

3. It has a psychological appear to the user because when the highest rate of return projects are selected, it satisfies the investors in terms of the rate of return and capital

4. It always suggests accepting to projects with maximum rate of return. 5. It is inconformity with the firm's objective of maximum owner's welfare.

Demerits:

1. It is very difficult to understand and use.

2. It involves a very complicated computational work.

3. It may not give unique answer in all situations.

Example 7: A firm whose cost of capital is 10% is considering two mutually exclusive projects X and Y, the details are:

Year	Cash Flows After Tax	
	Machine X (Rs.)	Machine Y (Rs.)
0	(70,000)	(70,000)
1	10,000	50,000
2	20,000	40,000
3	30,000	20,000
4	45,000	10,000
5	60,000	10,000

Find IRR for the two projects.

Solution:

Statement showing the NPV of Machine X

Year	Cash Flows	*Discounting Factor @ 25%	Present Value of Cash Flows @ 25%	*Discounting Factor @ 30%	Present Value of Cash Flows @ 30%
1	10,000	0.800	8,000	0.769	7,690
2	20,000	0.640	12,800	0.592	11,840
3	30,000	0.512	15,360	0.455	13,650
4	45,000	0.410	18,450	0.350	15,750
5	60,000	0.328	19,680	0.269	16,140
Total Present Value of Cash Inflows			74,290		65,070
Less: Present Value of Cash Outflow			(70,000)		(70,000)
Net Present Value of cash flows			4,290		(4,930)

Internal Rate of Return (IRR) = L + [(P1 - C) x D/(P1 - P2) x 100]

= 25 + [{(74,290 – 70,000) x (30-25)}/ {(74,290 – 65,070) x 100}]

= 25 + 2.33 = 27.33%

Statement showing the NPV of Machine Y

Year	Cash Flows	*Discounting Factor @ 35%	Present Value of Cash Flows @ 35%	*Discounting Factor @ 40%	Present Value of Cash Flows @ 40%
1	50,000	0.741	37,050	0.714	35,700
2	40,000	0.549	21,960	0.510	20,400
3	20,000	0.406	8,120	0.364	7,280
4	10,000	0.301	3,010	0.260	2,600
5	10,000	0.221	2,230	0.186	1,860
Total Present Value of Cash Inflows			72,370		67,840
Less: Present Value of Cash Outflow			(70,000)		(70,000)
Net Present Value of cash flows			2,370		(2,160)

Internal Rate of Return (IRR) = L + [(P1 - C) x D/(P1 - P2) x 100]

= 35 + [{(72,370 – 70,000) x (40-35)}/ {(72,370 – 67,840) x 100}]

= 35 + 2.72 = 37.72%

Interpretation: Since Machine Y has the highest IRR, hence Machine Y should be accepted.

Probability Index Method (PI)

The method is also called benefit cost ratio. This method is obtained after a slight modification of the NPV method. In case of PI the present value of cash out flows are divided by the present value of cash out flows. While NPV is a absolute measure, the PI is a relative measure.

If the PI is more than one (>1), the proposal is accepted else rejected. If there are more than one investment proposal with the more than one PI, the one with the highest PI will be selected. This method is more useful in case of projects with different cash outlays and hence is superior to the NPV method.

The formula for PI is

Gross Profitability Index (PI) = Total Present Value of Cash Inflow / Total Present Value of Cash Outflow

Net Profitability Index (PI) = Net Present Value of Cash Inflow / Net Present Value of Cash Outflow

Merits:

1. It requires less computational work than IRR method

2. It helps to accept / reject investment proposal on the basis of value of the index.

3. It is useful to rank the proposals on the basis of the highest/lowest value of the index.

4. It takes into consideration the entire stream of cash flows generated during the useful life of the asset.

Demerits:

1. It is very difficult to understand the analytical part of the decision on the basis of probability index.

Example 6: A choice is to be made between the two competing proposals which require an equal investment of Rs50,000/- and are expected to generate net cash flows as under

Year	Cash Flows	
	Project A (Rs.)	Project B (Rs.)
1	25,000	10,000
2	15,000	12,000
3	10,000	18,000
4	NIL	25,000
5	12,000	8,000
6	6,000	4,000

Cost of capital of the company is 10%. The following are the present factor at 10% P.A. Which proposal should be selected using PI method? Suggest the best project.

Solution:

Present Value of Cash Outflow = Initial investment + Present Value of Additional Working Capital

= Initial investment + (Additional Working Capital x Discounting Factor)

= Rs. 50,000 + NIL

= Rs. 50,000

Statement showing the NPV of two projects

Year	Cash Flows		*Discounting Factor @ 10% (c)	Present Value of Cash Flows	
	Project A (Rs.) (a)	Project B (Rs.) (b)		Project A (Rs.) (a)x(c)	Project B (Rs.) (b)x(c)
1	25,000	10,000	0.9091	22,725	9,090
2	15,000	12,000	0.8265	12,390	9,912
3	10,000	18,000	0.7513	7,510	13,518
4	NIL	25,000	0.6830	NIL	17,075
5	12,000	8,000	0.6209	7,452	4,968
6	6,000	4,000	0.5645	3,384	2,256
Total	68,000	77,000		53,461	56,819
Less: Present Value of Cash Outflow (Initial Investment + PV of additional working capital)				(50,000)	(50,000)
Net Present Value of cash flows				3,461	6,819

**Discounting Factor @ 10% accessed from present value table.

Gross Profitability Index (PI) = Total Present Value of Cash Inflow / Total Present Value of Cash Outflow

Gross PI of Project A = 53,461/ 50,000 = 1.07 : 1

Gross PI of Project B = 56,819/ 50,000 = 1.14 : 1

Net Profitability Index (PI) = Net Present Value of Cash Inflow / Net Present Value of Cash Outflow

Net PI of Project A = 3,461/ 50,000 = 0.07 : 1

Net PI of Project B = 6,819/ 50,000 = 0.14 : 1

Interpretation: Since project B has the highest PI, hence project B should be accepted.