Artificial Intelligence (AI) for Investments

Lesson 3: Making investment decisions

Introduction

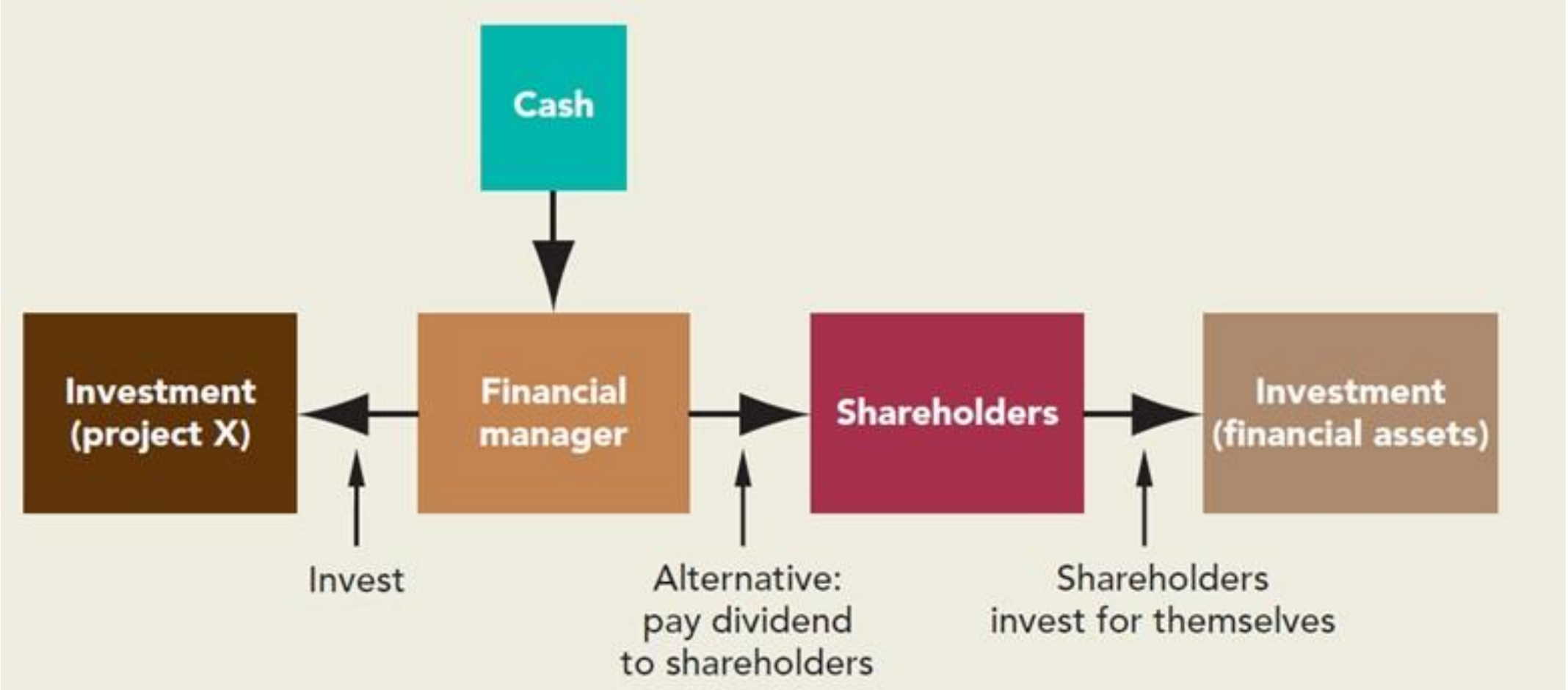
In this lesson we will cover the following topics:

- Review of NPV basics
- Alternatives to NPV rule – Payback period method
- Alternatives to NPV rule – Internal rate of return (IRR) method
- Pitfalls of IRR
- Capital investments with limited resources
- Summary and concluding remarks

Review of NPV basics

- Consider yourself in a position of a CFO where you are analyzing $1 million investment in a new venture called project P
- That the current market value of your firm is $10 million, which includes $1 million cash that you plan to invest min project P
- You find the NPV of this project by discounting the cash flows, adding them up to compute there PV, and subtracting the initial investment of $1 million
- It is easy to understand if PV>9 this project has a positive NPV

Review of NPV basics



Review of NPV basics

- NPV rule recognizes that a dollar today is worth more than a dollar tomorrow
- Any decision rule that is affected by managers' tastes, choice of accounting method, profitability of existing business, or that of other projects will lead to an inefficient decision
- NPV(A+B) =NPV(A)+NPV(B)
- Book incomes are not necessarily the same as cash flows
- Profitability measures such as book rate of returns, heavily depend on the classification of various items as capital investment and their rate of depreciation

Alternatives to NPV rule – Payback period method

- A project's payback period is simply found by estimating the years it takes for the project cash flows to meet the initial investment
- A washing machine is costing $800. You spend $300 a year on washing your clothes. As a thumb rule, if this machine is purchased, it will recover its expenses in 3 years
- The payback rule states that a project should be accepted if its payback period is less than some cut-off period
- Consider a simple example here

Project	C0	C1	C2	C3	Payback Period (years)	NPV at 10%
A	-2,000	500	500	5,000	3	+2,624
B	-2,000	500	1,800	0	2	-58
C	-2,000	1,800	500	0	2	+50

Alternatives to NPV rule – Discounted Payback period method

- An improved version of payback period is to employ discounted cash flows
- This discounted payback rule examines that how many years it takes for the discounted cash flows to recover the initial investment, i.e., become NPV positive
- Let us examine our previous example, with the help of discounted cash flows

Project	C0	C1	C2	C3	Discounted Payback Period (years)	NPV at 10%
A	-2,000	$\frac{500}{1.1} = 455$	$\frac{500}{1.1^2} = 413$	$\frac{5{,}000}{1.1^3} = 3757$	3	+2,624
B	-2,000	$\frac{500}{1.1} = 455$	$\frac{1{,}800}{1.1^2} = 1488$	-	-	-58
C	-2,000	$\frac{1{,}800}{1.1} = 1636$	$\frac{500}{1.1^2} = 413$	-	2	+50

Alternatives to NPV rule – Internal rate of return (IRR) method

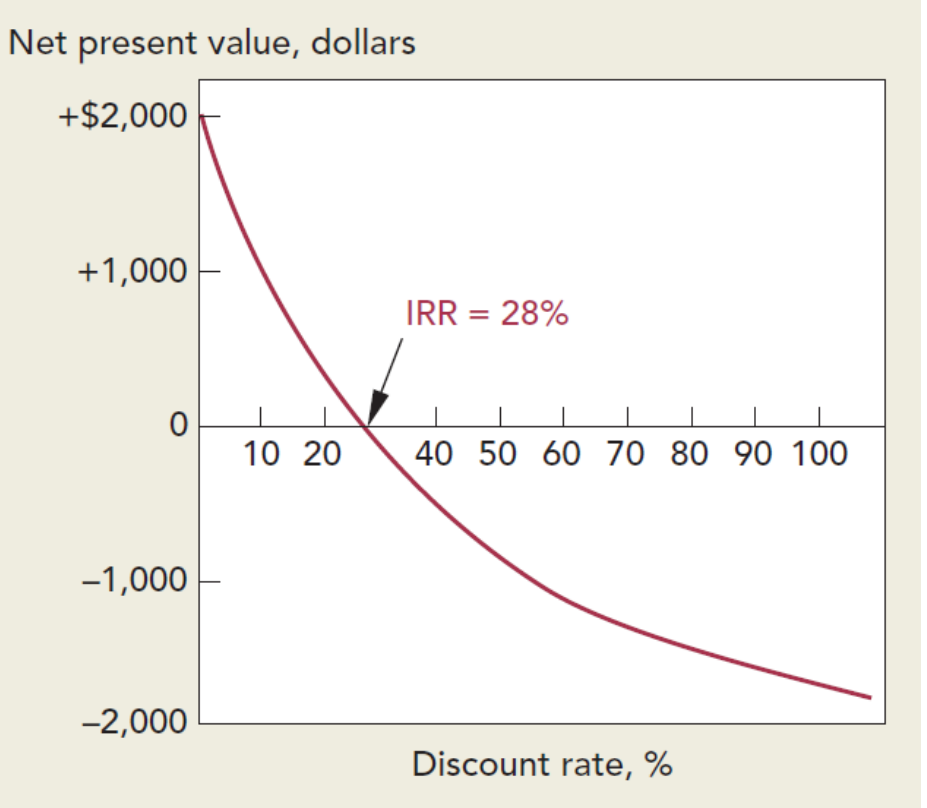
- IRR rule comes from the simple return measure
- $\text{Project return} = \frac{\text{Profit}}{\text{Investment}} = \frac{\text{Payoff}}{\text{Investment}} - 1$; or $-\text{Investment} + \frac{\text{Payoff}}{1+\text{Project Return}} = 0$
- IRR is the return or discount rate at which NPV=0
- $\text{NPV} = C_0 + \frac{C_1}{(1+\text{IRR})} + \frac{C_2}{(1+\text{IRR})^2} + \cdots + \frac{C_T}{(1+\text{IRR})^T} = 0$

C_0	C_1	C_2
-4000	+2000	+4000

- $NPV = -4000 + \frac{2000}{1+IRR} + \frac{4000}{(1+IRR)^2} = 0$; solving for this, we get IRR= 28.08%

Alternatives to NPV rule – Internal rate of return (IRR) method

- If the opportunity cost of capital is less than the 28.08% IRR, then the project has a positive NPV
- If opportunity cost of capital is greater than the IRR, the project has a negative NPV
- Please note that IRR is a profitability measure and depends solely on the timing of the project cash flows
- The opportunity cost of capital is the standard of profitability to judge the worth (or NPV) of the project



Pitfalls of IRR

- Pitfall 1: Problem of Lending vs borrowing
- Consider the project cash flows from projects A and B as shown here

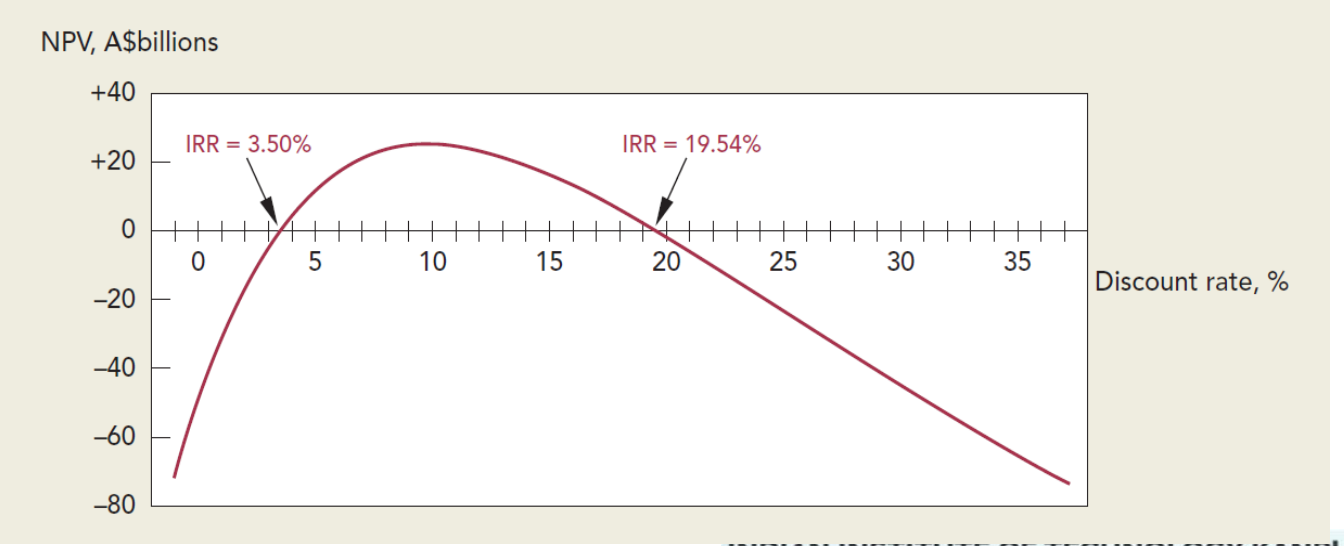
Projects	C_0	C_1	IRR	NPV at 10%
A	-1000	+1500	50%	+364
B	1000	-1500	50%	-364

- Both of these projects will give you the same IRR
- In project A, we are paying out $1000 initally, and getting $1500 later - Case of lending
- While in case of B, we are initially getting $1000 and paying back $1500 later- Case of borrowing
- When you lend money, you want a higher return and when you borrow money money you want a lower return

Pitfalls of IRR

- Pitfall 2: Multiple rates of return
- Consider another project that involves an initial investment of $3 Billion and then produce a cash flow $1 Billion per year, for next nine years
- At the end of the project, the company will incur $6.5 billion of cleanup costs

C_0	C_1	C_2	C_3	C_4
-3	1	1	1	1
C_5	C_6	C_7	C_8	C_9
1	1	1	1	1



Pitfalls of IRR

- Pitfall 3: Mutually exclusive projects
- Firms often have to choose from mutually exclusive projects, since it may not be feasible to take all of them
- In the project cash flows shown here, it seems IRR and NPV are contradicting each other

Projects	C_0	C_1	IRR (%)	NPV at 10%
D	-10000	+20000	100	8182
E	20000	+35000	75	11818

- In such cases, IRR can still be salvaged by examining incremental cash flows as shown here

Projects	C_0	C_1	IRR (%)	NPV at 10%
E-D	-10000	+15000	50	3636

IRR in Conclusion

- Many things can go wrong with IRR, but it is still a very useful benchmark
- To see its utility, have a look at the project cash flows, NPV, and IRR estimates for two projects X and Y as shown here ($, thousands)

Projects	C_0	C_1	C_2	C_3	NPV at 8%	IRR (%)
X	-9.0	2.9	4.0	5.4	1.4	15.58
Y	-9000	2560	3540	4530	1.4	8.01

- Both of these projects offer the same positive NPV of $1400
- As rational individuals you would select X over Y (Why?)
- The higher IRR associated with X (15.58%) reflects the low risk and efforts involved as compared with Y

Capital investments with limited resources

- Capital is a scarce resource, thus it is not possible to select all the positive NPV projects
- Thus, firms would like to select those projects that offer highest NPV per dollar of investment
- $\text{Profitability index (PI)} = \frac{\text{NPV}}{\text{Initial Investment}}$

Cash Flows ($ Mn)					
Project	**C0**	**C1**	**C2**	**NPV at 10%**	**PI**
A	-10	+30	+5	21	2.1
B	-5	+5	+20	16	3.2
C	-5	+5	+15	12	2.4

Capital investments with limited resources

- Let us add another project D, which needs $40 Mn investment in second year

Project	C0	C1	C2	NPV at 10%	PI
A	-10	+30	+5	21	2.1
B	-5	+5	+20	16	3.2
C	-5	+5	+15	12	2.4
D	0	-40	+60	13	0.4

- The firm can only raise $10 Mn in the second year: additional constraint of capital rationing
- The simple way of ranking projects as per PI may not work here
- This particular problem is rather simple, as A and D combined offer a higher NPV than B and C combined
- However, more complex problems are solved with linear programming (LP) techniques

Summary and concluding remarks

- In addition to NPV, other rules are also employed to examine alternate investments
- These include book rate of return, payback period, and IRR method
- Book rate of return is simply computed as book income divided by book value of investment
- Payback method examines the project cash flows against a certain specific cut-off period
- Only those projects with payback period is less than cut-off period, are considered
- Lastly, IRR is the discount rate at which the firm NPV is zero
- As per the IRR rule, firms should accept those projects that have an IRR greater than opportunity cost of capital

Thanks!