

Chapter 7 Investment Decision Rules

- 7-2. You are considering investing in a start-up company. The founder asked you for \$200,000 today and you expect to get \$1,000,000 in nine years. Given the riskiness of the investment opportunity, your cost of capital is 20%. What is the NPV of the investment opportunity? Should you undertake the investment opportunity? Calculate the IRR and use it to determine the maximum deviation allowable in the cost of capital estimate to leave the decision unchanged.

$$NPV = \frac{\$1,000,000}{1.2^9} - 200,000 = -6193$$

$$IRR = \left(\frac{\$1,000,000}{200,000} \right)^{1/9} - 1 = 19.58\%$$

Do not take the project. A drop in the cost of capital of just $20 - 19.58 = 0.42\%$ would change the decision.

- 7-4. Your firm is considering the launch of a new product, the XJ5. The upfront development cost is \$10 million, and you expect to earn a cash flow of \$3 million per year for the next five years. Plot the NPV profile for this project for discount rates ranging from 0% to 30%. For what range of discount rates is the project attractive?

r	NPV	IRR
0%	5.000	15.24%
5%	2.988	
10%	1.372	
15%	0.056	
20%	-1.028	
25%	-1.932	
30%	-2.693	

R	NPV	IRR
0%	5.000	15.24%
5%	2.846	
10%	1.248	
15%	0.049	
20%	-0.857	
30%	-1.546	

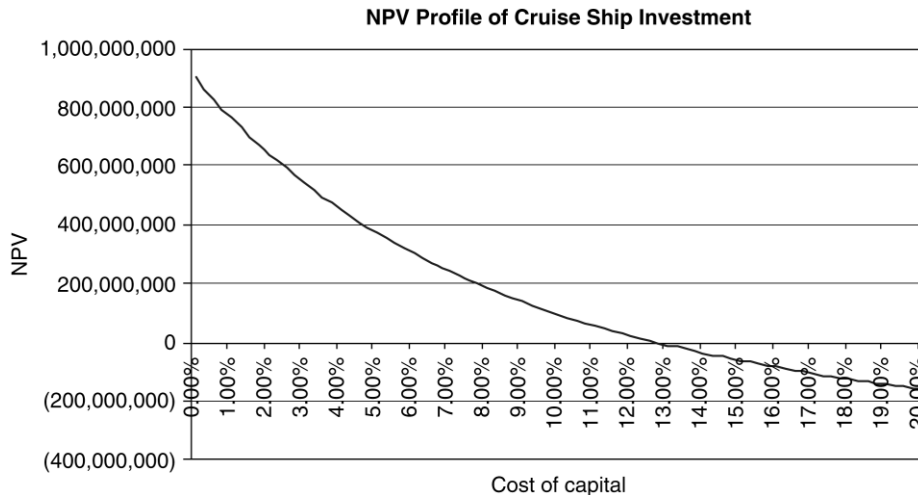
The project should be accepted as long as the discount rate is below 15.24%.



OpenSeas, Inc. is evaluating the purchase of a new cruise ship. The ship would cost \$500 million, and would operate for 20 years. OpenSeas expects annual cash flows from operating the ship to be \$70 million (at the end of each year) and its cost of capital is 12%.

- Prepare an NPV profile of the purchase.
- Estimate the IRR (to the nearest 1%) from the graph.
- Is the purchase attractive based on these estimates?
- How far off could OpenSeas' cost of capital be (to the nearest 1%) before your purchase decision would change?

a.



- b. The IRR is the point at which the line crosses the x-axis. In this case, it falls very close to 13%. Using Excel, the IRR is 12.72%.
- c. Yes, because the NPV is positive at the discount rate of 12%.
- d. The discount rate could be off by 0.72% before the investment decision would change.

R	NPV (000s)
0%	\$900.00
5%	\$372.35
10%	\$95.95
12%	\$22.86
13%	(\$8.27)
15%	(\$61.85)
20%	(\$159.13)
25%	(\$223.23)

7-8. You are considering an investment in a clothes distributor. The company needs \$100,000 today and expects to repay you \$120,000 in a year from now. What is the IRR of this investment opportunity? Given the riskiness of the investment opportunity, your cost of capital is 20%. What does the IRR rule say about whether you should invest?

IRR = $120000/100000 - 1 = 20\%$. You are indifferent

7-9. You have been offered a very long term investment opportunity to increase your money one hundredfold. You can invest \$1000 today and expect to receive \$100,000 in 40 years. Your cost of capital for this (very risky) opportunity is 25%. What does the IRR rule say about whether the investment should be undertaken? What about the NPV rule? Do they agree?

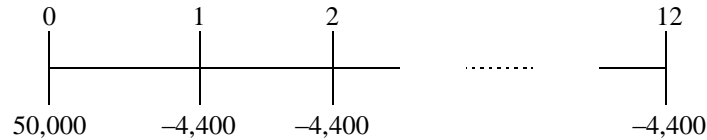
$$IRR = \left(\frac{100000}{1000} \right)^{1/40} - 1 = 12.2\%$$

$$NPV = \frac{100000}{1.25^{40}} - 1000 = -986.71$$

Both rules agree—do not undertake the investment.

- 7-12.** Professor Wendy Smith has been offered the following deal: A law firm would like to retain her for an upfront payment of \$50,000. In return, for the next year the firm would have access to 8 hours of her time every month. Smith's rate is \$550 per hour and her opportunity cost of capital is 15% (EAR). What does the IRR rule advise regarding this opportunity? What about the NPV rule?

The timeline of this investment opportunity is:



Computing the NPV of the cash flow stream

$$NPV = 50,000 - \frac{4,400}{r} \left(1 - \frac{1}{(1+r)^{12}} \right)$$

To compute the IRR, we set the NPV equal to zero and solve for r . Using the annuity spreadsheet gives

N	I	PV	PMT	FV
12	0.8484%	50,000	-4,400	0

The monthly IRR is 0.8484, so since

$$(1.008484)^{12} = 1.106696$$

then 0.8484% monthly corresponds to an EAR of 10.67%. Smith's cost of capital is 15%, so according to the IRR rule, she should turn down this opportunity.

Let's see what the NPV rule says. If you invest at an EAR of 15%, then after one month you will have

$$(1.15)^{1/12} = 1.011715$$

so the monthly discount rate is 1.1715%. Computing the NPV using this discount rate gives

$$NPV = 50,000 - \frac{4,400}{0.011715} \left(1 - \frac{1}{(1.011715)^{12}} \right) = \$1010.06,$$

which is positive, so the correct decision is to accept the deal. Smith can also be relatively confident in this decision. Based on the difference between the IRR and the cost of capital, her cost of capital would have to be $15 - 10.67 = 4.33\%$ lower to reverse the decision

7-13.

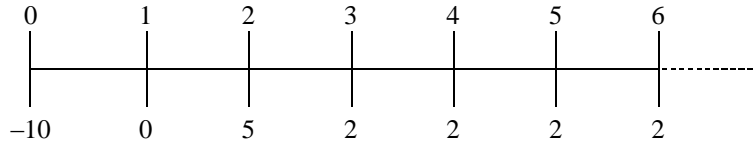
- 7-19.** You are a real estate agent thinking of placing a sign advertising your services at a local bus stop. The sign will cost \$5000 and will be posted for one year. You expect that it will generate additional revenue of \$500 per month. What is the payback period?

$$5000 / 500 = 10 \text{ months.}$$

- 7-20.** You are considering making a movie. The movie is expected to cost \$10 million upfront and take a year to make. After that, it is expected to make \$5 million when it is released in one year and \$2

million per year for the following four years. What is the payback period of this investment? If you require a payback period of two years, will you make the movie? Does the movie have a positive NPV if the cost of capital is 10%?

Timeline:



It will take 5 years to pay back the initial investment, so the payback period is 5 years. You will *not* make the movie.

$$NPV = -10 + \frac{5}{(1+r)^2} + \frac{2}{r} \left(1 - \frac{1}{(1+r)^4} \right) \frac{1}{(1+r)^2} = -10 + \frac{5}{(1.1)^2} + \frac{2}{0.1(1.1)^2} \left(1 - \frac{1}{(1.1)^4} \right) = -\$628,322$$

So the NPV agrees with the payback rule in this case.

0	1	2	3	4	5
-10	5	2	2	2	2
Payback =	4 years				
NPV at 10% =		\$0.31 million			

7-22. You have just started your summer internship, and your boss asks you to review a recent analysis that was done to compare three alternative proposals to enhance the firm's manufacturing facility. You find that the prior analysis ranked the proposals according to their IRR, and recommended the highest IRR option, Proposal A. You are concerned and decide to redo the analysis using NPV to determine whether this recommendation was appropriate. But while you are confident the IRRs were computed correctly, it seems that some of the underlying data regarding the cash flows that were estimated for each proposal was not included in the report. For Proposal B, you cannot find information regarding the total initial investment that was required in year 0. And for Proposal C, you cannot find the data regarding additional salvage value that will be recovered in year 3. Here is the information you have:

Proposal	IRR	Year 0	Year 1	Year 2	Year 3
A	60.0%	-100	30	153	88
B	55.0%	?	0	206	95
C	50.0%	-100	37	0	204 + ?

Suppose the appropriate cost of capital for each alternative is 10%. Using this information, determine the NPV of each project. Which project should the firm choose?

Why is ranking the projects by their IRR not valid in this situation?

a. Project A: $NPV(A) = -100 + 30/1.10 + 153/1.10^2 + 88/1.10^3 = \119.83

Project B: We can use the IRR to determine the initial cash flow:

$$CF_0(B) = -(206/1.55^2 + 95/1.55^3) = -\$111.25.$$

Thus, $NPV(B) = -111.25 + 0/1.10 + 206/1.10^2 + 95/1.10^3 = \130.37

Project C: We can use the IRR to determine the final cash flow:

$$CF_3(C) = 100 \times 1.50^3 - 37 \times 1.50^2 = \$254.25.$$

$$\text{Thus, } NPV(C) = -100 + 37/1.10 + 0/1.10^2 + 254.25/1.10^3 = \$124.65$$

- b. Ranking the projects by their IRR is not valid in this situation because the projects have different scales and different patterns of cash flows over time.

7-31. Kaimalino Properties (KP) is evaluating six real estate investments. Management plans to buy the properties today and sell them five years from today. The following table summarizes the initial cost and the expected sale price for each property, as well as the appropriate discount rate based on the risk of each venture.

Project	Cost Today	Discount Rate	Expected Sale Price in Year 5
Mountain Ridge	\$ 3,000,000	15%	\$18,000,000
Ocean Park Estates	15,000,000	15%	75,500,000
Lakeview	9,000,000	15%	50,000,000
Seabreeze	6,000,000	8%	35,500,000
Green Hills	3,000,000	8%	10,000,000
West Ranch	9,000,000	8%	46,500,000

KP has a total capital budget of \$18,000,000 to invest in properties.

- What is the IRR of each investment?
- What is the NPV of each investment?
- Given its budget of \$18,000,000, which properties should KP choose?
- Explain why the profitability index method could not be used if KP's budget were \$12,000,000 instead. Which properties should KP choose in this case?

- We can compute the IRR for each as $IRR = (\text{Sale Price}/\text{Cost})^{1/5} - 1$. See spreadsheet below.
- We can compute the NPV for each as $NPV = \text{Sale Price}/(1 + r)^5 - \text{Cost}$. See spreadsheet below.

Project	Cost Today	Discount Rate	Expected Sale Price in Year 5	IRR	NPV	Profitability Index
Mountain Ridge	\$ 3,000,000	15%	\$ 18,000,000	43.1%	\$ 5,949,181	1.98
Ocean Park Estates	15,000,000	15%	\$ 75,500,000	38.2%	22,536,844	1.50
Lakeview	9,000,000	15%	\$ 50,000,000	40.9%	15,858,837	1.76
Seabreeze	6,000,000	8%	\$ 35,500,000	42.7%	18,160,703	3.03
Green Hills	3,000,000	8%	\$ 10,000,000	27.2%	3,805,832	1.27
West Ranch	9,000,000	8%	\$ 46,500,000	38.9%	22,647,119	2.52

- We can rank projects according to their profitability index = NPV/Cost , as shown below. Thus, KP should invest in Seabreeze, West Ranch, and Mountain Ridge. (Note that ranking projects according to their IRR would not maximize KP's total NPV, and so would not lead to the correct selection.)
- The profitability index fails because the top-ranked projects do not completely use up the budget. In this case, you should take Mountain Ridge and West Ranch.