GESTÃO FINANCEIRA II

PROBLEM SET 2: Solutions

Chapters 6 and 7
Investment Decision Rules
Fundamentals of Capital Budgeting

(FROM BERK AND DEMARZO'S "CORPORATE FINANCE")

LICENCIATURA – UNDERGRADUATE COURSE

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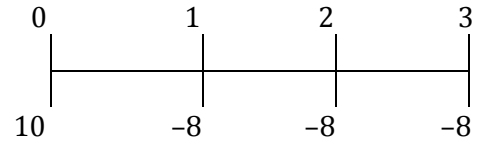
Instituto Superior de Economia e Gestão
UNIVERSIDADE TÉCNICA DE LISBOA

Chapter 6
Investment Decision Rules

6-5. Bill Clinton reportedly was paid $10 million to write his book *My Way*. The book took three years to write. In the time he spent writing, Clinton could have been paid to make speeches. Given his popularity, assume that he could earn $8 million per year (paid at the end of the year) speaking instead of writing. Assume his cost of capital is 10% per year.

a. What is the NPV of agreeing to write the book (ignoring any royalty payments)?

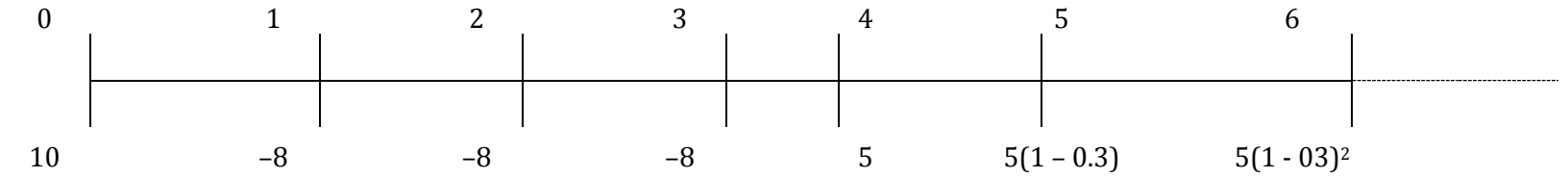
Timeline:



$$\text{NPV} = 10 - \frac{8}{0.1}\left(1 - \frac{1}{1.1^{3}}\right) = -\$9.895 \text{ million}$$

b. Assume that, once the book is finished, it is expected to generate royalties of $5 million in the first year (paid at the end of the year) and these royalties are expected to decrease at a rate of 30% per year in perpetuity. What is the NPV of the book with the royalty payments?

Timeline:



First calculate the PV of the royalties at year 3. The royalties are a declining perpetuity:

$$PV_3 = \frac{5}{0.1 - (-0.3)} = 12.5 million$$

So the value today is

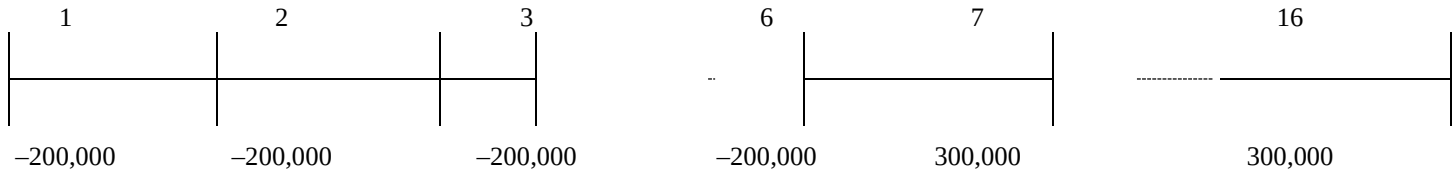
$$PV_{royalties} = \frac{12.5}{1.1^{3}} = 9.391$$

Now add this to the NPV from part a), $NPV = -9.895 + 9.391 = -\$503,381.$

6-6. FastTrack Bikes, Inc. is thinking of developing a new composite road bike. Development will take six years and the cost is $200,000 per year. Once in production, the bike is expected to make $300,000 per year for 10 years. Assume the cost of capital is 10%.

a. Calculate the NPV of this investment opportunity, assuming all cash flows occur at the end of each year. Should the company make the investment?

Timeline:



$$NPV = -\frac{200,000}{r}\left(1-\frac{1}{1+r^{6}}\right)+\left(\frac{1}{1+r^{6}}\right)\frac{300,000}{r}\left(1-\frac{1}{1+r^{10}}\right)$$

$$= -\frac{200,000}{0.1}\left(1-\frac{1}{1.1^{6}}\right)+\left(\frac{1}{1.1^{6}}\right)\frac{300,000}{0.1}\left(1-\frac{1}{1.1^{10}}\right)$$

=$169,482

NPV > 0, so the company should take the project.

b. By how much must the cost of capital estimate deviate to change the decision? (*Hint*: Use Excel to calculate the IRR.)

Setting the NPV = 0 and solving for r (using a spreadsheet) the answer is IRR = 12.66%.

So if the estimate is too low by 2.66%, the decision will change from accept to reject.

	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10
	-200	-200	-200	-200	-200	-200	300	300	300	300	300	300	300	300	300	300
IRR	12.66%															
NPV																
10%	$169.482															
14%	($64.816)															

c. What is the NPV of the investment if the cost of capital is 14%?

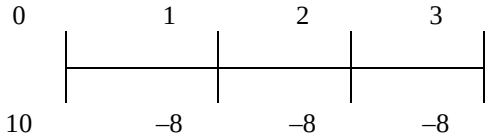
$$NPV = -\frac{200,000}{r}\left(1-\frac{1}{1+r^{6}}\right)+\left(\frac{1}{1+r^{6}}\right)\frac{300,000}{r}\left(1-\frac{1}{1+r^{10}}\right)$$

$$= -\frac{200,000}{0.14}\left(1-\frac{1}{1.14^{6}}\right)+\left(\frac{1}{1.14^{6}}\right)\frac{300,000}{0.14}\left(1-\frac{1}{1.14^{10}}\right)$$

= –$64.816

6-11. How many IRRs are there in part (a) of Problem 5? Does the IRR rule give the right answer in this case? How many IRRs are there in part (b) of Problem 5? Does the IRR rule work in this case?

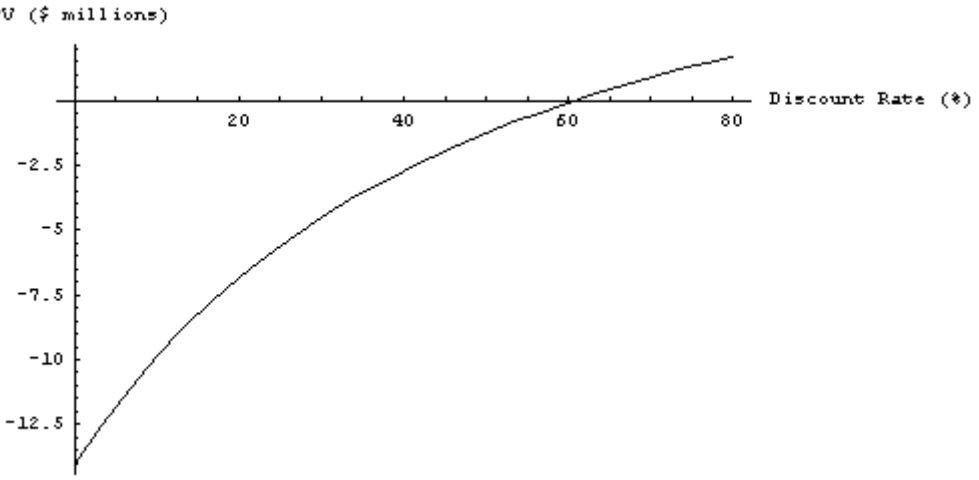
In part (a), the timeline is:



IRR is the r that solves

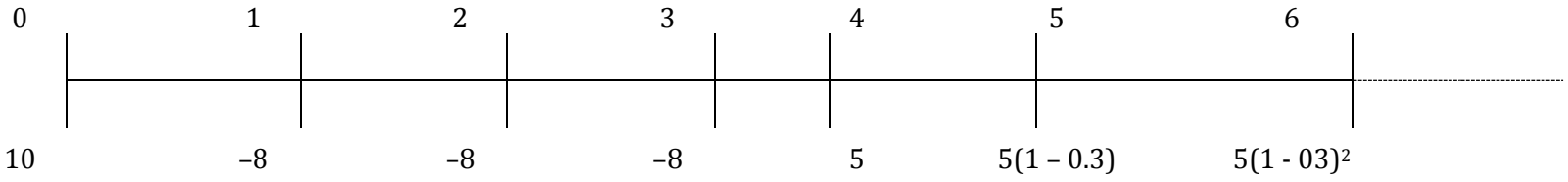
$$NPV = 0 = 10 - \frac{8}{r}\left(1 - \frac{1}{1+r^{3}}\right)$$

To determine how many solutions this equation has, plot the NPV as a function of r



From the plot there is one IRR of 60.74%.
Since the IRR is much greater than the discount rate, the IRR rule says write the book.
Since this is a negative NPV project (from 6.5a), the IRR gives the wrong answer.

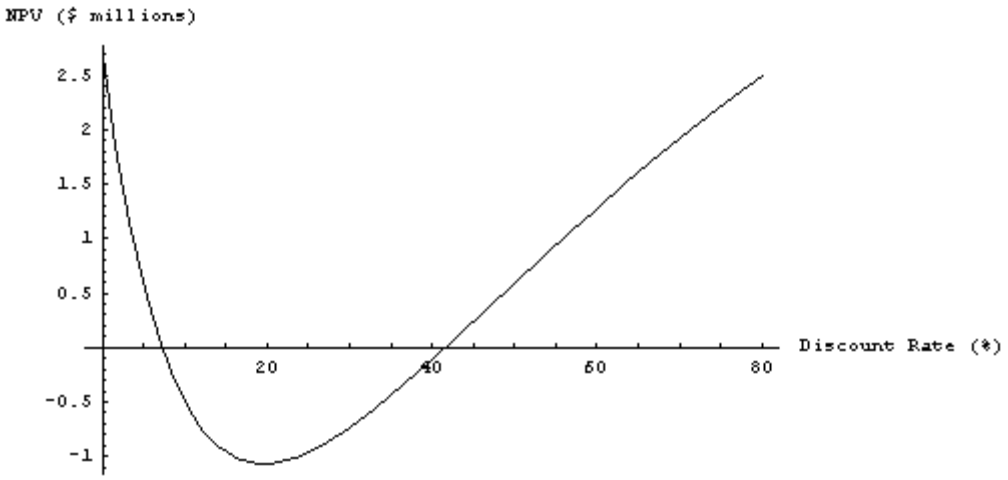
In part (b) the timeline is:



The NPV of these cash flows is

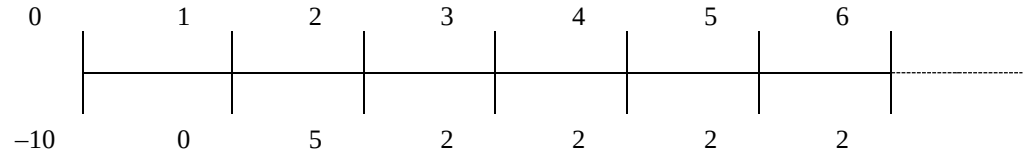
$$NPV = 10 - \frac{8}{r}\left(1 - \frac{1}{1+r^{3}}\right) + \frac{1}{1+r^{3}}\left(\frac{5}{r+0.3}\right)$$

Plotting the NPV as a function of the discount rate gives



The plot shows that there are 2 IRRs – 7.165% and 41.568%. The IRR does give a unique answer in this case, so it does not work.

6-20. 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 positive NPV if the cost of capital is 10%?



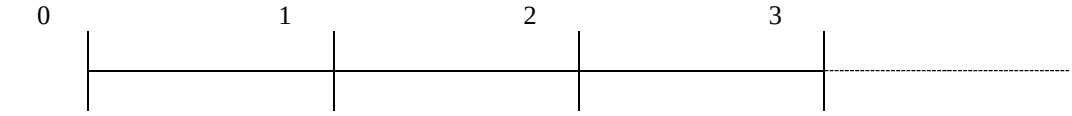
It will take 5 years to pay back the initial investment, so the payback period is 5 years. You will not make the movie.

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

So the NPV agrees with the payback rule in this case

6-23. You are deciding between two mutually exclusive investment opportunities. Both require the same initial investment of $10 million. Investment A will generate $2 million per year (starting at the end of the first year) in perpetuity. Investment B will generate $1.5 million at the end of the first year and its revenues will grow at 2% per year for every year after that.

a. Which investment has the higher IRR?



A	–10	2	2	2
B	–10	1.5	1.5(1.02)	$1.5(1.02)^2$

$$NPV_A = \frac{2}{r} - 10$$

Setting $NPV_A = 0$ and solving for r

$IRR_A = 20\%$

$$NPV_B = \frac{1.5}{r - 0.02} - 10$$

Setting $NPV_B = 0$ and solving for r

$$\frac{1.5}{r-0.02} = 10 \Rightarrow r - 0.02 = 0.15 \Rightarrow r = 17\%. \;\; So, \; IRR_B = 17\%$$

Based on the IRR, you always pick project A.

b. Which investment has the higher NPV when the cost of capital is 7%?

Substituting r = 0.07 into the NPV formulas derived in part (a) gives

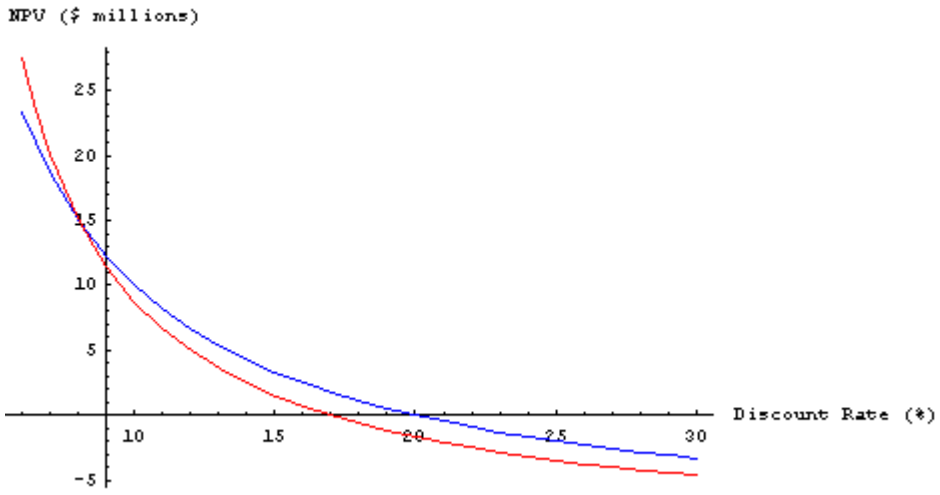
$NPV_A = \$18.5714$ million,

$NPV_B = \$20$ million.

So the NPV says take B.

c. In this case, for what values of the cost of capital does picking the higher IRR give the correct answer as to which investment is the best opportunity?

Here is a plot of NPV of both projects as a function of the discount rate. The NPV rule selects A (and so agrees with the IRR rule) for all discount rates to the right of the point where the curves cross.



$$NPV_A = NPV_B$$
$$\frac{2}{r} = \frac{1.5}{r-0.02}$$
$$\frac{r}{2} = \frac{r-0.02}{1.5}$$
$$1.5r = 2r - 0.04$$
$$0.5r = 0.04$$
$$r = 0.08$$

So the IRR rule will give the correct answer for discount rates greater than 8%

d. Use the incremental IRR rule to correctly choose between the investments when the cost of capital is 7%. At what cost of capital would your decision change?

To calculate the incremental IRR subtract A from B

0	1.5 – 2	1.5(1.02)–2	1.5(1.02)²–2	…

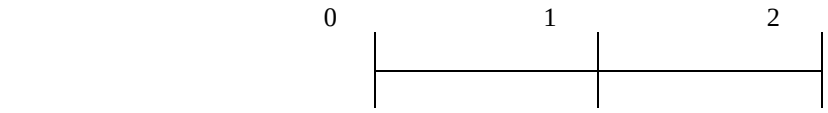
$$NPV = \frac{1.5}{r-0.02} - \frac{2}{r} = 0$$
$$\frac{2}{r} = \frac{1.5}{r-0.02}$$
$$\frac{r}{2} = \frac{r-0.02}{1.5}$$
$$1.5r = 2r - 0.04$$
$$0.5r = 0.04$$
$$r = 0.08$$

So the incremental IRR is 8%. This rate is above the cost of capital, so we should take B.

6-24. You work for an outdoor play structure manufacturing company and are trying to decide between two projects:

	Year-End Cash Flows ($ thousands)			
Project	**0**	**1**	**2**	**IRR**
Playhouse	–30	15	20	10.4%
Fort	–80	39	52	8.6%

You can undertake only one project. If your cost of capital is 8%, use the incremental IRR rule to make the correct decision.



Playhouse	–30	15	20
Fort	–80	39	52

Subtract the Playhouse cash flows from the Fort

–50 24 32

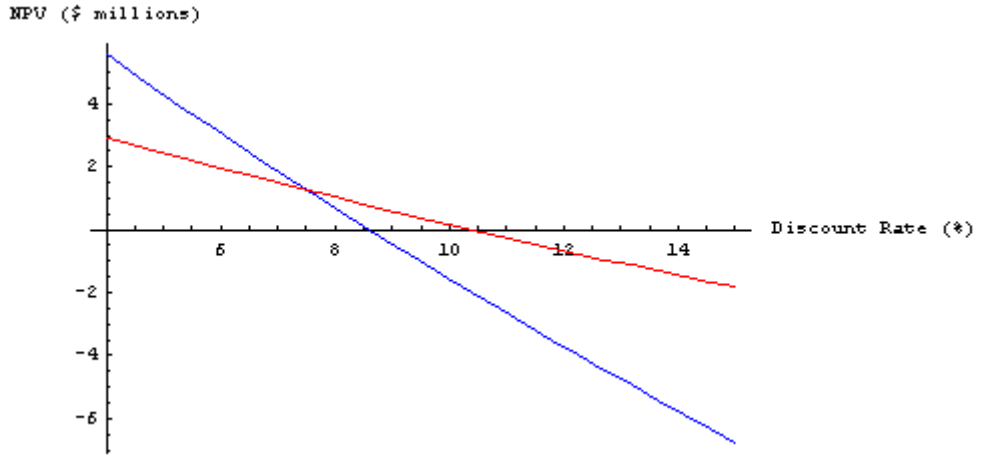
$$NPV = -50 + \frac{24}{1+r} + \frac{32}{1+r^{\ 2}}$$

Solving for r

$$r = \frac{-2\ \ 50\ \ + 24 + \sqrt{24^2 + 4\ \ 50\ \ \ 32}}{2\ \ 50}$$

= 7.522%

Since the incremental IRR of 7.522% is less than the cost of capital of 8%, you should take the Playhouse.



6-31. 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.

a. What is the IRR of each investment?

We can compute the IRR for each as IRR = (Sale Price/Cost)$^{1/5}$ – 1. See spreadsheet below

b. What is the NPV of each investment?

We can compute the NPV for each as NPV = Sale Price/(1+r)^5 – Cost. See spreadsheet below.

c. Given its budget of $18,000,000, which properties should KP choose?

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.)

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

d. Explain why the profitably index method could not be used if KP's budget were $12,000,000 instead. Which properties should KP choose in this case?
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.

Chapter 7
Fundamentals of Capital Budgeting

7-2. Kokomochi is considering the launch of an advertising campaign for its latest dessert product, the Mini Mochi Munch. Kokomochi plans to spend $5 million on TV, radio, and print advertising this year for the campaign. The ads are expected to boost sales of the Mini Mochi Munch by $9 million this year and by $7 million next year. In addition, the company expects that new consumers who try the Mini Mochi Munch will be more likely to try Kokomochi's other products. As a result, sales of other products are expected to rise by $2 million each year.
Kokomochi's gross profit margin for the Mini Mochi Munch is 35%, and its gross profit margin averages 25% for all other products. The company's marginal corporate tax rate is 35% both this year and next year. What are the incremental earnings associated with the advertising campaign?

	A	B	C	D	E
1			**Year**	**1**	**2**
2	**Incremental Earnings Forecast ($000s)**				
3	1	Sales of Mini Mochi Munch		9,000	7,000
4	2	Other Sales		2,000	2,000
5	3	Cost of Goods Sold		(7,350)	(6,050)
6	4	**Gross Profit**		3,650	2,950
7	5	Selling, General & Admin.		(5,000)	-
8	6	Depreciation		-	-
9	7	**EBIT**		(1,350)	2,950
10	8	Income tax at 35%		473	(1,033)
11	9	**Unlevered Net Income**		**(878)**	**1,918**

7-3. Home Builder Supply, a retailer in the home improvement industry, currently operates seven retail outlets in Georgia and South Carolina. Management is contemplating building an eighth retail store across town from its most successful retail outlet. The company already owns the land for this store, which currently has an abandoned warehouse located on it. Last month, the marketing department spent $10,000 on market research to determine the extent of customer demand for the new store. Now Home Builder Supply must decide whether to build and open the new store.
Which of the following should be included as part of the incremental earnings for the proposed new retail store?

a. The cost of the land where the store will be located.

No, this is a sunk cost and will not be included directly. (But see (f) below.)

b. The cost of demolishing the abandoned warehouse and clearing the lot.

Yes, this is a cost of opening the new store.

c. The loss of sales in the existing retail outlet, if customers who previously drove across town to shop at the existing outlet become customers of the new store instead.

Yes, this loss of sales at the existing store should be deducted from the sales at the new store to determine the incremental increase in sales that opening the new store will generate for HBS.

d. The $10,000 in market research spent to evaluate customer demand.

No, this is a sunk cost.

e. Construction costs for the new store.

This is a capital expenditure associated with opening the new store. These costs will, therefore, increase HBS's depreciation expenses.

f. The value of the land if sold.

Yes, this is an opportunity cost of opening the new store. (By opening the new store, HBS forgoes the after-tax proceeds it could have earned by selling the property. This loss is equal to the sale price less the taxes owed on the capital gain from the sale, which is the difference between the sale price and the book value of the property. The book value equals the initial cost of the property less accumulated depreciation.)

g. Interest expense on the debt borrowed to pay the construction costs.

While these financing costs will affect HBS's actual earnings, for capital budgeting purposes we calculate the incremental earnings without including financing costs to determine the project's unlevered net income.

7-7. Castle View Games would like to invest in a division to develop software for video games. To evaluate this decision, the firm first attempts to project the working capital needs for this operation. Its chief financial officer has developed the following estimates (in millions of dollars):

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash	6	12	15	15	15
Accounts Receivable	21	22	24	24	24
Inventory	5	7	10	12	13
Accounts Payable	18	22	24	25	30

Assuming that Castle View currently does not have any working capital invested in this division, calculate the cash flows associated with changes in working capital for the first five years of this investment.

		Year0	Year1	Year2	Year3	Year4	Year5
1	Cash		6	12	15	15	15
2	Accounts Receivable		21	22	24	24	24
3	Inventory		5	7	10	12	13
4	Accounts Payable		18	22	24	25	30
5	Net working capital (1+2+3-4)	0	14	19	25	26	22
6	Increase in NWC		14	5	6	1	-4

7-9. Elmdale Enterprises is deciding whether to expand its production facilities. Although long-term cash flows are difficult to estimate, management has projected the following cash flows for the first two years (in millions of dollars):

	Year 1	Year 2
Revenues	125	160
Costs of goods sold and operating expenses other than depreciation	40	60
Depreciation	25	36
Increase in net working capital	5	8
Capital expenditures	30	40
Marginal corporate tax rate	35%	35%

a. What are the incremental earnings for this project for years 1 and 2?

b. What are the free cash flows for this project for the first two years?

a.

	Year	1	2
Incremental Earnings Forecast ($000s)			
1	Sales	125.0	160.0
2	Costs of good sold and operating expenses other than depreciation	(40.0)	(60.0)
3	Depreciation	(25.0)	(36.0)
4	**EBIT**	60.0	64.0
5	Income tax at 35%	(21.0)	(22.4)
6	**Unlevered Net Income**	**39.0**	**41.6**

b.

Free Cash Flow ($000s)		1	2
7	Plus: Depreciation	25.0	36.0
8	Less: Capital Expenditures	(30.0)	(40.0)
9	Less: Increases in NWC	(5.0)	(8.0)
10	**Free Cash Flow**	**29.0**	**29.6**

7-17. Arnold Inc. is considering a proposal to manufacture high-end protein bars used as food supplements by body builders. The project requires use of an existing warehouse, which the firm acquired three years ago for $1m and which it currently rents out for $120,000. Rental rates are not expected to change going forward. In addition to using the warehouse, the project requires an up-front investment into machines and other equipment of $1.4m. This investment can be fully depreciated straight-line over the next 10 years for tax purposes. However, Arnold Inc. expects to terminate the project at the end of eight years and to sell the machines and equipment for $500,000. Finally, the project requires an initial investment into net working capital equal to 10% of predicted first-year sales. Subsequently, net working capital is 10% of the predicted sales over the following year. Sales of protein bars are expected to be $4.8m in the first year and to stay constant for eight years. Total manufacturing costs and operating expenses (excluding depreciation) are 80% of sales, and profits are taxed at 30%.

a. What are the free cash flows of the project?

Assumptions:

(1) The warehouse can be rented out again for $120,000 after 8 years.

(2) The NWC is fully recovered at book value after 8 years.

FCF = EBIT (1 – t) + Depreciation – CAPX – Change in NWC

FCF in year 0: – 1.4m CAPX – 0.48m Change in NWC = –1.88m

FCF in years 1-7:

$4.8m	Sales
–$3.84m	–Cost (80%)
$0.96m	=Gross Profit
–$0.12m	–Lost Rent
–$0.14m	–Depreciation
$0.70m	=EBIT
–$0.21m	–Tax (30%)
$0.49m	= (1 – t) x EBIT
$0.14m	+Depreciation
$0.63m	= FCF

Note that there is no more CAPX nor investment into NWC in years 1–7.

FCF in year 8: $0.63m + [$0.5m – 0.30 x ($0.5m – $0.28m)] + $0.48m = $1.544m

Note that the book value of the machinery is still $0.28m when sold, and only the difference between the sale price ($0.5m) and the book value is taxed.

The NWC ($0.48m) is recovered at book value and hence its sale is not taxed at all.

b. If the cost of capital is 15%, what is the NPV of the project?

The NPV is the present value of the FCFs in years 0 to 8:

NPV= -$1.88m

+ an annuity of $0.63m for 7 years

$$+ \frac{\$1.544m}{1.15^8}$$

$$= -\$1.88m + \frac{\$0.63m}{0.15}\left(1 - \frac{1}{1.15^7}\right) + \frac{\$1.544m}{1.15^8}$$

$$= \$1.2458m$$

7-23. Bauer Industries is an automobile manufacturer. Management is currently evaluating a proposal to build a plant that will manufacture lightweight trucks. Bauer plans to use a cost of capital of 12% to evaluate this project. Based on extensive research, it has prepared the following incremental free cash flow projections (in millions of dollars):

	Year 0	Years 1–9	Year 10
Revenues		100.0	100.0
– Manufacturing expenses (other than depreciation)		–35.0	–35.0
– Marketing expenses		–10.0	–10.0
– Depreciation		–15.0	–15.0
= EBIT		40.0	40.0
– Taxes (35%)		–14.0	–14.0
= Unlevered net income		26.0	26.0
+ Depreciation		+15.0	+15.0
– Increases in net working capital		–5.0	–5.0
– Capital expenditures	–150.0		
+ Continuation value			+12.0
= Free cash flow	–150.0	36.0	48.0

a. For this base-case scenario, what is the NPV of the plant to manufacture lightweight trucks?

	Year	0	1	2	3	4	5	6	7	8	9	10
Free Cash Flow Forecast ($ millions)												
1	Sales	—	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	Manufacturing	—	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)
3	Marketing Expenses	—	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
4	Depreciation	—	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)
5	EBIT	—	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
6	Income tax at 35%	—	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)
7	**Unlevered Net Income**	—	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
8	Depreciation	—	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
9	Inc. in NWC	—	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)
10	Capital Expenditures	(150.0)	—	—	—	—	—	—	—	—	—	—
11	Continuation value	—	—	—	—	—	—	—	—	—	—	12.0
12	**Free Cash Flow**	(150.0)	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	48.0
13	**NPV at 12%**	**57.3**	—	—	—	—	—	—	—	—	—	—

The NPV of the estimate free cash flow is

$$\text{NPV} = -150 + 36 \times \frac{1}{0.12}\left(1 - \frac{1}{1.12^{9}}\right) + \frac{48}{1.12^{10}} = \$57.3 \text{ million.}$$

b. Based on input from the marketing department, Bauer is uncertain about its revenue forecast. In particular, management would like to examine the sensitivity of the NPV to the revenue assumptions. What is the NPV of this project if revenues are 10% higher than forecast? What is the NPV if revenues are 10% lower than forecast?

Initial Sales	90	100	110
NPV	20.5	57.3	94.0

c. Rather than assuming that cash flows for this project are constant, management would like to explore the sensitivity of its analysis to possible growth in revenues and operating expenses. Specifically, management would like to assume that revenues, manufacturing expenses, and marketing expenses are as given in the table for year 1 and grow by 2% per year every year starting in year 2. Management also plans to assume that the initial capital expenditures (and therefore depreciation), additions to working capital, and continuation value remain as initially specified in the table. What is the NPV of this project under these alternative assumptions? How does the NPV change if the revenues and operating expenses grow by 5% per year rather than by 2%?

Growth Rate	0%	2%	5%
NPV	57.3	72.5	98.1

d. To examine the sensitivity of this project to the discount rate, management would like to compute the NPV for different discount rates. Create a graph, with the discount rate on the *x*-axis and the NPV on the *y*-axis, for discount rates ranging from 5% to 30%. For what ranges of discount rates does the project have a positive NPV?

NPV is positive for discount rates below the IRR of 20.6%.