Principles of Managerial Finance

9th Edition

Chapter 9

Capital Budgeting Techniques

Learning Objectives

- Understand the role of capital budgeting techniques in the capital budgeting process.
- Calculate, interpret, and evaluate the payback period.
- Calculate, interpret, and evaluate the net present value (NPV).
- Calculate, interpret, and evaluate the internal rate of return (IRR).

Learning Objectives

- Use the net present value profiles to compare net present value and internal rate of return techniques.
- Discuss NPV and IRR in terms of conflicting rankings and the theoretical and practical strengths of each approach.

Techniques that Ignore the Time Value of Money

- Payback. The payback method simply measures how long (in years and/or months) it takes to recover the initial investment.
- But payback has two major weaknesses:
- First, it fails to consider the importance of the time value of money.
- Second, it fails to consider cash flows that occur after the pre-set payback period.

Techniques that Ignore the Time Value of Money

- Payback Weakness: Failure to consider the time value of money (pattern of cash flows).

Mactool Payback Example (Failure to Recognize TVM)		
Cash Flow	**Project 1**	**Project 2**
Initial Outlay	45000	45000
Year 1 Inflow	20000	25000
Year 2 Inflow	25000	20000
Payback	2 years	2 years

But which is preferred?

Payback is the same!

Techniques that Ignore the Time Value of Money

- Payback Weakness: Failure to consider **all** relevant cash flows.

Mactool Payback Example (Failure to Recognize ALL Cash Flows)		
Cash Flow	**Project 1**	**Project 2**
Initial Outlay	45000	45000
Year 1 Inflow	20000	25000
Year 2 Inflow	20000	20000
Year 3 Inflow	25000	15000
Year 4 Inflow	30000	10000
Year 5 Inflow	35000	5000
Payback	2.2 years	2 years

But look at the total cash flows for Project 1!

Payback says pick Project 2!

Time Value Techniques

- Net Present Value (NPV). Net Present Value is found by subtracting the present value of the after-tax outflows from the present value of the after-tax inflows.

Decision Criteria

If NPV > 0, accept the project

If NPV < 0, reject the project

If NPV = 0, indifferent

Time Value Techniques

Net Present Value

Recall the Net Incremental Cash Flows for East Coast Drydock from Chapter 8

East Coast Drydock			
Net Incremental After Tax Cash Flows			
Year	**Existing**	**Hoist A**	**Hoist B**
0	$ -	$ (37,488)	$ (51,488)
1	9,936	6,504	8,064
2	9,936	8,808	12,144
3	9,040	7,208	11,120
4	8,400	6,504	10,080
5	8,400	19,264	29,880

Time Value Techniques

Net Present Value

With a 15% discount rate, we would keep the existing hoist

East Coast Drydock							
Net Incremental After Tax Cash Flows							
(NPV @ 15%)							
Year	**PVIF**	**Existing**	**PV Existing**	**Hoist A**	**PV Hoist A**	**Hoist B**	**PV Hoist B**
0	1.0000	$ -	$ -	$ (37,488)	$ (37,488)	$(51,488)	$ (51,488)
1	0.8696	9,936	$ 8,640	6,504	$ 5,656	8,064	$ 7,012
2	0.7561	9,936	$ 7,513	8,808	$ 6,660	12,144	$ 9,183
3	0.6575	9,040	$ 5,944	7,208	$ 4,739	11,120	$ 7,312
4	0.5718	8,400	$ 4,803	6,504	$ 3,719	10,080	$ 5,763
5	0.4972	8,400	$ 4,176	19,264	$ 9,578	29,880	$ 14,856
NPV = Sum of PV of CF			$ 31,076		$ (7,137)		$ (7,363)

Time Value Techniques

Net Present Value

In fact, even with a discount rate of 0%, we would keep the existing hoist since it has the highest NPV.

East Coast Drydock							
Net Incremental After Tax Cash Flows							
(NPV @ 0%)							
Year	**PVIF**	**Existing**	**PV Existing**	**Hoist A**	**PV Hoist A**	**Hoist B**	**PV Hoist B**
0	1.0000	$ -	$ -	$ (37,488)	$ (37,488)	$(51,488)	$ (51,488)
1	1.0000	9,936	$ 9,936	6,504	$ 6,504	8,064	$ 8,064
2	1.0000	9,936	$ 9,936	8,808	$ 8,808	12,144	$ 12,144
3	1.0000	9,040	$ 9,040	7,208	$ 7,208	11,120	$ 11,120
4	1.0000	8,400	$ 8,400	6,504	$ 6,504	10,080	$ 10,080
5	1.0000	8,400	$ 8,400	19,264	$ 19,264	29,880	$ 29,880
NPV = Sum of PV of CF			$ 45,712		$ 10,800		$ 19,800

Time Value Techniques

Net Present Value

Recall that the before tax operating cash inflows for Drydock in Chapter 9 were as follows:

East Coast Drydock			
	Profits Before Depreciation & Taxes		
Year	Hoist A	Hoist B	Existing
1	$ 21,000	$ 22,000	$ 14,000
2	21,000	24,000	14,000
3	21,000	26,000	14,000
4	21,000	26,000	14,000
5	21,000	26,000	14,000

Time Value Techniques

Net Present Value

What if -- because of a measurement error -- the cash inflows for A and B were double those initially estimated as shown below:

East Coast Drydock			
	Profits Before Depreciation & Taxes		
Year	Hoist A	Hoist B	Existing
1	$ 42,000	$ 44,000	$ 14,000
2	42,000	48,000	14,000
3	42,000	52,000	14,000
4	42,000	52,000	14,000
5	42,000	52,000	14,000

Time Value Techniques

Net Present Value

Recalculating the NPV at a discount rate of 15%, we get:

East Coast Drydock Net Incremental After Tax Cash Flows (NPV @ 15%)							
Year	PVIF	Existing	PV Existing	Hoist A	PV Hoist A	Hoist B	PV Hoist B
0	1.0000	$ -	$ -	$ (37,488)	$ (37,488)	$(51,488)	$ (51,488)
1	0.8696	9,936	$ 8,640				18,490
2	0.7561	9,936	$ 7,513				20,071
3	0.6575	9,040	$ 5,944				17,569
4	0.5718	8,400	$ 4,803				14,683
5	0.4972	8,400	$ 4,176	31,864	$	45,480	$ 22,612
NPV = Sum of PV of CF			$ 31,076		$ 35,101		$ 41,937

The Excel function for computing NPV is =NPV(int. rate, data range)

Time Value Techniques

Net Present Value

With the new numbers, we can now see that Hoist B should be used to replace the existing hoist. This will maximize NPV and ultimately, shareholder value.

Time Value Techniques

Internal Rate of Return

- **The IRR is the discount rate that will equate the present value of the outflows with the present value of the inflows:**
- **The IRR is the project's intrinsic rate of return.**

Decision Criteria

If IRR > k, accept the project

If IRR < k, reject the project

If IRR = k, indifferent

Time Value Techniques

Internal Rate of Return

Note that both replacement projects provide a return in excess of the cost of capital of 15%.

East Coast Drydock							
Net Incremental After Tax Cash Flows							
IRR on Excel							
Year	**PVIF**	**Existing**	**PV Existing**	**Hoist A**	**PV Hoist A**	**Hoist B**	**PV Hoist B**
0	1.0000	$ -	$	$ (37,488)	$ (37,488)	$(51,488)	$ (51,488)
1	0.7033	9,936				21,264	$ 14,955
2	0.4946	9,936				26,544	$ 13,129
3	0.3479	9,040				26,720	$ 9,295
4	0.2447	8,400	$ 2,055		$ 4,074	25,680	$ 6,283
5	0.1721	8,400	$ 1,445		$ 5,483	45,480	$ 7,826
Internal Rate of Return				47.63%		42.19%	

The Excel function for computing IRR is =IRR(data range)

Time Value Techniques

Internal Rate of Return

What if the cost of capital were 42.19%?

East Coast Drydock Net Incremental After Tax Cash Flows (NPV @ 42.19%)							
Year	PVIF	Existing	PV Existing	Hoist A	PV Hoist A	Hois	
0	1.0000	$ -	$ -	$ (37,488)	$ (37,488)	$(51	
1	0.7033	9,936	$ 6,988	19,104	$ 13,436	21	
2	0.4946	9,936	$ 4,915	21,408	$ 10,589	26	
3	0.3479	9,040	$ 3,145	19,808	$ 6,891	26	
4	0.2447	8,400	$ 2,055	19,104	$ 4,674	25	
5	0.1721	8,400	$ 1,445	31,864	$ 5,483	45,480	7,826
Internal Rate of Return				47.63%		42.19%	
Net Present Value			$ 18,548		$ 3,584		$ (0)
Profitability Index					1.10		1.00

Notice that for Hoist B, IRR = the discount rate and that NPV = 0

Time Value Techniques

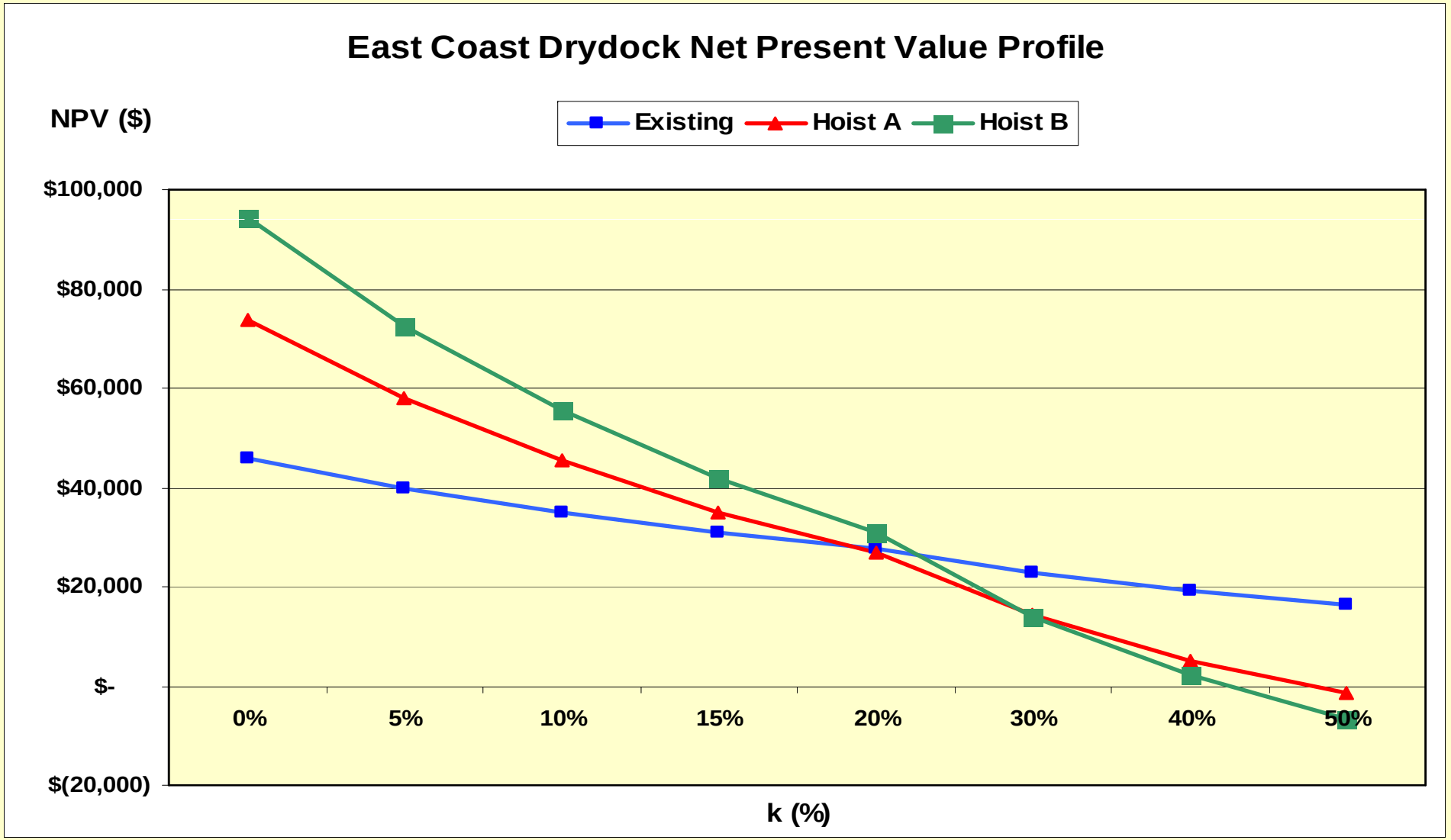
Net Present Value Profile

The NPV Profile shows how a project's value changes with changes in the discount rate.

NPV Profile			
Discount Rate	NPV @ Various Discount Rates		
	Existing	Hoist A	Hoist B
0%	$ 45,712	$ 73,800	$ 94,200
5%	$ 39,777	$ 57,918	$ 72,683
10%	$ 34,989	$ 45,287	$ 55,635
15%	$ 31,076	$ 35,101	$ 41,937
20%	$ 27,838	$ 26,780	$ 30,790
30%	$ 22,841	$ 14,162	$ 13,978
40%	$ 19,209	$ 5,196	$ 2,122
50%	$ 16,484	$ (1,399)	$ (6,536)

Time Value Techniques

Net Present Value Profile



Time Value Techniques

Profitability Index

- The profitability index which is also sometimes called the benefit/cost ratio, is the ratio of the present value of the inflows to the present value of the outflows.

$$PI = \frac{\text{PV Inflows}}{\text{PV Outflows}}$$

Decision Criteria

If PI > 1, accept the project

If PI < 1, reject the project

If PI = 1, indifferent

Time Value Techniques

Profitability Index

Returning to the last East Coast Drydock example, we get:

East Coast Drydock							
Net Incremental After Tax Cash Flows							
(NPV @ 15%)							
Year	**PVIF**	**Existing**	**PV Existing**	**Hoist A**	**PV Hoist A**	**Hoist B**	**PV Hoist B**
0	1.0000	$ -	$ -	$ (37,488)	$ (37,488)	$(51,488)	$ (51,488)
1	0.8696	9,936	$ 8,640	19,104	$ 16,612	21,264	$ 18,490
2	0.7561	9,936	$ 7,513	21,408	$ 16,188	26,544	$ 20,071
3	0.6575	9,040	$ 5,944	19,808	$ 13,024	26,720	$ 17,569
4	0.5718	8,400	$ 4,803	19,104	$ 10,923	25,680	$ 14,683
5	0.4972	8,400	$ 4,176	31,864	$ 15,842	45,480	$ 22,612
Profitability Index					**1.94**		**1.81**

Choose Hoist A since $PI_A > PI_B$

Problems with Discounted Cash Flow Techniques

Conflicting Rankings for Mutually Exclusive Projects

Mutually exclusive projects compete in some way with the same resources. A firm can pick one, or the other, but not both.

Dyer, Inc., Project Analysis (Mutually Exclusive Projects)			
	Project		
	Year	A	B
Acquisition Cost	0	(100,000)	(60,000)
Cash Inflows	1	60,000	36,000
	2	60,000	36,000
	3	60,000	36,000
NPV (@14%)		$39,300.00	$23,580.00
IRR		36%	36%

Problems with Discounted Cash Flow Techniques

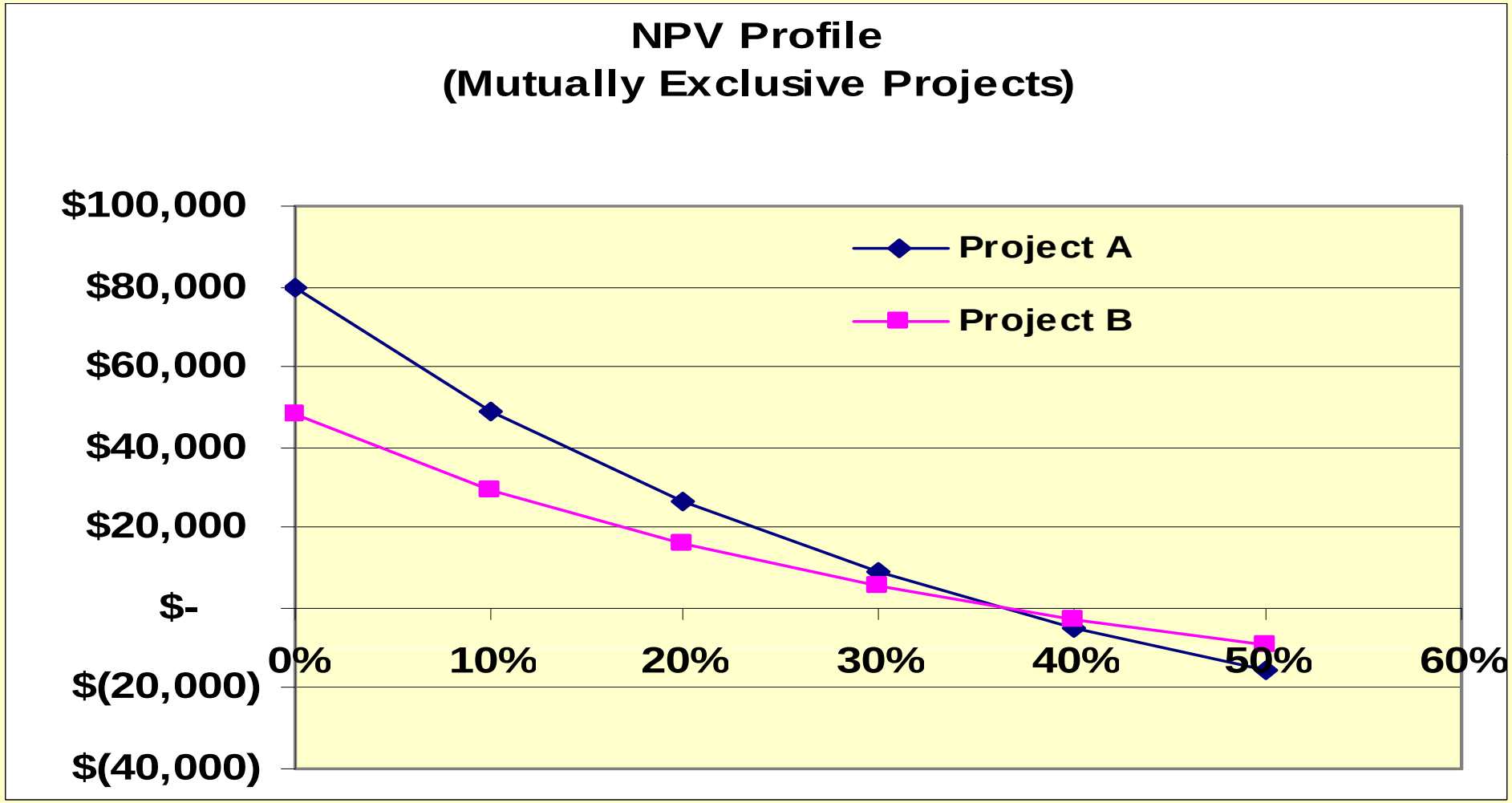
Conflicting Rankings for Mutually Exclusive Projects

Mutually exclusive projects compete in some way with the same resources. A firm can pick one, or the other, but not both.

Dyer, Inc		
NPV Profile		
	Project	
rate	NPV(A)	NPV(B)
0%	$ 80,000	$ 48,000
10%	$ 49,211	$ 29,527
20%	$ 26,389	$ 15,833
30%	$ 8,967	$ 5,380
40%	$ (4,665)	$ (2,799)
50%	$ (15,556)	$ (9,333)

Problems with Discounted Cash Flow Techniques

Conflicting Rankings for Mutually Exclusive Projects



Problems with Discounted Cash Flow Techniques

Conflicting Rankings for Mutually Exclusive Projects

- Interdependent projects are those that influence the value of others.
- In general terms, if there are two interdependent projects, then three appraisals are required:
  - **Project A**
  - **Project B**
  - **And Project A plus B**

Problems with Discounted Cash Flow Techniques

Summary

- If projects are mutually exclusive and not subject to capital rationing, the project with the higher NPV should be selected.
- If the projects are independent, and there is no capital restriction, both should be chosen if they have positive NPVs.
- In the presence of capital restrictions, the project with the higher NPV should be selected.