**Questions and Answers**

1. Investments A and B, suppose that each has a cost of capital of 10%. How long does it take for each investment’s discounted cash flows to pay back its $1,000,000 investment?

|  |  |  |
| --- | --- | --- |
| Year | Investment A | Investment B |
| 2001 | $400,000 | $100,000 |
| 2002 | 400,000 | 100,000 |
| 2003 | 400,000 | 100,000 |
| 2004 | 400,000 | 100,000 |
| 2005 | 400,000 | 100,000 |

**Answer 1:**

The discounted pay­back period for A is four years:

|  |  |  |
| --- | --- | --- |
| Year | Investment A | |
|  | Value at the end of 2000 | Accumulated discounted cash flows |
| 2001 | $363,640 | $363,640 |
| 2002 | 330,580 | 694,220 |
| 2003 | 300,530 | 994,750 |
| 2004 | 273,205 | 1,267,955 |
| 2005 | 248,369 | 1,516,324 |

The discounted payback period for B is five years:

|  |  |  |
| --- | --- | --- |
| Year | Value at the end of 2000 | Accumulated discounted cash flows |
| 2001 | $90,910 | $90,910 |
| 2002 | 82,645 | 173,555 |
| 2003 | 75,131 | 248,686 |
| 2004 | 683,013 | 931,699 |
| 2005 | 620,921 | 1,552,620 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cash flows ($) | | | | | |
| Project | C0 | C1 | C2 | C3 | C4 |
| A | −5,000 | +1,000 | +1,000 | +3,000 | 0 |
| B | −1,000 | 0 | +1,000 | +2,000 | +3,000 |
| C | −5,000 | +1,000 | +1,000 | +3,000 | +5,000 |

a.What is the payback period on each of the following projects?

b.Given that you wish to use the payback rule with a cutoff period of two years, which projects would you accept?

**Project** Cr **CF** *e3 e*

c.If you use a cutoff period of three years. which projects would you accept?

d.If the opportunity cost of capital is 10%. which projects have positive NPVs?

e.If a firm uses a single cutoff period for all projects. it is likely to accept too many shortlived projects? True or false?

f.If the firm uses the discounted payback rule, will it accept any negative NPV projects? Will it turn down any positive NPV projects?

**Answer 2:** a. A = 3 years; B = 2 years; C = 3 years

b. B

c. A, B, and C

d. B and C (At 10%, NPVA = –$1,011; NPV*B* = $3,378;NPV*C* = $2,405)

e. True. The payback rule ignores all cash flows after the cutoff date, meaning that future years’ cash inflows are not considered. Thus, payback is biased towards short-term projects.

f. It will accept no negative-NPV projects, but will turn down some with

positive NPVs. A project can have a positive NPV if all future cash flows

are considered but still not meet the stated cutoff period.

1. Consider the following projects:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Cash flows ($) | | | | | |  |
| Project | C0 | C1 | C2 | C3 | C4 | C5 |
| A | −1,000 | +1,000 | 0 | 0 | 0 | 0 |
| B | −2,000 | +1,000 | +1,000 | +4,000 | +1,000 | +1,000 |
| C | −3,000 | +1,000 | +1,000 | 0 | +1,000 | +1,000 |

1. If the opportunity cost of capital is 10%, which projects have a positive NPV?
2. Calculate the payback period of each project.
3. Which Project(s) would a firm using the payback rule accept if the cutoff period is three years?
4. Calculate the discounted payback period for each Project.
5. Which Project(s) would a firm using the discounted payback rule accept if the cutoff period is three years?

**Answer 3:** a. NPVA = –$1,000 + $1,000 / (1 + .10) = –$90.91

NPVB = –$2,000 + $1,000 / (1 + .10) + $1,000 / (1 + .10)2 + $4,000 / (1 + .10)3 +

$1,000 / (1 + .10)4 + $1,000 / (1 + .10)5

NPVB = $4,044.73

NPVC = –$3,000 + $1,000 / (1 + .10) + $1,000 / (1 + .10)2 + $1,000 / (1 + .10)4

+ $1,000 / (1 + .10)5

NPVC = $39.47

Projects B and C have positive NPVs.

1. Payback *A* = 1 year

Payback*B* = 2 years

Payback*C* = 4 years

1. Accept projects A and B

d. **Project A:**

PV = CF*t* / (1 + *r*)*t*

PVA = $1,000 / (1 + .10)

PVA = $909.09

The present value of the cash inflows for Project A is less than the initial outlay for the project, which means the project never pays back on a discounted basis. This is true for any negative NPV project.

**Project B:**

The present values of the cash inflows for Project B are shown in the second row of the table below, and the cumulative net present values are shown in the last row.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *C*0 | *C*1 | *C*2 | *C*3 | *C*4 | *C*5 |
| –$2,000 | $1,000.00 | $1,000.00 | $4,000.00 | $1,000.00 | $1,000.00 |
| –2,000 | 909.09 | 826.45 | 3,005.26 | 683.01 | 620.92 |
|  | –1,090.91 | –264.46 | 2,740.80 | 3,423.81 | 4,044.73 |

Since the cumulative NPV turns positive between year 2 and year 3, the discounted payback period is calculated as:

Discounted payback period = 2 + $264.46 / $3,005.26 = 2.09 years

**Project C:**

The present values of the cash inflows for Project C are shown in the second row of the table below, and the cumulative net present values are shown in the last row.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *C*0 | *C*1 | *C*2 | *C*3 | *C*4 | *C*5 |
| –$3,000 | $1,000.00 | $1,000.00 | $ 0.00 | $1,000.00 | $1,000.00 |
| –3,000 | 909.09 | 826.45 | 0.00 | 683.01 | 620.92 |
|  | –2,090.91 | –1,264.46 | –1,264.46 | –581.45 | 39.47 |

Since the cumulative NPV turns positive between year 4 and year 5, the discounted payback period is:

Discounted payback period = 4 + $581.45 / $620.92 = 4.94 years

1. Using the discounted payback period rule with a cutoff of three years, the firm would accept only Project B.
2. a) Calculate the NPV of the following Project for discount rates of 0, 50, and 100%.

b) What is the IRR of the project?

|  |  |  |
| --- | --- | --- |
| **Cash flows ($)** | | |
| **C0** | **C1** | **C2** |
| -6,750 | +4,500 | +18,000 |

**Answer 4:** a. NPV = –$6,750 + $4,500 / (1 + 0) + $4,500 / (1 + 0)2 = $15,750

NPV = –$6,750 + $4,500 / (1 + .50) + $4,500 / (1 + .50)2 = $4,250

NPV = –$6,750 + $4,500 / (1 + 1) + $4,500 / (1 + 1)2 = $0

b. 100%; NPV = 0 when the discount rate is 100 percent.

5. Assume that the projects are mutually exclusive and that the opportunity cost of capital is 10%. Calculate the profitability index for each Project.

|  |  |  |
| --- | --- | --- |
| **Cash flows ($)** | | |
| **Project** | **C0** | **C1** |
| D | -10,000 | +20,000 |
| E | -20,000 | +35,000 |

**Answer 5:** NPVD = –$10,000 + $20,000 / (1 +.10)

NPVD = $8,181.82

NPVE = –$20,000 + $35,000 / (1 + .10)

NPVE = $11,818.18

PI = NPV / investment

PID = $8,181.82 / $10,000

PID = .82

PIE = $11,818.18 / $20,000

PIE = .59

Each project has a positive PI, thus, both projects are acceptable.

1. Suppose you have the following investment opportunities, but only $90,000 available for investment. Which projects should you take?

|  |  |  |
| --- | --- | --- |
| **Project** | **NPV ($)** | **Investmet ($)** |
| 1 | 5,000 | 10,000 |
| 2 | 5,000 | 5,000 |
| 3 | 10,000 | 90,000 |
| 4 | 15,000 | 60,000 |
| 5 | 15,000 | 75,000 |
| 6 | 3,000 | 15,000 |

**Answer 6:**

The profitability index for each project is shown below:

|  |  |  |  |
| --- | --- | --- | --- |
| **Project** | **NPV** | **Investment** | **Profitability Index (NPV/Investment)** |
| 1 | 5,000 | 10,000 | 5,000 / 10,000 = .5 |
| 2 | 5,000 | 5,000 | 5,000 / 5,000 = 1 |
| 3 | 10,000 | 90,000 | 10,000 / 90,000 = .11 |
| 4 | 15,000 | 60,000 | 15,000 / 60,000 = .25 |
| 5 | 15,000 | 75,000 | 15,000 / 75,000 = .2 |
| 6 | 3,000 | 15,000 | 3,000 / 15,000 = .2 |

Start with the project with the highest profitability index and go from there.

* Project 2 has the highest profitability index and has an initial investment of $5,000.
* The next highest profitability index is for Project 1, which has an initial investment of $10,000.
* The next highest is Project 4, which will cost $60,000 up front.
* So far we have spent $75,000.
* Projects 5 and 6 both have profitability indexes of .2, but we only have $15,000 left to spend, so we will add Project 6 to our list.
* This gives us Projects 1, 2, 4, and 6.

1. The following investment proposals are independent. Assuming a required rate of return of 10 per cent, and using both the internal rate of return and net present value methods, which of the proposals are acceptable?

|  |  |  |  |
| --- | --- | --- | --- |
| Cash flows ($) | | | |
| Proposal | Year 0 | Year 1 | Year 2 |
| A | -40,000 | 8,000 | 48,000 |
| B | -40,000 | 42,000 |  |
| C | -40,000 | 48,000 |  |

**Answer 7: Net present value:**

Proposal A:

*NPV* = 

= −$40 000 + $7273 + $39 670

= $6943

Proposal B:

*NPV* = −$40 000 + 

= −$40 000 + $38 182

= −$1818

Proposal C:

*NPV* = −$40 000 + 

= −$40 000 + $43 636

= $3636

Accept Proposal A.

**Internal rate of return:**

Proposal A:

*NPV* = 0 = −40 000 + 

By trial and error, *r =* 20 per cent

Proposal B:

*NPV* = 0 = −40 000 + 

By trial and error, *r* = 5 per cent

Proposal C:

*NPV* = 0 = −40 000 + 

By trial and error, *r*, = 20 per cent

**Accept Proposals A and C.**

1. A company wishes to evaluate the following mutually exclusive investment proposals:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cash flows ($)** | | | |  |  |  |
| **Project** | **Year 0** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| A | -97,400 | 34,000 | 34,000 | 34,000 | 34,000 | 34,000 |
| B | -63,200 | 24,000 | 24,000 | 24,000 | 24,000 | 24,000 |

1. Calculate each proposal’s NPV and IRR. Assume the required rate of return is 8%.
2. How would you explain the different rankings given by the NPV and IRR methods?

**Answer 8:**

(a) Project A:

NPV = –$97 400 + 

= $38 351.08

Project B:

NPV = –$63 200 + 

= $32 624.80

Project A:

IRR *=*  $97 400 = ($440,000÷r)×(1−(1÷(1+r)5)

*r =* 22 per cent

Project B:

IRR = $63 200 = ($24,000÷r)×(1−(1÷(1+r)5)

*r* = $26 per cent

(b) The difference in ranking is due to the different scale of the projects.

1. Suppose you have an investment with the following expected cash flows:

|  |  |
| --- | --- |
| Year | Investment A |
| 0 | −$10,000 |
| 1 | +$3,000 |
| 2 | +$3,000 |
| 3 | +$6,000 |

The IRR of this project is 8.55% per year. What you would have at the end of the third year if you rein­vested each cash flow at 8.55%?

**Answer 9:**

|  |  |  |
| --- | --- | --- |
| Year | End-of-year cash flow | Future value at end of third year, using 8,55% |
| 1 | +$3,000 | $3,000 (1+0,0855)2 = $3,534.93 |
| 2 | +$3,000 | $3,000 (1+0,0855)1 = $3,256.50 |
| 3 | +$6,000 | $6,000 (1+0,0855)0 = $6,000.00 |
| FV3 |  | $12,791.43 |

Investing $10,000 today produces a value of $12,791.43 at the end of the third year. The return on this investment is calculated using the present value of the investment (the $10,000), the future value of the investment (the $12,791.43) and the number of periods (3):

Return on investment =

1. Here are the cash-flow forecasts for two mutually exclusive projects:

|  |  |  |
| --- | --- | --- |
| Year | Project A | Project B |
| 0 | -$100 | -$100 |
| 1 | 30 | 49 |
| 2 | 50 | 49 |
| 3 | 70 | 49 |

1. Which project would you choose if the opportunity cost of capital is 2%?
2. Which would you choose if the opportunity cost of capital is 12%?

**Answer 10:**

1. NPVA = –$100 + 30 / (1 + 0,02) + 50 / (1 + 0,02)2 + 70 / (1 + 0,02)3 = $43,43

NPVB = –$100 + 

= $41,31

Choose Project A.

1. NPVA = –$100 + 30 / (1 + 0,12) + 50 / (1 + 0,12)2 + 70 / (1 + 0,12)3 = $16,47

NPVB = –$100 + 

= $17,69

Choose Project B.