The Internal Rate of Return, The IRR

Let's try an example…

Ex. Your company invests in a new 3D Printing Machine for $100,000. The anticipated profits resulting from the printer are $40,000 per year for 5 years. The discount rate = 16%. What is the IRR, the actual rate of return for this project?

Let's first calculate the project's NPV…determined at the company's discount rate:

$$PV_{Benefits} = A\left[\frac{(1+i)^N - 1}{i\,(1+i)^N}\right]$$

$$PV_{Investments} = \$100{,}000$$

$$PV_{Benefits} = \$40{,}000\left[\frac{(1+0.16)^5 - 1}{0.16\,(1+0.16)^5}\right]$$

$$PV_{Benefits} = \$130{,}972$$

NPV = $30,972. The project is financially worthwhile.

What is the actual rate of return, the IRR?

Let's try an example…

Ex. Your company invests in a new 3D Printing Machine for $100,000. The anticipated profits resulting from the printer are $40,000 per year for 5 years. The discount rate = 16%. What is the actual rate of return?

Now calculate the project's IRR…where we calculate the "i" that forces $PV_{Inflows} = PV_{Outflows}$

$$PV_{Benefits} = A\left[\frac{(1+i)^N - 1}{i\,(1+i)^N}\right]$$

$$PV_{Investments} = P_0 = \$100{,}000$$

What is the rate of return that makes: $PV_{Benefits} = P_0$

When this is true, *i* is the IRR, the project's actual rate of return.

$$\$40{,}000\left[\frac{(1+IRR)^5 - 1}{IRR\,(1+IRR)^5}\right] = \$100{,}000$$

$$2.5 = \left[\frac{(1+IRR)^5 - 1}{IRR\,(1+IRR)^5}\right]$$

Calculating the IRR analytically can be messy, and usually involves an iterative approach…

IRR Function in Excel…

IRR: Returns the internal rate of return for any series of cash flows, provided they occur at regular intervals, such as monthly or annually.

Format: IRR(values, guess).

values: All the cash flows including the Initial Investment at Time = 0.

guess: A number that you guess is close to the IRR. Excel uses an iteration technique and this helps quickly home in on the answer. [In most cases you do not need to provide guess. You can leave it blank.]

While the NPV function starts the cash flows in Year 1, excluding the initial investment…

The IRR captures ALL the values, including the initial investment.

Internal Rate of Return (IRR)

Ex. Your company invests in a new 3D Printing Machine for $100,000. The anticipated profits resulting from the printer are $40,000 per year for 5 years. The discount rate = 16%. What is the actual rate of return?

	A	B	C	D	E	F	G
1	**3D Printer Example**						
2							
3	**Initial Investment:**	**$100,000**					
4	**Annual Profits:**	**$40,000**					
5	**Time (years):**	**5**					
6	**Discount Rate:**	**16%**					
7							
8		**End of Year Cash Flows**					
9	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
10	**Cash Flow**	-$100,000	$40,000	$40,000	$40,000	$40,000	$40,000
11							
12	PV (Yr 1-5):	$130,972	*=NPV(B6, C10:G10)*				
13	Initial Investment:	$100,000	*=B3*				
14	**Net Present Value, NPV:**	**$30,972**	*=B12-B13*				

The NPV > 0

Internal Rate of Return (IRR)

Ex. Your company invests in a new 3D Printing Machine for $100,000. The anticipated profits resulting from the printer are $40,000 per year for 5 years. The discount rate = 16%. What is the actual rate of return?

	A	B	C	D	E	F	G
1	**3D Printer Example**						
2							
3	**Initial Investment:**	**$100,000**					
4	**Annual Profits:**	**$40,000**					
5	**Time (years):**	**5**					
6	**Discount Rate:**	**16%**					
7							
8		**End of Year Cash Flows**					
9	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
10	**Cash Flow**	-$100,000	$40,000	$40,000	$40,000	$40,000	$40,000
11							
12	PV (Yr 1-5):	$130,972	*=NPV(B6, C10:G10)*				
13	Initial Investment:	$100,000	*=B3*				
14	**Net Present Value, NPV:**	**$30,972**	*=B12-B13*				
15							
16	**Internal Rate of Return, IRR:**	**29%**	*=IRR(B10:G10)*				

The NPV > 0
And the IRR > 16%
So this is a great project for investment!

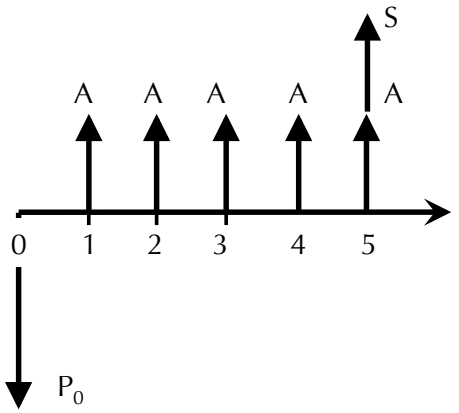
The IRR: Back to Palisade, Colorado

Rabbit Ridge Winery
Palisade, Colorado

What is the Internal Rate of Return (IRR) for Investing in the new Grape Crushing Machine?

Our Palisades example now using Excel…

	A	B	C	D	E	F	G
1	**Rabbit Ridge Grape Crusher**						
2							
3	**Initial Investment:**	**$52,000**					
4	**Net Benefits:**	**$23,000**					
5	**Salvage Value:**	**$10,400**					
6	**Time (years):**	**5**					
7	**Discount Rate:**	**12%**					
8							
9		**End of Year Cash Flows**					
10	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
11	**Cash Flow**	-$52,000	$23,000	$23,000	$23,000	$23,000	$33,400
12							
13	PV (Yr 1-5):	$88,811	*=NPV(B7, C11:G11)*				
14	Initial Investment:	$52,000	*=B3*				
15	**Net Present Value, NPV:**	**$36,811**	*=B13-B14*				

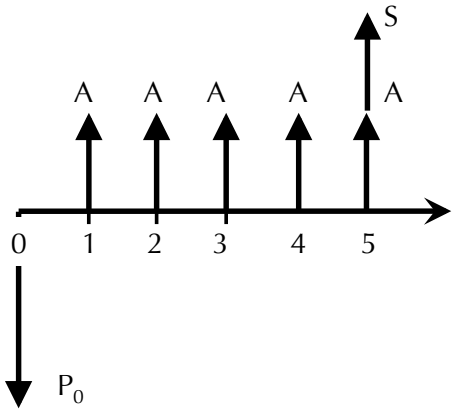


NPV > 0
This also means IRR > 12%!

What is the actual rate of return for this project.

Our Palisades example now using Excel…

	A	B	C	D	E	F	G
1	**Rabbit Ridge Grape Crusher**						
2							
3	**Initial Investment:**	**$52,000**					
4	**Net Benefits:**	**$23,000**					
5	**Salvage Value:**	**$10,400**					
6	**Time (years):**	**5**					
7	**Discount Rate:**	**12%**					
8							
9		**End of Year Cash Flows**					
10	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
11	**Cash Flow**	-$52,000	$23,000	$23,000	$23,000	$23,000	$33,400
12							
13	PV (Yr 1-5):	$88,811	*=NPV(B7, C11:G11)*				
14	Initial Investment:	$52,000	*=B3*				
15	**Net Present Value, NPV:**	**$36,811**	*=B13-B14*				
16							
17	**Internal Rate of Return, IRR:**	**36%**	*=IRR(B11:G11)*				



NPV = $36,811
IRR = 36%

This is a great project!

Our Palisades example now using Excel…

	A	B	C	D	E	F	G
1	**Rabbit Ridge Grape Crusher**						
2							
3	**Initial Investment:**	**$52,000**					
4	**Net Benefits:**	**$23,000**					
5	**Salvage Value:**	**$10,400**					
6	**Time (years):**	**5**					
7	**Discount Rate:**	**12%**					
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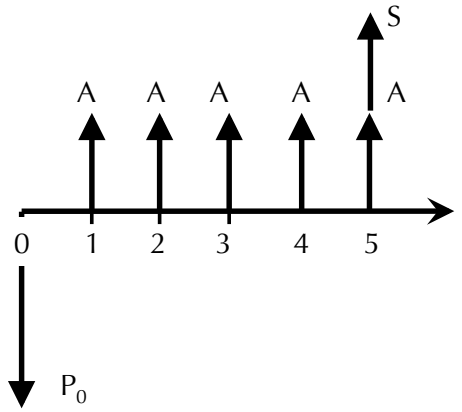
9		**End of Year Cash Flows**					
10	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
11	**Cash Flow**	-$52,000	$23,000	$23,000	$23,000	$23,000	$33,400
12							
13	PV (Yr 1-5):	$88,811	*=NPV(B7, C11:G11)*				
14	Initial Investment:	$52,000	*=B3*				
15	**Net Present Value, NPV:**	**$36,811**	*=B13-B14*				
16							
17	**Internal Rate of Return, IRR:**	**36%**	*=IRR(B11:G11)*				
18							
19	**Simple Payback Period:**	**2.26**					
20	**Discounted Payback Period:**	**2.80**					



NPV = $36,811
IRR = 36%
Simple PBP = 2.3 Years

This is truly a great project!

Main Takeaways…

The Internal Rate of Return, the IRR, is a project's actual rate of return.

The IRR is defined as the rate of return that makes the $PV_{Inflows} = PV_{Outflows}$, thereby NPV = 0.

While challenging to find the IRR analytically, it is easy with Excel's IRR Function.

The project is financially worthwhile if the IRR is greater than the Discount Rate.

The combined metrics of the Net Present Value, Payback Period, and Internal Rate of Return provide a comprehensive view of a proposed project's financial impact, something you now know how to do!

Next Time…

The Capital Budgeting Process

Credits & References

Slide 1: Concept of IRR - Internal Rate of Return by Elnur, Adobe Stock (399233762.jpeg).

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