

University of Rome  
  
Tor Vergata

DEPT. MANAGEMENT & LAW  
BACHELOR DEGREE IN BUSINESS ADMINISTRATION

*COURSE of Managerial Accounting  
- Basics of Cost Analysis -*

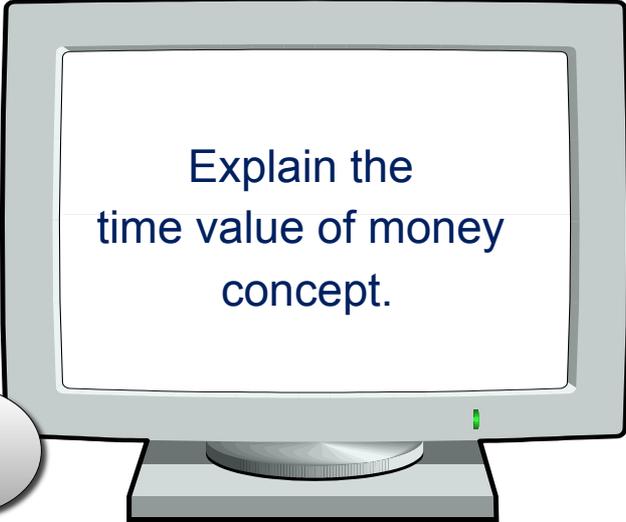
# Planning for Capital Investments

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## Learning Objective



Explain the  
time value of money  
concept.

LO1

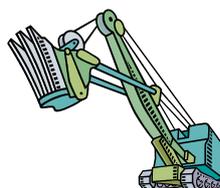
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## Capital Investment Decisions



Purchases of long-term operational assets are **capital investments**. Once a company purchases operational assets, it is committed to these investments for an extended period of time. Understanding the time value of money concept will help you make rational capital investment decisions.



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## Time Value of Money



This concept recognizes that the value of a dollar **received in the future** is less than today's dollar. The further into the future the receipt is expected to occur, the smaller its present value.

When a company invests in capital assets, it sacrifices present dollars in exchange for the opportunity to receive future dollars.



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## Minimum Rate of Return



Most companies consider the cost of capital to be the minimum expected **return on investment** opportunities. Creditors expect interest payments; in most companies, owners expect dividends and increased stock value. The blend of creditor and owner costs is considered the cost of capital for an organization.



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## Present and Future Value



### Present Value

Value today of a future cash flow.

### Future Value

Amount to which an investment will grow after earning interest

**NOTE** that **COMPOUNDING** is the process where the value of an investment increases because the earnings on an investment, both capital gains and interest, earn interest as time passes.

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## Future Values



**Future Value of \$100 = FV**

$$FV = \$100 \times (1 + r)^t$$

## Future Values



$$FV = \$100 \times (1 + r)^t$$



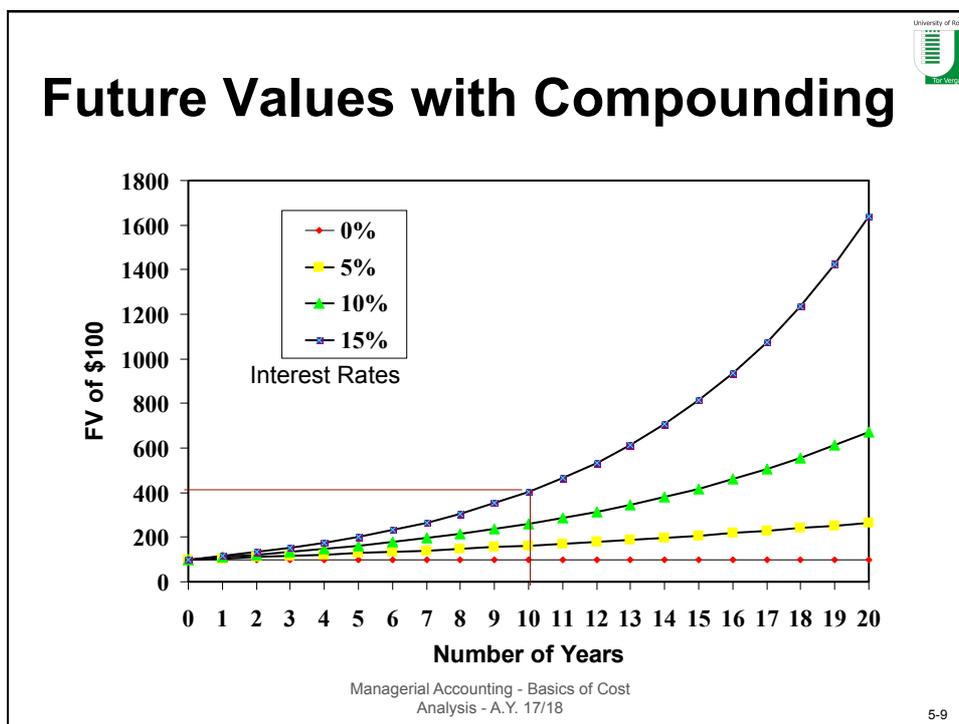
### Example - FV

*What is the future value of \$100 if interest is compounded annually at a rate of 7% for two*

*years?*

$$FV = \$100 \times (1.07) \times (1.07) = 114.49$$

$$FV = \$100 \times (1 + .07)^2 = \$114.49$$



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## Present Value

Present Value = PV

$$PV = \text{discount factor} \times C_1$$

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## Present Value



Discount Factor = DF = PV of \$1

$$DF = \frac{1}{(1+r)^t}$$

Discount Factors can be used to compute the present value of any cash flow.

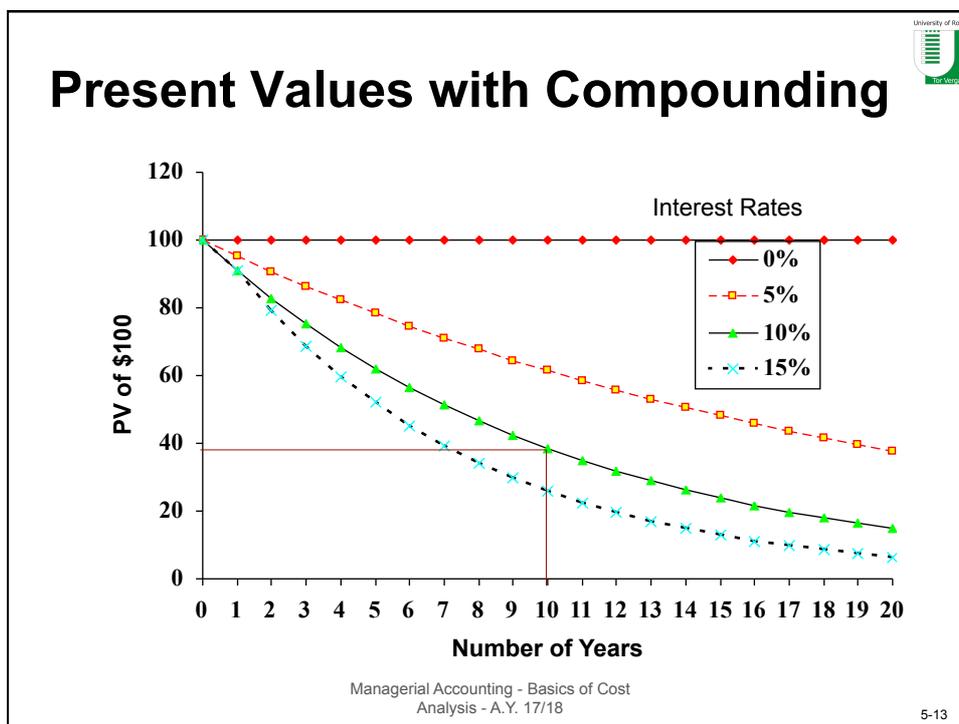
## Present Value



**The PV formula has many applications. Given any variables in the equation, you can solve for the remaining variable. Also, you can reverse the prior example.**

$$PV = DF_2 \times C_2$$

$$PV = \frac{1}{(1+.07)^2} \times 114.49 = 100$$



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## Example: Valuing an Office Building

*Step 1: Forecast cash flows*

Cost of building =  $C_0 = 370,000$

Sale price in Year 1 =  $C_1 = 420,000$

*Step 2: Estimate opportunity cost of capital*

If equally risky investments in the capital market offer a return of 5%, then

Cost of capital =  $r = 5\%$



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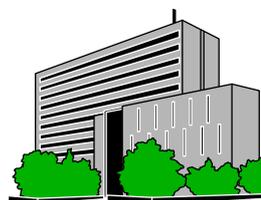
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## Valuing an Office Building



*Step 3: Discount future cash flows*

$$PV = \frac{C_1}{(1+r)} = \frac{420,000}{(1+.05)} = 400,000$$



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## Converting Future Cash Inflows to Their Equivalent Present Values



EZ Rentals wants to add LCD projectors to its product line. If EZ invests \$178,571 on January 1 and requires a rate of return of 12%, the company will expect a \$200,000 cash inflow at the end of the first year.

$$\text{Investment} + (0.12 \times \text{Investment}) = \text{Future cash inflow}$$

$$1.12 (\text{Investment}) = \$200,000$$

$$\text{Investment} = \$178,571$$



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## Present Value Table for Single-Amount Cash Inflows



Table 1 in the Appendix (p. 225)

Period	Present Value Factor for \$1		
	10%	12%	14%
1	0.909091	0.892857	0.877193
2	0.826446	0.797194	0.769468
3	0.751315	0.711780	0.674972
4	0.683013	0.635518	0.592080
5	0.620921	0.567427	0.519369

$$\$200,000 \times 0.892857 = \$178,571 \text{ (rounded)}$$



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## Present Value Table for Annuities



**An annuity is a series of equal periodic payments. Rent on your apartment or home, or insurance on your automobile is probably paid in the form an equal periodic payment.**

Let's assume that EZ Rentals is going to receive \$200,000 at the end of each of the next 4 years. The company uses an interest rate for present value calculations of 12%.

How do we determine the present value when faced with a series of payments?



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## Present Value Table for Annuities



Table 1 in the Appendix (p.225)

Period	Present Value Factor for \$1		
	10%	12%	14%
1	0.909091	0.892857	0.877193
2	0.826446	0.797194	0.769468
3	0.751315	0.711780	0.674972
4	0.683013	0.635518	0.592080
5	0.620921	0.567427	0.519369

Investing \$607,470 today at a 12% return is equivalent to receiving \$200,000 each year for the next four years.



PV of \$200,000 Cash Inflows Received for 4 Years			
Period	FV	Factor	Amount
1	\$ 200,000	× 0.892857	= \$ 178,571
2	200,000	× 0.797194	= 159,439
3	200,000	× 0.711780	= 142,356
4	200,000	× 0.635518	= 127,104
			\$ 607,470

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## Present Value Table for Annuities



An annuity must meet three criteria: (1) equal payment amounts, (2) equal time intervals between payments, and (3) a constant rate of return.

**$\$200,000 \times 3.037349 = \$607,470$  (rounded)**

Period	Present Value Factor for an Annuity of \$1			
	8%	10%	12%	14%
1	0.925926	0.909091	0.892857	0.877193
2	1.783265	1.735537	1.690051	1.646661
3	2.577097	2.486852	2.401831	2.321632
4	3.312127	3.169865	3.037349	2.913712
5	3.992710	3.790787	3.604776	3.433081

Table 2 in the Appendix (p.226)



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## Software Programs for PV



We will use Excel to demonstrate the use of software to complete our present value computations. Let's assume that EZ Rentals receives an annuity of \$200,000 at the end of each of the next 4 years. At 12% required return, how much could EZ invest in this project?



The screenshot shows an Excel spreadsheet with the following content:

	A	B	C	D
1	Special Function = PV			
2				
3			PV(Rate,Nper,Pmt)	
4			PV(0.12,4,200000)	
5			\$ (607,470)	

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## Software Programs for PV



Now let's assume that EZ Rentals receives an annuity of \$200,000 at the end of each of the next four years. At 14% required return, how much could EZ invest in this project?



The screenshot shows an Excel spreadsheet with the following content:

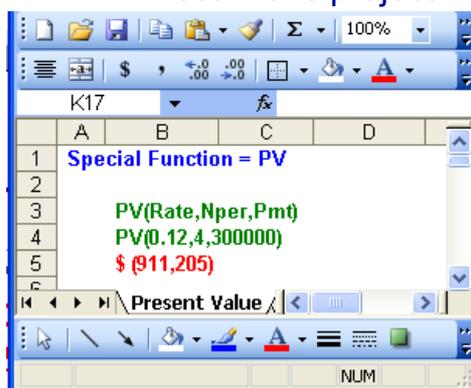
	A	B	C	D
1	Special Function = PV			
2				
3			PV(Rate,Nper,Pmt)	
4			PV(0.14,4,200000)	
5			\$ (582,742)	

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## Software Programs for PV



Now let's assume that EZ Rentals receives an annuity of **\$300,000** at the end of each of the next four years. At **12%** required return, how much could EZ invest in this project?



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## Ordinary Annuity Assumption



An ordinary annuity is a series of equal payments made at the end of each period.

Capital investment decisions often involve uncertainties about future cash inflows and outflows. The assumptions inherent in ordinary annuities simplify the calculation process.



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## Reinvestment Assumption

In the first example of using Excel to calculate present value, we determine that the present value of the investment was \$607,470 at a 12% rate of return. This calculation assumes that the periodic cash inflows, in our case \$200,000, will be reinvested at the desired rate of return, or 12%. Here is the proof.

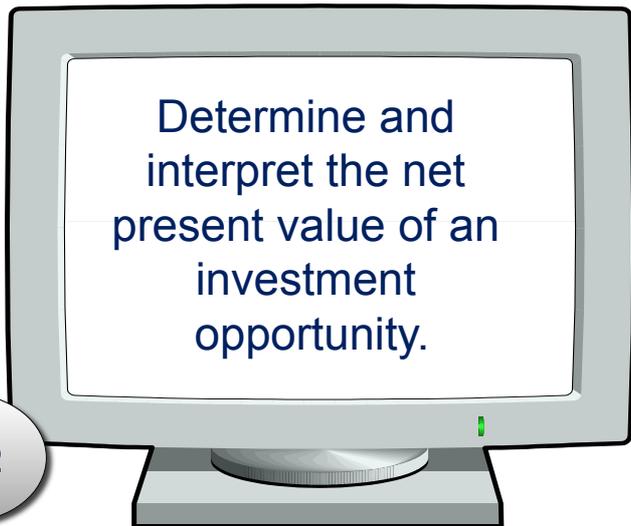
	A	B	C = A*12%	D = B-C	E = A-D
Period	Beginning Investment	Annual Cash Inflow	Return at 12%	Investment Recovery	Year-End Investment
1	\$ 607,470	\$ 200,000	\$ 72,896	\$ 127,104	\$ 480,366
2	480,366	200,000	57,644	142,356	338,010
3	338,010	200,000	40,561	159,439	178,571
4	178,571	200,000	21,429	178,571	(0)
		<u>\$ 800,000</u>	<u>\$ 192,530</u>	<u>\$ 607,470</u>	

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## Learning Objective



Determine and interpret the net present value of an investment opportunity.

LO2

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## Net Present Value



Subtracting the cost of the investment from the present value of future cash inflows determines the net present value of the investment opportunity. A positive net present value indicates the investment will yield a rate of return higher than the required return. A negative net present value means the return is less than the required return.

Let's look at an example.



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## Net Present Value



$$\text{NPV} = \text{PV} - \text{required investment}$$

$$\text{NPV} = C_0 + \frac{C_1}{1+r}$$

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## Example: Valuing an Office Building



### Step 1: Forecast cash flows

Cost of building =  $C_0 = 370,000$

Sale price in Year 1 =  $C_1 = 420,000$

### Step 2: Estimate opportunity cost of capital

If equally risky investments in the capital market offer a return of 5%, then

Cost of capital =  $r = 5\%$



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## Valuing an Office Building

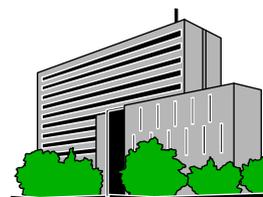


### Step 3: Discount future cash flows

$$PV = \frac{C_1}{(1+r)} = \frac{420,000}{(1+.05)} = 400,000$$

### Step 4: Go ahead if PV of payoff exceeds investment

$$\begin{aligned} NPV &= 400,000 - 370,000 \\ &= 30,000 \end{aligned}$$



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## Risk and Present Value



**Higher risk projects require a higher rate of return**  
**Higher required rates of return cause lower PVs**

PV of  $C_1 = \$420,000$  at 5%

$$PV = \frac{420,000}{1 + .05} = 400,000$$

## Risk and Present Value



PV of  $C_1 = \$420,000$  at 12%

$$PV = \frac{420,000}{1 + .12} = 375,000$$



PV of  $C_1 = \$420,000$  at 5%

$$PV = \frac{420,000}{1 + .05} = 400,000$$

## Risk and Net Present Value



$$\text{NPV} = \text{PV} - \text{required investment}$$

$$\begin{aligned} \text{NPV} &= 375,000 - 370,000 \\ &= \$5,000 \end{aligned}$$

## Net Present Value Rule



**Accept investments that have positive net present value**

### Example

*Use the original example. Should we accept the project given a 10% expected return?*

$$\text{NPV} = -370,000 + \frac{420,000}{1.05} = \$30,000$$

## Rate of Return Rule



**Accept investments that offer rates of return in excess of their opportunity cost of capital**

### Example

*In the project listed below, the foregone investment opportunity is 12%. Should we do the project?*

$$\text{Return} = \frac{\text{profit}}{\text{investment}} = \frac{420,000 - 370,000}{370,000} = .135 \text{ or } 13.5\%$$

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## Multiple Cash Flows



**For multiple periods we have the Discounted Cash Flow (DCF) formula**

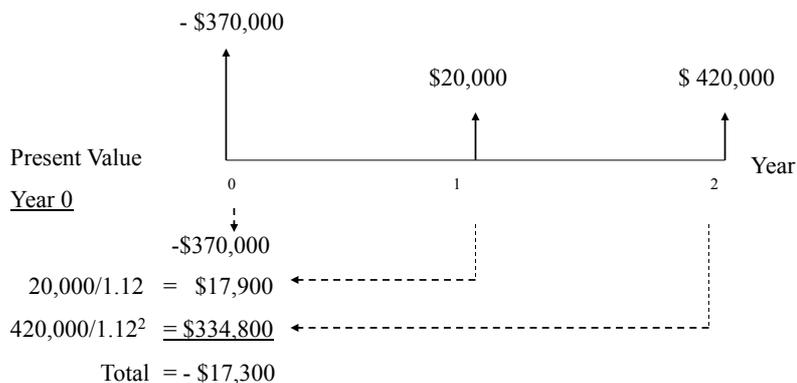
$$PV_0 = \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \dots + \frac{C_t}{(1+r)^t}$$

$$NPV_0 = C_0 + \sum_{t=1}^T \frac{C_t}{(1+r)^t}$$

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## Net Present Values



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## Net Present Value



Let's assume that EZ Rentals can purchase the LCD projectors for \$582,742. The company has a desired rate of return of 12%. The investment will provide a \$200,000 cash inflow for the next four years. Should EZ buy the projectors?

Present value of future cash inflows	\$ 607,470
Cost of the investment	(582,742)
Net present value	<u>\$ 24,728</u>

The positive net present value tells us that the investment will earn more than the desired rate of 12%. EZ should invest in the LCD projectors.



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## ✓ Check Yourself



To increase productivity, Wald Corporation is considering the purchase of a new machine that costs \$50,000. The machine is expected to provide annual net cash inflows of \$12,500 for each of the next five years. Wald desires a minimum annual rate of return of 10%. Would you recommend that Wald invest in the new machine?

PV of cash inflows =  $\$12,500 \times 3.790787 = \$47,385$

Present value of future cash inflows	\$ 47,385
Cost of the investment	(50,000)
Net present value	<u>\$ (2,615)</u>

**Wald should not purchase the new machine.**

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## Learning Objective



Determine and interpret the internal rate of return of an investment opportunity.

LO3

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## Internal Rate of Return



The internal rate of return is the rate at which the present value of cash inflows **equals** cash outflows.

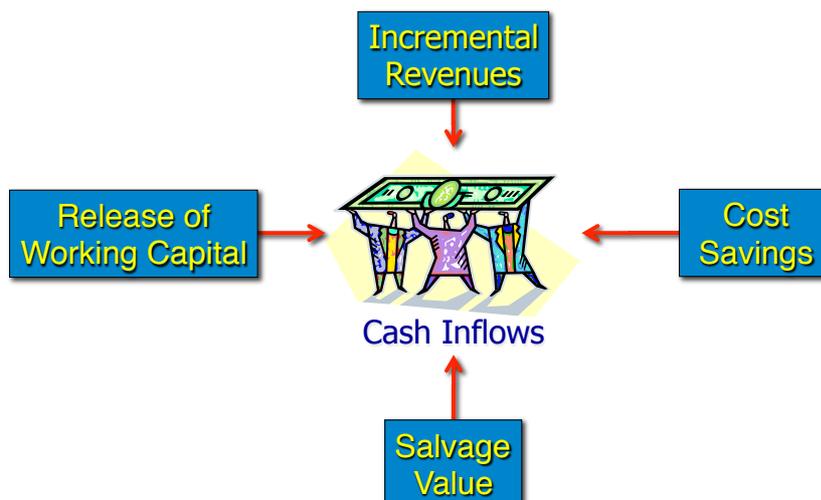
An investment cost \$582,742, and will return \$200,000 at the end of each of the next 4 years. What is the IRR?

$$\text{\$582,742} \div \text{\$200,000} = 2.91371$$

Period	Present Value Factor for an Annuity of \$1			
	8%	10%	12%	14%
1	0.92593	0.90909	0.89286	0.87719
2	1.78326	1.73554	1.69005	1.64666
3	2.57710	2.48685	2.40183	2.32163
4	3.31213	3.16987	3.03735	2.91371
5	3.99271	3.79079	3.60478	3.43308

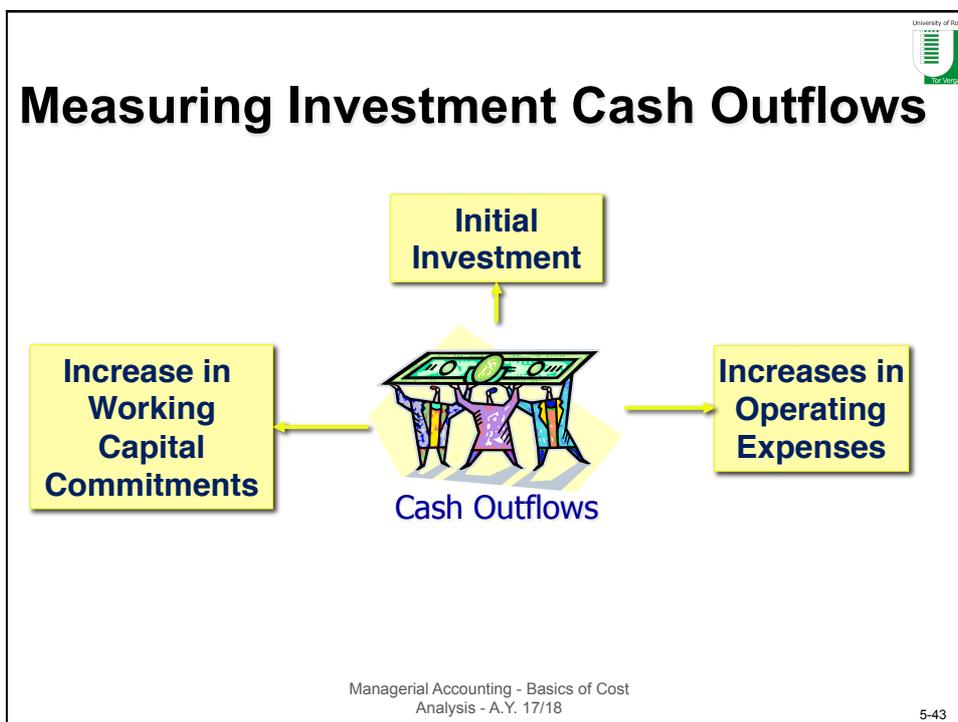
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## Measuring Investment Cash Inflows



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## Net Present Value: Alternative 1 (Modernize Maintenance Facility)



Cash inflows			
Cost savings	\$ 21,500	× 3.433081	= \$ 73,811
Salvage value	\$ 4,000	× 0.519369	= 2,077
Working capital recovery	\$ 12,000	× 0.877193	= 10,526
<b>Total</b>			<b>86,414</b>
Cash outflows			
Cost of equipment, less trade-in	\$ 75,000	× 1.000000	= 75,000
Training costs	\$ 3,000	× 1.000000	= 3,000
<b>Total</b>			<b>78,000</b>
<b>Net present value</b>			<b>\$ 8,414</b>

PV of annuity for 5 periods at 14%

PV of \$1 for 1 period at 14%

PV of \$1 for 5 periods at 14%

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## Net Present Value: Alternative 2



Alternative 2: Purchase Delivery Truck			
Cash inflows			
Incremental revenues	\$ 69,000	× 3.433081	= \$ 236,883
Salvage value	\$ 30,000	× 0.519369	= 15,581
Working capital recovery	\$ 5,000	× 0.519369	= 2,597
<b>Total</b>			<b>255,061</b>
Cash outflows			
Cost of truck	\$ 115,000	× 1.000000	= 115,000
Working capital increase	\$ 5,000	× 1.000000	= 5,000
Increase in operating expenses	\$ 32,000	× 3.433081	= 109,859
Major overhaul	\$ 20,000	× 0.674972	= 13,499
<b>Total</b>			<b>243,358</b>
<b>Net present value</b>			<b>\$ 11,703</b>

PV of annuity for 5 periods at 14%

PV of \$1 for 3 periods at 14%

PV of \$1 for 5 periods at 14%

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## PV Index



$$\text{PV index} = \frac{\text{PV of cash inflows}}{\text{PV of cash outflows}}$$

$$\text{Alternative 1} = \frac{\$86,414}{\$78,000} = \underline{1.108}$$

$$\text{Alternative 2} = \frac{\$255,061}{\$243,358} = \underline{1.048}$$

**Alternative 1 yields a higher return than Alternative 2.**

## Internal Rate of Return



When management uses the internal rate of return (IRR), the higher the return, the more profitable the investment. Calculating IRR can be tedious. Let's use Excel to make the process efficient. To use Excel's special functions, we must know the values involved and make a reasonable guess as to the IRR. The guess is necessary to help Excel determine the correct IRR.

Let's calculate the IRR for Alternatives 1 and 2 using Excel.

## Internal Rate of Return

Microsoft Excel - IRR.xls

Internal Rate of Return - Alternative 1  
 Excel Special Function = IRR(Values, Guess)  
 IRR(B6:B11,.1)  
**18.6932%**

T1	(78,000)	(\$80,000 cost of equipment - \$5,000 trade-in + \$3,000 training)
T2	33,500	(\$21,500 cost savings + \$12,000 working capital recovery)
T3	21,500	(Cost savings)
T4	21,500	(Cost savings)
T5	25,500	(\$21,500 cost savings + \$,4000 salvage value)

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## Internal Rate of Return

Microsoft Excel - IRR.xls

Internal Rate of Return - Alternative 2  
 Excel Special Function = IRR(Values, Guess)  
 IRR(B6:B11,.1)  
**17.6083%**

	\$(120,000)	(\$115,000 cost of truck + \$5,000 working capital required)
T1	37,000	(\$69,000 revenue - \$32,000 operating expenses)
T2	37,000	(\$69,000 revenue - \$32,000 operating expenses)
T3	17,000	(\$69,000 revenue - \$32,000 operating expenses - \$20,000 overhaul)
T4	37,000	(\$69,000 revenue - \$32,000 operating expenses)
T5	72,000	(\$69,000 revenue - \$32,000 operating expenses + \$30,000 salvage + \$5,000 working capital release)

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## Relevance and the Time Value of Money



You have an opportunity to invest in one of the two projects shown below. Both require an investment of \$6,000, and return total cash inflows of \$8,000.

	Project 1	Project 2
Period 1	\$ 3,500	\$ 2,000
Period 2	3,000	2,000
Period 3	1,000	2,000
Period 4	500	2,000
<b>Total</b>	<b>\$ 8,000</b>	<b>\$ 8,000</b>

If you have a desired rate of return of 10%, in which project would you invest?

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## Relevance and the Time Value of Money



Project 1			
Period	Cash Inflow	PV Factor	PV
1	\$ 3,500	× 0.909091	= \$ 3,182
2	\$ 3,000	× 0.826446	= 2,479
3	\$ 1,000	× 0.751315	= 751
4	\$ 500	× 0.683013	= 342
PV of cash inflows			\$ 6,754
PV of cash outflows			(6,000)
NPV of Project 1			\$ 754
Project 2			
PV of cash inflows			\$ 2,000 × 3.169865 = \$ 6,340
PV of cash outflows			(6,000)
			\$ 340

$$PV_{idx1} = \frac{\$6,754}{\$6,000} = 1.125$$

$$PV_{idx2} = \frac{\$6,754}{\$6,000} = 1.056$$

**Project 1 is clearly preferable to Project 2.**

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## Tax Considerations



Taxes affect the amount of cash flows generated by investments. In the following example, Wu Company purchases an asset for \$240,000. The asset has a four-year useful life, no salvage value, and straight-line depreciation is used. The asset is expected to generate incremental revenues of \$90,000 per year. Wu's income tax rate is 40%, and the company has a desired *after tax return* of 10%.



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## Tax Considerations



	Period 1	Period 2	Period 3	Period 4
Cash revenue	\$ 90,000	\$ 90,000	\$ 90,000	\$ 90,000
Depreciation expense (noncash)	(60,000)	(60,000)	(60,000)	(60,000)
Income before taxes	30,000	30,000	30,000	30,000
Income tax at 40%	(12,000)	(12,000)	(12,000)	(12,000)
Income after tax	18,000	18,000	18,000	18,000
Depreciation add back	60,000	60,000	60,000	60,000
Annual cash inflows	\$ 78,000	\$ 78,000	\$ 78,000	\$ 78,000

	Net PV
Annual cash annuity	\$ 78,000
PV of annuity of \$1, 4 periods, 10%	3.169865
PV of annual cash annuity	247,249
PV of cash outflow	(240,000)
Net present value	\$ 7,249

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**Exercise D.P. 5-1:****Net Present Value/Present Value Index**

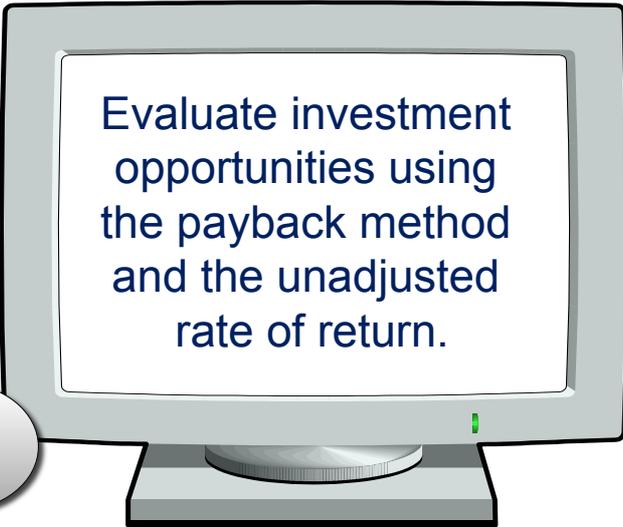
The management team at Savage Corporation is evaluating two alternative capital investment opportunities. The first alternative, modernizing the company's current machinery, costs \$45,000. Management estimates the modernization project will reduce annual net cash outflows by \$12,500 per year for the next five years. The second alternative, purchasing a new machine, costs \$56,500. The new machine is expected to have a five-year useful life and a \$4,000 salvage value. Management estimates the new machine will generate cash inflows of \$15,000 per year. Savage's cost of capital is 10%.

**Required**

- Determine the present value of the cash flow savings expected from the modernization program.
- Determine the net present value of the modernization project.
- Determine the net present value of investing in the new machine.
- Use a present value index to determine which investment alternative will yield the higher rate of return.

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**Learning Objective**


Evaluate investment opportunities using the payback method and the unadjusted rate of return.



LO4

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## Techniques That Ignore the Time Value of Money



### Payback Method

This is a simple and easy approach to looking at the recovery of an investment.

$$\text{Payback period} = \frac{\text{Net cost of investment}}{\text{Annual net cash inflows}}$$



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## Payback Method



Winston Cleaners can purchase a piece of equipment for \$100,000 that will reduce labor costs by \$40,000 per year over a four-year useful life.  
Let's calculate the payback period.

$$\text{Payback period} = \frac{\text{Net cost of investment}}{\text{Annual net cash inflows}}$$

$$\text{Payback period} = \frac{\$100,000}{\$40,000} = \mathbf{2.5 \text{ years}}$$

Generally, the shorter the payback period, the better.

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## Unequal Cash Flows



The payback method requires adjustment when cash flows are unequal. Let's assume a company purchases a machine for \$6,000 with the cash inflows shown below:

<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
\$ 3,000	\$ 1,000	\$ 2,000	\$ 1,000	\$ 500

Year	Annual Amount	Cumulative Amount
2010	\$ 3,000	\$ 3,000
2011	\$ 1,000	\$ 4,000
2012	\$ 2,000	\$ 6,000

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## Unequal Cash Flows



Another approach is to calculate the **average** annual cash inflows to compute the payback period.

Year	Annual Amount
2010	\$ 3,000
2011	1,000
2012	2,000
2013	1,000
2014	500
<b>Total</b>	<b>7,500</b>
	÷ 5
<b>Average</b>	<b>\$ 1,500</b>

$$\text{Payback period} = \frac{\$6,000}{\$1,500} = 4 \text{ years}$$



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## Unadjusted Rate of Return

Investment cash flows are not adjusted to reflect the time value of money. The return is computed as follows:

$$\text{Unadjusted rate of return} = \frac{\text{Average incremental increase in annual net income}}{\text{Net cost of original investment}}$$



To avoid distortions caused by the failure to recognize the recovery of invested capital, the unadjusted rate of return should be based on the average investment when working with investments in depreciable assets.

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## Unadjusted Rate of Return

Dining Table, Inc. is considering opening a new restaurant that will require an investment of \$2,000,000. Over a 10-year period the restaurant is expected to provide average after-tax return of \$280,000 per year.

$$\text{Unadjusted rate of return} = \frac{\$280,000}{\$2,000,000} = 14\%$$



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## Unadjusted Rate of Return

The accuracy of this method suffers from the failure to recognize the recovery of invested capital. Let's look at an example.

A company can purchase a depreciable asset with a two-year life and no salvage value for \$1,000. The asset produces incremental revenue of \$600 per year. The income statement for the first year would look like this:

Income Statement	
Revenue	\$ 600
Depreciation Expense	(500)
Net Income	<u>\$ 100</u>

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## Unadjusted Rate of Return

Given the pattern of cash flows over the life of the investment, the amount of invested capital will range from a beginning balance of \$1,000 to an ending balance of zero. On average, the company will have \$500 invested in the asset. The unadjusted rate of return should be calculated as follows:



$$\text{Unadjusted rate of return} = \frac{\$100}{\$500} = 20\%$$

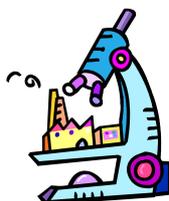
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## Postaudits



A postaudit is conducted at the completion of a capital investment project, using the same analytical technique that was used to justify the original investment. The focus should be on continuous improvement in the capital expenditure process.



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### Exercise D.P. 5-2: Payback/Unadjusted Rate of Return



EZ Rentals can purchase a van that costs \$24,000. The van has an expected useful life of 5 years and no salvage value. EZ expects cash revenue from leasing the van to be \$12,000 per year. Alternatively, EZ can purchase a car that costs \$16,000. EZ expects cash revenue from leasing the car to be \$10,000 per year over a 3-year useful life. Ignore income taxes.

#### Required

- Determine the payback period for the van.
- Determine the payback period for the car.
- Indicate which vehicle is the better alternative if payback is used as the sole investment criteria.
- Describe the possible shortcomings of using payback as the investment criteria.
- Determine the unadjusted rate of return for both alternatives.

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