Financial Accounting: Tools for Business Decision Making

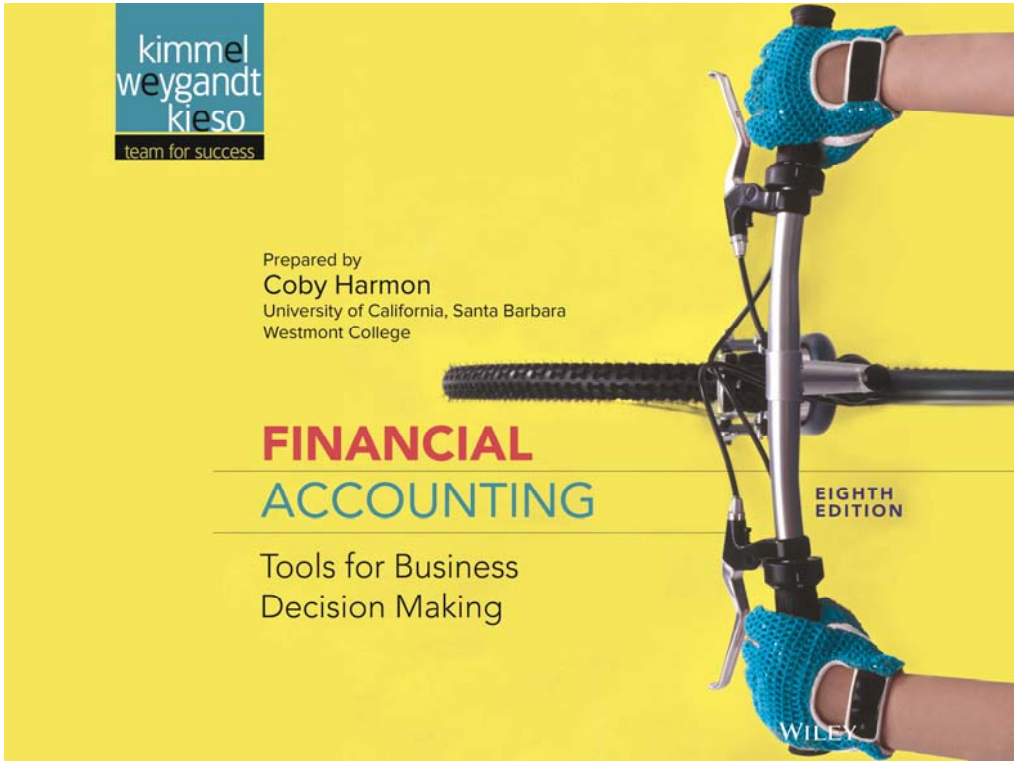
Eighth Edition

Kimmel ● Weygandt ● Kieso

Chapter G

Time Value of Money

Financial Accounting: Tools for Business Decision Making



Chapter Outline:

Learning Objectives

1. Compute interest and future values.
2. Compute present values.
3. Use a financial calculator to solve time value of money problems.

LO 1: Compute Interest and Future Values

Nature of Interest

- Payment for the use of money.
- Difference between amount borrowed or invested (**principal**) and amount repaid or collected.

Elements involved in financing transaction:

1. **Principal (*p*):** Amount borrowed or invested.
2. **Interest Rate (*i*):** An annual percentage.
3. **Time (*n*):** Number of years or portion of a year that the principal is borrowed or invested.

Nature of Interest (1 of 2)

Simple Interest

- Interest computed on the principal only.

Illustration: Assume you borrow $5,000 for 2 years at a simple interest rate of 12% annually. Calculate the annual interest cost.

2 Full Years

$$\begin{aligned} \text{Interset} &= p \times i \times n \\ &= \$5{,}000 \times .12 \times 2 \\ &= \$1{,}200 \end{aligned}$$

Nature of Interest (2 of 2)

Compound Interest

- Computes interest on
  - the **principal** and
  - any **interest earned** that has not been paid or withdrawn.
- Most business situations use compound interest.

Nature of Interest - Compound Interest

Illustration: Assume that you deposit $1,000 in Bank Two, where it will earn simple interest of 9% per year, and you deposit another $1,000 in Citizens Bank, where it will earn compound interest of 9% per year compounded annually. Also assume that in both cases you will not withdraw any interest until three years from the date of deposit.

Bank Two

Simple Interest Calculation	Simple Interest	Accumulated Year-end Balance
Year 1 $1,000.00 × 9%	$ 90.00	$1,090.00
Year 2 $1,000.00 × 9%	90.00	$1,180.00
Year 3 $1,000.00 × 9%	90.00	$1,270.00
	$ 270.00	

$25.03 Difference

Citizens Bank

Compound Interest Calculation	Compound Interest	Accumulated Year-end Balance
Year 1 $1,000.00 × 9%	$ 90.00	$1,090.00
Year 2 $1,090.00 × 9%	98.10	$1,188.10
Year 3 $1,188.10 × 9%	106.93	$1,295.03
	$ 295.03	

Future Value of a Single Amount (1 of 6)

Future value of a single amount is the value at a future date of a given amount invested, assuming compound interest.

$$FV = p \times (1 + i)^n$$

FV = future value of a single amount

p = principal (or present value; the value today)

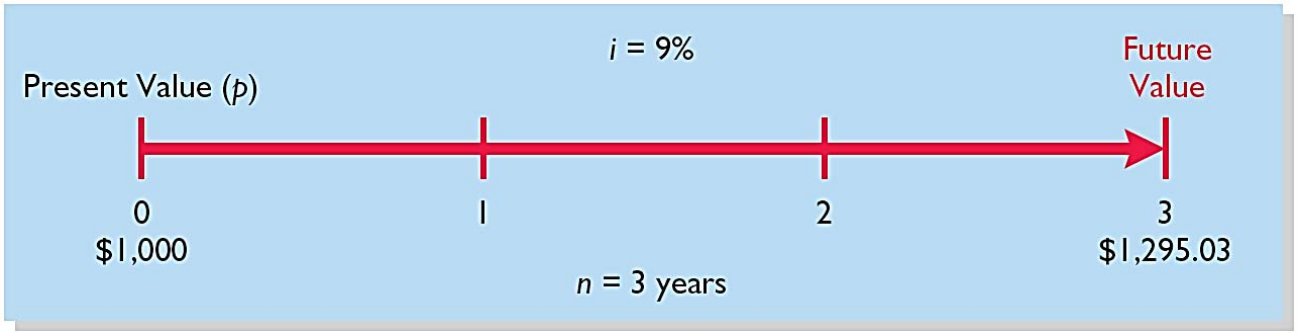
i = interest rate for one period

n = number of periods

Future Value of a Single Amount (2 of 6)

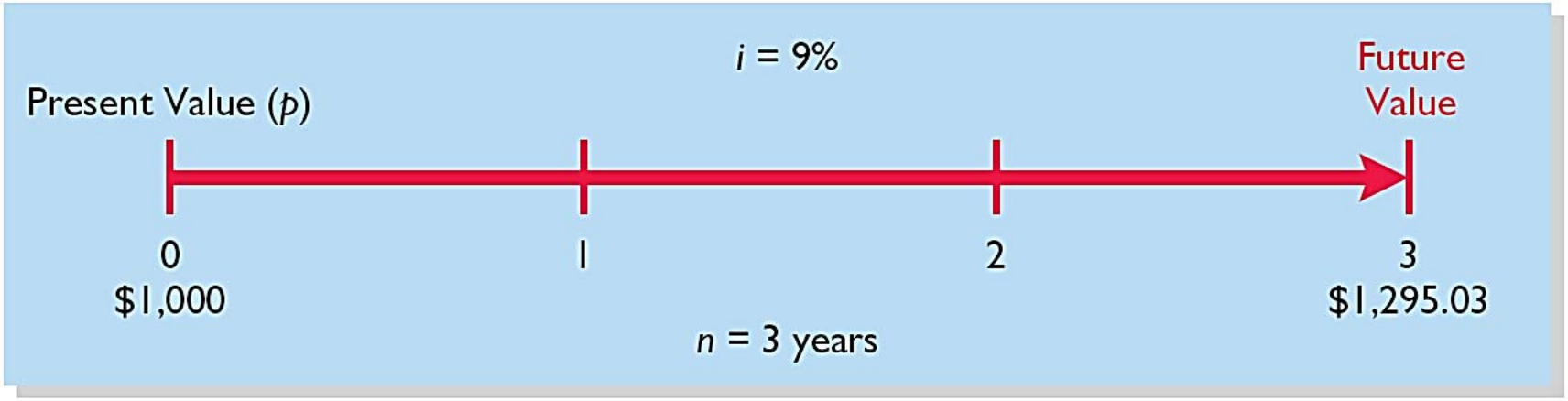
Illustration: If you want a 9% rate of return, you would compute the future value of a $1,000 investment for three years as follows:

$$FV = p \times (1+i)^n$$
$$= \$1,000 \times (1+.09)^3$$
$$= \$1,000 \times 1.29503$$
$$= \$1,295.03$$



Future Value of a Single Amount (3 of 6)

Illustration: If you want a 9% rate of return, you would compute the future value of a $1,000 investment for three years as follows:



What table do we use?

Future Value of a Single Amount (4 of 6)

Table 1 Future Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1	1.04000	1.05000	1.06000	1.08000	1.09000	1.10000	1.11000
2	1.08160	1.10250	1.12360	1.16640	1.18810	1.21000	1.23210
3	1.12486	1.15763	1.19102	1.25971	1.29503	1.33100	1.36763
4	1.16986	1.21551	1.26248	1.36049	1.41158	1.46410	1.51807
5	1.21665	1.27628	1.33823	1.46933	1.53862	1.61051	1.68506

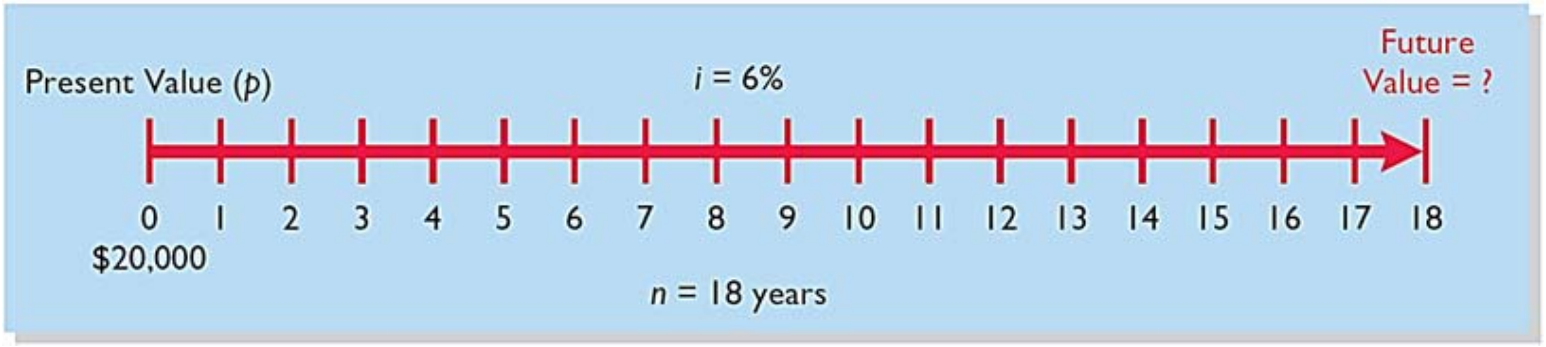
What factor do we use?

$1,000 Present Value × **1.2950 Factor** = **$1,295.03 Future Value**

Future Value of a Single Amount (5 of 6)

Illustration:

John and Mary Rich invested $20,000 in a savings account paying 6% interest at the time their son, Mike, was born. The money is to be used by Mike for his college education. On his 18th birthday, Mike withdraws the money from his savings account. How much did Mike withdraw from his account?



What table do we use?

Future Value of a Single Amount (6 of 6)

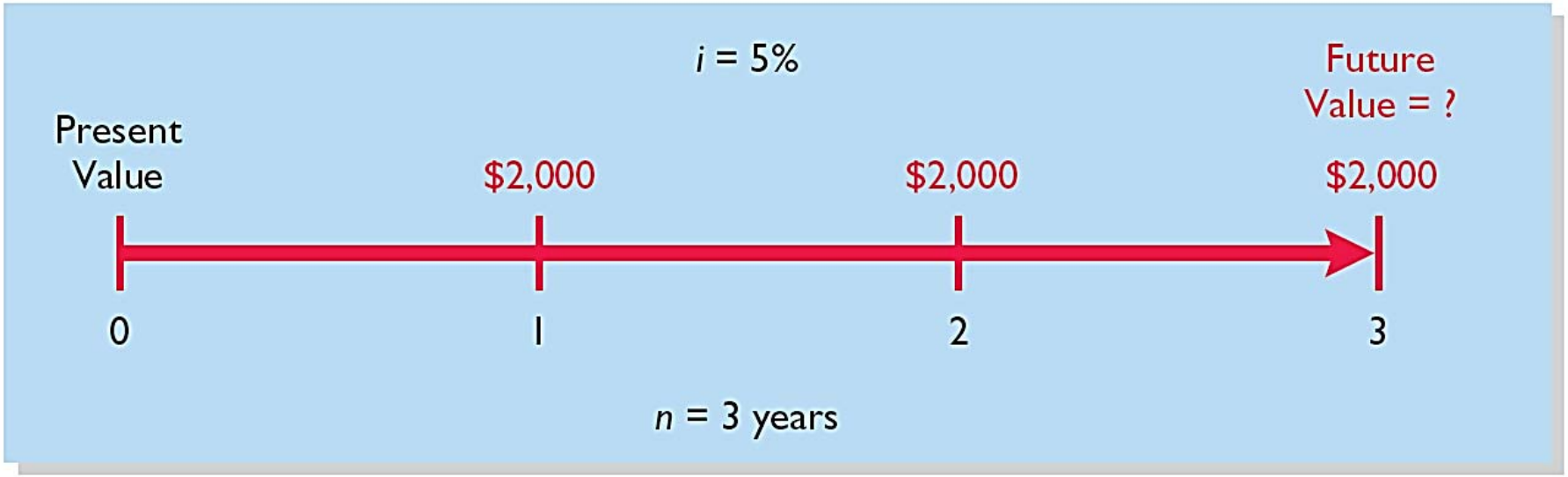
Table 1 Future Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1	1.04000	1.05000	1.06000	1.08000	1.09000	1.10000	1.11000
2	1.08160	1.10250	1.12360	1.16640	1.18810	1.21000	1.23210
3	1.12486	1.15763	1.19102	1.25971	1.29503	1.33100	1.36763
4	1.16986	1.21551	1.26248	1.36049	1.41158	1.46410	1.51807
5	1.21665	1.27628	1.33823	1.46933	1.53862	1.61051	1.68506
16	1.87298	2.18287	2.54035	3.42594	3.97031	4.59497	5.31089
17	1.94790	2.29202	2.69277	3.70002	4.32763	5.05447	5.89509
18	2.02582	2.40662	2.85434	3.99602	4.71712	5.55992	6.54355
19	2.10685	2.52695	3.02560	4.31570	5.14166	6.11591	7.26334
20	2.19112	2.65330	3.20714	4.66096	5.60441	6.72750	8.06231

$20,000 Present Value × **2.8543** Factor = **$57,086.80** Future Value

Future Value of an Annuity (1 of 5)

Illustration: Assume that you invest $2,000 at the end of each year for three years at 5% interest compounded annually.



Future Value of an Annuity (2 of 5)

Illustration:

Invest = $2,000

i **= 5%**

n **= 3 years**

Table 1 Future Value of 1

(*n*) Periods	4%	5%	6%	8%
0	1.00000	1.00000	1.00000	1.00000
1	1.04000	1.05000	1.06000	1.08000
2	1.08160	1.10250	1.12360	1.16640
3	1.12486	1.15763	1.19102	1.25971

Future Value of an Annuity (3 of 5)

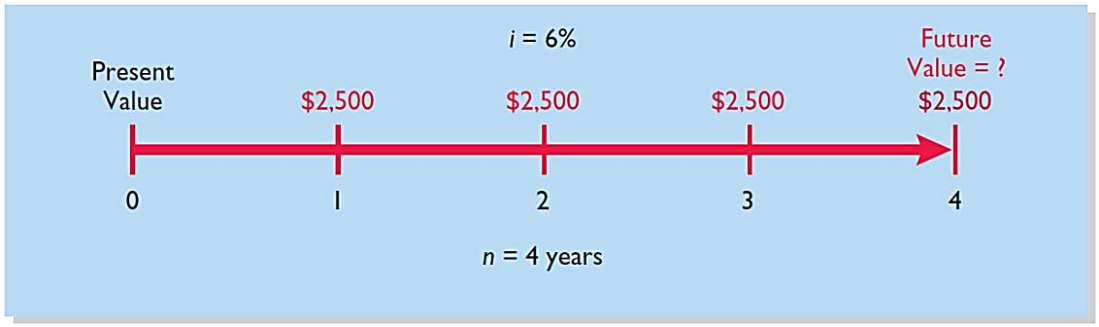
Invested at End of Year	Number of Compounding Periods	Amount Invested	×	Future Value of 1 Factor at 5%	=	Future Value
1	2	$2,000	×	1.10250		$2,205
2	1	$2,000	×	1.05000		2,100
3	0	$2,000	×	1.00000		2,000
				3.15250		$6,305

Future Value of an Annuity (4 of 5)

When the periodic payments (receipts) are the same in each period, the future value can be computed by using a future value of an annuity of 1 table.

Illustration:

John and Char Lewis' daughter, Debra, has just started high school. They decide to start a college fund for her and will invest $2,500 in a savings account at the end of each year she is in high school (4 payments total). The account will earn 6% interest compounded annually. How much will be in the college fund at the time Debra graduates from high school?



Future Value of an Annuity (5 of 5)

Table 2 Future Value of an Annuity of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2	2.04000	2.05000	2.06000	2.08000	2.09000	2.10000	2.11000
3	3.12160	3.15250	3.18360	3.24640	3.27810	3.31000	3.34210
4	4.24646	4.31013	4.37462	4.50611	4.57313	4.64100	4.70973
5	5.41632	5.52563	5.63709	5.86660	5.98471	6.10510	6.22780

What factor do we use?

$2,500 Payment × **4.3746 Factor** = **$10,936.55 Future Value**

LO 2: Compute Present Values

Present Value Variables

The **present value** is the value now of a given amount to be paid or received in the future, assuming compound interest.

Present value variables:

1. Dollar amount to be received (future amount).
2. Length of time until amount is received (number of periods).
3. Interest rate (the discount rate).

Present Value of a Single Amount (1 of 8)

$$\text{Present Value (PV)} = \frac{\text{Future Value}}{(1+i)^n}$$

p = principal (or present value)

i = interest rate for one period

n = number of periods

Present Value of a Single Amount (2 of 8)

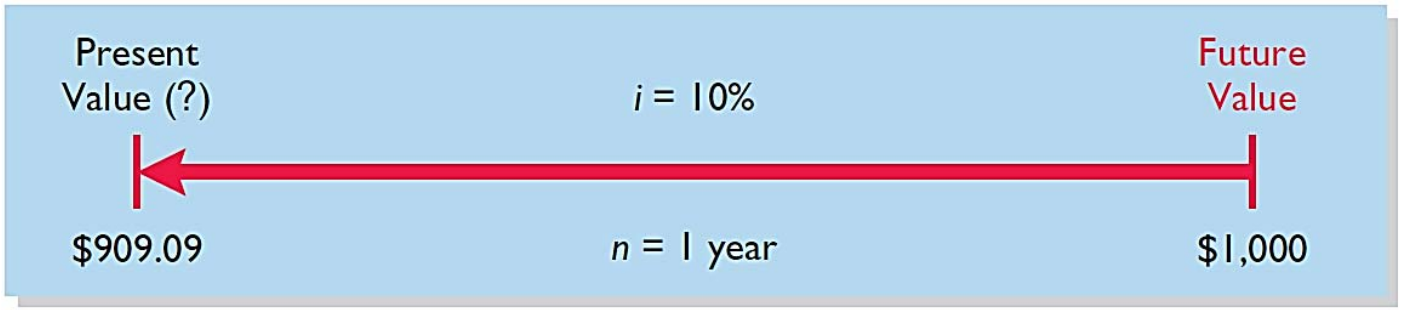
Illustration: If you want a 10% rate of return, you would compute the present value of $1,000 for one year as follows:

$$PV = FV \div (1+i)^n$$

$$= \$1,000 \div (1+.10)^1$$

$$= \$1,000 \div 1.10$$

$$= \$909.09$$



Present Value of a Single Amount (3 of 8)

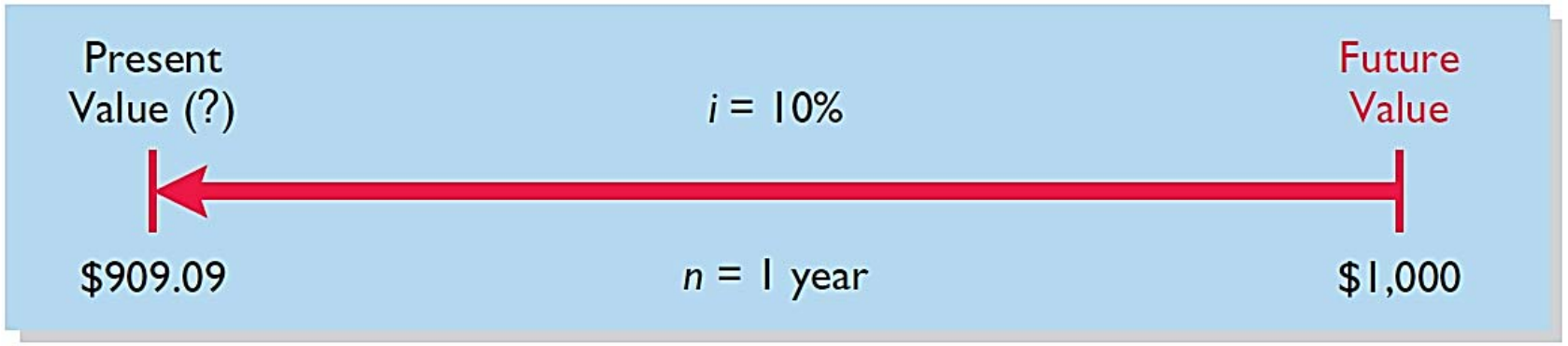


Illustration: If you want a 10% rate of return, you can also compute the present value of $1,000 for one year by using a present value table.

What table do we use?

Present Value of a Single Amount (4 of 8)

Table 3 Present Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	.92456	.90703	.89000	.85734	.84168	.82645	.81162
3	.88900	.86384	.83962	.79383	.77218	.75132	.73119
4	.85480	.82270	.79209	.73503	.70843	.68301	.65873
5	.82193	.78353	.74726	.68058	.64993	.62092	.59345

What factor do we use?

$1,000 Future Value × **.90909 Factor** = **$909.09 Present Value**

Present Value of a Single Amount (5 of 8)

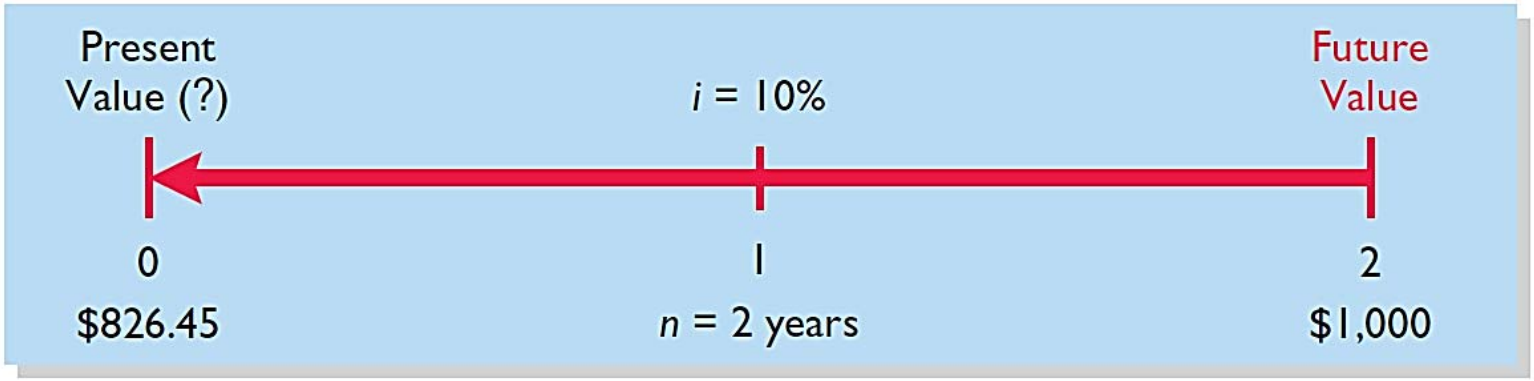


Illustration: If the single amount of $1,000 is to be received in two years and discounted at 10%

$\left[PV = \$1{,}000 \div \left(1+.10^{2}\right)\right]$, its present value is $826.45

$\left[\left(\$1{,}000 \div 1.21\right).\right]$

What table do we use?

Present Value of a Single Amount (6 of 8)

Table 3 Present Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	.92456	.90703	.89000	.85734	.84168	.82645	.81162
3	.88900	.86384	.83962	.79383	.77218	.75132	.73119
4	.85480	.82270	.79209	.73503	.70843	.68301	.65873
5	.82193	.78353	.74726	.68058	.64993	.62092	.59345

What factor do we use?

$1,000 Future Value × .82645 Factor = $826.45 Present Value

Present Value of a Single Amount (7 of 8)

Table 3 Present Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	.92456	.90703	.89000	.85734	.84168	.82645	.81162
3	.88900	.86384	.83962	.79383	.77218	.75132	.73119
4	.85480	.82270	.79209	.73503	.70843	.68301	.65873
5	.82193	.78353	.74726	.68058	.64993	.62092	.59345

Illustration: Suppose you have a winning lottery ticket and the state gives you the option of taking $10,000 three years from now or taking the present value of $10,000 now. The state uses an 8% rate in discounting. How much will you receive if you accept your winnings now?

$10,000		**.7938**		**$7,938.30**
Future Value	×	**Factor**	=	**Present Value**

Present Value of a Single Amount (8 of 8)

Table 3 Present Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	.92456	.90703	.89000	.85734	.84168	.82645	.81162
3	.88900	.86384	.83962	.79383	.77218	.75132	.73119
4	.85480	.82270	.79209	.73503	.70843	.68301	.65873
5	.82193	.78353	.74726	.68058	.64993	.62092	.59345

Illustration: Determine the amount you must deposit today in your SUPER savings account, paying 9% interest, in order to accumulate $5,000 for a down payment 4 years from now on a new car.

$5,000		**.70843**		**$3,542.15**
Future Value	×	**Factor**	=	**Present Value**

Present Value of an Annuity (1 of 5)

The value now of a series of future receipts or payments, discounted assuming compound interest.

Necessary to know the:

1. Discount rate,
2. Number of payments (receipts).
3. Amount of the periodic payments or receipts.

Present Value of an Annuity (2 of 5)

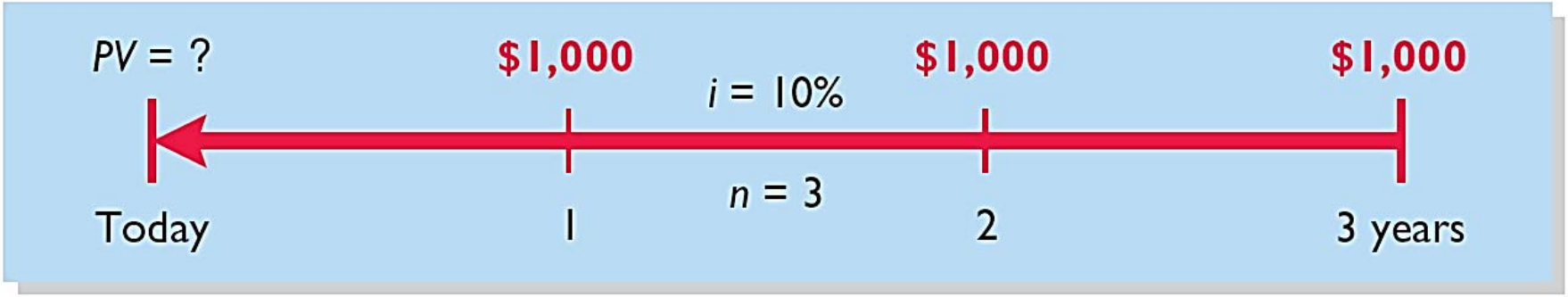


Illustration: Assume that you will receive $1,000 cash annually for three years at a time when the discount rate is 10%. Calculate the present value in this situation.

What table do we use?

Present Value of an Annuity (3 of 5)

Table 4 Present Value of an Annuity of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%	12%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090	.89286
2	1.88609	1.85941	1.83339	1.78326	1.75911	1.73554	1.71252	1.69005
3	2.77509	2.72325	2.67301	2.57710	2.53130	2.48685	2.44371	2.40183
4	3.62990	3.54595	3.46511	3.31213	3.23972	3.16986	3.10245	3.03735
5	4.45182	4.32948	4.21236	3.99271	3.88965	3.79079	3.69590	3.60478

What factor do we use?

$1,000 Annual Receipts × **2.48685 Factor** = **$2,486.85 Present Value**

Present Value of an Annuity (4 of 5)

Table 4 Present Value of an Annuity of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%	12%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090	.89286
2	1.88609	1.85941	1.83339	1.78326	1.75911	1.73554	1.71252	1.69005
3	2.77509	2.72325	2.67301	2.57710	2.53130	2.48685	2.44371	2.40183
4	3.62990	3.54595	3.46511	3.31213	3.23972	3.16986	3.10245	3.03735
5	4.45182	4.32948	4.21236	3.99271	3.88965	3.79079	3.69590	3.60478

Illustration: Kildare Company has just signed a capitalizable lease contract for equipment that requires rental payments of $6,000 each, to be paid at the end of each of the next 5 years. The appropriate discount rate is 12%. What is the amount used to capitalize the leased equipment?

$6,000 × 3.60478 = $21,628.68

Present Value of an Annuity (5 of 5)

Illustration: Assume that the investor received $500 semiannually for three years instead of $1,000 annually when the discount rate was 10%. Calculate the present value of this annuity.

Table 4 Present Value of an Annuity of 1

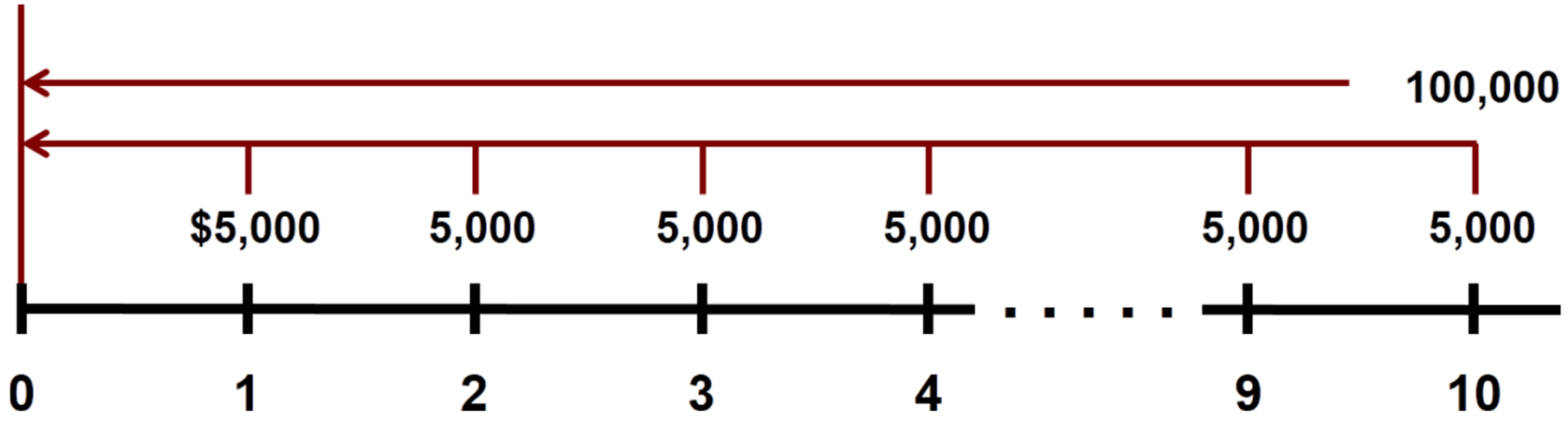
(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	1.88609	1.85941	1.83339	1.78326	1.75911	1.73554	1.71252
3	2.77509	2.72325	2.67301	2.57710	2.53130	2.48685	2.44371
4	3.62990	3.54595	3.46511	3.31213	3.23972	3.16986	3.10245
5	4.45182	4.32948	4.21236	3.99271	3.88965	3.79079	3.69590
6	5.24214	5.07569	4.91732	4.62288	4.48592	4.35526	4.23054
7	6.00205	5.78637	5.58238	5.20637	5.03295	4.86842	4.71220
8	6.73274	6.46321	6.20979	5.74664	5.53482	5.33493	5.14612

$500 × 5.07569 = $2,537.85

PV of a Long-Term Note or Bond (1 of 7)

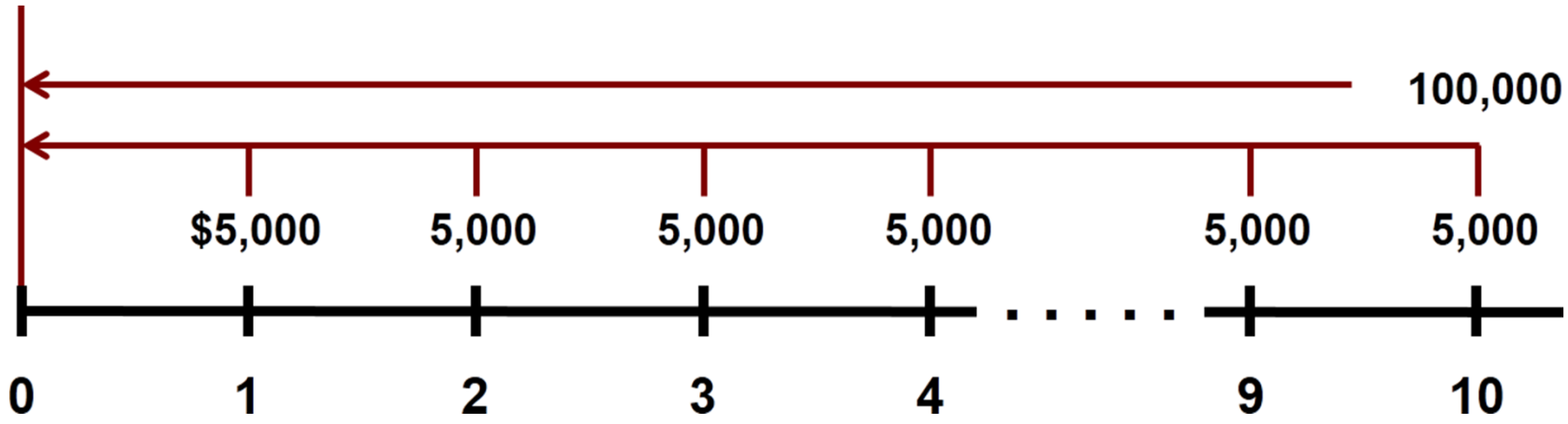
Two Cash Flows:

- Periodic interest payments (annuity).
- Principal paid at maturity (single sum).



PV of a Long-Term Note or Bond (2 of 7)

Illustration: Assume a bond issue of 10%, five-year bonds with a face value of $100,000 with interest payable semiannually on January 1 and July 1. Calculate the present value of the **principal** and **interest payments**.



PV of a Long-Term Note or Bond (3 of 7)

PV of Principal

Table 3 Present Value of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	.92456	.90703	.89000	.85734	.84168	.82645	.81162
3	.88900	.86384	.83962	.79383	.77218	.75132	.73119
4	.85480	.82270	.79209	.73503	.70843	.68301	.65873
5	.82193	.78353	.74726	.68058	.64993	.62092	.59345
6	.79031	.74622	.70496	.63017	.59627	.56447	.53464
7	.75992	.71068	.66506	.58349	.54703	.51316	.48166
8	.73069	.67684	.62741	.54027	.50187	.46651	.43393
9	.70259	.64461	.59190	.50025	.46043	.42410	.39092
10	.67556	.61391	.55839	.46319	.42241	.38554	.35218

$100,00 Principal × .6139 Factor = $61,391 Present Value

PV of a Long-Term Note or Bond (4 of 7)

PV of Interest

Table 4 Present Value of an Annuity of 1

(*n*) Periods	4%	5%	6%	8%	9%	10%	11%
1	.96154	.95238	.94340	.92593	.91743	.90909	.90090
2	1.88609	1.85941	1.83339	1.78326	1.75911	1.73554	1.71252
3	2.77509	2.72325	2.67301	2.57710	2.53130	2.48685	2.44371
4	3.62990	3.54595	3.46511	3.31213	3.23972	3.16986	3.10245
5	4.45182	4.32948	4.21236	3.99271	3.88965	3.79079	3.69590
6	5.24214	5.07569	4.91732	4.62288	4.48592	4.35526	4.23054
7	6.00205	5.78637	5.58238	5.20637	5.03295	4.86842	4.71220
8	6.73274	6.46321	6.20979	5.74664	5.53482	5.33493	5.14612
9	7.43533	7.10782	6.80169	6.24689	5.99525	5.75902	5.53705
10	8.11090	7.72173	7.36009	6.71008	6.41766	6.14457	5.88923

$5,000 Payment × 7.7217 Factor = $38,609 Present Value

PV of a Long-Term Note or Bond (5 of 7)

Illustration: Assume a bond issue of 10%, five-year bonds with a face value of $100,000 with interest payable semiannually on January 1 and July 1.

Present value of Principal	$61,391
Present value of Interest	38,609
Bond current market value	**$100,000**

Date	Account Title	Debit	Credit
	Cash	100,000	
	Bonds Payable		100,000

PV of a Long-Term Note or Bond (6 of 7)

Illustration: Now assume that the investor's required rate of return is 12%, not 10%. The future amounts are again $100,000 and $5,000, respectively, but now a discount rate of 6% (12% ÷ 2) must be used. Calculate the present value of the **principal** and **interest payments**.

10% Contractual Rate—12% Discount Rate

Present value of principal to be received at maturity	
$100,000 × .55839 (Table 3)	$55,839
Present value of interest to be received periodically over the term of the bonds	
$5,000 × 7.36009 (Table 4)	36,800
Present value of bonds	**$92,639**

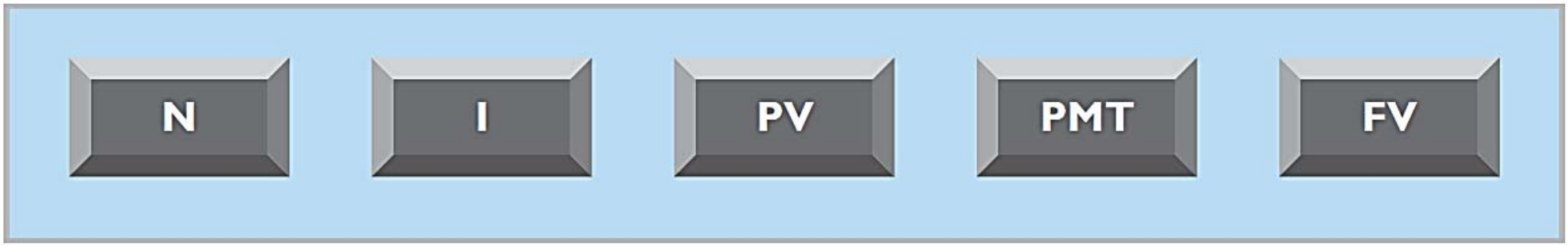
PV of a Long-Term Note or Bond (7 of 7)

Illustration: Now assume that the investor's required rate of return is 8%. The future amounts are again $100,000 and $5,000, respectively, but now a discount rate of 4% (8% ÷ 2) must be used. Calculate the present value of the **principal** and **interest payments.**

10% Contractual Rate—8% Discount Rate

Present value of principal to be received at maturity	
$100,000 × .67556 (Table 3)	$ 67,556
Present value of interest to be received periodically over the term of the bonds	
$5,000 × 8.11090 (Table 4)	40,555
Present value of bonds	**$108,111**

LO 3: Use a Financial Calculator to Solve Time Value of Money Problems



N = number of periods

I = interest rate per period

PV = present value

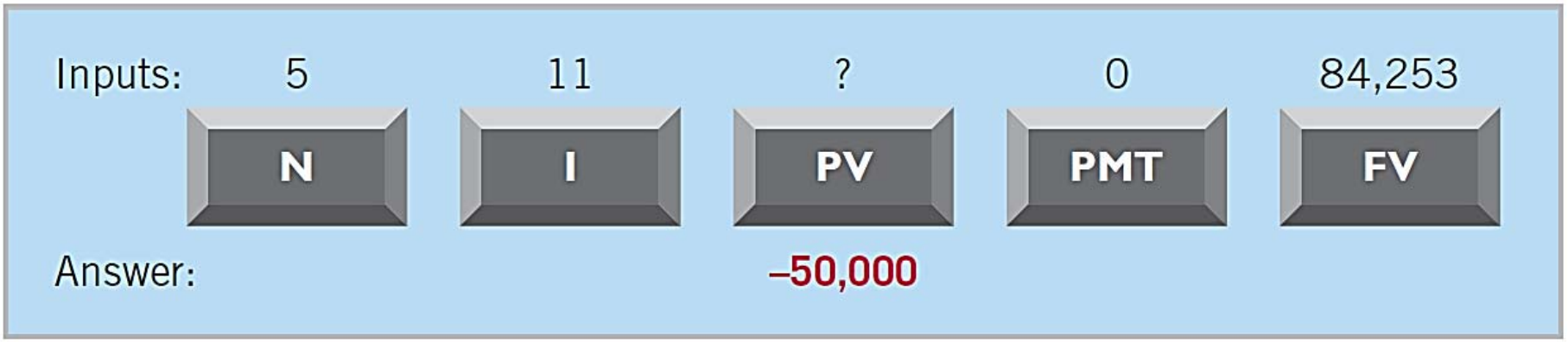
PMT = payment

FV = future value

Using Financial Calculators (1 of 4)

Present Value of a Single Sum

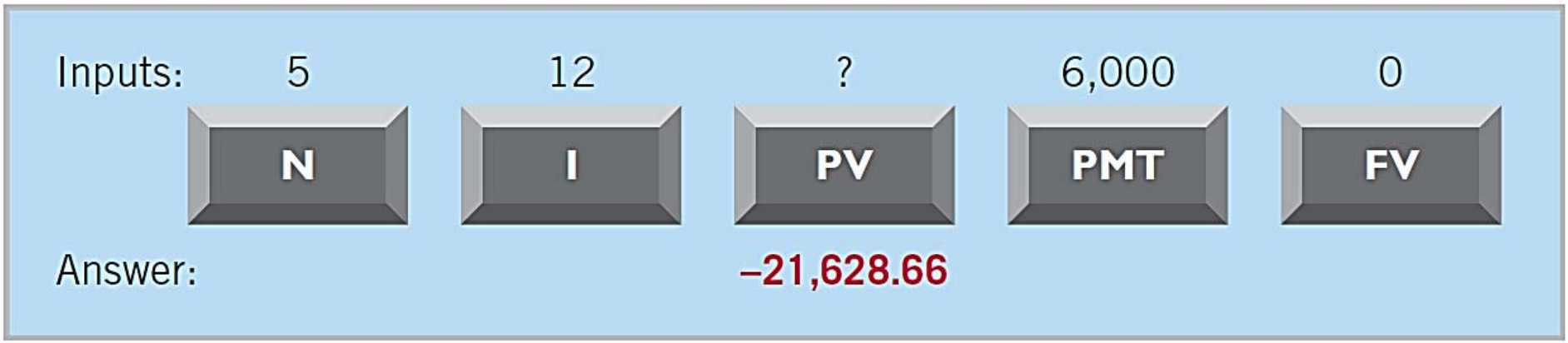
Assume that you want to know the present value of $84,253 to be received in five years, discounted at 11% compounded annually.



Using Financial Calculators (2 of 4)

Present Value of an Annuity

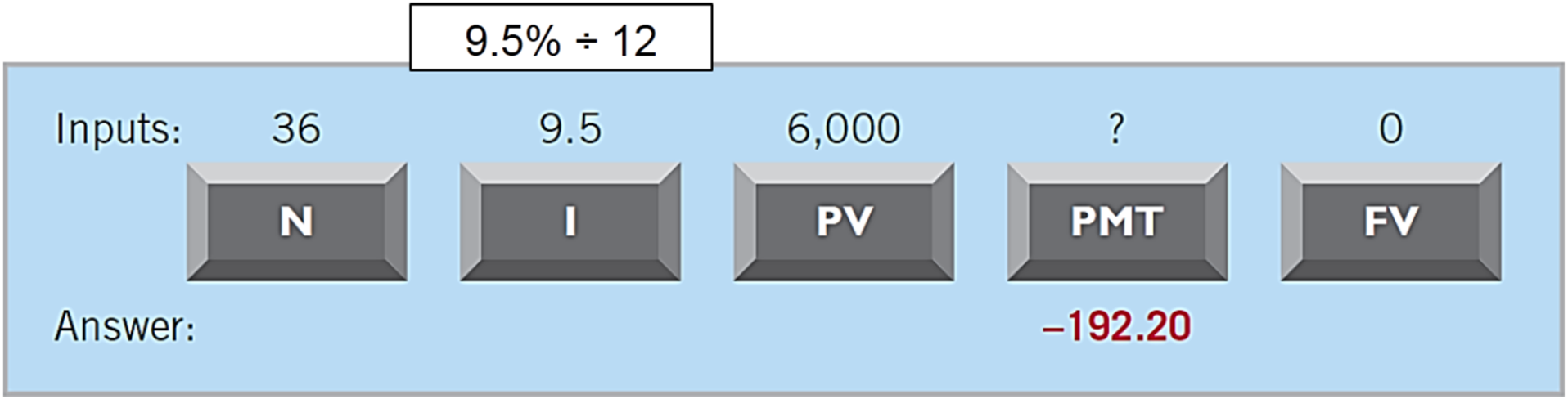
Assume that you are asked to determine the present value of rental receipts of $6,000 each to be received at the end of each of the next five years, when discounted at 12%.



Using Financial Calculators (3 of 4)

Useful Applications – Auto Loan

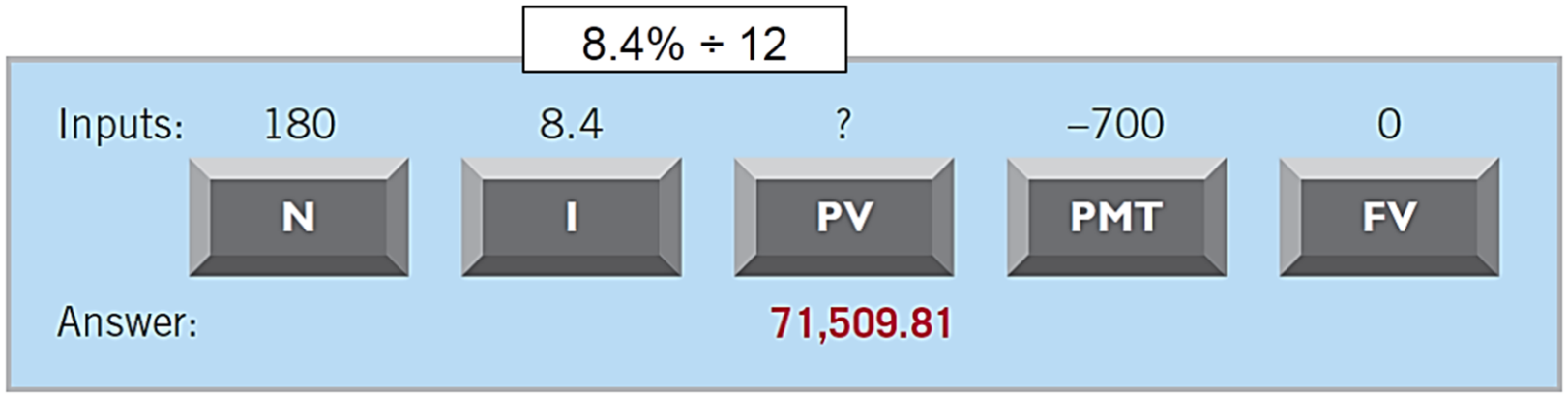
The loan has a 9.5% nominal annual interest rate, compounded monthly. The price of the car is $6,000, and you want to determine the monthly payments, assuming that the payments start one month after the purchase.



Using Financial Calculators (4 of 4)

Useful Applications – Mortgage Loan

You decide that the maximum mortgage payment you can afford is $700 per month. The annual interest rate is 8.4%. If you get a mortgage that requires you to make monthly payments over a 15-year period, what is the maximum purchase price you can afford?



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