

# The time value of money: Part I

A reading prepared by Pamela Peterson Drake

We begin with compounding because this is the most straightforward way of demonstrating the effects of interest. Consider the following example: Suppose you invest \$1,000 in an account that pays 6 percent interest, compounded annually. How much will you have in the account at the end of 1 year if you make no withdrawals? After 2 years? After 5 years? After 10 years? Using the subscript to indicate the year,

$$FV_1 = \$1,000 (1 + 0.06) = \$1,060$$

$$FV_2 = \$1,000 (1 + 0.06) (1 + 0.06) = \$1,000 (1 + 0.06)^2 = \$1,000 (1.1236) = \$1,123.60$$

$$FV_5 = \$1,000 (1 + 0.06)^5 = \$1,000 (1.3382) = \$1,338.23$$

$$FV_{10} = \$1,000 (1 + 0.06)^{10} = \$1,000 (1.7908) = \$1,790.85$$

What if interest was not compounded interest (that is, if interest is *simple* interest)? Then we would have a lower balance in the account:

$$FV_1 = \$1,000 + [\$1,000 (0.06)] = \$1,060$$

$$FV_2 = \$1,000 + [\$1,000 (0.06)] + [\$1,000 (0.06)] = \$1,000 + [\$1,000 (0.06)(2)] = \$1,120$$

$$FV_5 = \$1,000 + [\$1,000 (0.06) (5)] = \$1,300$$

$$FV_{10} = \$1,000 + [\$1,000 (0.06) (10)] = \$1,600$$

\$1000

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Column

interest 6%

174

Simple interest

Period	Time	balance	
start	0	1000	Dollars
After -one year	1	1060	Dollars
After -two years	2	1120	Dollars
After -three years	3	1180	Dollars
After -four years	4	1240	Dollars
After -five years	5	1300	Dollars
After -six years	6	1360	Dollars
After -7 years	7	1420	Dollars
After -8 years	8	1480	Dollars
After -9 years	9	1540	Dollars
After -10 years	10	1600	Dollars

Interest rate/ year	0.06
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$D_{14} = \$D\$4 * (1 + \$H\$4 * C14)$

Simple interest

# Compounded interest

From Prof Pamela refernce				Compound interest yearly			
Case of compound interest				Period	time	balance	
Present value	1000	Dollars	6%	start	0	1000	Dollars
Interest rate	6	%percent		After -one year	1	1060	Dollars
Terms(years)	2	years		After -two years	2	1123.6	Dollars
Terms(years)	5	years		After -three years	3	1191.02	Dollars
Terms(years)	10	years		After -four years	4	1262.48	Dollars
				After -five years	5	1338.23	Dollars
Future value fv2	\$ 1,123.60	=FV(\$D\$6%,D7,,-D5)		After -six years	6	1418.52	Dollars
Future value fv5	\$ 1,338.23			After -7 years	7	1503.63	Dollars
Future value fv10	\$ 1,790.85	=FV(\$D\$6%,D9,,-D5)		After -8 years	8	1593.85	Dollars
				After -9 years	9	1689.48	Dollars
				After -10 years	10	1790.85	Dollars

amount is in negative so as to get the future value amount in positive.

**Syntax** FV(rate, nper, , pv, [type])

Calculates the future value for a lump sum investment, assuming a constant interest rate.

For example, you've invested \$10,000 in a money market fund. You expect an average return of 2%, with interest paid monthly. The investment's future value after 5 years will be \$11,050.79.

**Syntax** `FV(rate, nper, , pv, [type])`

**Tip** Wondering why there's no **pmt** argument in the example above? That's because this is a lump sum, and you won't be making payments. This means you skip adding a value for **pmt**. But you do need to include a comma in its place so Excel knows you've deliberately left **pmt** out.

Why is **[type]** in square brackets? The brackets mean it's optional. If you skip this argument, 0 is assumed, which means interest is paid at the end of each period.

**Example** `=FV(2%/12,5*12, , 10000)`

The **FV** function has the following arguments when you use **FV** for a lump sum: **Rate**, **Nper**, and **Pv** are required. Enter a comma in place of the **pmt** argument before **pv**.

**Rate** (Required) The interest rate for the investment. For monthly interest income, divide this by 12.

**Nper** (Required) The total number of interest earning periods. For monthly interest income, multiply this by 12.

**,** (Required) Enter a comma followed by nothing.

**Pv** (Required) The present value; in other words, the lump sum you initially invest and will earn interest on.

**Type** (Optional) The number 0 (zero) means the

## 1.5 Terminology and Symbols ●●●

The equations and procedures of engineering economy utilize the following terms and symbols. Sample units are indicated.

$P$  = value or amount of money at a time designated as the present or time 0. Also  $P$  is referred to as **present worth** (PW), present value (PV), net present value (NPV), discounted cash flow (DCF), and capitalized cost (CC); monetary units, such as dollars

$F$  = value or amount of money at some future time. Also  $F$  is called future worth (FW) and future value (FV); dollars

$A$  = series of consecutive, equal, end-of-period amounts of money. Also  $A$  is called the annual worth (AW) and equivalent uniform annual worth (EUAW); dollars per year, euros per month

$n$  = number of interest periods; years, months, days

$i$  = interest rate per time period; percent per year, percent per month

$t$  = time, stated in periods; years, months, days

