VISUAL 15.1 ▲ Warm-Up

Use your calculator to evaluate the following expressions.

1. (a) 35^2 (b) 56.2^2

   (c) $(-2.5)^4$ (d) $-(2.5)^4$

   (e) 3.2^{-2} (f) 2.3445^{12}

2. $(1.00256)^3$

3. $\dfrac{1}{(2.3154)^5}$

4. $(3.14159)^{-2}$

5. 1.25% of 786 =

6. 19.8% of 3200 =

VISUAL 15.2 ▲ The Time Value of Money—Computing Present Value

- A dollar received today is more valuable than a dollar received one year from today.
- How much would you be willing to pay today for $1 received one year from today?

$$\text{PV of future \$1} = \frac{\text{Future Value}}{(1 + \text{interest rate})^1}$$

$$\text{In symbols: PV} = \frac{\text{FV}}{(1 + \text{r})^1}$$

where FV is the future value of the payment and r is the interest rate expressed in decimal form.

A general present value calculation (for payment n years from today):

$$\text{PV} = \frac{FV}{(1 + r)^n}$$

Calculating the Fixed Payment on an Installment Loan

- Calculated by setting the current value of a loan equal to the present value of future installment payments.

Formula for calculating the *annual* Fixed Payment (FP) of an installment loan:

$$\text{Current Loan Value} = \frac{FP}{(1+r)^1} + \frac{FP}{(1+r)^2} + \frac{FP}{(1+r)^3} + \ldots + \frac{FP}{(1+r)^n}$$

Where r is the interest rate expressed in decimal form and n is the number of years over which annual payments are made. For example, if n = 20, r = 8%, and the current loan value is $1000, then 20 equal sized annual payments are made on the loan. The fixed payment on this loan is calculated as follows:

$$\$1000 = \frac{FP}{(1+.08)^1} + \frac{FP}{(1+.08)^2} + \frac{FP}{(1+.08)^3} + \ldots + \frac{FP}{(1+.08)^{20}}$$

$$= FP\left\{\frac{1}{(1+.08)^1} + \frac{1}{(1+.08)^2} + \frac{1}{(1+.08)^3} + \ldots + \frac{1}{(1+.08)^{20}}\right\}$$

$$= FP\left\{\sum_{t=1}^{20} \frac{1}{(1+.08)^t}\right.$$

The annual fixed payment is determined as the solution to this problem.

Using summation notation, the general formula for determining the fixed payment on an installment loan is:

$$\text{Current Loan Value} = \sum_{t=1}^{n} \frac{FP}{(1+r)^t}$$

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Visual 15.2 (continued)

Since this expression is calculated using an *annual* rate of interest and *annual* payment, it is necessary to modify the formula to make it useful for calculating the *monthly* fixed payment on an installment loan. This is how the payment on a car, student, and home mortgage loan is calculated.

Current Loan Value

$$= \frac{\text{MFP}}{(1 + r/12)^1} + \frac{\text{MFP}}{(1 + r/12)^2} + \frac{\text{MFP}}{(1 + r/12)^3} + \ldots + \frac{\text{MFP}}{(1 + r/12)^{12n}}$$

which in summation notation is expressed as:

$$\text{Current Loan Value} = \sum_{t=1}^{12n} \frac{\text{MFP}}{(1 + r/12)^t}$$

where MFP is the monthly fixed payment, r is expressed in decimal form, and payments are made each month for n years.

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