

Solving for the Interest Rate

Technology where it's needed

This actually happened to a student in College Mathematics: Sara was buying her first car. She had found a car she liked and could afford if she could finance \$14000. The dealer offered to finance it for "6% for three years". That sounded like a good deal to Sara since she knew the University Credit Union would finance it for around 7% APR. She agreed to the offer and signed a two-page agreement to pay \$458.89 per month for the next 36 months. The agreement was long and hard to read, and she had not yet studied the "present value of an annuity" concept on which you now know car loans are based. She was surprised and angry when she offered her loan information as an example for us to use in class.

1. Calculate the monthly payment on a 36 month loan of \$14000 at 6% APR.

2. Solving for the interest rate in the formula

$$P = R \left(\frac{1 - (1 + i)^{-n}}{i} \right)$$

is impossible with elementary algebra. Even approximate methods are difficult if carried out by hand on this nonlinear equation. But your calculator can come to the rescue quite handily. First put the expression you wish to solve in the form $f(x) = 0$ by subtracting one side from both sides. For example you might write

$$\underbrace{P - R \left(\frac{1 - (1 + x)^{-n}}{x} \right)}_{f(x)} = 0$$

Notice that i has been replaced with x , since that is the variable we wish to solve for. And since we know the values of P , R , and n , they are not variables. Now all we need to do is find the value(s) of x which make

$$Y = P - R \left(\frac{1 - (1 + x)^{-n}}{x} \right)$$

have Y - value equal to zero. In other words, we need to find where this function crosses the x -axis.

- 2a. Graph this function (after you have supplied values for P , R , and n) to find where it crosses the x -axis. Remember that x here (or i in the original form) is the **monthly** interest rate. Choose your graph window wisely. Then choose successively smaller graph

windows or use the zoom feature of your calculator until you are satisfied with your approximate solution. Write your results here. Make sure the monthly interest rate is reported to at least three correct decimal places:

monthly interest rate: _____ APR: _____

- 2b. Construct a table of this function to find what value(s) of x makes $Y = 0$. Choose successively smaller increments (ΔTbl values) and appropriate starting values until you have at least four place accuracy for the monthly interest rate. Write your results here:

monthly interest rate: _____ APR: _____

- 2c. Most graphing calculators have an equation solving feature. On the TI-82, it is a **solve**(command on the Math menu. On the TI-83, there is a **Solver** on the Math menu. Read your calculator manual to determine how to use its solving feature and use it to solve this problem. The value you get should be more accurate than those you have written above. Write the calculator's answers here. Make sure the monthly interest rate is reported to at least five decimal places:

monthly interest rate: _____ APR: _____

3. Sara got ripped off. The dealer quoted her the "simple interest" rate, not the APR for compound interest. (a) How much more did she have to pay during the life of the loan over what she would have paid if she had really borrowed at 6% APR?

(b) How much more did she have to pay during the life of the loan over what she would have paid if she had borrowed at 7% APR from the credit union?

(c) How many calculators do you estimate you can buy for the amount you calculated in part (b) of this question? _____

4. State three things you have learned from this activity.