MATH 1070Q

Section F.1: Simple Interest and Discount

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Objectives

1. Understand simple interest and how to compute it.
2. Understand discount loans and how to compute their effective yields.

Simple interest

Suppose we borrow money from a bank. We will have to pay back:
- the initial amount borrowed, or **principal**, denoted P.
- extra charges, or **interest**, denoted I.

Let $r =$ interest rate (expressed as a decimal),
and $t =$ time (in years).

If we borrowed \$10,000 at an annual simple interest rate of 5.3% for 3 years, we have $P = 10000$, $r = 0.053$ and $t = 3$. Then the interest is:

$$I = Prt = 10000(0.053)(3) = 1590.$$

The total amount we owe after 3 years, or **future value**, is

$$F = P + I = 10000 + 1590 = 11590.$$

Investing with simple interest

Since we have $F = P + I = P + Prt = P(1 + rt)$, the formula for future value with simple interest is usually written as

$$F = P(1 + rt)$$

Example: suppose we invest \$5,700 at an annual simple interest rate of 3.81%. Find total value of our investment after 18 months.

How long it takes for an investment to grow

We plan to invest in an account with an annual simple interest rate of 4.8%. How much should we invest initially if we want the total value to be \$8,100 after 5 years?

Discount loans

Sometimes, a bank will give what is called a discount loan: in this case, interest is deducted at the time the loan is obtained.

For example, if we agree to pay a bank \$9,000 in 2 years at 6% simple discount, the bank will compute the interest:

$I = Prt = 9000(0.06)(2) = 1080,$

then deduct this from the total. So we would receive $9000 - 1080 = 7920$, and we would owe the bank 9000 after 2 years.

Notice that we end up paying 1080 in interest, which is 6% of 9000, but more than 6% or 7920.

Effective yield of a discount loan

When we get a discount loan, we are actually paying a higher effective rate, or effective yield, than what's advertised. We can compute this rate by the following formula.

$$r_{\text{eff}} = \frac{r}{1 - rt}$$

For instance, in our last example where we had a 2 year discount loan at a rate of 6%, the effective rate or effective yield is

$$\begin{aligned} r_{\text{eff}} = \frac{r}{1 - rt} = \frac{0.06}{1 - 0.06(2)} &= 0.0682 \text{ (4 dec plc)} \\ &= 6.82\% \text{ (2 dec plc)} \end{aligned}$$

Recap

1. Loans or investments accumulate interest.
2. If we are using simple interest, we can compute the future value of an investment (or the total amount owed on a loan) by the formula

$$F = P(1 + rt)$$

3. We can compute the effective rate of a discount loan by the formula

$$r_{\text{eff}} = \frac{r}{1 - rt}$$