Risk Management and Insurance

Tutorial 2. Simple Interest

The simple interest rate formula includes four variables:

$$V_t = V_0(1 + Rt)$$

Accordingly, it is possible to ask four types of questions where three variables are given and the fourth has to be determined. Questions 1 to 4 provide examples for those four questions.

Question 1

A person borrows \$12,000 and pays back \$12,240 after 3 months. What is the simple interest rate for this loan?

Question 2

A corporation raises funds by issuing commercial bills with a face value of \$ 10,000 and a maturity of 3 months. At what price should the bills be issued so that investors earn 6% simple interest?

Question 3

You borrowed \$ 5000. How much do you owe after 4 months if the simple interest rate is 7%?

Question 4

How long will it take for \$ 5000 to accumulate to \$ 5080 at 6% simple interest?

Additional questions:

Question 5

An individual puts \$ 100 into a bank account every two weeks. The deposit is made at the end of each two week period. How much is in the bank account at the end of one year (52 weeks) if the simple interest rate is 3%?

Question 6. *Arithmetic and Geometric Depreciation*

Consider a machine that costs \$ 1 million.

a) How long will it take until the machine is fully written down if it is depreciated by \$ 150,000 each year (arithmetic depreciation).

b) What is the book value of the machine after 10 years if a depreciation rate of 20% is applied each year (geometric depreciation). Will the machine ever be fully depreciated?

Question 7

A retailer pays monthly for goods received from a wholesaler. Depending on the payment date, the wholesaler offers the following discounts:

Payment date (day of month)	Discount %
5	0.50
15	0.40
25	0.20

Which payment option should the retailer choose if simple interest is 6%?

Tutorial 2

Question 1

$$V_t = V_0 (1 + Rt)$$
$$R = \left(\frac{V_t}{V_0} - 1\right) \cdot \frac{1}{t}$$
$$= \left(\frac{12'240}{12'000} - 1\right) \frac{1}{0.25} = 0.08 \longrightarrow \underline{8\%}$$

You can answer this question in your hand. The person pays 2% per quarter. Using simple interest, this is 8% per year.

Question 2

This is a present value calculation (discounting).

$$V_t = V_0 (1 + Rt)$$
$$V_0 = \frac{V_t}{1 + Rt}$$
$$= \frac{10'000}{1 + 0.06 \times \frac{1}{4}} = \underline{\underline{\text{₪ } 9852.22}}$$

Question 3

$$V_t = V_0(1 + Rt)$$
$$= 5000\left(1 + 0.07\,\frac{1}{2}\right) = \underline{\underline{\$\ 5116.67}}$$

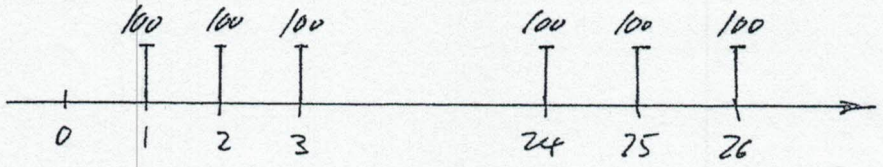
Question 4

$$V_t = V_0(1 + Rt)$$
$$t = \left(\frac{V_t}{V_0} - 1\right)\frac{1}{R}$$
$$= \left(\frac{5080}{5000} - 1\right)\frac{1}{0.06} = 0.26667 \text{ years}$$

It takes $365 \times 0.26667 = \underline{\underline{97.3 \text{ days}}}$

Question 5

There are 26 deposits.



Using simple interest (no compounding), the deposits form an arithmetic series.

Start with the last deposit.

$$100 + \left[100 + 100 \times 0.03 \times \frac{1}{26}\right] + \left[100 + 100 \times 0.03 \times \frac{2}{26}\right] + \cdots$$

$$\cdots + \left[100 + 100 \times 0.03 \times \frac{25}{26}\right]$$

The parameters of the arithmetic series are:

$a_1 = 100$, $d = 100 \times 0.03 \times \frac{1}{26} = 0.115385$

The 26th term of the series is:

$$100 + 100 \times 0.03 \times \frac{25}{26} = 102.8846$$

The sum of the series is:

$$S_n = (a_1 + a_n)\frac{n}{2}$$

$$= (100 + 102.8846)\frac{26}{2} = \underline{\underline{\$\ 2637.50}}$$

Question 6

a) $\frac{1'000'000}{150'000} = 6.67$

It takes 7 years until the machine is fully depreciated

b) note!

$a_{10} = a_0 q^{10} = 1'000'000 \times 0.8^{10} = \$\ 107'374.20$

Using geometric depreciation, the machine will never be fully written down. At some future date, the remainder must be written off.

Question 7

The intuition is that the retailer wants to pay the least amount possible on the 30th day of the month. To do that they have 4 options:

1. Borrow \$99.50 @ 6% and pay the supplier on the 5th day.
   On the 30th day they owe 99.50(1+0.06*25/365)=\$99.91 to the bank.
2. Borrow \$99.60 @ 6% and pay the supplier on the 15th day.
   On the 30th day they owe \$99.85 to the bank.
3. Borrow \$99.80 @ 6% and pay the supplier on the 25th day.
   On the 30th day they owe \$99.88 to the bank.
4. Pay the full \$100 on the 30th day.

Thus, option 2 (day 15) provides the best option to the retailer.

(These calculations use simple interest.)