INTEREST PERIODS AND EFFECTIVE RATES

Musayev Sardor Xabibullayevich
Teacher of the "Exact Sciences" Department of the
University of Science and Technologies
sardormusayev1999@mailru

Abstract. Although mathematics has a role in all types of economics, it's most common in mathematical economics, where it's a core component. In mathematical economics, economists apply mathematical principles to economic theory. An economist may use mathematics alongside other methods and tools and techniques, such as data harvesting and computer algorithms.

Keywords: Matrices, education, resources, capital, interest periods, computer, effective rates, annual rate.

Suppose a principal (or capital) of S_0 yields interest at the rate p% per period (for example one year). After t periods it will have increased to the amount $\boldsymbol{S(t) = S_0 \cdot (1 + r)^t}$, where $\boldsymbol{r = p/100}$. Each period the principal increases by the factor $1 + r$. Note that $p\%$ means $p/100$, and we say that the interest rate is $p\%$ or r.

More generally, suppose that interest at the rate $p/n\%$ is added to the principal at n different times distributed more or less evenly over the year. For example, $n = 4$ if interest is added quarterly, $n = 12$ if it is added monthly, etc. Then the principal will be multiplied by a factor $\boldsymbol{(1 + r/n)^n}$ each year. After t years, the principal will have increased to

$$\boldsymbol{S_0 \cdot (1 + r/n)^{nt}} \qquad \textbf{(1)}$$

The greater is n, the faster interest accrues to the lender.

EXAMPLE 1:

A deposit of £5000 is put into an account earning interest at the annual rate of 9%, with interest paid quarterly. How much will there be in the account after 8 years?

Solution: The periodic rate r/n is $0.09/4 = 0.0225$ and the number of periods nt is $4 \cdot 8 = 32$. So formula (1) gives:

$$5000 \cdot (1 + 0.0225)^{32} \approx 10\,190.52$$

EXAMPLE 2:

How long will it take for the £5000 in Example 1 (with annual interest rate 9% and interest paid quarterly) to increase to £15 000?

Solution: After t quarterly payments the account will grow to

$5000 \cdot (1 + 0.0225)^t$. So

$5000 \cdot (1 + 0.0225)^t = 15\,000$ or $(1.0225)^t = 3$.

To find t we take the natural logarithm of each side:

$t \cdot \ln 1.0225 = \ln 3$ (because $\ln a^p = p \ln a$)

$$t = \frac{\ln 3}{\ln 1.0225} \approx 49.37$$

Thus it takes approximately 49.37 quarterly periods, that is approximately 12 years and four months, before the account has increased to £15 000.

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