

Exercises 11 Exponential function and equations Compound interest, nominal/effective annual interest rate

Objectives

- be able to calculate the future capital that is invested at an interest rate which is compounded more than once per year.
- know and understand what a nominal and an effective annual interest rate is.
- be able to treat specific compound interest tasks.

Problems

11.1 An initial capital $C_0 = 1000$ CHF is invested at a nominal annual interest rate $r_a = 10\%$, compounded ...

- a) ... quarterly.
 - i) Determine the quarterly interest rate r .
 - ii) Determine the capitals after one, two, and three years.
 - iii) Determine the effective annual interest rate r_a^* .
- b) ... monthly.
 - i) Determine the monthly interest rate r .
 - ii) Determine the capitals after one, two, and three years.
 - iii) Determine the effective annual interest rate r_a^* .

11.2 Determine the effective annual interest rate for a nominal annual interest rate of 6%, compounded ...

- a) ... annually.
- b) ... semiannually.
- c) ... quarterly.
- d) ... monthly.
- e) ... daily (1 year = 360 days).

11.3 What is the future value if 3200 CHF is invested for 5 years at 8%, compounded quarterly?

11.4 Find the interest that will be earned if 10'000 CHF is invested for 3 years at 9%, compounded monthly.

11.5 The formula

$$C_n = C_0 \left(1 + \frac{r_a}{m}\right)^n$$

is used for calculating the future capital C_n in a compound interest scheme.

Solve the formula for C_0 , r_a , and n .

11.6 What amount of money do parents need to deposit in an account earning 10%, compounded monthly, so that it will grow to 40'000 CHF for their son's college tuition in 18 years?

11.7 (see next page)

- 11.7 An initial capital of 1000 CHF amounts to 1500 CHF if it is invested for 10 years at an unknown annual interest rate, compounded quarterly.
Determine the ...
- ... nominal annual interest rate.
 - ... effective annual interest rate.
- 11.8 How long (in months) would a capital have to be invested at 6%, compounded monthly, to double its value?
- 11.9 Ms Good wants to invest 100'000 CHF. Her bank makes two offers:
- effective annual interest rate of 8.5%
 - nominal annual interest rate of 8%, compounded monthly
- Which offer is better, offer A or offer B?
- 11.10 How long (in years) would 1000 CHF have to be invested at 2.5%, compounded daily, to earn 250 CHF interest?
- 11.11 At what nominal annual interest rate, compounded quarterly, would 20'000 CHF have to be invested to amount to 26'400 CHF in 7 years?
- 11.12 A couple needs 150'000 CHF as a down payment for a home. If they invest the 100'000 CHF they have at 8%, compounded quarterly, how long will it take for the money to grow into 150'000 CHF?
- 11.13 Decide which statements are true or false. Put a mark into the corresponding box.
In each problem a) to c), exactly one statement is true.
- The nominal annual interest rate ...
 - ... is generally higher than the effective annual interest rate.
 - ... is equal to the effective annual interest rate if interest is compounded annually.
 - ... is half as much as the effective annual interest rate if interest is compounded semiannually.
 - ... depends on the compounding period.
 - In a compound interest scheme where interest is compounded m ($m > 1$) times per year ...
 - ... the growth factor is m times as high as if interest is compounded only once per year.
 - ... the effective annual interest rate is m times lower than if interest is compounded only once per year.
 - ... the capital grows faster than if interest is compounded only once per year.
 - ... the capital grows more slowly than if interest is compounded only once per year.
 - If an initial capital of 1000 CHF grows to 1100 CHF in one year and interest is compounded semiannually ...
 - ... the effective annual interest rate is less than 10%.
 - ... the effective annual interest rate is greater than 10%.
 - ... the nominal annual interest rate is less than 10%.
 - ... the nominal annual interest rate is greater than 10%