An Introduction to Mathematical Finance Exercises 1
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Time value of money

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1. A sum of NOK90, 000 paid into a bank for two months (61 days) to attract simple interest will produce NOK90,200 at the end of the term. Find the interest rate r and the return on this investment.

2. How long will it take for a sum of NOK80,000 attracting simple interest to become NOK83,000 if the rate is 9%? Compute the return on this investment.

3. Find the principal to be deposited initially in an account attracting simple interest at a rate of 8% if NOK100,000 is needed after three months (91 days).

4. How long will it take to double a capital attracting interest at 6% compounded daily?

5. Find and compare the future value after two years of a deposit of NOK100,000 attracting interest at a rate of 10% compounded a) annually and b) semi-annually.

6. Find the present value of NOK100,000 to be received after 100 years if the interest rate is assumed to be 5% throughout the whole period and a) daily or b) annual compounding applies.

7. Which is greater, the interest rate r or the return $R(0, 1)$ if the compounding frequency m is greater than 1?

8. Consider a loan of NOK1,000,000 to be paid back in 5 equal instalments due at yearly intervals. The instalments include both the interest payable each year calculated at 15% of the current outstanding balance and the repayment of a fraction of the loan. What is the amount of interest included in each instalment? How much of the loan is repaid as part of each instalment? What is the outstanding balance of the loan after each instalment is paid?

9. How much can you borrow if the interest rate is 18%, you can afford to pay NOK100,000 at the end of each year, and you want to clear the loan in 10 years?

10. Suppose that you deposit NOK12,000 at the end of each year for 40 years, subject to annual compounding at a constant rate of 5%. Find the balance after 40 years.

11. Find a formula for the present value of an infinite stream of payments of the form $C, C(1+g), C(1+g)^2, ...$, growing at a constant rate g. Find a formula for the present value of n such payments.

12. In 1626 Peter Minuit, governor of the colony of New Netherland, bought the island of Manhattan from Indians paying with beads, cloth, and trinkets worth \$24. Find the value of this sum in year 2018 at 5% compounded a) continuously and b) annually.

13. Given that the future value of NOK9,500 subject to continuous compounding will be NOK10, 000 after half a year, find the interest rate.

14. Suppose that the logarithmic return over 2 months on an investment subject to continuous compounding is 3%. Find the interest rate.

15. Find the rate for continuous compounding equivalent to monthly compounding at 12%.

16. What is the present value of an annuity consisting of monthly payments of an amount C continuing for n years? Express the answer in terms of the effective rate r_e.

17. Find the interest rates for annual, semi-annual and continuous compounding implied by a unit zero-coupon bond with $B(0.5, 1) = 0.9455$.

18. Find the return on a 75-day investment in zero-coupon bonds if $B(0, 1) = 0.89$.

19. The return on a zero-coupon bond over six months is 7%. Find the implied continuous compounding rate.

20. After how many days will a zero-coupon bond purchased for $B(0, 1) = 0.92$ produce a 5% return?