

3 Problem Set 3

Nominal vs Effective

Problem 1

Calculate the future value of the following dated payments using an annual 6% nominal APR rate with annual compounding

1. 1.000€ today, capitalized 6 months from today
2. 1.500€ today, capitalized 3 years from today
3. 500€ 2 months from today, capitalized to 8 months from today
4. 2000€ next year, capitalized to 6 years from today
5. 500€ today and 500€ in 6 months, capitalized to 5 years from today

Problem 2

Redo the previous exercise using monthly compounding with the same 6% annual interest rate (nominal APR)

Problem 3

Compute the present value (value today) of the following dated payments, using an annual 12% effective APR and annual compounding

1. 1.000€ one month from today
2. 1.500€ in 3 years' time
3. 500€ in 3 months' time
4. 2000€ next year
5. 500€ in 6 months' time and 500€ in 12 months' time

Problem 4

Repeat the previous exercise using monthly compounding and the same 12% effective APR

Problem 5

1. Compute the equivalent effective APR for the following interest rates
 - 10% nominal APR with monthly compounding
 - 3% effective interest in 3 months with monthly compounding
 - 8% nominal interest in 6 months with monthly compounding
 - 5% nominal APR with continuous compounding
2. Compute the monthly effective interest rate for the following interest rates
 - 4% effective APR with annual compounding
 - 5% nominal APR with compounding every 3 months
 - 1% monthly nominal interest with annual compounding
 - 2% effective 2 month interest rate with compounding every 6 months

Miscellanea

Problem 6

Determine the discount factor for one year and the discount factor for two years with the following annual interest rates: 2%, 5%, 10% and 20%. Use both simple and compound annual capitalization.

Problem 7

You've won a prize from a breakfast cereal company. You can choose to receive the prize in one of the following ways:

- 100,000.00€ today
- 180,000.00€ in five years' time
- 29,500.00€ per year for five years
- 18,000.00€ every six months for five years

Which is the most valuable price is your bank offers you a money market account where you can save at a 3% nominal APR with interest paid every six months?

Problem 8

Jordi and Elena are saving to buy a 4x4 in five years' time. The car's price will be 40,000.00€ and they can get a 5% effective APR on their savings. What constant yearly amount do they need to save for the next five years in order to buy the car (in cash)?

Problem 9

Your company has debt with a value (today) of 100,000.00€. The firm's current liquidity problems force you to cancel the debt so you have to negotiate with the bank. They offer to refinance it by converting it into a debt with three equal annual installments. The first installment will be in one year's time. The bank demands a 5% effective APR. Determine the size of the installments.

Problem 10

You have two savings accounts in different banks. One pays interests every month and the other every three months. The first bank will give you a payment of 10€ this month, while the second bank will pay you 60€ this quarter. The nominal APR on both accounts is the same and equal to 6%. Determine how much money you have in each of the two accounts.

Problem 11

An investor is offered two different securities in which to invest. The first offers interest payments of 1.5% every six months, while the second 1.5% every three months. Which of the two offers you a higher effective APR? What would the half-yearly effective interest rate on the first security need to be in order for the effective APR on both securities to be the same?

Problem 12

You hold a bill of payment of 15.000€ from Elimpagao S.A which is due today. You receive a call from your bank manager informing you that the payment has not arrived. You call the financial director of Elimpagao S.A., Mr. Longshot. Longshot tells you that he is running into a temporary liquidity problem but will have the money in three months' time. He offers to pay back the debt with a 12% nominal APR. How much money (cash) will you receive if you accept his proposal? (Use simple capitalization)

Problem 13

You have a second bill of payment from Elimpagao S.A. for 15.000€ which is due in 6 months' time. You need the money now to pay your workers' salaries this month so you go to a financing company. They offer you a six month loan at an 8% nominal APR and accepts the bill of payment as collateral. What is the maximum amount of money you can borrow from the financing company such that you can pay back the loan plus interest with the 15.000€ you will be collecting from Elimpagao S.A.?

Problem 14

Your aunt has divorced and from the settlement, she has received 35.000€ in a savings account that earns a 5% annual interest rate with annual compounding and a house. The house was bought with a loan that has a single payment due: 42.000€ four years from today. The debt can be canceled today by paying 35.000€ and your aunt asks you what should she do

- What is her best option?
- How would your analysis change if you take into account that your aunt has to pay taxes of 15% on the interest she receives from her savings?

Problem 15

Shark Investments Corp. offers you the following investment product: invest 1000€ today and receive 1600€ in eight years' time. What is the effective APR on this investment? What is the continuously compounded interest rate?

Problem 16

If you invest 100€ today at a 15% effective APR for twenty years, how much money will you have at the end? What about if you had invested with a 15% continuous compounding rate?

Problem 17

1. Determine the equivalent forward rates if the spot rates are

$$r_1 = 5.5\%, \quad r_2 = 5.7\%, \quad r_3 = 6\%, \quad r_4 = 5.9\%$$

2. Determine the equivalent spot rates if the forward rates are

$$f_1 = 4.5\%, \quad f_2 = 4.7\%, \quad f_3 = 5\%, \quad f_4 = 5.2\%$$

Past Exam Questions**Problem 18 (ex 2013)**

Determine the nominal APR for an account with simple annual capitalization that you would need in order to obtain the same cash at the end of one year as another account that offers 12% effective APR with monthly capitalization

Problem 19 (EX 2013)

Suppose your family opened a savings account 5 years ago with 6000€. The annual return for each of those years have been 5%, 4%, 3%, 2% and 1% respectively. Determine how much money you can withdraw today (using annual compound capitalization). Take into account that when you withdraw the money you have to pay 21% of your capital gains (the interest part) as income tax.

Problem 20 (EX 2013)

Determine the monthly effective interest rate which is equivalent to a 5% annual effective rate

Problem 21 (EX 2014)

Using continuous compound capitalization at an unknown interest rate an investment triples after 6 years. How long will it take for that same investment to double?

Problem 22 (EX 2014)

You are the manager of friends.mof, a company that lends money to friends who need it (although always at a good interest rate). You have arranged with your partner a special arrangement for family members whereby they will get a lower interest rate: 10% nominal annual interest rate with simple capitalization. Your brother asks you for 10.000 euros but he doesn't want to pay more than 300euros in interest payments. For how many months can he borrow the money before the interest payments exceeded his proposed maximum payment.

Problem 23 (EX 2013)

You have money invested in an account that offers a 10% nominal annual interest rate with compounding every 6 months with compound capitalization. Suppose that you will now withdraw the money until it has tripled. Determine the number of years you will have to wait to receive the money.

Problem 24 (EX 2013)

Determine the Present Value of 60.000€ that you will receive in two year's time at a 5% nominal annual interest rate. a) Using continuous compound capitalization b) Using annual compounding c) Using monthly compounding

Problem 25 (EX 2011)

You work for a bank that is launching a new campaign to attract saving deposits. The deposit offers a 6% effective annual return. Your bank asks you to determine the equivalent annual nominal interest rate that you have to announce to clients in the following cases: a) annual compounding, b) monthly compounding and c) compounding every trimester.

Problem 26 (EX 2013)

Your bank launches a new advertising campaign for its savings accounts. The terms of the saving account are: a 3% effective annual interest rate, monthly compounding that is not paid out but is transferred to a second account that does not pay interest (and cannot be withdrawn). You deposit 1000€ and leave the money there for 6 months. Determine the cash amount that will be available in the second account (the interest payments)

Problem 27 (EX 2013)

Determine the annual effective interest rate that is equivalent to a 12% nominal annual interest rate with compounding every 15 days (use the 30:360 day count convention)

Problem 28 (EX 2011)

The manager of a Canadian pension plan knows that he has to pay 5 million dollars in 10 years time. This manager would like to know how much will he need to invest today so that in 10 years time he will have the 5 million dollars to make the payment. The best investment he has access to offers a 6% nominal annual interest rate with monthly compounding. Can you help him?

Problem 29 (EX 2014)

A large store offers clients a 10% cash discount for cash payments in the electronics department. Clients can also possible pay their purchases in three equal monthly installments (the first one at the end of one month) without any interest payments. You want to buy a computer with a price of 1500 euros and you have the money to pay in cash if you want to. What is the best option if the market interest rate is a 3% effective annual interest rate?

Problem 30 (EX 2016)

Determine the nominal APR in the following savings accounts

1. 1.5% nominal monthly with monthly compounding
2. 2.5% nominal over 3 months with monthly compounding
3. 6% effective APR with compounding every two months

– Determine the effective APR of an account that offers a 7% nominal APR with continuous compounding.

Problem 31 (EX 2017)

You want to buy a house with a market price of 150 000€. The bank will offer you a mortgage that will cover 80% of the price. You have to save to pay the other 20% at the time of the sale, which will be in 4 years' time. The bank offers you a savings deposit with a 2.8% nominal APR and monthly capitalization. How much money do you have to deposit in the savings account to have the cash you need for your part of the house price in four years' time?

Problem 32 (ex 2014)

You are thinking about buying a flat as an investment. You have cash now and you expect the price of the flat to increase. Normally you expect to get a 10% annual return on these operations. You expect the price to be 150000€ in 10 years.

1. Determine if the flat will give you your desired return if you can buy the flat for 70.000€
2. What is the maximum price you would be willing to pay if you want to get at least a 7% annual return on the investment?

Problem 33 (ex feb 2018)

Convert the following interest rates:

1. Convert 4% nominal APR with monthly capitalization into effective APR
2. Convert 7% effective APR with capitalization every 6 months into nominal APR
3. Convert 2% effective return over 2 months (with capitalization in 2 months) into a nominal APR
4. Convert a nominal return of 35% in 3 years with monthly capitalization into an effective return for a 2 year investment

Problem 34 (EX dec 2018)

The forward interest rate curve is 1.6% for the first year, 1.9% for the second, 2.1% for the third, and 2.2% for the fourth.

1. Determine the 3 year spot rate.
2. Determine the 4 year discount factor.