

## 10 Problem Set 5.iv

### Loans

#### Problem 1

Construct the amortization schedule (table) for a 15000€ loan with annual payments that is to be returned over three years, where the annual interest rate is 3% and

1. the loan repayment uses the French amortization method
2. the loan repayment uses the American amortization method

#### Problem 2

Your firm needs financing for a 5 million euro investment. It considers several alternatives, all of which have a 10 year term and a 6% (nominal) annual interest rate. You narrow your options to two

**Bank A** Offers to have the loan be paid back using constant monthly payments

**Bank B** Offers to have the loan be paid back using constant payments every six months

Determine:

1. The constant payments in both cases
2. The amount due after 2 years

#### Problem 3

John Doe got a loan on March 4, 2009 from the Blue Bank under the following conditions

- amount 72000€ due in 15 years
- first year interest rate 5,25%
- annual interest revised using Euribor+1%
- constant monthly payments

Two years later, March 4, 2011, Mr Doe is considering a change of bank. The Red Bank offers a constant 6% annual interest rate. Determine

1. The monthly payment made in april 2009 and 2010, where the Euribor for March 2010 was 3,5% and for March 2011 is 4%
2. The new montly payment he would have to pay if he changed banks (no commissions or costs of switching)

#### Problem 4

When you buy a new home, apart from having to pay the price for the house, you have to pay taxes. Suppose you have to pay VAT (IVA) which now stands at 8%, and that the additional expenses from buying the house amount to 3% of the house price. Your salary is 1800€ and that of your spouse is also 1800€ net per month. You are looking for a flat so that you could move into together. You have found one whose price is 260.000€.

Suppose the bank offers you a mortgage at a 6% nominal annual interest rate over 30 years, that covers the price of the flat, taxes and expenses.

1. How much would you have to pay each month?
2. How much would you owe after 15 years?
3. The Bank of Spain recommends that banks should not provide loans that require monthly payments that exceed 45% of the household income.

- (a) What is the maximum amount of money that the bank can lend you that respects the Bank of Spain's recommendation? (with a 30 year loan and 6% ir)
- (b) Determine the minimum term of the loan that you would need in order to borrow the total cost of the house purchase (price plus taxes and expenses) from a bank that respects the Bank of Spain's recommendations (and offers 6% loans).

### Problem 5

You ask for a personal loan to buy a new car. The terms of the loan from your bank allow you to borrow up to 35.000 euros. The loan would be for at most 6 years and with monthly payments. You take the maximum loan at an interest rate of 4% nominal APR for the duration of the loan. Suppose that after two years you receive an award that allows you to cancel part of the loan: 10.000€.

- What would your monthly payments be after the cancellation of part of the loan if you reduce the monthly payments
- If instead of reducing the monthly payments you decide to reduce the length of the loan, how many more months would you still need to pay back the loan?

### Problem 6

Read very carefully the following advertisement:

The “Crédito Estudios” is a borrowing option for university students that allows them to have access to a permanent source of credit while they are studying. It is designed to finance expenditures directly related to their studies (school fees, books, study material, transport and accommodation, ...). This is available regardless of the type of study: undergraduate, master, doctorate, ...



#### Terms

**Maximum amount:** up to 40.000€

**Loan duration:** from the time you finish your studies plus 5 years

**Interest rate:** fixed for the first year and thereafter: one-year Euribor

**Set up costs:** No set up costs for loan proposals, preparation or early cancellation for study related expenses, 1% cancellation for travel or accommodation expenses.

**You can select:** (a) Total deferment (you start paying back the loan once your studies are completed with monthly payments arranged to fit your needs) or (b) Partial deferment (you only pay interest while you study, and the rest at the end of your studies).

- Suppose that you accept these terms, and you borrow 12.000€ at the beginning of your studies. They last for 4 years and you ask for the maximum loan length (an extra 5 years thereafter). The interest rate during the grace period and the first year of payments is 4.25% per year, and you have chosen the partial deferment option. Determine:
  - The repayment amounts for the months of the first year after your studies
  - Suppose that after that initial year, the one-year Euribor is at 6%. What would be the monthly repayment amounts for the second part of the loan (the last four years)?

### Problem 7

MoF Savings Banks offers its clients a preferential loans at a 3% effective APR as long as the loan exceeds 200.000€ and is paid back over 10 years (at most). Amongst the preferential conditions you have

- Total deferment for the first two years, plus full write-off (condonación) of interest payments for those two years—that is you don't pay back the loan or interests for those two years and the interests are forgiven (the loan amount does not increase)
- During the following two years, no loan amounts will be repaid, only interests, which will be paid at the end of each year
- Thereafter, the loan will be repaid using constant monthly payments.

You ask for 240.000€ with the maximum payback period possible. The special loan terms allow you to save every month (even more in June and December). You decide to arrange a savings plan so as to pay back the loan comfortably. The objective is to save during the first four years, so that by the end of the fourth year you can pay back 25% of the original loan. MoF savings bank offers you a savings account that pays a 1.5% effective APR. You are asked to determine

1. The monthly payments at the end of the loan if you do not save anything
2. The monthly (prepayable) amount you will save during the first four years according to your early amortization plan
3. The monthly payments at the end of the loan if you do save as planned
4. Suppose that after four years you decide to use the money you have saved to reduce the term of the loan (rather than the monthly payments). How many months will you need to return the loan after the early amortization at the end of year 4 if you keep the same monthly payments as in the first question?

### Past Exam Questions

#### Problem 8 (EX 2014)

On January 1, 2014, Roberto signed a loan for 10000€. He agreed to pay 736.85€ at the end of each month. If the interest rate is 5% nominal APR, when will the loan mature?

#### Problem 9 (EX 2013)

On January 1, 2013 you received a loan for 100000€ to buy a house (a mortgage). The loan terms are: 30 year maturity, monthly payments of 421,50€ per month and a 3% nominal APR. On February 1, 2013 you made the first payment and on March 1st the second. On the morning of March 2nd you receive a payment from an inheritance and you decide to cancel the loan. Determine the balance on the loan on March 2nd (at the end of March 1st).

#### Problem 10 (EX 2013)

Determine the real effective APR for the borrower of a 10000€ loan that is due in 2 years with a 5% effective APR, and a single payment at maturity. In addition, there is an initial commission of 90€, and a cancellation fee payable at the end of the loan of 20€.

#### Problem 11 (EX 2013)

You have just bought a new car, and the dealer offers you the following four different payment options. Which is the best financing option if the interest rate is 5% (effective APR)

1. cash payment: 30.000€ today
2. financing: 5.000€ per year for the next seven years. First payment today
3. financing: 15000€ to be paid in one year's time and 20.000€ to be paid in 4 year's time
4. financing: 4000€ to be paid every year over 10 years, the first payment to be made in one year's time

**Problem 12 (EX 2013)**

Suppose you are offered the option to pay for your new motorcycle in two installments (one in six months and another in 12). Each installment is for 8000€. If the price of the motorcycle is 15000€, what is the effective APR of the financing option? (use the TIR/IRR function in a spreadsheet)

**Problem 13 (EX 2014)**

Determine the complete amortization table for a 3 year loan of 15000€, payable every year and amortized using constant amortization payments. The interest rate is 5%.

**Problem 14 (EX 2017)**

You are thinking of buying a house which has a 200.000€ price, and you are asking for a mortgage to cover 80% of the house's price. After considering different options you have chosen the CYBERSAVINGS bank that offers you a 1,10% fixed interest rate mortgage with monthly payments over 25 years.

1. Imagine that your monthly net salary is 1800€ per month. How much would you have left over after paying the mortgage?
2. Imagine that after 6 years you have managed to save 6000€. Determine how much you would have to pay every month if you decide to use your savings to amortize part of the mortgage and chose to keep the same maturity with a lower monthly payment.
3. Determine how many years you have remaining on your mortgage if instead of reducing the monthly payments you reduce the loan's maturity.

## 11 Extra Material (not for exams)

### Arbitrage

**Problem**

The following bond is trading at a price of 997,23€: 1000€ nominal value, 3 year maturity, amortization at par, 3% annual coupon. The term structure of interest rates is (spot rates): 1 year: 2.6%, 2 year 2.8%, and 3,0% for 3 years

1. Determine the (arbitrage-free) market price of the bond
2. Describe the arbitrage strategy that you would follow to take advantage of the mispricing, and how much profit can you make if you can repeat the arbitrage strategy with 1 million bonds.