

# BT 321, Corporate Finance

## Homework Assignment #1

Due: **10/03/2017 at 11:59am** (Before the review class)

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Dear Students,

Please consider the following points:

1. Please make the Honor Code pledge in your submitted work. You are allowed to work in teams and discuss the questions. However, every student should submit her/his own version and write-up of solutions, and acknowledge the students you worked with.
2. Please ***type*** your answers and upload them on **Canvas** before the beginning of the review class.
3. I am not just asking for final values. Show how you think about the problem and calculate any final value. When not asked explicitly, write down at least one of these four to demonstrate your ability to solve the problem: (a) Explicit math formula (b) Excel commands (with details) (c) Steps to use a financial calculator
4. There is a partial credit for every effort you make. If you show a correct way of thinking and solving the problem but get the final number wrong you will get up to 70% of available points.
5. All questions use very basic formulas and math techniques. Some of them may need a bit of thinking at conceptual level. Expect this homework to take between 4-5 hours to complete. You are *strongly encouraged* to try the extra credit question (I am trying to help).

Best,

Victor Xi Luo

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## Problem #1 (30 points)

Throughout this question, assume annual interest rate is 4% with monthly compounding.

You are a loan officer in the mortgage department of a local bank. A customer, who is also a Stevens alum, walks in and applies for a \$500,000 loan to buy a starter home in Hoboken. The standard terms your bank have been offering to previous customers are as followed,

*Contract A: a 15-year fixed rate loan, with an annual rate of 4% and with fixed monthly installment.*

**Question 1** (10 pts),

- Calculate the monthly payment, denote it as  $X_A$  using mathematical formulas.
- Create an Excel spreadsheet and calculate how your interest payments, principal payments, and the outstanding loan balances changes over time for *Contract A* (You do NOT need to print the entire excel sheet; just few cells from the beginning and end would be enough. However, you should explain your approach.)

**Question 2** (10 pts), Upon receiving terms of *contract A*, your customer realizes that monthly payment of  $X_A$  is beyond her earning power in year 1, 2 and 3, but it will be well within her means from year 4 onwards. You then decide to offer her the following alternative,

*Contract B: a 15-year variable rate loan, with a monthly payment of  $\frac{X_A}{2}$ , in the first three years (36 months), and a monthly payment of  $X_B$  for the remaining 12 years.*

Calculate using mathematical formulas the value of  $X_B$  that will make the present value of cash flows in *contract B* equal to that in *Contract A*.

**Question 3.** (10 pts) Mortgage interests are tax deductible, meaning that the one can subtract the amount of interest (not the total payment) from her annual taxable income. Suppose the customer's marginal income tax rate is 25% in year 1, 2 and 3, and 28% in year 4 and 5, and 33% from year 6 onwards<sup>1</sup>.

Using excel, calculate the present value (time 0 value) of all her future tax savings in contract A, contract B, and the earlier repayment scenario described in Question 3. The number you calculate is also called the tax shield value of debt. Which contract offers highest amount of tax shield value of debt?

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<sup>1</sup> We assume that the customer, a Stevens alum, is having a very successful career. As her annual income rises, her marginal tax rate increases as well.

<https://taxfoundation.org/2017-tax-brackets/>

**Question 4** (*Extra credit, 10 pts*). Suppose the customer chose *Contract B* and has made on-time payment for 5 years (60 monthly payments). At the beginning of year 6, she realizes that her career has taken off so well that she wants to pay off her remaining mortgage in the next five years instead of ten years. What is her monthly payment  $X_C$  between year 6 and year 10, that makes the present value of cash flows in this early repayment scenario equal to that in *Contract B*? Show your work.

## Problem #2 (30 points) Adjustable Rate Loan

Assume on Jan 1st, 2017 Aaron has a \$120,000 outstanding amount on an adjustable-rate loan from the Bank of America which amortizes over 10 years. According to the loan contract, he makes payment at the end of the month. His monthly payments during year  $t$  is calculated based on the 10-year treasury bond yield in December of year  $(t-1)$ , plus a 1% premium. For example, the treasury bond yield in December 2016 was 2.45%. Aaron's monthly payment in 2017 is then calculated based on an annual interest rate of 3.45%. Aaron's monthly disposable income is **\$1250**. However, the central bank is signaling an interest rate hike in December 2017, which might lead to an increase in the 10-year treasury interest rate.

- (a) Calculate Aaron's monthly payment in year 2017.
- (b) Assume that Aaron pays all his monthly installment amounts in 2017, but spends all his remaining disposal income frivolously. How much can the 10-year treasury bond yield increase in December 2017 before Aaron will have to default on his loans in Jan 2018?
- (c) Assume that Aaron is very prudent and repays \$1250 every month in 2017. (He repays above the requirement installment, and there is no prepayment penalty for that). Redo question (b).

## Problem #3 (20 points)

You are a loan analyst in the mortgage department of a bank in Chicago. A customer applies for a loan to buy a house with 80% debt (and 20% equity). The price of the house is constant, equal to \$500,000 and will remain constant. The penalty for re-financing or pre-payment is so high that in practice re-financing is not an option.

Assume the loan is a fixed-monthly-payment type. You do the math and the customer fixed payment is supposed to pay \$2000 per month for 30 years (i.e. 360 months), no matter how much the future interest rates are.

You are doing a risk analysis because the bank worries that following an expansionary monetary policy the interest rates may drop. What is the lowest threshold for the interest rates to potentially trigger a voluntary (strategic) default on this mortgage loan? For simplicity, assume there are no additional costs associated with default. (hint: Calculate the present value of customer's payments and compare it with the value of her house. Play with Excel to find the threshold rate.)

## Problem #4 (20 points)

Two years ago, you signed a loan contract with a re-payment schedule of 10-year fixed-rate, at 5.50 percent interest. You have paid all your monthly payments during the past two years and now have an outstanding balance of \$65,000. The current market rates are at 4.0% but you are obliged to continue paying your mortgage based on initial rate of 5.50%.

**Question 1.** If you could re-finance with the new rate of 4%, how much in total (in terms of present value) would have you gained?

**Question 2.** Suppose your lending officer approaches you with a new proposal: if you pay a \$5,000 lump-sum pre-payment penalty you can switch to a new contract with the current 4.00 percent repayment schedule for the remaining part of the loan. Will you accept this proposal? Why? What is the maximum penalty that still convinces you to accept the deal?