Université Paris 1 Panthéon Sorbonne
Master 2: Ingénierie Mathématique de la Finance

Programming in C++

FINAL EXAM

by
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January 11, 2018

The task

Write a function that calculates **yield to maturity**. You can find the elaboration on the topic in the class notes. Assume yearly coupons.

The function should at minimum take the following arguments:

- **c** - coupon value
- **d** - year fraction until next coupon payment
- **FV** - face (future) value of a bond
- **PV** - present value of a bond (its price)
- **N** - number of full years until maturity

Example 1:
Bond of face value of 100, with a coupon rate of 5%, paid yearly, traded at 95, maturing on 2019-12-31, will have the following input data as of 2018-01-01:

- *c = 5 (FV times coupon rate, which is 100 x 5% = 5)*
- *d = 1 (coupon has just been paid, we wait 1 year for another one)*
- *FV = 100 (given)*
- *PV = 95 (given)*
- *N = 1 (d + N must equal to period from valuation date to maturity date, there are 2 years, first was assigned to d, second to N)*

For the input given above, YTM ≈ 0.078 (or, equivalently, 7.8%)

Take into account special cases that simplify calculations, such as: zero-coupon bond, coupon payment day is today, bond's price is equal to its par (face) value.

Please find below example input and expected result:

Example 1:
If bond is traded at par and we are at coupon date (coupon has just been paid), YTM should be equal to coupon rate.
INPUT: c = 2.5, d = 1, FV = 100, PV = 100, N = 10
gives YTM = 0.025 (or, equivalently, 2.5%)

Example 2:
If bond is traded at discount, i.e. PV < FV, YTM will be higher than coupon rate.
INPUT: c = 1.0, d = 0.96, FV = 100, PV = 99.06, N = 7
gives YTM ≈ 0.011 (or, equivalently, 1.1%)

Example 3:
If bond is traded at premium, i.e. FV < PV, YTM will be lower than coupon rate.
INPUT: c = 2.625, d = 0.42, FV = 100, PV = 105.5, N = 2
gives YTM ≈ 0.009 (or, equivalently, 0.9%)

Contact

Please put any questions in the **comments under blog post**, so that everybody can follow questions and answers.
In case of any specific problem, you may contact me via:

- e-mail n.piatkowska@outlook.com
- WhatsApp: +48 517 455 124

Cooperation rule

You are encouraged to cooperate, use the Internet, friends, and every other source / opportunity you can find to help you but, everybody needs to **submit the exam separately**. Obviously, the solutions you submit may be identical if you work together.

Good programming practices

Remember about good programming practices. **Certain points will be granted solely for sticking to those rules**, in particular:

- **names** - name modules, classes, methods, functions, variables so that everybody can understand what a given object is or what it does
- **indents** - use a certain indent convention, that is clear and helps you to understand the code structure at one quick glance
- **avoid duplicating** - if you use a certain piece of instruction in many places, it is better to extract it to separate place, and then call it multiple times

Submitting

There are three ways I see to submit the project (1 point is dedicated solely to the way of submitting):

0p - pasting the code in the e-mail or sending in a .txt file

0.5p - sending *.cpp, optionally supporting *.h files in an e-mail; and optionally along with compiled executive file

1p - setting up account on github (or another online code repository) and sending me a link to the repository with the project

Deadline

Starting from 2018-01-11 at 19:00 UTC+1:00, you have full 24 hours to complete the task.

Ultimate deadline **is Friday, 2018-01-12 at 21:00 UTC+1:00**. Every hour of delay (time is rounded **up** to hours) decreases final score by 0.5 p.

Example: You submitted on 2018-01-12 at 22:15 UTC+1:00, which is 1h 15min overdue. Rounded up gives us 2h, equivalent to -1.0 point added to the final score.