Queens College, CUNY, Department of Computer Science

Computational Finance

CSCI 365 / 765

Spring 2019

Instructor: Dr. Sateesh Mane

Quiz 2 Spring 2019

Sunday Mar. 3, 2019, 11:59 pm

- **NOTE: It is the policy of the Computer Science Department to issue a failing grade to any student who either gives or receives help on any test.**
- This is a take home exam.
- **Any problem to which you give two or more (different) answers receives the grade of zero automatically.**
  1. It is preferred if you type your answers (docx or pdf).
  2. Scanned documents must be readable and not obscured by shadow, etc.
  3. **Handwritten answers must be legible: a failing grade will be awarded if the examiner is unable to decipher your handwriting.**
- **All program code for this test must be written in C++.**
- Submit your program code via email, as a file attachment, to `Sateesh.Mane@qc.cuny.edu`.

  `StudentId_first_last_CS365_quiz2_Spring2019.zip`
  `StudentId_first_last_CS765_quiz2_Spring2019.zip`
- For students who have submitted program code as a solution for Quiz1/HW2, your code will be accepted as satisfying the requirement for Question 2 of this quiz.
- You are permitted to submit revised solutions if you wish, but your revisions will not change your grade for Quiz1.
- Programs will be compiled and tested using the g++ compiler.
- **Programs which display any of the following behaviors will receive an automatic F:**
  1. Programs which do not compile successfully (compiler warnings which are not fatal are excluded, e.g. use of deprecated features).
  2. Array out of bounds and/or overwriting unauthorized memory.
  3. Dereferencing of uninitialized variables (including null pointers).
  4. Operations which yield NAN or infinity, e.g. divide by zero, square root of negative number, etc. *Infinite loops.*
  5. Programs which do NOT implement the public interface stated in the question.

Student id and parameters

- The following numbers will be employed in the questions below.
- Define the integers $d_1, d_2, \ldots, d_8$ as the digits of your student id:

$$(\text{your student id}) = d_1 d_2 d_3 d_4 d_5 d_6 d_7 d_8 \,. \tag{0.1}$$

- Hence $0 \leq d_i \leq 9$ for $i = 1, \ldots, 8$.
- Define a number β as your student id multiplied by 10^{-8}:

$$\beta = (\text{your student id}) \times 10^{-8} \,. \tag{0.2}$$

- Hence $0 < \beta < 1$.
- Example: if your student id is 12305670, then

$$d_1 = 1\,, \quad d_2 = 2\,, \quad d_3 = 3\,, \quad d_4 = 0\,, \quad d_5 = 5\,, \quad d_6 = 6\,, \quad d_7 = 7\,, \quad d_8 = 0\,,$$
$$\beta = 0.12305670\,.$$

1 Question 1

- Consider a bond with a maturity of four years.
- Suppose the bond pays semiannual coupons (two coupons per year).
- Hence the coupons are paid at times $t_i = 0.5,\ 1.0\,, \ldots\ 4.0$.
- Let the bond face be F and the annualized coupon rates be $c_1, \ldots, c_8$ and the yield be y.
- The face value of the bond is $F = 100$.
- The coupon values are given by the digits of your student id, i.e. $c_i = d_i$.
- **The current time is $t_0 = 0.5 + \beta$.**
- **Fill in the table below with the values of $B(y)$ (answers to two decimal places).**

y (%)	$B(y)$
0	(2 d.p.)
2	(2 d.p.)
4	(2 d.p.)
6	(2 d.p.)
8	(2 d.p.)
10	(2 d.p.)

- Let the market price of the bond be $B_{\text{market}} = 100 + \beta$.
- Denote the yield corresponding to B_{market} be y_*.

  1. **State which pair $(y, y+2)$ gives a lower and upper bound for y_*.**
  2. Call these values y_{low} and y_{high}, so $y_{\text{high}} = y_{\text{low}} + 2$ and define $y_{\text{mid}} = (y_{\text{low}} + y_{\text{high}})/2.0$.
  3. **Calculate the bond price $B(y_{\text{mid}})$.**
  4. **State the updated values of y_{low} and y_{high} for the next iteration step.**
  5. **Calculate the updated value of y_{mid} and the updated bond price $B(y_{\text{mid}})$.**
  6. STOP. No credit will be awarded if you attempt to iterate further.

- Submit your solution as a document in a zip archive following the instructions on the front page of this test.

2 Question 2

- Write the code for the Bond class and function `yield(...)` given in HW2.
- Submit your code in a zip archive following the instructions on the front page of this test.

3 Question 3

- **Use an interest rate $r = (5 + \beta)\%$ and a current time of $t_0 = 0.5 + \beta$ and calculate the present value of the sum of the cashflows of the bond in Question 1.**
- Calculate the present value to an accuracy of 2 decimal places.
- Denote your answer by B_{pv}.
- **State the value of B_{pv} to 2 decimal places.**
- **Use the function `yield(...)` from Question 2 to calculate the yield of the bond in Question 1, for a target fair value of B_{pv}.**
- Denote the value of that yield by y_{pv}.
- **Calculate and state the value of y_{pv} as a percentage accurate to 2 decimal places.**
- **Include your program code (including your main program) in your solution.**
- Submit your solution as a document (Q3.[docx/pdf]) and your code (Q3.cpp) in a zip archive following the instructions on the front page of this test.