Queens College, CUNY, Department of Computer Science

Computational Finance

CSCI 365 / 765

Spring 2019

Instructor: Dr. Sateesh Mane

Quiz 1 Spring 2019

Thursday Feb. 21, 2019 (in class questions)

Sunday Feb. 24, 2019, 11:59 pm (take home questions)

- **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 test is partly in class and partly take home (see below for instructions about the take-home part).
- The in-class part of the test is **open-book.**
- Once you leave the classroom, you cannot come back to the in-class test.
- **Any problem to which you give two or more (different) answers receives the grade of zero automatically.**
- Submit your solution in the envelope provided, with your name and student id on the cover.
  1. Write your answers in the blue book provided, with your name and student id on the cover of the blue book.
  2. If you require extra sheets of paper, write your name and student id at the top of each page and place the sheets in the envelope provided.
  3. **Answers must be written in legible handwriting: a failing grade will be awarded if the examiner is unable to decipher your handwriting.**
- Some questions require you to perform computations using a computer program.
  1. You are permitted to use Excel on your computer, and/or a pocket calculator.
  2. If you use software such as MatLab or Wolfram Alpha, etc., **state the software package you use.**
  3. It is permitted to use MatLab or Wolfram Alpha, etc., but you must state the name of the software.
- **The take home part of this test requires you to write program code.**
- **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_quiz1_Spring2019.zip`
  `StudentId_first_last_CS765_quiz1_Spring2019.zip`
- For students who have submitted program code as a solution for HW2, your code will be accepted as satisfying the requirement for the take home part of this quiz.

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 (in class)

- A cashflow F_1 at time t_1 has a present value of F_0 at time t_0 (= today).
- The times are measured in years, so $t_1 - t_0 = 1$ means a time interval of 1 year.
- Let d denote the discount factor of the above cashflows, i.e. F_1 discounted from t_1 to t_0.
- Let r be the corresponding interest rate (measured in percent).
- Let $F_0 = 100 + d_1$, $F_1 = 110 + d_2$, $t_0 = 0$ and $t_1 = 1 + \beta$.

  1. **Calculate the value of d to four decimal places.**
  2. **Calculate the value of r as a percentage to two decimal places.**
  3. You may employ Excel or a pocket calculator, etc. to answer this question.

2 Question 2 (in class)

- A cashflow F_1 at time t_1 has a present value of F_0 at time t_0 (= today).
- The times are measured in years, so $t_1 - t_0 = 1$ means a time interval of 1 year.
- Let d denote the discount factor of the above cashflows, i.e. F_1 discounted from t_1 to t_0.
- Let r be the corresponding interest rate (measured in percent).
- **Write a C++ function to calculate the discount factor d and interest rate r, given inputs F_0, F_1, t_0 and t_1.**
- **The output value of r must be expressed as a percentage.**
- The function signature is

```
int df_and_r(double F0, double F1, double t0, double t1, double &df, double &r);
```

- The function return type is `int` because we want some validation checks.
  1. If $t_1 - t_0$ equals zero, set $d = 0$ and $r = 0$ and exit with a return value -1.
  2. If $F_0 \leq 0$ or $F_1 \leq 0$, set $d = 0$ and $r = 0$ and exit with a return value -2.
  3. If everything is fine, then calculate d and r and exit with a return value 0.

3 Question 3 (in class)

- 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.

4 Question 4 (take home)

- Write the Bond class given in HW2.
- Submit your code in a zip archive following the instructions on the front page of this test.