HW2. Yifu He 10442277

Q1-4 calculated by excel "Q1-Q4" ①

Q1. the theoretical price of the bond is the present value of all cashflows.

(i)

$$P = 20\cdot e^{-0.02\times 0.5} + 20\cdot e^{-0.025\times 1} + 20\cdot e^{-0.027\times 1.5} + 1020\cdot e^{-0.032\times 2}$$

$$\approx 1015.318$$

(Calculated by Python)
Source code in the additional file.

(ii) suppose the bond yield is y.

$$20\cdot e^{-y\times 0.5} + 20\cdot e^{-y\times 1} + 20\cdot e^{-y\times 1.5} + 1020\cdot e^{-y\times 2} = 1015.318.$$

use method of bisection to approximate y,

use excel to calculate

$$y \approx 0.031777807 \approx 3.18\%$$

Q2: ① $B_1 = 2000\cdot e^{-1\cdot 0.1} + 6000\cdot e^{-10\cdot 0.1} = 4016.951$

$B_2 = 5000\cdot e^{-5.95\times 0.1} = 2757.813$

$D_1 = (1\times 2000\cdot e^{-1\times 0.1} + 10\times 2000\cdot e^{-10\times 0.1})/B_1 = 5.9454 \approx 5.95$

$D_2 = \dfrac{5.95\cdot e^{-5.95\times 0.1}\times 5000}{B_2} = 5.95$

② $P = \dfrac{\sum_{i=1}^{n} t_i\cdot C_i e^{-yt_i}}{B}$ when $y = 10.1\%$.

$\Delta B = \dfrac{dB}{dy}\cdot \Delta y$

$\Delta B = -BD\Delta y$

$\dfrac{\Delta B}{B} = -D\Delta y.$

$B_1' = 2000\cdot e^{-1\cdot 0.101} + 6000\cdot e^{-10\times 0.101} = 3993.180$

$B_2' = 5000\cdot e^{-5.95\times 0.101} = 2741.453$

$\dfrac{\Delta B_1}{B_1'} = \dfrac{B_1' - B_1}{B_1} \approx -0.59\%$

$\dfrac{\Delta B_2}{B_2} = \dfrac{B_2' - B_2}{B_2'} \approx -0.59\%$

③ when $y = 15\%$

$B_1' = 3900.276$

$B_2' = 2676.976$

Similar to (i)

$\Delta B_1 \approx -23.82\%$

$\Delta B_2 \approx -25.73\%$