MATH 373
Quiz 3
Spring 2018
February 13, 2018

1. Tyler purchases a US Treasury Bill that matures for 15,000 in 150 days. The Quoted Rate on this US Treasury Bill is 8.25%.

   Determine the annual effective interest rate that Tyler will earn on the US Treasury Bill. Your answer should be accurate to five decimal places.

   Solution:

$$Quoted\ Rate = \left(\frac{360}{Number\ of\ Days} \right)\left(\frac{Maturity\ Value\ -\ Price}{Maturity\ Value} \right)$$

$$0.0825 = \left(\frac{360}{150} \right)\left(\frac{15,000\ -\ Price}{15,000} \right) \Longrightarrow 15,000 - Price = 0.0825\left(\frac{150}{360} \right)(15,000) = 515.625$$

$$Price = 15,000 - 515.625 = 14,484.375$$

$$(14,484.375)(1+i)^{\frac{150}{365}} = 15,000$$

$$1+i = \left(\frac{15,000}{14,484.375} \right)^{\frac{365}{150}} = 1.088844798 \Longrightarrow i = 0.08845$$

2. Emily makes a loan of 100,000 to the US Government. Under the loan, the US Government will pay an annual rate of 3.5% compounded continuously plus the annual rate of inflation each year compounded continuously. Since US Government is considered a risk free borrower, there is no charge for default.

The annual rate of inflation compounded continuously is 2.3% during the first year, 4.2% during the second year, and $x\%$ during the third year.

At the end of three years, Emily receives a payment of 124,358.71 to repay the loan.

Determine x. Your answer should be accurate to five decimal places.

Solution:

$$(100,000)e^{(0.035+0.023+0.035+0.042+0.035+x/100)} = 124,358.71$$

$$e^{(0.17+x/100)} = 1.2435871$$

$$0.17 + x/100 = \ln(1.2435871) = 0.21800$$

$$x = 4.8\%$$

3. Brinkers Bank makes 4 year loans to college students. Brinkers wants to receive an annual rate of 2.5% compounded continuously to compensate for deferred consumption. Additionally, Brinkers expects that inflation will occur at an annual rate of 3.1% compounded continuously over the next four years. However, since the inflation rate could be higher, Brinkers would like to receive an annual rate of 0.25% compounded continuously as compensation for the inflation risk.

   Additionally, Brinkers expects 5% of the loans to default with a loan recovery rate of 42%.

   Determine the annual rate compounded continuously that Brinkers should charge for defaults. Your answer should be accurate to five decimal places.

   Solution:

   $$\text{Total Rate Desired Each Year} = 0.025 + 0.031 + 0.0025 = 0.0585$$

   $$e^{(4)(0.0585)} = (1-0.05)e^{(4)(0.0585+\delta_s)} + (0.05)(0.42)e^{(4)(0.0585+\delta_s)}$$

   $$1.263644492 = 0.971e^{(4)(0.0585+\delta_s)}$$

   $$\ln\left[\frac{1.263644492}{0.971}\right] = (4)(0.0585 + \delta_s)$$

   $$0.263428811 = 0.234 + 4\delta_s$$

   $$\delta_s = \frac{0.263428811 - 0.234}{4} = 0.00736$$