3.1 Bootstrapping

Refer to the Singapore government bond data in Table 3.1. Use bootstrapping to estimate the spot rates (semi-annually compounded, ICMA) for the following maturities:

(a) 21-Jun-2019
(b) 21-Dec-2019
(c) 21-Jun-2020
(d) 21-Dec-2020

Your valuation date is 21-Dec-2018 (i.e., the date when the rates in the table were current).

SOLUTION

(a) Interpolate between 1 (df for valuation date) and the df for 31-Oct-2019, which is 0.9826.

This gives a df of 0.98991. This is equivalent to a spot interest rate (semi-annual ICMA) of 2.03762 percent.

(b) We first need to solve for the df for 1-Sep-2020. In solving, we need to set the penultimate coupon-date df as an interpolation between the df for 31-Oct-2019 and this unknown df. We can use goal seek in a spreadsheet program like Microsoft Excel to solve. Set the unknown df for 1-Sep-2020 to a guess X, set the formula for the penultimate coupon-date df based on linear interpolation using this guess, and then use goal seek to solve for the value of X that results in a clean price of 102.1 for the bond maturing on 1-Sep-2020. We get the df for 1-Sep-2020 to be 0.96717.

Interpolate between 0.9826 (df for 31-Oct-2019), and the df for 1-Sep-2020, which is 0.96717. We get a df of 0.98003 for 21-Dec-2019.

This is equivalent to a spot interest rate (semi-annual ICMA) of 2.02753 percent.

(c) Interpolate between 0.9826 (df for 31-Oct-2019), and the df for 1-Sep-2020, which is 0.96717. We get a df of 0.97080 for 21-Jun-2020.

This is equivalent to a spot interest rate (semi-annual ICMA) of 1.98523 percent.

(d) We first solve for the df for 1-Jul-2023. In solving, we need to set the df for coupon dates after 1-Sep-2020 as an interpolation between the known df for 1-Sep-2020 and this unknown df. We can use goal seek in a spreadsheet program like Microsoft Excel to solve. Set the unknown df for 1-Jul-2023 to a guess X, set the formulae for the df for coupon dates after 1-Sep-2020 based on linear interpolation using this guess, and then use goal seek to solve for the value of X that results in a clean price of 103.21 for the bond maturing on 1-Jul-2023. We get the df for 1-Jul-2023 to be 0.91355.

Interpolate between 0.96717 (df for 1-Sep-2020), and the df for 1-Jul-2023, which is 0.91355. We get a df of 0.96141 for 21-Dec-2020.

This is equivalent to a spot interest rate (semi-annual ICMA) of 1.97733 percent.