**37011 Financial Markets Instruments**

# Assignment Part 1

*due 9 March 2025*

**Solutions must be submitted on Canvas as a Jupyter notebook using Python**

The file `RBAbondyields.xlsx` contains daily data (sourced from the Reserve Bank of Australia) on yields on two-, three-, five- and ten-year Australian Government Bonds, from 2 September 2013 to 6 March 2024. These series are "calculated from data representing the Reserve Bank of Australia (RBA)'s assessment of closing bond yields on Australian Government Securities." The RBA further states, "These assessments are informed by information provided to the RBA by a number of market participants, although the assessments are solely made by the RBA using its own judgment. These yields are not (and are not administered by the RBA as) financial benchmarks, and are not accorded any special status by the RBA. These yields are provided as a convenience for the public and are intended for academic research purposes. The data quality of the RBA's assessments of closing yields is not guaranteed, assessments may differ from market prices and the RBA's methodology[...]"[1] Thus, we will interpret these yields as the yields to maturity of hypothetical Australian Government Bonds trading at par, with times to maturity of exactly two, three, five and ten years. For these yields to maturity, we follow the Australian Government's definition,[2]

> "Yield to Maturity is the rate of return on a bond (expressed as an annual rate) if purchased at the current market price and held until the Maturity Date. The calculation of the yield assumes all Coupon Interest Payments are reinvested at the same rate."

Note that since Australian Government Bonds pay coupons every six months, this yield should assume semi-annual compounding.

1. Using loglinear interpolation where necessary, for each day determine the term structure of zero coupon bond prices (i.e., discount factors) consistent with these yields. For simplicity, you may assume that the spacing between coupon payments is exactly 0.5 years. *(6 marks)*

2. Suppose there are the following four Australian Government Bonds trading in the market:

[1] Reserve Bank of Australia, "Capital Market Yields – Government Bonds – Daily – F2", `https://www.rba.gov.au/statistics/tables/changes-to-tables.html`, accessed 13 March 2024.

[2] Australia Government, "Coupon Interest and Yield for eTBs", `https://www.australiangovernmentbonds.gov.au/bond-types/exchange-traded-treasury-bonds/coupon-interest-and-yield-etbs`, accessed 17 February 2025.

| Bond | Maturity date | Coupon |
|---|---|---|
| $\mathcal{B}_1$ | 21 April 2025 | 3.25% |
| $\mathcal{B}_2$ | 21 April 2026 | 4.25% |
| $\mathcal{B}_3$ | 21 May 2028 | 2.25% |
| $\mathcal{B}_4$ | 21 December 2029 | 1.00% |

For 21 April 2023, calculate the prices of these bonds consistent with the discount factors you have derived in the previous question. Also, calculate the duration and the convexity of these bonds, using the Fisher–Weil version of these concepts. For simplicity, you may assume that one month equals 1/12 of a year (i.e., ignoring the finer points of business day and daycount conventions). *(3 marks)*

3. Suppose a portfolio manager has a liability of $120 million to be paid on 21 April 2027. Suppose further that the portfolio manager wishes to manage the interest rate risk of this liability by investing in a portfolio of Australian Government securities $\mathcal{B}_1$ and $\mathcal{B}_4$, in the sense that on 21 April 2023, the present value of the hedge equals the present value of the liability, and the net Fisher/Weil duration of the hedged position is zero. What positions in $\mathcal{B}_1$ and $\mathcal{B}_4$ should the portfolio manager take? *(1 mark)*