Group of 100 Discount Rate

September 2019

Prepared by:

Craig McCulloch, FIAA FFA
Jessica Lim, CFA, FRM

Level 5
32 Walker Street
North Sydney
NSW 2060

Tel +61 (0)2 8090 9100

au.milliman.com

TABLE OF CONTENTS

1 Background

OBJECTIVES AND SCOPE

The Group of 100 has commissioned Milliman to generate a standardised set of discount rates to be made publicly available for the purpose of discounting employee benefit liabilities under Australian Accounting Standard 119 (AASB 119). The scope of the work is limited to Australian employee benefit schemes, and excludes any schemes of foreign subsidiaries of domestic entities which are denominated in foreign currency.

This report provides the Australian corporate bond discount rate curve as at the end of September 2019 produced under the methodology and assumptions described in the 'Discount Rates for Australian Employee Benefit Liability Valuation' report.

RELIANCE AND LIMITATIONS

In producing this report, we have relied upon the following information:

- Capital market data as sourced from Bloomberg. Should this data be incorrect, it could materially affect the analysis and conclusions drawn from it.

Users of this report should also be aware that it is subject to the following limitations:

- Current debt market conditions. Issuance of corporate bonds is subject to change over time, which may impact upon whether the accounting standard requirements of a deep market are met.

- Current capital market conditions, in particular the liquidity and credit ratings of corporate bond markets, which can change rapidly. The asset calibration set could change very rapidly under stressed market conditions.

- Reassessments of the suitability of the asset calibration set would be needed if the AAA and/or AA corporate bond market thins, which would require a prospective change to the assets selected for AASB 119 calibration purposes.

This report was prepared solely to provide assistance to the Group of 100 and the relevant Actuaries Institute of Australia subcommittee. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this report. Milliman recommends that any recipient of this report be aided by its own actuary or other qualified professional when reviewing the report. Milliman does not certify the information in this report, nor does it guarantee the accuracy, completeness, efficacy, or timeliness of such information. Use of such information is voluntary and should not be relied upon unless an independent review of its accuracy, completeness, efficacy, and timeliness has been performed. Materials may not be reproduced without the express consent of Milliman.

2 Methodology and Assumptions

SUMMARY OF THE ASSET CALIBRATION SET

The set of assets to be used to calibrate the discount rate curve is defined by those securities that meet the following conditions:

1. Individual bonds must have the following characteristics:
   a. Physical bonds, with no embedded derivatives (e.g., callable, putable, convertible, extendible, variable/floating coupon, index-linked)
   b. High-quality corporate bonds issued by both domestic and foreign entities
   c. Payments denominated in Australian dollars (AUD)
   d. Pay fixed (or zero) coupons, non-inflation-linked
   e. Maturity terms of greater than one month and less than 10 years
   f. Minimum amount outstanding on an individual security of $100 million
   g. Securitised bonds are included

2. A deep market for these bonds must exist, as characterised by the ready availability of observable prices and current trades.

What is meant by high quality?

Figure 1 defines the credit ratings by each agency that map to each of these broad categories. This forms the basis for the asset calibration set used in this report.

FIGURE 1: DEFINITION OF AAA AND AA CREDIT RATINGS BY AGENCY

CATEGORY	AAA	AA
S&P	AAA	AA+, AA, AA-
FITCH	AAA	AA+, AA, AA-
MOODY'S	AAA	AA1, AA2, AA3

Where there is disagreement between credit rating agencies on particular securities, we use the following conditions:

- If a security has at least two AAA ratings, then it is classified as a AAA security
- If a security has at least two AA ratings, then it is classified as a AA security
- If a security has only been rated by two agencies with different ratings, then the lower rating is used
- If a security has only been rated by one agency, then that rating becomes the sole reference

Hereafter, all references to credit ratings refer to those that meet the above conditions. For the purposes of this paper, we refer to this as the combined credit rating.

Corporate bond universe

The table in Figure 2 shows the decomposition of the market by the combined credit rating satisfying all but the 'high quality' characteristic.

FIGURE 2: AUSTRALIAN CORPORATE BOND MARKET OUTSTANDING DEBT BY COMBINED CREDIT RATING ($ MILLIONS)

Combined Rating	Number of Securities	Outstanding ($ Millions)	% of Total
AAA	15	7,440	7.9%
AA	118	30,955	33.0%
A	126	34,059	36.3%
BBB	67	21,369	22.8%
BB	0	0	0.0%
Other	1	100	0.1%
Total	**327**	**93,923**	**100.0%**

Source: Milliman analysis based upon Bloomberg data as at 30 September 2019.

The table in Figure 3 shows the universe of AAA and AA bonds used in the asset calibration set broken down into the composition of their respective S&P, Moody's and Fitch ratings.

FIGURE 3: AUSTRALIAN AAA/AA CORPORATE BOND MARKET OUTSTANDING DEBT ($ MILLIONS)

Credit Rating Composition	Number of Securities	Outstanding ($ Millions)	% of Total
Combined Credit Rating of AAA			
3 AAA ratings	0	0	0.0%
2 AAA ratings	13	6,850	92.1%
1 AAA rating	2	590	7.9%
Total Combined AAA	**15**	**7,440**	100.0%
Combined Credit Rating of AA			
3 AA ratings	39	9,975	32.2%
2 AA ratings	67	18,300	59.1%
1 AA rating	12	2,680	8.7%
Total Combined AA	**118**	**30,955**	100.0%

Source: Milliman analysis based upon Bloomberg data as at 30 September 2019.

INTERPOLATION METHODOLOGY

For fitting the discount curve to the asset calibration set, the Merrill Lynch Exponential Spline (MLES) method with nine exponential basis functions was used calibrated to yield data as at 30 September 2019, weighting each issue by the inverse duration of the issue. The results of the calibrated MLES parameters are shown in Figure 4.

FIGURE 4: MLES-CALIBRATED PARAMETERS AS AT 30 SEPTEMBER 2019

MLES Parameters		
Long-Run	**b0**	5.7%
Param1	**λ1**	149.4%
Param2	**λ2**	105.5%
Param3	**λ3**	-266.6%
Param4	**λ4**	61.4%
Param5	**λ5**	54.9%
Param6	**λ6**	57.0%
Param7	**λ7**	-89.6%
Param8	**λ8**	26.4%
Param9	**λ9**	1.7%

For the calibration of the MLES basis functions, an adjusted R-squared statistical goodness-of-fit measure was applied to the difference between modelled and actual bond prices.

An adjusted R-squared statistic value close to 100% indicates a very good fit, whilst lower values (closer to 0%) indicate poor fits. Figure 5 shows the results of the interpolation analysis used.

FIGURE 5: ADJUSTED R-SQUARED STATISTIC AS AT 30 SEPTEMBER 2019

Regression Statistic	
Adjusted R-Squared	**96.5%**

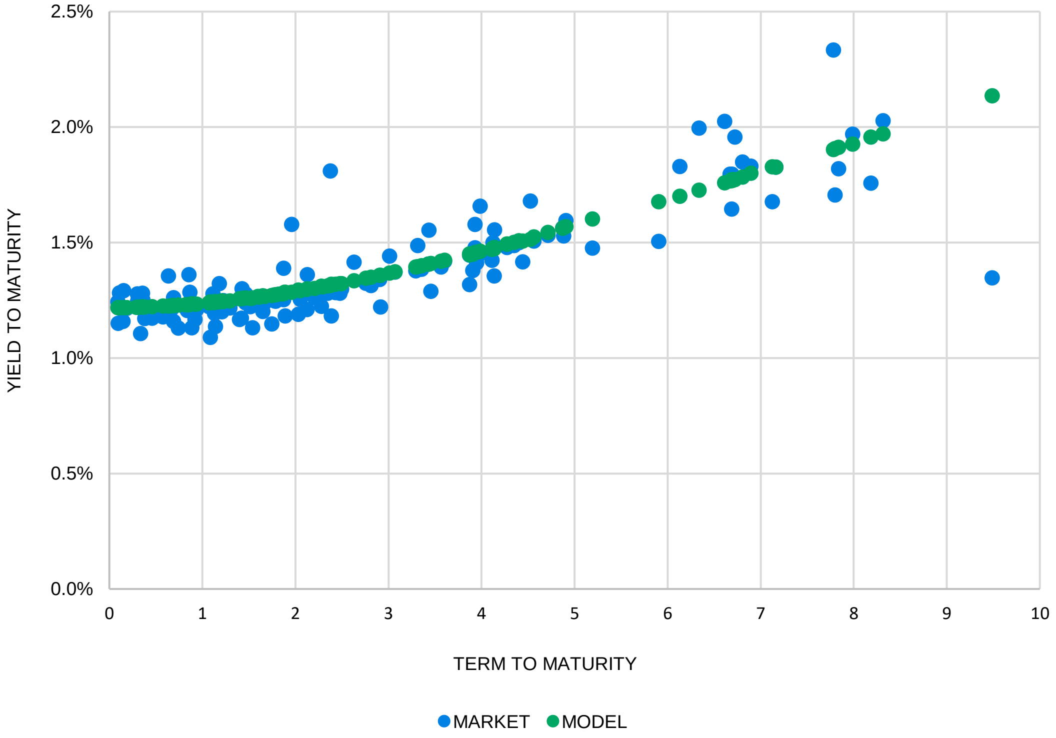
EXTRAPOLATION METHODOLOGY

For rates beyond 10-year maturities, the fitted yield curve has been extrapolated by assuming that 1-year forward rates remain constant for all subsequent maturities. This is based on the 1-year forward rate between 9- and 10-year maturities, based on the fitted MLES model.

3 Fitted Yield Curve

Figure 6 shows the modelled yield-to-maturity for each bond in the asset calibration set, compared with the actual yield-to-maturity, using the MLES method with inverse duration weightings. Note that these are the same bonds as those discussed and analysed in Section 2 above.

FIGURE 6: MODELLED VS. MARKET YIELDS TO MATURITY FOR ASSET CALIBRATION SET USING THE MLES METHOD WITH INVERSE DURATION WEIGHTINGS



Figures 7 and 8 show the resulting spot and forward yield curves of one to 50 years for the calibration set using the MLES method and extrapolated with the constant forward rate extrapolation method. Spot rates shown are quoted as annually compounded rates on zero coupon bonds with maturities of the specified term, forward rates shown are 1-year forward rates ending at the specified term.

FIGURE 7: SPOT AND FORWARD RATE CURVES FOR ASSET CALIBRATION SET USING AN MLES INTERPOLATION AND CONSTANT FORWARD RATE EXTRAPOLATION METHOD

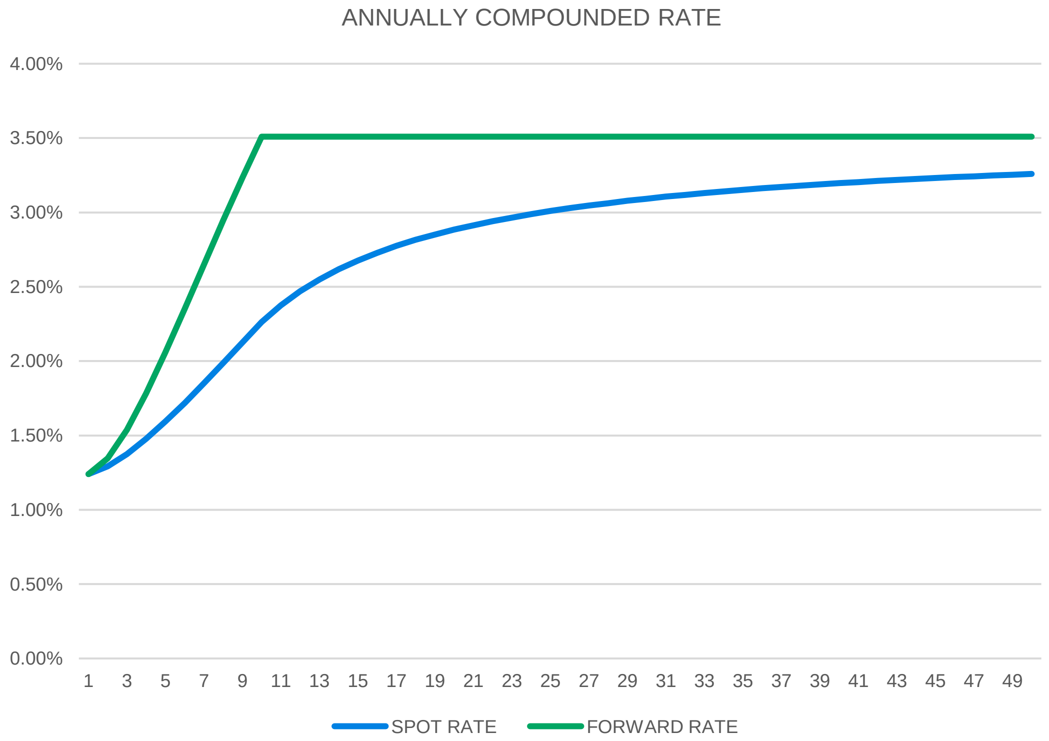


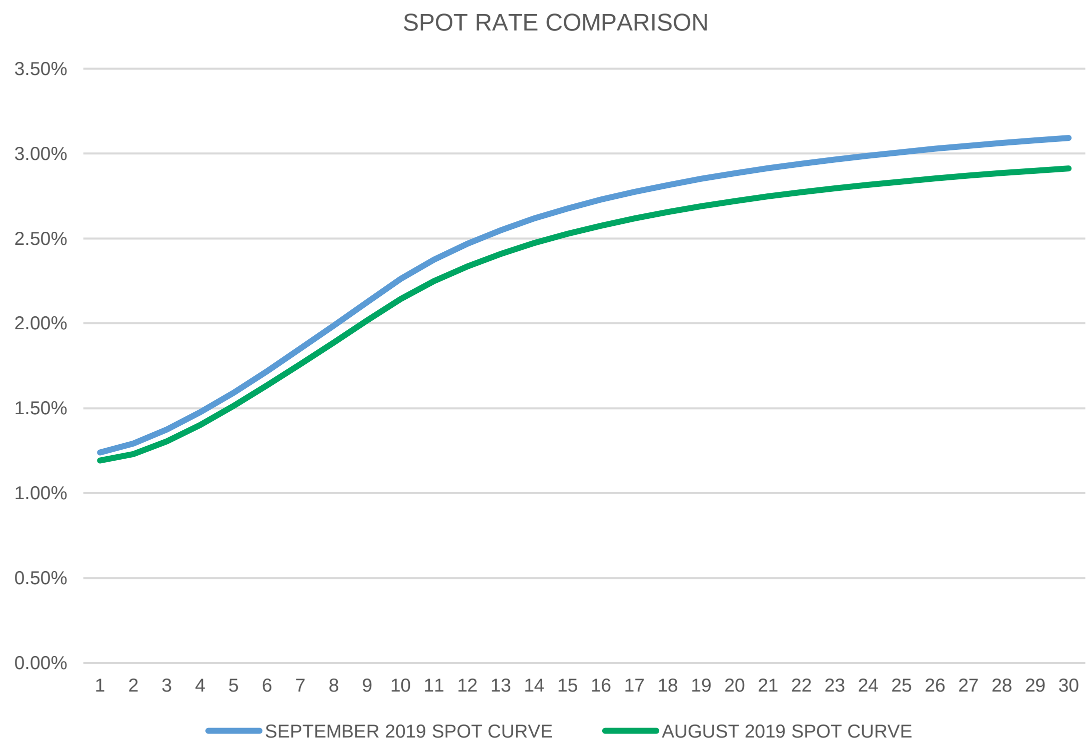
FIGURE 8: SPOT AND FORWARD RATE CURVES FOR ASSET CALIBRATION SET USING AN MLES INTERPOLATION AND CONSTANT FORWARD RATE EXTRAPOLATION METHOD

Term (Years)	Spot Rate	Discount Factor
1	1.24%	0.987751
2	1.29%	0.974626
3	1.37%	0.959861
4	1.48%	0.943046
5	1.59%	0.924016
6	1.72%	0.902779
7	1.85%	0.879465
8	1.99%	0.854292
9	2.13%	0.827527
10	2.26%	0.799470
11	2.38%	0.772364
12	2.47%	0.746178
13	2.55%	0.720879
14	2.62%	0.696438
15	2.68%	0.672825
16	2.73%	0.650013
17	2.77%	0.627975
18	2.82%	0.606683
19	2.85%	0.586114
20	2.88%	0.566242
21	2.91%	0.547043
22	2.94%	0.528496
23	2.97%	0.510578
24	2.99%	0.493267
25	3.01%	0.476542

Term (Years)	Spot Rate	Discount Factor
26	3.03%	0.460385
27	3.05%	0.444776
28	3.06%	0.429696
29	3.08%	0.415127
30	3.09%	0.401053
31	3.11%	0.387455
32	3.12%	0.374318
33	3.13%	0.361627
34	3.14%	0.349366
35	3.15%	0.337521
36	3.16%	0.326078
37	3.17%	0.315022
38	3.18%	0.304341
39	3.19%	0.294023
40	3.20%	0.284054
41	3.20%	0.274423
42	3.21%	0.265119
43	3.22%	0.256130
44	3.22%	0.247446
45	3.23%	0.239057
46	3.24%	0.230951
47	3.24%	0.223121
48	3.25%	0.215556
49	3.25%	0.208248
50	3.26%	0.201187

Figure 9 shows the resulting spot rate curve of one to 30 years relative to the prior period fitted curve.

FIGURE 9: SPOT RATE CURVES RELATIVE TO PRIOR PERIOD FITTED CURVE



Milliman

CONTACT

Craig McCulloch
craig.mcculloch@milliman.com

Jessica Lim
jessica.lim@milliman.com