The practical guide for ZARONIA-linked bond market instruments

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1. Overview

In international markets there has been a change in standards from using the interbank offered rates (IBORs) as reference rates to the use of more robust, alternative reference rates (ARRs), namely overnight reference rates (ONRRs) that are near risk-free and based on actual transactions. South Africa, through the South African Reserve Bank (SARB) has proposed the use of the South African Overnight Index Average (ZARONIA) as its ONRR.

Floating rate notes (FRNs) provide for the payment of interest for interest periods where each interest payment amount is dependent on the level of a reference rate. A margin/spread above the specified reference rate reflects the credit risk of the issuer and the structure and maturity of the note. Liquidity in the secondary market will determine demand for the instrument.

This document serves as a practical guide to applying the recommended ZARONIA conventions for FRNs. It does not cover pricing and valuations of such FRNs in the secondary market as each market participant will need to develop their own curves for projecting forward coupons and the discounting thereof. For a detailed technical explanation please refer to the 'Market conventions for ZARONIA-based Cash Market Instruments (Bond Market)' and the accompanying example spreadsheet.

2. Recommended conventions

The pertinent recommended conventions in the application of ZARONIA to FRNs are summarised below:

- The daily overnight rate is compounded over the interest period and is backward looking (i.e. the interest rate will not be known until the end of the interest period).
- To provide visibility of payment a 5-business day lookback without an observation shift is applied using the ZAJO calendar.
- The compounded rate is expressed as simple actual/365 and is rounded to six decimal places (four decimal places if expressed as a percentage).
- The margin/spread is added to the above compounded rate.
- Interest is then calculated rounding to two decimal places.

3. Calculating interest

To calculate the interest amount one can compound the daily ZARONIA rate over the interest period using the prescribed five-business-day lookback. This will be required for secondary market trading to calculate accrued interest to settle. Clean price calculation will most likely be par from an interest rate perspective but not from a credit spread perspective.

The following steps can be followed to calculate the rate and corresponding interest amount:

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to interest start date and less than interest end date.
- **Step 2:** For each good business day look up the ZARONIA rate, r_{i-5bd}.
- **Step 3:** Create a compounding index starting at 1 and apply the rates in **Step 2** over the respective days to accrue interest.

$$CompoundingIndex = \prod_i \left(1 + r_{i-5bd} * \frac{BusDay_{i+1} - BusDay_i}{365}\right)$$

- **Step 4:** Calculate the growth in the index expressed in simple terms over the period rounded to six decimal places (four decimal places if expressed as a percentage).

$$Rate = (CompoundingIndex - 1) * \left(\frac{365}{EndDate - StartDate}\right)$$

- **Step 5:** Add the FRN spread to the $Rate$ in **Step 4** over the interest period to determine the interest amount.

$$InterestAmount = Nominal * (Rate + Spread) * \left(\frac{EndDate - StartDate}{365}\right)$$

- **Step 6:** Round the $InterestAmount$ to two decimal places.

4. Accrued interest

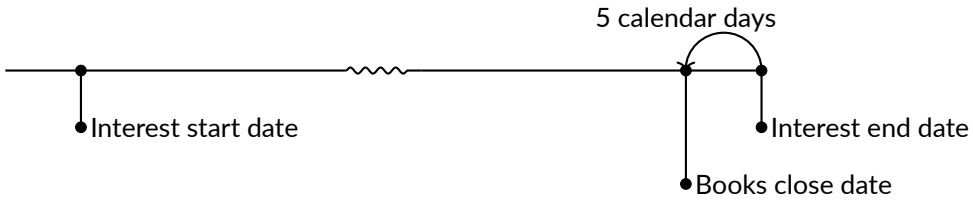
Accrued interest is determined in the same way as a conventional interest payment but is usually determined across a shorter interval as FRNs are often traded in the mid-interest period, especially in the secondary market.

A determining factor of whether accrued interest is due to either party is the books close date (BCD). The exchange uses the BCD to determine to whom the whole interest payment should be made.

The recommended BCD convention is five calendar days.

A bond settling before the BCD is known to be trading CUM or with its coupon. In this case, the bond purchaser should compensate the bond seller for the interest accrued to settlement date, as the bond purchaser will receive the entire coupon. This accrued interest would be calculated from the last coupon date (LCD) to the bond settlement date. A bond settling on or after the BCD is known to be trading EX or without its coupon.

Figure 1: Books close date.



The bond purchaser should then be compensated by the bond seller on a prorated basis for the days the seller will not receive any coupon as the coupon is due to the seller. This accrued interest is calculated from the bond settlement date to the next coupon date.

5. Worked examples

The following example will be used throughout the document to demonstrate the interest calculation and accrued interest described in the previous sections. For completeness, the date generation and adjustments will be performed. These, however, are consistent with the current FRN conventions. Consider an FRN with the following details:

Table 1: FRN example details.

Trade date	28-Mar-2023
Settlement date	31-Mar-2023
Tenor	3 years
Interest frequency	3-month
Index	ZARONIA
Traded spread	2.00%
Nominal	ZAR1 million

The interest payment dates are generated backward from the unadjusted maturity date, 31-Mar-2026. Since the unadjusted maturity date falls on the end of the month, each interest end date is assumed to be the end of its month. The dates are all then adjusted using a modified following convention, ensuring that the interest payment does not get paid into the following month.

Table 2: Interest dates.

Unadjusted dates	Adjusted dates
31-Mar-2023 Fri	31-Mar-2023 Fri
30-Jun-2023 Fri	30-Jun-2023 Fri
30-Sep-2023 Sat	29-Sep-2023 Fri
31-Dec-2023 Sun	29-Dec-2023 Fri
31-Mar-2024 Sun	28-Mar-2024 Thu
30-Jun-2024 Sun	28-Jun-2024 Fri
30-Sep-2024 Mon	30-Sep-2024 Mon
31-Dec-2024 Tue	31-Dec-2024 Tue
31-Mar-2025 Mon	31-Mar-2025 Mon
30-Jun-2025 Mon	30-Jun-2025 Mon
30-Sep-2025 Tue	30-Sep-2025 Tue
31-Dec-2025 Wed	31-Dec-2025 Wed
31-Mar-2026 Tue	31-Mar-2026 Tue

5.1. Compounding rate example

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to interest start date and less than interest end date.
- **Step 2:** For each good business day look up the ZARONIA rate, r_{i-5bd}, seen in Table 3.
- **Step 3:** Create a compounding index starting at 1 and apply the rates in **Step 2** over the respective days to accrue interest, seen in Table 3.

Table 3: Interest compounded rate example.

Ref rate	Accrual period		Lookback	Rate	Year frac	ON cap factor
	Start date	End date				
	Step 1		**Step 2**	**Step 2**		**Step 3**
ZARONIA	31-Mar-23	03-Apr-23	24-Mar-23	7.091%	3/365	$1 + 7.091\% \times \frac{3}{365}$
ZARONIA	03-Apr-23	04-Apr-23	27-Mar-23	7.091%	1/365	$1 + 7.091\% \times \frac{1}{365}$
ZARONIA	04-Apr-23	05-Apr-23	28-Mar-23	7.091%	1/365	$1 + 7.091\% \times \frac{1}{365}$
ZARONIA	05-Apr-23	06-Apr-23	29-Mar-23	7.101%	1/365	$1 + 7.101\% \times \frac{1}{365}$
ZARONIA	06-Apr-23	11-Apr-23	30-Mar-23	7.095%	5/365	$1 + 7.095\% \times \frac{5}{365}$
ZARONIA	11-Apr-23	12-Apr-23	31-Mar-23	7.569%	1/365	$1 + 7.569\% \times \frac{1}{365}$
ZARONIA	12-Apr-23	13-Apr-23	03-Apr-23	7.586%	1/365	$1 + 7.586\% \times \frac{1}{365}$
ZARONIA	13-Apr-23	14-Apr-23	04-Apr-23	7.579%	1/365	$1 + 7.579\% \times \frac{1}{365}$
...	...	...	...	...	...	...
ZARONIA	20-Jun-23	21-Jun-23	12-Jun-23	8.067%	1/365	$1 + 8.067\% \times \frac{1}{365}$
ZARONIA	21-Jun-23	22-Jun-23	13-Jun-23	8.066%	1/365	$1 + 8.066\% \times \frac{1}{365}$
ZARONIA	22-Jun-23	23-Jun-23	14-Jun-23	8.067%	1/365	$1 + 8.067\% \times \frac{1}{365}$
ZARONIA	23-Jun-23	26-Jun-23	15-Jun-23	8.067%	3/365	$1 + 8.067\% \times \frac{3}{365}$
ZARONIA	26-Jun-23	27-Jun-23	19-Jun-23	8.070%	1/365	$1 + 8.070\% \times \frac{1}{365}$
ZARONIA	27-Jun-23	28-Jun-23	20-Jun-23	8.072%	1/365	$1 + 8.072\% \times \frac{1}{365}$
ZARONIA	28-Jun-23	29-Jun-23	21-Jun-23	8.087%	1/365	$1 + 8.087\% \times \frac{1}{365}$
ZARONIA	29-Jun-23	30-Jun-23	22-Jun-23	8.078%	1/365	$1 + 8.078\% \times \frac{1}{365}$
				Observation cap factor Step 4		$1 + 7.7439\% \times \frac{91}{365}$

Source for ZARONIA: SARB - ZARONIA interest rate benchmark webpage

- **Step 4:** Calculate the growth in the index expressed in simple terms over the period rounded to six decimal places. This is shown in the last row in Table 3.
- **Step 5:** Add the FRN spread to the $Rate$ in **Step 4** over the interest period to determine the interest amount.

$$InterestAmount = 1,000,000 * (7.7439\% + 2.00\%) * \left(\frac{30Jun2023 - 31Mar2023}{365}\right) = 24,293.0109589041$$

- **Step 6:** Round the $InterestAmount$ to two decimal places, 24,293.01.

This interest amount would be paid at the end of the interest period, 30-Jun-2023.

5.2. Accrued interest CUM example

The accrued interest is an important factor in determining what interest has accrued on an FRN and is used in the secondary market when trading mid-coupon.

The BCD in our example is 25-Jun-2023, calculated by taking five calendar days off the interest end date, 30-Jun-2023. A purchaser of a bond before this date would receive the full coupon and therefore would need to pay the seller the interest accrued till the settlement date.

Let us assume we purchase the FRN defined in Table 1, settling on the 28-Apr-2023, before BCD.

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to the interest start date and less than settlement date.
- **Step 2:** For each good business day look up the ZARONIA rate, r_{i-5bd}, seen in Table 4.

- **Step 3:** Create a compounding index starting at 1 and apply the rates in **Step 2** over the respective days to accrue interest, seen in Table 4.
- **Step 4:** Calculate the growth in the index expressed in simple terms over the period rounded to six decimal places. This is shown in the last row in Table 4.

Table 4: Interest accrued CUM example.

Ref rate	Accrual period		Lookback	Rate	Year frac	ON cap factor
	Start date	End date				
	Step 1		**Step 2**	**Step 2**		**Step 3**
ZARONIA	31-Mar-23	03-Apr-23	24-Mar-23	7.091%	3/365	$1 + 7.091\% \times \frac{3}{365}$
ZARONIA	03-Apr-23	04-Apr-23	27-Mar-23	7.091%	1/365	$1 + 7.091\% \times \frac{1}{365}$
ZARONIA	04-Apr-23	05-Apr-23	28-Mar-23	7.091%	1/365	$1 + 7.091\% \times \frac{1}{365}$
ZARONIA	05-Apr-23	06-Apr-23	29-Mar-23	7.101%	1/365	$1 + 7.101\% \times \frac{1}{365}$
ZARONIA	06-Apr-23	11-Apr-23	30-Mar-23	7.095%	5/365	$1 + 7.095\% \times \frac{5}{365}$
ZARONIA	11-Apr-23	12-Apr-23	31-Mar-23	7.569%	1/365	$1 + 7.569\% \times \frac{1}{365}$
ZARONIA	12-Apr-23	13-Apr-23	03-Apr-23	7.586%	1/365	$1 + 7.586\% \times \frac{1}{365}$
ZARONIA	13-Apr-23	14-Apr-23	04-Apr-23	7.579%	1/365	$1 + 7.579\% \times \frac{1}{365}$
ZARONIA	14-Apr-23	17-Apr-23	05-Apr-23	7.580%	3/365	$1 + 7.580\% \times \frac{3}{365}$
ZARONIA	17-Apr-23	18-Apr-23	06-Apr-23	7.578%	1/365	$1 + 7.578\% \times \frac{1}{365}$
ZARONIA	18-Apr-23	19-Apr-23	11-Apr-23	7.574%	1/365	$1 + 7.574\% \times \frac{1}{365}$
ZARONIA	19-Apr-23	20-Apr-23	12-Apr-23	7.573%	1/365	$1 + 7.573\% \times \frac{1}{365}$
ZARONIA	20-Apr-23	21-Apr-23	13-Apr-23	7.582%	1/365	$1 + 7.582\% \times \frac{1}{365}$
ZARONIA	21-Apr-23	24-Apr-23	14-Apr-23	7.585%	3/365	$1 + 7.585\% \times \frac{3}{365}$
ZARONIA	24-Apr-23	25-Apr-23	17-Apr-23	7.588%	1/365	$1 + 7.588\% \times \frac{1}{365}$
ZARONIA	25-Apr-23	26-Apr-23	18-Apr-23	7.591%	1/365	$1 + 7.591\% \times \frac{1}{365}$
ZARONIA	26-Apr-23	28-Apr-23	19-Apr-23	7.590%	2/365	$1 + 7.590\% \times \frac{2}{365}$
				Observation cap factor Step 4		$1 + 7.4094\% \times \frac{28}{365}$

Source for ZARONIA: SARB - ZARONIA interest rate benchmark webpage

- **Step 5:** Add the FRN spread to the $Rate$ in **Step 4** over the interest period to determine the interest amount.

$$InterestAmount = 1,000,000 * (7.4094\% + 2.00\%) * \left(\frac{28Apr2023 - 31Mar2023}{365}\right) = 7,218.1698630137$$

- **Step 6:** Round the $InterestAmount$ to two decimal places, $7,218.17$.

This interest amount would be paid at the end of the interest period, 30-Jun-2023.

The seller of the bond should be compensated for this interest accrued in the price of the bond. This interest amount would be paid at the end of the interest period, 30-Jun-2023.

Current fixed rate bond pricing rounds accrued interest to five decimal places on a 100 nominal bond, 0.72182. This would infer an interest amount of $7,218.20$.

5.3. Accrued interest EX example

The BCD in our example is 25-Jun-2023, calculated by taking five calendar days off the interest end date, 30-Jun-2023. A purchaser of a bond before this date would receive the full coupon and therefore would need to pay the seller the interest accrued till the settlement date.

Let us now assume we purchase the FRN defined in Table 1, settling on the 26-Jun-2023, after BCD.

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to the settlement date and less than the interest end date.
- **Step 2:** For each good business day look up the ZARONIA rate, r_{i-5bd}, seen in Table 5.
- **Step 3:** Create a compounding index starting at 1 and apply the rates in **Step 2** over the respective days to accrue interest, seen in Table 5.
- **Step 4:** Calculate the growth in the index expressed in simple terms over the period rounded to six decimal places. This is shown in the last row in Table 5.

Table 5: Interest accrued EX example.

Ref rate	Accrual period		Lookback	Rate	Year frac	ON cap factor
	Start date	End date				
	Step 1		Step 2	Step 2		Step 3
ZARONIA	26-Jun-23	27-Jun-23	19-Jun-23	8.070%	$1/365$	$1 + 8.070\% \times \frac{1}{365}$
ZARONIA	27-Jun-23	28-Jun-23	20-Jun-23	8.072%	$1/365$	$1 + 8.072\% \times \frac{1}{365}$
ZARONIA	28-Jun-23	29-Jun-23	21-Jun-23	8.087%	$1/365$	$1 + 8.087\% \times \frac{1}{365}$
ZARONIA	29-Jun-23	30-Jun-23	22-Jun-23	8.078%	$1/365$	$1 + 8.078\% \times \frac{1}{365}$
					Observation cap factor Step 4	$1 + 8.0794\% \times \frac{4}{365}$

Source for ZARONIA: SARB - ZARONIA interest rate benchmark webpage

- **Step 5:** Add the FRN spread to the $Rate$ in **Step 4** over the interest period to determine the interest amount.

$$InterestAmount = 1,000,000 * (8.0794\% + 2.00\%) * \left(\frac{30Jun2023 - 26Jun2023}{365}\right) = -1,104.5952043528$$

- **Step 6:** Round the $InterestAmount$ to two decimal places, $-1,104.60$.

Notice that the accrued interest is negative since the buyer will not receive interest from 26-Jun-2023 till 30-Jun-2023. The buyer of the bond should be compensated for this interest not received. The bond seller owned the bond on BCD and therefore will receive the full coupon on the interest end date.

Current fixed rate bond pricing rounds accrued interest to five decimal places on a 100 nominal bond, -0.11046. This would infer an interest amount of $-1,104.60$.

Note: it is important that FRNs have an ex-interest date of five calendar days that is always less than or equal to the five-business day lookback.

Glossary

List of acronyms

ARR alternative reference rate. 4

BCD books close date. 5, 7, 8, 9

FRN floating rate note. 3, 4, 5, 6, 7, 8, 9

IBOR interbank offered rates. 4

ONRR overnight reference rate. 4

SARB South African Reserve Bank. 4

ZAJO South African calendar - Johannesburg Financial Centre. 4

ZARONIA South African Overnight Index Average. 4, 6, 7, 8, 9