

The practical guide for ZARONIA-linked loans

prepared by
**The Market Practitioners Group's
Cash Market Workstream**



SOUTH AFRICAN RESERVE BANK



Contents

1. Overview	4
2. Recommended conventions	4
3. Calculating interest	4
3.1. Compounded rate	4
3.2. Simple average rate	5
4. Prepayments and secondary market	6
5. Worked examples	7
5.1. Compounded rate example	7
5.2. Accrued interest example	8
5.3. Simple average rate example	9
Glossary	11



Tables and figures

List of tables

1	Linked loan example details.	7
2	Interest dates.	7
3	Interest compounded rate example.	8
4	Interest observation dates and calculation.	9
5	Interest simple average rate example.	10

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. 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 linked loans provide for the payment of interest where each interest payment amount is dependent on the level of a reference rate. A margin above the specified reference rate reflects the credit risk of the issuer and the structure and maturity of the loan.

This document serves as a practical guide to applying the recommended ZARONIA conventions for loans. For a more detailed explanation please refer to the 'Market conventions for ZARONIA-linked loans' and the accompanying example spreadsheet.

2. Recommended conventions

The pertinent recommended conventions in the application of ZARONIA to loans 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 five-business day lookback without 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 is then added to the above compounded rate.
- Interest payment amount is calculated rounding to two decimal places.

3. Calculating interest

Interest is determined by applying a ZARONIA rate on each day of the interest period. This section explains how a compounded daily overnight rate is calculated over an interest period.

Although not recommended, Section 3.2. explains, for completeness, how a simple average interest method works.

3.1. Compounded rate

To calculate the interest payment amount one can compound the relevant daily ZARONIA rate over the interest period and apply this to the nominal (this is known as the cumulative compounded rate (CCR)).

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

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to the interest start date and less than the interest end date.
- **Step 2:** For each good business day, look back five business days to find the ZARONIA rate, r_{i-5bd} , using the ZAJO calendar.

- **Step 3:** Create a compounding factor starting at 1 applying the rates in **Step 2** over the respective days to accrue interest (note that the rate on a Friday, for example, would apply for three days to include the weekend).

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

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

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

This is also known as the annualised cumulative compounded risk-free rate (RFR) (ACR) (also known as CCR).

- **Step 5:** Add the loan margin to the *Rate* in **Step 4** and apply over the interest period to determine the interest amount.

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

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

3.2. Simple average rate

To calculate the interest amount on a simple average basis one can average the relevant daily ZARONIA rates over the interest period and apply this to the nominal.

It must be noted that this method will give a different interest amount compared to the compounded rate calculation. The quoted margin should take cognisance of the rate averaging or compounding calculation.

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

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to the interest start date and less than the interest end date.
- **Step 2:** For each good business day, look back five business days to find the ZARONIA rate, r_{i-5bd} , using the ZAJO calendar.
- **Step 3:** Determine a weighted average rate based on the business dates (note that the rate on a Friday, for example, would apply for three days to include the weekend).

$$SimpleAverage = \sum_i \left(\frac{r_{i-5bd} * (BusDay_{i+1} - BusDay_i)}{EndDate - StartDate} \right)$$

- **Step 4:** Add the loan margin to the rate in **Step 3** and apply over the interest period to determine the interest amount.

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

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

4. Prepayments and secondary market

Prepayment and secondary market trading in loans mid-interest period is not uncommon. As the CCR method described in section 3.1 calculates a single compounded rate from the beginning of the interest period, there may be complexity when dealing with mid-interest period events if proportional accrued interest is not also prepaid, and for secondary market trading. For this reason, it is critical to have a consistent calculation method for the accrued interest.

For market participants who need to regularly deal with mid-interest period events, the use of a non-cumulative compounded rate (NCCR) (which is a daily compounded rate derived from CCR) may be preferred (see below).

In relation to secondary trades, if a lender sells out of a loan completely, they are owed interest based on the time they held part of the loan and do not earn further interest after they leave. They will be paid at the end of the interest period. A new lender buying into a loan during the interest period will have their interest calculated using the compounded rate as of that day in the interest period (i.e. NCCR for that day can be used). Interest will not compound separately from the date they buy.

To determine the NCCR for any given business day, first one needs to complete **Step 1 to Step 4** in section 3.1. for each good business date in the interest period, remembering to round to six decimal points (four decimal places if expressed as a percentage). The NCCR can then be inferred from the ACR using the following equation:

$$NCCR_i = \left(ACR_i * \frac{i}{365} - ACR_{i-1} * \frac{i-1}{365} \right) * \frac{365}{1bd}$$

NCCR can be used to determine interest for any given business day and the interest amounts can be added to calculate the interest for the entire interest period. It is important that daily interest amounts are not rounded to ensure that the final interest accrual calculated by the sum of the (unrounded) daily accruals equals the interest accrual produced if using the CCR at the end of the period. Please refer to the accompanying example spreadsheet.

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 described. These, however, are consistent with the current linked loan conventions. Consider the following loan:

Table 1: Linked loan example details.

Settlement date	14-Mar-2023
Tenor	1 year
Interest frequency	1-month
Index	ZARONIA
Margin	2.00%
Nominal	ZAR1 million

The interest payment dates are generated as if the loan was drawn immediately. 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
14-Mar-2023 Tue	14-Mar-2023 Tue
14-Apr-2023 Fri	14-Apr-2023 Fri
14-May-2023 Sun	15-May-2023 Mon
14-Jun-2023 Wed	14-Jun-2023 Wed
14-Jul-2023 Fri	14-Jul-2023 Fri
14-Aug-2023 Mon	14-Aug-2023 Mon
14-Sep-2023 Thu	14-Sep-2023 Thu
14-Oct-2023 Sat	16-Oct-2023 Mon
14-Nov-2023 Tue	14-Nov-2023 Tue
14-Dec-2023 Thu	14-Dec-2023 Thu
14-Jan-2024 Sun	15-Jan-2024 Mon
14-Feb-2024 Wed	14-Feb-2024 Wed
14-Mar-2024 Thu	14-Mar-2024 Thu

5.1. Compounded rate example

To calculate the interest amount for an interest period one can compound the relevant daily ZARONIA rate over the interest period and apply this to the nominal.

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 the interest start date and less than the interest end date, seen in Table 3.
- **Step 2:** For each good business day, look back five business days to find the ZARONIA rate, r_{i-5bd} , using the ZAJC calendar, seen in Table 3.

- **Step 3:** Create a compounding factor starting at 1 and apply the rates in **Step 2** over the respective days to accrue interest, seen in Table 3. 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	14-Mar-23	15-Mar-23	07-Mar-23	7.087%	1/365	$1 + 7.087\% \times \frac{1}{365}$
ZARONIA	15-Mar-23	16-Mar-23	08-Mar-23	7.085%	1/365	$1 + 7.085\% \times \frac{1}{365}$
ZARONIA	16-Mar-23	17-Mar-23	09-Mar-23	7.088%	1/365	$1 + 7.088\% \times \frac{1}{365}$
ZARONIA	17-Mar-23	20-Mar-23	10-Mar-23	7.089%	3/365	$1 + 7.089\% \times \frac{3}{365}$
ZARONIA	20-Mar-23	22-Mar-23	13-Mar-23	7.090%	2/365	$1 + 7.090\% \times \frac{2}{365}$
ZARONIA	22-Mar-23	23-Mar-23	14-Mar-23	7.134%	1/365	$1 + 7.134\% \times \frac{1}{365}$
ZARONIA	23-Mar-23	24-Mar-23	15-Mar-23	7.088%	1/365	$1 + 7.088\% \times \frac{1}{365}$
ZARONIA	24-Mar-23	27-Mar-23	16-Mar-23	7.087%	3/365	$1 + 7.087\% \times \frac{3}{365}$
ZARONIA	27-Mar-23	28-Mar-23	17-Mar-23	7.087%	1/365	$1 + 7.087\% \times \frac{1}{365}$
ZARONIA	28-Mar-23	29-Mar-23	20-Mar-23	7.089%	1/365	$1 + 7.089\% \times \frac{1}{365}$
ZARONIA	29-Mar-23	30-Mar-23	22-Mar-23	7.098%	1/365	$1 + 7.098\% \times \frac{1}{365}$
ZARONIA	30-Mar-23	31-Mar-23	23-Mar-23	7.092%	1/365	$1 + 7.092\% \times \frac{1}{365}$
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	$1 + 7.579\% \times \frac{1}{365}$
Observation cap factor Step 4						$1 + 7.1595\% \times \frac{31}{365}$

Source for ZARONIA: [SARB - ZARONIA interest rate benchmark webpage](#)

- **Step 4:** Calculate the growth in the factor expressed in simple terms over the period rounded to six decimal places, shown in the last row of Table 3.
- **Step 5:** Add the loan margin to the *Rate* in **Step 4** and apply over the interest period to determine the interest amount.

$$InterestAmount = 1,000,000 * (7.1595\% + 2.00\%) * \left(\frac{14Apr23 - 14Mar23}{365} \right) = 7,779.3013698630$$

- **Step 6:** Round the *InterestAmount* to two decimal places, 7,779.30.

5.2. Accrued interest example

The accrued interest is an important factor in determining what interest has accrued on a linked loan and is used in the secondary market when trading mid-interest period or when a client makes an early prepayment.

Let us assume we purchase the linked loan defined in Table 1, settling on the 28-Mar-2023. One can now use the method described in section 3.1. replacing the end date with the settlement date and follow the same calculation steps.

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to the interest start date and less than the interest end date, shown in Table 4.

- **Step 2:** For each good business day look back five business days to find the ZARONIA rate, r_{i-5bd} , using the ZAJO calendar, seen in Table 4.
- **Step 3:** Create a compounding factor starting at 1 applying the rates in **Step 2** over the respective days to accrue interest, as can be seen in Table 4.
- **Step 4:** Calculate the growth in the factor expressed in simple terms over the period rounded to six decimal places, shown in the last row of Table 4.

Table 4: Interest observation dates and calculation.

Ref rate	Accrual period		Lookback	Rate	Year frac	ON cap factor
	Start date	End date				
	Step 1		Step 2	Step 2		Step 3
ZARONIA	14-Mar-23	15-Mar-23	07-Mar-23	7.087%	1/365	$1 + 7.087\% \times \frac{1}{365}$
ZARONIA	15-Mar-23	16-Mar-23	08-Mar-23	7.085%	1/365	$1 + 7.085\% \times \frac{1}{365}$
ZARONIA	16-Mar-23	17-Mar-23	09-Mar-23	7.088%	1/365	$1 + 7.088\% \times \frac{1}{365}$
ZARONIA	17-Mar-23	20-Mar-23	10-Mar-23	7.089%	3/365	$1 + 7.089\% \times \frac{3}{365}$
ZARONIA	20-Mar-23	22-Mar-23	13-Mar-23	7.090%	2/365	$1 + 7.090\% \times \frac{2}{365}$
ZARONIA	22-Mar-23	23-Mar-23	14-Mar-23	7.134%	1/365	$1 + 7.134\% \times \frac{1}{365}$
ZARONIA	23-Mar-23	24-Mar-23	15-Mar-23	7.088%	1/365	$1 + 7.088\% \times \frac{1}{365}$
ZARONIA	24-Mar-23	27-Mar-23	16-Mar-23	7.087%	3/365	$1 + 7.087\% \times \frac{3}{365}$
ZARONIA	27-Mar-23	28-Mar-23	17-Mar-23	7.087%	1/365	$1 + 7.087\% \times \frac{1}{365}$
Observation cap factor Step 4						$1 + 7.0995\% \times \frac{31}{365}$

Source for ZARONIA: [SARB - ZARONIA interest rate benchmark webpage](#)

- **Step 5:** Add the loan margin to the *Rate* in **Step 4** and apply over the interest period to determine the interest amount.

$$InterestAmount = 1,000,000 * (7.0995\% + 2.00\%) * \left(\frac{28Mar23 - 14Mar23}{365} \right) = 2,723.0958904110$$

- **Step 6:** Round the *InterestAmount* to two decimal places, 2,723.10.

The seller of the linked loan should be compensated for the interest that has accrued in the price of the loan.

5.3. Simple average rate example

To calculate the interest amount on a simple average basis one can also average the relevant daily ZARONIA rates over the interest period and apply this to the nominal.

The following steps can be followed to calculate the simple average rate and corresponding interest payment:

- **Step 1:** Determine all the good business days, $BusDay_i$, greater than or equal to the interest start date and less than the interest end date, seen in Table 5.
- **Step 2:** For each good business day look back five business days to find the ZARONIA rate, r_{i-5bd} , using the ZAJO calendar, seen in Table 5.
- **Step 3:** Determine a weighted average rate based on the business dates. This can be seen in the last row of Table 5.
- **Step 4:** Add the loan margin to the rate in **Step 3** and apply over the interest period to determine the interest amount.

$$InterestAmount = 1,000,000 * (7.1394\% + 2.00\%) * \left(\frac{14Apr2023 - 14Mar2023}{365} \right) = 7,762.2191780822$$



Table 5: Interest simple average 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	14-Mar-23	15-Mar-23	07-Mar-23	7.087%	1/365	$7.087\% \times \frac{1}{365}$
ZARONIA	15-Mar-23	16-Mar-23	08-Mar-23	7.085%	1/365	$7.085\% \times \frac{1}{365}$
ZARONIA	16-Mar-23	17-Mar-23	09-Mar-23	7.088%	1/365	$7.088\% \times \frac{1}{365}$
ZARONIA	17-Mar-23	20-Mar-23	10-Mar-23	7.089%	3/365	$7.089\% \times \frac{3}{365}$
ZARONIA	20-Mar-23	22-Mar-23	13-Mar-23	7.090%	2/365	$7.090\% \times \frac{2}{365}$
ZARONIA	22-Mar-23	23-Mar-23	14-Mar-23	7.134%	1/365	$7.134\% \times \frac{1}{365}$
ZARONIA	23-Mar-23	24-Mar-23	15-Mar-23	7.088%	1/365	$7.088\% \times \frac{1}{365}$
ZARONIA	24-Mar-23	27-Mar-23	16-Mar-23	7.087%	3/365	$7.087\% \times \frac{3}{365}$
ZARONIA	27-Mar-23	28-Mar-23	17-Mar-23	7.087%	1/365	$7.087\% \times \frac{1}{365}$
ZARONIA	28-Mar-23	29-Mar-23	20-Mar-23	7.089%	1/365	$7.089\% \times \frac{1}{365}$
ZARONIA	29-Mar-23	30-Mar-23	22-Mar-23	7.098%	1/365	$7.098\% \times \frac{1}{365}$
ZARONIA	30-Mar-23	31-Mar-23	23-Mar-23	7.092%	1/365	$7.092\% \times \frac{1}{365}$
ZARONIA	31-Mar-23	03-Apr-23	24-Mar-23	7.091%	3/365	$7.091\% \times \frac{3}{365}$
ZARONIA	03-Apr-23	04-Apr-23	27-Mar-23	7.091%	1/365	$7.091\% \times \frac{1}{365}$
ZARONIA	04-Apr-23	05-Apr-23	28-Mar-23	7.091%	1/365	$7.091\% \times \frac{1}{365}$
ZARONIA	05-Apr-23	06-Apr-23	29-Mar-23	7.101%	1/365	$7.101\% \times \frac{1}{365}$
ZARONIA	06-Apr-23	11-Apr-23	30-Mar-23	7.095%	5/365	$7.095\% \times \frac{5}{365}$
ZARONIA	11-Apr-23	12-Apr-23	31-Mar-23	7.569%	1/365	$7.569\% \times \frac{1}{365}$
ZARONIA	12-Apr-23	13-Apr-23	03-Apr-23	7.586%	1/365	$7.586\% \times \frac{1}{365}$
ZARONIA	13-Apr-23	14-Apr-23	04-Apr-23	7.579%	1/365	$7.579\% \times \frac{1}{365}$
Weighted average rate Step 3						$7.1394\% \times \frac{31}{365}$

Source for ZARONIA: [SARB - ZARONIA interest rate benchmark webpage](#)

- **Step 5:** Round the *Interest Amount* to two decimal places, 7,762.22.

Glossary

List of acronyms

ACR	annualised cumulative compounded rate. 5, 6
ARR	alternative reference rate. 4
CCR	cumulative compounded rate. 4, 5, 6
IBOR	interbank offered rates. 4
NCCR	non cumulative compounded rate. 6
ONRR	overnight reference rate. 4
RFR	risk-free rate. 5
SARB	South African Reserve Bank. 4
ZAJO	South African calendar - Johannesburg Financial Centre. 4, 5, 7, 9
ZARONIA	South African Overnight Index Average. 4, 5, 7, 8, 9, 10