

Calculation principles for the Swedish Money- and Bond market

This document is intended for transactions made as from April 2nd 2001

This document is an unofficial translation of the "Beräkningsprinciper för den svenska Penningmarknaden" published in April 1996 by the Swedish Securities Dealers Association. In the event of any inconsistency between the Swedish text and this translation, the Swedish text shall prevail.

1. Principles for interest rate listings

The normal procedure is that trading takes place in terms of interest rate. In conjunction therewith, the interest rate convention for the respective instrument is complied with. For example, treasury bills and certificates are listed with simple annual rates of interest, bonds with terms until maturity of more than one year are listed with the effective annual rate of interest, while bonds with terms until maturity of one year or less are listed with simple annual rates of interest. In the case of bonds, ISMA's convention 30E/360 is used whereas Act/360 is used for Treasury Bills and Certificates¹. Conventions for futures trading are regulated in accordance with the respective contract specification.

Instrument	Capitalisation period	Interest rate convention
Deposits, Repo interest rate, Central Bank of Sweden certificates	Term until maturity	Act/360
Treasury bills, Certificates	Term until maturity	Act/360
Bonds with term until maturity > 360 days	360 days (1 year)	30E/360
Bonds with term until maturity ? 360 days	Term until maturity	30E/360

ISMA's 30E/360 convention:

The basic assumption for 360 days calculation is that each month consists of 30 days. Based on this assumption, and provided that the processing of the date at the end of the month is clarified, the period measured as the number of days between two dates can be calculated in accordance with the following:

"360-days" between the dates $Y_1M_1D_1$ and $Y_2M_2D_2$:

if $D_1=31$ set D_1 to 30

if $D_2=31$ set D_2 to 30

"360-days" = $(D_2 - D_1) + (M_2 - M_1) * 30 + (Y_2 - Y_1) * 360$

¹ If not specifically agreed between the parties, Act/360 is the market convention for Treasury Bills and Certificates for all trades carried out with business date 2 April 2001 or later.

Special provision where a coupon date is 28 February

There are two types of bonds with coupon dates on 28 February depending on whether the 28th is equated with the last day in the month and the interest for February is calculated on the basis of 30 interest days, or whether the interest for February is calculated on the basis of 28 days. When calculating the accrued interest, consideration must be given to the actual circumstances. In this context, other coupon dates can provide guidance.

2. General principles for the calculation of spot market transactions.

The following principles apply to all types of interest-bearing instruments, i.e. to, *inter alia*, coupon bonds, real interest rate bonds with coupons, real interest rate bonds without coupons and treasury bills and other discount instruments.

Note that in conjunction with the rounding of the rate (D in the following formulae), there is a difference between the calculation of real interest rate bonds without coupons, on the one hand, and other bonds with or without coupons, as well as real interest rate bonds with coupons, on the other hand. Real interest rate bonds without coupons are in this context treated as a discount instrument, i.e. there is no rounding of the rate.

The price is calculated on the basis of the transaction interest rate, which then forms the basis for the calculation of the Total consideration. The Total consideration can be divided into the following components: accrued interest and gross consideration. Accrued interest is not rounded. The gross consideration is calculated by multiplying the nominal amount by a rate calculated on the basis of the transaction interest rate and rounded to an agreed number of decimal places (in the calculation, a rate corresponding to 100.345 results in a factor of 1.00345). The rounding of the Total consideration, i.e. the total of the Gross consideration and the accrued interest, is thus dependent on the size of the nominal amount. In respect of bonds, the rate is rounded to the nearest three decimal places, while the rate for, e.g., OM's synthetic futures is currently rounded to five decimal places. The Total consideration for treasury bills is calculated by discounting the nominal amount by the transaction interest rate, after which the thereupon obtained amount is rounded to the nearest whole krona. The rate for treasury bills is thus not rounded to a pre-determined number of decimal places, but rather the rounding is carried out only in conjunction with the calculation of the Total consideration. For the purpose of reconciliation, however, the rate is often indicated to six decimal places, i.e. the number of decimal places which provides a correct rounded amount for the nominal sum of SEK 100 million. Generally, it is important in all cases that all sub-amounts are calculated with sufficient precision in order for the rounding of the Total consideration to be correct.

$$P = I + \sum_{i=1}^n \frac{CF_i}{(1 + r_k/k)^{T_i/k}}$$

$$U = I + \frac{360}{d_c} \cdot Cpn$$

$$K = \text{Round}(P + U; D)$$

$$L = \text{Round}\left(\frac{K + U}{100} \cdot N; 0\right)$$

where:

Cf_i = Payment flow at the time T_i

Cpn = Coupon for securities

D = Number of decimal places to which the rate is rounded (3 for coupon bonds, no rounding for discount paper)

d_c = Number of days until next coupon

I = Index factor for settlement date – see further under point 4 ($I = 1$ for all nominal securities)

k = Capitalisation period (where k is 1 for securities with effective annual interest rates and equated with T_i for securities with simple annual interest rates)

K = Price for the security

L = Total consideration

N = Nominal amount

P = Amount for the security

r_k = Interest with capitalisation period k

T_i = Term (years) until payment CF_i

U = Accrued interest

**Example 1: Government bond number. 1020,
(coupon: 10.75, maturity date: 23 January 1997)**

Settlement date: 15 March 1995

Transaction interest rate: 10.06

Nominal amount : SEK 40 million

$$P_x = \frac{10.75}{(1 + 0.1006)^{308/360/1}} + \frac{10.75 + 100}{(1 + 0.1006)^{688/360/1}} = 9.90358.. + 92.70387.. = 102.60745..$$

$$U = \frac{360 - 308}{360} \cdot 10.75 = 1.55278..$$

$$K = \text{Round}(P + U; 3) = \text{Round}(102.60745.. + 1.55278..; 3) = \text{Round}(104.16023..; 3) = 104.160$$

This results in the following amounts for the transaction:

Gross consideration: 40,000,000 x 1.01055 = 40,422,000

Accrued interest: 40,000,000 x 0.0155278.. = 62 111.2 = 621,111.2
 Total Consideration: (Gross consideration + Accrued interest; 0) = 41,043,111

Example 2: Treasury bill 19 September 2001

Settlement date: 01-04-04
 Maturity date: 01-09-19
 Days to maturity [01-09-19]-[01-04-04]=168
 Transaction interest rate: 4.02
 Nominal amount: SEK 40 million

$$P = \frac{100}{(1 + 0.0402 \cdot 168/360)} = 98.158546.$$

This results in the following amounts for the transaction:

Nominal amount 40 000 000
 Interest rate amount: Nominal amount – Settlement amount= 736 582
 Settlement Amount: Round (Nominal amount x 0.98158546 ;0)= 39 263 418

3. Principles for calculation of repurchase agreements

The rate for the first leg of the repurchase agreement is rounded in accordance with market principles for the instrument in question. The Total consideration for the second leg of the repurchase agreement is calculated on the basis of the first leg's Total consideration and actual repo interest rate, whereupon settlement for the second leg takes place at a rate with six decimal places. From this rate, the interest for the security can be calculated as required.

$$L_1 = \text{Round} \left(\frac{K_1 \cdot U_1}{100} ; N; 0 \right)$$

$$L_2^* = L_1 \cdot \left(1 + r_{rep} \cdot \frac{d_{rep}}{360} \right) + I_{Cpn} \cdot N \cdot \frac{Cpn}{100} \cdot \left(1 + r_{rep} \cdot \frac{T_2 - T_{Cpn}}{360} \right)^{\text{sgn}(T_2 - T_{Cpn})}$$

$$U_2 = I_2 \cdot \frac{360 \cdot d_{c2}}{360} + Cpn$$

$$K_2 = \text{Round} \left(\frac{L_2^*}{N} ; 100 ; U_2 ; D_2 \right)$$

$$L_2 = \text{Round} \left\{ \frac{K_2 \cdot U_2}{100} \cdot N; 0 \right\}$$

where:

- L_1 = Total consideration for repurchase agreement's first leg (in conjunction with settlement date 1)
- N = Nominal amount
- I_2 = Index factor for repurchase agreement's second settlement day - see separate paragraph for calculation ($I_2 = 1$ for all nominal securities)
- I_{Cpn} = Index factor for coupon payment date see separate paragraph for calculation ($I_{Cpn} = 1$ for all nominal securities)
- K_1 = Rate for repurchase agreement's first leg (calculated on the basis of relevant market interest rate and rounded in accordance with market practice)
- U_1 = Accrued interest for repurchase agreement's first leg
- L_2^* = Fictitious non-rounded amount for repurchase agreement's second leg
- {..} = Term added in conjunction with coupon reconciliation during the repo period
- Cpn = Coupon for securities
- T_2 = Repurchase agreement's second settlement date
- T_{Cpn} = Coupon payment date
- sgn = Signum function which gives the value +1 where $T_2 - T_{Cpn} > 0$ and the value -1 where $T_2 - T_{Cpn} < 0$
- r_{rep} = Repo interest rate (period interest, Act/360)
- d_{rep} = Term for repurchase agreement (actual number of days)
- d_{c2} = Number of days from repurchase agreement's second settlement date until the following coupon payment date (360 days)
- K_2 = Rate for repurchase agreement's second leg
- D_2 = Number of decimal places to which the rate on the repurchase agreement's second leg is rounded
- U_2 = Accrued interest for the repurchase agreement's second leg
- L_2 = Total consideration for repurchase agreement's second leg

**Example: Repurchase agreement for government obligation no. 1020,
(coupon: 10.75, maturity date: 23 January 1927)**

Settlement date 1:	95-03-15
Settlement date 2:	95-03-17
Market interest rate:	10.06
Repo interest rate:	7.95

Nominal amount: 40 million

$$P_1 = \frac{10.75}{(1 + 0.1006)^{308/360}} = \frac{10.75 + 100}{(1 + 0.1006)^{688/360}}$$

$$P_1 = 9.90358 \dots = 92.70387 \dots = 102.60745 \dots$$

$$U_1 = \frac{360 - 308}{360} \times 10.75 = 1.55278 \dots$$

$$K_1 = \text{Round}(P_1 + U_1; 3) = \text{Round}(102.60745 \dots + 1.55278 \dots; 3) = \text{Round}(104.16023 \dots; 3) = 104.160$$

This results in the following amounts for the first leg of the repo transaction:

Gross consideration: 40,000,000 x 1.01055 = 40,422,000

Accrued interest: 40,000,000 x 0.0155278 = 621,111.2

Total consideration: Round(Gross consideration + Accrued interest; 0) = 41,043,111

$$L_2^* = L_1 \times (1 + r_{\text{rep}} \times \frac{d_{\text{rep}}}{360}) = 41\,043\,111 \times (1 + 0.0795 \times \frac{2}{360}) = 41\,061\,238.37$$

$$U_2 = \frac{360 - d_{c2}}{360} \times \text{Cpn} = \frac{360 - 306}{360} \times 10.75 = 1.6125$$

$$K_2 = \text{Round}(\frac{L_2^*}{N} \times 100 + U_2; D_2) = \text{Round}(\frac{41\,061\,238.37}{40\,000\,000} \times 100 + 1.6125; 5)$$

$$K_2 = \text{Round}(101.0405959 \dots; 5) = 101.04060$$

$$L_2 = \text{Round}(\frac{K_2 \times U_2}{100} \times N; 0) = \text{Round}((101.04060 + 1.6125) \times 40\,000\,000 / 100; 0)$$

$$L_2 = 41\,061\,240$$

This results in the following amount for the second leg of the repo transaction:

Gross consideration: 40,000,000 x 1.0104060 = 40,416,240

Accrued interest: 40,000,000 x 0.016125 = 645,000

Total Consideration: Round(Gross consideration + Accrued interest; 0) = 41,061,240

4. Principles for the calculation of index factors for real interest rate bonds

The reference index for the first day of every month is comprised of the consumer price index for the month which occurred three months prior thereto. The reference index for other days in a month is obtained through a linear interpolation between the reference indices which occurred two and three months prior thereto. In conjunction with the calculation, no month is assumed to have more than 30 days.

A base index is linked to every loan. However, during a single period several loans may have the same base index.

$$I = \frac{\text{Reference index}_{\text{Settlement date}}}{\text{Base index}}$$

$$\text{Reference index}_{\text{Settlement date}} = F_{M-3} + \frac{d_L - 1}{30} (F_{M-2} - F_{M-3})$$

where:

d_L = The calendar day on which the settlement date occurs (the 31st is, however, changed to the 30th).

F_{M-x} = Official index for inflation for the calendar month which occurred x months prior to the settlement date.

Example: Purchase of real interest rate bonds 3101 with settlement 7 February 1996.

Base index = 245,1

Consumer price index for November 1995 = 256.8

Consumer price index for December 1995 = 256

$$\text{Reference index}_{7 \text{ Feb } 96} = \text{Reference index}_{1 \text{ Feb } 96} + \frac{7-1}{30} (\text{Reference index}_{1 \text{ March } 96} - \text{Reference index}_{1 \text{ Feb } 96})$$

$$= 256,8 + 0,2 (256 - 256,8) = 256,64$$

$$I = \frac{\text{Reference index}_{6 \text{ Feb } 96}}{\text{Base index}} = \frac{256,64}{245,1} = 1,04708282\dots$$

5. Principles for handling of coupons due during repurchase agreement terms

In conjunction with repurchase agreements with terms past coupon payment, a number of parameters are added in order to unequivocally establish the relationship between the two Total considerations which form the basis of the repurchase agreement.

5.1 Re-investment interest or discount interest for coupon payments

Unless otherwise agreed, coupon payments are re-invested at the repo interest rate, i.e. at an interest rate based on the actual number days (Act/360). In a corresponding manner, reconciled but non-paid coupons are discounted to the repo interest rate. In this context, regard is not normally given to the fact that the original repo interest rate normally has a capitalisation period which is different from the period during which the coupons are re-

invested or discounted. In the event the coupon is paid during the repo period, the coupon is re-invested until the expiry date of the repurchase agreement. If, on the other hand, the coupon is reconciled during the repo period but only paid after the repurchase agreement's expiry date, the coupon is instead discounted to the repurchase agreement's expiry date. When calculating the Total consideration for the repurchase agreement's second leg, a hypothetical Total consideration is first calculated on the basis of the repo interest rate and the Total consideration for the first leg. From this, hypothetical Total consideration, the current value of the coupon payment is then subtracted on the basis of the repurchase agreement's second settlement date.

5.2 Processing of coupons which are theoretically paid on days which are not bank days

In conjunction with normal price calculations for bonds, regard is not given to the fact that the actual coupon payment date differs from the theoretical one. The actual payment generally occurs only on the next trading day. A coupon which theoretically should be received on a Saturday is thus normally paid only on the following Monday. This effect influences market interest rates for the bonds to a certain extent where actual payment flows differ greatly from the theoretical ones. The negative aspect of receiving a coupon payment a number of days later than the theoretical payment date is, however, a characteristic which is intrinsic to the security in question and should not be allowed to affect the repo interest rate. The basis for a repo transaction is that it should be possible to make an investment or financing at the repo interest rate with the underlying security as collateral. Hence coupon payments are re-invested or discounted on the basis of the actual coupon payment date.

Example: Repurchase agreement for government bond no. 1028, (coupon: 11.00, maturity date: 21 January 1999)

Settlement date 1:	95-01-16
Settlement date 2:	95-01-25
Market interest rate:	10.00
Repo interest rate:	7.20
Nominal amount:	SEK 40 million

$$P_1 = \frac{11.00}{(1 + 0.1000)^{5/360}} + \frac{11.00}{(1 + 0.1000)^{365/360}} + \frac{11.00}{(1 + 0.1000)^{725/360}} + \frac{11.00}{(1 + 0.1000)^{1085/360}} + \frac{11.00 + 100}{(1 + 0.1000)^{1445/360}}$$

$$P_1 = 10.98545.. + 9.986771.. + 9.07888.. + 8.25352.. + 75.71420.. = 114.01883..$$

$$U_1 = \frac{360 \cdot 5}{360} \cdot 11.00 = 10.847222..$$

$$K_1 = \text{Round}(P_1 + U_1; 3) = \text{Round}(114.01883.. + 10.847222..; 3) = \text{Round}(124.866052..; 3) = 124.866$$

This results in the following amounts for the first leg of the repo transaction:

Gross consideration: $40,000,000 \times 1.03172 = 41,268,800$
 Accrued interest: $40,000,000 \times 0.1084722.. = 4\,338\,888.889 = 4,338,888.9$
 Total consideration: $\text{Round}(\text{Gross consideration} + \text{Accrued interest}; 0) = 45,607,689$

The coupon record date for loan 1028 is 16 January 1995, which in the case of a normal repurchase agreement means that the coupon vests in the person who purchases the bond on the repurchase agreement's first settlement date. Theoretically, the coupon should be paid on 21 January 1995. However, since this day is Saturday, the coupon is only paid on 23 January 1995. The holder of the bond can thus re-invest the paid coupon for two days, i.e. between 23 January 1995 and 25 January 1995.

$$L_2^* = L_1 \cdot \left(1 + r_{\text{rep}} \cdot \frac{d_{\text{rep}}}{360}\right) \cdot N \cdot \frac{\text{Cpn}}{100} \cdot \left(1 + r_{\text{rep}} \cdot \frac{T_2 - T_{\text{Cpn}}}{360}\right)^{\text{sgn}(T_2 - T_{\text{Cpn}})}$$

$$L_2^* = 45,607,689 \cdot \left(1 + 0.0720 \cdot \frac{9}{360}\right) - 40,000,000 \cdot 0.11 \cdot \left(1 + 0.0720 \cdot \frac{2}{360}\right)^{\text{sgn}(2)}$$

$$L_2^* = 45,689,782.84.. - 4,401,760 = 41,288,022.84..$$

$$U_2 = \frac{360 - d_{c2}}{360} \cdot \text{Cpn} \cdot \frac{360 - 356}{360} \cdot 11.00 \cdot 0.12222..$$

$$K_2 = \text{Round}\left(\frac{L_2^*}{N} \cdot 100 + U_2; D_2\right) = \text{Round}\left(\frac{41\,288\,022.84..}{40\,000\,000} \cdot 100 + 0.12222..; 5\right)$$

$$K_2 = \text{Round}(103.0978349..; 5) = 103.09783$$

$$L_2 = \text{Round}\left(\frac{K_2 \cdot U_2}{100} \cdot N; 0\right) = \text{Round}((103.09783 + 0.122222..) \cdot 40\,000\,000 / 100; 0)$$

$$L_2 = 41\,288\,021$$

This results in the following amounts for the second leg of the repo transaction:

Gross consideration: $40,000,000 \times 1.0309783 = 41,239,132$
 Accrued interest: $40,000,000 \times 0.0012222.. = 488,888.9$
 Total Consideration: $\text{Round}(\text{Gross consideration} + \text{Accrued interest}; 0) = 41,288,021$

6. Principles for calculation of accrued interest

Interest on financial instruments which are registered in accounts with Värdepapperscentralen (the Swedish Central Securities Depository) VPC's system for contract accounts vests in to the person who, on the record date for the payment of interest, is registered as the person entitled to receive interest. Where a transaction takes place in such an instrument and the settlement date is a day other than the interest due date, the following rules shall apply in conjunction with calculation of the accrued interest.

Where the settlement date occurs during the period from one interest due date until the record date for the following interest settlement date, the interest shall vest in the purchaser (or the successor in interest thereof). The purchaser shall thus provide the seller with compensation for the accrued interest from the last interest due date up to and including the settlement date.

Where the settlement date occurs during the period from the record date to the interest due date, the interest vests in the seller (or the successor in interest thereof). The seller shall thus credit the purchaser with an amount corresponding to the interest from the settlement date up to and including the interest due date.

7. Principles for rounding of rates

Rounding shall take place in accordance with ISMA's principles, where the number 5 is rounded upwards.

103.4765	?	103.477
103.47649	?	103.476

8. Principles for rounding of final amounts

Final amounts for transactions are rounded to whole krona. No rounding of sub-amounts may occur. Amounts which end with 1 öre up to and including 49 öre are rounded without change in the number of krona. Amounts which end in 50 öre up to and including 99 öre are rounded through an increase by one krona.