Fixed Income Margin Guide (DK)

A guide to margin calculations on Danish fixed income products

11/5/2010
NASDAQ OMX Stockholm (NOMX)

Table of Contents

Introduction

Purpose of document

This document describes the methods applied by NOMX in order to calculate margins for Danish fixed income products. The products covered include the CIBOR forward rate agreements (CFRA contracts) and the future contract mortgage bonds (MBF futures). The document is divided into two main sections.

1. Naked margin calculations; describes the basic formulas applied to calculate the margins for a portfolio that consists of uncorrelated instruments.
2. Cross margining; describes the methodology applied by NOMX in order to give correlation benefits when margining portfolios with correlated instruments.

Purpose of margin calculations

One of the principal functions of the clearinghouse is to guarantee that all contracts registered with it for clearing will be honored. This means that NOMX becomes the counterparty in all transactions, i.e. as buyer to the seller and as seller to the buyer. Each clearing participant thereby acquires rights and obligations with respect to the clearinghouse, not the original counterparty.

NOMX requires margins from the clearing participants. The margin requirement should theoretically be the market value of the participant's account. However, under normal conditions an account cannot be closed at the instant a participant defaults at the prevailing market prices. It typically takes time to neutralize the account and the value of the account can change during this period, and this market risk must be catered for in the margin methodology.

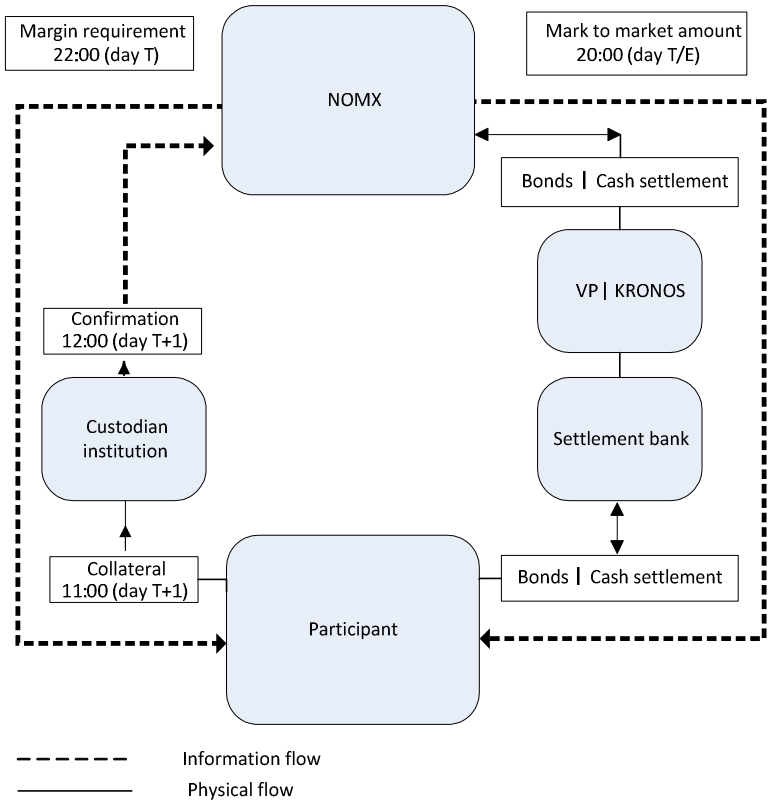
For a clearing organization the level of margins is of crucial importance. Low level of margins will affect the counterparty risk of the clearing organization in a negative manner. Very high level of margins will limit the counterparty risk taken by the clearing organization but may discourage trading. To achieve the right balance, NOMX uses a system called RIVA, based on a methodology called OMS II.

Basic flows

There are two main flows between NOMX and the clearing participants.

1. Margin – Collateral; NOMX calculates the margin requirement for all open contracts at the end of each trading day (T). The margin requirement becomes available to the clearing participants at around CET 22:00 on day T. The clearing participants cover their margin requirement with collateral. The collateral is placed at a custodian institution in an account pledged to NOMX. The clearing participants must have sufficient collateral in place before CET 11:00 on day T+1. The custodian institutions are required to confirm to NOMX before CET 12:00 on day T+1 that the margin requirements are covered with collateral.
2. Mark to market – Settlement; NOMX provides the clearing participants with settlement instructions. The daily mark to market amounts for the CFRA contracts and the MBF futures are provided after each trading day (T) and the final settlement instructions are provided on the expiration day (E) of the contracts. The cash settlement takes place in the Danish central bank's electronic cash clearing system for banks (KRONOS) and the bond delivery takes place in the Danish central securities depository (VP). The settlement takes place at CET 12:00 on day T/E+X and the bond delivery takes place in between CET 16:45 E+X-1 to CET 12:00 E+X (X is product specific).

Figure



Naked margin calculations

CIBOR futures

Daily Fix: During the Futures Contract's Term, Fix shall be determined on behalf of the Exchange in accordance with the following: For each Series in question, an average of CIBOR-FRA forwards contracts bid and ask yields published by each respective market maker shall be calculated. Only up-to-date quotations which include both bid and ask quotations shall be included in the calculation. Fix shall be the median value of the average prices calculated in accordance with the above and be expressed as [100 – (median value in yield)]. In the event that indicative bid and ask prices are not available the Exchange may calculate Fix according to other methods. The Exchange shall notify Exchange Members and Clearing Members, on behalf of the member or customer, of the determined Fix.

Definitions

t - Day
Q - Number of open contracts
Par - Risk interval parameter (given in basis points)
P - Daily Fix
Adj - Adjustment factor for bought/sold contracts
Tick Value - A market's tick value is the cash value of one tick (one minimum price movement).
Tick size - The minimum price movement (0,005)

$$\text{Tick Value} = \frac{Tick\ size}{100} \cdot \text{Nominal value} \cdot \frac{90}{360}$$

Margin

A position's open margin, also referred to as initial margin, shall cover market movements for two days. The naked open margin is the open margin if there are no correlated contracts in the portfolio. The naked open margin is calculated according to Equation (1).

$$\text{Naked open margin} = [\pm\ \text{Par} \pm \text{Adj}\ ]_2 \cdot \text{Tick value} \cdot 2^1 \cdot Q \qquad (1)$$

Mark to market

The CIBOR future contracts are daily cash settled products. This implies that the contracts are daily marked to market. The mark to market amount is given by Equation (2) and Equation (3).

Bought contracts

$$\text{Mark to market amount} = [\ P_t - P_{t-1}\ ] \cdot 100 \cdot \text{Tick value} \cdot Q \cdot 2 \qquad (2)$$

Sold contracts

$$\text{Mark to market amount} = [\ P_{t-1} - P_t\ ] \cdot 100 \cdot \text{Tick value} \cdot Q \cdot 2 \qquad (3)$$

[1] Tick value is based on Tick size = 0,005 and the parameter is expressed in whole basis points

Note

1. $[\ldots]_x$ means rounding to x decimals.
2. The risk interval parameters are reviewed regularly by NOMX. They can be found on http://nordic.nasdaqomxtrader.com

MBF future

Definitions

t	-	Day
Q	-	Number of open contracts
Par	-	Risk interval parameter (given in percent)
$p_{cb/s}$	-	Average contracted price for bought/sold contracts
p_t	-	Fixing price of the relevant MBF future at day t
Adj	-	Adjustment factor for bought/sold contracts

Margin

A position's open margin, also referred to as initial margin, shall cover market movements for two days. The naked open margin is the open margin if there are no correlated contracts in the portfolio. The naked open margin is calculated according to Equation (4) and Equation (5).

Bought contracts

$$\text{Naked open margin} = [\, p_t \cdot (1 - \text{Par} - \text{Adj}) - p_t \,] \cdot 10\,000 \cdot Q \quad (4)$$

Sold contracts

$$\text{Naked open margin} = [\, p_t - p_t \cdot (1 + \text{Par} + \text{Adj}) \,] \cdot 10\,000 \cdot Q \quad (5)$$

Mark to market

The MBF futures are daily cash settled products. This implies that the contracts are daily marked to market. The mark to market amount is given by Equation (6) and Equation (7).

Bought contracts

$$\text{Mark to market amount} = [\, p_t - p_{t-1} \,] \cdot 10\,000 \cdot Q \quad (6)$$

Sold contracts

$$\text{Mark to market amount} = [\, p_{t-1} - p_t \,] \cdot 10\,000 \cdot Q \quad (7)$$

Note

1. For positions that were bought/sold on day t the average contracted price is used instead of p_{t-1} in Equation (6) and Equation (7).
2. The final mark to market amount is kept as settlement margin in between the expiration and settlement of the MBF contracts.
3. The risk interval parameters are reviewed regularly by NOMX. They can be found on http://nordic.nasdaqomxtrader.com.

Example

Consider the below portfolio of 100 bought MBFH9 contracts.

t	-	2009-09-23
Q	-	100
Par	-	3 %
p_{cb}	-	101,8
p_t	-	101,7
Adj	-	0,1 %

Open margin

Since this portfolio only contains MBFH9 contracts the open margin is equal to the naked open margin calculated according to Equation (6).

Open margin = [101,7 · (1 – 0,03 – 0,001) – 101,7] · 10 000 · 100 = [98,55 – 101,7] · 10 000 · 100 =

= DKK -3 152 700.

Mark to market

The daily cash settlement amount is equal to the position's profit or loss and it is calculated according to Equation (6).

Mark to market amount = [101,7 – 101,8] · 10 000 · 100 = DKK -100 000.

Cross margining

Background

A number of the fixed income contracts cleared by NOMX demonstrate a historical statistical relationship that indicates that they are correlated in some way, i.e. they tend to move in the same direction with a similar magnitude. It is therefore required that the margining system takes such relationship into account when calculating the margin requirement. Calculations of allowed correlation between two or more instruments are based on the strength of the historical relationship.

The figure below show which Danish fixed income products that are given correlation benefits by NOMX, a cross (X) in the figures implies that correlation benefits are given between the contracts.

Figure

	CFRA	MBF
CFRA	X	
MBF		X

The methodology applied by NOMX in order to perform cross margining between different contracts is called the window method. This document describes the window method with an example.

Example

Portfolio

Consider a portfolio consisting of 1 000 bought contracts of CFRAU9 at a contracted yield of 3,6% and 700 sold contracts of CFRAH9 at a contracted yield of 3,9%.

CFRAU9 (bought)		
T	-	2009-09-03
IMM	-	91
N	-	DKK 1 000 000
Q	-	1 000
Par	-	40 basis points
r_{cb}	-	3,6 %
r_t	-	3,6 %
Adj	-	0,02 %

CFRAH9 (sold)		
t	-	2009-09-03
IMM	-	91
N	-	DKK 1 000 000
Q	-	700
Par	-	40 basis points
r_{cs}	-	3,8 %
r_t	-	3,8 %
Adj	-	0,02 %

Vector files

RIVA produces vector files for each contract cleared at NOMX. The vector files are built up of several nodes and each node contains its corresponding stressed margin price as well as the open margin calculated with that price. This document gives a simplified description of the vector file concept. A more profound description of the different vector files and their construction is given in the NOMX API Manual.

The fixed income vector files contain 201 nodes, and the margin price (i.e. the fixing yield) will scan between $r_t \pm$ Par evenly distributed over the 201 nodes. Each node of the vector file also contains an open margin calculated according to Equation (10) and Equation (11). It should be noted that Equation (10) and Equation (11) in fact are the same as Equation (2) and Equation (3) but rewritten as functions of the fixing yield, r_t, and the adjusted fixing yield at the node, r_{node}.

Bought contracts

$$\text{Open margin}_{node}(r_{node}, r_t) = [\, P_{CFRA}(r_{node} - \text{Adj}) - P_{CFRA}(r_t) \,]_2 \cdot Q \qquad (10)$$

Sold contracts

$$\text{Open margin}_{node}(r_{node}, r_t) = [\, P_{CFRA}(r_t) - P_{CFRA}(r_{node} + \text{Adj}) \,]_2 \cdot Q \qquad (11)$$

The given portfolio would result in two vector files, one for CFRAU9 and one for CFRAH9, as can be seen by the figures below. It should be noted that in order to easier facilitate an understanding of the window concept the vector files of this example contain 31 nodes instead of 201.

Figure

CFRAU9 vector file

Node	r_{node}	Open margin
0	3,30 %	-1 061 670
1	3,33 %	-994 260
2	3,35 %	-926 850
3	3,38 %	-859 440
4	3,41 %	-792 040
5	3,43 %	-724 630
6	3,46 %	-657 220
7	3,49 %	-589 810
8	3,51 %	-522 410
9	3,54 %	-455 000
10	3,57 %	-387 590
11	3,59 %	-320 190
12	3,62 %	-252 780
13	3,65 %	-185 370
14	3,67 %	-117 960
15	3,70 %	-50 560
16	3,73 %	16 850
17	3,75 %	84 260
18	3,78 %	151 670
19	3,81 %	219 070
20	3,83 %	286 480
21	3,86 %	353 890
22	3,89 %	421 300
23	3,91 %	488 700
24	3,94 %	556 110
25	3,97 %	623 520
26	3,99 %	690 930
27	4,02 %	758 330
28	4,05 %	825 740
29	4,07 %	893 150
30	4,10 %	960 560

CFRAH9 vector file

Node	r_{node}	Open margin
0	3,40 %	672 392
1	3,43 %	625 205
2	3,45 %	578 018
3	3,48 %	530 831
4	3,51 %	483 651
5	3,53 %	436 464
6	3,56 %	389 277
7	3,59 %	342 090
8	3,61 %	294 910
9	3,64 %	247 723
10	3,67 %	200 536
11	3,69 %	153 349
12	3,72 %	106 169
13	3,75 %	58 982
14	3,77 %	11 795
15	3,80 %	-35 392
16	3,83 %	-82 572
17	3,85 %	-129 759
18	3,88 %	-176 946
19	3,91 %	-224 133
20	3,93 %	-271 313
21	3,96 %	-318 500
22	3,99 %	-365 687
23	4,01 %	-412 867
24	4,04 %	-460 054
25	4,07 %	-507 241
26	4,09 %	-554 428
27	4,12 %	-601 608
28	4,15 %	-648 795
29	4,17 %	-695 982
30	4,20 %	-743 169

Window size

In this example the window size between CFRAU9 and CFRAH9 is 40 % (which corresponds to a correlation of around 60 %). A window of 13 nodes (40% of 31 that must be an odd number) is therefore created. The window represents the maximum number of nodes that the CFRAU9 and the CFRAH9 fixing prices may differ from each other in the margin calculations.

Window method

The window will slide through the CFRAU9 and CFRAH9 vector files and during this process a result vector file is created. The value in the result vector file is the sum of the worst open margin for CFRAU9 and CFRAH9 within the window.

The 13 nodes wide window will start in the first node of the vector files i.e. at node 0. The worst possible combined margin at this node is equal to CFRAU9's open margin from node 0 plus CFRAH9's open margin from node 6. This can be seen in the figure below.

Figure

CFRAU9 vector file				CFRAH9 vector file				Result vector			
Node	r_{node}	Open margin		Node	r_{node}	Open margin		Node	r_{node}		Combined margin
0	**3,30 %**	**-1 061 670**		0	3,40 %	672 392		**0**	**3,30 %**	**3,56 %**	**-672 393**
1	3,33 %	-994 260		1	3,43 %	625 205		1			
2	3,35 %	-926 850		2	3,45 %	578 018		2			
3	3,38 %	-859 440		3	3,48 %	530 831		3			
4	3,41 %	-792 040		4	3,51 %	483 651		4			
5	3,43 %	-724 630		5	3,53 %	436 464		5			
6	3,46 %	-657 220		**6**	**3,56 %**	**389 277**		6			
7	3,49 %	-589 810		7	3,59 %	342 090		7			
8	3,51 %	-522 410		8	3,61 %	294 910		8			
9	3,54 %	-455 000		9	3,64 %	247 723		9			
10	3,57 %	-387 590		10	3,67 %	200 536		10			
11	3,59 %	-320 190		11	3,69 %	153 349		11			
12	3,62 %	-252 780		12	3,72 %	106 169		12			
13	3,65 %	-185 370		13	3,75 %	58 982		13			
14	3,67 %	-117 960		14	3,77 %	11 795		14			
15	3,70 %	-50 560	+	15	3,80 %	-35 392	=	15			
16	3,73 %	16 850		16	3,83 %	-82 572		16			
17	3,75 %	84 260		17	3,85 %	-129 759		17			
18	3,78 %	151 670		18	3,88 %	-176 946		18			
19	3,81 %	219 070		19	3,91 %	-224 133		19			
20	3,83 %	286 480		20	3,93 %	-271 313		20			
21	3,86 %	353 890		21	3,96 %	-318 500		21			
22	3,89 %	421 300		22	3,99 %	-365 687		22			
23	3,91 %	488 700		23	4,01 %	-412 867		23			
24	3,94 %	556 110		24	4,04 %	-460 054		24			
25	3,97 %	623 520		25	4,07 %	-507 241		25			
26	3,99 %	690 930		26	4,09 %	-554 428		26			
27	4,02 %	758 330		27	4,12 %	-601 608		27			
28	4,05 %	825 740		28	4,15 %	-648 795		28			
29	4,07 %	893 150		29	4,17 %	-695 982		29			
30	4,10 %	960 560		30	4,20 %	-743 169		30			

The window will slide down the vector files until all nodes have been covered and the result vector has been completely filled. The value in the result vector is always the worst outcome within the window which can be seen by the figure below.

Figure

CFRAU9 vector file				CFRAH9 vector file				Result vector			
Node	r_{node}	Open margin		Node	r_{node}	Open margin		Node	r_{node}		Combined margin
0	3,30 %	-1 061 670		0	3,40 %	672 392		0	3,30 %	3,56 %	-672 393
1	3,33 %	-994 260		1	3,43 %	625 205		1	3,30 %	3,59 %	-719 580
2	3,35 %	-926 850		2	3,45 %	578 018		2	3,30 %	3,61 %	-766 760
3	3,38 %	-859 440		3	3,48 %	530 831		3	3,30 %	3,64 %	-813 947
4	3,41 %	-792 040		4	3,51 %	483 651		4	3,30 %	3,67 %	-861 134
5	3,43 %	-724 630		5	3,53 %	436 464		5	3,30 %	3,69 %	-908 321
6	3,46 %	-657 220		6	3,56 %	389 277		6	3,30 %	3,72 %	-955 501
7	3,49 %	-589 810		7	3,59 %	342 090		7	3,33 %	3,75 %	-935 278
8	3,51 %	-522 410		8	3,61 %	294 910		8	3,35 %	3,77 %	-915 055
9	3,54 %	-455 000		9	3,64 %	247 723		9	3,38 %	3,80 %	-894 832
10	3,57 %	-387 590		10	3,67 %	200 536		10	3,41 %	3,83 %	-874 612
11	3,59 %	-320 190		11	3,69 %	153 349		11	3,43 %	3,85 %	-854 389
12	**3,62 %**	**-252 780**		12	3,72 %	106 169		12	3,46 %	3,88 %	-834 166
13	3,65 %	-185 370		13	3,75 %	58 982		13	3,49 %	3,91 %	-813 943
14	3,67 %	-117 960		14	3,77 %	11 795		14	3,51 %	3,93 %	-793 723
15	3,70 %	-50 560	+	15	3,80 %	-35 392	=	15	3,54 %	3,96 %	-773 500
16	3,73 %	16 850		16	3,83 %	-82 572		16	3,57 %	3,99 %	-753 277
17	3,75 %	84 260		17	3,85 %	-129 759		17	3,59 %	4,01 %	-733 057
18	3,78 %	151 670		18	3,88 %	-176 946		**18**	**3,62 %**	**4,04 %**	**-712 834**
19	3,81 %	219 070		19	3,91 %	-224 133		19			
20	3,83 %	286 480		20	3,93 %	-271 313		20			
21	3,86 %	353 890		21	3,96 %	-318 500		21			
22	3,89 %	421 300		22	3,99 %	-365 687		22			
23	3,91 %	488 700		23	4,01 %	-412 867		23			
24	3,94 %	556 110		**24**	**4,04 %**	**-460 054**		24			
25	3,97 %	623 520		25	4,07 %	-507 241		25			
26	3,99 %	690 930		26	4,09 %	-554 428		26			
27	4,02 %	758 330		27	4,12 %	-601 608		27			
28	4,05 %	825 740		28	4,15 %	-648 795		28			
29	4,07 %	893 150		29	4,17 %	-695 982		29			
30	4,10 %	960 560		30	4,20 %	-743 169		30			

The margin requirement for the combined portfolio is chosen as the worst value in the result vector. In this example this is equal to DKK -955 501, which is the value at node 6 in the result vector. The result shall be interpreted as follows.

The worst value for the portfolio is that the price for CFRAU9 goes down to 3,30 %. If this happens the worst possible outcome for CFRAH9, given the correlation history of the two contracts, is that it goes down to 3,72 %. Therefore the margin requirement for the complete portfolio is the sum of the open margin for the two contracts given that the CFRAU9 fixing goes down to 3,30 % and the CFRAH9 fixing goes down to 3,72 %.

Figure

Result vector

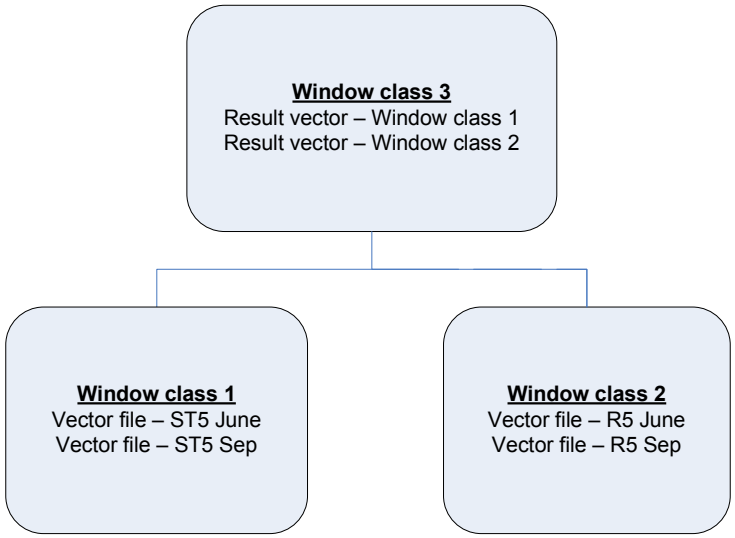
Node	r_{node}		Combined margin
0	3,30 %	3,56 %	-672 393
1	3,30 %	3,59 %	-719 580
2	3,30 %	3,61 %	-766 760
3	3,30 %	3,64 %	-813 947
4	3,30 %	3,67 %	-861 134
5	3,30 %	3,69 %	-908 321
6	**3,30 %**	**3,72 %**	**-955 501**
7	3,33 %	3,75 %	-935 278
8	3,35 %	3,77 %	-915 055
9	3,38 %	3,80 %	-894 832
10	3,41 %	3,83 %	-874 612
11	3,43 %	3,85 %	-854 389
12	3,46 %	3,88 %	-834 166
13	3,49 %	3,91 %	-813 943
14	3,51 %	3,93 %	-793 723
15	3,54 %	3,96 %	-773 500
16	3,57 %	3,99 %	-753 277
17	3,59 %	4,01 %	-733 057
18	3,62 %	4,04 %	-712 834
19	3,65 %	4,07 %	-692 611
20	3,67 %	4,09 %	-672 388
21	3,70 %	4,12 %	-652 168
22	3,73 %	4,15 %	-631 945
23	3,75 %	4,17 %	-611 722
24	3,78 %	4,20 %	-591 499
25	3,81 %	4,20 %	-524 099
26	3,83 %	4,20 %	-456 689
27	3,86 %	4,20 %	-389 279
28	3,89 %	4,20 %	-321 869
29	3,91 %	4,20 %	-254 469
30	3,94 %	4,20 %	-187 059

Window trees

The fixed income instruments are placed in window trees. A window tree is built up of several layers of window classes and the instruments with the closest correlation are placed in the same window class in the bottom of the tree.

The window method is a recursive method; it is first applied to the window classes in the bottom of the window tree. It is here applied on the vector files of the instruments within the same window class. During this process a new vector file, the result vector, is created according to the procedures described by the above example. The result vector is then combined with result vectors from the other window classes in the tree and, as a result, a new result vector is created. This procedure is repeated until the top of the window tree has been reached.

Figure



Please note that a complete list of the current window trees and their respective window sizes can be found on http://nordic.nasdaqomxtrader.com.