CFM Replication

Guide for using the API and interface files for replication of margin calculations

9/13/2013
NASDAQ OMX Stockholm (NOMX)

Document information

General reading guidelines

This document provides an outline for using the risk cubes provided through the Clearinghouse's API for reproducing margin requirements.

The descriptions are on a general level, focusing on concepts that have to be understood in order to efficiently use the extract files.

A GUIDE TO MARGIN REPLICATION USING INTERFACE FILES

Through the API, NOMX offers access to risk cubes which can be used to replicate the margin calculation exactly. These risk cubes are also available as interface files. In this appendix we will focus on information from queries EQ10, JQ16, JQ40 and JQ41. With the use of this information together with information on trade level which the replicating party needs to manage on its own side CFM margin requirements can be fully replicated.

EQ10 (INTERFACE FILE *.YCT)

This query answer/interface file contains information regarding the curves used in the CFM calculation. When replicating margins we are foremost interested in the information it holds about which curves are correlated. The curve identification codes are found in the first column, and the corresponding curve correlation window group (if any) can be found in the second column.

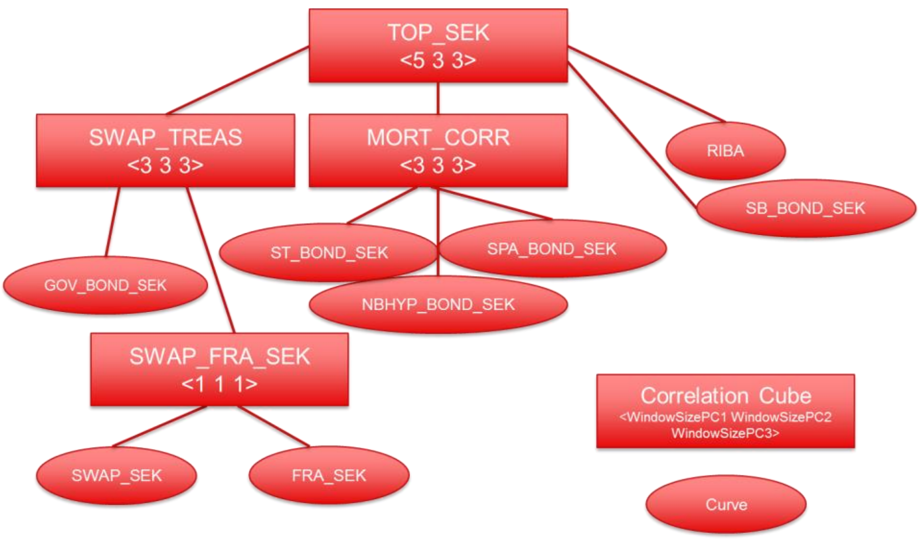
JQ16 (INTERFACE FILE *.CCT)

This query answer/interface file describes the different curve correlation window groups. Most importantly, in the third, fourth and fifth column the window size in each principal component dimension is found. In the second column, the upper curve correlation window group (if any) can be found.

If there is an upper window group for a specific window group, this means that correlation occurs in a correlation tree, and calculations have to be performed for each step through that tree.

Below, please see a schematic picture of the correlation tree in place 2013-09-13. Note that the exact structure of the correlation tree is subject to change. Curves can be removed or added to the correlation tree at different levels, and the number of levels in the tree might change. It is therefore recommended that replicating parties implement a dynamic approach to automatic replication of margin requirements.

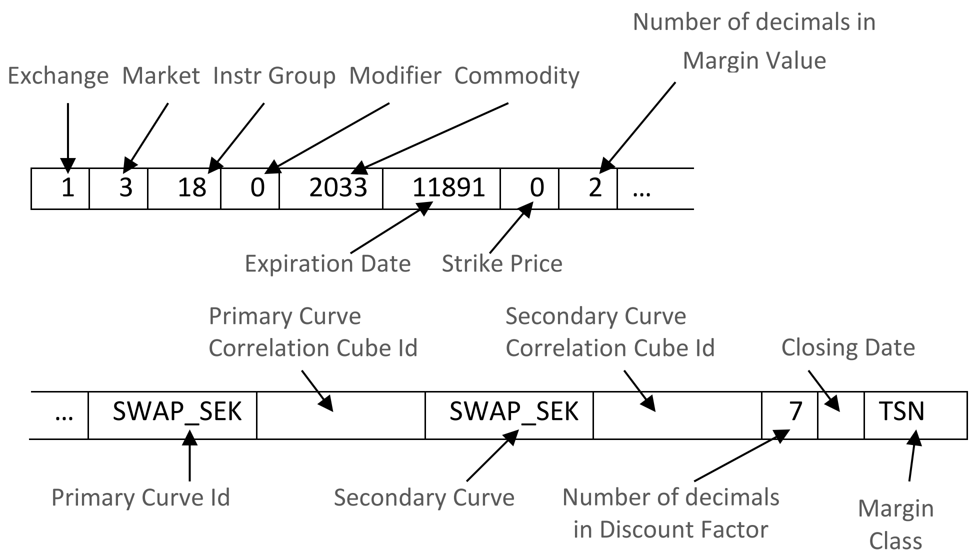
Figure: Correlation structure for SEK fixed income contracts 2013-09-13.



JQ40 (INTERFACE FILE *.RCT)

This query answer/interface file contains instrument series specific information used in the margin calculation. The file is only available for instruments with standardized series. For OTC-style contracts, see JQ41 below.

The first row contains metadata. Please study the example below, for the instrument series FRAO12.



The following data rows each represent one of the curve scenarios. If, for example, the scanning range is 5 in each principal component dimension, there will be 5*5*5 = 125 rows.

These data rows can be divided into three parts;

- The first three columns described the stress applied to the yield curve, Where 0 indicates that the PC was stressed to its minimum level. If the resolution is 5 in each PC, 4 indicates that the PC was stressed to its maximum leve, and 2 indicates no stress in the PC.

Stress in each principal component - PC1 PC2 PC3

Scenarios

PC1	PC2	PC3
0	0	0
0	0	1
0	0	2
0	0	3
0	0	4
0	1	0
0	1	1
0	1	2
0	1	3
0	1	4

- The next six columns describe the NPV for the "unknown" part of the Instrument in each scenario. The "unknown" part means the floating cash flow of a FRA, and the bond cash flows of a bond forward. NB, this is a NPV and does not need to be discounted further. The six columns represent the six combinations of whether the position is long or short, and of whether the calculations are made under a low, mid or high volatility stress. Note that for all instruments except options, it suffices to use the first two of these six columns. When interpreting the figures, the field *Number of Decimals in Margin Value* from the meta data row has to be used. In this example it is 2, meaning that the NPV of the floating cash flow in one (1) long position in the FRAO12 in scenario number 1 is 6569,33 SEK.

Volatility:	Low	Low	Mid	Mid	High	High
Position:	Long	Short	Long	Short	Long	Short
Scenarios	656933	-656933	656933	-656933	656933	-656933
	648636	-648636	648636	-648636	648636	-648636
	640375	-640375	640375	-640375	640375	-640375
	632120	-632120	632120	-632120	632120	-632120
	623876	-623876	623876	-623876	623876	-623876
	670887	-670887	670887	-670887	670887	-670887
	662619	-662619	662619	-662619	662619	-662619
	654348	-654348	654348	-654348	654348	-654348
	…	…	…	…	…	…

- The last two columns contain the discount factors used to calculate the NPV of the contracted cash flow for long and short positions respectively. Since the contracted rate depends on when the contract was entered, it is left to the replicating agent to determine the undiscounted contracted cash flow. When interpreting these figures, remember to use the field *Number of Decimals in Discount Function* in the first meta data row. In this example the number of decimals in the discount function is 7, so the discount function for a long position in scenario 1 would be 0,9747635.

JQ40 is clearing house specific. Different members will get the same response from JQ40, since it covers the margin calculations of standardized contracts. When it comes to cleared OTC derivatives, whose contract details vary greatly between different trades, member specific risk cubes / interface files are needed. This need is covered by JQ41.

JQ41 (Interface file *.CRV)

This query answer/interface file contains margin calculation information for cleared OTC-trades, such as repos and swaps. The answer/file has one meta data row per curve, one per trade, and thereafter one row for each scenario (which currently makes 2 + 125 = 127 rows), multiplied by the number of cleared OTC-trades.

The metadata rows contain the information needed to identify the trade and to interpret the scenario margin figures. The first of these rows is similar in design to the metadata row in JQ40. The second metadata row contains the clearing account code and the trade number.

The following data rows each represent one of the curve scenarios. If, for example, the scanning range is 5 in each principal component dimension, there will be 5*5*5 = 125 rows per trade. There are six columns in each row, the first three describing the combination of principal component stress in that specific scenario. The three rightmost columns represent the NPV for the trade under three volatility regimes. Notice that if the cleared trade is not an option, the NPV will be the same for all three of the rightmost columns.

As noted the long-short perspective is not reflected in these kinds of interface files. This is because the files are member specific and reflect the member’s position only.

REPLICATING NAKED MARGIN

Naked margin in CFM means the margin that is the result of one position or trade being stressed in isolation. To replicate the naked margin follow these steps:

- For positions in standardized contracts, first calculate the contracted cash flow using contract specific information held by the replicating party. Then use the appropriate discount factor depending on if dealing with a long or short position in JQ40 to calculate the NPV of the contracted cash flow in each curve scenario.
- For positions in standardized contracts, then calculate the “unknown” part of the instrument. For FRAs this means the floating cash flow, for bond forwards this means the NPV of the bond cash flows. This is done through multiplying the value in the corresponding column (long or short) with the number of contracts in the net position, after dividing it with 10^(Number of decimals in Margin Value).
- For positions in standardized contracts, then calculate the total NPV for each scenario by adding the two values above. The vector that is the result we shall hereafter refer to as the **positional level stressed NPV vector**.
- For OTC-trades, all the information needed to create the **trade level stressed NPV vector** can be found in the Margin Value columns in JQ 41, after dividing them with 10^(Number of decimals in Margin Value).
- Finally, we can now find the naked margin per position/trade by choosing the lowest value from the stressed NPV vector.
- NB, for derivatives where both the primary and secondary curves are used for discounting, (e.g. repos and bond forwards) and where these curves are different, one needs to take the worst of all NPVs of the contracted rate and the worst of all NPVs of the bond cash flows, and add these together to get the naked margin.

REPLICATING MARGIN

The required margin for a specific portfolio takes into account the correlation benefits in CFM which can be said to occur on two levels.

On a curve level there is a strong built-in correlation which applies to all positions and trades priced against the same curve.

On an inter curve level, there is the possibility of configuring a correlation in terms of putting a limit on how much the applied stress can vary for curves within the same window group. The theoretical workings are described in greater detail in the CFM Margin Guide; here we will focus on how to achieve this effect with the help of the interface files.

The first step in replicating the margin is to aggregate all trades and positions that are priced against the same curve. This is done by creating one stressed NPV vector per curve, by adding together all of the stressed NPV vectors for the client's positions, scaled with the size of respective position, and OTC-trades that are margined against this curve. We hereafter call this aggregated vector the **curve level stressed NPV vector.**

The second step of applying the correlation in between curves requires more attention to detail. One needs to perform the shifting of a smaller cube (representing the size of the window group) within a larger cube (representing the total set of stress scenarios), but in just one dimension (in the set of stressed NPV vectors). What is required is a method that translates the set of neighboring nodes in a certain node of the cube, to rows in the vector file.

Below is the description of a function, which can be called recursively to solve this problem .

```
function [ neighbours ] = neighbours( n, w_size, step , mod)

    neighbours = [];

    %Loop through the list of rows
    for i=1:size(n,2)

        %find the "level" of the current row, to be able to distinguish
        %points outside the cube
        level = floor((n(i)-1)/mod);

        %find the neighbours in this dimension
        w = [-(w_size-1)/2:1:(w_size-1)/2];
        new_neighbours = n(i) + step*w;

        %remove the neighbours which fall outside the given "level"
        new_neighbours = new_neighbours(floor((new_neighbours-1)/mod) == level);
        neighbours = [neighbours, new_neighbours];
    end
end

scenarios = neighbours( neighbours( neighbours(n,z,1,Z)...
                                  ,y,Z,Y*Z)…
                        ,x,Y*Z,X*Y*Z);
```

The code above finds the window group members for row n in the the stressed NPV vector for a scenario space of size X*Y*Z, and a correlation window group of size x*y*z. X, Y, Z and x, y, z are all odd numbers.

The code assumes that the list of scenarios is ordered in the same way as in the interface files, starting from negative stress in PC1 and ending with positive stress in PC3.

To calculate the value in each row in the **total stressed NPV vector** for all positions and trades margined by curves that lie in the same window group, take the worst values from the neighboring rows in each **curve stressed NPV vector** and add them together.

Notice that this can be a recursive process, where a window group defining the correlation in between one set of curves, in a subsequent upper level step is correlated to other window groups or curves. Also note that there might exist parallel correlation structures that are not interconnected.

Once the highest level in the correlation tree(s) have been reached, a number of stressed NPV vector are the end result. The end number of stressed NPV vectors is the number of top level window groups plus the number of curves that don't lie in any window group. The portfolio margin is replicated through taking the worst values from each of these vectors and adding them together.

NB, for derivatives where both the primary and secondary curves are used for discounting, (e.g. repos and bond forwards) and where these curves are different, one needs to let the NPVs of the contracted rate and the NPVs of the bond cash flows form part of their respective curve NPV vectors in order to replicate the margin calculation.

On the following pages, find a list of which rows that are neighbors to a certain row in a framework where the total number of scenarios are 125 (5*5*5) and the size of the window correlation cube is 27 (3*3*3).

Row	Rows that are neighbours given a 3*3*3 correlation cube
1	1, 2, 6, 7, 26, 27, 31, 32
2	1, 2, 3, 6, 7, 8, 26, 27, 28, 31, 32, 33
3	2, 3, 4, 7, 8, 9, 27, 28, 29, 32, 33, 34
4	3, 4, 5, 8, 9, 10, 28, 29, 30, 33, 34, 35
5	4, 5, 9, 10, 29, 30, 34, 35
6	1, 2, 6, 7, 11, 12, 26, 27, 31, 32, 36, 37
7	1, 2, 3, 6, 7, 8, 11, 12, 13, 26, 27, 28, 31, 32, 33, 36, 37, 38
8	2, 3, 4, 7, 8, 9, 12, 13, 14, 27, 28, 29, 32, 33, 34, 37, 38, 39
9	3, 4, 5, 8, 9, 10, 13, 14, 15, 28, 29, 30, 33, 34, 35, 38, 39, 40
10	4, 5, 9, 10, 14, 15, 29, 30, 34, 35, 39, 40
11	6, 7, 11, 12, 16, 17, 31, 32, 36, 37, 41, 42
12	6, 7, 8, 11, 12, 13, 16, 17, 18, 31, 32, 33, 36, 37, 38, 41, 42, 43
13	7, 8, 9, 12, 13, 14, 17, 18, 19, 32, 33, 34, 37, 38, 39, 42, 43, 44
14	8, 9, 10, 13, 14, 15, 18, 19, 20, 33, 34, 35, 38, 39, 40, 43, 44, 45
15	9, 10, 14, 15, 19, 20, 34, 35, 39, 40, 44, 45
16	11, 12, 16, 17, 21, 22, 36, 37, 41, 42, 46, 47
17	11, 12, 13, 16, 17, 18, 21, 22, 23, 36, 37, 38, 41, 42, 43, 46, 47, 48
18	12, 13, 14, 17, 18, 19, 22, 23, 24, 37, 38, 39, 42, 43, 44, 47, 48, 49
19	13, 14, 15, 18, 19, 20, 23, 24, 25, 38, 39, 40, 43, 44, 45, 48, 49, 50
20	14, 15, 19, 20, 24, 25, 39, 40, 44, 45, 49, 50
21	16, 17, 21, 22, 41, 42, 46, 47
22	16, 17, 18, 21, 22, 23, 41, 42, 43, 46, 47, 48
23	17, 18, 19, 22, 23, 24, 42, 43, 44, 47, 48, 49
24	18, 19, 20, 23, 24, 25, 43, 44, 45, 48, 49, 50
25	19, 20, 24, 25, 44, 45, 49, 50
26	1, 2, 6, 7, 26, 27, 31, 32, 51, 52, 56, 57
27	1, 2, 3, 6, 7, 8, 26, 27, 28, 31, 32, 33, 51, 52, 53, 56, 57, 58
28	2, 3, 4, 7, 8, 9, 27, 28, 29, 32, 33, 34, 52, 53, 54, 57, 58, 59
29	3, 4, 5, 8, 9, 10, 28, 29, 30, 33, 34, 35, 53, 54, 55, 58, 59, 60
30	4, 5, 9, 10, 29, 30, 34, 35, 54, 55, 59, 60
31	1, 2, 6, 7, 11, 12, 26, 27, 31, 32, 36, 37, 51, 52, 56, 57, 61, 62
32	1, 2, 3, 6, 7, 8, 11, 12, 13, 26, 27, 28, 31, 32, 33, 36, 37, 38, 51, 52, 53, 56, 57, 58, 61, 62, 63
33	2, 3, 4, 7, 8, 9, 12, 13, 14, 27, 28, 29, 32, 33, 34, 37, 38, 39, 52, 53, 54, 57, 58, 59, 62, 63, 64
34	3, 4, 5, 8, 9, 10, 13, 14, 15, 28, 29, 30, 33, 34, 35, 38, 39, 40, 53, 54, 55, 58, 59, 60, 63, 64, 65
35	4, 5, 9, 10, 14, 15, 29, 30, 34, 35, 39, 40, 54, 55, 59, 60, 64, 65
36	6, 7, 11, 12, 16, 17, 31, 32, 36, 37, 41, 42, 56, 57, 61, 62, 66, 67
37	6, 7, 8, 11, 12, 13, 16, 17, 18, 31, 32, 33, 36, 37, 38, 41, 42, 43, 56, 57, 58, 61, 62, 63, 66, 67, 68
38	7, 8, 9, 12, 13, 14, 17, 18, 19, 32, 33, 34, 37, 38, 39, 42, 43, 44, 57, 58, 59, 62, 63, 64, 67, 68, 69
39	8, 9, 10, 13, 14, 15, 18, 19, 20, 33, 34, 35, 38, 39, 40, 43, 44, 45, 58, 59, 60, 63, 64, 65, 68, 69, 70
40	9, 10, 14, 15, 19, 20, 34, 35, 39, 40, 44, 45, 59, 60, 64, 65, 69, 70
41	11, 12, 16, 17, 21, 22, 36, 37, 41, 42, 46, 47, 61, 62, 66, 67, 71, 72
42	11, 12, 13, 16, 17, 18, 21, 22, 23, 36, 37, 38, 41, 42, 43, 46, 47, 48, 61, 62, 63, 66, 67, 68, 71, 72, 73
43	12, 13, 14, 17, 18, 19, 22, 23, 24, 37, 38, 39, 42, 43, 44, 47, 48, 49, 62, 63, 64, 67, 68, 69, 72, 73, 74
44	13, 14, 15, 18, 19, 20, 23, 24, 25, 38, 39, 40, 43, 44, 45, 48, 49, 50, 63, 64, 65, 68, 69, 70, 73, 74, 75
45	14, 15, 19, 20, 24, 25, 39, 40, 44, 45, 49, 50, 64, 65, 69, 70, 74, 75
46	16, 17, 21, 22, 41, 42, 46, 47, 66, 67, 71, 72
47	16, 17, 18, 21, 22, 23, 41, 42, 43, 46, 47, 48, 66, 67, 68, 71, 72, 73
48	17, 18, 19, 22, 23, 24, 42, 43, 44, 47, 48, 49, 67, 68, 69, 72, 73, 74
49	18, 19, 20, 23, 24, 25, 43, 44, 45, 48, 49, 50, 68, 69, 70, 73, 74, 75
50	19, 20, 24, 25, 44, 45, 49, 50, 69, 70, 74, 75
51	26, 27, 31, 32, 51, 52, 56, 57, 76, 77, 81, 82
52	26, 27, 28, 31, 32, 33, 51, 52, 53, 56, 57, 58, 76, 77, 78, 81, 82, 83
53	27, 28, 29, 32, 33, 34, 52, 53, 54, 57, 58, 59, 77, 78, 79, 82, 83, 84
54	28, 29, 30, 33, 34, 35, 53, 54, 55, 58, 59, 60, 78, 79, 80, 83, 84, 85
55	29, 30, 34, 35, 54, 55, 59, 60, 79, 80, 84, 85
56	26, 27, 31, 32, 36, 37, 51, 52, 56, 57, 61, 62, 76, 77, 81, 82, 86, 87
57	26, 27, 28, 31, 32, 33, 36, 37, 38, 51, 52, 53, 56, 57, 58, 61, 62, 63, 76, 77, 78, 81, 82, 83, 86, 87, 88
58	27, 28, 29, 32, 33, 34, 37, 38, 39, 52, 53, 54, 57, 58, 59, 62, 63, 64, 77, 78, 79, 82, 83, 84, 87, 88, 89
59	28, 29, 30, 33, 34, 35, 38, 39, 40, 53, 54, 55, 58, 59, 60, 63, 64, 65, 78, 79, 80, 83, 84, 85, 88, 89, 90
60	29, 30, 34, 35, 39, 40, 54, 55, 59, 60, 64, 65, 79, 80, 84, 85, 89, 90
61	31, 32, 36, 37, 41, 42, 56, 57, 61, 62, 66, 67, 81, 82, 86, 87, 91, 92
62	31, 32, 33, 36, 37, 38, 41, 42, 43, 56, 57, 58, 61, 62, 63, 66, 67, 68, 81, 82, 83, 86, 87, 88, 91, 92, 93
63	32, 33, 34, 37, 38, 39, 42, 43, 44, 57, 58, 59, 62, 63, 64, 67, 68, 69, 82, 83, 84, 87, 88, 89, 92, 93, 94
64	33, 34, 35, 38, 39, 40, 43, 44, 45, 58, 59, 60, 63, 64, 65, 68, 69, 70, 83, 84, 85, 88, 89, 90, 93, 94, 95

65	34, 35, 39, 40, 44, 45, 59, 60, 64, 65, 69, 70, 84, 85, 89, 90, 94, 95
66	36, 37, 41, 42, 46, 47, 61, 62, 66, 67, 71, 72, 86, 87, 91, 92, 96, 97
67	36, 37, 38, 41, 42, 43, 46, 47, 48, 61, 62, 63, 66, 67, 68, 71, 72, 73, 86, 87, 88, 91, 92, 93, 96, 97, 98
68	37, 38, 39, 42, 43, 44, 47, 48, 49, 62, 63, 64, 67, 68, 69, 72, 73, 74, 87, 88, 89, 92, 93, 94, 97, 98, 99
69	38, 39, 40, 43, 44, 45, 48, 49, 50, 63, 64, 65, 68, 69, 70, 73, 74, 75, 88, 89, 90, 93, 94, 95, 98, 99, 100
70	39, 40, 44, 45, 49, 50, 64, 65, 69, 70, 74, 75, 89, 90, 94, 95, 99, 100
71	41, 42, 46, 47, 66, 67, 71, 72, 91, 92, 96, 97
72	41, 42, 43, 46, 47, 48, 66, 67, 68, 71, 72, 73, 91, 92, 93, 96, 97, 98
73	42, 43, 44, 47, 48, 49, 67, 68, 69, 72, 73, 74, 92, 93, 94, 97, 98, 99
74	43, 44, 45, 48, 49, 50, 68, 69, 70, 73, 74, 75, 93, 94, 95, 98, 99, 100
75	44, 45, 49, 50, 69, 70, 74, 75, 94, 95, 99, 100
76	51, 52, 56, 57, 76, 77, 81, 82, 101, 102, 106, 107
77	51, 52, 53, 56, 57, 58, 76, 77, 78, 81, 82, 83, 101, 102, 103, 106, 107, 108
78	52, 53, 54, 57, 58, 59, 77, 78, 79, 82, 83, 84, 102, 103, 104, 107, 108, 109
79	53, 54, 55, 58, 59, 60, 78, 79, 80, 83, 84, 85, 103, 104, 105, 108, 109, 110
80	54, 55, 59, 60, 79, 80, 84, 85, 104, 105, 109, 110
81	51, 52, 56, 57, 61, 62, 76, 77, 81, 82, 86, 87, 101, 102, 106, 107, 111, 112
82	51, 52, 53, 56, 57, 58, 61, 62, 63, 76, 77, 78, 81, 82, 83, 86, 87, 88, 101, 102, 103, 106, 107, 108, 111, 112, 113
83	52, 53, 54, 57, 58, 59, 62, 63, 64, 77, 78, 79, 82, 83, 84, 87, 88, 89, 102, 103, 104, 107, 108, 109, 112, 113, 114
84	53, 54, 55, 58, 59, 60, 63, 64, 65, 78, 79, 80, 83, 84, 85, 88, 89, 90, 103, 104, 105, 108, 109, 110, 113, 114, 115
85	54, 55, 59, 60, 64, 65, 79, 80, 84, 85, 89, 90, 104, 105, 109, 110, 114, 115
86	56, 57, 61, 62, 66, 67, 81, 82, 86, 87, 91, 92, 106, 107, 111, 112, 116, 117
87	56, 57, 58, 61, 62, 63, 66, 67, 68, 81, 82, 83, 86, 87, 88, 91, 92, 93, 106, 107, 108, 111, 112, 113, 116, 117, 118
88	57, 58, 59, 62, 63, 64, 67, 68, 69, 82, 83, 84, 87, 88, 89, 92, 93, 94, 107, 108, 109, 112, 113, 114, 117, 118, 119
89	58, 59, 60, 63, 64, 65, 68, 69, 70, 83, 84, 85, 88, 89, 90, 93, 94, 95, 108, 109, 110, 113, 114, 115, 118, 119, 120
90	59, 60, 64, 65, 69, 70, 84, 85, 89, 90, 94, 95, 109, 110, 114, 115, 119, 120
91	61, 62, 66, 67, 71, 72, 86, 87, 91, 92, 96, 97, 111, 112, 116, 117, 121, 122
92	61, 62, 63, 66, 67, 68, 71, 72, 73, 86, 87, 88, 91, 92, 93, 96, 97, 98, 111, 112, 113, 116, 117, 118, 121, 122, 123
93	62, 63, 64, 67, 68, 69, 72, 73, 74, 87, 88, 89, 92, 93, 94, 97, 98, 99, 112, 113, 114, 117, 118, 119, 122, 123, 124
94	63, 64, 65, 68, 69, 70, 73, 74, 75, 88, 89, 90, 93, 94, 95, 98, 99, 100, 113, 114, 115, 118, 119, 120, 123, 124, 125
95	64, 65, 69, 70, 74, 75, 89, 90, 94, 95, 99, 100, 114, 115, 119, 120, 124, 125
96	66, 67, 71, 72, 91, 92, 96, 97, 116, 117, 121, 122
97	66, 67, 68, 71, 72, 73, 91, 92, 93, 96, 97, 98, 116, 117, 118, 121, 122, 123
98	67, 68, 69, 72, 73, 74, 92, 93, 94, 97, 98, 99, 117, 118, 119, 122, 123, 124
99	68, 69, 70, 73, 74, 75, 93, 94, 95, 98, 99, 100, 118, 119, 120, 123, 124, 125
100	69, 70, 74, 75, 94, 95, 99, 100, 119, 120, 124, 125
101	76, 77, 81, 82, 101, 102, 106, 107
102	76, 77, 78, 81, 82, 83, 101, 102, 103, 106, 107, 108
103	77, 78, 79, 82, 83, 84, 102, 103, 104, 107, 108, 109
104	78, 79, 80, 83, 84, 85, 103, 104, 105, 108, 109, 110
105	79, 80, 84, 85, 104, 105, 109, 110
106	76, 77, 81, 82, 86, 87, 101, 102, 106, 107, 111, 112
107	76, 77, 78, 81, 82, 83, 86, 87, 88, 101, 102, 103, 106, 107, 108, 111, 112, 113
108	77, 78, 79, 82, 83, 84, 87, 88, 89, 102, 103, 104, 107, 108, 109, 112, 113, 114
109	78, 79, 80, 83, 84, 85, 88, 89, 90, 103, 104, 105, 108, 109, 110, 113, 114, 115
110	79, 80, 84, 85, 89, 90, 104, 105, 109, 110, 114, 115
111	81, 82, 86, 87, 91, 92, 106, 107, 111, 112, 116, 117
112	81, 82, 83, 86, 87, 88, 91, 92, 93, 106, 107, 108, 111, 112, 113, 116, 117, 118
113	82, 83, 84, 87, 88, 89, 92, 93, 94, 107, 108, 109, 112, 113, 114, 117, 118, 119
114	83, 84, 85, 88, 89, 90, 93, 94, 95, 108, 109, 110, 113, 114, 115, 118, 119, 120
115	84, 85, 89, 90, 94, 95, 109, 110, 114, 115, 119, 120
116	86, 87, 91, 92, 96, 97, 111, 112, 116, 117, 121, 122
117	86, 87, 88, 91, 92, 93, 96, 97, 98, 111, 112, 113, 116, 117, 118, 121, 122, 123
118	87, 88, 89, 92, 93, 94, 97, 98, 99, 112, 113, 114, 117, 118, 119, 122, 123, 124
119	88, 89, 90, 93, 94, 95, 98, 99, 100, 113, 114, 115, 118, 119, 120, 123, 124, 125
120	89, 90, 94, 95, 99, 100, 114, 115, 119, 120, 124, 125
121	91, 92, 96, 97, 116, 117, 121, 122
122	91, 92, 93, 96, 97, 98, 116, 117, 118, 121, 122, 123
123	92, 93, 94, 97, 98, 99, 117, 118, 119, 122, 123, 124
124	93, 94, 95, 98, 99, 100, 118, 119, 120, 123, 124, 125
125	94, 95, 99, 100, 119, 120, 124, 125