International Public Finance Score Builder Component API Version 1.1

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1 Overview

This document describes the API input and output data structures required to call the analytical calculation of the International Public Finance scoring component as described in the model specification [1].

The model generates the Stand Alone Credit Profile (SACP) and Illustrative Credit Ratings (ICR) scorea given the various factors and configuration data defined in the criteria document [2].

The goal of the component is to encapsulate the analytical implementation in order to enable its use from different user interfaces (Web, Excel and iOS front ends) to produce consistent and validated results in all platforms.

The API structure of the component corresponds to that of the QMD Model Bridge [3]. We will use the shorthand notation described in appendix A to describe the input and output data types.

2 Input Description

2.1 Input Structure Overview

The input data container structure can be summarized as:

```
Input:PS ................................................................................... Table 1
  IFA:I
  Economy:PS................................................................................Table 2
    Score:D
    Overwrite:B
    ECA1:I
    ECA2:I
    ECA3:I
    ECA4:I
    ECA5:I
    ECA6:I
  Management:PS .............................................................................. Table 4
    Score:I
    Overwrite:B
    FMA1:I
    FMA2:I
    FMA3:I
    FMA4:I
    FMA5:I
```

```
          └─FMTR:B
    ├─BudgetFlexibility:PS ............................................................ Table 5
    │   ├─Score:I
    │   ├─Overwrite:B
    │   ├─BFA1:I
    │   ├─BFA2:I
    │   ├─BFA3:I
    │   ├─BFA4:I
    │   └─BFA5:I
    ├─BudgetPerformance:PS ........................................................... Table 6
    │   ├─Score:I
    │   ├─Overwrite:B
    │   ├─BPA1:I
    │   ├─BPA2:I
    │   ├─BPA3:I
    │   ├─BPA4:I
    │   ├─BPA5:I
    │   └─BPA6:I
    ├─Liquidity:PS ................................................................... Table 7
    │   ├─Score:I
    │   ├─Overwrite:B
    │   ├─LQ_Ext_Adj:I
    │   ├─LQA1:I
    │   ├─LQA2:I
    │   ├─LQA3:I
    │   └─LQA4:I
    ├─Debt:PS ........................................................................ Table 9
    │   ├─Score:I
    │   ├─Overwrite:B
    │   ├─DBA1:I
    │   ├─DBA2:I
    │   ├─DBA3:I
    │   └─DBA4:I
    ├─ContLiability:I ................................................................ Table 1
    └─Overrides:PS ................................................................... Table 10
        ├─CPW:I
        ├─CIR:I
        ├─NP1:I
        ├─NP2:I
        ├─NP3:I
        ├─NR1:I
        └─NS1:I
```

2.2 Input Description

The input parameters in the model consist of the specification of 8 factors. The first factor, `IFA`, takes values in the range [1..6] where the rest of the factors are constructed from a score in the range [1..5] (Where lower values imply a better state) and are modified by a collection of associeted adjustment questions. The adjustment are Yes/No answers which by default are set to No, in which case the score is not affected. After the adjustments are cumulatively applied the resulting value is capped to the original range.

Optionally the UI can provide an overwrite feature in which case the score is selected directly and all adjustment features are ignored.

As the number of input parameters to specify is rather large we group them by factor name in its own sub

container. This approach should reduce the chance of mixing up the adjustment responses for each factor.

Table 1: *Input PS structure*

Label	Type	Required	Description
IFA	I	Y	Institutional Framework factor, Int $\in [1..6]$.
Economy	PS	Y	Economy score and adjustments data (See table 2).
Management	PS	Y	Management score and adjustments data (See table 4).
BudgetFlexibility	PS	Y	Budgetary Flexibility score and adjustments data (See table 5).
BudgetPerformance	PS	Y	Budgetary Performance score and adjustments data (See table 6).
Liquidity	PS	Y	Liquidity score and adjustments data (See table 7).
Debt	PS	Y	Debt score and adjustments data (See table 9).
ContLiability	I	Y	Contingent Liability score, Int $\in [1..5]$.
Overrides	PS	Y	Notch and Cap settings (See table 10).

Below we provide a description of each the parameters that describe the factor features

2.2.1 Economy

The factor is contructed by selecting a score from the table below. The input to the model is the score and it is left to the UI driving the component to implement the score selection.

Table 2: *Economy PS structure*

Label	Type	Required	Factor Parameters
Score	I	Y	Score value as Int $\in [1..5]$
Overwrite	B	N	If present and set to True the adjustments options are ignored
ECA1	I	N	Participation in larger broad and diversified economy. Int $\in [0..2]$
ECA2	I	N	Above-average growth prospects. Int $\in [0..2]$
ECA3	I	N	Positive budget impact from a demographic profile. Int $\in [0..2]$
ECA4	I	N	Very volatile and/or concentrated economy. Int $\in [0..2]$
ECA5	I	N	Limited growth prospects. Int $\in [0..2]$
ECA6	I	N	Negative budget impact from a demographic profile. Int $\in [0..2]$

The adjustments to the score are provided as answers to the questions with 3 possible outcomes that are encoded as an integer as

Table 3: *Likelihood Adjustment*

Label	Value
Not Likely	0
Somewhat Likely	1
Very Likely	2

2.2.2 Management

The factor is constructed by selecting the score from the table

Table 4: *Management PS structure*

Label	Type	Required	Factor Parameters
Score	I	Y	Score value as Int $\in [1..5]$
Overwrite	B	N	If present and set to True the adjustments options are ignored
FMA1	I	Y	Political and managerial strength, Int $\in [1,5]$
FMA2	I	Y	Long-term capital and financial planning, Int $\in [1,5]$
FMA3	I	Y	Revenue and expenditure management, Int $\in [1,5]$
FMA4	I	Y	Debt and liquidity management, Int $\in [1,5]$
FMA5	I	Y	Management of GREs, Int $\in [1,5]$
FMTR	B	Y	Transparent Financial Reporting, Bool

2.2.3 Budgetary Flexibility

The score is selected from the table

Table 5: *BudgetFlexibility PS structure*

Label	Type	Required	Factor Parameters
Score	I	Y	Score value as Int $\in [1..5]$
Overwrite	B	N	If present and set to True the adjustments options are ignored
BFA1	I	Y	Demonstrated capability and willingness to cut operating spending ($> 5\%$), Int $\in [0..2]$
BFA2	I	Y	Ability to increase operating revenues ($> 5\%$), Int $\in [0..2]$
BFA3	I	Y	Demonstrated ability to postpone capital expenditures ($> 20\%$ of capital spending.), Int $\in [0..2]$
BFA4	I	Y	Possess above-average capacity to generate revenues from asset sales ($> 20\%$ of operating revenues), Int $\in [0..2]$
BFA5	I	Y	Highly limited leeway to adjust modifiable revenues ($< 2\%$), Int $\in [0..2]$
BFA6	I	Y	Highly limited ability to cut expenditures, Int $\in [0..2]$

2.2.4 Budgetary Performance

The factor score is selected from the table:

Table 6: *BudgetPerformance PS structure*

Label	Type	Required	Factor Parameters
Score	I	Y	Score value as Int $\in [1..5]$
Overwrite	B	N	If present and set to True the adjustments options are ignored
BPA1	I	Y	Expected structural improvement, Int $\in [0..2]$
BPA2	I	Y	High cash reserve levels, Int $\in [0..2]$
BPA3	I	Y	Expected structural deterioration, Int $\in [0..2]$
BPA4	I	Y	Pronounced volatility in performance, Int $\in [0..2]$
BPA5	I	Y	Underestimated spending, Int $\in [0..2]$

2.2.5 Liquidity

The factor score is selected from the table:

Table 7: *Liquidity PS structure*

Label	Type	Required	Factor Parameters
Score	I	Y	Score value as Int $\in [1..5]$
Overwrite	B	N	If present and set to True the adjustments options are ignored
LQ_Ext_Adj	I	Y	External liquidity adjustment, In $\in [1..5]$
LQA1	I	Y	Internal cash flow generation is very strong, Int $\in [0..2]$
LQA2	I	Y	Track record of appropriate and timely policy response from the LRG to liquidity pressures, Int $\in [0..2]$
LQA3	I	Y	Very large expected funding needs beyond the coming year, Int $\in [0..2]$
LQA4	I	Y	Expected volatility in the liquidity ratio during or beyond the 12 coming months, Int $\in [0..2]$

Table 8: *External Liquidity Adjustment*

LQ_Ext_Adj	Label	Adjustment
1	Exceptional	-2
2	Strong	-1
3	Satisfactory	0
4	Limited	1
5	Uncertain	2

2.2.6 Debt Burden

The factor score is selected from the table:

Table 9: *Liability PS structure*

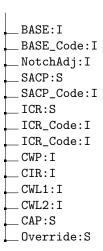| Label	Type	Required	Factor Parameters
Score	I	Y	Score value as Int $\in [1..5]$
Overwrite	B	N	If present and set to True the adjustments options are ignored
DBA1	I	Y	Exceptionally high operating balance (direct debt is less than 3 years of operating margin.), Int $\in [0..2]$
DBA2	I	Y	Debt burden mitigated by self-supporting on-lent debt, Int $\in [0..2]$
DBA3	I	Y	Potential significant volatility in the debt burden owing to high exposure to market risks, Int $\in [0..2]$
DBA4	I	Y	Risk stemming from pension liabilities and OPEBs, Int $\in [0..2]$

2.2.7 Overrides

Table 10: *Overrides PS structure*

Label	Type	Required	Factor Parameters
CWP	I	Y	Weak Payment Culture, Int $\in [0, 1]$
CIR	I	Y	Insufficient revenues and uncertain or limited access to external liquidity, Int $\in [0, 1]$
NP1	I	Y	Performance below benchmark (debt is in excess of 1.5 times the level of a '5' score), Int $\in [0, 1]$
NP2	I	Y	Performance below benchmark (deficit after capital accounts is in excess of 1.5 tiles the level of a '5' score), Int $\in [0, 1]$
NP3	I	Y	Performance below benchmark (contingent liabilities substantially worse than the benchmark of the '5' score category), Int $\in [0, 1]$
NR1	I	Y	Likelihood of Event Risk, Int $\in [0..2]$
NS1	I	Y	Extraordinary support, Int $\in [0, 1]$

3 Output Description

3.1 Output Structure Overview

The output data is organized as:

Output:PS .... Table 11
    ├── status:B
    ├── error:S
    ├── IFA:I
    ├── IPC:D
    ├── IPC_EC:I
    ├── IPC_FM:I
    ├── IPC_BF:I
    ├── IPC_BP:I
    ├── IPC_LQ:I
    ├── IPC_DB:I
    └── IPC_CL:I

```
__ BASE:I
__ BASE_Code:I
__ NotchAdj:I
__ SACP:S
__ SACP_Code:I
__ ICR:S
__ ICR_Code:I
__ ICR_Code:I
__ CWP:I
__ CIR:I
__ CWL1:I
__ CWL2:I
__ CAP:S
__ Override:S
```

The Indicative Credit Rating is generated from a mapping of the weighted sum of all the input factors, to a rating scale as described in the model specification. The final ICR is then obtained after applying the capping rules and the notching overrides provided.

The table below provides a description of each element:

Table 11: *Output PS structure*

Label	Type	Present	Description
status	B	Y	True if there was no issue.
error	S	Y	Error message if status is False.
IFA	I	Y	Institutional Framework Assessment score, Int $\in [1..6]$
IPC	D	Y	Individual Credit Profile score, Double $\in [1..5]$
IPC_EC	I	Y	① Economic Assessment score, Int $\in [1..5]$
IPC_FM	I	Y	② Financial Management score, Int $\in [1..5]$
IPC_BF	I	Y	③ Budgetary Flexibility score, Int $\in [1..5]$
IPC_BP	I	Y	④ Budgetary Perfomance score, Int $\in [1..5]$
IPC_LQ	I	Y	⑤ Liquidity score, Int $\in [1..5]$
IPC_DB	I	Y	⑥ Debt Burden score, Int $\in [1..5]$
IPC_CL	I	Y	⑦ Contingent Liabilities score, Int $\in [1..5]$
BASE	S	Y	⑧ Base score from IFA and IPC matrix lookup, String $\in [aaa..d]$
BASE_Code	I	Y	⑨ Base score from IFA and IPC matrix lookup, Int $\in [3..23]$
NotchAdj	I	Y	Notch adjustment, Int $\in [-5..1]$
SACP	S	Y	SACP score, String $\in [aaa..d]$
SACP_Code	I	Y	SACP score, Int $\in [3..23]$
ICR	S	Y	⑩ ICR score, String $\in [aaa..d]$
ICR_Code	I	Y	⑪ ICR score, Int $\in [3..23]$
CWP	I	Y	Weak Payment Culture, Int $\in [0, 1]$
CIR	I	Y	Insufficient revenues and uncertain or limited access to external liquidity, Int $\in [0, 1]$
CWL1	I	Y	Weak Liquidity OR Very Weak Fianancial Management, Int $\in [0, 1]$
CWL2	I	Y	Weak Liquidity AND Very Weak Fianancial Management, Int $\in [0, 1]$

CAP	S	Y	Applied cap. If active it will be different from aaa.
Override	S	Y	$\boxed{12}$ Set to "-" if the base is not modified by notching or capping, the ICR score otherwise.

The credit score output will be using the convention:

Credit Score	Int. Code
aaa	23
aa+	22
aa	21
aa-	20
a+	19
a	18
a-	17
bbb+	16
bbb	15
bbb-	14
bb+	13
bb	12
bb-	11
b+	10
b	9
b-	8
ccc+	7
ccc	6
ccc-	5
cc	4
d	3

Table 12: *Credit score table*

3.2 Error Messages

The component will not produce a result if the inputs provided are in the valid ranges described in table 1. When an error is encountered the component will return the output structure with the **status** value set to *FALSE* and **error** will contain a description of which input variable was missing or of the incorrect type as the cause of the failure.

In the cases where the Institutional Framework Assessment input and the computed Individual Credit Profile score combination is not valid the model flags the error as before with the message:

> Combination of Institutional Framework Assessment (*IFA Score*) and Individual Credit Profile is invalid

3.3 Heartbeat Output Fields

The UI contains a hearbeat line composed of dots and lables conected by lines that is used to provide a visual description of the factor and intermediate variables used in the score calculation.

The first seven circled values in the output table 11 correspond to the seven scoring factors. The eighth and ninth values are a label (squared value in the table) and numeric value corresponding to the BASE score before notching and capping is applied. The tenth and eleventh values correspond to the ICR output.

The twelth value is a string that is set to a dash if the BASE is not modified by the notching and capping otherwise it receives the ICR score string.

Appendix A   QMD Model Bridge

The model API corresponds to that of the QMD Model Bridge [3]. As the input and output data structure is complex will use the shorthand notation table below to describe the fields in a compact way.

Type Code	C++ Type	Java Type	Description
D	**double**	**double**	Floating point number
I	**int**	**int**	Integer number
B	bool	**boolean**	Boolean
S	std :: string	String	String
M	MatrixOf<**double**>	MatrixOfDouble	Floating point matrix
PS	ParameterSet	PS	Key type value container
VD	std :: vector<**double**>	DoubleVector	Floating point vector
VI	std :: vector<**int**>	IntVector	Integer vector
VB	std :: vector<bool>	BooleanVector	Boolean vector
VS	std :: vector<std::string >	StringVector	String vector
VPS	std :: vector<ParameterSet>	PSVector	Vector of key type value container

Table 13: *ParameterSet type notation*

Appendix B   Document Change History

Doc. Ver.	Date	Author(s)	Model Ver.	Change Description
1.0	Nov 26, 2014	S. Fanchiotti	1.0	Initial Version
1.1	Feb 5, 2015	S. Fanchiotti	1.0	Updated UI hints

References

[1] Standard & Poor's International Non-US Local Government Scenario Builder Model Specification Version 1.0, Nov 25, 2014.

[2] Methodology For Rating Non-U.S. Local and Regional Governments, Daniela D Brandazza et. al., Criteria/Governments/International Public Finance, Standard & Poor's, June 20, 2013,

[3] QMD Bridge API Release 1.0, June 4, 2012.