

Internal Private Rating Model

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Abstract: *Internal Rating Models are intended to evaluate the rating of counterparts using set of objective data and subjective criteria. A private rating model is described. It is accomplished using a rule-based approach and the CLIPS language to script the programming interface and the business logic. The script is interpreted by C++ application.*

Key words: *Rule-based System, Expert System, Rating Systems, Credit Risk, Credit Rating, Rating Model, Computer Systems and Technologies*

INTRODUCTION

Many banks are developing more robust internal risk rating processes in order to increase the precision and effectiveness of credit risk measurement and management. This trend will continue as banks implement advanced portfolio risk management practices and improve their processes for measuring and allocating economic capital to credit risk. Further, expanded risk rating system requirements are anticipated for banks that assign regulatory capital for credit risk in accordance with the Basel Committee on Bank Supervision's proposed internal-ratings-based approach to capital. More and more banks are:

- Expanding the number of ratings they use, particularly for pass credits;
- Using two rating systems, one for risk of default and the other for expected loss;
- Linking risk rating systems to measurable outcomes for default and loss probabilities; and
- Using credit rating models and other expert systems to assign ratings and support internal analysis.

According to the definition of Basel II the term rating system comprises all of the methods, processes, controls, and data collection and IT systems that support the assessment of credit risk, the assignment of internal risk ratings (minimum 7 for non-defaulted borrowers and one for those that have defaulted). Each rating grade defines certain level of risk and quantifies loss or default estimates. A bank must have specific rating definitions, processes and criteria for assigning exposures to grades within a rating system. The rating definitions and criteria used for assigning grades to counterparts must be both plausible and intuitive and must result in a meaningful differentiation of risk. Rating criteria and procedures must differ for different types of borrowers or facilities.

Credit scoring models and other mechanical rating procedures generally use only a subset of available information. Sufficient human judgement and human oversight is necessary to ensure that all relevant information, including that which is outside the scope of the model, is also taken into consideration, and that the model is used appropriately

AUTOMATED SCORING SYSTEMS

While statistical models that estimate borrower risk have long been used in consumer lending, internal credit risk models have only recently begun to gain acceptance. Increasing information about credit risk and rapid advances in computer technology have improved modeling techniques for both private and firm credit. Because of these

advancements, the internal risk rating processes at some large banks can and do rely considerably on credit models. These banks use models to confirm internal ratings, assign finer ratings within broad categories, and supplement judgmentally assigned ratings. Most credit scoring models are either statistical systems or expert systems:

- A statistical system relies on quantitative factors that are indicators of default.
- An expert system attempts to duplicate a credit analyst's decision making.

Like other models, automated credit rating systems should be carefully evaluated and periodically validated. Until banks gain more experience with them under a range of market conditions, they should use such systems to supplement more traditional tools of credit risk management: credit analysis, risk selection at origination, and individual loan review.

MODEL DESCRIPTION

The rating model represents a multilevel hierarchy of criteria, intermediate and end results. The first level includes a set of appropriate basic exact or non-exact criteria describing the applicant's to cover his outstanding obligations. Criteria are grouped in three directions: personal data, income and expenditure and future prospects

Personal data

This group includes 13 indicators such as age, citizenship, profession, education and qualification, occupation, etc.

Income and Expenditure

Property, income, expenditure, relation property to debt are among the nine indicators in the second direction.

Future prospects

This group consist of four indicators: how long the applicant has been client of the bank, job offers, [Account Behavior](#), [Estimation of Business Relation](#).

For all indicators, the user may enter a grade, possible values are 0, 1, 2, 2.5, 4 and 5. The meaning of values are: insignificant for 0, unknown for 2.5 and for the others according to the indicators.

The next level defines a set of intermediate results for each direction. The result is evaluated as average grade. The grades are converted to scores. Weight factors are assumed to the direction groups as follows 0.4 to Personal Data, 0.4 to income and expenditure, and 0.2 to Prospects.

The result for rating is obtained from the scores using following expression:

$$(100-S)*0.05+1$$

where S is the sum of weighted results for the separate groups.

The end result is calculated in scores from the scores of personal data, income and expenditure and future prospects, and converted to a grade, which is finally mapped by separate rules to external SnP and Moodys rating scale.

Private Rating	SnP / Moodys
<= 1,30	AAA / Aaa
<= 1,80	AA / Aa
...	
...	
...	
<= 5,25	CCC / Caa
> 5,25	(C)
n.r.	D / D

MODEL IMPLEMENTATION

The evaluation of a counterpart rating is based on the model variables entered during a rating session and realizes following steps:

- Calculation of Indicators using formulae
- Estimation of Indicators to scores by expressions
- Weighing and aggregation to a total score
- Assigning to master scale - mapping the total score to default probability
- Obtaining the rating

The user can't monitor these steps but he can control the input of model variables, initiate the start of the rating procedure and decide what do with the rating results.

MODEL STRUCTURE

The Rating model script contains all definitions of templates, facts and rules needed to produce applicatnt's rating according to the implemented model. The model script is independent from the individual. The model scripts are saved in text files with the extension .clp.

Script includes several sections:

TEMPLATES for Structure of Classes, Groups, Fields and Texts. Templates dialogroot, dialogclass, dialoggroup, dialogfield and dialogtext are provided.

Example:

```
(deftemplate dialogroot
  "Dialog"
  (slot ID (type STRING) (default ?NONE))
  (slot type (type STRING) (default ?NONE))
  (slot name (type STRING) (default ?DERIVE))
  (slot explain (type STRING) (default ?DERIVE))
  (slot style (type INTEGER) (default 1))
  (slot font_name (type STRING) (default ?DERIVE))
  (slot font_size (type INTEGER) (default ?DERIVE))
)
```

This section exists by default and the model developer doesn't change it.

VARIABLE TEMPLATES

In this section are stored templates of all the variables needed for the evaluation process.

Example:

```
(deftemplate occ_grade          ;; Control ID "Name of Edittext"
  (slot type                    (type STRING) (default "CB") )      ;; Control Type (Double)
  (slot str_value              (type STRING) (default "2.5") )
  (slot value                  (type INTEGER) (default 3) )      ;; Default for DB Control types
  (slot list                   (type STRING) (default "list_PersonalData") )
)
```

Definition of Facts used as Lists or Properties for Listboxes, Comboboxes, Edittexts, etc.

Example:

```
(deffacts lists
  "Dialog Lists"

  (list_Personaldata    "0" "1" "2" "2,5" "3" "4" "5")
  (list_Property       "0" "1" "2,5" "3" "5")
  (list_Score          0.00 100.00 2)
  (list_Relation       0.0 100.0 4)
  (list_PD             0.0 100.0 4)
  .....
)
```

Definition of Panels, Groups, Field and Texts

Examples:

```
(dialoggroup (ID "PK0100g")
  (type "GROUPBOX")
  (name "Personaldata")
  (x-coord 7)
  (y-coord 7)
  (length 357)
  (hight 263)
  (style 2) ;;WS_GROUP)
  (explain "Personaldata")
)
```

```
dialogfield (ID "PK0108")
  (type "COMBOBOX")
  (name "Occupation")
  (control "")
  (x-coord 166)
  (y-coord 142)
  (length 30)
  (hight 90)
  (style 130)
  (question "")
  (explain "")
  (variableID "occ_grade")
```

The facts are defined by the statement deffacts and initfacts and loaded into the fact base after parsing the rating model script. The facts refer to the fact templates and set values (strings) for the template slots. The inference engine works only with the referenced variables for fields linked by the slots named "variableID" that connect facts to simple variable templates.

RULE Section

Rule is a primary method of representing knowledge in CLIPS. Sets of rules are defined to work together to solve a problem – determining credit rating. CLIPS rules may consist of arithmetic or logic expressions and generate values for intermediate or result facts.

The RULE Section includes all rules describing dependencies between facts (questions and results). These dependencies are expressed by the general form:

```
IF      facts variables (questions or results) are present in the fact base
THEN
        calculate the value of new or same facts (results) and
        insert these facts into fact base
```

Example:

```
(defrule r-SnP_Moodys_Rating
  (GE0000n (value ?GE0000nv))

=>
  (if (<= ?GE0000nv 1.30) then
    (bind ?Rating "AAA/Aaa")
    (bind ?SaveRating "AAA")
    (bind ?RatingIndex 0)
  ))
```