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Uncertainty in expert systems and credit granting decisions

Tomasz Żurek*

Institute of Computer Science, Maria Curie-Skłodowska University,
Pl. Marii Curie Skłodowskiej 1, 20-031 Lublin

Abstract

One of the most popular utilization of expert systems is supporting credit granting decisions. Usually, certain systems without possibilities of representing of uncertain knowledge are used. The main aim of this paper is to compare certain and uncertain expert systems supporting credit granting decisions, and stating which one is superior over another.

1. Introduction

Supporting of credit decisions is a very popular way of expert system usage, which is the result of specific properties of such decisions, and advantages of expert systems in which the group of conditions cause one final conclusion. Usually in such expert systems the conditions can be only true or false, and the systems do not use any representation of uncertain knowledge. Some of the conditions are ultimately certain e.g. financial data. Some of them are not however especially, all the conditions connected with future predictions, as well as estimation of important, but difficult to measure values.

Lots of ways of representing the uncertain knowledge have been developed during the years. Some of them have their source in the probabilistic theory, some of them come from the fuzzy sets theory. Finally, some of them have its own way of representation of uncertain knowledge.

Usually, expert systems, which are used in banks to evaluate firms, use only representation of certain knowledge [1-5]. A main reason lies in the point, that the final conclusion has two possible values: whether to give credit or not. In such a situation, uncertainty is not necessary. On the other hand, most of the conditions are uncertain, and it is important for the bank to know that estimation of the enterprise is certain enough. Sometimes, in circumstances of uncertain decision, the bank wants to have bigger collateral or a special way of collecting

* *E-mail address*: zurek@kft.umcs.lublin.pl

rates to make credit safer. In such a situation, the expert system with uncertain knowledge representation could be useful.

Most of the human experts use their own private way of making decisions with uncertainty of conditions. Sometimes not even realizing it.

The expert system with uncertain knowledge representation, allows to get more information about the enterprise.

The expert system with uncertain knowledge representation usually has a different knowledge base from the classical certain expert system. It is important to research how both of the systems work and to compare their constructions and conclusions.

Such comparison of the systems would allow to find differences in their conclusions, as well as the reasons for the differences.

Finally, the main aim of the work is to compare certain and uncertain expert systems supporting credit granting decisions, and state which one is superior over another.

2. Knowledge representation

The RMSE (Rule and Model Based Expert Systems) expert system shells with certain and uncertain knowledge representation were used throughout the whole paper. The uncertain expert system uses modified stanford certainty factors algebra [6,7]. In the system, every condition and conclusion have their own certainty factor which is a real from the interval <-1;1>. This certainty factor can be interpreted as a degree of confidence or belief [6]. CF = 1 assuming that the condition or conclusion is absolutely true. If CF=-1 the condition or conclusion is absolutely untrue; if CF=0, it means that nothing is known about this condition or conclusion. Intermediate value of certainty factor indicates an intermediate degree of certainty.

3. Differences in construction of the knowledge bases

Knowledge bases of both expert systems have different constructions. The reason for which lies in the knowledge representation. In the classical certain system, every attribute is divided into several conditions (or conclusions). For example the estimation of finances is divided into: “good finances”, “average finances”, and “bad finances”. In such a situation the uncertain expert system has only one condition (conclusion): “good finances”, and certainty factor of the condition describes the condition of the enterprise’s finances. If the CF is positive and high, it means that the firm has good finances. If the CF is negative it means that “good finances” of the enterprise are not true, so consequently, they are bad.

Both knowledge bases differ not only in the case of construction, but also in the case of a number of rules too. Due to specific abilities of knowledge

representation with the use of the certainty factors, the knowledge base of an uncertain system can be much smaller. The uncertain knowledge base includes only 227 rules, while the certain knowledge base has 740 rules.

4. Research procedure

The same credit granting procedure was a source of knowledge for both knowledge bases: certain and uncertain. The systems were tested using the examples of 7 real enterprises and 2 ideal firms: ideal good and ideal bad.

5. Comparison of the conclusions of both systems

Final conclusions obtained from both uncertain and certain systems are shown below.

Table 1. Comparison of both systems' conclusions

Enterprise	Uncertain system	Certain system
	Good estimation of the borrower's power with CF=	Final conclusion
1	0.18	Good estimation of the borrower's power
2	0.13	Good estimation of the borrower's power
3	-0.15	Bad estimation of the borrower's power
4	-0.06	Bad estimation of the borrower's power
5	0.12	Good estimation of the borrower's power
6	0.01	Bad estimation of the borrower's power
7	0.15	Good estimation of the borrower's power
Ideal good	0.47	Very good estimation of the borrower's power
Ideal bad	-0.44	Very bad estimation of the borrower's power

Conclusions of the uncertain system should be interpreted in the context of results of ideal enterprises: the best and the worst. If the certainty factor of a conclusion is positive, it means that a "good estimation of borrower's power" is true, and the value of the factor describes a degree of belief in it. If the certainty factor of a conclusion is negative, it means that a good estimation of borrower's power is not true.

Comparison of the results obtained from both systems allows to notice that they are similar (if the certain system provides good estimation, the uncertain system provides good estimation with the positive certainty factor). Only one enterprise obtained different evaluation in each system. The enterprise number 6 obtained good evaluation (but with a very small certainty factor) in the uncertain system, and bad evaluation in the certain system. Analyzing all conditions of this enterprise, it is easy to notice that the conditions of the estimation are close to the border between good and bad. In such a situation, the final decision is very

uncertain, and only uncertain system can notice and evaluate it. The bank official knows more about the enterprise and can make a better credit decision.

To make the analysis better, it is important to compare not only final results, but also some main conclusions reached during the inference. In this paper, three attributes will be compared: evaluation of enterprise's finances, evaluation of economical statement, and evaluation of management.

Table 2. Transitive conclusions obtained from the uncertain expert system

Enterprise	Certainty factor of a conclusion		
	good evaluation of management	Good evaluation of finance	Good evaluation of economical statement
1	0.45	0.18	0.08
2	0.12	0.15	0.13
3	0.00	-0.23	-0.21
4	0.00	0.02	-0.21
5	0.48	0.00	0,08
6	0.36	-0.02	-0.19
7	0.41	0.18	-0.09
Ideal good	0.55	0.61	0.58
Ideal bad	-0.55	-0.48	-0.58

Table 3. Transitive conclusions obtained from the certain expert system

Enterprise	Evaluation of an enterprise in a filed of		
	Management	Finance	Economical statement
1	Very good	Average	Bad
2	Average	Average	Good
3	Average	Bad	Bad
4	Average	Average	Bad
5	Very good	Average	Very good
6	Very good	Bad	Very bad
7	Very good	Good	Bad
Ideal good	Very good	Very good	Very good
Ideal Bad	Very bad	Very bad	Very bad

The results obtained from both systems are similar. In some cases, the certain system provided "average" evaluation, which can be compared to estimation with very a low certainty factor in the uncertain system. This is a kind of evaluations which should not have great influence on the final conclusion.

The results obtained from the systems are similar. Sometimes, small differences appear in the situations in which values are on the border between good and very good, or between average and good. There is only one important difference between evaluation obtained from the certain and uncertain systems.

In the filed of economical statement, enterprise number 1 obtained bad estimation in the certain system and good estimation with CF = 0.08 in the uncertain system.

Several attributes have an influence on the economical statement. Evaluation of prospects of development is one of them. The other two attributes have influence on "evaluation of prospects of development": "evaluation of prospects of a product" and "evaluation of possibilities of changing the product". It is on this level of inference that the root of the difference between the results obtained from the systems can be found. The value of evaluation of prospects of product is negative in both systems (in the certain system it is bad, in the uncertain system, the attribute has negative CF), and the "value of evaluation of possibilities of changing product" is positive in both systems. However, influence of the first attribute on the conclusion in the uncertain system is not big enough to change the value of evaluation of "prospects of development" like in the certain system was. Of course, it is possible to correct it by means of changing the value of certainty factor of the rule, which can change the degree of influence of attributes on the conclusion.

However, to examine how it works in the certain system would be much more interesting. In the certain system, in a given case, a small change of value of evaluation of "possibilities of product change" from average to good causes great changes in the final conclusion, which results in great changes from "bad estimation of economical statement" to "good estimation of economical statement". Such is a very specific case, because the values are close to the border between good and bad, but sometimes in reality such situations happen. The ultimate conclusion is: a small change of value of unimportant attribute can make a great change of final conclusions' value without any notification about uncertain nature of such a decision.

In such a situation, the uncertain system provides the conclusion with a very small certainty factor which explains the user the specific nature of this conclusion.

Conclusions

Two ways of knowledge representation in the expert systems were compared in the work. The comparison was made in the field of credit granting. Knowledge bases of both systems were built on the base of the same credit granting procedure. The data of 7 enterprises were used to compare the conclusions reached by each system.

Comparison of the conclusions obtained from the systems indicates that evaluation of the enterprises in each system is the same in most of the cases. There were some exceptions (one in comparison of the final conclusions), which appear, however, only in the situations in which the conditions of the evaluation are close to the border between good and bad.

The detailed analysis of the differences allows to notice that in the certain system, even a small change of one attribute's value can sometimes lead to an important change of the final conclusion. In such a situation, the uncertain system provides a very small value of certainty factors, which helps to interpret the conclusion properly.

The credit decision can have only one of two values: to give or not to give credit, but decisions made by the bank officers are usually not that simple. Usually the officials should make more complex decisions about collateral and the way of credit repayment. In situations where big uncertainty of decisions is, the uncertain expert system can help make such a decision, and, at the same time, makes this decision much safer.

References

[1] Baldwin Morgan A.A. Sangster A., *Strategy and Impacts of Expert Systems for Bank Lending*, Expert Systems With Applications, Elsevier, 11(4) (1996) 455.

[2] Doumpos M. Kosmidou K. Baourakis G. Zopounidis C., *Credit risk assessment using a multicriteria hierarchical discrimination approach: A comparative analysis*, European Journal of Operational Research, Elsevier, 138 (2002) 392.

[3] Liebowitz J. Edited by., *The handbook of applied expert systems*, CRC Press, (1998)

[4] Michalik K. Twardowski Z., *Technologia sztucznej inteligencji we wspomaganiu oceny ryzyka kredytowania podmiotów gospodarczych*, Conference „Zastosowania rozwiązań informatycznych w bankowości", Akademia Ekonomiczna im. Oskara Langego, Wrocław, (1999) 217, in Polish.

[5] Sangster A., *The Bank's of Scotland COMPASS – The Future of Bank Lending?*, Expert Systems with Applications, Elsevier, 9(4) (1995) 457.

[6] Niederliński A., *Rodzina skorupowych hybrydowych systemów ekspertowych RMSE*, In: "Krajowa Konferencja Automatyki", KKA XIV, Zielona Góra, June 24-27 2002, 2 (2002) 863, in Polish.

[7] Niederliński A., *Regułowe systemy ekspertowe*, Wydawnictwo Pracowni Komputerowej Jacka Skalmierskiego, Gliwice (2000), in Polish.