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Final Assignment

Qualitative Bankruptcy Data Set

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1 Problem knowledge area

The problem chosen is of a social-economic nature. With the current economic crisis worldwide it is only natural that a considerable number of companies end up being dragged towards bankruptcy. The information regarding bankruptcy prediction gathered by experts in this area is still considered quite important due to the subjectivity attached to their predictions. The objective here is to simulate and automatize these predictions, representing in a way the predictions that would be made by the experts. Data classification remains as one of the most important issues for most business applications, and the business classification problem was the one selected for this work.

2 Problem

Corporate bankruptcy is a serious problem triggering other sets of problems leading to social and economic disaster across the countries spreading with a rippling effect. Given the problematic nature of this issue the aim here is the prediction of bankruptcy for a given company given a set of qualitative risk factors assessed by experts for that particular company.

2.1 Attributes

Regarding the attributes there are 6 different attributes which have the same domain, each attribute can hold one of 3 possible values, positive (P), average (A) and negative (N) and the prediction/classification will be either as bankruptcy (B) or non-bankruptcy (NB). The 6 attributes present are the companies' internal risks, Industrial Risk (IR), Management Risk (MR), Financial Flexibility (FF), Credibility (CR), Competitiveness (CO), and Operating Risk (OP). Details about the risk factors can be found on table 1.

Risk factor	**Variables**	**Risk components**
Industry risk	IR	Government policies and International agreements
		Cyclicality
		Degree of competition
		The price and stability of market supply
		The size and growth of market demand
		The sensitivity to changes in macroeconomic factors
		Domestic and international competitive power
		Product Life Cycle

Management risk	MR	Ability and competence of management
		Stability of management
		The relationship between management/owner
		Human resources management
		Growth process/business performance
		Short and long term business planning, achievement and feasibility
Financial Flexibility	FF	Direct financing
		Indirect financing
		Other financing (Affiliates, Owner, Third parties)
Credibility	CR	Credit history
		The reliability of information
		The relationship with financial institutes
Competitiveness	CO	Market position
		The level of core capacities
		Differentiated strategy
Operating Risk	OP	The stability and diversity of procurement
		The stability of transaction
		The efficiency of production
		The prospects for demand, for product and service
		Sales diversification
		Sales price and settlement condition
		Collection of A/R
		Effectiveness of sale network

Table 1: Details about qualitative risk factors

3 Bayes Network

The Bayes Network for this problem and the probabilities table for the Bankruptcy class can be found in the next two figures.

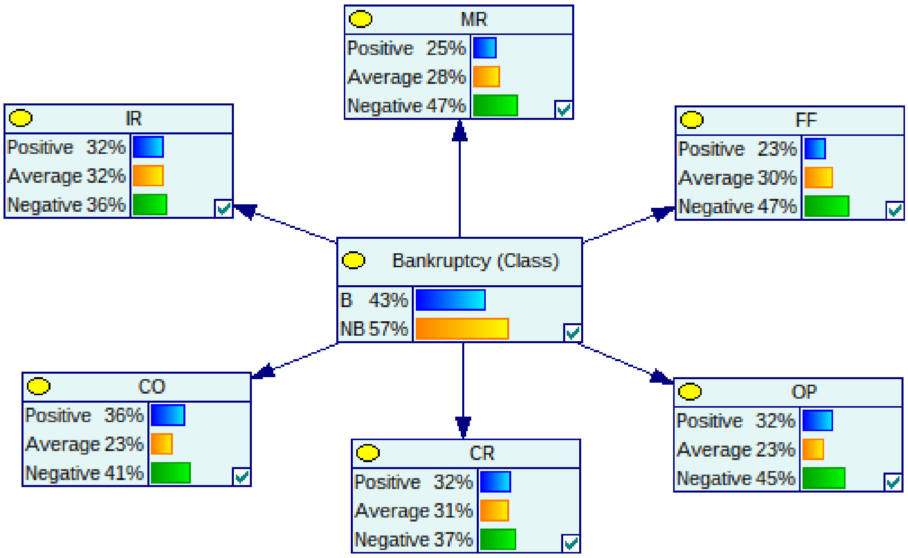

Figure 1: Bayes Network

B	0.428
NB	0.572

Figure 2: Bankruptcy class probabilities (BR)

3.1 Conditional Probabilities Tables

Bankruptcy (Class)	B	NB
Positive	0.244	0.377
Average	0.263	0.37
Negative	0.493	0.253

Figure 3: Conditional probabilities (IR)

Bankruptcy (Class)	B	NB
Positive	0.106	0.356
Average	0.217	0.322
Negative	0.677	0.322

Figure 4: Conditional probabilities (MR)

Bankruptcy (Class)	B	NB
Positive	0.014	0.391
Average	0.041	0.488
Negative	0.945	0.121

Figure 5: Conditional probabilities (FF)

Bankruptcy (Class)	B	NB
Positive	0.033	0.529
Average	0.161	0.419
Negative	0.806	0.052

Figure 6: Conditional probabilities (CR)

Bankruptcy (Class)	B	NB
Positive	0.005	0.633
Average	0.041	0.363
Negative	0.954	0.004

Figure 7: Conditional probabilities (CO)

Bankruptcy (Class)	B	NB
Positive	0.18	0.419
Average	0.226	0.232
Negative	0.594	0.349

Figure 8: Conditional probabilities (OP)

4 Problem Reformulation

A venture capitalist finds a venture he believes to have some potential for investment purposes and wants to decide if it is worth investing. The venture capitalist wants to invest €850,000 in the venture. Based on qualitative bankruptcy predictions he can guess if the venture is going to be successful.

If the venture is indeed successful, he will collect an additional maximum amount of €2,150,000. But in the other hand, if the venture turns out to be unsuccessful he looses the initial investment of €850,000. If he chooses to not invest in the venture and go through a risk-free path he can make a risk-free investment in a bank which which will earn him an additional €150,000.

This venture capitalist is interested solely in its financial gain. If there are any other factors involved like changes in the value of money or intangible values, they can be represented through means of the utility function. This utility function will represent the financial gain. So in the end what matters is the decision which brings the maximum amount of financial gain to the venture capitalist.

Given the data provided for the problem the values for the Financial Gain Utility function would be the following:

Venture Success	Success		Failure	
Invest?	Invest	DoNotInvest	Invest	DoNotInvest
Value	2150000	150000	-850000	150000

Figure 9: Financial Gain utility function values

The gain here is indexed by the decision to invest or not and the success of the venture which in turn is influenced by the qualitative bankruptcy prediction for the venture. The values specified are the respective monetary gain for each combination of values from the Invest? and Venture Success nodes.

5 Decision Network

After reformulating the problem a bit and adding the required decision and utility nodes the decision network in the next figure was obtained.

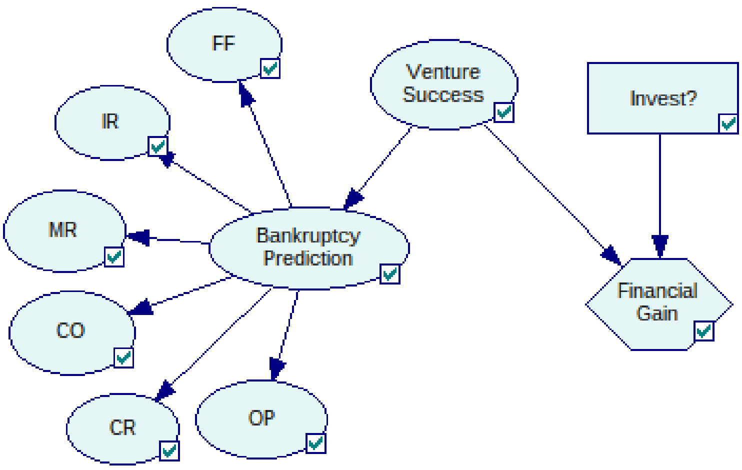

Figure 10: Bayes Decision Network

5.1 Probabilities

The probabilities for the Bankruptcy Prediction node were altered due to the insertion of a new node for the Venture Success Prediction. The Probabilities tables for each can be found in the next figures. The remaining probabilities for the companies internal risk factors remain the same.

Venture Success	Success	Failure
B	0.348	0.552
NB	0.652	0.448

Figure 11: B. Prediction node probabilities

Success	0.381
Failure	0.619

Figure 12: Venture Success probabilities

6 Results

6.1 Case 1

If the default probability values were considered for Venture Success (shown in figure 12) the expected utility values of investing or not investing would be the following:

Expected utilities for different policies:

Invest?	Invest	DoNotInvest
Exp. utility	293000	150000

Figure 13: Expected Utility Values (Example 1)

Given these values the **decision** here would be to invest in the venture.

6.2 Case 2

If the probability values for the venture success were the following,

Success	0.15
Failure	0.85

Figure 14: Venture Success Probabilities (Example 2)

then the expected utility values of investing or not investing would be the following:

Expected utilities for different policies:

Invest?	Invest	DoNotInvest
Exp. utility	-400000	150000

Figure 15: Expected Utility Values (Example 2)

Given these values the **decision** here would be to not invest in the venture and make a risk-free investment in a bank instead.

6.3 Case 3

If the probability values for the venture success were the following,

Success	0.65
Failure	0.35

Figure 16: Venture Success Probabilities (Example 3)

then the expected utility values of investing or not investing would be the following:

Expected utilities for different policies:

Invest?	Invest	DoNotInvest
Exp. utility	1100000	150000

Figure 17: Expected Utility Values (Example 3)

Given these values the **decision** here would be to invest in the venture.

6.4 Case 4

If the probability values for the venture success were the following,

Success	1
Failure	0

Figure 18: Venture Success Probabilities (Example 4)

then the expected utility values of investing or not investing would be the following:

Expected utilities for different policies:

Invest?	Invest	DoNotInvest
Exp. utility	2150000	150000

Figure 19: Expected Utility Values (Example 4)

Given these values the **decision** here would be to invest in the venture.

6.5 Case 5

If the probability values for the venture success were the following,

Success	0
Failure	1

Figure 20: Venture Success Probabilities (Example 5)

then the expected utility values of investing or not investing would be the following:

Expected utilities for different policies:

Invest?	Invest	DoNotInvest
Exp. utility	-850000	150000

Figure 21: Expected Utility Values (Example 5)

Given these values the **decision** here would be to not invest in the venture and make a risk-free investment in a bank instead.

7 Conclusion

Taking into account the results here the best result here is to invest in the company unless the probability for Venture success is too low, which is backed by a bigger probability in the prediction of the venture going bankrupt. The bankruptcy prediction values can indirectly influence the utility functions' values depending on the difference of probabilities between both predictions. In cases like the default one (figure 12 where the probability for success is way less than 50%, but the probability for a Non-Bankruptcy prediction is still higher than average it is still worth investing because the gains will still be higher than those that come from not investing in the venture and making instead the risk-free investment in a bank.

This was a relatively easy assignment to make, and the decision network is a simple one and easy to understand, despite the difficulties in the beginning while trying to come up with a simple problem reformulation to introduce action and utility nodes into the Bayes Network using the already existent nodes.

References

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