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DOI: 10.15290/oes.2018.04.94.18

THE APPLICATION OF SAW METHOD TO SUPPORT THE DECISIONS CONCERNING START-UP FINANCING

Summary

The aim of the paper was to present the problem of risk assessment of financing start-ups of individual economic activities as the problem of multi-criteria decision making. The detailed goal of the study was to build a decision model and its empirical verification. Research methodology – The SAW method - was used to build the model based on the concept of the aggregation of the decision-maker's preferences. In the process of building the model, the correspondence analysis was also used.

Result – The result of the research is the decision model, the usability of which has been subjected to empirical verification.

Originality/value – The model approach proposed in the paper is an original approach for two reasons: Firstly, the correspondence analysis was used in the stage of assigning ranks to verbal or interval variables; Secondly, the use of Cramer's V coefficient to calculate the weightings of criteria and decision sub-criteria was proposed, hence the resulting algorithm of the model should be recognized as the added value of the conducted research.

Key words: economic activity, loans, credit risk modeling, multiple criteria decision methods (MCDM), SAW

JEL classification: C5, C6

1. Introduction

The development of the sector of enterprises is one of the major factors that decide upon the development of the state. In Poland in 2016 there were 2.01 mln registered active enterprises in the non-financial sector, while in 2009 there were only 1.67 mln companies. The increase in the number of enterprises in this sector amounted to more than 20%, yet the particularly dynamic increase was observed as regards companies from the sector of micro enterprises: in the years 2009-2016 the dynamics amounted to 21%. Enterprises to an increasing degree are now contributing to the creation of GDP in Poland. In 2008 the participation of enterprises in the creation of GDP amounted to 71.1%, while in 2015 it increased to 75%. The largest participation in the creation of GDP is ascribed to micro enterprises –

presently the participation amounts to 30.5%. In case of micro enterprises there may be observed also the increase of both production and the number of people employed in this sector. In the years 2008-2016 the added value created by micro enterprises increased from 221.1 to 291 bln PLN. The sector of micro enterprises and also small and medium-sized enterprises (SME) is the driving force of the European economy. In the EU the SME sector constitutes 99% of all the enterprises and offers 75 mln working positions. Nevertheless, micro enterprises and also small and medium-sized enterprises frequently have difficulties with obtaining capital for development, especially in the stage of starting business.

2. The problems with financing individual start-ups

It is a difficult task to make the decision to grant financing for individual start-ups. The evaluation regards the application form of a physical person, whereas the financing is offered for the newly established enterprise. The form of financing may adopt various forms: a preferential loan or a credit, non-returnable subsidy and the obtainment of funds of the *venture capital* type. Each form of financing has its specific character as well as the risks connected with granting it, in particular in the situation when the start-up of a company is financed using returnable funds there increases the risk connected with granting a credit or a loan. Regardless of what is the type of the capital that will serve the financing of the start-up of an individual business activity, the application of classical methods supporting the evaluation of the enterprise's financial situation in the discussed decision-making problem may encounter a number of difficulties. In the classical approach the assessment of the application form is made on the basis of the historical data concerning the applicant, including especially the financial data. The assessment of the applicant in this case (i.e. an enterprise with the history of operational activity is subject to the evaluation regarding a number of criteria in accordance with the methodology of granting a certain type of financing an entity with capital. These criteria may be divided into the criteria regarding both objective and subjective factors. The objective factor that may have impact on the enterprise's ability to timely fulfill the credit commitments could be the financial situation of the entity receiving a credit that is measured by the profitability of an enterprise or other financial indicators describing a certain entity. The evaluation of the enterprise's financial situation may be made in a number of ways. The first way (which is used very often) is connected with the evaluation of the company's financial indicators [Leszczyński, Skowronek-Mielczarek, 2000; Gabrusewicz, 2014]. The analysis of this type implies the expert's written description of the indicators or ascribing the numerical evaluation to particular values of indicators most frequently while using intervals (the evaluation of financial indicators may be made also while using the concept of a fuzzy set or a fuzzy conclusion [Korol, 2013, p. 83; Konopka, 2013, p. 285]). Another way of assessing the company's financial situation is the construction of a decision-making model based on data in the form of financial indicators. The model's purpose is to

ascribe an enterprise to one of two groups: solid (prosperous) or non-solid enterprises (bankrupts). One of the models of this type was the model created by E. Altman – it was based on the discriminant analysis [Altman, 1968, p. 589], while in the subsequent years the concept was developed [Eisenbeis, Avery, 1972; Altman, Eisenbeis, 1978, p. 185]. The models aiming at the evaluation of the financial condition of enterprises and using the discriminant analysis were established also on the basis of data concerning Polish enterprises. Extensive research in this aspect was conducted, among others, by E. Mączyńska and M. Zawadzki [2006], J. Pociecha, B. Pawełek, M. Baryła, S. Augustyn [2014] as well as by A. Holda [2006, p. 286]. In the subject literature one may also find the examples of the usage of Bayesian analysis for the prediction of the insolvency of bank credits [Marzec, 2008] and also both logit and probit models [Marzec, 2003, pp. 103-117].

The aforementioned models have common denominator in the information used for their construction, i.e. the data used in the construction of these models is in the form of historical financial results (numerical values measured using the quotient scale). There may be observed the domination of the conducted research using the models operating with numerical data over the research using data in the linguistic form [Kitowski, 2014. p. 345]. In case of the start-up of an individual business activity there is data of various types: linguistic (verbal), numerical, the formulations expressed approximately, range values. The type of the possessed information there has uncertain and imprecise character. Therefore, the problem of financing start-ups of individual economic activities belongs to the group of decision-making problems that are either poorly structured or are not structured at all. This fact considerably reduces the number of methods that may be used in the construction of the model supporting decision-making in financing individual economic activities. In the issues of this type there may be applied methods of multi-criteria decision-making, the methods using the concept of a fuzzy set and fuzzy conclusion. In the previous research concerning the analyzed problem there were used, among others, the methods based on the paradigm of disaggregation of the decision-maker's preferences: MARS method and UTA method [Konopka, Roszkowska, 2015; Roszkowska, Konopka, 2016] and WINGS method (Weighted Influence *Non-linear Gauge System*) [Michnik, 2016]. In order to construct the presented model the SAW method has been used (*Simple Additive Weihiting Method*) – it was presented in the next chapter of the paper.

3. SAW method

In order to construct the decision-making model there was used **SAW method** (*Simple Additive Weighting Method*) which had been presented in 1954 by Churchman and Ackoff [1954, pp. 172-187]. The method's advantage lies in its simplicity and intuitive application in the process of modeling the decision-maker's preferences. It should be noted that the application of this method requires the adoption of the assumption regarding the independence of the decision-maker's preferences owing

to the discussed decision criteria [Trzaskalik, 2014, p. 21]. The discussed problem regarding decision-making may be presented in a general form of a decision table 1.

TABLE 1

Decision table

Criterion / Decision variant	K_1	K_2	⋯	K_n
W_1	a_{11}	a_{12}	⋯	a_{1n}
W_2	a_{21}	a_{22}	⋯	a_{2n}
…	…	…	…	…
W_m	a_{m1}	a_{m1}	⋯	a_{mn}

where:
- $K_1, K_2, \dots, K_n$ - decision criteria,
- $W_1, W_2, \dots, W_n$ – analyzed decision variants,
- a_{ij} – numeric value, verbal label, or.

Source: own elaboration on the basis of: [Trzaskalik, 2014, p. 123]

The algorithm of SAW method in case of the criteria described using numerical values, linguistic terms or range values is as follows:

Step 1. The specification of the decision criteria, the type of criteria (the type of a profit or the type of a loss), sets of the evaluations regarding the values of the criteria and the completed set of evaluated application forms. For each linguistic or range variable (adopted as the decision's criterion/sub-criterion) there is ascribed verbal assessment and the numerical equivalent by using an appropriate scale. For the needs of the paper there was used a nine-degree scale which is presented in table 2 [Jadidi et al., 2008], but ultimately all the decision criteria and sub-criteria are of the following type: "The more, the better".

TABLE 2

Adding ranks to linguistic expressions

Verbal assessment	Evaluation using points (rank)
Pass (P)	1
Satisfactory (S)	3
Good (G)	5
Very Good (VG)	7
With distinction (D)	9
Values	2,4,6,8

Source: own elaboration on the basis of: [Jadidi et al., 2008, p. 764].

Step 2. The determination of the normalized decision matrix. In the discussed decision problem there was used one scale (comp. table 2), owing to which in this case the stage may be omitted. In the general approach the normalization may be realized in the following way [Roszkowska, Brostowski, 2014; Trzaskalik, 2014, p. 40]:

a) for the criteria of "profit" type we calculate:

$$\bar{a}_{ij} = \frac{a_{ij} - \min_{1 \le l \le m} a_{lj}}{\max_{1 \le l \le m} a_{lj} - \min_{1 \le l \le m} a_{lj}}, \tag{1}$$

b) for the criteria of "loss" type we calculate:

$$\bar{a}_{ij} = \frac{\min_{1 \le l \le m} a_{lj} - a_{ij}}{\min_{1 \le l \le m} a_{lj} - \max_{1 \le l \le m} a_{lj}}. \tag{2}$$

Other normalization methods may be found in [Roszkowska, Brzostowski, 2014; Trzaskalik, 2014, p. 40].

Step 3. The specification of the weighting [Roszkowska et.al., 2013, pp. 207 - 227] of decision criteria where for each decision criterion K_j there is ascribed positive weighting w_j in order to:

$$\sum_{j=1}^{n} w_j = 1 \tag{3}$$

Step 4. Having certain normalized decision variant $\bar{W}_i = [\bar{a}_{i1,}\bar{a}_{i2,}, \dots, \bar{a}_{in,}]$ we set its **normalized weighted** equivalent i.e. $\tilde{W}_i = [\tilde{a}_{i1,}\tilde{a}_{i2,}, \dots, \tilde{a}_{in,}]$, where $\tilde{a}_{ij} = \bar{a}_{ij} w_j$. Ultimately for each application form there is specified value:

$$V_{SAW}(W_i) = \sum_{j=1}^{n} \tilde{a}_{ij} \tag{4}$$

Values $V_{SAW}(W_i)$, are organized in a decreasing order, yet the value 1 is the highest possible evaluation of the decision variant (loan application), whereas 0 is the worst possible evaluation in case of using normalization (1)-(2). In the presented approach, where all the discussed decision sub-criteria are subject to ranking in accordance with the scale from table 2 (thus the normalization of variables was necessary), the values $V_{SAW}(W_i)$ will oscillate from 1 to 9, yet 1 is minimal, and 9 is the maximal value that may be achieved.

A very important stage in the described procedure is the stage of ascribing ranks to linguistic expressions. The ascribing of ranks to linguistic expressions takes place most frequently on the basis of the possessed expertise, but in the analyzed decision problem it was suggested to use the analysis of correspondence [Stanimir, 2005].

The application of this method enables the co-occurrence of the variable referring to the quality of repayment. The way of using the analysis of correspondence for ascribing ranks to linguistic expressions was presented in the subsequent chapter as one of the stages of forming the model.

4. The model of offering support in decision-making concerning the financing of individual start-ups of economic activities on the basis of SAW method

The main goal of the presented model is the support of decision-making concerning the financing of start-ups of individual economic activities. The model aims at reducing the time that a credit analyst spends on analyzing the customers who are either unequivocally "good" or unequivocally "bad". In this case the work of an analyst is reduced to the analysis of consumer who were not classified by the model into any of the aforementioned groups. The application of the model may have the following impacts: maximizing the bank's profits (more analyzed applications per time unit), minimizing the risk, reducing the operational costs of the institutions responsible for the financing. In order to form the model there was used bank data regarding 80 per cent of the borrowers who financed the start-up of an individual economic activity by using the preferential loan. Among borrowers one may distinguish the borrowers having the repayment status referred to as: ordinary (delays in the loan repayment are shorter than 1 month); under surveillance (delays in the loan repayment oscillate from 1 to 3 months); questionable (delays in the loan repayment oscillate from 3 to 12 months) and lost (delays in the loan repayment are longer than 12 months). The main criteria and the interrelated sub-criteria were isolated on the basis of the analysis of the application for a loan and on the basis of the possessed expertise from the area of credit activity. The criteria discussed in the paper and interrelated sub-criteria are presented in table 3.

The analyzed variables adopted as the decision sub-criteria are measured using various measurement scales: nominal (e.g. the marital status, the type of source of the obtained incomes), sequential (e.g. education), with intervals (e.g. the years of service) and quotient (e.g. the percentage value of the financial contribution to the investment). Owing to this there was used the procedure of verbal assessment of particular sub-criteria and the procedure of ascribing ranks. The ascribing of the ranks led to the situation where all the variables were transformed into the variables of "the more - the better" type (higher rank means better verbal assessment).

TABLE 3

The main decision criteria and interrelated decision sub-criteria in the analyzed decision problem

Design.	The name of the main criterion	Sub-criteria related to the main criterion
K 1	The personal profile of the applicant	$\boldsymbol{k_{11}}$ – the age of the borrower, $\boldsymbol{k_{12}}$ – the marital status of the borrower, $\boldsymbol{k_{13}}$ – the number of individuals maintained by the applicant, $\boldsymbol{k_{14}}$ – education, $\boldsymbol{k_{15}}$ – the years of service,
K 2	The financial situation of the applicant	$\boldsymbol{k_{21}}$ – the type of the source of obtaining incomes, $\boldsymbol{k_{22}}$ – the status of possessing the real estate,
K 3	Loan from the application, the type of investment and security of the debt repayment	$\boldsymbol{k_{31}}$ – the percentage value of own contribution to the investment, $\boldsymbol{k_{32}}$ – security for the loan.

Source: own elaboration.

The form of the model was specified as the weighted sum of the assessments of particular main criteria presented in table 3. For each main criterion there was constructed decision model based on SAW method. The model was based on the cub-criteria related to the main criteria, e.g. the assessment of the main criterion K1 was based on the sub-criteria $\boldsymbol{k_{11} - k_{15}}$ in this way there was formed synthetic variable $\mathbf{S_{K1}(W_i)}$. The general form of the model was presented as follows:

$$S(W_i) = w_1 S_{K1}(W_i) + w_2 S_{K2}(W_i) + w_3 S_{K3}(W_i) \tag{5}$$

where:

- $S(W_i)$ - the global assessment of the application form,
- w_1, w_2, w_3 - weighting vector of the main criteria, where $w_1 + w_2 + w_3 = 1$,
- $S_{K1}(W_i)$ – the assessment of variant W_i owing to the main criterion K1,
- $S_{K2}(W_i)$ – the assessment of variant W_i owing to the main criterion K2,
- $S_{K3}(W_i)$ – the assessment of variant W_i owing to the main criterion K3.

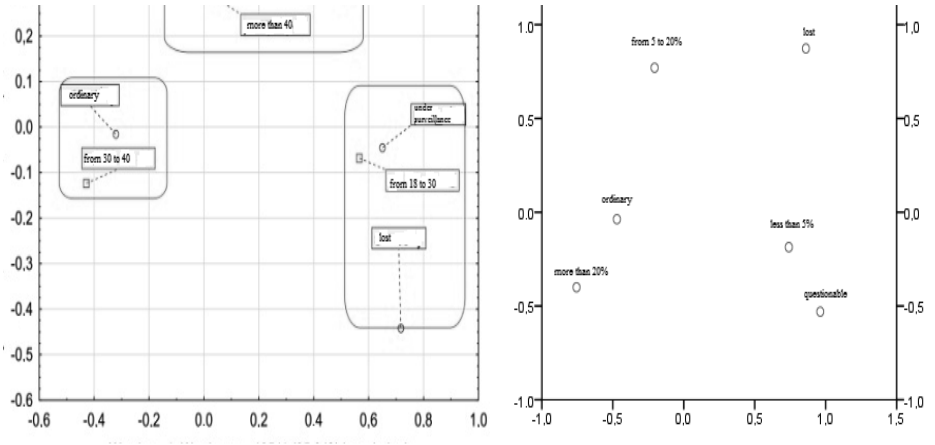
where: $S_{K1}(W_i)$, $S_{K2}(W_i)$, $S_{K3}(W_i)$ are specified using SAW method.

The advantage of using the proposed model is the possibility of recreating the decision-maker's preferences in relation to the profiles of consumers considered as "good" and "bad" borrowers. In the standard approach the credit analyst uses the possessed knowledge and experience while ascribing appropriate ranks to particular linguistic or interval expressions. In the suggested approach in order to support the process it was suggested to apply the correspondence analysis. While analyzing the

co-occurrence of particular verbal expressions of the discussed sub-criteria with the variable illustrating the quality of the repayment (i.e. the linguistic variable adopting the following values: ordinary, under surveillance, questionable and lost), the analyst makes the decision regarding the ascribing of a rank while using both the possessed knowledge and the available historical data concerning the borrowers. Chart 1 presents the results of the conducted analysis of correspondence for selected variables.

CHART 1

The result of the conducted analysis of the correspondence for the variables, the borrower's age (left graph) and the value of own contribution to the investment (right graph)



Source: own elaboration using Statistica packages (left side, the program's test version) and SPSS package (right side).

On the basis of the analysis of the aforementioned graph it may be stated that the repayment status referred to as "*ordinary*" regards the borrowers aged 30-40 and the borrowers having their own contribution to the investment that constitutes more than 20% of the investment value. The statuses *"lost"* and *"under surveillance"* are used to denote the individuals aged 18-30 and those with their own contribution to the investment oscillating from 5 to 20%. The status "questionable" is used to describe the individuals older than 40 and the individuals with their own contribution to the investment worth less than 5%. While using the aforementioned information and on the basis of the possessed bank data the variables were ranked (table 4).

TABLE 4

Adding ranks to linguistic expressions for the variables, the borrower's age and the value of own contribution in the investment

The age of the borrower	The value of own contribution in the investment	Verbal assessment	The total score in points
Less than 25 years old	Less than 5%	Pass (P)	1
-	From 5 to 20%	Satisfactory (S)	3
-	-	Good (G)	5
-	-	Very good (VG)	7
From 30 to 45 years old	Less than 20%	With disctinction (D)	9
From 25 to 30 years old, over 45 – the average value 6 was scribed	-	Intermediate values between the ranks	2,4,6,8

Source: own elaboration.

In the suggested approach to the estimation of the weightings of sub-criteria there was applied the author's objective method based on Cramer's V coefficient. Weighting coefficients are specified as follows:

$$w_j = \frac{v_j}{\sum_{k=1}^{n} v_k} \tag{6}$$

where: $v_{j=}\sqrt{\frac{\chi^2}{m(w-1)}}$ – Cramer's V coefficient between j variable defined as the decision criterion and the analyzed dependent variable (in this case: "solid borrower" i.e. having the following repayment statuses: ordinary, "not solid borrower" – i.e. "under surveillance", "questionable", "lost"), w = min{r,c}, r, c– the dimension of the contingency table, m – the total number in the contingency table, n – the number of the sub-criteria.

The values of weighting coefficients are presented in table 5.

TABLE 5

The weightings of the main criteria designated on the basis of Cramer's V coefficient

The main criterion	K1					K2		K3		
Sub-criterion	k_{11}	k_{12}	k_{13}	k_{14}	k_{15}	k_{21}	k_{22}	k_{31}	k_{32}	Total
Cramer's V coefficient	0.33	0.27	0.26	0.31	0.38	0.30	0.37	0.35	0.26	2.82
Weighting	0.21	0.17	0.17	0.20	0.24	0.45	0.55	0.57	0.43	3

Source: own elaboration.

In case of main weightings the values were calculated in the first step by determining the average values of Cramer's V coefficient for the sub-criteria connected with the main criterion, e.g.: in case of criterion K1 the sum of sub-criteria in Cramer's V coefficients increased 0.33 + 0.27 + 0.258 + 0.309 + 0.377 = 1.544, the arithmetic average 1.544/5 = 0.309.

TABLE 6

The weightings of the main criteria calculated on the basis of Cramer's V coefficient

The main criterion	K1	K2	K3	Total
The average value of Cramer's V coefficient	0.309	0.334	0.305	0.947
Weighting	0.326	0.352	0.322	1

Source: own elaboration.

The usefulness of the offered model was verified using real data from one of cooperative banks operating in Podlaskie district that finances the start-ups of individual economic activities. While using the aforementioned assumptions there were determined global assessments for each of 80 lenders/applicants. The obtained results of the classification were presented in table 5.

TABLE 7

The assessment of loan applications using the analyzed model

Application	The assessment of the main criterion taking weightings into consideration			Overall scores	Application	The assessment of the main criterion taking weightings into consideration			Overall scores
	$w_1S_{K1}(W_i)$	$w_2S_{K2}(W_i)$	$w_3S_{K3}(W_i)$	$S(W_i)$		$w_1S_{K1}(W_i)$	$w_2S_{K2}(W_i)$	$w_3S_{K3}(W_i)$	$S(W_i)$
W1	1.682	1.910	1.800	5.392	W41	2.303	1.910	2.159	6.372
W2	2.412	2.539	2.898	7.849	W42	0.949	0.352	2.159	3.460
W3	2.013	0.352	1.420	3.785	W43	1..852	0.352	2.159	4.363
W4	1.630	1.910	2.159	5.699	W44	2.934	3.168	2.898	9.000
W5	2.412	1.910	2.898	7.220	W45	2.934	3.168	2.898	9.000
W6	2.546	0.352	1.800	4.698	W46	1.922	1.610	2.159	5.691
W7	2.437	3.168	2.159	7.764	W47	2.934	3.168	2.159	8.261
W8	2.297	1.910	2.898	7.105	W48	0.949	0.352	1.420	2.721
W9	2.317	3.168	0.322	5.807	W49	2.412	1.910	1.420	5.742
W10	2.934	1.910	1.420	6.264	W50	2.038	1.610	2.898	6.546
W11	2.108	3.168	1.061	6.337	W51	2.165	3.168	2.159	7.492
W12	1.643	1.910	1.061	4.614	W52	2.412	1.910	1.420	5.742
W13	1.108	1.610	1.420	4.139	W53	2.303	3.168	2.898	8.369
W14	0.949	0.352	2.159	3.460	W54	2.165	1.910	2.159	6.234
W15	2.108	1.610	2.159	5.877	W55	1.471	0.352	2.159	3.982
W16	1.825	1.910	2.159	5.894	W56	2.546	1.910	1.420	5.876
W17	1.573	1.910	0.322	3.805	W57	0.949	0.352	2.898	4.199
W18	2.274	3.168	2.159	7.601	W58	1.625	0.352	2.159	4.136
W19	1.791	1.910	0.322	4.023	W59	2.095	1.910	2.898	6.903

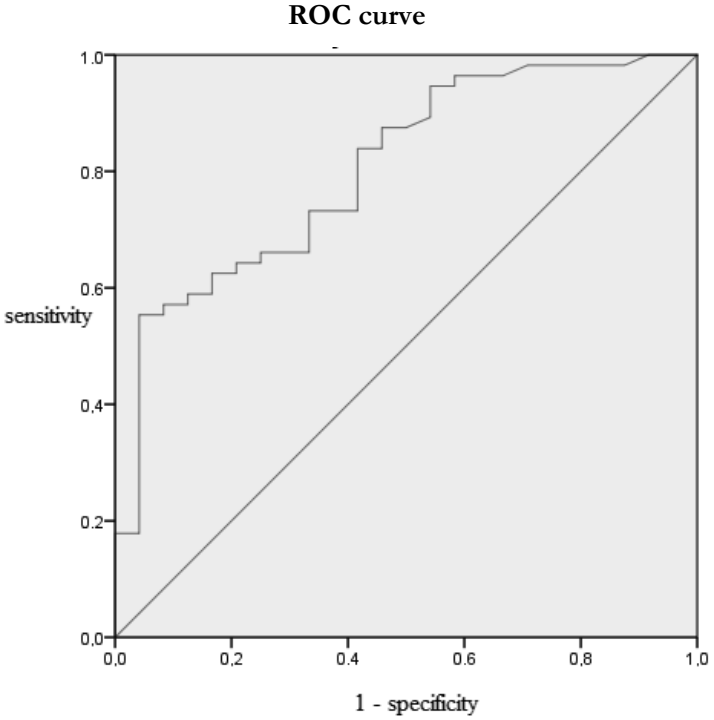
Application	The assessment of the main criterion taking weightings into consideration			Overall scores	Application	The assessment of the main criterion taking weightings into consideration			Overall scores
	$w_1S_{K1}(W_i)$	$w_2S_{K2}(W_i)$	$w_3S_{K3}(W_i)$	$S(W_i)$		$w_1S_{K1}(W_i)$	$w_2S_{K2}(W_i)$	$w_3S_{K3}(W_i)$	$S(W_i)$
W20	1.643	3.168	1.420	6.231	W60	0.949	0.352	1.420	2.721
W21	2.716	1.910	2.898	7.524	W61	2.716	1.610	1.420	5.746
W22	1.734	1.910	1.061	4.705	W62	1.904	1.610	1.420	4.934
W23	2.934	1.610	0.322	4.866	W63	1.630	1.610	2.898	6.138
W24	1.739	0.352	2.159	4.250	W64	1.630	0.352	2.898	4.880
W25	2.934	3.168	1.420	7.522	W65	2.934	3.168	1.800	7.902
W26	1.167	0.352	1.420	2.939	W66	2.934	3.168	2.898	9.000
W27	2.934	3.168	2.898	9.000	W67	2.616	3.168	2.159	7.943
W28	2.317	1.610	2.898	6.825	W68	2.934	3.168	1.420	7.522
W29	2.655	1.910	2.898	7.463	W69	2.274	3.168	1.420	6.862
W30	1.630	0.352	2.898	4.880	W70	2.203	3.168	1.420	6.791
W31	2.412	3.168	2.898	8.478	W71	2.412	1.910	0.322	4.644
W32	1.388	1.910	0.322	3.620	W72	2.303	1.610	2.898	6.811
W33	2.108	0.981	1.420	4.509	W73	2.412	3.168	2.159	7.739
W34	2.133	1.910	1.061	5.104	W74	2.934	3.168	1.061	7.163
W35	2.070	3.168	2.898	8.136	W75	2.825	1.910	2.898	7.633
W36	0.949	0.352	2.898	4.199	W76	2.655	3.168	1.420	7.243
W37	2.934	1.610	2.898	7.442	W77	0.949	1.910	1.420	4.279
W38	2.592	3.168	2.898	8.658	W78	1.108	0.352	0.322	1.782
W39	2.716	1.910	2.898	7.524	W79	1.108	0.352	1.420	2.880
W40	2.024	1.910	1.420	5.354	W80	1.108	0.352	0.322	1.782

Source: own elaboration.

The unequivocally "good" consumer, i.e. the consumer for whom the value S(W) was equal to 9 (W27, W44, W45, W66) or close to 9 (W38) was characterized by the age from 30 to 45, contributed to the investment by adding more than 20% of their funds, had children and the marital status was "married". Additionally, the individuals from this group had higher education, more than 5 years of service, were the owners of real estate or offered guarantee of the loan taken by another person or people. The unequivocally "bad" consumers for whom the value S(W) was close to 1, were characterized by the age of less than 25, did not contribute financially to the investment, their marital status was "single" and were postgraduates of a primary school or high school did not possess any real estate.

Another step was the specification of the so-called cut-off point, i.e. the borderline synthetic S^* value of the model. If the global assessment of the application form adopts the value above the borderline value, the application form is classified into the group of solid consumers. The border value may be specified in the professional way by a credit analyst, i.e. in accordance with the possessed knowledge and experience. Another way of specifying the borderline value may be the analysis of ROC curve (Receiver Operating Characteristic) [DeLong et al., 1988 pp. 837-845]. ROC curve for the model is presented in chart 2.

CHART 2



Source: own elaboration using SPSS package.

The quality of the classification is verified on the basis of comparing the area under the curve and the area under the diagonal. The verified hypothesis is whether the area under the ROC curve (AUC) is considerably larger than the area under the straight line y = x, i.e. larger than 0.5. The following hypotheses are tested here: H0: AUC = 0.5 and H1: AUC ≠ 0.5. In the analyzed case)when the adopted level is e α = 0,05) it is necessary to reject the hypothesis H0 (AUC = 0,808 and $p<0,00$). The obtained classification ought to be considered as considerably different than the classification being accidental. While assuming $S^* = 0,404$ the model correctly classified 4 out of 5 customers having the "lost" credit status and correctly pointed at 67 out of 75 loan borrowers that realize their commitments in a solid way.

5. Conclusions

The evaluation of application forms of individual consumers planning the financing the start-up of their economic activity using a loan or a credit is a complicated task. The difficulties in the evaluation process result from the lack of knowledge on this type of borrowers, the lack of data on the past credit or loans in this segment of consumers, the lack of elaborated credit methods for this segment of consumers

and the lack of econometric models that may be helpful in the evaluation of applications for a loan. In this case the problem with the decision ought to be included into the group of decision problems that are either difficult to structure or have not been structured at all. The problems of this type may include the methods of multi-criteria decision-making. The usefulness of this type of methods has been verified using the decision model described in the paper. Further research will include the verification of the usefulness of other methods of multi-criteria decision-making in the analysis of the discussed decision problem (e.g. the application of either TOPSIS method or SAW method in the fuzzy version or the application of TOPSIS method while using GDM2 metric data proposed by M. Walesiak [2012]).

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