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THE POOR, THE DEPRIVED, THE EXCLUDED – HOW TO MEASURE PEOPLES' MISFORTUNES

Abstract: The paper presents an attempt of formal analysis of such phenomena as poverty, deprivation and social exclusion, beginning from their definitions, through interrelations, stepping towards measurement. Both definitions and methods of measurement were based on the concept of fuzzy set methodology. The empirical study was carried out in voivodships in Poland, where the level of poverty, deprivation and social exclusion was estimated. As a result, fuzzy rankings of voivodships were constructed, and significantly different levels of synthetic variables were shown on maps. The paper shows that fuzzy approach to social problems deriving from poverty allows for open analysis, where relative aspects of these terms can be taken into account.

Keywords: poverty, deprivation, social exclusion, fuzzy set, membership function.

1. Introduction

Every human being is alone in the huge world they are sentenced to fight for a living. It does not matter much whether we have a family, friends or pets – in any conditions our lives are in our hands and the responsibility for successes or failures is ours. We can blame the world for our advantages or disadvantages, which does not change the fact that it is our task to find our way through.

Man's fortune or misfortune seems to be rather ambiguous except for extreme situations. It changes in time and space. It is also a personal case – in consequence – relative.

There are many ways of measuring relativity, one of which is the tool of fuzzy sets. Fuzzy set methodology is very popular in the context of social science [Ostasiewicz 1993; Ragin 2000]. It seems very adequate as a basis for the analysis in the article – the terms poverty, deprivation and social exclusion are close in their meaning, although they define sets of objects that are overlapping, but distinct (see Figure 1). Furthermore, the borders of each set are fuzzy, they emerge from the features we decide to be proper to describe the person, who is poor, deprived or socially excluded.

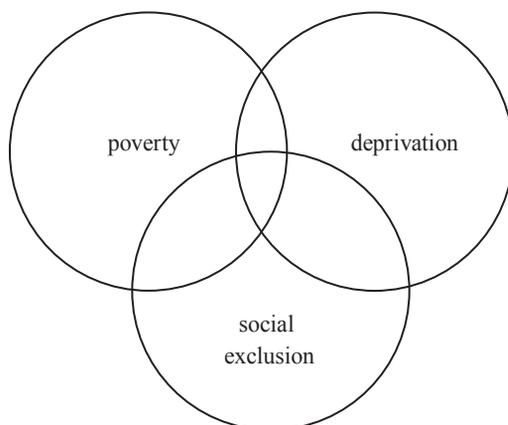


Figure 1. Graphical illustration of the relationship between poverty, deprivation and social exclusion

Source: [Saunders et al. 2008].

When it comes to identifying persons who are affected, the three concepts seem to be undistinguishable. Yet the awareness of the complexity of the phenomenon in its background could be very helpful both for understanding further problems of social science and in terms of policy responses.

2. Poverty, deprivation, social exclusion – definitions

First step to measurement is to define precisely the subject of measurement. The degree of precision depends on the kind of science the concepts are embedded in. Social science seems to be fuzzy in its nature, therefore there is a variety of terms and definitions. Some works are based on classic methods, but fuzzy set theory becomes more and more popular among social scientists.

The paper presents an attempt to apply fuzzy set approach to investigate poverty, deprivation and social exclusion seen as three distinct, but overlapping concepts.

2.1. Poverty as a starting point in the analysis of peoples’ disadvantages

The term of poverty derives from the context of peoples’ income seen as a principal factor influencing standards and quality of life. “Poverty is a situation in which someone’s income is so inadequate as to preclude them from having an acceptable standard of living. It exists when people’s actual income is below a poverty line” [Saunders et al. 2008]. Such definition allows for poverty measurement based only on one feature – income. Although it is a very convenient approach, it attracts a lot of criticism for not setting poverty line out of touch with the lived realities of poverty. The other aspects of poverty identified as peoples’ disadvantage in general can be analysed separately within the scope of deprivation and social exclusion.

The basic term in poverty research is a poverty line, which determines who is regarded as poor. The statistical measure that is considered to be relevant here is median – not always directly, but expressed in terms of fractions or percentages.

When it comes to fuzzy set analysis the poverty line is not a single line, but it is “thick”. It allows to consider some people neither poor nor not poor, but as “in between” category. It reflects fuzzy character of this term, which is the consequence of its relative background. Therefore two thresholds are set in the estimation of poverty level – the lower one, below which persons are regarded as poor and the higher level, above which persons are not poor. Between the two lines there is a fuzzy area of persons neither in nor out of the set of the poor. The size of the three categories differs correspondingly to the values of thresholds, that in turn are determined respectively to the given situation, which may be related to the country, period of time or preferences of the researcher.

2.2. Deprivation – lack of life essentials

The phenomenon of deprivation is often seen as a part of a widely understood poverty. As it has already been stated in the analysis carried out in the paper, poverty measurement is based only on income while its other features are considered separately as deprivation and social exclusion. “Deprivation exists when a lack of resources prevents people from accessing the goods and activities that are essential. Following international convention, it is defined as an enforced lack of socially perceived essentials” [Saunders et al. 2008]. Unlike in case of income-based poverty measurement estimating deprivation is very complicated. The problem arises from the necessity to determine the set of features that would constitute life essentials. In the research based on public data collected by census procedures there are limitations following from what is accessible. The investigation in this paper was carried out on the basis of the data of *Rocznik Statystyczny Województw 2011* (Statistical Yearbook of the Regions – Poland 2011). From the collection of data, grouped in several categories, the following features have been chosen to describe deprivation.

Category I. Population income. Household budget – essential goods

Households furnished with selected durable goods in 2010

- 1) washing machine,
- 2) dishwasher,
- 3) microwave oven,
- 4) passenger car,
- 5) satellite or cable television equipment,
- 6) personal computer with internet access.

Category II. Justice – safe streets

1) Ascertained crimes by the police and prosecutors office in completed preparatory proceedings in 2010.

Category III. Education – well educated children

- 1) graduates of higher education institutions in academic year 2010/11,

2) graduates of non-public higher education institutions in academic year 2010/11.

The set of data listed above is a sort of definition of human’s deprivation for the need of this article. Many investigations have been carried out up to now that seem to confirm and justify this choice [Panek 2007, 2011; Saunders et al. 2008; Czapiński, Panek (Eds.) 2011]. Of course it might be different for each country and other periods of time. We could also think about much more information that would be adequate to describe deprivation, but they could be accessible only for sampling survey.

2.3. Social exclusion – left out

Social exclusion attracts more and more attention in both academic research and empirical investigations. Like deprivation, it has grown up from poverty studies and also has fuzzy character. One may say that “social exclusion exists when people do not participate in key activities in society” [Saunders et al. 2008]. We can distinguish three different forms of social exclusion:

- 1) disengagement – lack of participation in social community activities,
- 2) service exclusion – lack of access to key services when needed,
- 3) economic exclusion – restricted access to economic resources and low economic capacity.

To find quantitative reflection for these aspects of social exclusion phenomenon the following features have been proposed.

Category I. Culture, tourism and sport – disengagement

- 1) audience in theatres and music institutions in 2010,
- 2) audience in fixed cinemas in 2010,
- 3) museum and exhibition visitors in 2010,
- 4) members of groups in cultural centres in 2010,
- 5) members of sport clubs in 2010.

Category II. Health care and social welfare – service exclusion

- 1) public healthcare institutions in 2010,
- 2) nurseries in 2010,
- 3) beneficiaries of socialization, family and intervention centres in 2010.

Category III. Labour market – economic exclusion

- 1) unemployment in 2010.

One may discuss whether the list is too short or too long, with some features not appropriate and some still lacking. Still, the data mentioned above carry important information about peoples’ living standards and constitute a solid basis for further empirical analysis.

Of course, we have to be aware of the fact that underneath each number that express the level of a certain feature lie many single numbers expressing single person’s behaviour resulting from different reasons and moods, sometimes one day hump.

3. Method

Fuzzy sets – apart from the intuitional understanding following from many-valued logic application – are defined in the algebraic context of lattice theory [Drewniak 1984]. The definitions are as follows.

Definition 1. The ordered set (L, L) is called a lattice when all its two-element subsets have either superior or inferior.

Definition 2. There is a given space X and lattice (L, L) . Any mapping $A : X \rightarrow L$ is called L -fuzzy set in X or L -set in X . The family of L -sets in X is noted by $L(X)$. If, in particular, $L = \langle 0; 1 \rangle$, L -sets are called fuzzy sets in X and are noted by $F(X)$.

Definition 3. The elements of the set U are called L -fuzzy in X if there exists a mapping $m : U \rightarrow L(X)$ that assigns them L -fuzzy objects. Then the image of $A = m(A)$ of the object A in the mapping m is called a membership function of this object while the value $A(x)$ in the point x is called the degree of membership of the point x to the fuzzy object A .

3.1. Construction of the membership function

The general model of the membership function applied in the article was proposed by the pioneer scientist within the field of fuzzy set theory, L.A. Zadeh [1965]. It was modified by many authors in different contexts [Rószniewicz 1998; Panek 2007].

The first step for the construction of the membership function is the value of synthetic variable.

We have a set of objects (voivodships) described by a set of diagnostic features, which is divided into three subsets: one assigned to poverty definition, the other two defining deprivation and social exclusion respectively. The starting point to obtain synthetic variable is to make the features comparable in each one of the three cases. To normalize features zero unitarization method was applied [Kukuła 2000]. In case of poverty and deprivation all features were stimulants while social in description of exclusion two destimulants were included. In case of poverty the synthetic variable (e) was formed by one value – income (average monthly *per capita* available income in households in 2010, while in case of the two aspects of disadvantage – it was a sum of several values being the normalized values (z) of the relevant diagnostic features.

The second step in the construction of the membership function is to set the fuzzy border between the objects belonging to the set being analysed and those that definitely do not belong there – in other words – two thresholds: the upper – c_{01} and the lower one – c_{02} . Objects with values of synthetic variable higher than the upper thresholds form the set fulfilling the given criterion (poor), while objects with values lower than the lower thresholds definitely do not belong to the set (are not poor). The objects with values between the two form the fuzzy area. We can look at them closer having the value of membership function – the degree of their membership in the set under investigation.

Finally we can formulate the membership function as follows:

$$f^*(o_i) = \begin{cases} 1, & \text{for } c_{01} \leq e_i \leq \max_i e_i \\ \frac{e_i - c_{02}}{c_{01} - c_{02}}, & \text{for } c_{02} < e_i < c_{01} \\ 0, & \text{for } \min_i e_i \leq e_i \leq c_{02} \end{cases}, \quad (*)$$

where:

$$e_i = \sum_{j=1}^m z_j, \quad i - \text{number of objects, } i = 1, 2, \dots, n.$$

One can easily notice that the membership function can be obtained in linear transformation of synthetic variable. It is shown in Figure 2.

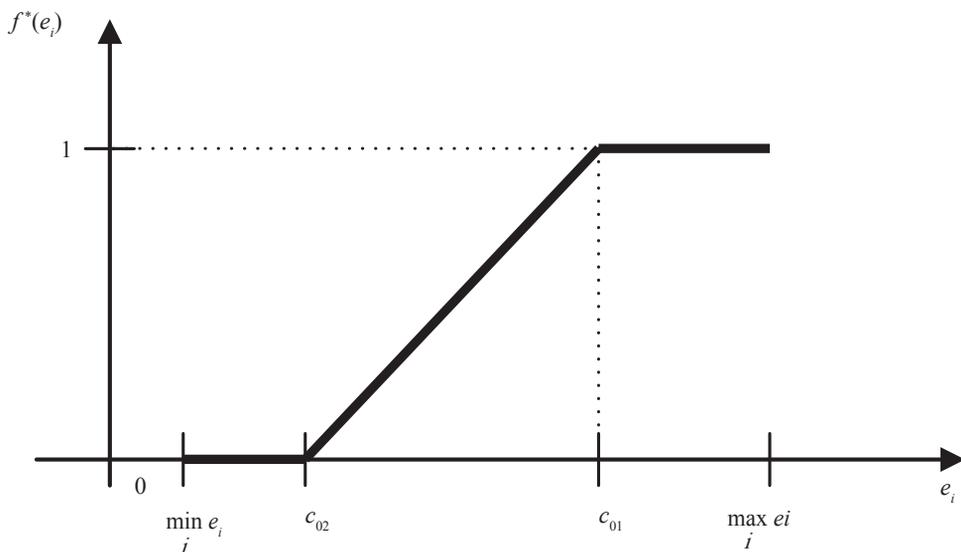


Figure 2. The general shape of membership function

Source: own elaboration.

3.2. Determination of thresholds

The determination of thresholds is the crucial point in the analysis. It has to be done in the context of the given research area, taking into account both its geographic and political location and present economic situation.

The poverty line is well known and often used in social science. As it was already stated, it is often based on the median or its fraction. When we make the threshold fuzzy we have to set two new thresholds: upper and lower. After many simulations

the thresholds for poverty were determined as follows: c_{01} – 105% of the median, c_{02} – 95%.

With deprivation and social exclusion the situation is more complex. It is not one feature that constitutes synthetic variable, but many. The computations were carried out for different values. The application of the pattern used for poverty, even when the median was replaced by the arithmetic mean, did not give satisfactory results.

Finally, the thresholds here were determined with regard to the arithmetic mean and standard variable – in both cases the same pattern was used, i.e.:

$$c_{01} = m + 0,5S, \quad c_{01} = m - 0,5S$$

where m is an arithmetic mean of synthetic variable and S is its standard deviation.

4. Results

The application of the algorithm constructed on the basis of the method described in the previous paragraph allowed for distinguishing fuzzy sets of objects (voivodships) fulfilling the criteria of poverty, deprivation and social exclusion formulated in the paper.

Each category – poverty, deprivation and social exclusion, has its own membership function and at the same time has its image in cartographic form. The maps show three levels of object membership to the given set: belongs to – 1, not belongs to – 0, fuzzy belonging – the interval (0; 1).

4.1. Results for poverty

The membership function for poverty was constructed on the basis of one diagnostic feature – monthly average income per capita. It is shown in Table 1.

Table 1. Membership function for voivodships with respect to poverty criterion

Voivodship	Degree of membership
1	2
Podkarpackie	1
Lubelskie	1
Świętokrzyskie	1
Podlaskie	0.817711
Warmińsko-mazurskie	0.816044
Małopolskie	0.779621
Opolskie	0.707741
Wielkopolskie	0.619888
Lubuskie	0.380112
Kujawsko-pomorskie	0.332456

1	2
Śląskie	0.245305
Łódzkie	0.154818
Zachodniopomorskie	0.083026
Dolnośląskie	0
Pomorskie	0
Mazowieckie	0

Source: own elaboration.

It can be presented on a map (Figure 3).



Figure 3. Voivodships in Poland grouped with respect to poverty level

Source: own elaboration.

As one can see only three objects (voivodships: lubelskie, podkarpackie, świętokrzyskie) form the set of the poor. It is southeast of Poland. The same number of objects is assigned to the category of those definitely not poor: voivodships pomorskie, mazowieckie and dolnośląskie. Observation of values of membership

function indicates that zachodniopomorskie voivodship is very close to the category of those not poor, while podlaskie and warmińsko-mazurskie – close to the category of the poor.

4.2. Results for deprivation

The membership function for deprivation was constructed on the basis of the set of features concerning some important non-income variables influencing the quality of life. It is presented in Table 2.

Table 2. Membership function for voivodships with respect to poverty criterion

Voivodship	Degree of membership
Lubelskie	1
Świętokrzyskie	1
Podlaskie	1
Podkarpackie	1
Warmińsko-mazurskie	1
Łódzkie	1
Zachodniopomorskie	0.951893
Kujawsko-pomorskie	0.408956
Małopolskie	0.165087
Opolskie	0.059584
Lubuskie	0.014859
Dolnośląskie	0
Pomorskie	0
Śląskie	0
Wielkopolskie	0
Mazowieckie	0

Source: own elaboration.

There are six objects considered to be deprived – voivodships lubelskie, świętokrzyskie, podlaskie, podkarpackie, warmińsko-mazurskie and łódzkie. Five objects (voivodships dolnośląskie, pomorskie, śląskie, wielkopolskie, mazowieckie) form the category of those definitely not deprived. Looking at the values of membership function one can see that zachodniopomorskie voivodship is close to the deprived category while opolskie and lubuskie voivodship are almost definitely excluded from the set of the deprived.

The levels of membership function are also presented on a map (Figure 4).

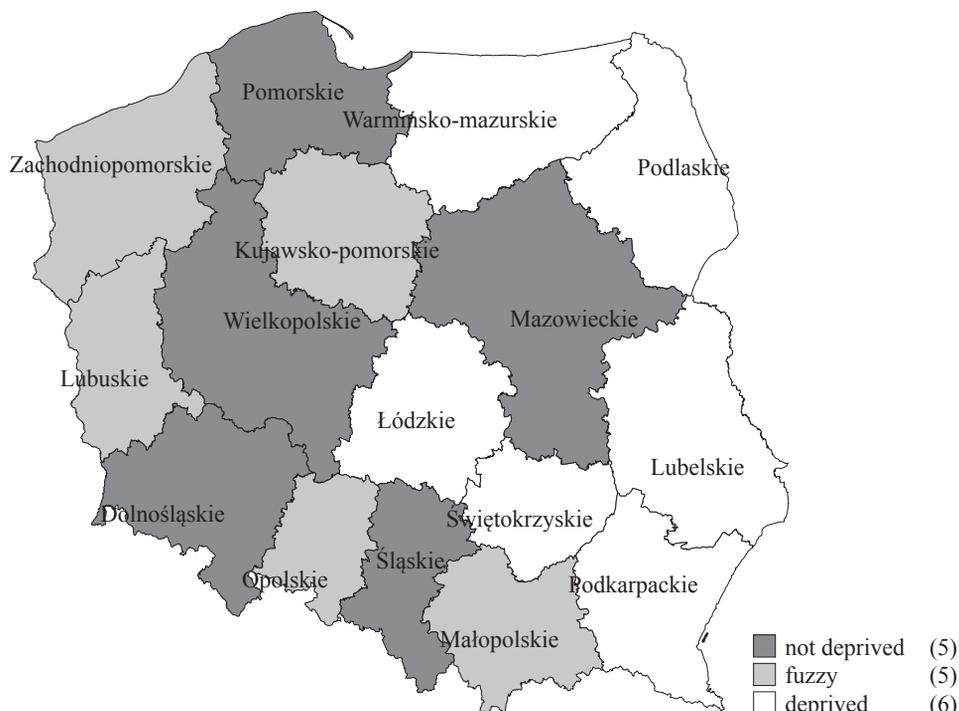


Figure 4. Voivodships in Poland grouped with respect to deprivation level

Source: own elaboration.

4.3. Results for social exclusion

The shape of membership function for social exclusion follows from many features that cover three different fields of human existence: disengagement, service exclusion and social exclusion. They found reflection in the set of variables, the choice of which was rather subjective, but restricted by the access to the relevant data base.

Table 3. Membership function for voivodships with respect to social exclusion criterion

Voivodship	Degree of membership
1	2
Świętokrzyskie	1
Opolskie	1
Lubuskie	1
Zachodniopomorskie	1
Podlaskie	1
Warmińsko-mazurskie	1
Podkarpackie	1

Table 3, cont.

1	2
Kujawsko-pomorskie	0.990053
Lubelskie	0.937783
Pomorskie	0.691268
Łódzkie	0.364884
Dolnośląskie	0.33498
Wielkopolskie	0
Małopolskie	0
Śląskie	0
Mazowieckie	0

Source: own elaboration.

The three levels of membership function values (0; 1; (0; 1) interval) are shown on a map (Figure 5).

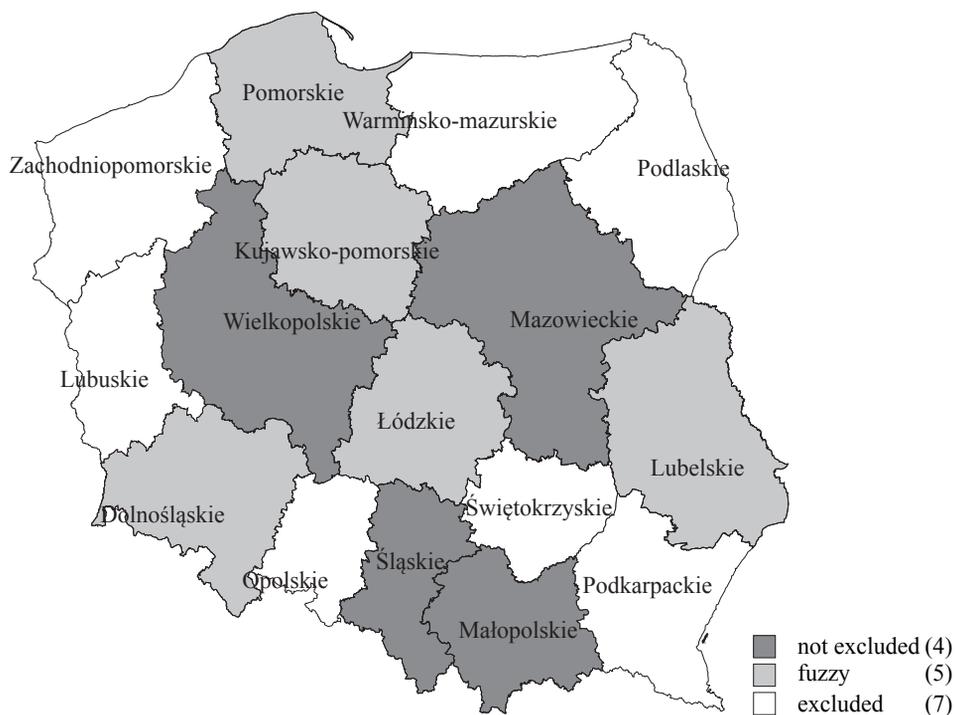


Figure 5. Voivodships in Poland grouped with respect to deprivation level

Source: own elaboration

The set of the excluded consists of seven voivodships: świętokrzyskie, podkarpackie, opolskie, lubuskie, zachodniopomorskie, warmińsko-mazurskie and podlaskie. The objects considered to be definitely not excluded are voivodships: mazowieckie, wielkopolskie, śląskie and małopolskie. Observing the values of membership function indicates that kujawsko-pomorskie and voivodship is very close to the group considered to be excluded while dolnośląskie and łódzkie voivodships are close to those being definitely out of this set.

5. Conclusions

In our attempts to formulate conclusions we have to bear in mind Samuel Butler's reflections, who writes: "Life is an art to draw sufficient conclusions from insufficient information."

There is a lot of information on any subject that is more or less precise. The analysis carried out in the paper was based on statistical yearbook data, in particular, some chosen features concerning population income and household budget, justice, education, culture, tourism and sport, health care and social welfare and labour market. The choice resulted from literature studies and was restricted to the data accessible in yearbooks.

The phenomena of poverty, deprivation and social exclusion were investigated separately, on the basis of separable datasets. Some features were correlated, but not all of them. The results show that poverty, deprivation and social exclusion does concern one problem – human's disadvantage or misfortune, but each of the three has slightly different meaning, which is reflected in compositions of the sets of voivodships recognized as the poor, the deprived and socially excluded. In particular:

- there are two voivodships that belong to all of three sets: świętokrzyskie and podkarpackie voivodship,
- there is one voivodship that is definitely out in each of the three cases: mazowieckie voivodship,
- the voivodships recognized as socially excluded form the most numerous set,
- the voivodships recognized as poor form the least numerous group.

Poverty, deprivation and social exclusion are substantial elements of social reality not only in Poland, but in all countries. Estimation of their levels as three distinguishable phenomena may help to find adequate policies for solving these problems.

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BIEDA, UBÓSTWO, WYKLUCZENIE SPOŁECZNE – JAK MIERZYĆ LUDZKIE NIEPOWODZENIA

Streszczenie: Praca stanowi próbę formalnej analizy zjawisk takich jak bieda, ubóstwo, wykluczenie społeczne, poczynając od ich definicji, poprzez wzajemne powiązania, zmierzając w stronę pomiaru. Zarówno definicje, jak i metody pomiaru oparto na koncepcji metodologicznej zbiorów rozmytych. Badania empiryczne przeprowadzono w podziale na województwa Polski, dla których oszacowano poziom biedy, ubóstwa oraz wykluczenia społecznego. W konsekwencji otrzymano rankingi województw, a różne poziomy zmiennej syntetycznej przedstawiono na mapie. W świetle dokonanej analizy widać, że rozmyte podejście do problemów społecznych wywodzących się z ubóstwa daje duże możliwości otwartej analizy uwzględniającej względny charakter rozważanych pojęć.

Słowa kluczowe: ubóstwo, deprywacja, wykluczenie społeczne, zbiór rozmyty, funkcja przynależności.