Encontros Bibli

ANALYSIS OF FACTORS INFLUENCING THE TRUST LEVELS OF KYRGYZSTAN RESIDENTS, USING NEURAL NETWORK ANALYSIS

Análise dos fatores que influenciam os níveis de confiança dos residentes do Quirguistão, usando análise de rede neural

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Abstract
Objective: Kyrgyzstan, located in Central Asia, is a country which has a strong will to achieve national development. The aim of this study is to measure the levels of trust of local residents, a highly important factor in national development, and to derive suggestions for improving it. To this end, the primary means employed is to target the residents of Kyrgyzstan and measure the levels of trust they have towards each other.
Methods: The study uses data relating to aid projects for rural development that Korea's Good Neighbors International organization (GNI) is jointly carrying out in Kyrgyzstan along with the Korea International Cooperation Agency (KOICA), a Korean aid provider. In order to carry out the aid project to Kyrgyzstan, these organizations conducted a baseline survey at the initial stage, and the results of this study were used for analysis. As regards the analytical method used in this study, neural network analysis was employed for the questionnaire survey data of 583 people in Kyrgyzstan that was used for the baseline survey.
Results: Neural network analysis, a component of the big data analysis method, has recently been in the academic limelight. The analysis revealed that ethnicity had the greatest influence on the trust levels of Kyrgyzstan residents, followed by gender and education level, in that order.
Conclusions: From this, it can be seen that multifaceted efforts are needed to increase the levels of trust of peoples other than ethnic Kyrgyzstanis, as they occupy a central position in Kyrgyzstan.
KEYWORDS: Kyrgyz ODA. Trust. Neural network analysis.

Resumo
Objetivo: O Quirguistão, localizado na Ásia Central, é um país que tem uma forte vontade de alcançar o desenvolvimento nacional. O objetivo deste estudo é medir os níveis de confiança dos residentes locais, fator de grande importância para o desenvolvimento nacional, e apresentar sugestões para a sua melhoria. Para esse fim, o principal meio empregado é atingir os residentes do Quirguistão e medir os níveis de confiança que eles têm uns nos outros.
Método: O estudo usa dados relativos a projetos de ajuda para o desenvolvimento rural que a Organização Internacional de Bons Vizinhos da Coréia (GNI) está realizando em conjunto no Quirguistão, juntamente com a Agência de Cooperação Internacional da Coréia (KOICA), um provedor de ajuda coreana. Para realizar o projeto de ajuda ao Quirguistão, essas organizações realizaram uma pesquisa de base na fase inicial, e os resultados desse estudo foram usados para análise. No que diz respeito ao método analítico usado neste estudo, a análise de redes neurais foi empregada para os dados da pesquisa por questionário de 583 pessoas no Quirguistão, que foi usada para a pesquisa de linha de base.
Resultados: A análise de redes neurais, um componente do método de análise de big data, tem estado recentemente no centro das atenções acadêmicas. A análise revelou que a etnia teve a maior influência nos níveis de confiança dos residentes do Quirguistão, seguida por gênero e nível educacional, nessa ordem.
Conclusão: A partir disso, pode-se ver que são necessários esforços multifacetados para aumentar os níveis de confiança de pessoas que não são de etnia quirguiz, pois ocupam uma posição central no Quirguistão.
PALAVRAS-CHAVE: Quirguistão ODA. Confiança. Análise de redes neurais.

1 Introduction

Almost all countries, developed or developing, focus their social policy on improving the quality of life of their citizens. Among the factors that affect quality of life are institutional factors such as the capacity of the government, but singular characteristics such as the trust level of each individual are also important (ECONOMIDES; KALYVITIS; PHILIPPOPOULOS, 2004; GROOTAERT, 2004; GROOTAERT; VAN BASTELAER, 2001). In particular, today, many social science studies report that social capital exerts a great influence on individuals' quality of life, and it is pointed out that individuals' levels of trust are an important factor in such social capital (ADLER; KWON, 2002; AGNEESSENS; WITTEK, 2008; AVEY et al., 2010; GARA; LA PORTE, 2020; KROT; LEWICKA, 2012). Even when developed countries successfully promote Official Development Assistance (ODA) projects that support developing countries, it is necessary to give attention not only to the institutional capacities of the aid-recipient countries, but also to social capital such as the levels of trust of the people receiving the aid.

In 1960, personal per-capita income in Korea was only 92 dollars. However, through successfully carrying out a continuous economic development plan, it has achieved economic development at a globally unprecedented rate. As a result, as of 2022 Korea is among the world's top ten economic powerhouses, and passes on its own successful development experience to developing countries in the name of ODA. Korea was itself a recipient of foreign aid from the mid-1950s up until 1999, whereas now it is the only formerly aid-receiving country that provides aid. Although the role of government officials, including that of the President in the 1960s, was a major factor in Korea's rapid economic growth, the high level of social capital of the people also acted as an important factor. The case of Korea shows that levels of public trust acts as an important factor influencing national development ("KOICA 홈페이지", [s.d.]).

Against this background, this study measures the trust levels of the residents of Kyrgyzstan, analyses the factors that affect this, and suggests ways of further improving this level of trust. Good Neighbors International (GNI), a private Korean organization, along with the Korea International Cooperation Agency (KOICA), the Korean Government's aid execution agency, is conducting a rural development project in Kyrgyzstan examining the levels of trust of the residents it surveys. The official name of this aid project is the Integrated Rural Development Project in Kyrgyz Republic. As mentioned above, this project is being

carried out by GNI as part of KOICA's public–private partnership project, under the name 'Strategic Partner Project'. The present study uses the data from the baseline survey conducted by this project.

The ultimate goal of the project is to develop rural areas in Kyrgyzstan in an integrated way, and this particularly requires the voluntary participation of residents. The aim of the project is to improve the social and economic environment of Kyrgyzstan, improve women's rights, and establish a foundation to promote a sustainable increase in residents' incomes. The first phase of the project began on 14 September 2021 and runs to 31 December 2025. The project will cost around 10.6 billion Korean won (around 9 million in US dollars). Naturally, if the first stage of the project is carried out successfully there is the possibility of a second (2026–30) and a third (2031–5) stage. The target areas for the project are the Osh Oblast (Province) and Batken Oblast (Province) regions of Kyrgyzstan, thirty villages in these two regions being included in the project targets. The number of direct beneficiaries from this project is estimated to be 85,570 (KOICA; GNI, 2021).

Summarizing the purpose of this study once again, the trust level of local residents of Kyrgyzstan located in Central Asia is measured and the importance of variables affecting the trust level is analyzed. Based on these data, we intend to discover implications that can help residents increase the acceptability of ODA policies and increase the chances of success when carrying out ODA projects in Kyrgyzstan in the future.

2 Theoretical Discussion and Research Problems

Trust can be defined in various ways. The dictionary definition of trust speaks of the belief 'that someone is good and honest and will not harm you, or that something is safe and reliable' (BURKE et al., 2007; DIENER, 2000) an academic point of view, meanwhile, trust occupies the most important place in the concept of social capital, social capital being defined as 'the trust and the networks of relationships among people who live and work in a particular society, enabling that society to function effectively'. Among conceptions of social capital, trust is the most important core concept. However, in general terms trust means mutual trust and reliance among people, in particular the mutual trust and reliance on neighbours that people have with those around them. This mutual will leads to the formation of a network, and eventually becomes the most important core concept in the concept of social capital. Sub-concepts of the trust-concept include empowerment, self-help,

involvement in community activities, and sense of community (BEN HADOR, 2016; FERRES; CONNELL; TRAVAGLIONE, 2004; GRUMAN; SAKS, 2013).

For this reason, trust among residents can foster a sense of co-operation, reduce unnecessary regulation, and reduce the transaction costs required in business execution. Further, compliance with government policies can be enhanced, and based on it, policy implementers can successfully and quickly implement them (HANSEN; BUITENDACH; KANENGONI, 2015; HELLIWELL; HUANG, 2010; HOBFOLL, 2002; LEUNG et al., 2013; SPENCE LASCHINGER et al., 2012). Above all, a high level of trust among residents can foster a sense of ownership by cultivating community spirit among residents. In addition, high levels of trust among residents can be a factor in the successful implementation of ODA projects such as GNI's rural development projects currently being carried out in Kyrgyzstan.

There have been many studies (LI et al., 2014; LUTHANS, 2002; MAYER; DAVIS; SCHOORMAN, 1995; MINCU, 2015) on the factors affecting the level of trust among residents. Some studies have suggested that personal factors greatly affect levels of trust. Other studies (NATVIG; ALBREKTSEN; QVARNSTRØM, 2003; PASTORIZA, 2008; PERERA; WEERAKKODY, 2018; SCHOORMAN; MAYER; DAVIS, 2007; SELIGMAN, 2002; SENDJAYA et al., 2019) have argued that government institutions, or policy factors, have a strong influence. However, recent studies (SALAS-VALLINA; ALEGRE, 2021; SINGH; AGGARWAL, 2018; TAŞTAN, 2018, 2018; TAŞTAN; GÜÇEL, 2017) claim that various factors within the community, such as race, income levels and gender, are becoming increasingly important in influencing individual levels of trust. Considering that there are various factors that both make up and affect levels of trust, the following research questions were set in this study:

1. What is the level of trust among Kyrgyzstan residents?
2. What are the important variables that affect this?

3 Analysis Design

3.1 Target areas

The target areas for analysis in this study are two provinces in Kyrgyzstan, Osh and Batken. These two provinces were selected because the Korean ODA projects are being carried out there, including a survey of residents. More specifically, the target areas comprise thirty villages included in the two provinces of Osh and Batgen. Survey data on local residents living in these village were used for the analysis. The number of households

that responded to the survey was 583, and the total number of respondents, including family members and heads of family, was 3,591; however, in this study, the 583 heads of families were analysed.

3.2 Survey period

This survey was conducted at Osh University of Technology and Science from March 1 to March 11, 2022, and the analysis results and report writing were done between March and May 2022.

3.3 Questionnaire composition

The questionnaire used in this study was prepared by Professor Yang-Hoon Song, who is in charge of monitoring the ODA project in Kyrgyzstan. The questionnaire consists of four sections. Section 1 covers Household Demographics, Section 2 Income Structure, Section 3 Living Expenditure & Government Support Regarding Poverty, and Section 4 Community Activity. In particular, 'trust level', to be used as a dependent variable in this study, is composed of one question, How much do you generally trust your neighbours? The measurement scale used is a Likert 5-point scale, ranging from Do not trust at all (1 point) to Highly trust (5 points).

3.4 Variables

As stated, the dependent variable in this study is trust. Since the concept of trust is difficult to measure with a single variable, multiple indices can be used. It may be stated that there is no great difficulty in measuring the level of trust by measuring how much trust a person has in their neighbours. The independent variables, meanwhile, consist of ethnicity, type of residence, gender, marital status, income level, education level, age and occupation. The results of coding and processing this information are shown in Table 1.

Table 1: Variables

Variable	Variable name	Explanation
Trust (dependent variable)	trust_1	1 if below the average trust score of 3.85 (highest score is 5 points, lowest score is 1 point), 2 if above

Ethnicity	ethnicity_1	1 for Kyrgyzstan and 2 for other ethnic groups
Form of residence	residence_1	1 if living in own town, otherwise 2
Gender	sex_1	1 female, 2 male
Marriage	marital status_1	2 if married, otherwise 1
Level of education	education_1	1 for high-school graduates or lower, 2 for college graduates or higher
Age	age_1	1 for all respondent-age averages of 52.37 or less, 2 for those above 52.37
Occupation	occupation_1	farmer 1, others 2
Income level	income2021_1	1 if the average annual income of the respondents is less than 133,890 som, 2 if more than 133,890 som

4 Analysis

4.1 Basic structure of neural network model

Neural network analysis was performed to analyse the importance of the variables affecting the trust level of residents. The analysis was divided into multi-layer perceptron (MLP) and radial basis function, and in this study the MLP method is used. The reason for this is that MLP is the most basic algorithm of neural network analysis and has a great advantage in performing classification and discrimination (CHO, 2020; REED; O'DONOGHUE, 2005). The basic structure of the multi-layer perceptron model used for this paper is shown in Figure 1. This model has a three-layer structure consisting of one input layer, one or more hidden layers and one output layer. Each layer consists of nodes. Each layer processes the data, and at the same time, each node takes over the output value of the previous step and goes through the process of calculating the output value again via the activation function.

Neural network analysis goes through a process of adjusting the connection weights of nodes in a direction in which the error between the output value and the actual value is reduced, which is called learning. In this study, an optimal neural network model that was not overfitted was built through a total of 2,000 repetitions of learning.
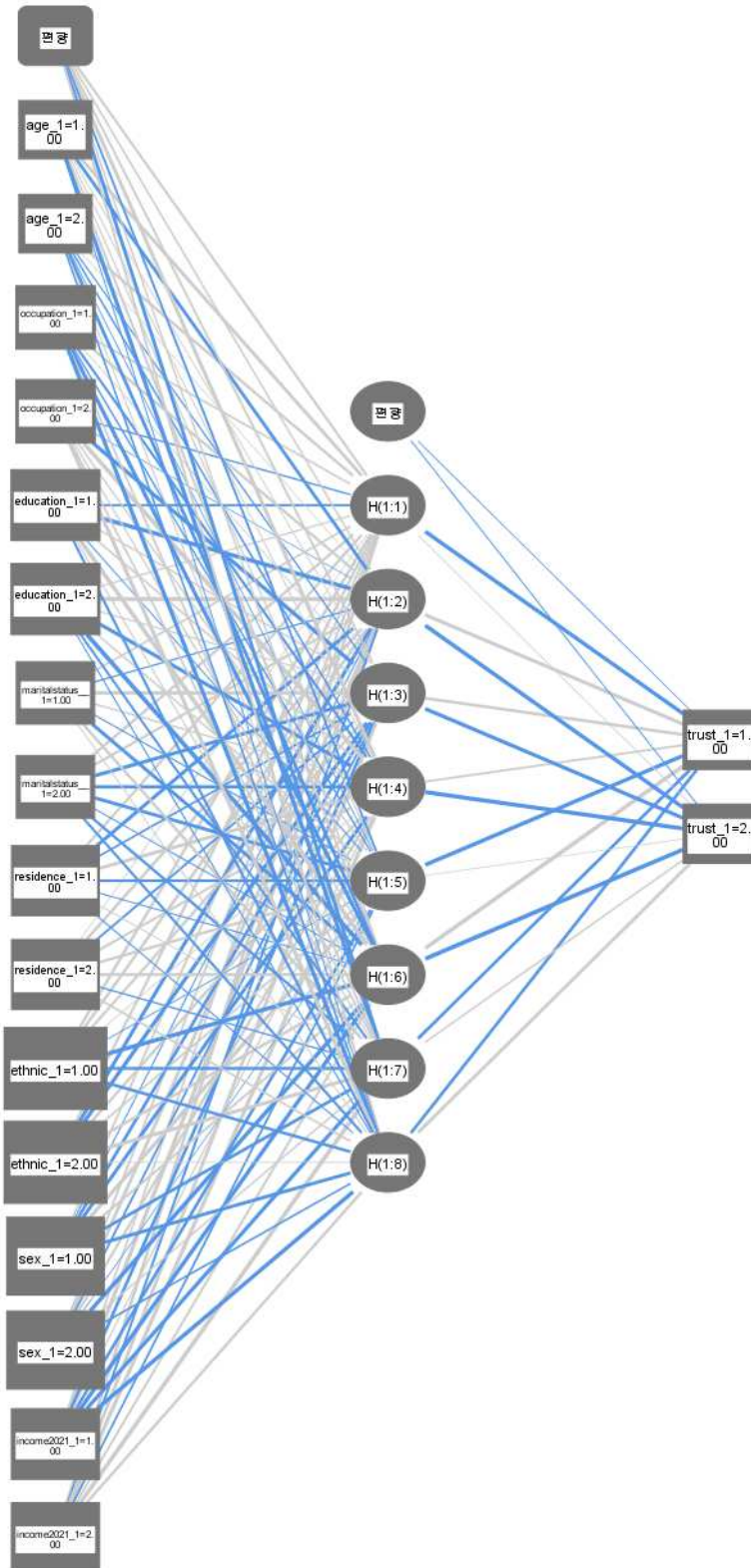
은닉층 활성화 함수: 쌍곡 탄젠트

출력층 활성화 함수: 소프트맥스

Figure 1: Artificial neural network structure

Neural network analysis also presents results such as shown in the parameter estimation table (Table 2). This is the result of selecting synapse weight values in the artificial neural network structure. That is, the table calculates the connection strength between the independent variable presented in the neural network structure diagram as shown above and the hidden layer, and the connection strength between the hidden layer and the output layer. From the parameter estimates, it can be seen that ethnicity has a large influence.

Table 2: Parameter estimates

		모수 추정값									
		예측									
		은닉층 1								출력층	
예측자		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	H(1:8)	[trust_1=1.00]	[trust_1=2.00]
입력층	(편향)	.337	.201	.299	.576	-.271	.175	-.534	.305		
	[age_1=1.00]	.506	-.489	.050	.056	.114	.323	-.742	-.053		
	[age_1=2.00]	.381	.001	-.129	-.195	-.047	-.483	.089	-.204		
	[occupation_1=1.00]	.214	.359	.049	-.325	-.157	-.678	.262	-.738		
	[occupation_1=2.00]	-.164	-.005	-.709	1.112	.171	.141	.257	.657		
	[education_1=1.00]	-.266	-1.061	.157	.201	-.085	1.328	.113	-.354		
	[education_1=2.00]	.137	1.200	.125	-.637	.184	-1.568	-.307	-.111		
	[maritalstatus__1=1.00]	.230	-.130	.588	.168	-.112	-.586	.398	.060		
	[maritalstatus__1=2.00]	.371	.339	-.601	-.509	-.546	-.090	-.378	-.336		
	[residence_1=1.00]	.348	-.587	-.240	.532	-.399	-.092	.053	-.104		
	[residence_1=2.00]	.038	.417	-.300	.325	.372	.405	-.147	.227		
	[ethnic_1=1.00]	.405	.413	.356	.050	-.050	-1.063	-.446	-.427		
	[ethnic_1=2.00]	.360	-.603	-.689	.361	.255	.401	.594	.041		
	[sex_1=1.00]	.278	-.099	-.475	-.585	.618	.323	-.479	-.570		
	[sex_1=2.00]	.277	.530	-.268	.355	-.009	-1.025	.177	-.213		
	[income2021_1=1.00]	.236	.710	-.458	.123	-.439	-.782	-.680	-.920		
	[income2021_1=2.00]	.455	-.323	.488	.680	-.264	.305	1.172	.383		
은닉층 1	(편향)									-.050	-.069
	H(1:1)									-.757	.042
	H(1:2)									.592	-.820
	H(1:3)									.450	-.683
	H(1:4)									.270	-1.124
	H(1:5)									-.760	.028
	H(1:6)									1.037	-1.408
	H(1:7)									-.481	.201
	H(1:8)									-.476	.496

4.2 Verification of the model's goodness of fit

In terms of a neural network analysis used as an analysis model in this study, the suitability and power of the multilayer perceptron model were analysed. To test the suitability of the multilayer perceptron model, prediction accuracy, Receiver Operating Curve (ROC) analysis was conducted. This is a method of analysis that provides a criterion for determining the suitability of a neural network model. As a result of this analysis, the ROC analysis result, which is the result of plotting sensitivity on the y-axis and plotting 1-specificity on the x-axis, can be derived. The ROC standard is classified as fail if ROC is less than 0.6, poor if less

than 0.7, fair if less than 0.8, good if less than 0.9 and excellent if less than 1.0 (CHO, 2020). In this study, as Table 3 indicates, it is 0.773, which is the FAIR level. Therefore, it appears that there is no major problem in terms of the adequacy of the model.

Table 3: ROC values

trust_1	1.00	.773
	2.00	.773

Figure 2 shows the predicted probability analysis result derived from the neural network analysis. In this graph, the x-axis is the value of trust_1, the actual target variable, and the y-axis is the probability value of the predicted outcome.
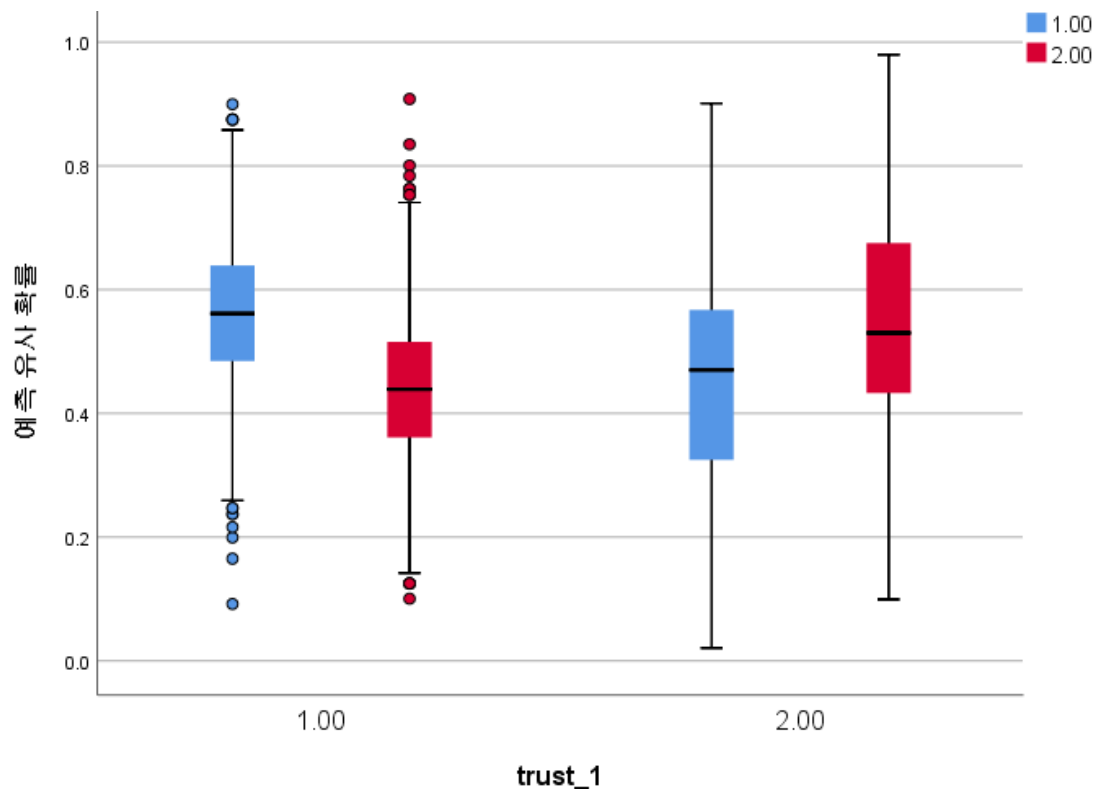
Figure 2: Prediction probability chart

The most important criterion in neural network analysis is ROC. Figure 3 shows the ROC curve results derived from neural network analysis. The ROC graph is used to verify the suitability of the neural network analysis. This curve is evaluated as good when it presents a curved shape in a rapidly increasing and then lessening form. In other words, when it has this shape, it can be evaluated that the neural network analysis model is well suited. To judge from Figure 3, based on the ROC, the goodness of fit is not very great, but

as Table 3 shows, the ROC value is 0.773, so the model's goodness of fit level can be said to be fair.
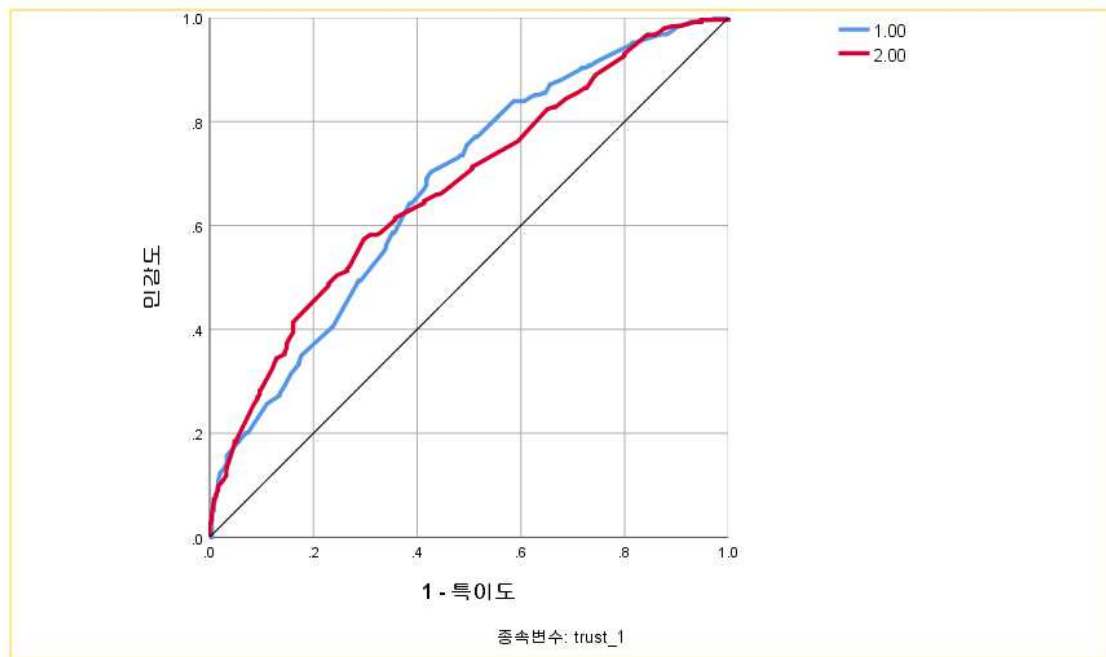
Figure 3: ROC curve result

Figure 4 shows the cumulative profit chart derived from neural network analysis. Here, the same logic as for the ROC chart analysis is applied to determine goodness of fit. In other words, it may be interpreted that a rapidly rising curve indicates a better fit.
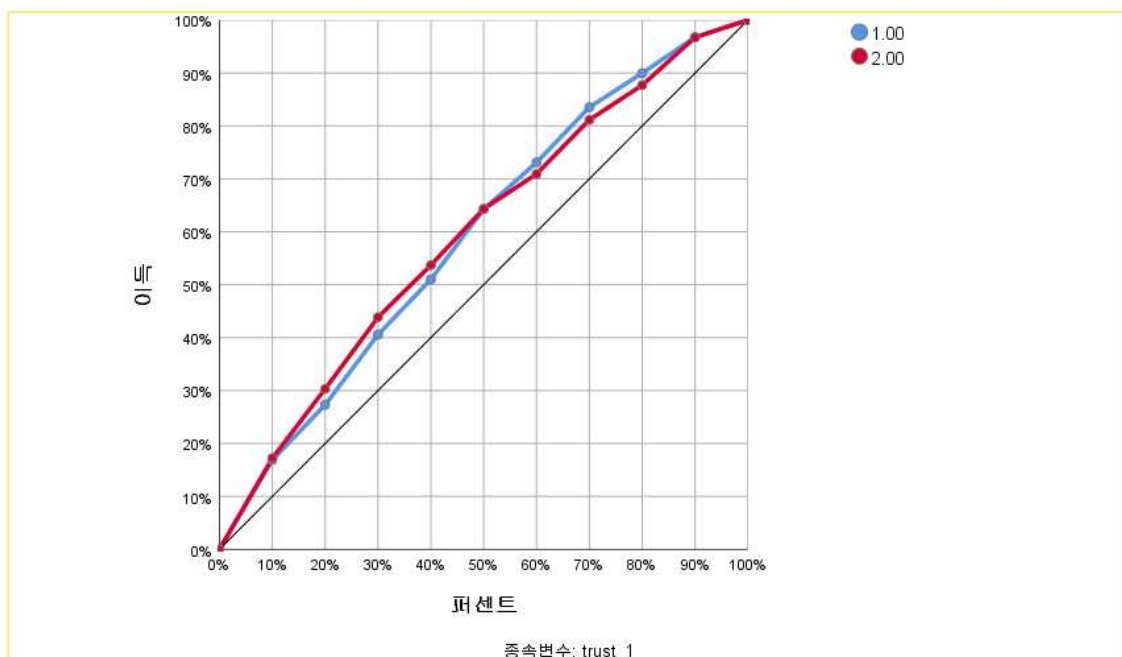

Figure 4: Cumulative profit chart

Figure 5 presents the lift diagram. The lift chart is evaluated as good if it has the opposite form to the cumulative profit chart mentioned above: that is, when the lift curve has a curve shape with a sharp decline, it is interpreted that the model shows a better fit. In general, when verifying the fit of a neural network model, the common practice is to mainly use the ROC chart to verify the fit of the model, and to use the cumulative profit chart and lift chart as an aid. Looking at these two figures, we can see that the fit of the neural network analysis model used in this study is relatively good.
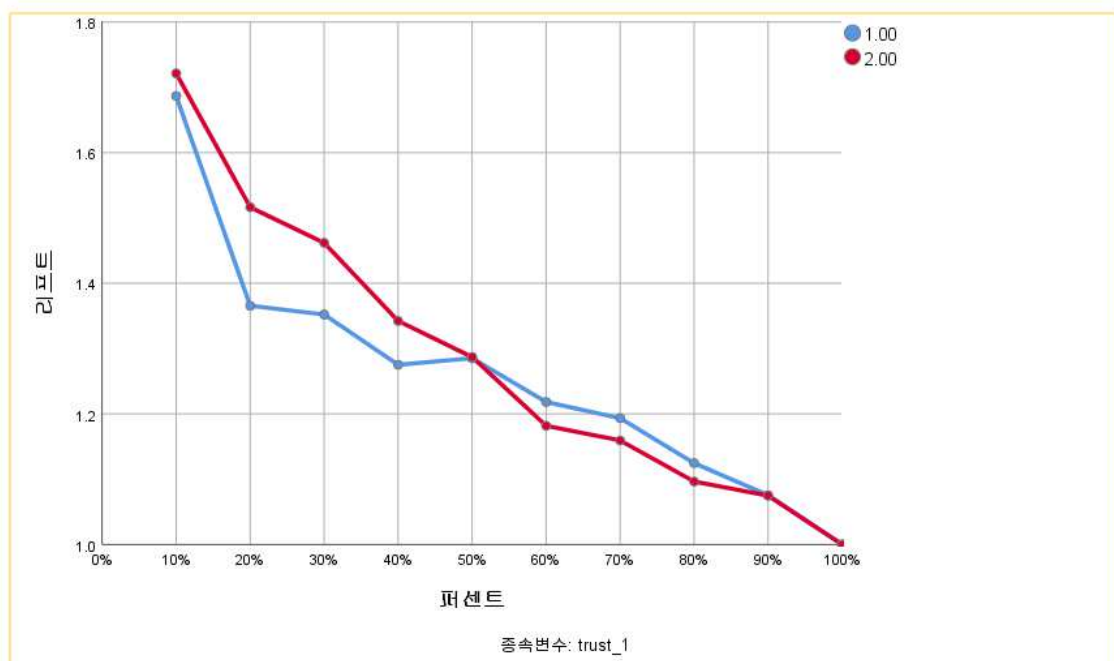
Figure 5: Lift diagram

4.3 Importance of independent variables

Table 4 shows the relative importance of various independent variables that affect the trust (happiness_1) of Kyrgyzstan residents. Among the independent variables that affect trust, the ethnicity variable appears to have the greatest effect. This means that the Kyrgyz people have higher levels of trust than other peoples. The next variable is gender, with men having higher confidence levels than women.

Table 4: Relative importance of independent variables

	Weight	Normalized relative weight
age_1	.083	48.3%
occupation_1	.102	59.0%
education_1	.131	75.8%
maritalstatus__1	.099	57.3%
residence_1	.127	73.8%
ethnic_1	.172	100.0%
sex_1	.157	91.0%
income2021_1	.129	74.7%

Figure 6 shows the degree of influence of the independent variables on the level of trust, which is the dependent variable, in order of importance. The variable that has the greatest influence on the dependent variable is ethnicity. Assuming that the influence of this ethnicity variable on the dependent variable is 100, the next most important variable is sex, which has an influence of 91 per cent.
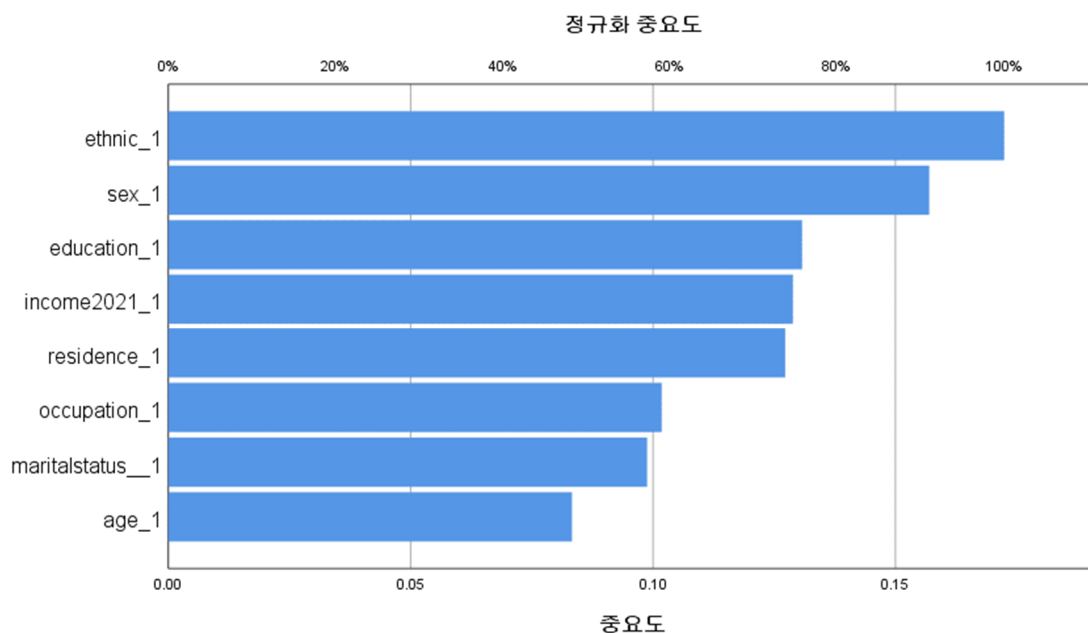
Figure 6: Relative importance of independent variables

5 Conclusion and Implications

This study analysed important factors that affect the level of trust that residents of Kyrgyzstan have in their neighbours by using a multi-layer perceptron model, one of the

neural network analyses. As regards the analysis procedure, importance analysis was performed using the weight division method for the weight value for each node calculated by neural network analysis. The important variables that affect the level of trust of local residents in Kyrgyzstan are ethnicity, sex, education, income, type of residence, occupation, marriage status and age, and it can be said that the importance is high in the order of these. The results of this study and its implications may be summarized as follows:

1. For the Kyrgyzstan residents, ethnicity variables have the greatest influence on level of trust. In other words, ethnic Kyrgyz people have a higher level of trust than other ethnic groups, such as Uzbeks. More in-depth study is needed to determine the reason(s) for this phenomenon.

2. The trust level of male local residents is higher than that of female residents. Men are often the heads of households. Even if the difference here is not a significant one, the fact that men have a higher level of trust than women is also an issue that requires more in-depth research.

3. There is a significant difference in terms of education levels. It was found that the level of trust among residents with higher levels of education appeared greater than among those with lower levels of education. This phenomenon also represents an area that requires more in-depth research through questionnaire analysis or interviews with Kyrgyzstan residents.

4. This study is significant in that it uses a new methodological approach instead of the statistical method traditionally used. The distinctive contribution of the study resides in the fact that it derived meaningful research results by analysing important factors affecting the trust levels of local residents in Kyrgyzstan. Nevertheless, it should be recognized that there are limitations to neural network analysis. In particular, due to its black box characteristics, it has a limitation in that it cannot provide a basis for causal relationships between variables and model calculation results. In addition, since this neural network analysis assumes that all independent variables inputted into this analysis are statistically significant, the statistical significance between the dependent variable, trust, and the independent

variables that are assumed to affect this dependent variable is not evaluated. However, the analysis checks whether the order of importance of the calculated independent variables matches the theoretical background, and if the size of the influence is different or unsatisfactory from the common-sense or theoretical point of view, it is characterized by going back to the beginning and re-creating the model.

Recognizing the above points, it is necessary to supplement the work of identifying the influence relationship between important variables and dependent variables through complementary analysis such as logit model analysis. In the future, there is a need for methodological improvement that can overcome the limitations of neural network analysis and further increase the accuracy of prediction and classification.

Acknowledgements

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RESEARCH DATA SET

Choose one of the options and erase the other ones.
   1)   The research data set that gives support to the results for this research is not publicly available.