

DOI: 10.36683/2306-1758/2022-3-41/34-47

УДК (UDC) 004.032.26:004.383.4

JEL: C35, C45, C58, C65, D14, D81, G17

Ray S.

DOES PERSONALITY AND DEMOGRAPHIC VARIANCES OF INDIVIDUAL INVESTORS CHALLENGE THE ASSUMPTION OF RATIONALITY? A TWO STAGED REGRESSION MODELING-ARTIFICIAL NEURAL NETWORK APPROACH

Ray Samrat

Assistant Professor, Management sciences
ISMS Sankalp Business School;
S.No 9/1/1, Wadgaon Budruk, Sinhgad Campus Ext, Ambegaon,
Pune, Maharashtra - 411041
e-mail: samratray@rocketmail.com
ORCID: 0000-0002-9845-2974

Рэй Самрат

доцент менеджмента
Бизнес-школа ISMS Sankalp;
Индия, 411041, штат Махараштра, г. Пуна, Амбегаон, кампус
Синггад Экст, Вадгаон Будрук, д. 9/1/1
e-mail: samratray@rocketmail.com
ORCID: 0000-0002-9845-2974

Behavioral finance theory is considered as an alternate theory to traditional finance theories as it views investors normal and not rational. There are many factors that can influence the decisions making of investors, some of these factors has been researched extensively and some remains unexplored. The main focus of existing studies remained the behavioral biases. Apart from biases, personality traits also determine the investment behavior of investors which mainly remains unexplored. The main purpose of the present study is to examine the influence of personality traits and demographic variances on short-term and long-term investment decisions of individual investors in North India. The other aim of this study is the application of Artificial Neural Network modeling in the field of behavioral finance, which will assist the researchers in determining the investment behavior in more convenient way. The present study is quantitative in nature. For the fulfillment of the purpose, a survey was conducted among the individual investors in North India and data was collected from them through a structured questionnaire. Along with two regression models Artificial Neural Network model (ANN) was used to test the study hypothesis. Data was analyzed with the help of SPSS software package. Findings of the study revealed the significant positive impact of neuroticism on short-term investment decisions and the significant negative impact on long-term investment decisions. The role of conscientiousness in predicting the investment decisions was not found high. Also the least influence of demographic factors was found in determining both short-term and long-term investment decisions, which was also verified through the sensitivity analysis in the ANN model.

Теория поведенческих финансов рассматривается как альтернатива традиционным финансовым теориям, поскольку она рассматривает инвесторов как нормальных, а не рациональных. Существует множество факторов, которые могут влиять на принятие решений инвесторами. Некоторые из этих факторов были тщательно исследованы, а некоторые остаются неисследованными. Основным направлением существующих исследований оставались поведенческие предубеждения. Помимо предубеждений, личностные черты также определяют инвестиционное поведение инвесторов, которое в основном остается неисследованным. Основной целью настоящего исследования является изучение влияния личностных черт и демографических различий на краткосрочные и долгосрочные инвестиционные решения отдельных инвесторов в Северной Индии. Еще одной целью данного исследования является применение моделирования искусственной нейронной сети в области поведенческих финансов, что поможет исследователям определять инвестиционное поведение более удобным способом. Настоящее исследование носит количественный характер. Для достижения этой цели был проведен опрос среди индивидуальных инвесторов в Северной Индии, и данные были получены при помощи структурированной анкеты. Наряду с двумя регрессионными моделями для проверки гипотезы исследования использовалась модель искусственной нейронной сети (ANN). Данные были проанализированы с помощью программного пакета SPSS. Результаты исследования выявили значительное положительное влияние невротизма на принятие решения о краткосрочной инвестиции и значительное негативное влияние при принятии долгосрочного инвестиционного решения. Роль честности в прогнозировании инвестиционных решений была признана невысокой. Также было обнаружено наименьшее влияние демографических факторов при определении как краткосрочных, так и долгосрочных инвестиционных решений, что также было подтверждено с помощью анализа чувствительности в модели ANN.

Keywords: neuroticism, conscientiousness, demography, investment decisions, regression, ANN model.

Ключевые слова: невротизм, честность, демография, инвестиционные решения, регрессия, модель ANN.

Ray S. Does personality and demographic variances of individual investors challenge the assumption of rationality? A two staged regression modeling-artificial neural network approach. *Economic environment*. 2022; 3 (41): 34-47. — <http://dx.doi.org/10.36683/2306-1758/2022-3-41/34-47>.

Рэй С. Ставят ли личностные и демографические различия отдельных инвесторов под сомнение предположение рациональности? Двухэтапное регрессионное моделирование – подход искусственной нейронной сети // *Экономическая среда*. – 2022. – № 3 (41). – С. 34-47. — <http://dx.doi.org/10.36683/2306-1758/2022-3-41/34-47>.

1. Introduction

Pandemic had not only affected the labor community but had also affected the job holding section throughout the world. People lost their jobs, which drive them towards investment. In recent years Indian Stock Market had witnessed a huge rush of investors getting themselves registered with Stock Exchanges. The National Securities Exchange of India solely has witnessed the share growth of 45% of retail investors in 2021 from 33% in 2016 (NSE). Investment is the commitment of funds for future gain. Investment can be more appropriately described as sacrificing something in the present to get benefits in future. All traditional theories of finance were based upon the assumption of rationality, when investors' get through the obscurity and wariness in making choices, they use cognitive prejudices to make decisions (Nga & Ken Yien, 2013). Rationality concept popularized by traditional theorists was criticized by Daniel Kahneman and Amos Tversky (1974), they in their study "Judgment under Uncertainty: Heuristics and Biases" proposed that investors do not always behave rationally in their financial decision making. After these two noble laureates, many other theorists gave their views and challenged the overweighed assumption of rationality of the traditional theories of finance. Nowadays there are numerous investment alternatives or options available to the investor for investing. The investment decisions of investors are shaped by many factors as no two individuals are alike (Mayfeild et al., 2008). There are a group of factors that holds the possibility to influence investment decisions (Bajaj and Kalra, 2018). Risk is a significant factor to consider in financial decision making. Financial advisors usually do the analysis of various risk measurements to predict the behavior of investors towards risk in financial markets (Grable & Lytton, 2003). In response to traditional finance, behavioral finance researchers have unearthed the number of factors that determine the investment behavior of investors like demographic factors (Barber and Odean 2001; Ozmen and Sumer, 2011), psychological factors (Shleifer, 2000; Dolan et al., 2012; Chang 2008), personality (Durand et al., 2008; Sadiq and Azad 2019; Mayfield et al. 2008). Planned behavior theory (PBT) debated many related factors (Personality, socioeconomic position, gender, age, ethnicity, education, and investment proficiencies) that can possibly impact the behavioral aspects held by people (Ajzen, 2002). However, there is a dearth of literature on the influence of personality traits on investment decisions. Thus to increase the understanding of investment decision-making behavior of the individual investors, the present study inspects the role of vital background aspects that are the personality traits and demographic factors. Psychology states personality as a 'relatively permanent pattern of behavior, opinions and feelings, these characteristics under certain events respond in definite ways which extricate an individual from one another (Maslej et al., 2017). Individuals differ in terms of their personality traits, level of risk perception, emotional stability and financial literacy (Sadi et al., 2011). Investors who are risk seekers often put their funds in risky investment instruments (Lutfi et al., 2020). Demographic differences are the most influential factors that shape the investment decisions of investors regarding their investment choices (Patel and Vasudevmodi, 2017). Along with other factors, demographic variances of the investors also affect their investment management process (Sadiq and Ishaq, 2014). Demographic factors clearly define why people behave in separate ways in managing their investment avenues (Thaler, 1999). Demographic variables like sex, age and social groups influence the investment behavior of respondents (Sireesha and Laxmi, 2013).

1.1. Research Rationale

Investor behavior interpretations deals with evaluating the behavior of an investor based on his psychographic factors and demographic factors, such as age, income groups, and gender.

It depicts the importance of utilizing the portfolio of investors in stock markets. At the same time, each investor differs from other investors in all aspects due to different demographic factors, such as sex, race, educational attainment level, age, and socio-economic background.

The most crucial and remarkable challenge confronted by the investors is in making investment decisions. This challenge has been pointed out in Indian market majorly due to the diversity of this country. Furthermore, it also created difficulties in terms of undertaking.

International investment based decisions. Additionally, an optimum investment decision refers to a significant consideration in stock market, having an effective role in investment decisions. According to the principles of prospect theory; psychological aspects of investors drive their actual decision-making procedure for deviating from rationality. Concerning this, several rationality-based work, also argued about this opinion. However, psyche and emotions, very often, influence investment decisions of investor, which lead them to act in an irrational way. Therefore, it prevented them from getting on-going flow in ROI and stock market whereby, sudden fall down of stock market hindered their psychological state.

Despite having a huge rush of investors (7.7 crore), India's Stock Market is still considered as a developing Stock market. This vast Stock market is mostly dominated by retail investors having 44% of total share in NSE of India (NSE). One of the main reason behind the development of stock markets in developed countries is the depth research on individual investors, who make up the stock markets. Despite having the immense role of individual investors in making the Indian stock market efficient, very few studies have been conducted on their behavioral aspects. Behavioral factors as per behavioral finance theory have an imperial role in determining the investor's decision making pattern (Kahneman and Tversky, 1979). The paper is going to shed light on the factors, which are affecting the investment decisions of investors in India concerning their personality and demographic traits.

2. Literature review and hypothesis development

2.1. Theoretical background

Shiller (1999) states that key aspects of behavioral finance constitutes Prospect theory, Regret Theory, Anchoring and Over and under reaction.

Prospect theory: Kahneman and Tversky (1979) project the prospect theory as an alternate of expected utility theory for decision making of individuals under conditions of uncertainty. They suggests that people comprehend their results as gains and losses. Prospects are divided into risk free and risky factors. Maheeran and Abdullah (2009) prospect of losses make investors feel stressed and prospect of gains cheer them. Schwartz (1998) investors incline to evaluate their prospect of gains and losses in relation to point of reference instead of final wealth. Relentless biases of investors driven by psychological forces impact their decision making options under risk.

Regret theory: Larrick & Boles (1995) investors are sentimental while responding to the judgmental error. Bell (1983) postulates that acquisition of results of a relinquish alternate make the possibility of feeling regret.

Behavioral portfolio theory: Developed as an alternate to Markowitz portfolio theory by Shefrin and Statman (1994; 2000; 2009) proposed that portfolios are constructed as overlying pyramids with related goals of each layer.

Under and over reaction: Nik Maheeran (2009) investors give more importance to the current news at the cost of other data. Over confidence is displayed by investors. Investors express pessimistic nature in the rise of markets and show optimistic nature in the fall of markets. Kahneman and Odeon (1999) observed that prompt purchase of stock while selling another stock and the sold stock perform better in the coming year by 3.4% on average. They also highlighted "cognitive illusions" encountered by individuals.

Rationality assumption of the traditional finance theories such as efficient market hypothesis was first criticized by Kahneman and Tversky (1979) in their article "Judgment under Uncertainty: Heuristics and Biases". Investors may take a high risk to avoid the loss and a low risk for gain (Kahneman & Tversky, 1979). People set a higher price to the things they own than what they would have to pay for the same thing they don't own (Thaler, 1999).

Demography and investment decisions

The investment decision-making strategy of an individual is based on a multifaceted blending of demographic profile like age, gender, income and level of education (Hallahan et al., 2003; Ozmen and Sumer, 2011; Mayfield and Shapiro, 2010). Not all demographic factors have a relationship with

investment decision making. Only age, income and family size display a strong relationship (Getha & Ramesh, 2012). Demographic characteristics and investment choices of investors are positively correlated with each other (Lutfi, 2010). Gender significantly affects investment decisions. Male investors always prefer to invest in risky instruments (Raza et al., 2013). The age of the investors should be considered before guiding the investors regarding financial decisions because their investment choices vary according to their age (Singh, 2006). Investment decisions vary according to the investors' marital status, married people prefer bank deposits while single invest their funds in the capital market (Sireesha & Laxmi, 2013).

H1: demographic factors significantly impact the investment decisions both short-term and long-term of individual investors.

2.2. Personality and investment decisions

Personality is defined as "the way a person interacts, reacts, and acts with others, which is typically expressed through quantitative attributes (Crysel et al., 2013). Although different research studies have suggested different personality traits though "Big five model" is the most universally used taxonomy developed by Allport and Odbert (1936). This model is based upon the five different traits viz extraversion, conscientiousness neuroticism, openness to experience and agreeableness. Investor personality is significantly related to his investment choices (Dolan et al., 2012). Researchers have used a varied number of traits to determine investment choices. Mayfeild et al., (2008) operationalize the two dimensions (Conscientiousness and Openness to experience) of the big five model. Oehler et al. (2018) make use of two traits (Extraversion and Neuroticism) to determine the investor's decision making in asset markets. Ishfaq et al. (2020) operationalize the extraversion dimension of the big five model to determine its moderating effect on investment decisions. Same in the current study two dimensions (Neuroticism and Conscientiousness) are operationalized along with the demographic variables to predict the short-term and long-term investment decisions of individual investors.

2.2.1. Neuroticism and Investment decisions

Depressed, anxious and pessimistic individuals came underneath the neurotic category of the Big Five model (William, 1992). When it emanates to risky decision making neurotic people sense anxiety and nervous and they don't take risks, on the other hand, persons with low neuroticism are not as easily worried and less emotionally sensitive (Costa and McCrae, 1992). Neurotic persons are emotionally wobbly and quite cynical in their tactics towards decisions in their lives (Oehler & Wedlich 2018; Noe & Vulkan 2017). Neurotic people are generally short-term oriented and evade taking long-term risks (Bakir Hussain, 2020)

H2: there is a significant positive impact of neuroticism on short-term investment decisions

2.2.2. Conscientiousness and investment decisions

This personality type includes those persons who are dependable, determined, reliable and planned (Costa & McCrae, 1992). Conscientiousness means a fondness for structured, organized instead of imprudent, volatile behavior. It affects the way wherein we cope, control and direct our wishes, stimulation, habits and predispositions. People who rank stumpy in this trait tend to be unfocused, disorganized and erratic (Costa & McCrae, 1992). This personality feature may assist as a fundamental determinant for why some persons are more likely to use money as a tool to impact others (Lim and Teo, 1997). Conscientiousness and long-term investment are positively related to each other (Mayfeild et al., 2008). Conscientious individuals are very careful and accountable and they believe in being ready, so they chose long-term investment options as compared to short-term options (Bakir Hussain, 2020).

H3: there is a significant positive impact of conscientiousness on long-term investment decisions

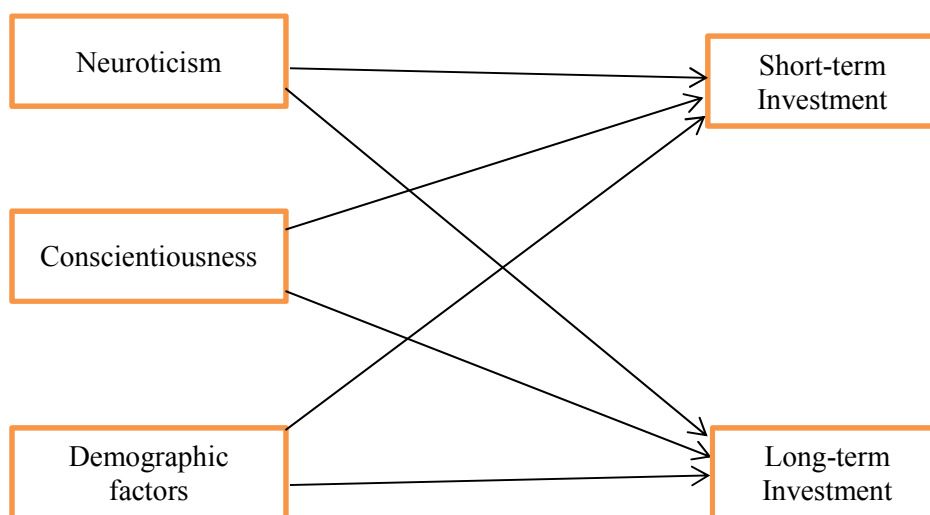


Figure 1 – Research Model

3. Research Methodology

3.1. Sampling and Data organizing

Respondents include the individual investors of North India. Data was collected from Delhi NCR; the same was also done by Aarzoo Sharma (2019). Purposive sampling was used as it suits best to the current study. 354 questionnaires were distributed after discarding the wrong or invalid questionnaires only 315 were found fit for analysis. The 50 times rule of thumb for artificial neural network testing, which bounds the benchmark sample size to not below 50 times the number of modifiable parameters in the neural network, has also been exceeded by this sample size (Alwosheel et al., 2018). Because the ANN model has six parameters, the minimum sample size required is 300. Therefore, the sample size of 315 is sufficient for the ANN analysis.

3.2. Measurement of constructs

Similar to Riaz and Hunjra (2016) items to measure the studying constructs were extracted from the existing literature and then EFA (exploratory factor analysis) was conducted to know their appropriateness. Personality traits measuring items were derived from Costa and McCrae, (1992). To measure the investment decisions, measuring items were taken from Mayfeild et al. (2008). Five point Likert scale was employed to gather the data because it minimizes the participant's hindrance level and improves the response rate as 7 point scales are complex and can obscure the respondents (Pai & Huang, 2011).

3.3. Pre-testing and Pilot-testing

Before the final data collection, pre-test and pilot tests were done. Like Kim et al. (2009) to assess the survey instrument's face and content validity, we conducted an interview of five professors who were rich in the knowledge of behavioral finance. Based on their responses we identified vagueness in the wordings and did slight changes. Similar to Kapoor et al. (2014), for pilot testing the questionnaires were distributed among 72 participants. Cronbach's alpha for all constructs supersedes 0.70 that shows good construct reliability.

3.4. EFA and Reliability

To measure the reliability of the sample KMO and Bartlett's test was used. The results (KMO 0.80, Bartlett's test of sphericity 0.00) were found well under the acceptable limit. Reliability of the measuring instruments was checked by Cronbach's alpha, as it is a common statistic to test the reliability of the scales (Keith Taber, 2018). Different researchers have different views relating to the acceptance range of Cronbach's alpha value. Alpha value "0.6 to 0.7" shows the acceptable level, value "0.8 to 0.9" is considered a very good level of reliability (Hulin et al., 2001). Factor loading shows strongly the variable and its measuring items are related to each other. Factor loadings > 0.4 are treated as an acceptable limit (Stevens, 1992). The following figure shows the reliability of the studying constructs along with factor loadings of the measuring items.

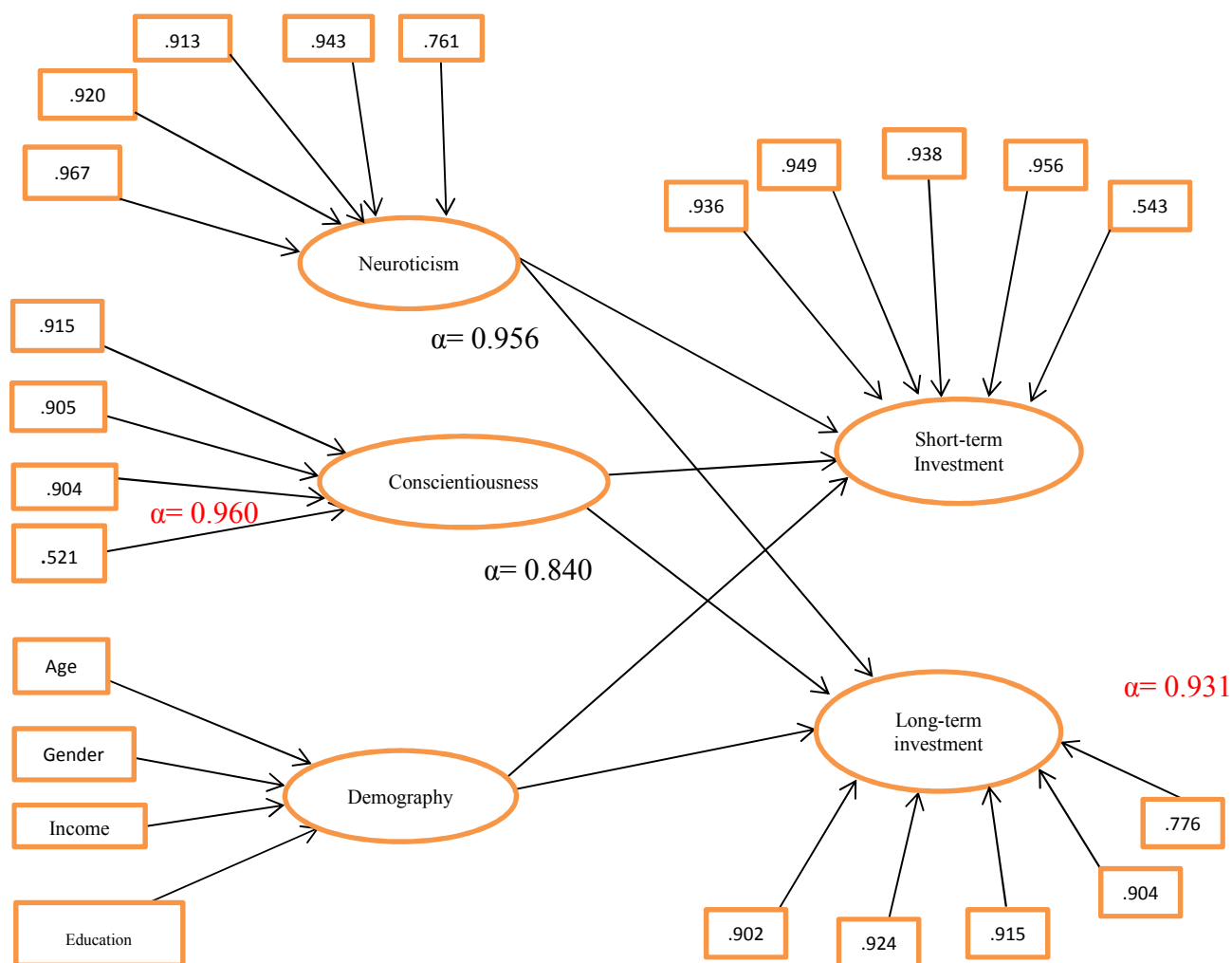


Figure 2 – Factor loadings and Cronbach's Alpha

4. Data Analysis

4.1. Descriptive Statistics

Table 1 – Descriptive analysis

Variables	Percentage	Mean	SD	Skewness	Kurtosis
Neuroticism		11.237	5.908	0.322	-1.396
Conscientiousness		11.5111	4.454	-0.344	-.656
Short-term investment		12.3905	5.538	0.33	-1.251
Long-term investment		13.4730	5.7211	-0.403	-1.330
Gender					
Male	62.5				
Female	37.5				
Age					
Below 20	7.6				
20 to 40	67.3				
Above 40	25.1				
Income					
Less than 2 lac	20.3				
2 to 4 lac	35.9				
4 to 6 lac	29.5				

Above 6 lac	14.3
Education	
Secondary	12.4
Bachelors	28.9
Masters	35.6
Other	23.1

4.2. Regression Analysis (Short-term Investment decisions)

Table 2 – ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6185.780	7	883.683	118.138	.000 ^a
	Residual	2296.391	307	7.480		
	Total	8482.171	314			

a. Predictors: (Constant), Occupation, Neuroticism, Gender, Age, Education, Conscientiousness, Income

b. Dependent Variable: STID

Table 3 – Regression Results

	R	R Square	F value	Adjusted R Square	Beta	T value	Sig
	.854	.729	184.497	.724			0.000
Nero					.846	20.023	
Cons					-.028	-0.686	
Gender					-.030	-.949	
Age					-.0018	-.491	
Education					.053	1.473	
Income					.048	1.219	

a. Predictors: (Constant), Education, Gender, Cons, Age, Income, Nero

b. Dependent Variable: STID

The ANOVA result shown in above table 2 are significant with F value of 118.138. The results depicted by the above table 3 are linear regression results, short-term investment decision making dependent variable and demographic factors (qualification, gender, income, age) and personality traits (neuroticism and conscientiousness) independent variables. The results of the model summary were evaluated to assess the model fit. The result depicts that R Square shows 0.729 variations in short-term investment is determined by the model. The value of the Adjusted R Square is 0.724 which is very close to R Square. The reliability of the model is indicated by the high value of R (R= 0.854). Neuroticism is the only predictor with a high Beta value of 0.846, all others have a negligible influence on the dependent variable.

4.3. Regression Analysis (Long-term Investment decisions)

Table 4 – ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9862.261	7	1408.894	148.666	.000 ^a
	Residual	2909.421	307	9.477		
	Total	12771.683	314			

a. Predictors: (Constant), Occupation, Neuroticism, Gender, Age, Education, Conscientiousness, Income

b. Dependent Variable: LTID

Table 5 – Regression Results

	R	R Square	F value	Adjusted R Square	Beta	T value	Sig
	.888	.770	190.445	.766			0.000
Nero					-.778	-19.994	
Cons					.139	3.692	
Gender					-.14	.484	
Age					-.044	-1.306	
Education					-.036	-1.078	
Income					-.034	-.937	

a. Predictors: (Constant), Education, Gender, Cons, Age, Income, Nero

b. Dependent Variable: LTID

The table 4 above states the significant ANOVA results with a significance level of < 0.05 and F value of 148.66. The above regression results in the table 5 depicts the high impact of demographic factors and personality traits on long-term investment decisions. 0.770 value of R Square shows the good fitness of a model. The value of the Adjusted R Square is 0.766 which is very close to the R Square value. The high value of R (0.888) shows the significant relationship between the variables. Neuroticism is the only highest influencer among the predictors with a Beta value of -0.778. All others have a negligible impact on long-term investment making.

4.4. Correlation Analysis

Table 6: Correlation

		Gender	Age	Income	Education	Occupation	Neuroticism	Conscientiousness	STID	LTID
Gender	Pearson Correlation	1	-.152**	-.215**	-.014	.061	-.148**	.004	-.163**	.144*
	Sig		.007	.000	.806	.281	.009	.944	.004	.011
Age	Pearson Correlation	-.152**	1	.540**	.357**	-.282**	.120*	-.055	.134*	-.178**
	Sig	.007		.000	.000	.000	.034	.329	.017	.002
Income	Pearson Correlation	-.215**	.540**	1	.492**	-.434**	-.105	.113*	-.022	.020
	Sig	.000	.000		.000	.000	.062	.046	.698	.729
Education	Pearson Correlation	-.014	.357**	.492**	1	-.254**	-.248**	.235**	-.146**	.158**
	Sig	.806	.000	.000		.000	.000	.000	.009	.005
Occupation	Pearson Correlation	.061	-.282**	-.434**	-.254**	1	-.004	.018	-.029	.006
	Sig	.281	.000	.000	.000		.944	.748	.613	.922
Neuroticism	Pearson Correlation	-.148**	.120*	-.105	-.248**	-.004	1	-.680**	.850**	-.868**
	Sig	.009	.034	.062	.000	.944		.000	.000	.000
Conscientiousness	Pearson Correlation	.004	-.055	.113*	.235**	.018	-.680**	1	-.585**	.659**
	Sig	.944	.329	.046	.000	.748	.000		.000	.000
STID	Pearson Correlation	-.163**	.134*	-.022	-.146**	-.029	.850**	-.585**	1	-.852**
	Sig	.004	.017	.698	.009	.613	.000	.000		.000
LTID	Pearson Correlation	.144*	-.178**	.020	.158**	.006	-.868**	.659**	-.852**	1
	Sig	.011	.002	.729	.005	.922	.000	.000	.000	

** . Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level (2)

STID: short-term investment

LTID: long-term investment

The above table shows the correlation strength among the study variables. Among demographic factors, significant positive correlation was found between education and long-term investment decisions while as long-term investment decisions shows the negative correlation with age of the investors. Also a negative significant correlation was found between gender and short-term investment decisions. Among personality traits neuroticism shows a significant positive correlation (0.850) with short-term investment decisions and significant negative correlation (-0.868) with long-term investment decisions. A significant positive correlation (0.659) was found between conscientiousness and long-term investment decisions and conscientiousness shares a significant negative correlation (-0.585) with short-term investment decisions.

4.5. Artificial Neural Network

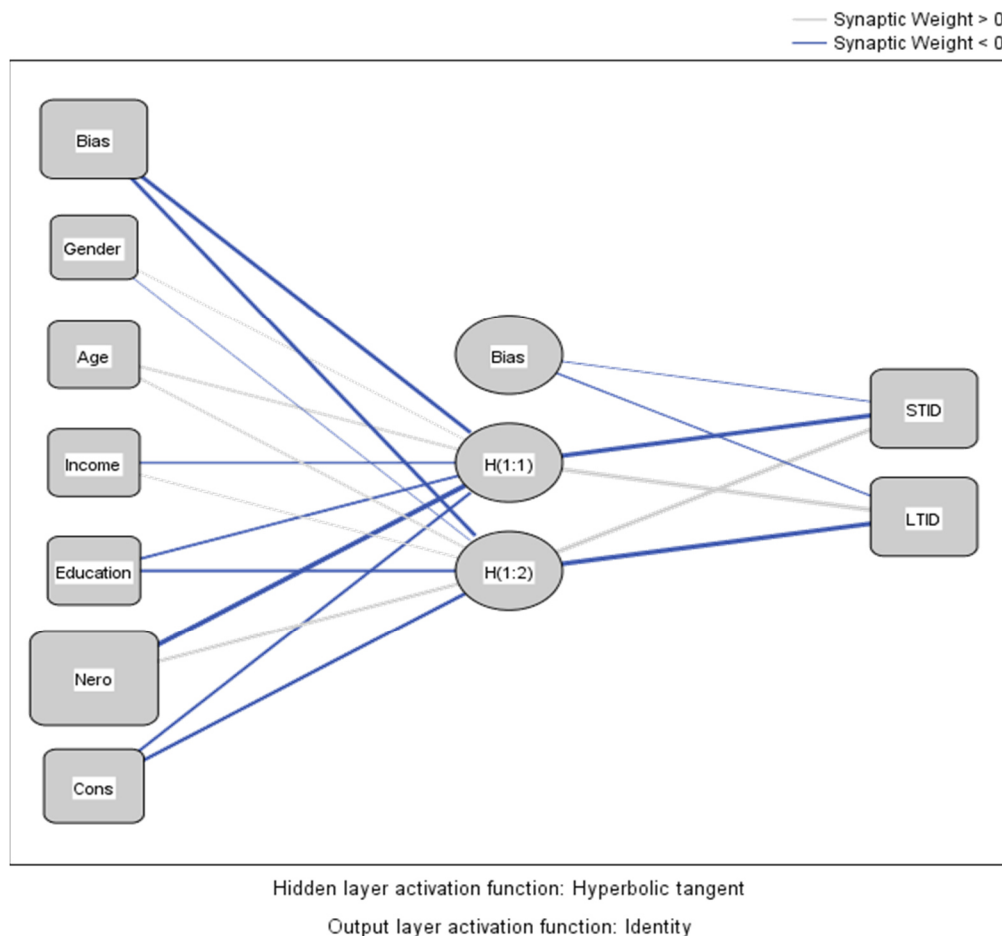


Figure 3 – ANN model

Outliers and small sample sizes are no longer a problem thanks to the ANN. It can be used to create non-compensatory models, in which a decrease in one factor is not compensated by an increase in another. IBM's SPSS neural network module was used to conduct the ANN test. The ANN algorithm can detect both linear and nonlinear relationships. (Teo et al., 2015). For hidden and input layers Multilayer Perceptrons and Sigmoid activation functions were used (Leong et al., 2019). ANN takes several rounds to learn a process, which reduces the errors and improves the accuracy (Idrissi et al., 2019). Similar to Leong et al. (2019) 90% of samples were allocated to the training procedure and 10% to the testing procedure. A ten-fold cross-validating procedure was used to elude the over fitting of the model and RMSE (root mean square of errors) was obtained (Tan et al., 2014). The table depicts that the Average RMSE values (0.173 and 0.171) for training and testing respectively, which is not too far away from the threshold limit. The model 10 fits is the most significant model as it has the lowest values of RMSEA for training and testing both.

Table 7 – RMSEA

Network	Sample size training	Sample Size Testing	RMSEA Training	RMSEA Testing
1	278	37	.212	.212
2	285	30	.199	.218
3	286	29	.196	.190
4	280	35	.187	.170
5	275	40	.173	.156
6	284	31	.169	.173
7	277	38	.167	.148
8	283	32	.148	.157
9	272	43	.147	.128
10	287	28	.135	.155
Mean			.173	.171
S.D			0.0252	0.0286

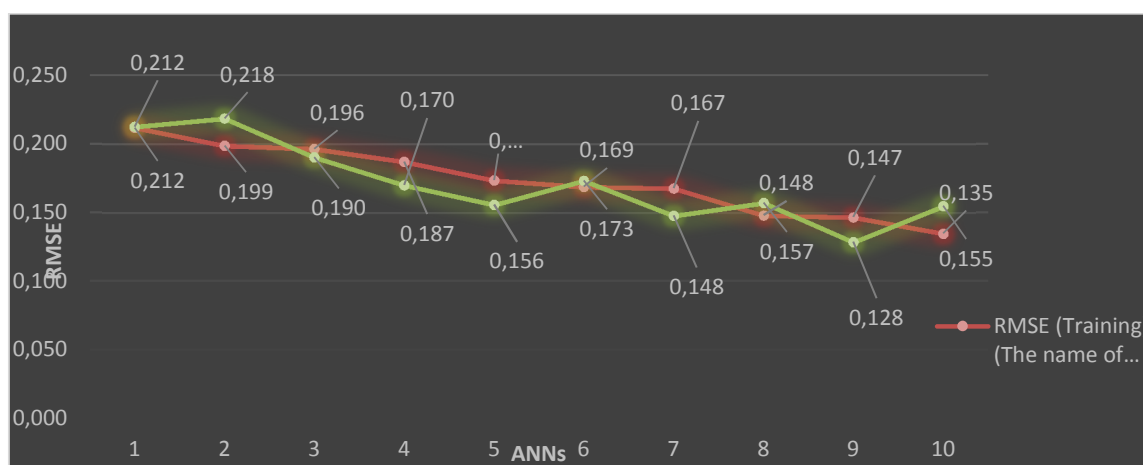


Figure 4 – RMSEA

4.6. Sensitivity Analysis

To determine the strength of the predictive power of each neuron, Sensitive analysis was conducted to predict the normalized importance of the neurons and this was presented in percentage form (Karaca et al., 2019). The result depicts that neuroticism is the most important predictor with an average importance of 96.524% followed by conscientiousness that has 35.46%. This is followed by Education (14.27%). Gender is the least important predictor having a value of only 4.52%.

Table 8 – Sensitivity Analysis

Network	Gender	Age	Income	Education	Neuroticism	Conscientiousness
N1	3.5	9.2	14.6	14.3	92.86	35.7
N2	3.6	13.4	14.3	17.3	99.56	33.8
N3	4	14.4	16.5	18.7	97.7	34.7
N4	5.5	8.5	7.1	11.2	94.78	27.6
N5	6.4	13.1	17.3	18.2	98.62	37.4
N6	3.5	16.5	12.5	17.3	96.11	21.2
N7	4	8.3	8.8	12.8	95.78	31.9
N8	4.7	18.8	16.9	13.8	97.57	44.8
N9	6.6	10	3.8	8	93.28	41.5
N10	3.4	8	9.5	11.1	98.98	46.3
Average Im- portance %	4.52	12.02	12.13	14.27	96.524	35.46
Normalised Importance	0.046	0.124	0.125	0.147	1	0.367

5. Discussion

The outcome of the study shows the weak and insignificant impact of demographic factors in determining the investment decisions provide the support for the rejection of our hypothesis 1. These results contradict the results of Bali et al., (2009); Ozmen & Summer, (2011); Mayfeild & Shapiro, (2010). The results of our study weigh neuroticism as the most important predictor of investment decisions. These findings go against the results of Mayfeild et al., (2008) and Sadiq & Khan, (2018). Neuroticism was found strong predictor of both short-term and long-term investment decisions. A positive impact of neuroticism was found on the short-term investment decisions and a negative impact on long-term investment decisions. The more individuals will be neurotic the more they will make short-term investment decisions. So, our hypothesis 2 is accepted. Apart from neuroticism, the findings show that conscientiousness has the least positive impact on long term investment decisions. These findings did not provide the support to our hypothesis 3 to get accepted, hence it is rejected. To make the results valid, correlation analysis was also incorporated to show the strength of the relation between study variables. Not much high significant correlation was found between the demographic factors and the dependent variables. Significant positive and high correlation was recorded between neuroticism and short-term investment decisions, while as significant high negative correlation was found between neuroticism and long-term investment decisions. Conscientiousness shared a significant high positive correlation with long-term investment decisions and significant high negative correlation with short-term investment decisions.

5.1. Theoretical Contribution

The integration of the personality traits along with the demographic variables in our study has added a new theoretical contribution to the behavioral finance literature. With insertion of age, gender, income, education along with the neuroticism and conscientiousness traits will provide a better understanding of the influence on the investor's investment decision making. The other contribution was the measurement of investment decision making based on time horizon and not risk. Finally, unlike the existing studies that have used linear models, we have engaged a two-staged linear regression and ANN approach. Linear models suffered several limitations, suppose the drop in the value of one predictor will be compensated by the rise in the value of another predictor. So, we used the non-compensatory ANN model and by this, we offered a significant theoretical contribution to the existing literature.

5.2. Practical Contribution

Not only the theoretical contribution but the present study also offered practical contributions. This study will act as a guide to the financial advisors in selecting the investment choices for their clients as not all individuals are alike and they differ in terms of their personalities. This study will also assist the retail investors who take investment decisions without consulting the financial advisors, to make the best financial decisions based on their personality variances.

5.3. Limitations and Future research

Firstly, this study only involves the investors of North India; hence the findings can't be generalized and applied to the whole investor population. Therefore, the future research study can incorporate the whole investor population of the country and also the cross-country analysis can be done to have a better understanding. Secondly, among the five constructs of the big five model, only two were used in the current study. Future studies may test all five constructs of the big five. Finally, the current study only incorporated the four demographical variables; future studies may incorporate more demographical variables and may study their impact on investment decisions.

6. Conclusion

This study was carried out to verify the effects of personality traits (neuroticism and conscientiousness) on the investment decisions of individual investors by using the linear regression model and ANN model. We also include four demographic factors to verify their impact on investment decisions. Among six predictors neuroticism was found the best predictor both for short-term and long-term investment decisions, which was also verified through the sensitivity analysis in the ANN model. After neuroticism, conscientiousness was found the second most influencer.

References:

1. Ajzen, I. (2002), "Perceived behavioral control, self-efficacy, locus of control, and the Theory of planned behavior", *Journal of Applied Social Psychology*, Vol. 32 (4), 665-683.
2. Allport, G. W., & Odbert, H. S. (1936), "Trait-names: A psycho-lexical study", *Psychological Monographs*, Vol. 47 No.1, DOI: 10.1037/h0093360.
3. Alwosheel, A., van Cranenburgh, S., & Chorus, C. G. (2018), "Is your dataset big enough? Sample size requirements when using artificial neural networks for discrete choice analysis", *Journal of Choice Modelling*, 28(September 2018), 167-182. <https://doi.org/10.1016/j.jocm.2018.07.002>.
4. Barber, B. & Odean, T. (2001), "Boys will be Boys: Gender, Overconfidence and Common Stock Investment", *The Quarterly Journal of Economics*, 116, 261-292.
5. Chang, C.-H. (2008), "The impact of behavioral pitfalls on investors' decisions: The disposition effect in the Taiwanese warrant market", *Social Behavior and Personality: An International Journal*, 36(5), 617-634.
6. Costa, P. T., & McCrae, R. R. (1992). *NEO PI-R professional manual*, psychological assessment resources. Odessa: TX.
7. Crysel, L. C., Crosier, B. S., & Webster, G. D. (2013), "The dark triad and risk behavior", *Personality and Individual Differences*, 54(1), 35-40.
8. Dolan, P., Elliott, A., Metcalfe, R., & Vlaev, I. (2012), "Influencing financial behavior: From changing minds to changing contexts", *Journal of Behavioral Finance*, 13(2), 126-142.
9. Durand, R. B., Newby, R. and Sanghani, J. P. (2008), "An Intimate Portrait of the Individual Investor", *Journal of Behavioral Finance*, 9, 193-208.
10. EL Idrissi, T., Idri, A., & Bakkoury, Z. (2019), "Systematic map and review of predictive techniques in diabetes self-management", *International Journal of Information Management*, Vol. 46, 263-277. <https://doi.org/10.1016/j.ijinfomgt.2018.09.011>.
11. Geetha, M. and Ramesh. M. (2012), "A Study on Relevance of Demographic Factors in Investment Decisions", *Perspective of Innovations, Economics and Business*, 10(1), 4-27.
12. Grabble, J.E & Lytton, R.H. (2003), "The development of risk assessment instrument: A follow-up", *Financial Service Review*, 12(3), 257-274.
13. Ravi, S., Kulkarni, G.R., Ray, S., Ravisankar, M., krishnan, V.G. and Chakravarthy, D.S.K., 2022. Analysis of user pairing non-orthogonal multiple access network using deep Q-network algorithm for defense applications. *The Journal of Defense Modeling and Simulation*, p.15485129211072548.
14. Hunjra, Ahmed Imran and Qureshi, Salman and Riaz, Lubna (2016), "Psychological Factors and Investment Decision Making: A Confirmatory Factor Analysis", *Journal of Contemporary Management Sciences*, 2(1). <https://ssrn.com/abstract=3229744>.
15. Ishfaq, Muhammad & Nazir, Mian Sajid & Qamar, Jibran & Usman, Muhammad. (2020), "Cognitive Bias and the Extraversion Personality Shaping the Behavior of Investors", *Frontiers in Psychology*, Vol. 11, pp. 1-11. DOI: 10.3389/fpsyg.2020.556506.
16. Jaspal Singh, S. C. (2006), "Investor's Preference for Investment in Mutual Funds: Empirical Evidence", *The IUP Journal of Behavioural Finance*, 7-17.
17. Kahneman & Odean (1999), "Do Investors trade too much?", *American Economic Review*, 89, 1279-98.
18. Kahneman, D. & Tversky, A. (1974), "A Judgment under Uncertainty: Heuristics and Biases", *Science*, New Series, 185(4157), 1124-1131.
19. Kahneman, D. & Tversky, A. (1979), "Prospect Theory: An Analysis of Decision under Risk", *Econometrica*, 47(2), 263-291.
20. Kapoor, K., Dwivedi, Y., Piercy, N. C., Lal, B., & Weerakkody, V. (2014), "RFID integrated systems in libraries: Extending TAM model for empirically examining the use", *Journal of Enterprise Information Management*, 27(6), 731-758. <https://doi.org/10.1108/JEIM.10.2013.0079>.
21. Karaca, Y., Moonis, M., Zhang, Y. D., & Gezgez, C. (2019), "Mobile cloud computing based stroke healthcare system", *International Journal of Information Management*, 45(April 2019), 250-261. <https://doi.org/10.1016/j.ijinfomgt.2018.09.012>.
22. Keith S. Taber (2018), "The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education", 48(6), 1273-1296.
23. Kim, C., Oh, E., Shin, N., & Chae, M. (2009), "An empirical investigation of factors affecting ubiquitous computing use and U-business value", *International Journal of Information Management*, 29(6), 436-448. <https://doi.org/10.1016/j.ijinfomgt.2009.06.003>.

24. Leong, L. Y., Hew, T. S., Ooi, K. B., & Lin, B. (2019), "Do electronic word-of-mouth and elaboration likelihood model influence hotel booking?", *Journal of Computer Information Systems*, 59(2), 146-160. <https://doi.org/10.1080/08874417.2017.1320953>.
25. Lim, V. K. G., & Teo, T. S. H. (1997), "Sex, money and financial hardship: An empirical study of attitudes towards money among undergraduates in Singapore", *Journal of Economic Psychology*, 18, 369-386.
26. Lutfi (2010), "The Relationship between Demographic Factors and Investment Decision in Surabaya, *Journal of Economics*", *Business and Accountancy Ventura*, 13(3).
27. Lutfi (2016), "The Relationship between Demographic Factors and Investment Decisions in SURABAYA", *Journal of Economics, Business and Accountancy Ventura*, 213-224.
28. Maslej, M. M., Oatley, K., & Mar, R. A. (2017), "Creating fictional characters: The role of experience, personality, and social processes", *Psychology of Aesthetics, Creativity and the Arts*, 11(4), 487.
29. Mayfield, S. and Shapiro, M. (2010), "Gender and risk: women, risk taking and risk aversion", *Gender in Management: An International Journal*, 25(7), 586-604.
30. MS, & Patel, MS. Bhoomi & Vasudevmodi, Dr. (2017), "Impact of Demographic Factors on Investment Decisions: An Empirical Study from South Gujrat region", *International Journal of Latest Engineering and Management Research*, 2(12), 1-08, ISSN: 2455-4847.
31. Muhammad, N.M.N; and Ismail, N. (2009), "Investment Decision making Style: Are Malaysian Investors Rational Decision Makers?" *Interdisciplinary Journal of Contemporary Research in Business*. 1(3), 96-108.
32. Nauman Sadiq, Hafiz Muhammad Ishaq, M. (2014), "The Effect of Demographic Factors on the Behaviour of investors during the choice of investments: Evidence from Twin Cities of Pakistan", *Global Journal of Management and Business Research*, 14(3), 46-56, ISSN: 2249-4588.
33. Noe, T., & Vulkan, N. (2017), "The role of personality in financial decisions and financial crises".
34. Larrick, R. P., & Boles, T. L. (1995). "Avoiding regret in decisions with feedback: A negotiation example", *Organizational Behavior and Human Decision Processes*, 63(1), 87-97. <https://doi.org/10.1006/obhd.1995.1064>.
35. Oehler, A., Wendt, S., Wedlich, F., Horn, M. (2018), "Investors' personality influences investment decisions: Experimental evidence on extraversion and neuroticism", *Journal of Behavioral Finance*, 19(1), 30-48.
36. Ozmen, O., & Sumer, Z. H. (2011), "Predictors of risk-taking behaviors among Turkish adolescents", *Personality and Individual Differences*, 50(1), 4-9.
37. P. Bhanu Sireesha & Ch. Sreelaxmi (2013), "Impact of Demographics on select Investment Avenues: A case study of twin cities of Hyderabad and Secunderabad, India", *International Journal of Marketing, Financial Services Management Research*, 2(6).
38. Pai, F. Y., & Huang, K. I. (2011), "Applying the Technology Acceptance Model to the introduction of healthcare information systems", *Technological Forecasting and Social Change*, 78(4), 650-660. <https://doi.org/10.1016/j.techfore.2010.11.007>.
39. Patel, A & Dattani, M (2017), "An Empirical study on Private Equity fund Manager's decision making criteria's and its impact on the selection of Investment proposals", *Indian Journal of Commerce & Management Studies*, 8(3). DOI: 10.18843/ijcms/v8i3/06.
40. Raza Ahmad, S., Jahangir, S., Zaigham, H.S., Shafi, S. (2013), "Investment preferences and risk level: Behavior of salaried individuals", *IOSR Journal of Business and Management*, 10(1), 68-78.
41. Sadiq, M.N., Khan, R.A.A., Bashir, M.K. (2018), "Individuals demographic differences and financial satisfaction: Evidence from Pakistan", *Business and Economics Journal*, 9(3), 1-7, DOI: 10.4172/2151-6219.1000369.
42. Sadi, R., Asl, H. G., Rostami, M. R, Gholipour, F. (2011), "Behavioral Finance: The Explanation of Investor's Personality and Perceptual Biases Effects on Financial Decisions", *International Journal of Economics and Finance*, 3(5), 234-241. <http://doi.org/10.5539/ijef.v3n5p234>.
43. Schwartz, H. (1998). "Rationality Gone Awry? Decision Making Inconsistent with Economic and Financial Theory West-port", CT: Greenwood Publishing Group, Inc.
44. Ray, S. (2021). "Can economics of olfactory branding be replicated through historical sensation: cases from college street booksellers?" *Вестник Бурятского государственного университета. Экономика и менеджмент*, 3, pp.66-73.
45. Роков, А.И., Тенгиз, М. and Рэй, С. (2021). "Энергетические проблемы в новых экономических условиях". *E-Scio*, 9(60), pp.324-332.
46. Shefrin, H. and Statman, M. (2009), "Striking regulatory irons while hot". *Journal of Investment Management* 7, 29-42

47. Shleifer, A. (2000), "Inefficient markets: An introduction to behavioural finance", Oxford University Press.
48. Bangare, J.L., Kapila, D., Nehete, P.U., Malwade, S.S., Sankar, K. and Ray, S., 2022, February. "Comparative Study on Various Storage Optimisation Techniques in Machine Learning based Cloud Computing System". 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM) (Vol. 2, pp. 53-57). IEEE.
49. Tan, G. W. H., Ooi, K. B., Leong, L. Y., & Lin, B. (2014), "Predicting the drivers of behavioral intention to use mobile learning: A hybrid SEM-Neural Networks approach", Computers in Human Behavior, 36(July 2014), 198-213. <https://doi.org/10.1016/j.chb.2014.03.052>.
50. Thaler, R. (1999), "Mental Accounting Matters". Journal of Behavioral Decision Making, 12(3), 183-206.
51. Teo, A. C., Tan, G. W. H., Ooi, K. B., Hew, T. S., & Yew, K. T. (2015), "The effects of convenience and speed in m-payment", Industrial Management & Data Systems, 115(2), 311-331. <https://doi.org/10.1108/IMDS-08-2014-0231>.
52. Williams, D. G. (1992), "Dispositional optimism, neuroticism, and extraversion", Personality and Individual Differences, 13(4), 475-477.

Received 30.09.2022

Статья поступила 30.09.2022 г.