Uluslararası Yönetim İktisat ve İşletme Dergisi, Cilt 8, Sayı 17, 2012
Int. Journal of Management Economics and Business, Vol. 8, No. 17, 2012

A COMPARATIVE STUDY OF USING THE METHODS OF MULTIPLE LINEAR REGRESSION AND ARTIFICIAL NEURAL NETWORKS IN ORGANIZATIONAL CORRELATIONS FOR THE FIELDS OF MANAGEMENT AND ORGANIZATION

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ABSTRACT

The purpose of this study is to compare the performances of the Multiple Linear Regression (MLR) and Artificial Neural Networks (ANN) used in correlations for the fields of management and organization, and to demonstrate that the ANN method can be used in organizational studies. Therefore, first, comprehensive information is provided about the ANN method and its use in literature and comparative studies. Work–family conflict, affective commitment, and turnover intention have been used as the variable group to compare the performance of the ANN with that of the MLR. Validity and reliability tests have been carried out, and the correlation coefficient R (correlation coefficient) and RMSE (Root Mean Square Error) have been considered as the criteria for performance. Within the scope of the findings, the ANN method is found to demonstrate higher R and lower RMSE values, when compared with the MLR method, although the effect coefficients obtained through both methods regarding correlations are noted to be similar.

Keywords: *Management and Organization; Organization Behavior; Regression; Artificial Neural Network.*

YÖNETİM VE ORGANİZASYON ALANINDA ÖRGÜTSEL DEĞİŞKENLER ARASI İLİŞKİLERDE REGRESYON VE YAPAY SİNİR AĞLARI YÖNTEMLERİNİN KARŞILAŞTIRMASI

ÖZET

Bu araştırmanın amacı, Yönetim ve Organizasyon alanında değişkenler arası ilişkilerde kullanılan Çoklu Doğrusal Regresyon analizi (MLR) ile Yapay Sinir Ağları (ANN) yönteminin performanslarını karşılaştırarak ANN yönteminin örgütsel araştırmalarda uygulanabilirliğini ortaya koyabilmektir. Araştırmanın örneklemi kamu ve özel sektör kuruluşlarından tesadüfi örnekleme yoluyla seçilen 392 çalışandan oluşmaktadır. Araştırmada geçerlilik ve güvenilirlik testleri yapılmış, performans ölçütü olarak R^2 (correlation coefficient) ve RMSE (root mean square error) dikkate alınmıştır. Elde edilen bulgular çerçevesinde değişkenler arası ilişkilere yönelik etki katsayıları birbirine benzemekle birlikte, ANN yönteminin MLR yöntemine göre daha yüksek R^2 ve daha düşük RMSE değerleri ortaya koyduğu tespit edilmiştir.

Anahtar kelimeler: *Yönetim ve Organizasyon; Örgütsel Davranış; Regresyon; Yapay Sinir Ağları.*

www.jimeb.org ISSN:1301-4749 E-ISSN:1301-8051
http://dx.doi.org/10.11122/ijmeb.2012.8.17.343

1. Introduction

With the changes in the scientific literature and developments in the business world, studies on managements and organizations are gradually increasing. In this process, many variables concerning managerial life become the topics of theoretical and empirical studies. Such studies generally handle the realization level of the variables examined or their mean values and correlations and interactions. It is ascertained that organizational and behavioral inferences are made from such findings. Mostly, statistical analysis methods are used in the subject-matter studies. In particular, the method of simple and multiple linear regressions (MLR) is the primary statistical analysis method used to determine the direction and level of organizational correlations. However, in recent years, it may be stated that the method of artificial neural networks (ANN), with its different advantages, has started to become an alternative to the method of simple linear regression and MLR in many fields. The ANN may be accepted as one of the successful results of the objective of developing systems that think and act as humans, which was developed in 1943. The ANN is a method that is capable of taking actions like humans, producing highly reliable and consistent results on similar problems. Use of general survey methods, such as data collection tools, to determine correlations in organizational studies and obtaining such data from the human factor in the organization make the ANN technology even more important in terms of management and organizational discipline (Zurada 1992:18-21; Haykin, 1999:30-34; Nabiyev, 2010:560).

Some difficulties encountered in the studies conducted by use of ANN in terms of different disciplines; concerns about proving and the fact that some aspect of the ANN method have not been sufficiently discovered yet, thus may remove the researchers from using ANN. However, the need for innovation in the methods of researches renders the ANN a relative center of attraction in the fields not previously used. For this reason, researchers in different disciplines head for studies which are based on comparing ANN with traditional statistical methods and thus, they show an effort to remove the property of being a “closed box” of the ANN method (Walczak, 2012:1-2).

This study aims to compare the performances of the ANN and MLR analysis methods using some organizational variables and present the usability of the ANN method in managerial and organizational studies. The simple and multiple correlations between the variables consisting of work–family conflict, affective commitment, and turnover intention are used together in the study. The effect coefficients, correlation coefficient (R) and root mean square error (RMSE) values obtained from both the analysis methods are used as the performance criteria for comparison.

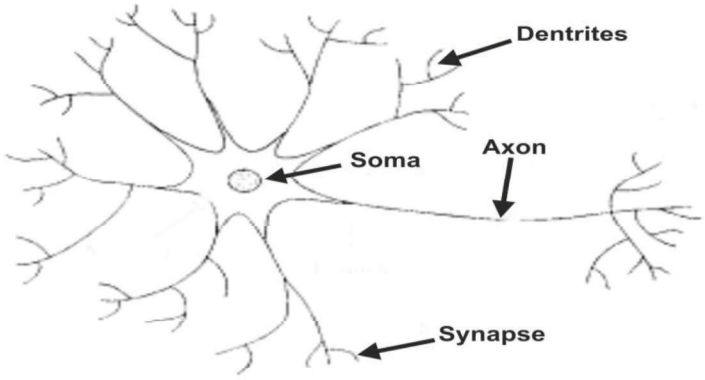
2. Artificial Neural Network

2.1. Basic Structure of the Artificial Neural Networks

The ANN is an information processing system formed in the light of the performance properties of the biological neural network (Fausett, 1994:3). Biological neural networks are capable of learning, thinking, and interpreting, and the brain, comprising the neural cells, has this capability. The desire to develop an intelligent machinery is based on adapting such capabilities to the computer environment. The

neurons forming the biological neural network have four basic components: somas, axons, dendrites, and synopses. Figure 1 shows the structure of a biological neural cell. Soma, meaning the body of cell, conducts cellular activities. Dendrites, one of the extensions coming out of the cellular body, appear like branches of trees and collect information coming from other cells. Axons transmit such information to dentrites. Synapses are areas of electrochemical contact between neurons (Li, 1994:304). When the stimuli through the synaptic connections between neurons exceed a certain level of threshold, an activity starts. Such activities start only when such a threshold is exceeded. When an activity starts, it will be transmitted to all the terminals through the axons (Simpson, 1990:3-10; Elmas, 2007:26-29; Nabiyev, 2010:549-555).

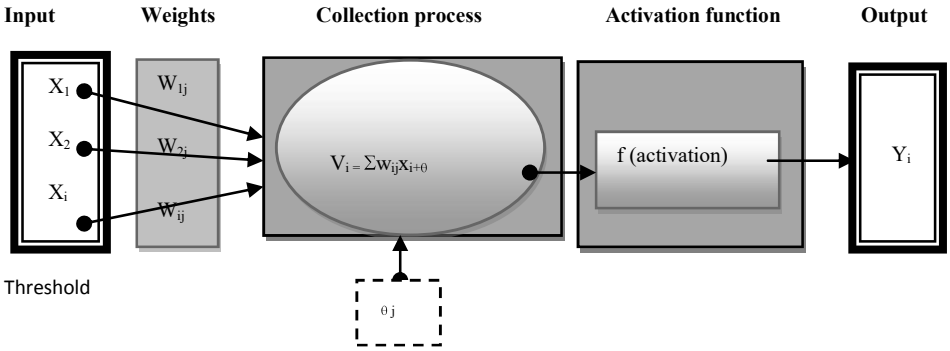
Figure 1. Biological Neuron



Resource: Li, Y. E. (1994). Artificial neural networks and their business applications, *Information & Management*. 27, 303-313.

ANNs are the structures consisting of many interconnected processors (artificial nerves) operating in parallel. Such processors are called simple nerves consisting of many nodules. Though artificial nerves are simpler than biological nerves, they imitate the basic functions as well as learning and generalizing capabilities of the biological nerves. Figure 2 shows an artificial nerve and its activity process. Inputs that enter the data, coming from the environment or from itself again into the nerves, are shown as X_i. Such inputs will be multiplied by (w), which is called weight, and the products obtained will be added to θ. The greater weight means the stronger connection of the input to the nerve. Thus, the activity will start and the Y_i output will be formed. Each nerve activity will produce an output above the threshold level. Such outputs may be inputs to other nerves. (Ahn, Cho & Kim, 2000: 67; Eberhart & Shi, 2007: 170-175; Elmas, 2007: 30-33; Nabiyev, 2010; 549-555).

Figure 2. An ANN as a Process Component

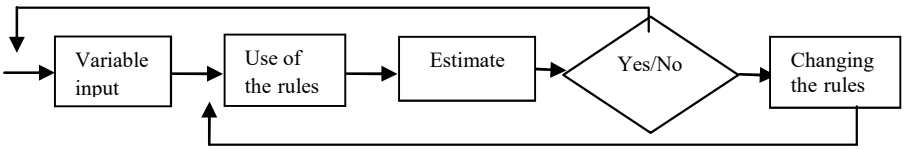


Resource: Elmas, Ç. (2003). *Yapay sinir sğları (Artificial neural networks; theory, architecture, education, application)*. Ankara: Seçkin Publications.

2.2. Learning with Artificial Neural Networks

The objective properties perceived by human brain and classification parameters of a network are identical. Figure 3 shows a simple learning process in a computer environment. Pursuant to this algorithm, the system will request the properties of an object from the user and will decide according to the result being Yes/No. If the user fails to approve such a decision made, then the decision-making mechanism will be changed. The final decision will be made after getting all the required information. Thus, the system will be able to improve itself continuously during the process of learning (Nabiyev, 2010: 542).

Figure 3. The Process of Learning



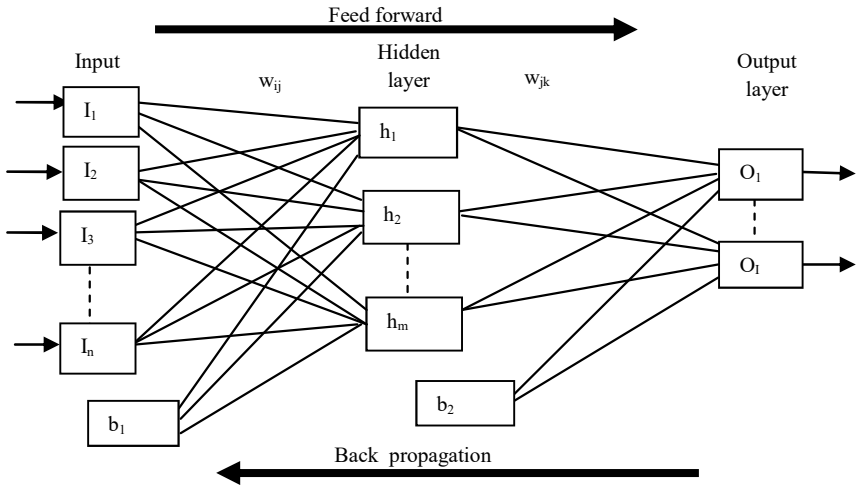
In the ANN, the available data are divided into training data and testing data. When dividing such data, generally 70% of the data are used for training and 30% are employed for testing, or 80% for training and 20% for testing (Günaydın, 2008:1408).

2.3. Number of Layers in Artificial Neural Networks and Backpropagation Networks

As shown in Figure 4, in an ANN, hidden layers will be used, especially to solve complicated problems, in addition to the input and output layers. The number of hidden layers in an artificial neural system should be determined as balanced and proper. The input layer transmits the inputs, while the output layer transmits the outputs to the external environment, and there is an interlayer between them (Bone & Roehm, 2002:287; Hamzaçebi, 2011:17-26). Each nerve in a layer is connected to all the nerves of the next layer and there is no connection between the nerves in the same layer. In this

study, a multilayer feedforward-backpropagation ANN has been used. A backpropagation network has at least one input and one output layer, and one hidden layer. (Öztemel, 2003: Benardos & Vosniakos, 2007: 366).

Figure 4. The ANN Model Feedforward-Backpropagation Network Structure



Note: I_n: Input neuron; h_m: Hidden neuron; O_l: Output neuron; w_{ij}: Weight

Resource: Günaydın, K. (2008). The estimation of monthly mean significant wave heights by using artificial neural network and regression methods, *Ocean Engineering,* 35, 1406–1415.

2.4. Characteristics of the Artificial Neural Networks

It may be stated that the ANN method has six basic characteristics (Li, 1994: 304-306). (1) It has a certain network structure: In traditional processors, one single central processor carries out every motion in turn. The ANN itself consists of many simple processors, each of them dealing with a part of a big problem (Zurada, Karwowski & Marras, 1997: 50). (2) It is able to take action in parallel: Neurons can interact simultaneously with more than one neuron and can affect the result. (3) It is able to learn. (4) It is able to show fault tolerance: YSA may be operated with new data and estimates may be produced. The performance of a network is measured with the aimed signal and error criteria. The output of the network is compared with the aimed output and, thus, an error margin is obtained. (Haykin, 1999: 154-160; Livingstone, Manallack, & Tetko, 1997: 135).

2.5. Advantages and Disadvantages of the Artificial Neural Networks

The ANN has significant advantages and disadvantages, when compared with the conventional statistical methods (Wasserman, 1993; Haykin, 1999:14-25; Haykin, 2011:42; Tu, 1996:1225-1236; Ennett, Frize & Walker, 2001:450; Benardos & Vosniakos, 2007:365-370; Co & Boosarawongse, 2007:618; Nabiyev, 2010:579). (1) The ANNs do not require any mathematical model. (2) Events in real life and various factors behind such events are automatically correlated. (3) They can produce easy solutions for nonlinear relations and their error tolerances are high. However, ANN has some disadvantages as well: (1) There is no specific rule for selecting the samples for

training the ANN. (2) Training may take time. (3) Sometimes, it may be difficult to explain the behaviors of the net. (4) There are no specific rules to determine a proper network structure.

2.6. Interpretation of Values in Artificial Neural Networks

The data obtained in relational or multilayered studies in which the ANN method is used allow the relative or comparative comparison of the various variables. In particular, in multivariable models, it is necessary to compare the value of a variable with those of other variables in the same context and demonstrate their significance levels. However, the values obtained with the ANN range between (0) and (1) or (0) and (−1) (Zorlu, 2012:3019).

3. Areas Where Artificial Neural Networks are Used

ANNs are used or adopted in many areas today owing to the new approaches developed concerning the method, although from time to time, till the 1980s, they have caused disappointment and been subjected to criticism due to the failure to meet the exaggerated expectations. Generally, ANNs are used in applications, including projecting, classifying, data-merging, data-conceptualizing, and picture or image processing. In addition, ANNs are also used in industries, such as transportation and aviation, finance, exchanges, credit cards, medicine, biomedicine and drug industry, communications industry, engineering services, and robotics (Kuo, Wu & Wang, 2002; Gevrey, Dirnopoulos & Lek, 2003; Kim, Street, Russell, & Menczer, 2005; Lisboa & Taktak, 2006; Köse, 2008; Kiranyaz, İnce, Yıldırım & Gabbouj, 2009; Elmas, 2007:161-165; Tolon & Tosunoğlu, 2008).

3.1. Artificial Neural Networks are Used in Management and Organization

It may be stated that the ANN method is quite new and has not been used in management and organization disciplines. Furthermore, it can be noted that the empirical studies mostly use statistical analysis methods. Table 1 shows the journals in which studies that use the ANN method within management and organization analysis as well as their aimed variables have been published. It can be observed that such studies are mostly concentrated on organizational behavior, performance management, human resources, and strategic management (Wong, Bondowich & Selvi, 1997; Vellido, Lisboa & Vaughan, 1999; Wong, Lai & Lam, 2000).

Table 1. Studies that Used ANN and Their Application on Fundemental Issues in the Field of Management and Organization

Publication journal	References	Application
Organizational behavior	Collins & Clark, 1993	*Personnel Psychology*
	Minbashian, Bright & Bird, 2009	*Organizational Research Met.*
	Tung, Huang, Chen, & Shih, 2005	*Expert Systems with App.*
	Wong, Wong & Chin,2011	"
	Lane & Scott,2007	*Human Decision Processes*
	Somers, 1999	J. of Applied Psychology;
	Somers, 2001	J. of Occup. and Org. Psychology
	Zorlu, 2010	*The Int. Higher Educ. Congress*
	Zorlu, 2011	*ICICKM-2011*

	Zorlu, 2012	*Afr.J.of.Business Manag.*
Strategic management	Goul, Shane &Tange, 1986 Schumann, Gongla, Lee & Sakamoto, 1989 Montagno, Sexton & Smith, 2002	*J. of Manag.Information Systems* *J.of Information Systems Manag.* *European J. of Op. Research*
Performance management	Bansal, Kauffman &Weitz, 1993 Jain & Nag, 1997	*J. Manag. Information Systems* "
Human resources research	Proctor, 1991	*Int. J. Manpower*
Organizational decision	Benders & Manders, 1993 Bode, 1998	*Information and Manag.* *Information & Management*
Nursing management	Ernst, 1994	*Nursing management*

4. Comparison of the Artificial Neural Network Method with Multiple Linear Regression

Regression analysis is a method used for determining the correlations between two or more variables by a mathematical function and making estimates about the dependent variables using such correlations. It allows one to make estimates on the unknown future events based on the known findings (Mata, 2011:904; Chokmani et al. 2008). Linear models give objective, normally distributed, minimum-variance estimates, while nonlinear regression models can do it only with very large dimension samples. In addition, deducing is more difficult, when compared with the linear models (Kutner et al., 2004: 270-275).

It may be stated that the property of the ANNs to learn and generalize the data acquired has a meaning similar to statistical inference. All the estimate problems in daily life are not formed in parallel with linear correlations. Nonlinear regression models can produce successful results in estimating such problems. The ANN method can be accepted as a serious alternative to the cases where it is difficult to determine the level of nonlinear regression model. Inputs to the ANN represent the independent variables, while the outputs represent the dependent variables. (Hamzaçebi, 2011:86-87). Effect level in the MLR method is determined by **(β)**, while it is determined in the ANN by (w).

It is seen that the studies based on the comparison of ANN and MLR in scientific literature concentrate generally on medicine, engineering and finance and that there are limited numbers of studies of organizational variables in management (e.g. Griffin 1998; Pao, 2008; Minbashian, Bright & Bird, 2009; Paloocysay & White, 2004; Somers & Casal 2008; Scarborough & Somers, 2006; Walczak, 2012). It is determined that ANN gives better results and can eliminate the restrictions of MLR models in most studies conducted by certain performance criteria (Table 3). The data of 6 studies conducted by Minbashian, Bright & Bird (2009) in organizational behavior using ANN are compared with MLR and it is determined that ANN gives more reliable results. However, the same study presents that there are some restrictions and question marks compared to traditional statistical methods using ANN. The most important one of such

restrictions is that comparisons of MLR with ANN conducted especially based on RMSE values could not eliminate the question marks concerning the interpretation of the values. Another restriction is that ANN may not be able to explain the correlations in the cases where the number of samples is relatively less.

Table 2 presents some researches based on various criteria of performance comparison. In the present study, the correlation coefficient (R) and RMSE have been preferred, which have been commonly used in similar previous studies.

Table 2. Results Obtained in the Literature Based on the Comparison of ANN vs. MLR Performances

	MLR	ANN	Same	Criter of Comparison
Liu, Kang & Li (2009)		X		*R= 0.882 / 0.953
Heuvelmans, Muys & Feyen (2006)	X			*R= 0.64 / 0.56*
Pao (2008)		X		*R= 0.56 / 0.83*
Khashei, Hamadani & Bijari (2012)	X			*R= 89.17 / 71.74*
Mata (2011)			X	*R=0.98 / 0.98*
Jiao & Li (2010)		X		*R= 0.86 / 0.97*
Chelgani, Hower & Hart (2011)		X		*R=0.89 / 0.94*
Asiltürk & Cunkaş (2011)	X			*R= 0.989 / 0.994*
Chelgani et al. (2008)		X		*R= 0.81 / 0.95*
Arupjyoti & Iragavarapu (1998)			X	*R= 0.9374 / 0.9328*
Uysal & Roubi (1999)			X	*R=0.98 / 0.97*
Paruole & Tomasel (1997)		X		*R= 0.36 / 0.64*
Kim (2008)			X	*RMSE=0.990 / 0.990
Subramanian, Yajnik & Murthy, 2004		X		*RMSE= 0.056 / 0.021*
Dvir, David, Sadeh & Shenhar (2006)		X		*MSE= 0.0579 / 0.0476*
Kuzmanovski & Aleksovska, (2003)		X		*RMSE= 0.0251 / 0.0417; R^2= 0.954 / 0.989*
Wang & Elhag (2007)		X		*RMSE= 4.78 / 11.00; R^2=0.98 / 0.93*
Sousa, Alvim-Ferraz & Pereira (2007)		X		*RMSE= 29.50 / 25.65; R^2= 0.70 / 0.78*
Chokmani et al.(2008)		X		*RMSE=0.20 / 0.15; R^2= 0.62 / 0.82*
Heiat (2002)		X		*MAPE= 40.37 / 31.96
Hsu, Li & Chao (2011)		X		*APE= 6.7 / 1.2; R^2= 0.968/0.998
Brey, Teichmann & Borlich (1996)		X		*AAD=%85 / %69

X: Higher performance; **R^2** : Correlation coefficient; **RMSE**: Root mean square error; **MSE**: Mean square error; **MAPE**: Mean absolute percentage error; **APE**: Average percentage error; **AAD**: Average absolute deviations..

5. Forming Organizational Variables and Hypotheses Used in the Study

In this study, the correlations between family conflict, affective commitment, and turnover intention and the hypotheses developed accordingly have been used to compare the performances of the ANN and MLR analysis methods.

5.1. Work–family Conflict

Work–family conflict and its effects have gradually become more important in recent years (Frone et al., 1997; Greenhaus & Powell, 2003; Netemeyer et al., 1996). Work–family conflict, which is a special form of the role conflict, is a concept intended for expressing mutual competition or possible conflicts between the roles assumed by the employees in business and family life. Studies on this issue show that conflicts may be experienced between the roles assumed by the employees in business and family life (Greenhaus & Beutell, 1985:76; Northcraft & Neale, 1990:239; Trachtenberg, Anderson & Sabatelli, 2009:472). This process generally occurs in the form of "work to family conflict" (W-TFC) or "family to work conflict" (F-TWC) (Posig & Kickul, 2004: 375; Eby et al., 2005: 180) There are studies showing that work–family conflicts have negative effects on organizational performance and organizational loyalty (Allen et al., 2000; Byron, 2005; Kossek & Ozeki, 1999; Judge & Colguitt, 2004; Karatepe & Uludağ, 2008). In the present study, both the reflections of work–family conflict (W-TFC and F-TWC) have been determined to be variables and kept within the scope of analysis.

5.2. Turnover Intention

Turnover intention is an interesting subject of study examined by different disciplines in recent years. Shaw et al. (1998) stated that there are more than 1500 researches on this issue (Nadiri & Tanova, 2010: 34). In terms of organizations, increase in turnover intention or high employee turnover rates load direct and indirect costs on organization managements (Lambert et al., 2010:10). The fact that turnovers or turnover intentions are considered in an organization intensively causes other organization members to be affected and results in loss of motivation at different levels (Costigan et al., 2011:74). Thus, capable and experienced employees tend to leave the work voluntarily.

5.3. Affective Organizational Commitment

Organizational commitment is used in the literature as a dependent or independent variable, as well as an intermediary variable (Culpepper, 2011; Scotter, 2000; Meyer, Srinivas, Lal & Topolnytsky, 2007; Vandenberg & Self, 1993). Affective organizational commitment means that the employees accept the objectives of the organization and act accordingly, and strongly maintain their will to stay in the organization (Zorlu, 2010:112) Affective commitment is the employees' statement of request for staying in the organization and a commitment dimension providing identification with the objectives and values of the organization in a process formed by organizational support, trust, and supervision (Allen & Meyer, 1996:253; Somers, 1995:49).

5.4. Forming Hypotheses

The fact that work–family conflict enhances turnover intentions is an acceptable topic of study in the literature (Andreassi & Thompson, 2005:332-334). Studies conducted on work–family conflict and turnover intention show in general that there are positive relations between these two variables (eg: Shaffer et al 2001; Haar, 2004, Blomme, Rheede & Tromp, 2010, Anderson, Coffey, & Byerly, 2002; Greenhaus, Parasuraman & Collins, 2001; Pasewark & Viator, 2006; Karatepe & Uludag, 2008). Cohen (1997) argued that work–family conflict causes loss of motivation in workplace and unhappiness in family life, and thus, it strengthens the turnover intention of the employee (Haar & Roche, 2011: 5). There are various researches suggesting that work–family conflict (both W-TFC and F-TWC) has negative relations with the employees' affective commitment levels (Casper et al, 2011; Allen et al., 2000; Good, Sisler, & Gentry, 1988; Lyness & Thompson, 1997; Netemeyer, Boles, & McMurrian, 1996; Streich, Casper, & Salvaggio, 2008; Navasimayam & Zhao, 2007).

There are studies suggesting that affective commitment decreases turnover intention and absenteeism (Allen & Meyer, 1996; Wasti, 2002; Vandenberghe & Tremblay, 2008; Maertz et al., 2007; Meyer et al., 2002; Eby et al., 1999; Somers, 1995), which positively affects the employees' concern towards the work thus increasing the performance and satisfaction levels (Allen & Meyer, 1996; Namasivayam & Zhao, 2007; Meyer et al., 2002; Vandenberghe et al., 2004). This may be shown as a sign of potential mediator role of the affective commitment variable. For this reason, the following hypotheses have been developed as the basis for comparing the performances between the methods:

H1: Employees turnover intentions increase as long as W-TFC increases.

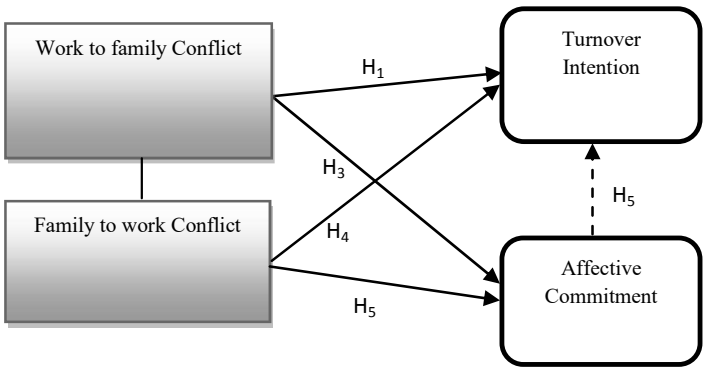
H2: Employees turnover intentions increase as long as F-TWC increases.

H3: Affective commitment decreases as long as W-TFC increases.

H4: Affective commitment decreases as long as F-TWC increases.

H5: AFC decreases the effect of W-TFC and F-TWC on turnover intention.

Figure 5. Research Model Due to the Variables



6. Methodology

6.1. Purpose, Scope, and Importance

The main purpose for this study is to compare the ANN analysis method that has been started to be used in different disciplines in recent years along with the MLR method that has been frequently employed to determine the correlations between organizational variables, as well as to present proposals and determinations for its applicability in the fields of management and organization. Within the scope of the study multiple and intermediary correlations between work–family conflict (W-TFC/F-TWC), affective commitment (AFC), and turnover intention are emphasized. This study aims to integrate new and different research methods to oblain more consistent and more reliable results in determining correlation between management and organization. It is considerably important to present such results in comparison with traditional analysis methods mostly used in the subject-matter field (Correlation) in terms of the permanence of the results and of contributing to the researchers. Thus study suggests some determinations and proposals to be able to present the usability, advantages and disadvantages of the ANN method, which is mostly used in different fields and whose certain superiorities are determined, for the researchers in management and organization. This study has the potential to contribute to similar future studies in the fields of management and organization, because the use of ANN will gradually become more common and more important in different disciplines.

6.2. Sample

The sample of the study consisted of 206 employees, with 111 from the public sector and 95 from the private sector, selected by random sampling. Public employees were selected from Kırıkkale Provincial Health Directorate and private employees were recruited from enterprises within Kırşehir City with more than 10 employees.

6.3. Scale and Data Collection Tool

Survey method was used in this study as a data collection tool. The survey form included statements intended for measuring demographic variables, work–family conflict, affective commitment, and turnover intention Five statements used for W-TFC and F-TWC, respectively, were adapted from the study by Karatepe & Uludağ (2008), five statements for turnover intention were adapted from the study by Brashear, Manolois & Brooks (2005), and four statements for affective commitment were adapted from three-dimensional organizational commitment developed by Meyer and Allen (1991), and proved by Zorlu (2010a). A 5-point Likert scale (1. “I do not share at all”; 2. “I share a little”; 3. “I do not have opinion”; 4. “I share lot”; and 5. “I share completely”) was used in the survey forms. The statements in the surveys were translated from English to Turkish by professionals before putting into practice.

6.4. Method

The methodology used in this study was hypothesized on multiple correlations between the variables intended for comparing the ANN and MLR analysis methods. The survey forms were tested for validity and reliability, and information was given on demographic properties. The study emphasized on multiple relations between work–family conflict, work–family culture, turnover intention, and affective commitment

variables. This study includes 3 models. The first model measures the effect of W-TFC and F-TWC on turnover intention. The second model measures the effect of W-TFC and F-TWC on AFC. The third model measures the effect of W-TFC and F-TWC plus AFC on turnover intention. Model 1 and Model 2 have 2 input layers, 5 interlayers and 1 output layer while Model 3 has 3 input layers, 5 inter layers and 1 output layer.

As a basis for comparison within the scope of MLR, MLR Model, and Enter Method were used. Feedforward-backpropagation method was used for the ANN analysis, which has been frequently used in recent years. During the process of comparing the analysis, first, the averages, standard inclinations, and correlation values to determine the degree of relation were determined. For comparing the performances of the ANN and MLR methods, the R and RMSE values obtained from both the analyses were provided.

In the studies where ANN is compared with MLR, it is generally seen that only the above-mentioned performance criteria are compared instead of the influence degree of independent variables on dependent variables (Somers, 1999; Minbashian, Bright & Bird, 2009). In fact, what is important is to test the hypotheses to be set up for the researchers in the field of management and to determine the influence levels of the variables in different numbers. This study compares the influence levels of the variables as well as the R and RMSE criteria and examines whether the ANN method gives realistic results in organizational correlations.

When conducting analyses by Artificial Neural Networks, data in the data set are randomly divided into three parts: training, validity and test set. First, the training set has formed 80 % of the data set, the validity set has formed 10% of the data set and the test set has formed 10 % of the data set, as there is not a fixed rule in the training of the net in the ANN method. This time, 70 % of the data set has been used for training to determine the number of latent layers and to reach a higher reliance level and the findings are obtained by this distribution.

6.5. Validation and Reliability Tests

The survey forms used in the study were tested for validation and reliability. In the confirmatory factor analysis, the statements whose factor loads were < 0.40 and which represented only a single factor were removed from the analysis. Furthermore, the factor-based Cronbach's Alpha (α) coefficients of the statements in the survey forms were found to be "reliable." Factor analysis results and α values for the surveys are given in Table 3.

Table 3. Factor Loadings Concerning the Second Variable Group and Cronbach's Alpha (α) Coefficients

Work–Family Conflict (α=0.940) Loadings
The demands of my work interfere with my home and family life. 0.808
The amount of time my job takes up makes it difficult to fulfill my family responsibilities. 0.864
Things I want to do at home do not get done because of the demands my job puts on me. 0.895
My job produces strain that makes it difficult to fulfill my family duties. 0.880
Due to work-related duties, I have to make changes to my plans for family activities. 0.774
Family–Work Conflict (α=0.913)
The demands of my family or spouse interfere with work-related activities. 0.698
I have to put off doing things at work because of demands on my time at home. 0.852
Things I want to do at work do not get done because of the demands of my family or spouse. 0.892
My home life interferes with my responsibilities at work such as getting to work on time, accomplishing daily tasks, and working overtime. 0.862
Family-related strain interferes with my ability to perform job-related duties. 0.835
Affective Commitment (α=0.902)
I feel myself as a member of the family in this workplace. 0.816
I am proud of telling others that I work in this workplace. 0.885
I feel the problems of my workplace as my own. 0.904
I feel a strong attachment for the workplace. 0.934 I feel emotionally attached to my workplace. 0.917
Turnover Intention (α=0.919)
I often think about quitting my present job. 0.928
I intend to quit my present job. 0.919
I am constantly searching for a better job. 0.906
I often think about an alternative line of work. 0.842

6.6. Demographic Properties

Information on gender, age, education, marital status, position, service period, and sector of employment was requested.

Table 4. Demographic Properties Regarding both the Samples

Factor	Frequency		Factor	Frequency	%
Gender			**Public-Private**		
Man	165	80	Public	111	53.9
Woman	41	20	Private	95	46.1

Age			**Service period**		
Up to 25	19	9.2	<5 years	43	20.1
26–35	62	30.1	6–10 years	40	19.6
36–45	70	34.1	11–20 years	65	31.9
46–5	50	24.3	20+ years	58	28.4
56–65	5	2			
Position			**Education**		
Administrative pers.	55	26.7	Primary school	11	5.4
Assisted services	47	22.8	Middle school	26	12.7
Technical personnel	95	46.1	High school	77	37.7
Top-level managers	3	1.5	Associate degree	43	21.1
Medium-level managers	6	2.9	Bachelor degree	42	19.6
Marital status		75.5	Postgraduate degree	7	3.4
Married	155	20.1			
Single	42	4.4			
Widow	9				
Total	**206**	**100**	**Total**	**206**	**100**

As can be seen in Table 4, a great majority of the participants in the sample group consisted of men in the age groups of 36–45 and 26–35 years. With regard to the participants' service periods, it can be noted that participants with a service period of < 5 years are more in number. Most of the participants are married. With regard to their positions, technical persons are more in number. Furthermore, with respect to the education level of the participants, high-school graduates form the majority.

7. Findings

7.1. Semantic, Standard Deviation, and Correction Values

Semantic values, standard deviation, and correction coefficients for the variable group are shown in Table 5. It can be noted that the level of organizational commitment among the employees is above the average with a value of 3.4155 and W-TFC is higher than F-TWC. In terms of correlation, it can be seen that the turnover intention has a strong and positive correlation with both the types of work–family conflict. Furthermore, the table shows that affective commitment has a negative correlation with both the types of work–family conflict.

Table 5. Semantic, Standard Deviations, and Correlations

	M	**SD**	**1**	**2**	**3**	**4**
1. Turnover ıntention	2.1047	1.16618	1			
2. Affective commitment	3.4155	1.22086	−0.457**	1		
3. Work to family conflict	2.1141	1.18310	0.673**	−0.462**	1	
4. Family to work conflict	1.8760	1.22679	0.610**	−0.410**	0.701**	1

Note= **p < 0.01

7.2. Comparison of the ANN with MLR for the Variable Group

Within the frame of the study method and hypotheses for the variable group, the effect coefficients, including intervariable simple and multiple were included, comparatively pursuant to the MLR and ANN methods. Model 1 shows only the effect of W-TFC and F-TWC on turnover intention, while Model 2 shows only the effect of W-TFC and F-TWC on AFC. In Model 3, AFC is included in the model in addition to W-TFC and F-TWC variables and its influence on turnover intention is examined. As seen in Table 6, W-TFC and F-TWC have a positive effect on turnover intention, while they have a negative effect on AFC. When AFC is included in the model, the increasing effect of W-TFC and F-TWC on turnover intention decreases. Based on the similar results from both the analysis methods, the hypotheses H4 cannot be accepted, while the other hypotheses can be accepted

Table 6. Intervariable Comparative Effect Coefficients

Effect Coefficient	**Turnover Intention**	
	MLR (β)	**ANN (W)**
Model 1		
W-TFC	0.43	0.46
F-TWC	0.39	0.53
Level of significance and Explanation	*F = 93.585 (sig=0.000)*	
Model 2	Affective Commitment	
	MLR (β)	**ANN (W)**
W-TFC	−0.40	−0.85
F-TWC	−0.11 (sig.=0.321)	−0.15
Level of significance and Explanation	*F = 26.875 (sig=0.000)*	
Model 3	Turnover Intention	
	MLR (β)	**ANN (W)**
W-TFC	0,39	0,44674
F-TWC	0,31	0,28602
AFC	-0,21	-0,26924
Level of significance and Explanation	*F = 66.003 (sig=0.000)*	

p < .05

7.3. Comparison between the Performances of the ANN and MLR Analysis Method

The comparative results of the performances of the ANN and MLR analysis methods are given in Table 7. For the comparison, training and test results for R and RMSE values were used as the basic criteria. Accordingly, in the comparison of MLR and ANN performances in terms of correlations in both the variable groups, it can be seen that the ANN method has a higher explanation rate concerning R values, both at the stages of training and test. With regard to the RMSE values, it can be noted that the lowest values are achieved in the ANN method.

Table 7. Comparison of ANN and MLR Performances

	Model 1			**Model 2**			**Model 3**		
	LR	*ANN*		*LR*	*ANN*		*LR*	*ANN*	
R*	0.51	*0.67*		*0.23*	*0.59*		*0.53*	*0.91*	
R **	0.50	*0.79*		*0.21*	*0.55*		*0.54*	*0.82*	
RMSE	0.72	*Training*	*Test*	*0.84*	*Training*	*Test*	*0.65*	*Training*	*Test*
		0.21	*0.19*		*0.25*	*0.20*		*0.16*	*0.15*

***Training R / R^2 **Test R /Adjusted R^2**

8. Practical Implications and Conclusion

Within the scope of this study, the R values, mostly used in different disciplines, obtained from training and test stages, and RMSE (root mean square error) values have been taken into consideration. Furthermore, with respect to the correlations examined based on the hypotheses presented in this study, the ANN method has been observed to have higher R values and lower RMSE values, when compared with the MLR method. It should be stated that the R values determined in the ANN method give relatively lower values against medical, engineering, and finance fields, which are completely solvable by digital data. However, it could be noted that the ANN method can explain the data obtained from the surveys containing personal attitudes and evaluations, with a high rate. With regard to the various studies in the literature, it could be observed that the R and RMSE values of the MLR method, used with the data on organizational data obtained from surveys, occur at specific intervals. Such values, in the studies where the MLR method has been used, may be accepted as "reasonable" if the R value is >0.50 and the RMSE is <0.20. (Rousseau & Aube, 2010; Chiocchio & Frigon, 2006; McComb, Green & Compton, 2007; Voirin, Akremi & Vandenberghe, 2010; Namasivayam & Zhao, 2007; Casper et al., 2010; Bragger et al., 2005; Lee, Magnini & Kim, 2011; Zorlu 2010a; Huang et al., 2004; Fang & Chiu, 2010).

The comparison between the performances of MLR and ANN methods should be interpreted relatively, considering the studies in different disciplines, because the ANN method is expected to provide a higher R (closest to 1) in the fields where digital data and solutions are dense (medicine, engineering, finance, etc.), and a lower RMSE

value (closest to 0). In this study, the data and solutions include the correlations between the variables in management and organization. When using ANN method, in case of increasing the number of variables (number of inputs) it is seen hat a higher level of explanation is reached as in the MLR method.

For this reason, it may be stated that a method that presents similar effect coefficients, higher explanations, and lower faults, and which may also be used in hypothesis tests, is very important in terms of management and organization discipline.

However, with the results from this study it is not possible to present the absolute advantage of the ANN method over the MLR method. Taking only the R and RMSE criteria as a basis may prevent different advantages of both analysis methods from being noticed; because, it is seen that the value of R occurs higher and the value of RMSE occurs lower in the analysis conducted using ANN method in different disciplines and especially in medicine and engineering. Also, it is obvious that there some question marks in the cases where the effect of one single independent variable of the ANN method on the dependant variable is examined.

One of the criticisms which may be brought against the ANN method is that its characteristic of being a "closed box" causes a failure to understand the operation of the system fully. The fact that there are no certain rules of determining modeling, iteration, number of latent layers, training and testing set in the analyses conducted by ANN and loss of time which may occur may be accepted to be disadvantages for researchers.

Though the ANN method, which may be used in categorical data and which may present quantitative results, may submit a higher explanation and a lower error value in correlations compared to MRL, it may present contradictions in determining the effect of independent variables on a dependant variable, mostly in terms of the researchers who carry out analyses using traditional methods, because evaluating the values in ANN is considerably different compared to MLR and it includes relative evaluations of correlations. The variables which explain or affect a dependent variable determined to be an output within ANN is included in the process as part of a whole and then such obtained effect coefficients may be interpreted. The findings and results of the present study are very important because they show that the ANN method may be used as an effective alternative to the MLR method to determine the inter-variable correlations in organizational studies.

9. Limitations

The most important restriction on the study is that ANN is not a method commonly used in management and organization and that the studies based on the comparison between ANN and MLR are not sufficient in number. For his reason, this study tries to give conceptional and theoretical information on ANN considering the general knowledge of the researchers. Though this creates a restriction on time, forms also a basis for presenting the study within a broader frame. Another restriction is that the findings and results obtained from the study cannot be generalized when considering the sample and variable quantity of the study. In terms of the applicability of the ANN method in management and organization, it is very important to support the findings,

determinations, and results of this study with similar studies, and prove them through more comprehensive empirical studies

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