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Predicting Properties of Single Jersey Fabrics Using Regression and Artificial Neural Network Models

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Abstract: In our previous works, we had predicted cotton ring yarn properties from the fiber properties successfully by regression and ANN models. In this study both regression and artificial neural network has been applied for the prediction of the bursting strength and air permeability of single jersey knitted fabrics. Fiber properties measured by HVI instrument and yarn properties were selected as independent variables together with wales' and courses' number per square centimeter. Firstly conventional ring yarns were produced from six different types of cotton in four different yarn counts (Ne 20, Ne 25, Ne 30, and Ne 35) and three different twist multipliers (α_e 3.8, α_e 4.2, and α_e 4.6). All the yarns were knitted by laboratory circular knitting machine. Regression and ANN models were developed to predict the fabric properties. It was found that all models can be used to predict the single jersey fabric properties successfully. However, ANN models exhibit higher predictive power than the regression models.

Keywords: Artificial neural network, Knitted fabric, Regression analysis, Ring yarn, Cotton, Textile

Introduction

A comprehensive model allowing the prediction of fabric properties from fiber and yarn properties and production parameters is very important for the textile experts. However the linear and nonlinear relationship between independent variables and the property to be predicted is of high importance. The application of intelligent systems such as artificial neural networks, fuzzy logics etc. show great potential because these systems can adapt to the nonlinear relations easily. Therefore a lot of papers have been published in the last decade in the field of prediction of fabric properties by intelligent systems especially by ANN techniques. On the other hand, as pointed out by the Chattopadhyay and Guha [1], researchers have usually focused on the prediction of subjective fabric properties like hand [2-7] and drape [8] or identification of the fabric defects [9-13]. There are a few number of works based on the evaluation of knitted fabric physical properties from fiber and yarn properties. Ertuğrul and Uçar [14] realized a study about prediction of bursting strength of cotton plain knitted fabrics from the fabric weight and yarn tensile properties before manufacturing by using neural network and adaptive network based fuzzy inference system (ANFIS). But performance of ANN and ANFIS couldn't be compared because of the limited number of independent variables and data. Uçar and Ertuğrul [15] also studied the prediction of fuzz fibers on fabric surface by using neural network and regression analysis. Yarn hairiness, yarn count and the fabric tightness factor were selected as input elements. They found a good correlation between yarn hairiness and fuzz fibers. On the other hand very low correlation coefficients were obtained by the regression models and ANN. Ju and Ryu [16] examined the effects of the structural properties of plain knit fabrics on the subjective perception of textures, sensibilities, and preference among consumers. Besides they aimed to predict the subjective characteristics of plain knitted fabrics from their structural properties by using statistical analysis tools, such as factor and regression analysis and ANFIS. They pointed out the necessity of the new methods for the prediction of non-linear relations. Park *et al*. [4] investigated the objective evaluation of total hand value in knitted fabrics by using the theory of neural networks and the comparison of two methods. The result of the study showed that neural network adapted simulation method was compatible with subjective test results. Fayala *et al.* [17] used neural network method for predicting thermal conductivity of jersey knitted fabrics. The nonlinear relationship between fabric parameters and thermal conductivity was analyzed by using fabric properties such as porosity, air permeability and weight and fiber conductivity as input elements in neural network approach. Murrells *et al.* [18] predicted the degree of spirality of single jersey fabrics made from 100 % cotton conventional and modified ring spun yarns by applying artificial neural network. The factors investigated were the twist liveliness, yarn type, yarn linear density, fabric tightness factor, the number of feeders, rotational direction and gauge of the knitting machine and dyeing method. It was found that yarn liveliness, tightness factor and yarn count are the most important parameters for the fabric spirality. Semnani and Vadood [19] applied artificial neural network (ANN) to predict the apparent quality of knitted fabrics. The study conducted by Beltran *et al.* [20] used artificial neural networks to model the multi-linear relationships between

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fiber, yarn and fabric properties and their effect on the pilling propensity of pure wool knitted fabrics. It was suggested that the prediction of pilling propensity by ANN is possible.

In our previous works, we had predicted cotton ring yarn properties from the fiber properties successfully by regression and ANN models [21-24]. In this study artificial neural network has been applied to the prediction of the bursting strength and air permeability of single jersey knitted fabrics from the selected fiber and yarn parameters. Multiple linear regression models were also developed to compare with the ANN models.

Material and Method

The bursting strength and air permeability of the fabrics were related with the fiber properties, yarn properties and fabric parameters. According to literature, the quantity and quality of the data is very important to predict the fabric parameters. Therefore, in order to produce a wide range of fabrics having different values of bursting strength and air permeability, the single jersey fabrics were manufactured from ring yarns which were produced from six different cotton types. All cotton samples were supplied in sliver and roving forms from different spinning mills and the fiber properties were measured from the finisher draw frame slivers for all materials on Uster HVI instrument to eliminate the effect of the yarn preparation stages on the fiber properties. Table 1 shows the mean HVI test results of six types of cotton fibers.

As it is generally known, the yarn count (yarn linear density) and the yarn twist have an important effect on the bursting strength as well as on the air permeability of knitted fabrics. Thus, the yarns used to produce the knitted fabrics were manufactured in four yarn counts as Ne 20, Ne 25, Ne 30 and Ne 35 with three different twist coefficients of α_e 3.8, α_e 4.2, and α_e 4.6 on ring spinning machine (Rieter G30 model). As a result 72 different ring cotton yarns were produced (6×4×3=72). The tensile properties of the yarns were evaluated on an Uster Tensorapid tensile testing machine. Unevenness and hairiness tests were performed on an Uster Tester 3.

All the fabrics were knitted by single cylinder laboratory circular knitting machine (Mesdan-LabKnitter).

The images of the fabrics were taken by Leica microscope and then the number of the wales and courses per square centimeter were counted for each fabric type. The bursting strength and air permeability properties of the samples were measured with James H. Heal TruBurst Tester and Textest AG FX 3300 air permeability tester according to the ISO 13938-2 and ISO 9237, respectively.

For the estimation of the aforementioned fabric properties, linear regression and artificial neural network analyses (ANN) were applied and the performances of the models were compared. Because of the very high correlations between the fiber and yarn properties, two different regression models including fiber properties and yarn properties were developed separately.

In ANN analysis, a multilayer feed forward network with one hidden layer trained by back propagation algorithm was used to predict the bursting strength and air permeability properties of the single jersey knitted fabrics except for the bursting strength predicted with using fiber properties. ANN model for the prediction of bursting strength of the fabrics with using fiber properties consisted of two hidden layers. In all models developed in the study, linear transfer function was used in the input and output layers, whilst hyperbolic transfer function was used in the hidden layers for the fabric property estimations. For all estimations, the training of the network was performed in two phases. In the first stage, back propagation algorithm was applied for 100 epochs. Learning rate and momentum coefficient used in the back propagation algorithm were set to 0.01 and 0.3 respectively. In the second stage of the training, conjugate gradient descent algorithm was applied for 20 epochs. Of the 72 single jersey fabric samples, 51 (70 %) samples were chosen as the training set at random, while the rest (30 %) was chosen for the testing set.

SPSS 18.0 and STATISTICA 6 statistics programs were used in regression analysis and ANN models, respectively.

Results and Discussion

Predicting Bursting Strength of Single Jersey Fabrics

Except fiber properties measured by HVI, yarn count, yarn twist and number of wales x courses were selected as independent variables for the first regression analysis. The

Table 1. Mean values of the cotton fiber properties

Sample Nr	Fineness	Strength (gr/tex)	Elongation (%)	UHML (mm)	ML (mm)	Uniformity (%)	SFI (%)
1	4.5	33.1	5.7	27.45	22.62	82.4	8.1
2	4.2	47.8	7.7	35.10	31.87	90.8	3.5
3	4.9	31.7	5.6	27.60	23.02	83.4	6.8
4	4.8	32.0	6.2	29.35	25.21	85.9	3.5
5	4.9	34.3	6.6	29.50	25.43	86.2	3.5
6	4.1	34.2	5.8	27.70	23.13	83.5	6.7

UHML: upper half mean length, ML: mean length, and SFI: short fiber index.

linear multiple regression equation based on fiber properties is as follows:

$$y = 523.621 + 7.85\times x_1 - 200.53\times x_2 + 49.93\times x_3 - 15.12\times x_4 + 0.824\times x_5 \quad (1)$$

where x_1=fiber strength, x_2=fiber elongation, x_3=fiber mean length, x_4=yarn count, x_5=wales×courses.

In regression analysis, relative importance of different variables can be interpreted according to the standardized beta coefficients. Standardized beta coefficients of the equation (1) are listed in Table 2. As the results are examined in detail, it can be seen that the most important parameter that has an effect on fabric bursting strength is fiber mean length which is followed by fiber elongation. There is a positive linear relation between fiber length and fabric bursting strength. Using longer fibers certainly increases the yarn strength and therefore bursting strength of the fabrics. Yarn count is another parameter that has an effect on the fabric bursting strength. There is a negative linear relation between the yarn count and fabric bursting strength which means that as the yarn gets thinner there will be a decrease in the bursting strength values. As it is expected, positive linear relation between the fiber strength and fabric bursting strength was found. On the other hand negative relation was found between bursting strength and fiber elongation. Autocorrelation between fiber strength and elongation is the main reason of this problem (correlation coefficient is 0.91). In addition, the significance values are based on fitting a single model. Therefore significance values can be invalid when a stepwise method is chosen. Number of wales and courses has also positive effect on the bursting strength. According to the regression analysis, the values of predicted and adjusted regression coefficients are 0.9187 and 0.903 respectively.

Second regression model was developed with using the yarn properties. Yarn tenacity, unevenness and hairiness properties were selected as independent variables. The second regression model based on yarn properties is as follows:

$$y = 587.86 - 9.578\times x_1 + 14.977\times x_2 - 9.047\times x_3 + 0.415\times x_4 \quad (2)$$

where x_1=yarn count (Ne), x_2=yarn tenacity, x_3=yarn unevenness, x_4=wales×courses.

Table 2. Standardized beta coefficients for the prediction of the bursting strength with fiber properties

	β	Fiber length	Fiber elongation	Yarn count	Fiber strength	Wales× courses
β_s	-	1.511	-1.385	-.882	.425	0.295
T	13.850	6.545	-7.058	-13.714	4.356	4.477
P	0.000	0.000	0.000	0.000	0.000	0.000
Rank		1	2	3	4	5

β_s: Standardized beta coefficients.

According to the equation (2), as the yarn count increases the bursting strength of the fabrics decreases. Increasing of the yarn tenacity causes stronger fabrics. On the other hand, as the unevenness in the yarn increases, the bursting strength of the fabrics decreases. This is because of the yarn properties get worse when the unevenness increases. The number of wales and courses is also included in the model. When the standardized beta coefficients are examined in detail, the most important parameters affecting the estimation of bursting strength property of single jersey fabrics is yarn count which is followed by yarn tenacity (Table 3).

With the second equation, one can estimate the bursting strength of the fabrics via using only four inputs three of

Table 3. Standardized beta coefficients for the prediction of the bursting strength with yarn properties

	β	Yarn count	Yarn tenacity	Yarn unevenness	Wales× courses
β_s	-	-0.559	0.547	-0.189	0.149
T	10.132	-7.293	9.823	-2.952	2.198
P	0.000	0.000	0.000	0.004	0.031
Rank		1	2	3	4

β_s: Standardized beta coefficients.

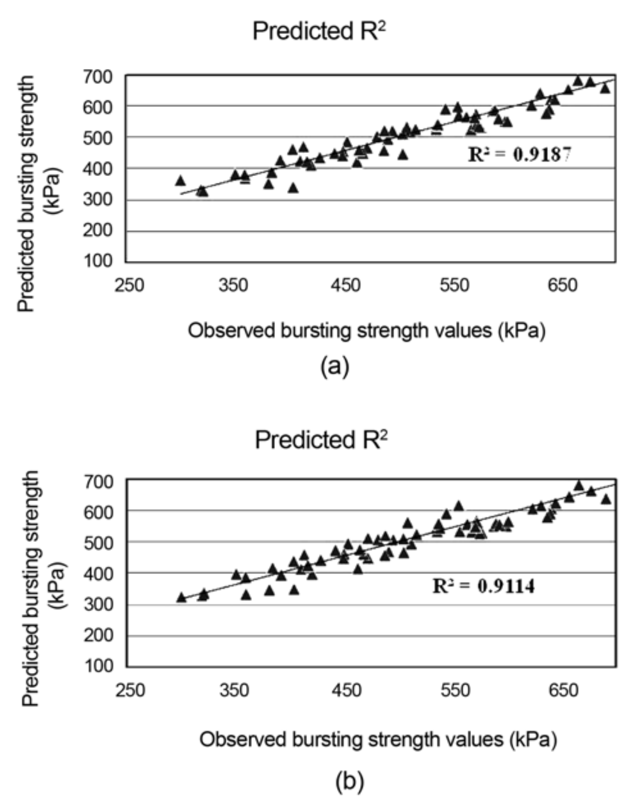

Figure 1. Experimental and predicted ((a) based on fiber properties, (b) based on yarn properties) values of fabric air permeability.

which are yarn properties as well as with the prediction of R^2_{adj}=0.91 and RMSE of 30.26. The scatter plot of experimental values versus predicted values and regression lines of our two models are shown in Figure 1. With the second regression model, the value of the RMSE is almost halved.

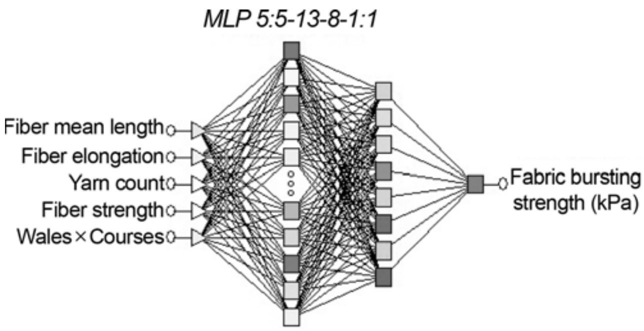

Figure 2. Neural network based on fiber properties for the estimation of fabric bursting strength (kPa).

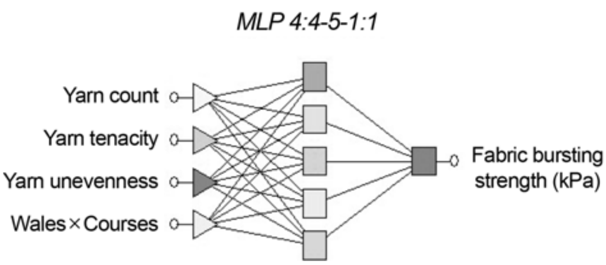

Figure 3. Neural network based on yarn properties for the estimation of fabric bursting strength (kPa).

Two neural network models were developed for the prediction of the bursting strength of the fabrics. The first neural network based on fiber properties is presented in Figure 2 which is a multi layer perceptron having four layers of one input, two hidden and one output (MLP 5:5-13-8-1:1). There are five neurons in the input layers, and one neuron in the output layer. Thirteen and eight neurons exist in the hidden layers respectively. The parameters which were selected for the estimation of the fabric bursting strength are mean fiber length (mm), yarn count (Ne), fiber strength (gr/tex), wales×courses (1/cm^2), fiber elongation (%) as it is found important with regression analysis.

Second neural network based on yarn properties is shown in Figure 3. Yarn count, yarn tenacity, yarn unevenness and number of wales and courses were selected as independent variables. The second neural network based on yarn properties is presented in Figure 3 which is a multi layer perceptron having three layers of one input, one hidden and one output (MLP 4:4-5-1:1). There are four neurons in the input layers, and one neuron in the output layer. Five neurons exist in the hidden layer.

In Figure 4, the regression coefficients of the two neural networks according to the training and testing phases are given.

In order to observe the significance levels of each variable in neural networks for bursting strength of the single jersey fabrics, sensitivity analysis of the neural networks was performed. Sensitivity analysis gives an idea about the significance levels of each variable in the network. In this analysis, the sensitivity is a ratio which is calculated as the ratio of the error in the absence of values to total network

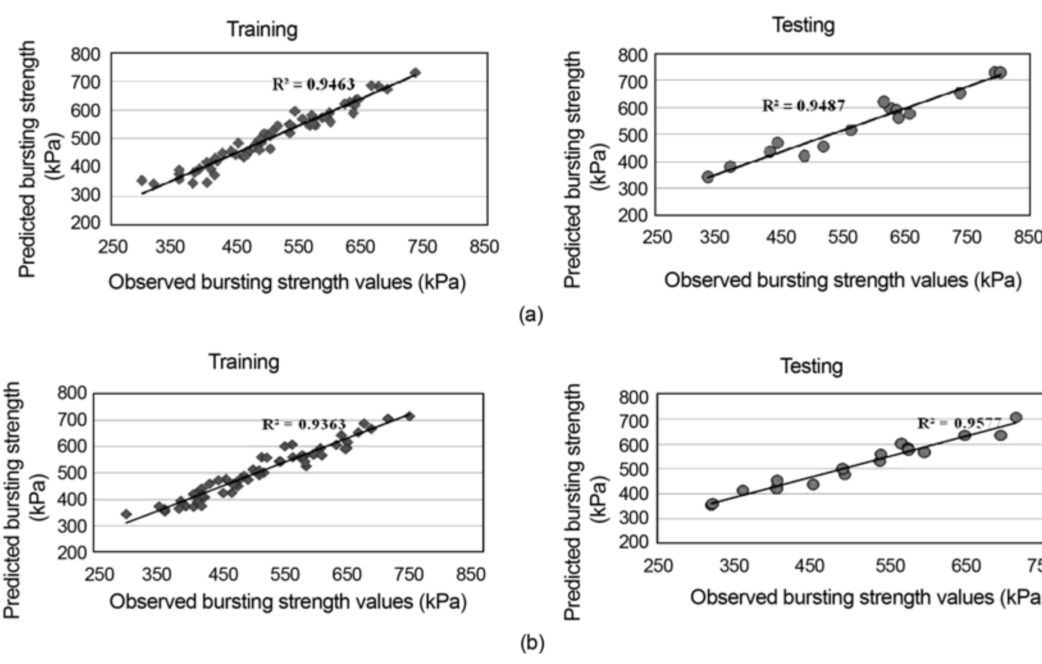

Figure 4. Regression coefficient of neural networks ((a) based on fiber properties, (b) based on yarn properties) for bursting strength of training and testing.

Table 4. Sensitivity analysis of the neural networks for the bursting strength with fiber properties

	ANN based on fiber properties					ANN based on yarn properties			
	Fiber length	Fiber elongation	Yarn count	Fiber strength	Wales× courses	Yarn count	Yarn tenacity	Yarn unevenness	Wales× courses
Ratio	6.01	5.58	3.71	2.19	1.28	2.538	2.527	1.309	1.112
Rank	1	2	3	4	5	1	2	3	4

error for each variable. This ratio denotes the significance level of that particular variable to the network. If the ratio is high, the deterioration will be high which means that the network is more sensitive to that particular variable. Once sensitivities have been calculated for all variables, they are ranked in order. The sensitivity analyses of the neural networks for bursting strength of the fabrics are given in Table 4.

The most important parameter of first model which affects the bursting strength is fiber length which is followed by fiber elongation and yarn count. Although the ratios give an idea about the importance of that particular variable, the ratios of the fiber mean length and fiber elongation are very close to each other. On the other hand, these two values are by far greater than the rest of the variables. The third variable that has an important effect on the bursting strength of the fabrics is yarn count. Increasing of this value decreases the values of the bursting strength. As there is a linear positive correlation among fiber strength, wales× courses and fabric strength, these variables are another important parameter that takes place in neural network model. On the other hand the most important parameters of the second model are yarn count and yarn tenacity. All these results show parallelism with the results of the regression analysis.

In Table 5, the descriptive statistics of the neural network and regression models for the estimation of the fabric bursting strength are presented. The regression estimation coefficients of the regression models are very high to predict the bursting strength of the single jersey fabrics but the coefficients obtained from the neural networks are higher than that of the regression models. Although the difference in the estimation coefficients of regression analysis of the bursting strength property is not too distinct, it will be more convenient to evaluate the performance of the statistical methods point at issue with regard to the root mean square error criteria. When the root mean square errors of testing phase and regression are compared, it can be seen that the error ratios of testing are about 5 % whereas in regression models these ratios are between 6-12.5 %. The regression equations obtained to estimate the bursting strength of single jersey fabrics are explanatory equations. However the neural network structures designed for the prediction of bursting strength property are better estimators.

Predicting Air Permeability of Single Jersey Fabrics

The regression equation which is developed for the prediction of air permeability properties of single jersey fabrics with fiber properties as independent variables is given below;

$$y = -873 + 45.2\times x_1 + 56\times x_2 + 59.2\times x_3 - 3.12\times x_4 \quad (3)$$

where x_1=fiber length, x_2=yarn twist per inch, x_3=yarn count, x_4=wales×courses.

In order to determine the relative importance of different variables in regression analysis, standardized beta coefficients are given in Table 6. When the results are observed in Table 6, the most important parameter that has an effect on fabric air permeability is yarn count which is followed by yarn twist. As the yarn count increases which means that yarn gets thinner, the air permeability of the fabrics increase due to the increase of fabric porosity. In addition to yarn count, the increase in yarn twist also causes an increment in the air permeability values of the fabrics. Increasing the yarn twist

Table 5. Descriptive statistics of all models for the prediction of the bursting strength

	Models established on fibre properties				Models established on yarn properties			
	ANN			Regression	ANN			Regression
	Training	Testing	Total		Training	Testing	Total	
Data mean	508.3332	522.4660	510.759	510.759	512.2944	508.2206	511.3190	510.759
Data S.D.	100.6515	116.2062	103.6718	103.6718	99.9965	116.8371	104.2912	103.6718
Error mean	0.2079	15.8955	3.5222	6.541458	-0.0956	10.6687	2.4818	-0.00021
Root mean S.E.	23.3345	26.4610	24.8677	62.7349	25.0366	28.4719	26.3049	30.26176
Abs E. mean	18.5946	25.8560	20.1287	28.3879	19.8888	24.4816	20.9885	25.84463
Correlation	0.9728	0.9740	0.9712	0.9581	0.9682	0.9786	0.9683	0.9546
Regression	0.9463	0.9487	0.9433	0.9187	0.9363	0.9577	0.9376	0.9114

Table 6. Standardized beta coefficients for the prediction of the air permeability with fiber properties

	β	Yarn count	Yarn twists/"	Fiber length	Wales× courses
β_s	-	0.771	0.321	0.308	-0.250
T	-2.60	7.31	3.30	5.21	-3.118
p	0.012	0.000	0.002	0.000	0.028
Rank		1	2	3	4

β_s: Standardized beta coefficients.

Table 7. Standardized beta coefficients for the prediction of the air permeability with yarn properties

	β	Yarn count	Yarn hairiness	Wales× courses	Yarn twist/"
β_s	-	0.744	-0.388	-0.379	0.217
T	4.734	6.874	-4.664	-3.047	2.159
p	0.000	0.000	0.000	0.003	0.034
Rank		1	2	3	4

β_s: Standardized beta coefficients.

under the constant fabric density will cause porous fabric structure because of the lower yarn thickness and yarn hairiness. Similarly increasing mean fiber length causes a decrease in the yarn hairiness values which will result in less air friction. Increasing the number of wales and courses per square centimeter in the knitted fabric will certainly decrease the air permeability of the fabrics depending on the increase in the fabric density.

According to the regression analysis, the values of predicted and adjusted regression estimation coefficients are 0.7806 and 0.767 respectively.

The regression equation which is developed for the prediction of air permeability properties of single jersey fabrics by using yarn properties as independent variables is given as below;

$$y = 2303.226 + 57.145 \times x_1 - 221.842 \times x_2 + 37.812 \times x_3 - 4.733 \times x_4 \quad (4)$$

where x_1=yarn count, x_2=yarn hairiness, x_3=yarn twist/", x_4=wales×courses.

According to the equation (4), as the yarn count increases the air permeability of the fabrics increases. There is a negative correlation between the air permeability and the yarn hairiness. Yarn hairiness causes air friction which will lead to low air permeability. The relation between yarn twist per inch and air permeability is positive linear. As the number of turns per inch increases the yarn will get thinner and less hairy which will cause more porous fabrics. And the last parameter is the number of wales and courses which has a negative effect on the air permeability. As this parameter increases the values of the air permeability decrease based on the tight structure of the fabric. In the forth equation the most effective parameters on the air permeability is yarn count followed by the number of wales and courses (Table 7). By using the forth equation, one can estimate the air permeability of the fabrics with the prediction of R^2_{adj}=0.735 and RMSE of 240.678. The scatter plot of experimental values versus predicted values and regression lines of two regression models were shown in Figure 5.

Two neural network models were developed for the prediction of the air permeability of the fabrics. The first neural network based on fiber properties is presented in Figure 6 which is multi layer perceptron having three layers

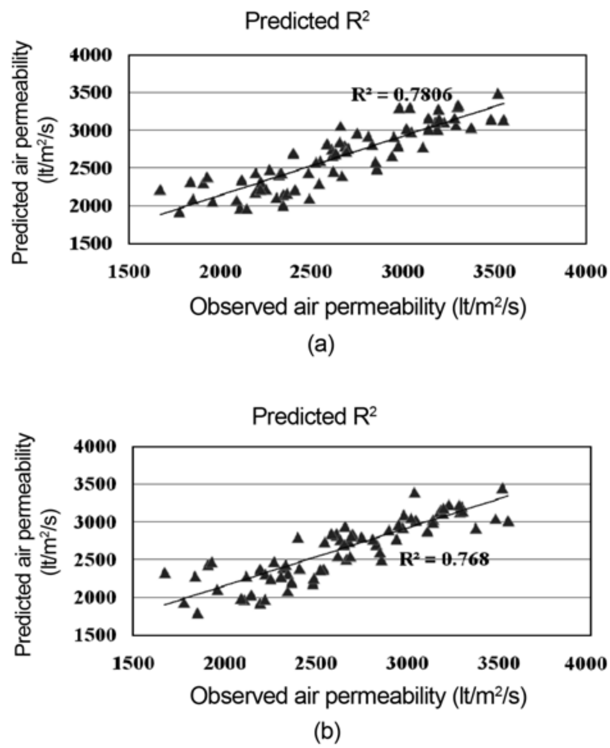

Figure 5. Experimental and predicted ((a) based on fiber properties, (b) based on yarn properties) values of fabric air permeability.

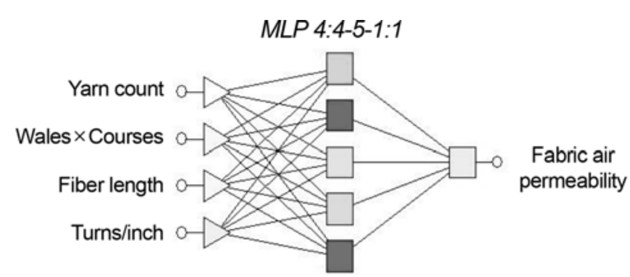

Figure 6. Neural network based on fiber properties for the estimation of fabric air permeability (lt/m^2/s).

of one input, one hidden and one output (MLP 4:4-5-1:1). There are five neurons in the hidden layer, four neurons in the input and one neuron in the output layer. The parameters

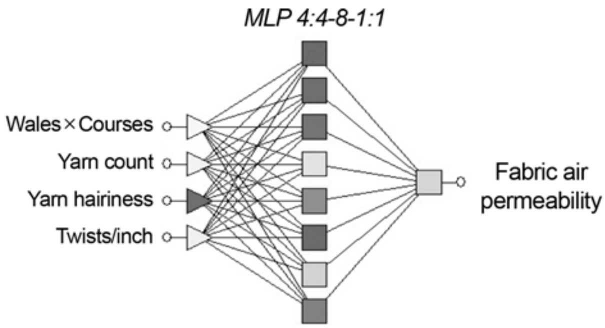

Figure 7. Neural network based on yarn properties for the estimation of fabric air permeability (lt/m^2/s).

which were found to be significant are yarn count (Ne), fiber length, wales×courses, and yarn twist (turns/inch).

Second neural network based on yarn properties is shown in Figure 7. Yarn count, yarn hairiness, yarn twist and number of wales and courses were selected as independent variables. The second neural model consists of three layers which one of them is the hidden layer contains eight neurons.

In Figure 8, the regression coefficients of the two neural networks according to the training and testing phases are given.

The sensitivity analyses of the neural networks for air permeability of the fabrics are given in Table 8. The most important parameter for both models which affects the air permeability of the fabrics is number of wales and courses which is followed by yarn count. It was found that mean fiber length and yarn hairiness have significant effect on the air permeability of the fabrics.

The descriptive statistics of the all models for the estimation of the air permeability of the single jersey fabrics are shown in Table 9. According to the results of root mean square error value, the error rates of the testing phase of ANN models are about 6 % whilst they are about 9 % in regression models. The difference between the RMSEs of testing and RMSEs of regressions are approximately 60. Since the range of air permeability values differs from 1,600 to 3,500. This difference in RMSE causes maximum 3.75 % improvement in the estimation of air permeability of single jersey fabrics with ANN models. Therefore, the regression equation obtained to predict the air permeability of single

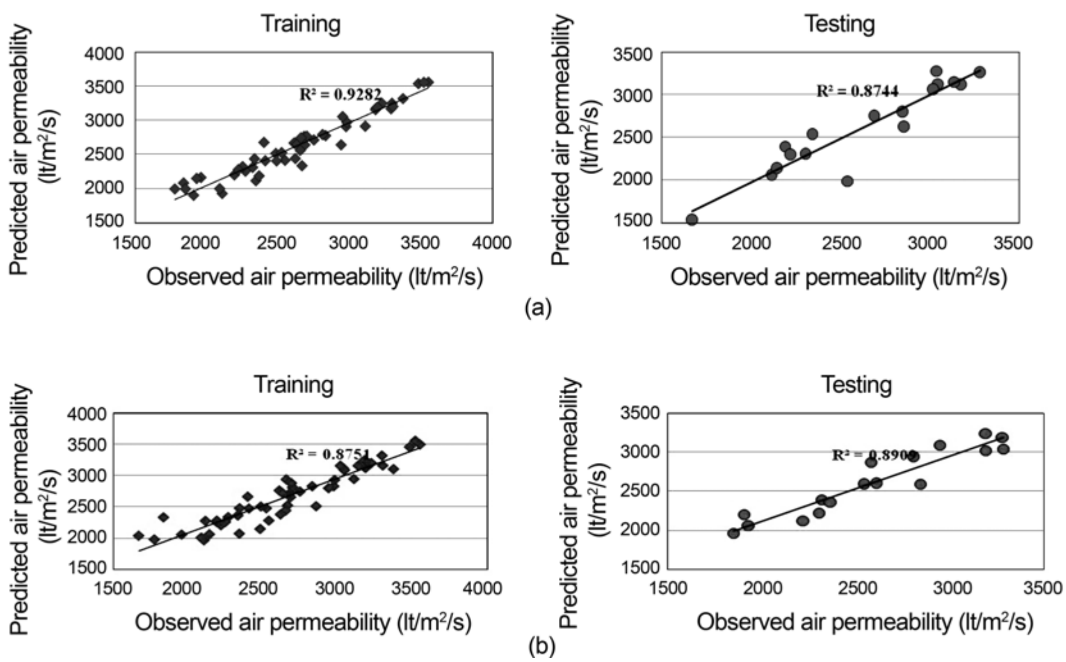

Figure 8. Regression coefficient of neural networks ((a) based on fiber properties, (b) based on yarn properties) for air permeability of training and testing.

Table 8. Sensitivity analysis of the neural network for the air permeability

	ANN based on fiber properties				ANN based on yarn properties			
	Wales× Courses	Yarn count (Ne)	Fiber length (mm)	Twists/"	Wales× Courses	Yarn count (Ne)	Yarn hairiness	Twists/"
Ratio	3.408	2.871	1.970	1.820	3.301	3.212	2.211	1.458
Rank	1	2	3	4	1	2	3	4

Table 9. Descriptive statistics of all models for the prediction of the air permeability

	Models established on fibre properties				Models established on yarn properties			
	ANN			Regression	ANN			Regression
	Training	Testing	Total		Training	Testing	Total	
Data mean	2664.480	2624.008	2654.789	2654.789	2672.340	2599.039	2654.789	2654.789
Data S.D.	469.951	456.285	467.034	467.035	465.166	468.581	467.034	467.034
Error mean	0.372	-11.372	-2.440	2654.7	0.238	15.821	3.969	-0.73219
Root mean S.E.	133.032	177.576	145.036	237.34	164.429	158.125	163.078	240.678
Abs E. mean	96.183	118.086	101.427	187.51	123.159	131.516	125.160	181.0657
Correlation	0.959	0.935	0.948	0.8835	0.935	0.944	0.937	0.8763
Regression	0.928	0.874	0.899	0.7806	0.875	0.891	0.878	0.768

jersey fabrics is an explanatory equation. On the other hand the differences between the regression equations of models show that relationship among the fiber and yarn properties and fabric air permeability is not linear.

Conclusion

In this study, single jersey knitted fabrics were produced from ring spun yarns in four different counts and having three different twist coefficients. Yarns were manufactured by using six different types of cotton. Bursting strength and air permeability properties of the fabrics were measured and were associated with fiber and yarn properties separately by using regression and artificial neural networks. Moreover, these aforementioned prediction methods were examined in terms of estimation power. The results of the study led to the following conclusions:

According to the fiber properties, either with regression or artificial neural networks, bursting strength of the single jersey fabrics is affected by fiber strength, fiber elongation, fiber mean length, yarn count and number of wales and courses. In all of these parameters the most significant parameter is fiber mean length which is followed by fiber elongation and yarn count. When the bursting strength of the single jersey fabrics is examined with using yarn properties, it is found that yarn count, yarn tenacity, yarn unevenness and number of the wales and courses have a significant effect. Regardless of the prediction method, the significance levels of the parameters are the same.

Air permeability of the fabrics were predicted with fibre and yarn properties separately both using regression analysis and artificial neural networks. Air permeability of the single jersey fabrics based on fiber properties are affected by fiber mean length, yarn twists per inch, yarn count and number of wales and courses. According to the yarn properties, the parameters that have an effect on air permeability of single jersey fabrics are yarn count, yarn hairiness, yarn twist and number of wales and courses.

When the performance of these two different modeling methods are examined, multi linear regression analysis is as good as artificial neural networks at explaining the linear relations such as bursting strength and air permeability properties of single jersey knitted fabrics. When the root mean square errors of testing phase and regression analysis of bursting strength results are compared, it can be seen that the error ratios of testing are about 5 % whereas in regression models these ratios are between 6-12.5 %. According to the air permeability analysis, the difference between the RMSEs of testing and RMSEs of regressions are approximately 60. Since the range of air permeability values differs from 1,600 to 3,500. This difference in RMSE causes maximum 3.75 % improvement in the estimation of air permeability of single jersey fabrics with ANN models.

As a conclusion, in all analysis, descriptive statistics such as root mean square error, absolute error mean and coefficients of correlation and regression are better in neural network architectures than those in regression.

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