Neural Network to Develop Sizing Systems for Production and Logistics via Technology Innovation in Taiwan

CHIH-HUNG HSU[1], CHENG-YUEH TSAI[2], TZU-YUAN LEE [3]
[13]Department of Industrial Engineering and Management, Hsiuping Institute of Technology, Taiwan, R.O.C.
[2]Department of Marketing and Logistics Management, Far East University, Taiwan, R.O.C.

Abstract: - Human body type classifications are very crucial issue, play an even important role for physiology, medical treatment, sports talent and garment production and logistics. The extraction of knowledge from large database has been successfully applied in a number of advanced fields by data mining. However, little research has been done in the area of identifying the significant rules of human body types, using data mining. The goal of this study was to identify the significant rules of human body types from the anthropometric data of adult males, using the neural network-based data mining procedure. Certain advantages may be observed when the significant rules are identified, using the neural network-based data mining procedure. Body types could be accurately classified for physiology, medical treatment, sports talent and garment manufacturing according the newly classification rules. The results of this study can provide an effective procedure of identifying the significant rules for classifying human body type to satisfy the demands of garment production and logistics.

Key-Words: - Data mining; Neural network; Human body types; Production and logistics

1 Introduction

With the quick advances in the social and economic environment, people's body dimensions and shape are changeable. Each nation requires realizing the people's body types for industrial and commercial demand. Human body type classifications are very crucial issue, play an even important role for physiology, medical treatment, sports talent and garment production and logistics. Taking the sizing systems used in the garment manufacturing industry as an example, garment manufacturers have never developed standard sizing systems according classified body type, finally resulting in heavy stock burden for production and logistics.

Human body types could be accurately classified, garment manufacturers can correctly predict numbers of items and ratio of sizes to be produced, resulting in accurate inventory control and production planning according standard sizing systems [1]. Thus, the classification of human body type is long overdue.

Human body types can be classified by taking various methods. Taking body type classifications for sizing systems development as an example, many approaches utilize approximate range of the girth difference to determine body types for developing sizing systems, but these body types could not be accurately classified. Moreover, few studies have applied the neural network approach to body typing. On the other hand, data mining has been successfully applied in many fields [7]. The application domain is quite broad and plausible in marketing [2], human resource management [3], risk prediction [4], biomedical technology [5] and health insurance [6]. However, research on identifying body type classifications using data mining is lacking. Accordingly, this study attempts to classify body types using the anthropometric data by the neural network-based data mining procedure to identify unknown rules for body type classifications. By applying data mining procedure, body types can be classified from an anthropometric database.

2 The Data Mining Procedure

The data mining procedure involves a series of activities, from defining the goal to evaluating the results. The previous steps can be served as the baseline reference for the next step.

2.1 Defining the goal

Owing to outdated and incomplete the classification of human body type, an anthropometric database was created for Taiwanese adult males. The ages of these samples are from 40 to 60 years old. The anthropometric database based on 52 anthropometric variables measured in each of 226 males according to the definition of the ISO 8559 [8].The goal of this study was to explore and analyze a huge amount of

data, by employing the neural network-based data mining procedure, so as to identify significant rules within body dimensions. Based on these rules, the body types classification of Taiwanese adult males may be classified.

2.2 Data preparation

Before mining the data, the data had to be processed, with all missing data being separated out [9]. As a result, of the 226 samples of adult males, 6, which had missing data, were deleted; this left a total of 220 valid samples.

Not all of the 52 anthropometric variables were suitable for use in identifying significant rules within body dimensions; therefore, in coordination with the judgment of domain experts, this study identified 11 variables.

2.3 Data mining by factor analysis

It would be highly complex task to use a total of 11 anthropometric variables for the development of sizing systems; therefore, the most critical factors were identified first via factor analysis to simplify this task. Factor analysis obtained the eigenvalues of the 11 anthropometric variables. Two factors with eigenvalues exceeding 1 were chosen according to the eigenvalue criterion of Kaiser. Consequently, anthropometric variables, with factor loadings of greater than 0.5, were found to be clustered within Factors 1 and 2, as shown in Table 1.

The anthropometric variables concentrated within Factor 1 were chest girth, waist girth, hip girth, neck girth, chest width; those in Factor 2 included body height, cervical height, arm length. Therefore, two critical factors were thus identified, with Factor 1 being named the girth factor and Factor 2 the height factor.

These findings provide the important framework for the development of sizing systems. The results of the factor analysis listed in Table 1 demonstrate that the top anthropometric variables most closely correlated with the girth factor were chest girth. Because chest girth is also the most important anthropometric variables in clothing making [1], it was chosen to represent the girth factor. In addition, body height was correlated with all height related anthropometric variables and was selected to represent the height factor. Two factors were trainned and classified by using neural network-based data mining procedure.

Table 1. Factor analysis results

	1	2	3	4	5
Chest girth	.857	.148	.164	9.196E 02	.277
Waist girth	.907	2.122E 02	4.141E 03	7.113E 02	.156
Hip girth	.820	.235	.168	7.659E-02	.188
Neck girth	.805	3.854E 02	1.181E 02	.138	7.526E 02
Chest width	.761	.148	.281	-5.364E-02	3.129E-02
Back width	.396	7.823E-02	.106	4.046E-02	.899
Shoulder width	.253	7.552E-02	.917	9.147E-02	.104
Body height	8.269E-02	.920	.236	.201	1.590E-02
Cervical height	.142	.921	.199	.171	2.674E-02
Back waist length	.149	.246	8.518E-02	.943	3.843E-02
Arm length	4.802E-02	.857	-.332	-1.408E-02	8.834E-02

2.4 Data mining by neural network

Two factors of 226 adult males were trainned and classified by using neural network, this study discovered three clusters. By applying neural network-based data mining procedure, body types can be classified from an anthropometric database, as shown in Figure 1.

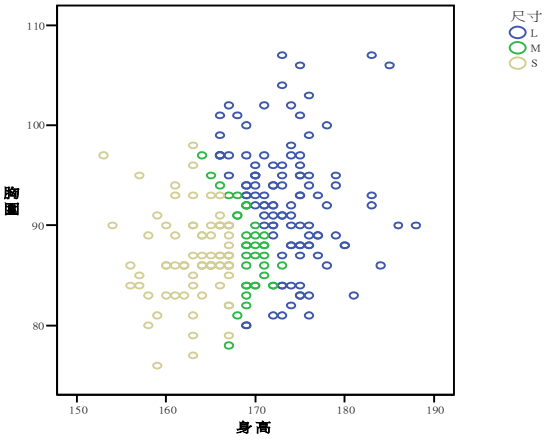

Fig. 1. The classified results of neural network

To gain a better insight into the differences resulting from the analysis, the Analysis of variance (ANOVA) was then conducted. In order to verify the anthropometric variables of all body types, and to determine whether notable differences existed among them. As the reaults that the three clusters bear significant differences in the girth anthropometric variables and the height anthropometric variables

Therefore, this study defined the body type, with large girth anthropometric variables, as type L; the body type, with medium girth anthropometric variables, were defined as type M; and the body type, with small girth anthropometric variables, were defined as type S.

The means of sizing variables for the three body types, used in this study, is shown in Table 2.

2.5 Evaluation of Results

Having classified the males into three body types, the new classified body types were identified using the neural network-based data mining procedure. Body types could be accurately classified for physiology, medical treatment, sports talent and garment manufacturing according the newly classification rules.

Taking the sizing systems used in the garment manufacturing industry as an example, garment manufacturers can correctly predict numbers of items and ratio of sizes to be produced, resulting in accurate inventory control and production planning according the newly classified body types. Furthermore, the sizing systems thus developed provide the percentage of males, and the distribution of body types, enabling manufacturers to access reference points and facilitating garment production for specific markets, and supplying effective manufacturing information, improving production planning and material control. The standard sizing systems can then be developed to facilitate garment production according to the new classified body types. The newly classification rules play an even important role for production and logistics.

Table 2. The means of the three body types

	L	M	S
	Mean	Mean	Mean
Chest girth	93	88	87
Waist girth	82	78	77
Hip girth	96	92	90
Neck girth	39	38	37
Chest width	33	32	31
Back width	45	43	42
Shoulder width	38	37	36
Body height	174	170	164
Cervical height	147	143	137
Back waist length	37	36	35
Arm length	64	62	59

3 Conclusion

Human body type classifications are very crucial issue, play an even important role for physiology, medical treatment, sports talent and garment production and logistics. The application domain of data mining has been quite broad. However, little research has been done in the area of identifying the significant rules of human body types, using data mining. This study applied the neural network-based data mining procedure to identify the significant rules of human body types. Certain advantages may be observed when the significant rules are identified, using the data mining procedure. Body types could be accurately classified for physiology, medical treatment, sports talent and garment manufacturing according the newly classification rules. The results of this study can provide an effective procedure of identifying the significant rules for classifying human body type to satisfy various demands.

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