International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:3, No:6, 2009

# A Study on the Attractiveness of Heavy Duty Motorcycle

Kaishuan Shen, Pan Changyu, Yuhsiang Lu, Zongshao Liu, Chishxsin Chuang, Minyuan Ma

***Abstract*—**The culture of riding heavy motorcycles originates from advanced countries and mainly comes from Europe, North America, and Japan. Heavy duty motorcycle riders are different from people who view motorcycles as a convenient mean of transportation. They regard riding them as a kind of enjoyment and high-level taste. The activities of riding heavy duty motorcycles have formes a distinctive landscape in domestic land in Taiwan. Previous studies which explored motorcycle culture in Taiwan still focused on the objects of motorcycle engine displacement under 50 cc.. The study aims to study the heavy duty motorcycles of engine displacement over 550 cc. and explores where their attractiveness is. For finding the attractiveness of heavy duty motorcycle, the study chooses Miryoku Engineering (Preference-Based Design) approach. Two steps are adopted to proceed the research. First, through arranging the letters obtained from interviewing experts, EGM (The Evaluation Grid Method) was applied to find out the structure of attractiveness. The attractive styles are eye-dazzling, leisure, classic, and racing competitive styles. Secondarily, Quantification Theory Type I analysis was adopted as a tool for analyzing the importance of attractiveness. The relationship between style and attractive parts was also discussed. The results could contribute to the design and research development of heavy duty motorcycle industry in Taiwan.

***Keywords*—**attractiveness, evaluation, heavy duty motorcycle, miryoku engineering

## I. INTRODUCTION

SINCE Taiwan government removed the embargo to let heavy duty motorcycles be imported on July 1, 2002, the ecology of motorcycle market in Taiwan was gradually changed and people's perspective on heavy duty motorcycle do, too. Heavy duty motorcycles emerge as a kind of high-level taste, different from the subculture of biker gangs. Such a transition naturally originates from the gap among different consumption levels. While the high-level bike culture has being formed gradually, local motorcycle manufacturers in Taiwan, having accumulated experience in designing and making scooters for many years, are eager for moving into the business of heavy duty motorcycle of engine displacement over 500 cc. in order to share the high value added market.

The culture of riding heavy duty motorcycle originates from advanced countries and mainly comes from Europe, North America, and Japan. Heavy duty motorcycle riders are different from the people who view motorcycles as a convenient mean of transportation. They regard them as a kind of enjoyment and often gather in flocks to travel for pursuing the identification of common value. Even someone with independent character imagines that he becomes a racing hero while steeling and promoting riding skill.

At all events, the activities of riding heavy duty motorcycles have formed a distinctive landscape in domestic land in Taiwan. Previous studies which explored motorcycle culture in Taiwan still focused on the objects of motorcycle engine displacement under 50 cc.. The study aims to study the heavy duty motorcycles of engine displacement over 550 cc. and explores where their attractiveness is and structure the network of factors by Miryoku Engineering. In Japan, Miryoku Engineering Forum (1992) has recommended the method, called the preference-based design, to find out the attractiveness from users[7].

## II. LITERATURE REVIEW

### A. Miryoku Engineering

Riding heavy duty bicycles has formed a culture of high-level taste in Taiwan. This kind of taste has close relation to the attractiveness of bike. How the attractiveness in psychology is worth exploring. "Miryoku"[1], a Japanese word, means "power of attractiveness". For the purpose of finding attractiveness from users, Miryoku Engineering Forum, interdisciplinary meetings hold by Ujigawa et. al. (1999), had been trying to find it via discussing the problems and collecting significant theories and methods since 1991. Miryoku Engineering recommends Preference-Based Design, a technical system to find the attractiveness from users' preferences. Then, the relationship between the preference and the attractiveness could also be uncovered. In this study, the first part is Evaluation Grid Method (EGM) and the second part is Quantification type I Method as the following.

### B. Evaluation Grid Method (EGM)

In order to comprehend evaluation items and the structure of network of factors, the goal of EGM is to extract consumers' language. This is also a method to understand how consumers evaluate product value by in-depth investigation on individual. In the process of investigation, what consumers perceive and where their value exists are analyzed through the process of interview. Especially for the structure of semantic visualized hierarchy structure, from the abstract to the concrete, the structure of consumers' value by the structure of originate evaluation, letter-up, and letter-down items can be visualized and concreted. The repertory grid method, developed by Kelly (1955), can capture the mechanism of people's comprehension

K. S., P. C., Y. L., Z. L., and C. C. Author is with the National Cheng Kung University, Tainan,70101 Taiwan (corresponding author to provide phone: 886-6-275-7575; e-mail: creativekevin2001@ hotmail.com).

M. M. Author was with the National Cheng Kung University, Tainan, 70101 Taiwan. , (E-mail: mamy@mail.ncku.edu.tw)

TABLE I
THE RANKING FROM HIERARCHICAL DIAGRAM BY THE NUMBER OF TIMES

| Style | Letter up(reason) | Letter down (concrete article) |
|---|---|---|
| Eye-dazzling 8 | Quality-goods 8 | Huge storage compartment 5 |
| Leisure 8 | Easy to be controlled 8 | Two-valve 5 |
| Racing Competitive 6 | Speeding-up 7 | ABS brake 4 |
| Speedy 6 | High-tech equipment 6 | Frame 4 |
| Classic 6 | Make a turn easily 5 | Low handle for street bike 4 |
| High-level taste 5 | Wave of sound 4 | Separate handle for racing bike 4 |
| Modern 5 | Multi-function 3 | Single rocker arm 4 |
| Overwhelming 3 | Streamline 3 | Rectifier mask 4 |
| Well-executed 3 | Body of structure 3 | Huge torque 4 |
| Dream 2 | Safety 3 | Sofa-style cushion 4 |
| Wilderness 1 | Loading 2 | Cushion 4 |

and recognition of their environments, especially in human relationships. Through an interview that inquiring what the similarities and differences between two objects from people's responses [2], the repertory grid method can be conducted. Sanui (1996) advanced it into evaluation grid method in two processes. First pace is to compare objects to be evaluated. People are asked to response what is satisfied or unsatisfied and what they prefer or disfavor about them. Second, according to their answers, the meaning or conditions are made clear through supplemental questions. The mechanism of their reasoning in a hierarchic structure can by codified in this pace. The method was named the "evaluation grid method

(EGM)"[3]. EGM, a kind of depth interview method, paired comparison and interpretive structural modeling for structure identification. The method is able to grasp evaluation items to decide if product appeals are necessary. In the study, in order to capture the attractiveness, the hierarchical diagram of attractiveness factors for heavy duty motorcycle would be built by EGM[7].

### C. Quantification Theory Type I

The study also adopts Quantification type I as the analysis tool for the attractiveness of heavy duty motorcycle. With the assistance of it, we can analyze the importance of attractiveness. Especially the importance of original evaluation, letter-up and letter-down items can be measured and quantified.

By using the multi-plelinear regression method, Hayashi's quantification theory Type I [4] can statistically predicts the relationship between a response value and categorical values. In the aspect of product design, Hayashi's quantification theory Type I also could be adopted to access the weight between the factors from users' preferences [5][6].

### D. Formalistic

Compared with other product, a heavy duty motorcycle has very strong style. Heavy duty motorcycles manufactured from different manufacturers and countries have huge difference of style in appearance among them. In addition, according to different purposes of using heavy duty motorcycle, such as travelling or crossing land, the styles of bikes are also very different among them.

The formalistic put emphasis on the constant art feature of a specific country (area) or a race. The attitude of the study can be applied to product design. A product is usually the first hand data of design study. A researcher can capture much valuable relative information by the form and texture of products in different areas or epochs.

## III. METHODS AND MATERIALS

In order to gain the attractiveness of heavy duty motorcycle, the interview was held by EGM. 11 male experts of the ages from 20~50 years old are investigated.

### A. Interview of EGM

After choosing some experts at studying heavy duty motorcycle, the 30-minutes session of interview was held in an independent room without the interruption from outside. The procedure of EGM is as following. (a) 50 sample cards, with half A4 size and uniform scale, of heavy duty motorcycle were selected from all kinds of typical heavy duty motorcycles, which are made by several major manufacturers in market, and classified for interview. (b) Selecting preference heavy duty motorcycles from cards, and grouping them by their preference in order. (c) The Original Evaluation Items, established by different preferences and reasons, would be asked by comparing groups. (d) Each Original Evaluation Item would be processed "letter-up and letter down". The "letter-up" process is to inquire the reason of Original Evaluation Item and the "letter-down" process is to inquire the concrete traits from Original Evaluation Item. According to above process, the structure of every testee's evaluation items could be shown. The Original Evaluation Items are leisure, eye-dazzling, classic and racing competitive.

### B. The hierarchical diagram of heavy duty motorcycle

Then, all the testees' evaluation structure would be made up. The figure 1 shows the hierarchical diagram of heavy duty motorcycle preferences by EGM. The numbers in the right side of letter indicate the number of times of the same opinion appeared. For example, In the Original Evaluation Item, "Leisure" the number "8" means 8 times have been listed from 11 testees. According to the preference interview by EGM, the attractiveness of heavy duty motorcycle could be found.

### C. Weighting the attractiveness

Based on the above results, the heavy duty motorcycle style could be divided into 12 parts from the Original Evaluation Items (see table I). In order to quantify the range of items and score of categories for the attractiveness of heavy duty motorcycle, the questionnaire is made from the following arrangement.

### D. Preparation for Questionnaire

The best 4 was chosen from the Original Evaluation Items. There are", "Eye-dazzling", "leisure", "racing competitive", "speedy", "classic" and the letter-up reason could be chosen as showed in Table 2. The Attribute Level for heavy duty motorcycle style section could be set as showed in Table 3.

According to these results, by the settings of the attribute items and categories, questionnaires could be made.

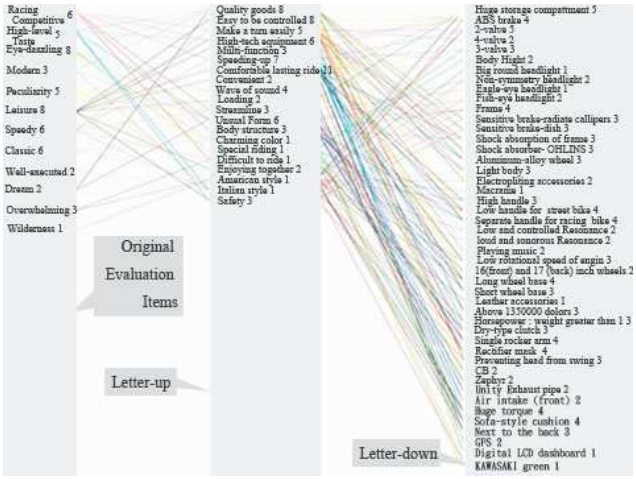


Fig. 1 The hierarchical diagram of heavy duty preferences by EGM

### *E. Questionnaire survey*

In order to measure the weight of attributes for the best 4 of heavy duty motorcycle attractiveness (see table II), we hold the questionnaire survey and analyze them by quantification theory Type I. 50 testees (46 males, 4 females, age from 18~48 years old) were tested. Then four parts, "leisure", "eye-dazzling", "classic" and "racing competition" styles of heavy duty motorcycle would be discussed.

## IV. Results

### *A. Leisure style*

"Leisure" style, the first classified, mainly includes "Easy to be controlled", "High-tech equipment", and "Multi-function" in letter-up. It means this type of heavy duty motorcycle could give them the impression of "Leisure" for the reason of "Easy to be controlled", "High-tech equipment", "Multi-function". The coefficient of determination ($R_2$=0.461) is on the basis of the results of Quantification type I Method. "Easy to be controlled", the highest Partial Correlation Coefficient, affects the image of "Leisure" style. The categories includes "ABS brake", "Shock absorption of frame", "Low handle for street bike", "16(front) and 17(back) inch wheel" and "Long wheel base".

TABLE II
THE BEST 4 OF LETTER-UP FROM HIERARCHICAL DIAGRAM BY THE NUMBER OF TIME

| Classified | Style | Reason |
|---|---|---|
| First | Leisure 8 | Easy to be controlled 8 |
| | | High-tech equipment 6 |
| | | Multi-function 3 |
| Second | Eye-dazzling 8 | Unusual form 6 |
| | | Wave of sound 4 |
| | | Special ride 1 |
| Third | Classic 6 | Wave of sound 4 |
| | | Body structure 3 |
| | | Italian style 1 |
| Fourth | Racing Competitive 6 | Streamline 3 |
| | | Body structure 3 |
| | | Difficult to ride 1 |

TABLE III
THE CATEGORY SCORE FOR ITEMS OF LEISURE

| Items | Categories | Category Score | Partial Correlation coefficient |
|---|---|---|---|
| Easy to be controlled | ABS brake | *0.04514 | *0.510618458 |
| | Shock absorption of frame | 0.00529 | |
| | Low handle for street bike | -0.0192 | |
| | 16(front) and 17(back) inch wheel | -0.3286 | |
| | Long wheel base | 0.008 | |
| High-tech equipment | ABS brake | -0.0563 | 0.398772767 |
| | Radiate-type calipers | -0.0331 | |
| | Disk brake | 0.10609 | |
| | Aluminum alloy wheel | 0.09634 | |
| | GPS | -0.0236 | |
| | Digital LCD dashboard | 0.04437 | |
| | Carbon filament disk | *0.1763 | |
| Multi-function | Huge storage compartment | -0.0099 | 0.099488245 |
| | High body | *0.01223 | |
| | Music playing | 0.01553 | |
| C | | 0.77833 | |
| R = 0.67919606475781 | | | |
| R Square= 0.461307294382495 | | | |

TABLE V
THE CATEGORY SCORE FOR ITEMS OF CLASSIC

| Items | Categories | Category Score | Partial Correlation coefficient |
|---|---|---|---|
| Italian style | Huge trunk | 0.07517 | *0.55359189 |
| | V-type double cylinder | -0.1584 | |
| | Big round headlight | -0.0432 | |
| | Electroplating accessory | -0.0338 | |
| | Macrame | -0.1297 | |
| | High handle | -0.0467 | |
| | Low and controlled resonance | -0.0115 | |
| | Low rotational speed of engine | -0.1857 | |
| | Long wheel base | *0.23937 | |
| | Leather accessory | 0.0739 | |
| | Huge torque | 0.19875 | |
| | Sofa-type cushion | 0.07028 | |
| Wave of sound | 2 Valves | -0.0195 | 0.39036384 |
| | 4 Valves | 0.04399 | |
| Wave of sound | 3 Valves | *0.05626 | |
| | Low and controlled resonance | 0.01552 | |
| | Loud and sonorous resonance | -0.1694 | |
| Body structure | Diamond frame | -0.0394 | 0.35215568 |
| | Shock absorption of frame | *0.15802 | |
| | Low handling for street bike | -0.0568 | |
| | Separate handling for racing bike | -0.0168 | |
| | 18(front) and 15(back) inch wheel | 0.00647 | |
| | Long wheel base | 0.02613 | |
| | Short wheel base | 0.00462 | |
| | Single rocker arm | 0.08261 | |
| | Low handling for street bike | -0.0195 | |
| C | | 0.72625 | |
| R = 0.578190160535203 | | | |
| R Square= 0.334303861739723 | | | |

TABLE IV
THE CATEGORY SCORE FOR ITEMS OF EYE-DAZZLING

| Items | Categories | Category Score | Partial Correlation coefficient |
|---|---|---|---|
| Wave of sound | 2 Valves | -0.1933 | *0.673 34885 |
| | 4 Valves | 0.02865 | |
| | 3 Valves | -0.1525 | |
| | Low and controlled resonance | 0.047 | |
| | Loud and sonorous resonance | *0.0597 | |
| Unusual form | Non-symmetry headlight | *0.12231 | 0.6097 6353 |
| | Fish-eye headlight | 0.09513 | |
| | Special frame | 0.00281 | |
| | Single rocker arm | -0.0985 | |
| | Rectifier mask | 0.05789 | |
| | Unity exhaust pipe | -0.0863 | |
| Special ride | 3 valves | 0.00528 | 0.5817 9851 |
| | High body | -0.2129 | |
| | High handling | -0.0478 | |
| | Separate handling for racing bike | *0.03987 | |
| | Dry-type clutch | -0.1101 | |
| | Huge torque | *0.0574 | |
| C | | 0.763 | |
| R = 0.768675253702144 | | | |
| R Square= 0.59086164565401 | | | |

According to Category Score in table III, it shows that "ABS brake" has more effect on "Easy to be controlled" than others. Then, "16(front) and 17(back) inch wheel" has more negative effect on it than others.

### B. *Eye-dazzling style*

"Eye-dazzling" style, the second classified, mainly includes "Wave of sound", "Unusual form", and "Special ride" in letter-up. The coefficient of determination ($R_2$=0.591) is on the basis of the results of Quantification type I Method. The highest Partial Correlation Coefficient was "Wave of sound" (see Table 4) which affect the image of "Eye-dazzling" style. The categories include "2 valves", "4 valves", "3 valves", "Low and controlled resonance" and "Loud and sonorous resonance"

According to Category Score in table IV, it shows that "Loud and sonorous resonance" has more effect on "Wave of sound" than others. Then, "2 valves" has more negative effect on it than others. Figure 2 shows the examples of categories belong to the items of unusual form and special riding, which get higher category scores to "Eye-dazzling".

(a) (b)

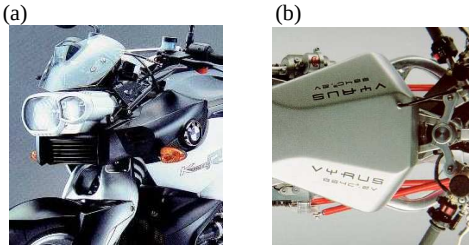

Fig. 2 (a) Non-symmetry headlight (b) Separate handle for racing bike

### C. *Classic style*

"Classic" style, the third classified, includes "Wave of sound", "Body structure" and "Italian style. The coefficient of determination ($R_2$=0.978) is on the basis of the results of Quantification type I Method. The highest Partial Correlation Coefficient was "Italian style" (see Table V) which affect the image of "Invitation" style. The categories include "Huge trunk", "V-type double cylinder", "Big round headlight", "Electroplating accessory ", "Macrame", "High handle", "Low and controlled resonance", "Low rotational speed of engine", "Long wheel base", "Leather accessory", "Huge torque" and "Sofa-type cushion."

### D. *Racing competitive style*

"Racing competitive" style, the fourth classified, includes "Making a turn easily", "Speeding up", "Difficult to ride", "Italian style", "High-tech equipment" and "Body structure". The coefficient of determination ($R_2$=0.891) is on the basis of the results of Quantification type I Method. The highest Partial Correlation Coefficient was "Streamline" (see Table VI) which affect the image of "Racing competitive" style. The categories include "Eagle-eye headlight", "Rectifier mask", "Air intake (front)", (see figure 3)

Then, "Italian style" also has high Partial Correlation Coefficient. The categories of the item includes "V-type double cylinders", "Non-symmetry headlight", "Fish-eye headlight", "Round-tube frame", "Light body", "Loud and sonorous resonance", "Rectifier mask" and "Ducati red".

Furthermore, "Seeding up" also has high Partial Correlation Coefficient. The categories of the item includes "V-type double cylinders", "3 valves", "Aluminum-alloy wheel", "light body", "Separate handle for racing bike", "Short wheel base", "Horsepower : weight greater than 1", "Dry-type clutch", "Rectifier Mask", "Unity exhaust pipe", "Air intake (front)" and "Huge torque"

According to Category Score in table VI, it shows that "Air intake (front)" has more effect on "Streamline" than others. Then, "Rectifier mask" has more effect on "Italian style" than others. Last, "Separate handle for racing bike" has more effect on "Speeding up" than others.

## V. DISCUSSION AND CONCLUSION

The results of this study, the hierarchical diagram of heavy duty motorcycle preferences are found by EGM (Figure 1). The most attractiveness of heavy duty motorcycle are "Eye-dazzling", "Leisure", "Classic" and the "Racing competitive" could be found from evaluation items. The rider choosing a heavy duty motorcycle mainly has 15 reasons: being easy to be controlled, high-tech equipment, multi-function, unusual form, wave of sound, special ride, making a turn easily, speeding up, difficult to ride, Italian style, high-tech equipment, body structure, wave of sound, body structure and Italian style.

Finally, the weight of feature in heavy duty motorcycle was analyzed by quantification theory Type I, and the attractiveness of the heavy duty motorcycle was found for four styles, "Eye-dazzling", "Leisure", "Classic" and "Racing

competitive." Among them, "Racing competitive" has the highest value of R square (0.89). It means that the test reliability of the item "Racing competitive" is the best. Hence, the result also shows testees' have more feeling of identification toward "Racing competitive" style than they do toward other styles. Furthermore, the majority of the testees, younger people, have close relation to the result. It is mainly about that younger people, who prefer the kind of the speedy motorcycle to others, don't dabble in other kinds of motorcycles very much.

The research initially explored the attractiveness of heavy duty motorcycle. Due to the long history of individual bike manufacturers, the forms of bikes they develop are fundamentally different. Such differences among them attract different groups of fans. However, it causes that they rarely dabble at other types of bikes. Hence, two points will be suggested to the following researches. First, a certain type of bike, such as street bike, could be chosen for study exploration in order to search more appropriate experts, who can be inquired for more detailed key points. 2. The brand of bike could be viewed as the factor of attractiveness for exploration. Many bike fans are faithful to some brands. Hence, why they have such faith could be worth being explored.

TABLE VI
THE CATEGORY SCORE FOR ITEMS OF RACING COMPETITIVE

| Items | Categories | Category Score | Partial Correlation coefficient |
|---|---|---|---|
| Streamline | Eagle-eye headlight | 0.0331808 | *0.919656 |
| | Rectifier mask | -0.110829 | |
| | Air intake (front) | *0.335018 | |
| Italian style | V-type double cylinders | -0.013764 | |
| | Non-symmetry headlight | -0.032247 | |
| | Fish-eye headlight | -0.24834 | |
| | Round-tube frame | 0.0978677 | |
| | Light body | 0.0422917 | |
| | Loud and sonorous resonance | 0.0306198 | |
| | Rectifier mask | *0.2026991 | |
| | Ducati red | -0.141738 | 0.91770411 |
| Speeding up | V-type double cylinders | | 0.88637943 |
| | | -0.01214 | |
| | 3 valves | -0.374752 | |
| | Aluminum-alloy wheel | -0.260866 | |
| | light body | -0.089697 | |
| | Separate handle for racing bike | *0.5208215 | |
| | Short wheel base | -0.175037 | |
| | Horsepower : weight greater than 1 | 0.0397073 | |
| | Dry-type clutch | 0.0508695 | |
| | Rectifier Mask | 0.0453487 | |
| | Unity exhaust pipe | 0.1364309 | |
| | Air intake (front) | -0.057828 | |
| | Huge torque | -0.009003 | |
| Difficult to ride | Low handling for street bike | *0.1519146 | 0.87193048 |
| | Horse power : weight larger than 1 | 0.0825673 | |
| | Dry-type clutch | -0.07245 | |
| | Huge torque | -0.048556 | |
| C | | 0.7821429 | |
| R = 0.944067413325485 | | | |
| R Square=0.891263280903073 | | | |

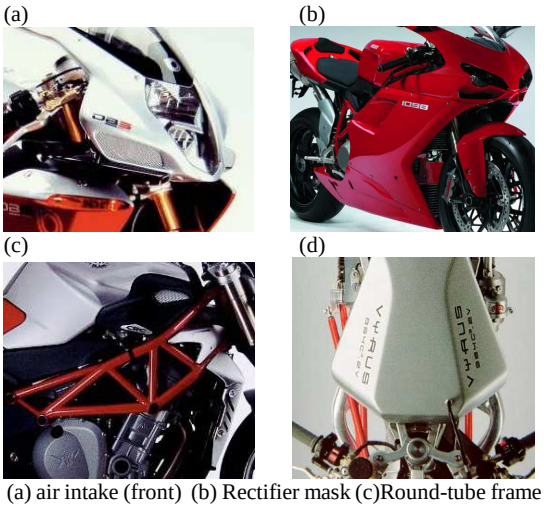

Fig. 3 (a) air intake (front) (b) Rectifier mask (c)Round-tube frame (d) Separate handle for racing bike

## REFERENCES

[1] Miryoku Engineering Forum, 1992, Miryoku Engineering. Kaibundo.(Japanese)
[2] Kelly, G. A (1955). The psychology of personal constructs. 2 volumes, New York: Norton.
[3] Junichiro Sanui, 1996, Visualization of users' requirements: Introduction of the Evaluation Grid Method. Proceedings of the 3rd Design & Decision Support Systems in Architecture & Urban Planning Conference, Vol.1, pp.365-374.
[4] C. Hayashi, 1950, On the Quantification of Qualitative Data from the Mathematico-Statistical Point of view, Annals of the Institute of Statistical Mathematics, Vol. 2.
[5] C. Iwabuchi, et. al, 2001, Data Management and Analysis by Yourself, Japan: Humura publishing, pp180-185.
[6] K. Sugiyama, et. al, 1996, The basic for Survey and Analysis by Excel, Japan: Kaibundo publishing, pp.51-62.
[7] M. Minyuan, 1996, A study on the attractiveness of wedding dress, Cheng Kung University, Tainan.