An Alternative Approach to Analyze Customer or Employee Satisfaction Data Based on Kano Model

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Abstract: In recent years a companies’ need for information about customer requirements, which represent the key to retain actual customers and attract new ones, has steadily increased. Kano et al. [9] proposed an interesting model aiming at the classification of product or service characteristics as dissatisfiers, delighters, performance or indifferent attributes. Unfortunately, the required questionnaire structure is quite complex, consequently the rate of incomplete/inconsistent questionnaires is not negligible at all. In the present manuscript, the authors propose a model which allows allocation of a customers’ requirements into Kano’s categories in a simple way. The underlying idea is to conduct two distinct analysis on the same attributes. Both analysis aim at investigating the attributes’ relationships with the overall variable (satisfaction, loyalty, etc), but one analysis focuses attention on the bottom part of the scale (low scores), while the other on the top part (high scores).

Keywords: Customer requirements, Herzberg theory, Kano model, satisfaction theory.

1. The Herzberg and Kano Models

One of the most interesting theories about satisfaction was provided by Herzberg in 1959 (Herzberg et al. [6]): the Two-Factor theory. Also known as Motivation-Hygiene theory, it was developed for studying satisfaction aspects at work. Herzberg was the first to notice that satisfaction and dissatisfaction in a work environment are caused by different sets of factors. He identified as motivator factors those driving job satisfaction and those related to work itself, such as personal growth, responsibility, and recognition. These are supposed to motivate employees to high performances. In contrast, he identified as hygiene or maintenance factors those preventing dissatisfaction and related to conditions surrounding the doing of a job, such as salary, physical working conditions, interpersonal relations, and job security. When hygiene factors are at a low level, workers are dissatisfied, but when hygiene factors are at a high level, workers are neither dissatisfied nor necessarily satisfied. Similarly, when motivator factors are at a high level, workers are satisfied and motivated to higher performances, but when motivator factors are at a low level, workers are neither satisfied nor necessarily dissatisfied. In other words, Herzberg considered satisfaction and dissatisfaction as two separate dimensions. Despite the fact that Herzberg constructed this two-dimensional paradigm of factors for studying specifically employee satisfaction, the model can be proficiently applied to customer satisfaction as well. However, Herzberg did not provide an effective and rigorous methodology to collect the necessary information in order to properly analyze the satisfaction phenomenon according to his theory.

Probably, the most significant efforts derived from Herzberg’s framework were done by Kano and his team at Tokyo Rika University in 1984. They developed an effective method
for investigating the characteristics of customer requirements (Kano et al. [9]), mostly referred to as the Kano model. In general, customers tend to have confused ideas about quality. However, with some effort, their ideas can be made clear and thus the customer requirements can emerge. These factors can then be plotted in a two-dimensional diagram, the Kano diagram (Figure 1), where the horizontal axis indicates the factor’s performance/functionality, while the vertical axis indicates the satisfaction associated with the factor.

According to Kano et al. [9], product or service characteristics can be classified as dissatisfier, delighter, or performance attributes. Dissatisfier attributes (threshold, basic, must have) represent the minimum requirements which will cause dissatisfaction if not fulfilled. However, they will not produce satisfaction if they are fulfilled or exceeded. They are considered prerequisites in the market and customers take them for granted and don’t even think about. Attribute’s presence is generally not noticed, but absence generates discontent. Delighter attributes (satisfiers, attractive) will produce delight and inspire loyalty when delivered. However, they will not produce dissatisfaction if the product/service lacks the feature. They are considered strategic attributes because a company can differentiate its products or services from competitors in a positive way. They are frequently unexpected by customers that do not have a conscious need for them; they might rather represent latent needs. Performance attributes (linear, one-dimensional) will produce satisfaction when functionality is high, dissatisfaction when functionality is low. Therefore, the relationship between performance and satisfaction tend to be linear. These features are often related to customers’ explicit needs. Both their presence and absence are noticed, leading to fulfillment or disappointment respectively.
In this framework, the underlying idea is that customers’ requirements change over time. In fact, with time and imitation by competitors, delighters tend to become expected and will turn into performance attributes, and thereafter these will turn into dissatisfiers. Therefore, because of competitive pressure, survival and long term success require continuous unexpected innovations. Any company that intends to be competitive should identify all three attributes’ types and enhance the associated satisfaction. While fulfilling basic attributes provides the grounding for the elimination of discontent and complaints, fulfilling attractive attributes provides the foundation for exciting and delighting customers, and therefore it represents a differentiation that leads to a marketing competitive advantage.

In their research, Kano et al. [9] proposed a structured questionnaire to help identifying and classifying customers’ requirements. The overall methodology proposed is rather straightforward. The researcher should:

- identify a set of main product or service characteristics which are assumed to affect the overall satisfaction/loyalty and need to be properly classified into the Kano’s categories;
- ask two questions for each characteristic: a functional question, investigating the satisfaction when the characteristic is present (‘How would you feel if the product had feature X?’), and a dysfunctional question, investigating the satisfaction when the characteristic is absent (‘How would you feel if the product didn’t have feature X?’). Each pair of questions aims at understanding how actual or potential customers/employees would feel whether the characteristic is present or absent. For each question five possible answers are defined: I like it; I expect it/It is a must; I am neutral/I do not care; I can tolerate it/I can live with it; I dislike it;
- analyze each respondent’s data to determine into which Kano’s category a given product or service characteristic falls for that respondent. This is accomplished by the Kano Evaluation Table presented in Table 1. As the reader can see, there are some additional feature classifications: indifferent attribute, to which the customer does not pay attention; questionable attribute, when responses are contradictory; reversal, when the researcher’s a priori judgement of functional and dysfunctional is the reverse of what the respondent reveals;
- average sample responses to statistically identify into which category the feature falls and infer the results to the target population;
- plot the results into the Kano diagram to provide a visual guide.

For further details regarding the development, administration, and analysis of Kano’s questionnaires, we suggest the reader to consider Berger et al. [1] and Sauerwein et al. [16].

<table>
<thead>
<tr>
<th></th>
<th>Dysfunctional</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Like</td>
<td>Expect</td>
<td>Neutral</td>
<td>Tolerate</td>
<td>Dislike</td>
</tr>
<tr>
<td>Functional</td>
<td>Like question.</td>
<td>delighter</td>
<td>delighter</td>
<td>deligher</td>
<td>perfor</td>
</tr>
<tr>
<td></td>
<td>Expect reverse</td>
<td>question.</td>
<td>indifferent</td>
<td>indifferent</td>
<td>dissatis</td>
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<tr>
<td></td>
<td>neutral reverse</td>
<td>reverse</td>
<td>indifferent</td>
<td>indifferent</td>
<td>indifferent</td>
</tr>
<tr>
<td></td>
<td>Tolerate reverse</td>
<td>reverse</td>
<td>reverse question.</td>
<td>dissatisfier</td>
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<td></td>
<td>Dislike reverse</td>
<td>reverse</td>
<td>reverse question.</td>
<td>question.</td>
<td></td>
</tr>
</tbody>
</table>
2. The Traditional Approach

Characterizing the customer requirements into the Kano’s categories is very valuable as the results of a Kano survey tend to be very accurate. Its main drawback is that many respondents are not enthusiastic by having the same questions asked in two different ways and, consequently, the rate of incomplete questionnaires is not negligible at all. In addition, given the unfamiliarity with Kano surveys, some respondents get distracted by the wording and order of the five standard answers, as they keep perceiving this categorical scale to be an ordinal scale from better to worse, like in traditional surveys. Because of these disadvantages, most researchers investigating satisfaction prefer to renounce to the analytical advantages provided by the Kano model and to adopt a traditional approach.

In traditional customer/employee satisfaction surveys, respondents are generally asked a set of performance evaluations regarding some aspects/features of the product/service and an overall evaluation for the product/service itself, such as satisfaction, likelihood to buy, likelihood to recommend, or loyalty (sometimes derived as a composite index).

Traditionally (see, among others, Beyers et al. [2]; Hausknecht [5]; Ho and Wu [7]; Mittal and Kamakura [11]; Montaguti and Orsingher [12]; Rennekamp et al. [14]), respondents are asked to express their satisfaction for each aspect/feature, by using either a five-point scale (very dissatisfied, dissatisfied, neither satisfied nor dissatisfied, satisfied, very satisfied) or a seven-point scale (extremely dissatisfied, very dissatisfied, fairly dissatisfied, neither satisfied nor dissatisfied, fairly satisfied, satisfied, extremely satisfied). However, there are several alternative ways to collect performance evaluations. Respondents could be asked to express themselves directly in terms of performance (usually, by using a five or seven-point scale from very poor to extremely good); they could be asked to rate the attributes in terms of how well each of them describes the product/service (1:10 anchored scale: 1 = very poorly, 10 = very strongly); or they could be asked to indicate their degree of agreement with the statement (usually, by using a five-point Likert scale: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).

Regarding the likelihood to buy or to recommend, respondents could be asked to express themselves either by percentages (likelihood from 0% to 100%), by a five-point scale (definitely won't buy, probably won't buy, might or might not buy, will probably buy, will definitely buy), or by a seven-point scale (extremely unlikely, very unlikely, fairly unlikely, neither likely nor unlikely, fairly likely, very likely, extremely likely).

Some variables investigating behavior (share of spend), commitment (recommendation, stay with, consider other products), and emotional ties (valued customer, trust, reputable company, attractive brand) could also be combined, for example by taking a weighted average, in order to express loyalty.

These variables are generally assumed to be pseudo-interval and are used with interval procedures. In the simplest framework, the researcher analyzes the relationships between the overall and performance evaluations by computing a set of Spearman correlation coefficients (see, among others, Bobko [3]; Cohen et al. [4]; Rodgers and Nicewander [15]). Each single coefficient is associated with one product feature and it is usually interpreted as an importance score because it provides information on how the individual performance drives the overall evaluation. However, correlation analysis does not take into account the whole set of relationships at the same time, as it is a pairwise analysis.

To overcome this limitation, researchers often prefer to apply a multiple linear regression model, where the overall question is considered to be the dependent variable, and the
performance questions are the explanatory variables. Unfortunately, a customer/employee satisfaction project is basically an observational study where the researcher has no control over the design points, thus the explanatory variables can vary in rather similar ways and be dependent upon each other. This is particularly common when variables meanings are similar to each other, describing similar aspects of the product/service and pertaining to the same underlying trait. In this case, predictors tend to be highly correlated (high multicollinearity) and, as a consequence, the coefficient estimates are very sensitive to random variation in the dependent variable. In other words, the solution is not robust, as the coefficient estimates strongly depend on the particular way the error terms happen to come out.

One of the most common solutions used to compensate for multicollinearity negative effects in multiple linear regression is ridge regression (see, among others, Hoerl and Kennard [8]; Marquardt [10]; Price [13]). This technique in similar to least square regression except that an appropriate constant value is added to the elements of the diagonal of the matrix (XX). This addition leads to a new set of data characterized by a lower degree of multicollinearity. Ridge regression works quite well in explaining how the individual performances drive the overall evaluation. However, it does not provide any information at all about the classification of the attributes into the dissatisfier, delighter, and performance categories considered in Section 1. In fact, the results are obtained by considering the whole attributes' scale and the linear analysis simply provides an importance coefficient for each attribute.

3. An Innovative Approach Based on the Kano Model

In this manuscript, we introduce and develop an innovative approach concerning the classification of attributes as dissatisfiers, delighters, and performance attributes by using the questionnaire structure commonly adopted in traditional customer/employee satisfaction surveys (Section 2).

The underlying idea is to conduct two distinct analysis on the same attributes. Both analysis aim at investigating the attributes' relationships with the overall variable, but one analysis focuses attention on the bottom part of the scale (low scores), while the other on the top part (high scores). Attributes strongly associated with the overall variable only when focusing on the bottom part of the scale (dissatisfaction) should be classified as dissatisfiers, while attributes strongly associated with the overall variable only when focusing on the top part of the scale (delight, high satisfaction) should be classified as delighters. Attributes strongly associated with the overall variable when focusing on both the top and the bottom part of the scale should be classified as performance attributes. Finally, attributes not strongly associated with either the bottom part or the top part of the scale should be classified as indifferent attributes.

3.1. The Process

The first step toward characterizing the customer requirements into the Kano's categories consists in the identification of the overall evaluation variable and of the set of explanatory variables evaluated on the same scale as the overall variable.

Once identified, the researcher should study the distribution of the overall variable and select its bottom category/categories such that the proportion of respondents whose answers fall in those selected categories is about 10-20%. The researcher should repeat the same operation for the top categories. For an optimal performance of the model, we should have both the bottom and the top categories for the overall variable being of a similar size and gathering about 10-20% of evaluations. In fact, the researcher usually assumes that, in the
typical market, both the delighted and the dissatisfied customers segments are about 10-20%, in order to have segments of appropriate sizes to address the marketing strategy to. It is also worth noting that a larger or smaller percentage of respondents classified as overall delighted or overall dissatisfied might jeopardize the classification power of the model.

Two new datasets should be created. The first, referred to as data. B, characterized of dummy variables where the bottom categories of each variable (included the overall evaluation variable) are recoded to 1s and all other categories are recoded to 0s (this includes missing values). The second, referred to as data. T, characterized of dummy variables where the top categories of each variable (included the overall evaluation variable) are recoded to 1s and all other categories are recoded to 0s (this includes missing values). Bottom and top categories are those identified based on the analysis of the overall variable distribution.

At this point, we need to define a statistical measure and employ it in both datasets, in order to properly classify the explanatory variables as dissatisfiers, delighters, or performance attributes. For the sake of clarity, let us pretend we have only one explanatory variable/item in the customer satisfaction questionnaire and let us focus attention only on the data. B dataset. This means to classify respondents based on a single item and overall dissatisfaction. As respondents can be either dissatisfied (D) or not dissatisfied (D) on either the single item or overall, the resulting possible situations are represented in Figure 2.

In statistical terms, we have the four following areas:

- \( P(D_1 \cap D_o) \) true positives;
- \( P(D_1 \cap D_o) \) true negatives;
- \( P(D_1 \cap D_0) \) false positives (Type I error);
- \( P(D_1 \cap D_0) \) false negatives (Type II error),

as shown in Figure 3.

![Figure 2. Single item and overall dissatisfaction: possible situations.](image-url)
We are interested in identifying the dissatisfier attributes. When these attributes are not fulfilled the respondent is dissatisfied, but when these attributes are fulfilled the respondent is not dissatisfied nor necessarily satisfied. In other words, when the respondent is dissatisfied in a dissatisfier attribute this implies that the customer is dissatisfied overall, but not the other way round, when a customer is dissatisfied overall does not mean that the respondent is dissatisfied in all single dissatisfier attributes. Therefore, we should focus our attention on the area representing respondents who are both item and overall dissatisfied, and require large positive predictive value (PPV = \( \frac{P(D_I \cap D_O)}{P(D_I)} = \frac{P(D_O|D_I)}{P(D_I)} \)) associated with the item.

Based on this approach, the researcher should analyze, within each dataset, the pairwise relationships between the overall and each explanatory variable: the PPV associated with each explanatory variable has to be computed. The explanatory variables along with their associated PPVs will be collected in two tables: the dissatisfier table based on the analysis of the \textit{data.B} dataset, and the delighter table based on the analysis of the \textit{data.T} dataset. For an easier interpretation of findings, these tables should list the explanatory variables based on their PPVs in decreasing order.

- The combined reading of the PPVs in both tables will provide valuable information regarding the classification of the explanatory variables into the Kano’s categories;
- variables with a high PPV only in the dissatisfier table should be classified as dissatisfiers;
- variables with a high PPV only in the delighter table should be classified as delighters;
- variables with a high PPV in both the dissatisfier and the delighter tables should be classified as performance attributes;
- all other variables should be classified as indifferent attributes.

It is worth to note that the researcher can freely decide the cutoff in both tables, that is...
to say the point beyond which PPVs are considered to be low rather than high. More details about cutoff values are provided in the following section.

3.2. Further Considerations

There is a number of aspects that should be considered when analyzing satisfaction data by the approach presented in this manuscript. Below, we will discuss the most critical aspects.

SCALE: usually, researchers are keen to use an ordinary five or seven-point scale in the questionnaire (see Section 2). These scales work quite well, however, a higher number of points should be preferred, as it helps the researcher to find an appropriate proportion of dissatisfied and delighter respondents (see Section 3.1).

CUTOFF VALUES: the cutoff values in the tables have a direct effect on the attributes' classification. A larger number of attributes considered to have a high PPV in either the tables would mean a larger number of attributes classified in the three valuable Kano's categories and a smaller number of indifferent attributes. Sometimes there is a natural cutoff point in the table, as PPVs show an evident gap, whereas in other occasions there is not. However, the researcher should always use his/her expertise in classifying attributes, as well as consider the objectives of the study and previous findings.

OVERALL VARIABLE/S: rather than using the same overall variable for both the relationships within $data.B$ and $data.T$, the researcher might prefer to use two distinct overall variables. For example, for the bottom relationships he/she might use overall (dis)satisfaction, while for the top relationships loyalty might represent a better choice.

DIFFERENT BASES: rather than using the same sample base for both analysis, the researcher might prefer to base the delighter table only on those respondents who are not dissatisfied on any of the explicative variables with a high PPV in the dissatisfier table. This would lead to a more ‘clean’ delighter table based exclusively on respondents who are not dissatisfied on important attributes.

STRUCTURAL MISSING VALUES: in the questionnaire there are, quite often, one or more sections not seen/evaluated by all respondents. In such a situation, more than one analysis would be required. One analysis should be conducted only on the variables not affected by the structural missing values and based on the whole sample. Additional analysis should consider one section affected by missing values at-a-time along with all variables not affected at all; only respondents entering such a section should be included in the analysis.

4. An Application

In order to test our approach, we decided to use the data collected by KPA Ltd for the ‘ABC 2004 Annual Customer Satisfaction Survey’ and made available on the website ‘http://www.economia.unimi.it/statistica/CSProject/’ for the ‘Non Standard Analysis of Survey Data’ project.

Since the questionnaire was very long and a lot of information was collected, we decided to focus our attention only on the first part of the questionnaire, where performance evaluations regarding 28 features of ABC's products and services grouped in five areas (equipment, sales support, technical support, training, and supplies & media) were collected. Respondents were asked to indicate their degree of agreement with the statements by using a five-point semantic differential. The antonyms used to anchor each end of the scale were ‘strongly disagree’ (1) and ‘strongly agree’ (5).
Regarding the dependent variable to use in our analysis, we chose ‘Overall satisfaction level with ABC’ collected on a five-point anchored scale (1 = very low, 5 = very high) for both the relationships within data.B and data.T. We removed the four respondents with missing information on the overall variable, ending up with 262 respondents. Regarding the missing values among the explicative variables, we decided not to include in the analysis any variable with more than 20% of missing values. Therefore, a whole area (training) was excluded from the analysis because structural missing values. Table 2 lists the variables included in our analysis along with their distribution and number of missing values.

Based on the overall variable distribution, we created data.B from the two bottom categories (1, 2) of the five-point variables, while only the top category (5) was used to produce data.T. We computed all PPVs within both datasets, obtaining the dissatisfier table presented in Table 3 and thedelimiter table presented in Table 4.

The delimiter table seems to have a natural cutoff: only the first two attributes could be considered to have a high PPV, both of them related to performance of supplies. They are evident drivers of satisfaction/delight and the company might differentiate its offer from competitors based on them to enhance customer loyalty. We disregarded all attributes with PPV lower than 0.42.

We decided to use the same cutoff in analyzing the dissatisfier table, for which we do not have any natural and reasonable cutoff. Eight attributes have a PPV greater than 0.42 in the dissatisfier table. It is interesting to note that half of them belong to the technical support area, suggesting that this is definitely an area to be monitored and whose performances should be improved as they produce dissatisfaction.

### Table 2. Distribution of variables included in the analysis (n = 262).

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>NAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q1 Overall satisfaction level with ABC</td>
<td>4.2%</td>
<td>9.5%</td>
<td>26.7%</td>
<td>45.0%</td>
<td>14.5%</td>
<td>0</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q6 The equipment’s features and capabilities meet your needs</td>
<td>1.2%</td>
<td>9.3%</td>
<td>21.8%</td>
<td>55.3%</td>
<td>12.5%</td>
<td>5</td>
</tr>
<tr>
<td>q7 Improvements and upgrades provide value</td>
<td>4.3%</td>
<td>9.9%</td>
<td>28.5%</td>
<td>40.5%</td>
<td>16.5%</td>
<td>20</td>
</tr>
<tr>
<td>q8 Output quality meets or exceeds expectations</td>
<td>3.5%</td>
<td>10.5%</td>
<td>28.7%</td>
<td>45.7%</td>
<td>11.6%</td>
<td>4</td>
</tr>
<tr>
<td>q9 Uptime is acceptable</td>
<td>4.4%</td>
<td>9.9%</td>
<td>20.2%</td>
<td>46.0%</td>
<td>19.4%</td>
<td>10</td>
</tr>
<tr>
<td>Sales Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q12 Verbal promises have been honored</td>
<td>12.2%</td>
<td>13.9%</td>
<td>21.7%</td>
<td>35.2%</td>
<td>17.0%</td>
<td>32</td>
</tr>
<tr>
<td>q13 Sales personnel communicate frequently enough with you</td>
<td>14.8%</td>
<td>15.6%</td>
<td>22.5%</td>
<td>27.0%</td>
<td>20.1%</td>
<td>18</td>
</tr>
<tr>
<td>q14 Sales personnel respond promptly to requests</td>
<td>10.5%</td>
<td>15.1%</td>
<td>19.7%</td>
<td>30.1%</td>
<td>24.7%</td>
<td>23</td>
</tr>
<tr>
<td>q15 Sales personnel are knowledgeable about equipment</td>
<td>5.5%</td>
<td>10.2%</td>
<td>30.9%</td>
<td>35.6%</td>
<td>17.8%</td>
<td>26</td>
</tr>
<tr>
<td>q16 Sales personnel are knowledgeable about market opportunities</td>
<td>6.1%</td>
<td>10.8%</td>
<td>28.6%</td>
<td>35.5%</td>
<td>19.0%</td>
<td>31</td>
</tr>
<tr>
<td>Technical Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q18 Technical support is available when needed</td>
<td>7.4%</td>
<td>11.6%</td>
<td>15.1%</td>
<td>28.3%</td>
<td>37.6%</td>
<td>4</td>
</tr>
<tr>
<td>q19 The technical staff is knowledgeable</td>
<td>1.2%</td>
<td>6.2%</td>
<td>11.9%</td>
<td>30.4%</td>
<td>50.4%</td>
<td>2</td>
</tr>
<tr>
<td>q20 The technical staff is well informed about the latest updates</td>
<td>1.6%</td>
<td>6.7%</td>
<td>18.1%</td>
<td>33.5%</td>
<td>40.2%</td>
<td>8</td>
</tr>
<tr>
<td>q21 Parts are available when needed</td>
<td>5.4%</td>
<td>12.3%</td>
<td>19.2%</td>
<td>38.8%</td>
<td>24.2%</td>
<td>2</td>
</tr>
<tr>
<td>q22 The remote support care center is valuable/meets your expect.</td>
<td>20.4%</td>
<td>20.8%</td>
<td>26.0%</td>
<td>20.0%</td>
<td>12.8%</td>
<td>12</td>
</tr>
<tr>
<td>q23 Problems are resolved within the required time frame</td>
<td>14.3%</td>
<td>9.7%</td>
<td>22.0%</td>
<td>39.4%</td>
<td>14.7%</td>
<td>3</td>
</tr>
<tr>
<td>q24 The technical staff is courteous and helpful</td>
<td>0.8%</td>
<td>1.2%</td>
<td>5.0%</td>
<td>25.0%</td>
<td>68.1%</td>
<td>2</td>
</tr>
<tr>
<td>Supplies &amp; Media</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q32 Performance of supplies has consistently improved</td>
<td>4.1%</td>
<td>11.4%</td>
<td>40.0%</td>
<td>38.8%</td>
<td>5.7%</td>
<td>17</td>
</tr>
<tr>
<td>q33 ABC branded performance meets your expectations</td>
<td>5.5%</td>
<td>7.4%</td>
<td>39.6%</td>
<td>41.5%</td>
<td>6.0%</td>
<td>45</td>
</tr>
<tr>
<td>q35 Orders placed are delivered when promised and complete</td>
<td>2.0%</td>
<td>7.2%</td>
<td>14.5%</td>
<td>43.0%</td>
<td>33.3%</td>
<td>13</td>
</tr>
<tr>
<td>q36 The range of commercial consumables is sufficient</td>
<td>6.2%</td>
<td>20.3%</td>
<td>31.3%</td>
<td>35.7%</td>
<td>6.6%</td>
<td>35</td>
</tr>
</tbody>
</table>
The attribute ‘ABC branded performance meets your expectations’ has a high PPV in both tables. As it produces both dissatisfaction and satisfaction, we classified it as a performance attribute.

It is worth to note that the attributes have greater PPV in the dissatisfier table than in the delighter table. As a consequence, the attributes analyzed are better drivers of dissatisfaction than of satisfaction which, in fact, seems harder to predict. This could be due to an inappropriate structure of the questionnaire: important drivers of satisfaction have not been included.

A graphical representation of the findings is provided in Figure 4. The attributes are plotted according to their PPVs within the dissatisfier table (horizontal axis) and delighter table (vertical axis). The cutoff values (0.42 for both tables) are represented by dotted lines that divide the overall area in four regions. Each region identifies one of the four Kano’s category, according to the last paragraph of Section 3.1.

Table 3. Dissatisfier table based on PPV within data.B (n = 262).

<table>
<thead>
<tr>
<th>Variable</th>
<th>PPV</th>
<th>dissatisfied on item</th>
</tr>
</thead>
<tbody>
<tr>
<td>q20 The technical staff is well informed about the latest updates</td>
<td>0.62</td>
<td>21</td>
</tr>
<tr>
<td>q24 The technical staff is courteous and helpful</td>
<td>0.60</td>
<td>5</td>
</tr>
<tr>
<td>q9 Uptime is acceptable</td>
<td>0.50</td>
<td>36</td>
</tr>
<tr>
<td>q19 The technical staff is knowledgeable</td>
<td>0.47</td>
<td>19</td>
</tr>
<tr>
<td>q33 ABC branded performance meets your expectations</td>
<td>0.46</td>
<td>28</td>
</tr>
<tr>
<td>q8 Output quality meets or exceeds expectations</td>
<td>0.44</td>
<td>36</td>
</tr>
<tr>
<td>q7 Improvements and upgrades provide value</td>
<td>0.43</td>
<td>35</td>
</tr>
<tr>
<td>q18 Technical support is available when needed</td>
<td>0.43</td>
<td>49</td>
</tr>
<tr>
<td>q6 The equipment’s features and capabilities meet your needs</td>
<td>0.41</td>
<td>27</td>
</tr>
<tr>
<td>q35 Orders placed are delivered when promised and complete</td>
<td>0.39</td>
<td>23</td>
</tr>
<tr>
<td>q23 Problems are resolved within the required time frame</td>
<td>0.37</td>
<td>62</td>
</tr>
<tr>
<td>q12 Verbal promises have been honored</td>
<td>0.35</td>
<td>60</td>
</tr>
<tr>
<td>q32 Performance of supplies has consistently improved</td>
<td>0.32</td>
<td>38</td>
</tr>
<tr>
<td>q13 Sales personnel communicate frequently enough with you</td>
<td>0.30</td>
<td>74</td>
</tr>
<tr>
<td>q14 Sales personnel respond promptly to requests</td>
<td>0.30</td>
<td>61</td>
</tr>
<tr>
<td>q21 Parts are available when needed</td>
<td>0.30</td>
<td>46</td>
</tr>
<tr>
<td>q16 Sales personnel are knowledgeable about market opportunities</td>
<td>0.26</td>
<td>39</td>
</tr>
<tr>
<td>q15 Sales personnel are knowledgeable about equipment</td>
<td>0.24</td>
<td>37</td>
</tr>
<tr>
<td>q22 The remote support care center is valuable/meets your expectations</td>
<td>0.24</td>
<td>103</td>
</tr>
<tr>
<td>q36 The range of commercial consumables is sufficient</td>
<td>0.18</td>
<td>60</td>
</tr>
</tbody>
</table>
Table 4. Delighter table based on PPV within data $T(n = 262)$.

<table>
<thead>
<tr>
<th>Variable</th>
<th>PPV</th>
<th>Satisfied on item</th>
</tr>
</thead>
<tbody>
<tr>
<td>q32 Performance of supplies has consistently improved</td>
<td>0.57</td>
<td>14</td>
</tr>
<tr>
<td>q33 ABC branded performance meets your expectations</td>
<td>0.54</td>
<td>13</td>
</tr>
<tr>
<td>q9 Uptime is acceptable</td>
<td>0.41</td>
<td>49</td>
</tr>
<tr>
<td>q23 Problems are resolved within the required time frame</td>
<td>0.39</td>
<td>38</td>
</tr>
<tr>
<td>q20 The technical staff is well informed about the latest updates</td>
<td>0.35</td>
<td>102</td>
</tr>
<tr>
<td>q18 Technical support is available when needed</td>
<td>0.33</td>
<td>97</td>
</tr>
<tr>
<td>q6 The equipment's features and capabilities meet your needs</td>
<td>0.31</td>
<td>32</td>
</tr>
<tr>
<td>q7 Improvements and upgrades provide value</td>
<td>0.30</td>
<td>40</td>
</tr>
<tr>
<td>q8 Output quality meets or exceeds expectations</td>
<td>0.30</td>
<td>30</td>
</tr>
<tr>
<td>q16 Sales personnel are knowledgeable about market opportunities</td>
<td>0.30</td>
<td>44</td>
</tr>
<tr>
<td>q13 Sales personnel communicate frequently enough with you</td>
<td>0.29</td>
<td>49</td>
</tr>
<tr>
<td>q19 The technical staff is knowledgeable</td>
<td>0.28</td>
<td>131</td>
</tr>
<tr>
<td>q22 The remote support care center is valuable/meets your expectations</td>
<td>0.28</td>
<td>32</td>
</tr>
<tr>
<td>q12 Verbal promises have been honored</td>
<td>0.26</td>
<td>39</td>
</tr>
<tr>
<td>q15 Sales personnel are knowledgeable about equipment</td>
<td>0.26</td>
<td>42</td>
</tr>
<tr>
<td>q14 Sales personnel respond promptly to requests</td>
<td>0.25</td>
<td>59</td>
</tr>
<tr>
<td>q35 Orders placed are delivered when promised and complete</td>
<td>0.22</td>
<td>83</td>
</tr>
<tr>
<td>q24 The technical staff is courteous and helpful</td>
<td>0.21</td>
<td>177</td>
</tr>
<tr>
<td>q21 Parts are available when needed</td>
<td>0.19</td>
<td>63</td>
</tr>
<tr>
<td>q36 The range of commercial consumables is sufficient</td>
<td>0.07</td>
<td>15</td>
</tr>
</tbody>
</table>

5. Conclusions

In this manuscript, we introduced a new approach to characterize the customer requirements into the Kano's categories. It stands as an efficient and economic alternative to the original Kano’s approach because it does not require the same questions to be asked in two different ways. Indeed, it can be profitably exploited with the questionnaire structure commonly adopted for most of non-Kano customer/employee satisfaction surveys. This feature makes of our approach an appropriate tool for re-analyzing data collected in the past based on the powerful Kano et al. [9] idea.

Another positive aspect of our approach consists in the fact that by considering only the attributes with the highest PPV in order to identify the dissatisfiers, delighters, or performance attributes, we take the structure of the questionnaire into account. As a consequence, the researcher does not have to worry about the inclusion of less important items, as they will never get a high PPV.

Nevertheless our results are encouraging, they have to be considered part of a preliminary work. Future work will aim at acquiring a deeper comprehension of this approach. Among our priorities are studying the effect of the sample size on the robustness of the attributes classification and comparing the findings from our approach with attribute stated importance. Regarding the questionnaire structure, we would like to experiment...
alternative dependent variables (e.g., likelihood to buy or loyalty) and we would also like to understand whether the classification improves or not when adding a specific category labeled “delighted” or “outstanding” to each satisfaction/performance question. Finally, it would be useful to develop a better method for dealing with structural missing values as an alternative to the one outlined in this manuscript (Section 3.2).

![Figure 4. Attributes’ classification into the Kano’s categories.](image)

**References**


**Authors’ Biographies:**

**Roberto Furlan**, MS and PhD in Statistics, is Senior Methodologist at TNS Healthcare, Epsom, UK, a leading market research agency. He is responsible for the statistical needs of the division, for the statistical training of the researchers, and for the development and implementation of innovative methodologies. In addition, he collaborates with the Department of Statistics and Applied Mathematics ‘Diego De Castro’, University of Torino, Italy, where he supports PhD candidates. His main research interest is multivariate statistics, in particular conjoint analysis, with a strong orientation towards the practical aspects of statistics.

**Roberto Corradetti** is an Associate Professor of Statistics at the Department of Statistics and Applied Mathematics ‘Diego De Castro’, University of Torino, Italy. He is responsible for the statistics section of the department and he is also director of the Doctorate School of Business and Management at the University of Torino, Italy. His main research interest is statistics applied to quality control and customer satisfaction.