STRATEGIC PRICING OF ADDED FUNCTIONS BY INCORPORATING THE CUSTOMERS' UNCERTAIN JUDGMENTS

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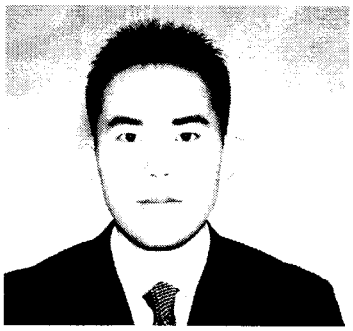

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ABSTRACT

Manufacturers often make distinctive products as their strategy to establish competitive advantage. They improve the performance of the basic functions or add some new functions. These newly added functions are called added functions(Remarks). This study has been made to propose a new method for setting up a logical price for these added functions. The procedure is as follows.

First, people to be studied are selected as representatives of potential customers, and they are asked to answer questionnaires to decide the price zones for the added functions according to their subjective evaluation. Secondly, these price zones are integrated by a linear model for information integration to obtain the representative price for the people being studied. This is a new method nonexistent so far.

Thirdly, the price elasticity of demand is obtained for this representative price. A new approach nonexistent so far has also been used here. Fourthly, these are integrated so that the manufacturer can set up a strategic price for the added functions logically.

1 Introduction

There are two specific features in customer's pricing of added functions. The first point is that pricing includes vagueness (it is shown with some range).

The second is that there is some variation in these price zones among those people being studied. Therefore, it is necessary for manufacturers to integrate these vague price zones with variation and obtain a representative price for all the people which had been studied. Thus, a strategic price for the added function is decided by further considering the price elasticity of demand for the representative price. This can be shown by the following conceptual relation.

$$\left(\begin{array}{l}\text{The representative}\\ \text{price of an added}\\ \text{function}\end{array}\right) + \left(\begin{array}{l}\text{Price}\\ \text{elasticity of}\\ \text{demand}\end{array}\right) = \left(\begin{array}{l}\text{Strategic price of}\\ \text{the added function}\end{array}\right)$$

The composition of this study is to first logically decide a representative price of an added function. The second is to consider the price elasticity of demand for this representative price to set up a flexible price. Thus, top management can decide a strategic price for the added function based on these obtained information.

2 The Pricing of Added Functions by Potential Customers

(1) The Conventional Pricing of an Added Function

Most of the conventional methods for pricing added functions have been to evaluate by comparing with similar/competitive functions from the producers' viewpoint.

However, the desirable method for pricing an added function from its characteristics is to select many people to be studied as representatives of potential customers and to integrate their price zones. There are such methods for the above as a method for evaluating the added functions by using the new Delphi method and some methods using fuzzy theory.

However, these methods have the following unsolved problem. That is, the representative price of the evaluated values (price zones) by the people

being studied often do not converge within an allowable range

The method mentioned in this paper can theoretically solve this problem Furthermore, more important than above, it can set up the price of the added functions flexibly and strategically by forecasting the price elasticity of demand for the added function taken up

(2) The Outline of This Method

The contents mentioned in this study are, first the method for calculating the representative price for the people being studied representing potential customers, and secondly the method for forecasting the price elasticity of demand The procedure is as shown in Fig 1

This concept will be mentioned according to the procedure shown in Fig 1

① Carrying Out a Study of the Actual State of the Drifting Zone

In general, when people being studied decide to purchase something, they will have already decided in their minds such prices at which they will certainly purchase when its price is equal to or less than a specific price a , and will certainly decide not to purchase when the price is equal to or more than a specific price b Therefore, it has been considered in this study that there exists a drifting price zone in-between a and b at which people will not be able to make up their minds whether to purchase or not to purchase

Thus, it has been clarified by this study the price zone for the added function to be evaluated at which people couldn't make up their minds whether to purchase or not to purchase by studying the prices a and b for individual persons studied

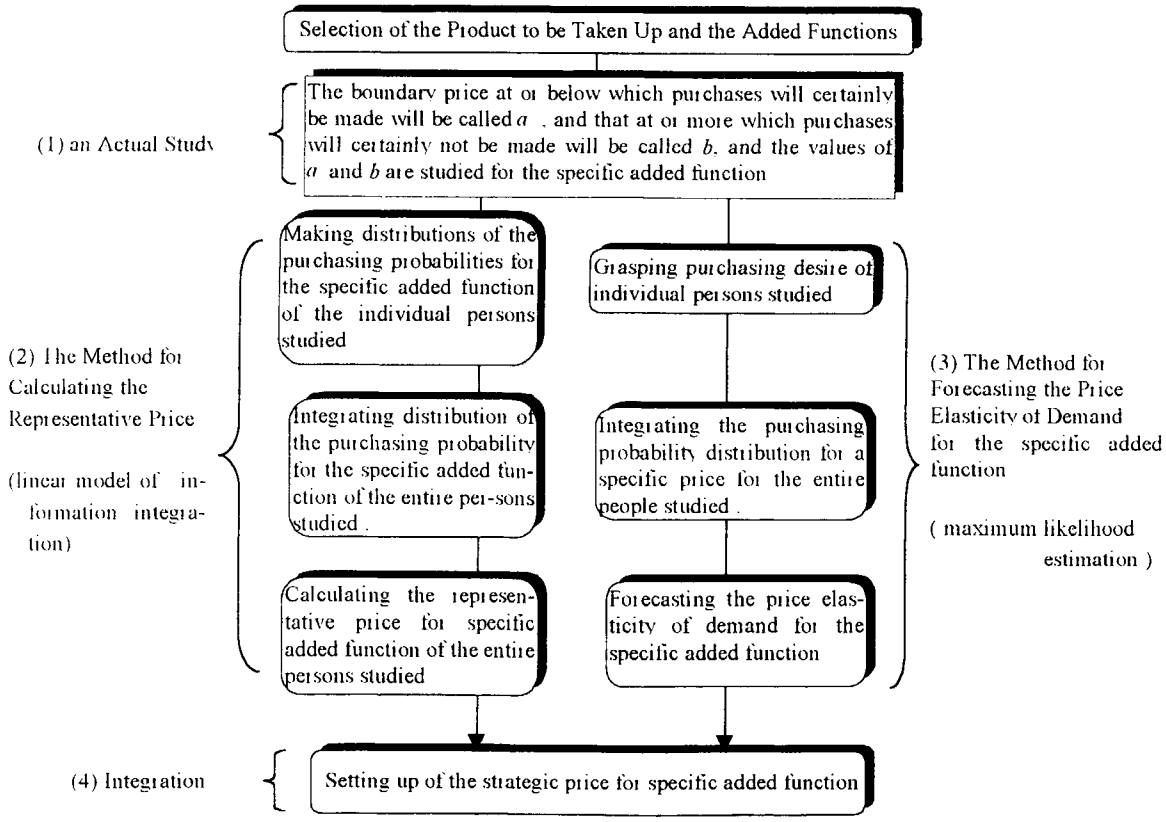

Fig 1 The setting up of a price for an added function

② The Method for Calculating the Representative price for the Entire Persons Studied from the Price Zones of individual Persons Studied

The following method was carried out to calculate the representative price for the entire persons studied from the price zones of the added function of individual persons studied First, the meanings of the price zones for individual persons studied should be fully utilized Secondly, for the price zones for the individual persons studied, the representative price for people studied should be integrated by giving high weight coefficients to those people studied with narrow ranges for the prices a and b

There are several methods for the above, but the linear model for information integration[5] was considered to be optimal , and was taken up

③ The Method for Forecasting the Price Elasticity of Demand

A reasonable price can be set up when the representative price of an added function is clarified by the linear model for information integration, but a new method of considering a strategic factor to the above has been devised and taken up in this study That is, the relation between the volume of demand and the price has been analyzed and the setting up of a strategic price by forecasting the price elasticity of demand has become possible The maximum likelihood estimation method[6] has been utilized in this study as the method for forecasting the price elasticity of demand

The main reason was that it has been considered that this method can show the desire of persons studied to purchase by a probability based on the decision of a price zone for an added function by devising the study method so that the maximum likelihood estimation method using vague information has been considered as the most appropriate method

④ The Setting Up of a Strategic Price for an Added Function

The representative price obtained from those people studied representing potential customers can be regarded as the standard price for the added function taken up If the price elasticity of demand obtained logically is added to this price, then the setting up of a strategic price will become possible That is, compared with the case of taking up the strategy of maintaining the standard price, when the price elasticity of demand is further considered , the most profitable price for the enterprise will become clear If such a price can be known, top management can make a managerial decision strategically Therefore, this method will be of great value for strategic pricing together with the strategy of product distinction

3 The Method for Calculating the Representative Price of an Added Function

(The Procedure for the Linear Model for Information Integration)

The procedure for calculating the representative price of an added function will be explained based on the following temporary hypothetical example

The price zones (the prices a and b) in which five people studied cannot make up their minds whether to purchase or not regarding a specific added function of a certain product are assumed to be as follows

person 1 a=8 0 , b=10 5
person 2 a=6 0 , b=7 5
person 3 a=5 0 , b=12 0
person 4 a=9 0 , b=10 0
person 5 a=7 0 , b=13 0

(1) The Distributions of the Purchasing Probabilities of the Individual Persons Studied

It is considered that the individual persons studied will purchase at some price within the price zone (between a and b) decided by the person himself/herself However, which price has a high possibility of actually being purchased is not known So, it has been considered in this study that the possible price of being purchased is uniformly distributed between a and b (see Fig 2)

(2) The Method for Calculating the Representative Price for the Entire Persons Studied

The representative price Z for the entire persons studied based on the price zones X_1, X_2, X_5 of an added function for persons 1,2, , 5 studied can be shown by Eq (1)

$$Z=c_1X_1+c_2X_2+ \cdots +c_5X_5$$
$$c_1+c_2+ \cdots +c_5=1,\ c_1\geq 0, c_2\geq 0, \cdots, c_5\geq 0 \quad (1)$$

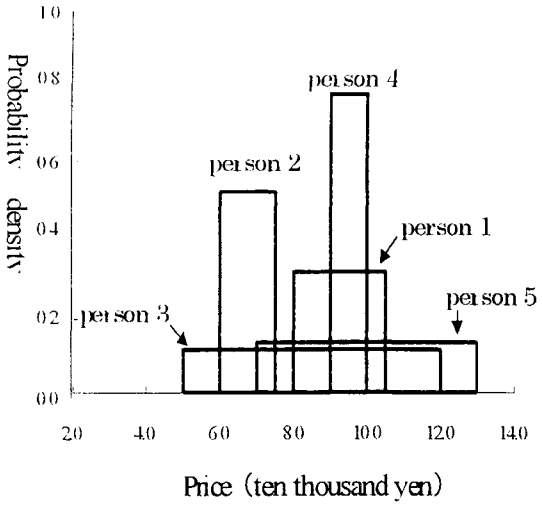

Fig 2 The Distribution of the price zone decided by the person himself/herself

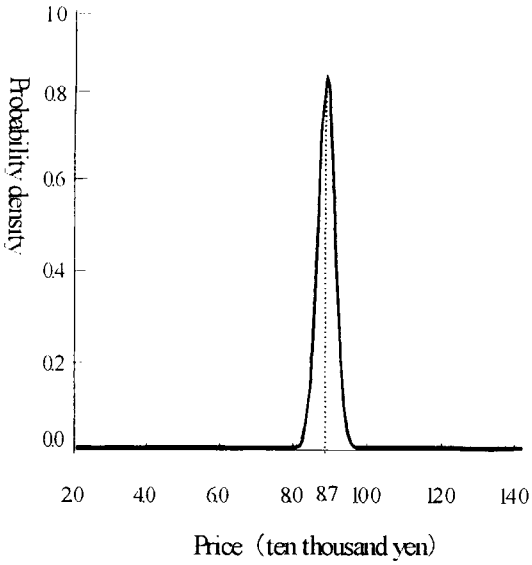

Fig 3 The Distribution of Calculating the Representative Price for the Entire Persons Studied

The thinking behind the linear model for information integration is to obtain Z by linearly integrating X_1, X_2, X_5 by the weighted means as in Eq (1) Next, the weight coefficients c_1, c_2, c_5 are obtained so as to make the variance of Z minimum

Let the means and the variances of the price zones X_1, X_2, X_5 of the added function be μ_1, μ_2, , μ_5 and σ_1, σ_2, , σ_5, respectively, then the weight coefficients c_1, c_2, c_5 of Eq (1) which minimize the variance of the integrated representative price Z for the entire persons studied can be expressed by Eq (2)

$$c_i=\frac{1/\sigma_i^2}{1/\sigma_1^2+1/\sigma_2^2+1/\sigma_3^2+1/\sigma_4^2+1/\sigma_5^2},\quad i=1,2,\ \cdots,5 \quad (2)$$

Eq (2) shows that the smaller the variance of the price zone of the each person studied, in other

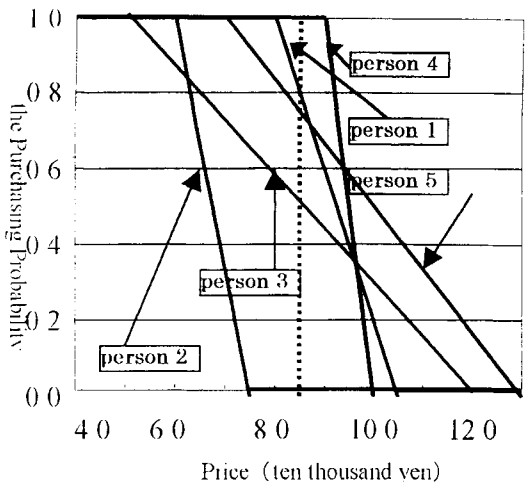

Fig 4 The relation between the purchasing desire and the price for each person studied

For example, when the price is set to be ¥85,000, and when the purchasing probabilities for persons studied 1 to 5 are expressed as r_1, r_2, , r_5, then from Fig 4, r_1= 0 8, r_2= 0, r_3= 0 5, r_4= 1, r_5= 0 75

When the purchasing probability for the person studied i is expressed by r_i, and i =1, 2, , n, then the purchasing probabilitiy for the entire persons studied are integrated and called the purchasing rate and is expressed by θ ($0 \leqq \theta \leqq 1$) The likelihood function $L(\theta)$ expressing the purchasing rate distribution becomes like Eq (4) [5]

$$L(\theta)=\{(1-r_1)(1-\theta)+r_1\theta\}\{(1-r_2)(1-\theta)+r_2\theta\}\cdots\{(1-r_n)(1-\theta)+r_n\theta\} \quad (4)$$

The following result was obtained by substituting r_1, r_2, , r_5 obtained from Fig 4 when the price is ¥ 85,000 into Eq (4)

$$L(\theta)=\{(1-0\,8)(1-\theta)+0\,8\,\theta\}\{(1-0)(1-\theta)+0\,\theta\}\{(1-0\,5)(1-\theta)+0\,5\theta\}\{(1-1)(1-\theta)+1\,\theta\}\{(1-0\,75)\theta+0\,75\,\theta\}$$
$$=\frac{1}{40}\theta(1+3\theta)(1-\theta)(1+2\theta) \quad (5)$$

The Value of the likelihood function $L(\theta)$ was obtained by varying the purchasing rate θ from 0 to 1 in Eq (5) The maximum likelihood estimator for the purchasing rate (the most reliable value for the purchasing rate) θ becomes 0 70 when the price is ¥85,000 This shows that a potential customer will make a purchase with probability 0 70

Similarly, the purchasing rates for the entire people studied will become as follows when the prices are ¥60,000, 65,000, , ¥100,000

Price (¥)	purchasing rate
65 000	1 00
70 000	1 00
75 000	0 76
80 000	0 74
85 000	0 70
90 000	0 58
95 000	0 00
100 000	0 00

The representative price for the added function in this hypothetical example was ¥87,300 (see Fig 3) The representative price elasticity of the demand for this case, that is the purchasing rate, was obtained as about 67% If this becomes known, then the purchasing rate will change about 3% by changing the price ¥1,000 around the actual central value of ¥87,300 A strategic price can be decided from such considerations

5 An Application of This Proposed Method

(1) Selection of the Product to be Taken Up and the Added Functions

The telephone for home use was selected as the object for study here, since it was considered as a durable consumer goods with many competitive products, and also with comparatively large roles for added functions

Added functions were collected from catalogues of 124 types of telephones made by 10 major telephone manufacturers sold in Japan during 1995～1996 in selecting the added function The following 6 comparatively important functions among them were selected The added functions and their abbreviations were as follows

- Record the contents of telephone calls
  (abbreviated as a voice-mail function)
- Display phone numbers
  (abbreviated as a visual [an LCD]display function)
- Possible of calling without holding the receiver
  (abbreviated as a speakerphone function)
- Ring a set time
  (abbreviated as an automatic wake-up call function)
- Make the primary receiver portable
  (abbreviated as a cordless phone function)
- Make the secondary receiver portable
  (abbreviated as an auxiliary cordless phone function)

(2) Carrying Out an Actual Study

The boundary price at or below which purchases will certainly be made will be called a, and that at or more which purchases will certainly be not made will be called b, and the values of a and b were studied The number of effective answers was 165

(3) The Calculation of the Representative Price of an Added Function by the Linear Model for Information Integration

When the linear model for information integration is applied according to the aforementioned procedure to the 165 people studied , the following representative prices for the entire people studied were obtained

Added Function (Abbreviation)	Representative Price (¥)
voice-mail function	3,690
visual display function	1,880
speakerphone function	2,500
automatic wake-up call function	840
cordless phone function	5,800
auxiliary cordless phone function	5,390

(4) The Forecasting of the Price Elasticity of Demand

The likelihood function values were obtained for the speakerphone function for every ¥400 according to the aforementioned procedure to the 165 people studied When the price was taken as the horizontal axis and the maximum likelihood estimator of the purchasing rate corresponding to the above was taken as the vertical axis, the

relationship between the price and the purchasing rate is expressed as in Fig 5

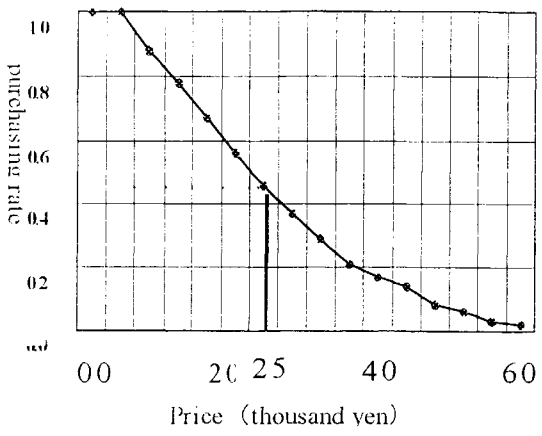

Fig 5 the Price Elasticity of Demand (speakerphone function)

The Setting Up of a Strategic Price for an Added Function

The representative price calculated for the speakerphone function was ¥2,500 as shown in (3) The purchasing rate corresponding to the price ¥2,500 was 44% in Fig 5 And it can be seen from Fig 6 that when the price is varied ¥400 centered around ¥2,500, the purchasing rate will change about 10% The actual price will be set based on the representative price and the change in the demand (purchasing rate) for this price change by considering management strategy

And, the manufacturing cost target for the taken up added functions can be set up at the development stage based on the price of the added functions set up as above

6 Conclusions

A new method for calculating the vague representative price of an added function for the entire people actually studied by integrating the price zones which vary among the people studied has been proposed Furthermore, a new method for forecasting the variation in the volume of demand corresponding to the increase and decrease in this representative price

The setting of a strategic price of an added functions and the manufacturing cost target at the development/design stage of similar products can be logically done by utilizing these methods And the methods proposed as a result of this study was applied to the price analysis of major added functions of home-use telephones and it has been found out that the obtained price was found to be able to become a guideline for it actual value, so these methods can be said to be both theoretically and practically effective

That is, the added function prices (representative prices) taken up or the entire people actually studied were calculated only by studying the two prices a and b for the people studied as having made clear from this application example Furthermore, the increase and decrease in the amount of demand corresponding to a change in this representative price were able to be logically forecast

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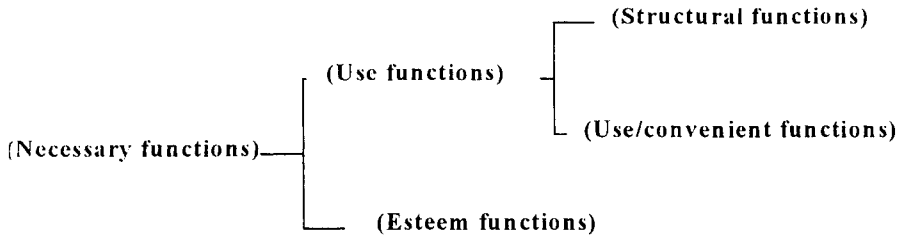
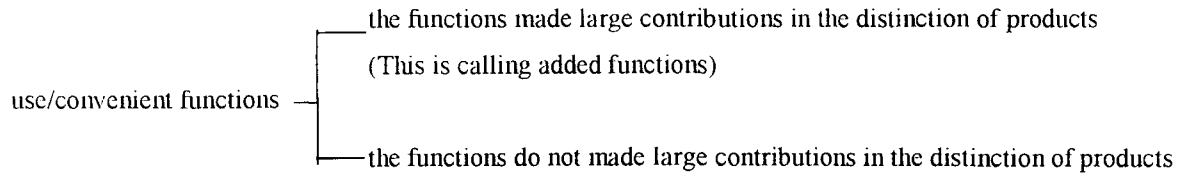
(Remarks) ·

Added functions and necessary functions have been classified in this paper as follows



The use/convenient functions are grossly classified as follows according to the degree of contribution to the distinction of products



In general, the degree of contribution of added functions to the distinction of products decrease with time and the degree of severity of competition The above discussions have been made by considering that the added functions taken up in this study made large contributions in the distinction of products