PRICING MANAGEMENT BETWEEN AIRCONDITIONER RETAIL PRICES AND SPECIFICATION FACTORS –APPLYING T(TAGUCHI) METHOD–

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***ABSTRACT*:** This paper analyzes the relationship between retail price and specification factors using T (Taguchi) method. So, the specifications factors data from catalogue , and retail price data from internet web data and prices for manufacturer's employee. The results show that effective factors are total weight , number of features ,cooling capacity ,COPs etc. There is different pricing decision management between mass merchant retail price and prices for manufacturer's employee.

KEYWORDS: T(1) method , unit norm(space), retail price, price for manufacturer's employee , air-conditioner, MT system ,MT distance

1. INTRODUCTION

This paper showed decision making concept of retail prices. Designer and product planning members decide the product's price, so called suggested retail price. Initially cost and target price are decided by manufacturers. But the buying power of retail-store (mass merchant) becomes big ,so store managers decide the real retail price. This price is decided between the suppliers price and stores' competitive prices. So, the minimum retail prices are chosen from the internet retail price web site (kakaku.com), and specification factors of air conditioners are chosen from manufacturer's catalogue data. Which factors are influenced to the retail price in relating store managers decisions are researched in using T(1) method of MT (Mahalanobis-Taguchi)system, that is pattern recognition thinking. Next, prices for manufacturer's employee also are analyzed. After that comparison and considerations are discussed.

2. METHODOLOGY

Taguchi's T(1) method is applied. This method is developed by Dr. Genichi Taguchi from late 1970. This method is applying to the wide areas , such as medical diagnosis, price of real estate and land , company management ,process engineering etc. T method has 3 types, T(1), T(2), T(3).and MT system has MT, MTA, TS, and T methods.

T(1) method 's steps are as follows.

(1) Definition of unit norm(space) ,and calculation of members average.
(2) Definition of signal data
(3) Normalization of signal data
(4) Proportional constant β are calculated
(5) Total estimation of each members output calculation
(6) Total estimation of SN ratio
(7) Evaluation of importance of items by using orthogonal array table (so called item selection)
(8) Total estimate for unknown data calculation
(9) Total estimate calculation

3. UNIT NORM(SPACE) AND SIGNAL DATA

The concept of unit norm and signal data is shown in

Fig.1. Unit norm is not extraordinary data. So unit norm is thought the new , good performance products, that is good COP(coefficient of performance). And, as another idea ,unit norm is average price of products.

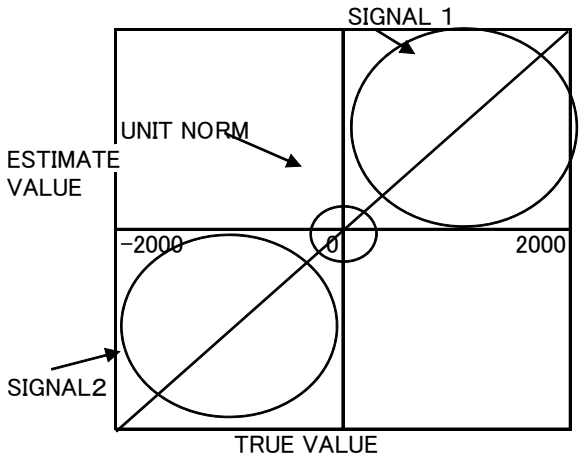

Fig.1CONCEPT OF UNIT NORM AND SIGNAL

Objective airconditioners are one selected manufacturer's models. Total airconditioners are 31 models, and unit norm are 3 models, and product specification are 11 factors from manufacturer's catalogue.

4. CASE1: APPLYING T(1)METHOD TO MINIMUM RETAIL PRICE ,UNIT NORM IS HIGH COP MODEL PRICE

Normalization of unit norm was done. Features data(x) and signal data (M) are subtracted by average . Orthogonal arrays characteristics values are calculated. Factors and gains of SN ratio of factors are calculated in Fig.2 and Table 1.

Here 1 is the factor should be used, 2 is the factors should not be used.

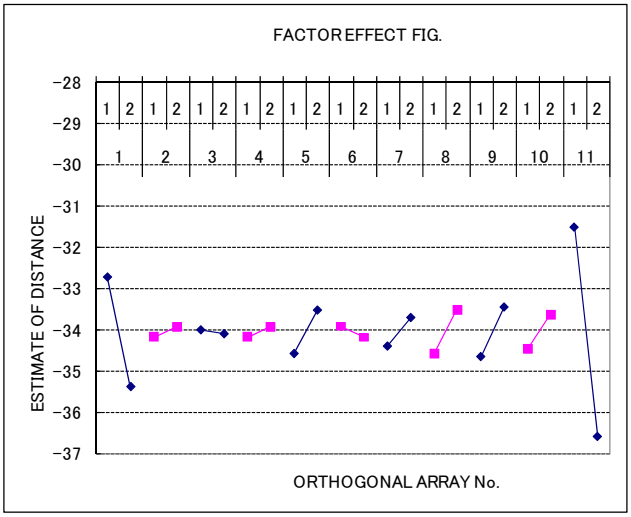

Fig.2 FACTOR EFFECT FIG.(MINIMUM PRICE ,HIGH COP PRICE UNIT NORM)

Table 1. SN RATIO GAIN SEQUENCE(MINIMUM PRICE ,HIGH COP PRICE UNIT NORM)

No	factor	gain	factor item
1	11	5.070749	weight
2	1	2.654221	no.of features
3	6	0.271662	cooling capacity
4	3	0.095151	heat consumption
5	2	−0.24825	heating capacity
6	4	−0.25465	heating COP
7	7	−0.69303	cool consumption
8	10	−0.84503	average COP
9	5	−1.05271	heating noise
10	8	−1.07571	cooling COP
11	9	−1.19952	cooling noise

So, 1 over 2 will be selected an appropriate factors.

The plus gain factors are indoor& outdoor total weight ,numbers of features ,cooling capacity , heating consumption electricity,

The estimation of true value is done by using 4 plus factors(11, 1, 6, 3) in Fig. 3.

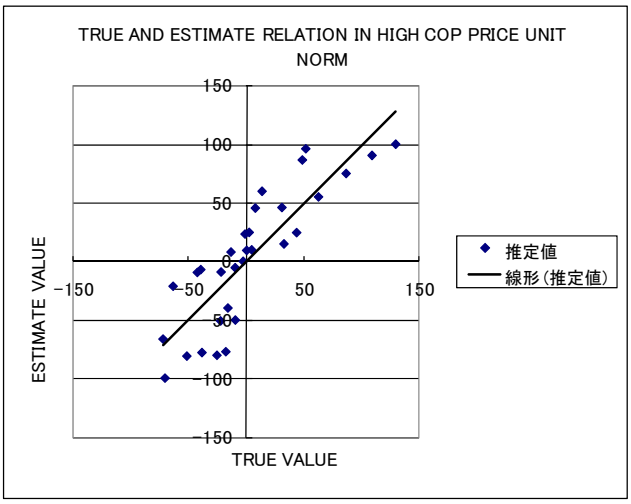

Fig. 3.MINIMUM PRICE COMPARISON (HIGH COP PRICE UNIT NORM)

Here the minus gain factors are heating capacity, heating COP, cooling consumption, average COP. heating noise, cooling COP, cooling noise.

Here SN ratio is -30.1 , sensitivity is -0.061.

These data scatter a little and approximate line of true value is line of 45 deg. angle, through 0 point.

Translating this data , products total weight is representing total dimensions size and total cooling & heating capacity.

Heating consumption is meant as heating capacity.

Managers of mass-merchant decide the price from size, numbers of features , cooling capacity.

The minimum prices of many mass-merchant decide from the mass-merchant profit structure from cost (suppliers' price) and competition of mass-merchant.

So, scatter is not so large.

In case 1, high COP models are adopted as unit norm , but it shows COPs are not effective factors. This fact should be considered. It may not appropriate that high COP models as unit norm in this case .

5. CASE2: APPLYING T(1)METHOD TO MINIMUM RETAIL PRICE ,UNIT NORM IS AVERAGE PRICE

Normalization of unit norm was done. Features data(x) and signal data (M) are subtracted by average . Orthogonal arrays characteristics values are calculated. Factors and gains of SN ratio of factors are calculated in Fig.4 and Table 2.

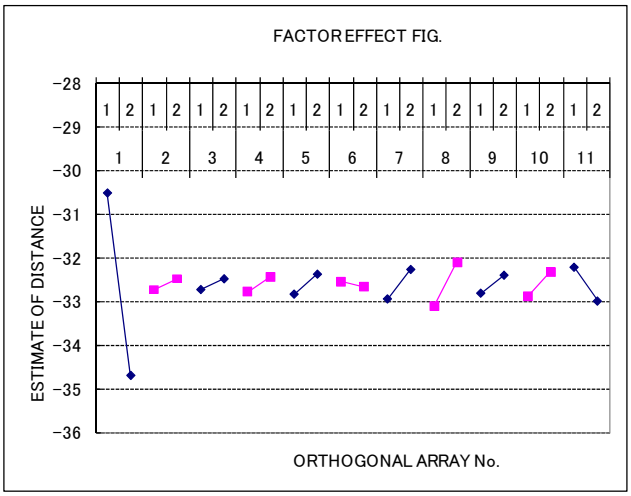

Fig.4 FACTOR EFFECT FIG.(MINIMUM PRICE ,AVERAGE PRICE UNIT NORM)

Table 2. SN RATIO GAIN SEQUENCE(MINIMUM PRICE ,AVERAGE PRICE UNIT NORM)

No	factor	gain	factor item
1	1	4.162771	no. of features
2	11	0.772584	weight
3	6	0.120227	cooling capacity
4	3	−0.2446	heat consumption
5	2	−0.24936	heating capacity
6	4	−0.34294	heating COP
7	9	−0.40996	cooling noise
8	5	−0.45566	heating noise
9	10	−0.54888	average COP
10	7	−0.67225	cool consumption
11	8	−1.00634	cooling COP

Here 1 is the factor should be used, 2 is the factors should not be used.

So, 1 over 2 will be selected an appropriate factors.

The plus gain factors are numbers of features ,indoor& outdoor total weight , cooling capacity.

The estimation of true value is done by using 3 plus factors(11, 1, 6,) in Fig. 5.

Here the minus gain factors are heating consumption electricity, heating capacity, heating COP, cooling noise, heating noise, average COP, cooling consumption, cooling COP.

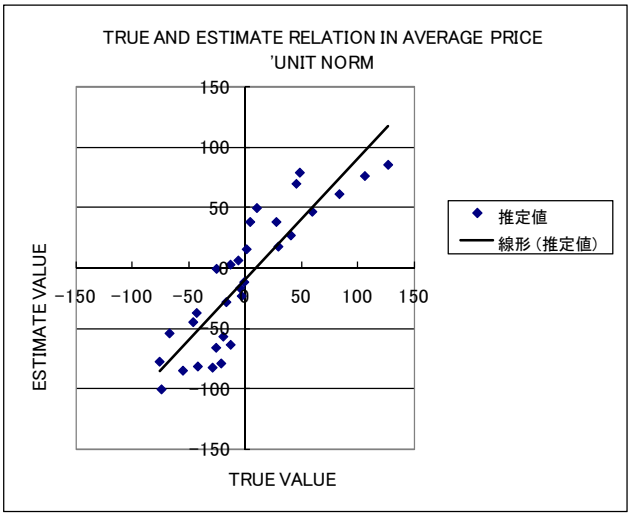

Fig. 5.MINIMUM PRICE COMPARISON (AVERAGE PRICE UNIT NORM)

Here SN ratio is -29.809 , sensitivity is -0.0563.

These data scatter a little and approximate line of true value is line of 45 deg. angle, through 0 point.

Translating this data , numbers of features affect prices, and products total weight is representing total dimensions and total cooling & heating capacity. And cooling capacity also affect the price.

Managers of mass-merchant decide the price from numbers of features , size, cooling capacity.

The minimum prices of many mass-merchant decide from the mass-merchant profit structure from cost (suppliers' price) and competition of mass-merchant.

So, scatter is not so large.

This price estimation formula (M2) is calculated as follows.

M2=2.488381(no.of features-23.8) +2.99026(weight-49)+11.59294(cooling capacity-4.32)+124.146

6. CASE3: APPLYING T(1)METHOD TO PRICE FOR MANUFACTURE EMPLOYEE ,UNIT NORM IS AVERAGE PRICE (1 MODEL)

Unit norm is 1 model near average price.

Normalization of unit norm was done. Features data(x) and signal data (M) are subtracted by average . Orthogonal arrays characteristics values are calculated. Factors and gains of SN ratio of factors are calculated in Fig.6 and Table 3.

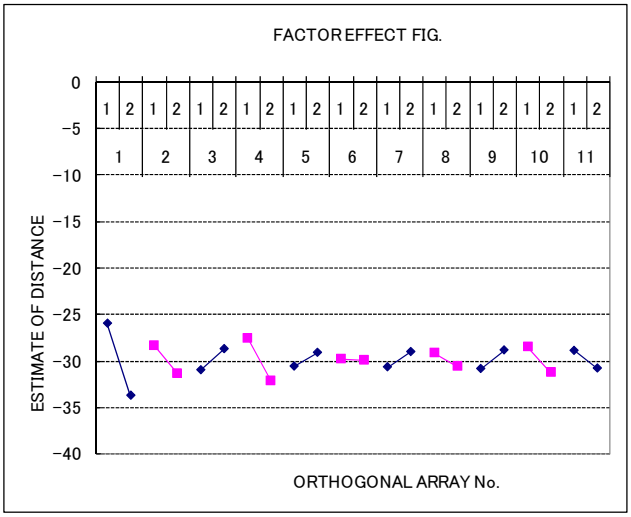

Fig.6 FACTOR EFFECT FIG.(MANUFACTURER EMPLOYEE PRICE ,AVERAGE PRICE UNIT NORM)

Table 3. SN RATIO GAIN SEQUENCE (MANUFACTURER EMPLOYEE PRICE , AVERAGE PRICE UNIT NORM)

No	factor	gain	factor item
1	1	7.760232	no. of features
2	4	4.567761	heating COP
3	2	2.988558	heating capacity
4	10	2.669825	average COP
5	11	1.898715	weught
6	8	1.4667	cooling COP
7	6	0.173268	cooling capacity
8	5	−1.47646	heating noise
9	7	−1.64123	cool consumption
10	9	−2.00576	cooling noise
11	3	−2.272	heat consumption

Here 1 is the factor should be used, 2 is the factors should not be used.

So, 1 over 2 will be selected an appropriate factors.

The plus gain factors are numbers of features , heating COP, heating capacity, average COP, weight, cooling COP, cooling capacity.

The estimation of true value is done by using 7 plus factors(1,4,2,10,11,8,6) in Fig. 7.

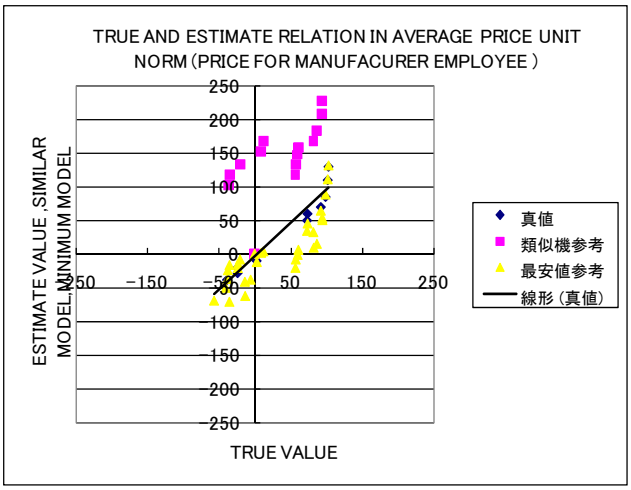

Fig. 7 MANUFACTURER EMPLOYEE PRICE COMPARISON (AVERAGE PRICE UNIT NORM)

Here the minus gain factors are heating noise, cooling noise, cooling consumption, heating consumption.

Here SN ratio is -24.277 , sensitivity is -0.0232.

This scatters a little and approximate line of true value is line of 45 deg. angle, through 0 point.

The minimum price data are near, but similar ,brand new models prices are different.

Translating this data , price for manufacturer employee is based company product cost .Because numbers of features affect prices. In design of airconditioner , high COP model has high cost.

In Japanese weather condition, heating capacity should be higher than cooling capacity. So heating capacity decide the dimension size of airconditioner mainly. Weight also is representing the product size, that is, heat exchanger size, and compressor size.

We understand manager of mass-merchant evaluate cooling capacity, but manager of manufacturer employees' price evaluate heating capacity and COPs.

This price estimation formula (M3) is calculated as follows.

M 3=2.876809(no. of features-15) +5.177086(heating capacity-5)+ 2.247396(heating cop-3.012048) +1.048973(cooling capacity-5) +1.17661(cooling cop-2.762431) +1.937919(average cop-2.88724) +2.77958(weight-48)+128

7. COMPARISON AND RELATED ISSUES

7.1 Comparison

The factors of 3 cases are shown in Table 4.

Table 4. COMPARISON OF 3CASES' RESULTS

SALES TYPE	UNIT NORM	PLUS FACTOR	MINUS FACTOR
RETAIL	HIGH COP	11,1,6,3	9,8,5,10,7,4,2
RETAIL	AVERAGE PRICE	1,11,6	8,7,10,5,9,4,2,3
MANU.EMPLOY	AVERAGE PRICE	1,4,2,10,11,8,6	5,7,9,3

Retail and manufacturer employee price have different plus factors except 1(no. of features), 6(cooling capacity), 11(weight). Retail price is cooling capacity(as basic quality) oriented. Manufacturer employee price is cost (derived from COP, heating capacity) oriented

The estimated price formula are as follows.

M2=2.488381(no.of features-23.8) +2.99026(weight-49)+11.59294(cooling capacity-4.32)+124.146

M 3=2.876809(no. of features-15) +5.177086(heating capacity-5)+ 2.247396(heating cop-3.012048) +1.048973(cooling capacity-5) +1.17661(cooling cop-2.762431) +1.937919(average cop-2.88724) +2.77958(weight-48)+128

Comparison of factors contribution is shown in Table 5.

Table 5. COMPARISON OF FACTORS CONTRIBUTION

factor item	comparison of coefficient	ratio of coefficient M3/M2
no. of features	M2＜M3	1.156
weight	M2＞M3	0.930
cooling capacity	M2＞M3	0.090
heating capacity	−＜M3	∞
cooling COP	−＜M3	∞
heating COP	−＜M3	∞
average COP	−＜M3	∞

Price variation with cooling capacity and with

no. of features are shown in Fig. 8 & 9, that is, value line curve.

Cooling capacity's contribution is larger in M2.

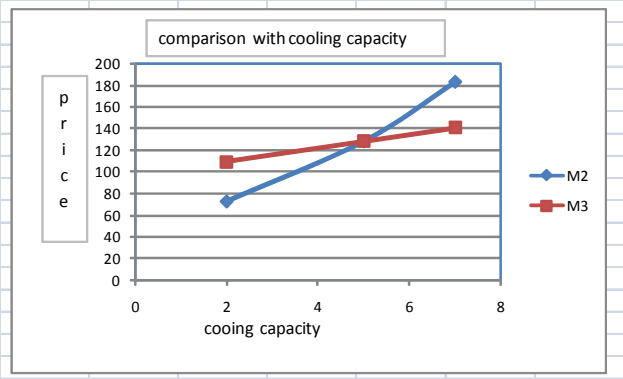

Fig. 8 PRICE COMPARISON WITH COOLING CAPACITY

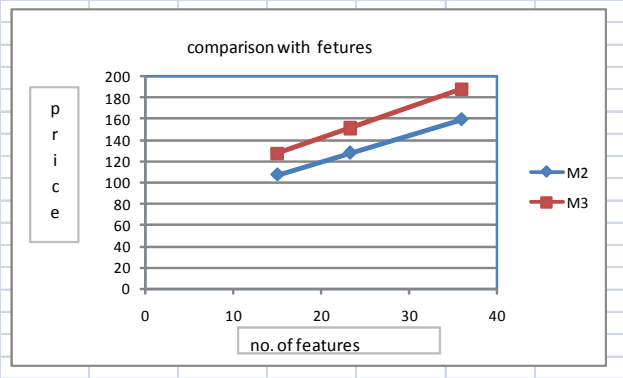

Fig. 9 PRICE COMPARISON WITH NO. OF FEATURES

In the both equations, no. of features and weight have almost same contribution, but cooling capacity 's contribution of M2(minimum retail price) is higher than M3(manufacture employee price) by 10 times.

This shows minimum retail price is cooling capacity, no. of features & weight (as basic quality) oriented by mass merchant and manufacturer employee price is cost (derived from COPs, &heating capacity) oriented by manufacturer.

7.2Future issues

Future issues are as follows.

(1) Evaluate the time series data will be measured speed of models commodity change.

(2) Unit norm's propriety.

(3) Integrate these total data as one formula.

8. CONCLUSION

Decision making concept between prices and factors are different among sales managers and manufacturers managers .

Conclusions are as follows.

(1)Taguchi's T(1) method is applied to the airconditioner prices and factors

(2)Case 1 (retail minimum price , unit norm is high COP model):Contributions of factors are weight, numbers of features, cooling capacity, heating consumption. Unit norm's propriety should de considered.

(3)Case 2 (retail minimum price ,unit norm is average price model):Contributions of factors are numbers of features, weight, cooling capacity,

(4)The managers of mass-merchant decide the price from total size(weight), numbers of features ,cooling capacity , so that is same as consumers thinking normally. Decision of the minimum price is not considered the point of save-energy (COPs), noise level. Minimum price is judged only basic quality factors.

(5)Case 3 (manufacturer employee's price ,unit norm is average price model):Decision of price is considered the cost of product. Contributions of factors are numbers of features, product COPs, cooling & heating capacity,

(6)The estimated price formula are as follows.

M2=2.488381(no.of features-23.8) +2.99026(weight-49)+11.59294(cooling capacity-4.32)+124.146

M 3=2.876809(no. of features-15) +5.177086(heating capacity-5)+ 2.247396(heating cop-3.012048) +1.048973(cooling capacity-5) +1.17661(cooling cop-2.762431) +1.937919(average cop-2.88724) +2.77958(weight-48)+128

Comparison of factors contribution is shown in Table

5. Comparison of value line are shown in Fig.8&9. This shows minimum retail price is cooling capacity, no. of features & weight (as basic quality) oriented and manufacturer employee price is cost (from COPs & heating capacity) oriented.

Next future issues are as follows.

(1) The unit norm is selected high COP model, as non-commodity model, because manufacturer are developing strongly , and average price model. Both unit norm cases are almost same results. Are there any other appropriate unit norm? High COP models may not appropriate. Average price model may appropriate as unit norm for mass sales models.

(2) Structures of decision making prices are understandable in case of one special manufacturers model . Other manufacturers model will be researched near future , and we need to compare.

(3) The translation of total SN ratio and sensitivity.

In future as the tool of management, such as marketing and product plan, we would like to expedite to deploy to the researchers et al, too.

REFERENCES

1) Ohken: multi-dimensional information system data analysis software