

COMPARISON OF PRICE COMPETITIVENESS OF AIRCONDITIONER –APPLYING T(TAGUCHI) METHOD BETWEEN RETAIL PRICE AND SPECIFICATIONS –

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ABSTRACT: This paper gives application of T (Taguchi) method to the relationship between retail price and specification factors of airconditioners. So, the specifications factors data from catalogue, and retail price data from internet web data and retail store as mass-merchant. The results show that effective factors are some specification factors, some manufacturer, some stores. There are cost competitiveness and brand power between mass merchant and manufacturer's route store, and each manufacture.

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 price competitiveness. 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 retail prices are chosen from the internet minimum retail price web site (kakaku.com), mass-merchant store price, manufactures route store price, 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. 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 as average data.

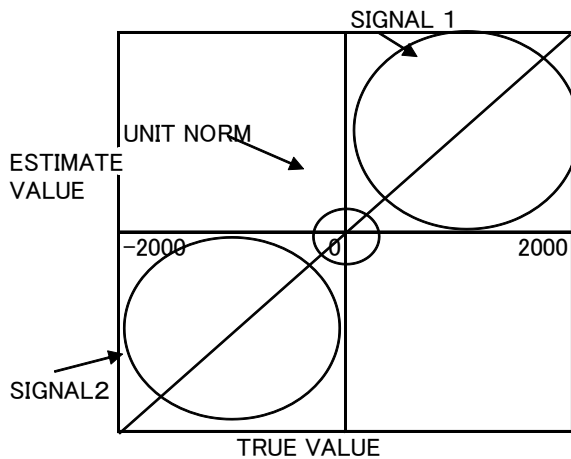


Fig.1 CONCEPT OF UNIT NORM AND SIGNAL

Objective airconditioners are two selected manufacturer's models. Total airconditioners are 177 time-related models, and product specification are 12 factors from manufacturer's catalogue. No. of factors stores manufacturers are 7.

4. BACKGROUND , OBJECTIVE AND HYPOTHESIS

As the factors which determines the appliance prices ,there are brand status ,cost competitiveness, price decision strategy of sales stores (such as mass-merchant etc) specification factors , timing of sales start , time duration past sales-start (that is, ratio of change of commodity).

Thinking these factors ,I analyze the product competitiveness from prices.

Hypothesis are ① manufactures have different brand power and cost power. ② stores have different price strategies. ③ high

price setting are from high quality and high performance of specifications. ④ new year model is evaluated highly rather than old model. ⑤ new model's price will decrease with time duration.

The prerequisite conditions are ① selection 2 manufacturers ② sales stores are small manufacturer's route store, middle size mass-merchant, and internet minimum retail web site. ③ price timing are April and August in 2009. ④ products models are 2009, partially 2008 model. ⑤

Specifications are from manufacturers catalogue ,and numbers of features, compressor output, total weight, model year, heating capacity, heating consumption, cooling & heating noise, cooling COP, heating COP, average COP, are selected. In the specifications, no. of features are different from manufacturers. So, I adjusted the maximum no. of features to the same numbers, because no. of features are effective factor in each manufacturers' calculation, but in the case of synthesis of manufacturers, no. of features is not effective . ⑥ manufacturer name and store name are input as dummy factors ,such as 1 or 0.

Unit norm(space) is used average value . So, I analyze 19 factors, and 177 data.

5. RESULT OF APPLICATION TO AIRCONDITIONER PRICE

Applied data is shown Table 1.

Table 1. INPUT DATA ,19 FACTORS AND TOTAL 177 DATA

メーカー	メーカーID	修正特許 数/1.7	販売能力	消費電力 COP	騒音	冷凍能力	消費電力 COP	騒音2	平均COP	質量計	年度	圧縮機出力	価格月	ネット最低 価格	中壁裏版 度	メーカー 系列	価格	
1	0	12 45675	2.2	385	5.14286	45.5	2.2	450	4.835185	45.5	5.274725	29	2009	600	4	1	0	31.16
1	0	12 45675	2.5	435	5.747126	45.5	2.5	520	4.807692	45.5	5.277409	33	2009	750	4	1	0	41.49
1	0	12 45675	2.8	535	5.236465	45.5	2.8	610	4.930164	45.5	5.280006	36	2009	900	4	1	0	52.32
1	0	12 45675	2.8	535	5.236465	45.5	2.8	610	4.930164	45.5	4.911904	36	2009	750	4	1	0	45.7
1	0	12 45675	2.8	520	5.384615	45.5	2.8	630	4.444444	45	4.91453	36	2009	750	8	1	0	48.78
1	0	12 45675	2.8	450	5.659286	45.5	2.8	630	4.444444	45	5.277778	36	2009	750	4	1	0	48.78
1	0	14 53287	2.2	390	5.641026	45.5	2.2	445	4.94382	45	5.292423	32	2009	600	4	1	0	52.5
1	0	12 45675	2.5	435	5.747126	45.5	2.5	520	4.807692	45.5	5.277409	33	2009	750	4	1	0	54.9
1	0	14 53287	2.5	465	5.617638	46	2.5	505	4.90626	45.5	5.284236	36	2009	600	4	1	0	55.7
1	0	12 45675	4.2	1000	4.2	47	3.6	1040	3.481538	46	3.830769	36	2009	950	4	1	0	62.62
1	0	12 45675	2.8	450	5.384615	45.5	2.8	630	4.444444	45	4.74823	36	2009	750	4	1	0	65.4
1	0	12 45675	2.2	395	5.66862	45.5	2.2	440	5	45	5.28481	28	2008	600	4	0	1	64.6
1	0	12 45675	5	1210	4.132231	47	4	1130	3.338823	46	3.836027	44	2009	1100	4	1	0	66.8
1	0	14 53287	2.2	385	5.714286	44.5	2.2	450	4.888889	43.5	5.301587	32	2009	600	4	1	0	67.8
1	0	14 53287	2.2	385	5.714286	45.5	2.2	450	4.888889	45.5	5.301587	32	2009	600	4	1	0	68
1	0	14 53287	3	565	5.309735	46	2.8	620	4.516129	45.5	4.912932	37	2008	750	4	1	0	68.4
1	0	12 45675	5	1210	4.132231	47	4	1130	3.338823	46	3.836027	44	2009	1100	8	1	0	69.78
1	0	14 53287	2.5	440	5.681818	46	2.5	510	4.901961	45.5	5.291889	36	2009	750	4	1	0	71
1	0	12 45675	2.5	450	5.595268	45.5	2.5	500	5	45.5	5.277778	36	2009	750	4	1	0	72.8
1	0	14 53287	2.5	460	5.37143	46	2.5	520	4.48	45	4.918571	37	2009	750	8	1	0	77.2
1	0	12 45675	2.2	385	5.714286	45.5	2.2	455	4.835165	45.5	5.274725	29	2009	600	4	1	0	77.8
1	0	14 53287	4.2	900	4.421053	47.5	3.6	1015	3.546798	46.5	3.883925	37	2009	950	4	1	0	81.7
0	1	14	2.8	495	5.66	46	2.5	510	4.9	46.5	5.28	40.5	2009	600	4	1	0	83.77
0	1	14	2.8	500	5.233465	45.5	2.8	610	4.590164	45	4.911904	36	2009	750	4	1	0	84.8
0	1	14 18685	2.2	385	5.714286	44	2.2	450	4.888889	43.5	5.301587	33.5	2009	600	4	1	0	85.39
0	1	20 41522	2.5	390	6.102264	45	2.2	445	5.333333	44	5.292223	41	2009	600	4	1	0	85.72
0	1	20 41522	2.8	470	5.957447	44.5	2.5	470	5.319149	44.5	5.338208	43	2008	750	4	1	0	87.39
0	1	12 45675	2.8	520	5.384615	45.5	2.8	630	4.444444	45	5.292423	32	2009	600	4	1	0	87.8
0	1	14	3.2	605	5.29	47	2.8	620	4.52	47.5	4.905	40.5	2009	600	8	1	0	87.9
0	1	12 45675	5	1210	4.132231	47	4	1130	3.338823	46	3.836027	44	2009	1100	4	1	0	89.8
0	1	20 41522	2.5	390	6.102264	45	2.2	445	5.333333	44	5.292223	41	2009	600	4	1	0	89.8
0	1	14 53287	2.2	390	5.641026	45.5	2.2	445	4.94382	45	5.292423	32	2008	600	4	1	0	90.8
0	1	20 0692	2.5	460	5.633333	43.5	2.2	440	5	45	5.292423	32	2009	600	8	1	0	91.1
0	1	20 0692	2.5	460	5.633333	43.5	2.2	440	5	45	5.292423	32	2009	600	8	1	0	91.8
0	1	14 53287	4.2	955	4.397906	47.5	3.6	1030	3.495146	46.5	3.946256	37	2009	950	8	1	0	92.2
0	1	14 53287	4.2	955	4.397906	47.5	3.6	1030	3.495146	46.5	3.946256	37	2009	950	8	1	0	92.65
0	1	20 41522	2.8	445	6.292135	44.5	2.5	410	6.097561	43	6.194848	57	2008	750	4	1	0	92.65
0	1	20 0692	2.5	420	6.097561	43.5	2.2	430	6.097561	43	6.097561	57	2008	750	4	1	0	92.65
0	1	14 18685	2.5	445	5.617978	45	2.5	505	4.904949	44.5	5.284236	37.5	2009	750	4	1	0	96.99
0	1	12 45675	2.8	520	5.384615	45.5	2.8	630	4.444444	45	5.284236	36	2009	750	8	1	0	97.9
0	1	20 0692	3	550	5.454545	46	2.8	555	5.054045	44.5	5.249795	46	2009	750	8	1	0	98.6
0	1	14	2.8	495	5.66	46	2.2	445	5.2	46	5.28	40.5	2009	600	4	1	0	99.4
0	1	14 53287	2.5	445	5.617978	46	2.5	505	4.904949	45.5	5.284236	38	2009	750	4	1	0	99.8
0	1	20 0692	2.5	450	5.333333	44.5	2.2	445	5.333333	44	5.333333	38.5	2009	600	4	1	0	100
0	1	20 41522	2.5	410	6.097561	43.5	2.2	405	5.432099	43	5.76483	43	2009	600	4	1	0	102
0	1	20 41522	4.2	985	4.370741	47.5	3.6	1035	3.67	46	4.52	38.5	2009	950	8	1	0	102.574
0	1	14	4.2	985	4.35	47	3.6	1105	3.28	47	3.805	40.5	2009	600	8	1	0	102.574
0	1	14	2.8	495	5.66	47	2.8	635	3.83	47	3.83	40.5	2009	600	4	1	0	102.8
0	1	12 45675	5	1210	4.132231	47	4	1130	3.338823	46	3.836027	44	2009	1100	4	1	0	104.8
0	1	12 45675	6	1590	3.733883	47.5	5	1800	2.777778	47.5	3.25681	48	2009	1500	8	1	0	104.86
0	1	12 45675	6	1590	3.733883	47.5	5	1800	2.777778	47.5	3.25681	48	2009	1500	8	1	0	104.86
0	1	14	2.8	495	5.66	46	2.5	510	4.9	46.5	5.28	40.5	2009	600	4	1	0	106
0	1	20 0692	2.5	460	5.633333	43.5	2.2	440	5	45.5	5.146667	39.5	2009	750	4	1	0	107.7
0	1	14 18685	3	525	5.714286	46	2.8	610	4.590164	45.5	5.152225	39.5	2009	750	4	1	0	107.7
0	1	12 45675	4.2	1000	4.2	47	3.6	1040	3.481538	46	3.830769	36	2009	950	4	1	0	109
0	1	12 45675	3.2	495	6.597193	45.5	3.2	465	6.063636	44	6.738767	46	2009	750	4	1	0	109
0	1	14 53287	3	565	5.309735	46	2.8	620	4.516129	45.5	4.912932	37	2008	750	4	1	0	109.8
0	1	14 53287	3	565	5.309735	46	2.8	620	4.516129	45.5	4.912932	37	2008	750	4	1	0	109.8
0	1	20 0692	4.2	905	4.480884	47	3.6	900	4	45.5	4.320442	46	2009	950	8	1	0	110.89
0	1	20 0692	4.2	905	4.480884	47	3.6	900	4	45.5	4.320442	46	2009	950	8	1	0	110.89
0	1	14	2.8	495	5.66	46	2.2	445	5.2	46	5.28	40.5	2009	600	4	1	0	112
0	1	14 53287	2.5	445	5.617978	46	2.5	505	4.904949	45.5	5.284236	38	2009	750	4	1	0	112.8
0	1	20 41522	2.5	390	6.097561	43.5	2.2	440	5.432099	43	5.76483	43	2009	600	4	1	0	114
0	1	14	3.2	605	5.29	47	2.8	620	4.52	47.5	4.905	40.5	2009	600	3	1	0	114
0	1	14 18685	2.2	385	5.714286	44	2.2	450	4.888889	43.5	5.301587	33.5	2009	600	4	1	0	114.8
0	1	21 79931	2.5	390	6.102264	45												

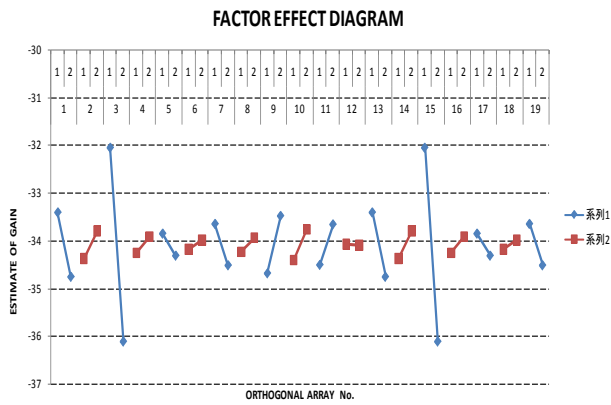


Fig.1 FACTOR EFFECT DAIGRAM

I selected the factors from the factor-effect diagram ,and did the item selection and calculation. So ,price equation's coefficients (that is, sensitivity) and constant data (that is, unit norm data) are shown in Table 2.

Table.2 FACTORS ,GAIN,ESTIMATE EQUATION'S COEFFICIENT AND CONSTANT

FACTOR	GAIN	COEFFICIENT	CONSTANT OF UNIT NORM
MAKER A	1.348742031	-15.1595	0.857143
MAKER B	-0.562165619	0	0.142857
NO. OF FEATURES REVISED	4.059252632	4.368279	21.15818
HEATING CAPACITY	-0.330145685	0	4.557143
HEAT CONSUMPTION	0.462200271	0.023939	937.8571
HEAT COP	-0.189577825	0	5.155114
HEATING NOISE	0.867837199	7.402042	46.85714
COOLING CAPACITY	-0.294752822	0	3.7
COOL CONSUMPTION	-1.202313081	0	870
COOL COP	-0.621749338	0	4.561305
COOL NOISE	-0.846846191	0	45.71429
AVERAGE COP	0.025414844	-2.98042	4.85821
TOTAL WEIGHT	1.348742031	1.112137	53.5
MODEL YEAR	-0.562165619	0	2008.571
COMPRESSOR OUTPUT	4.059252632	0.024768	1021.429
DURATION TIME	-0.330145685	0	4.571429
INTERNET WEB STORE MINIMUM	0.462200271	-18.5082	0.714286
MIDDLE SIZE MASS-MERCHANT	-0.189577825	0	0.285714
MAKER ROUTE STORE	0.867837199	32.0718	0
			148.23

Comparison between true and estimate is shown in Fig.2.

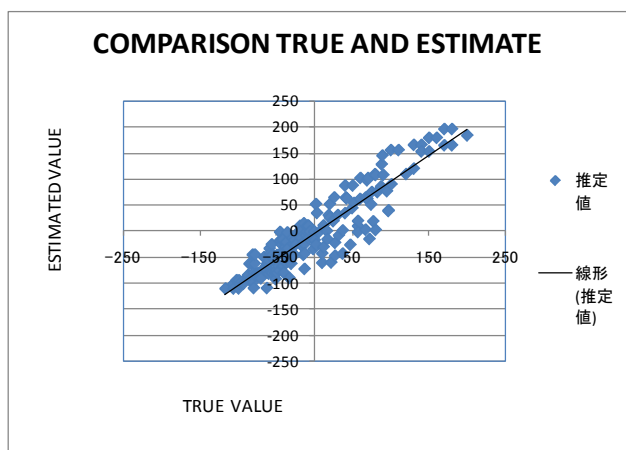


Fig.2 COMPARISON TRUE AND ESTIMATE

6. RESULT OF COMPETITIVENESS OF AIRCONDITIONER PRICE

The conclusions are as follows.

- 1) Manufacturer B is as standard ,then manufacturer A is priced lower by 15k¥. This is translated that A is cost –competitive, B is priced higher ,so B has the brand power ,but is not cost-competitive. We can not decide which factor is more effective.
- 2) Middle size mass merchant price is standard ,and manufacturer route sales store price is higher by 32k¥. Internet web site minimum price is lower by 18.5k¥.
- 3) There is not different with products sales start year, and duration time from these models sales-start . These factors maybe effective ,but I guess the larger randomness of data conceal the factor effects.
- 4) In the specifications, no. of features ,compressor output, total weight, heating consumption, heating noise, average COP are effective, we guess these are reasonable. This is similar results of former report.
- 5) Coefficient of COP is minus ,so better performance corresponds lower price. I guess manufacturer makes high performance products ,

but manufacturer and sales store can not put the higher price.

- 6) In this case I tried to evaluate two manufacturers, and 3 kinds stores, and we can expand this method to many manufacturers and many stores.

7. CONCLUSIONS AND SUMMARY

I analyze the competitiveness of airconditioner using T method.

I understand dummy factors ,such as 1 or 0, are useful to analyze.

I thank to the cooperation of appliances stores in Kochi pref..

I would like to understand this method deeply. I would like to use this method as teaching tool of management education for product planning and pricing strategy.

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