A System of Categorized Normal Distribution Population Model will perhaps bring a Revolution in an Economic Science

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The Summary of High Points

******* Preface *******

(1). Period from 1930 to 1980, the author calls it a policybeloving age for an Economic Science.

(2). What are the reasons why such up-side-down-concept, "Putting a cart before a horse" has reigned more than half a century in Economics as well as in Political World?

(3). A research to find a proper and right model for the economic science is entirely different from a research to solve a problem of a limited field of an economic policy.

(4). Hypothesis of a Rational or of a Theoretical Economics is a Fallacy.

(5). We all know the Central Limit Theory which prohibits Categorization of any kind, and which automatically prohibits to use Subjective Economic Value System in the operational system. How can we call such Macro Econometrics as an Economic Science ?

(6). The Limits Theory of Categorization.

(7). Theory of Half Normal.

(8). Elasticity Coefficients.

(9). From one to Several Categorized Normal Population Distribution of Subjective Value System V.S. Many Categorized Normal Population Distributions, the Integral Parts of the Corresponding Subjective Value System (Categorized Objective Values of Goods and Services).

(10). Total System of Japanese Internal Economy based on the Economic Marginal Theorem.

(11). Linkaged Parametric Simulation System, Consumer Economics Example No.1.

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(17). Example No.4. Calculation Table for Basic Linkaged Parametric Simulation of Oligopoly Industry, 1977.

******* Preface *******

This paper is written in answer to Late Professor Harold Hotelling's paper, entitled, "Impact of R. A. Fisher" that was given me by him personally at the Tokyo Imperial Hotel, where and when I.S.S. session was held there.

Present paper is rather brief one, but it is the concluding paper of my past 16 years experimental and research study. Between times, however I have written several numerical tables, books and many essays on the related topics.

1. Period from 1930 to 1980, the author calls it a policybeloving age for an Economic Science.

Modern Statistics has been right to have a normal distribution belonging to the same family for its population model. This is because, so far as the economic date are subjected to an experimental design of some sort, through various methods of randomization processes, the researcher can bring the data to the point at which he can apply an analysis of variance.

However, the economic data that are not subject to an experimental design, Economists have been quite odd at them, and have been unable to find a correct and right distributional model for them.

Under pressure of the emergency situation 1930s, economists as well as politicians all over the countries could not help but adopted Keynsian Theorem, "Inflation had better been adomitted rather than letting the rate of unemployment increasing freely.

Without exception, the followers of the Keynsian Theorem, the policy-loving economists and econometricians have not only wasted their energies but also have let peoples of the world away from approaching the true story of the economic science. It seems to me that the policy-loving economists and econometoriians have been beating along the bushes fruitlessly past half a century. Since a scientific procedure must proceed the policy to attain an aim. Econometric science basing on a hypothesis of a theoretical economics or a simultanious equations that has been stinged with a strong doubt, won't last long.

2. What are the reasons why such up-side-down-concept, "Putting a cart before a horse" has reigned more than half a century in Economics as well as in Political World?

As the author wishes to write as briefly as possible, he can mention three reasons as followes :

1st reason, what he can mention is, of course, the pressure of the business depression of 1930s, that necessitated an urgent financial action on the part of the Governments to save the National Economies.

2nd reason has been the fame and authority of J. M. Keynes.

3rd reason has been that the researchers have failed to find a proper and right population model for the economic science, but have mentioned some mathematical equations based on a prevailing common sense in the mathematical world.

3. A research to find a proper and right model for the economic science is entirely different from a research to solve a problem of a limited field of an economic policy.

So far as the author knows, neither economist, nor mathematician or statistician has ever attempted to find a proper and right model or hypothesis on which the economic science can be built. In order to do so, the following conditions have to be met by a single model or a single hypothesis.

(1) The model or the hypothesis must be inclusive of the Marginal Theorem on an operational state.

(2) The model must overcome the difficulties of non-experimental state of economic data.

(3) Reproductive property of the parametric information must

be maintained.

(4) Additive property of the parameters must be maintained throughout the operational system.

(5) The system should be operational and simulational at the same time.

(6) Values of the paramaters in the operation must correspond actual data realized in the economic world.

(7) Dynamic concept (income concept) retained in the economic data must be treated very carefully in such a way that the effectiveness of the dynamic information can be retained in the most suitable and stable condition.

These very rigid 7 conditions are given for the purpose of finding an effective hypothesis or a population model to deal with the economic science. Judging from the informational science, a certain family of a Population of Normal Distributional Model will probably do the best work.

4. Hypothesis of a Rational or of a Theoretical Economics is a Fallacy.

The Theoretical Economics based on an Objective Economic Value System without Categolization, the Economic Subjective Value System does not have or can not have a full information that we need to start to analyse with.

Without Categolization of the Economic Subjects, we cannot put the information of the Marginal Theorem in the economic operational model in identifiable way. The proof of this fact is that the Mathematical Model or Simultaneous Equations based on the Theoretical Economics must always bring a very troublesome problem, if not a questionable, "Identification Problem", since, if our assumption is based not on the Theoretical Economics, but on some Axiomatic Assumption such as "the Marginal Theorem", we should not be so nervous as to rely on such an "Identification Problem".

Defective points of Theoretical Economics may be summed up as follows :

(a) Among others, a hypothesis of Theoretical Economics lacks information about Marginal Theorem.

(b) Thus it lacks an Axiomatic Hypothesis.

(c) Theoretical Economics lacks entirely information about the system of Categorization. The lacks of the concept of the categolization in the social science is said to have no strategic information or behavior patterns of the economic subjects.

(d) Central Limit Theory upon which a normal distribution of random error of the simultaneous equations based, has nothing to do with Gaussian Normal Laws of Error which is ristricted to apply a primary distribution, while Central Limit Theory can only be applied to the Secondary Distribution, and that means, that the theory furnishes us with a consolidated information, but prohibits Categorization of any kind.

5. We all know the Central Limit Theory which prohibits Categorization of any kind, and which automatically prohibits to use Subjective Economic Value System in the operational system. How can we call such Macro Econometrics as an Economic Science?

The Marginal Theorem furnishes us with a full information for the Subjective Economic Value System, while the system of the Macro Econometorics based on a system of simultaneous equations furnishes us but with a consolidated total objective economic value information (Market Price times Quantity) and no Categorization. The system does not furnishes us with any information corresponding to the actual date realized in production as well as in consumption.

The best we can expect the reult of, or the simmulation of the Macro Economics are, a General price level, a General production level, a General stock level, a Total export and import level, a General unemployment level with certain probability allowances.

Economic Value System consists of two Systems, Subjective Value and Objective Value, Subjective Economic Value System supplies a full information about the Marginal Theorem of Economics which consist of Elasticity Coefficients and Engel Coefficients, while Objective Economic Value System supplies only the market price times the quantity that can be derived from the information furnished through Engel Coefficients. Therefore, this fact has proved that the Subjective Economic Value System embraces the Objective Value System completely.

After a long research study, the author has found that a right and proper hypothetical population model for the economic science in order to consolidate the foregoing 7 conditions and problems discussed in Sections, 3, 4, and 5, is the marginal theorem and a System of a Categorized Normal Population Model for the Economic Science.

6. The Limits Theory of Categorization.

What the limits theory of Categolization in the social science corresponding to the Normal Distribution condition is equal to what the Limits Theory of a mathematical function in the physical science to calculus. Thus, the concept of categorization in economics has made it possible to use distributional theory in economics. The theory runs as follows :

K. Pearson made it known his famous coefficient of variation as a categorization coefficient in the philosophical Journal of 1896 as c.v. (coefficient of variation) $\frac{100\ s}{m}$. Therefore, it is necessary for us to find a deliverance of the coefficient of variation. Since $\frac{100}{m}$ is constant, as m is unity, and therefore, the Limits of Categorization is $\frac{ds}{dx}=0$

s is a decreasing function as a Categorization progresses, the value of s becomes less than any preasigned value e, and in the extreme case, one sample one Category may be had. In that case the value of s becomes 0.

7. Theory of Half Normal.

The second study in this paper deals with the theory of Half Normal. It sounds somewhat strange, however, it is quite effective approach in establishing parametric relationships among three factors, changes in price level, changes in consumption level, and changes in income level. In Micro-economics state, a consumer tends to allocate his income in such a way that the marginal utility that he can realize from each category of goods tend to be equal. How can we be possible to treat Macro-economics-state so that they may be able to behave themselves to allocate their income in such a way that the marginal utility that they can realize from each category of goods tend to be equal?

The only possibility is the assumption of a normal distribution of the same income strata. This is the very important condition which makes it possible to treat a macro-economics-state unit as a micro-economics-state unit, in the application of an economic theory originated in micro-economics-state.

When we came to find the elasticity coefficients in distribution theory, we realized that the distribution of an income strata is normal and therefore, symmetric on both sides (of course, we deliverately took it so), however, the distribution of the upper half and the lower half of expenditure values are not symmetrical. Therefore, in deriving the elasticity coeffcients, the best combination can be had by letting the lower half of the income distribution corresponds to the lower half of the expenditure value of a category, and the upper half of the income distribution corresponds to the upper half of the expenditure value of a category. That is,

$$\sum_{l}^{\bar{x}} D^{\frac{1}{2}N1}_{\text{c.v.}l}(\overline{x_1}) \; us \; \sum_{l}^{\bar{x}} D^{\frac{1}{2}N1}_{\text{c.v.v}\,l}(\overline{v_1})$$

$$\sum_{x}^{h} D^{\frac{1}{2}N1}_{\text{c.v.}h}(\overline{x_1}) \; us \; \sum_{\bar{x}}^{h} D^{\frac{1}{2}N1}_{\text{c.v.v}\,h}(\overline{v_1})$$

(l means the lowest point of the category h means the highest point of the category)

8. Elasticity Coefficients

Let v stands for value and p for price or $y=p$ where y stands for income.

We have two formula for the elastcity coefficient.

(i) Point formula.

$$\eta_P = \frac{v_1 - v_0}{p_1 - p_0} \bigg/ \frac{v_0}{p_0}$$

(ii) Arc formula.

$$\eta_P = \frac{v_1 - v_0}{p_1 - p_0} \bigg/ \frac{v_1 + v_0}{p_1 + p_0}$$

(iii) Expanding (i) in distribution theory :

$$\eta_P=\frac{\frac{1}{2}\text{ Range of } a\%\ D_{\text{c.v.}v0}(v_0)}{\frac{1}{2}\text{ Range of } a\%\ D_{\text{c.v.}P0}(p_0)}\Big/\frac{v_0}{p_0}$$

$$=\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(v_0)\cdot p_0}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0)\cdot v_0}$$

$$=\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(v_0 p_0)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0 v_0)}$$

$$=\frac{\text{Range of } 99\%\ D_{\text{c.v.}v0}(50)}{\text{Range of } 99\%\ D_{\text{c.v.}P0}(50)}$$ ......We have the table for this value

(iv) Expanding (ii) in distribution theory :

$$\eta_P=\frac{\frac{1}{2}\text{ Range of } a\%\ D_{\text{c.v.}v0}(v_0)}{\frac{1}{2}\text{ Range of } a\%\ D_{\text{c.v.}P0}(p_0)}\Big/\frac{v_1+v_0}{p_1+p_0}$$

$$=\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(v_0)\cdot(p_1+p_0)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0)\cdot(v_1+v_0)}$$

$$=\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(p_0v_0+v_0p_1+p_0v_1-p_0v_1)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0v_0+p_0v_1)}$$

$$=\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(p_0v_0+p_0v_1)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0v_0+p_0v_1)}$$

$$+\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(p_1v_0-p_0v_1)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0v_0+p_0v_1)}$$

$$\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(p_1v_0-p_0v_1)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0v_0+p_0v_1)}$$ ......Generally negrigible.

$$=\frac{\text{Range of } a\%\ D_{\text{c.v.}v0}(p_0v_0+p_0v_1)}{\text{Range of } a\%\ D_{\text{c.v.}P0}(p_0v_0+p_0v_1)}$$

$$\doteqdot\frac{\text{Range of } 99\%\ D_{\text{c.v.}v0}(50)}{\text{Range of } 99\%\ D_{\text{c.v.}P0}(50)}$$ ......We have a table for this value

Thus we have the Elasticity Coefficient for the value of the items against the price and the Elasticity Coeffcient for the price against the value of the items.

$$\eta_P=\frac{\text{Range of } 99\%\ D_{\text{c.v.}v0}(50)}{\text{Range of } 99\%\ D_{\text{c.v.}P0}(50)}$$

$$\eta_P = \frac{\text{Range of } 99\%\ D_{c.v.P}(50)}{\text{Range of } 99\%\ D_{c.v.v0}(50)}$$ ......We have a table for this value

Thus we have the elasticity coefficients for the value of the items against the price and for the price against the value of the items.

Theorem of Marginal Decreasing Utility may be absorbed into a system of an Elasticity Coefficient in a Categorized Distributional Theorem. Thus the concept of the marginal decreasing utility theorem may correspond to a deliverance in calculus, or a tangent in a trigonometric function.

9. From one to Several Categorized Normal Population Distributions of Subjecitive Value System V. S. many Categorized Normal Population Distributions, the Integral Parts of the Corresponding Objective Value System (Categorized Objectve Values of Goods and Services).

The Limits Theory of Categorization makes it possible for us to write the Distributional Populations of the Subjective Value System as well as the Objective Value System as follows :

I. Consumption Economy (Consumption Distribution)	Coresponding Objective Value System (Theory of Half-Normal) (Categorized Goods and Services)
$\Sigma D^{N1}_{c.v.\bar{y}1}(\bar{y}_1)$	$\Sigma D^{\frac{1}{2}N1}_{c.v.i\,L}(\bar{v}_i)$; $\Sigma D^{\frac{1}{2}N1}_{c.v.i\,u}(\bar{v}_i)$
$\Sigma D^{N2}_{c.v.\bar{y}2}(\bar{y}_2)$	$\Sigma D^{\frac{1}{2}N2}_{c.v\,i\,L}(\bar{v}_i)$; $\Sigma D^{\frac{1}{2}N2}_{c.v.i\,u}(\bar{v}_i)$
$\Sigma D^{N3}_{c.v.\bar{y}3}(\bar{y}_3)$	$\Sigma D^{\frac{1}{2}N3}_{c.v.i\,L}(\bar{v}_i)$; $\Sigma D^{\frac{1}{2}N3}_{c.v.i\,u}(\bar{v}_i)$

11. Production Economy	Corresponding Objective Value System
(Production Distribution)	(Theory of Half-Normal)
$\Sigma D_{c.v.k}(\bar{x}_k)$	Sales Price Distribution $\Sigma D_{c.v.KL}(\bar{x}_K)$; Sales Price Distribution $\Sigma D_{c.v.Ku}(\bar{x}_K)$
III. Local and Central Government Finance and Economic Mixed Economy	(Theory of Half-Normal) Sales Price Distribution; Sales Price Distribution
(1) Categorized Income Distribution Population Model	(1) Categorized Resales Income Distribution Population Model
Number of Categorized Income Distributions Population Models in Operational Form	Number of Categorized Income Distributions Population Models in Operational Form
(2) Categorized Production Distribution Population Model	(2) Categorized Goods and Service Expense Distribution Population Model
Number of Categorized Production Distribution Population Model in Operational Form	Number of Categorized Goods, Services, and Expense Distribution Population Model in Operational Form

This is an "Explanatory Graph 1" that is to show A Total System of Japanese Internal Economy based on the Economic Marginal Theorem. It is shown by the Equilibrium Distribution Coefficient under Marginal Theorem into Three Sectors, Consumption Economic Sector, Production Economic Sector and Public or Local as well as Central Government Economic Sector.

To Prove Parametric Simulation based on Equilibrium Distribution Coefficient under Marginal Theorem against Actual Events realized

Financial Outlay Economic Subject

Eco. Subj. by Whole, by District.		
Consumer by Income Strata.		
1.	1st Income Strata, Lower Half.	
	1st Income Strata, Upper Half.	
2.	2nd Income Strata, Lower Half.	
	2nd Income Strata, Upper Half.	
3.	3rd Income Strata, Lower Half.	
	3rd Income Strata, Upper Half.	
Eco. Subj. by Whole, by District.		
Consumer by Income Strata.		
1.	1st Income Strata, Lower Half.	
	1st Income Strata, Upper Half.	
2.	2nd Income Strata, Lower Half.	
	2nd Income Strata, Upper Half.	
3.	3rd Income Strata, Lower Half.	
	3rd Income Strata, Upper Half.	
Eco. Subj. by Whole, by District.		
Financial Economic Subject.		
Public Legal Person	Religion	Legal Person Finance Subject
	Education	Legal Person Finance Subject
	Medical	Legal Person Finance Subject
	Social Wellfare	Legal Person Finance Subject
Eco. Subj. by Whole, by District.		
Financial Economic Subject.		
1. Labor	Union / Association	Finance Subject.
2. Consolidated Labor Union		Finance Subject
3. By Political Parties	Finance Economic	Subject
Finance Economic Subject		
By Whole, By District		
Central Government	1. Central Finance-Eco. Government Subject	
	2. By Ministry Finance Eco. Subject	
	3. By Section Finance Eco. Subject	
Local Government	1. Local Government Subject.	
	2. By Section Finance Subject	

Simulation blocks

Consumer Economics under Marginal Theorem

Consumer Equilibrium Distribution Coefficient (By Income Strata)

$$\phi_i = \frac{\eta_{ii}\times\frac{\bar{v_i}}{Y}}{\Sigma\eta_{ii}\times\frac{v_i}{Y}}$$

Objective Value System

Market Price X Quantity

Producer Economics under Marginal Theorem

Producer Equilibrium Distribution Coefficient (By Production and Articles)

$$\phi_k = \frac{\eta_{kk}\times\frac{\bar{x_k}}{Y}}{\Sigma\eta_{kk}\times\frac{x_k}{X}}$$

Consumer Preference Theorem ϕ_i

Producer Preference Theorem ϕ_k

Consumer Economics under Marginal Theorem

Consumer Equilibrium Distribution Coefficient (By Income Strata)

$$\phi_i = \frac{\text{Coefficient of Elasticity} \times \text{Engel Coefficient}}{\Sigma\,\text{Coefficient of Elasticity} \times \text{Engel Coefficient}}$$

Objective Value System

Market Price X Quantity

Producer Economics under Marginal Theorem

Producer Equilibrium Distribution Coefficient (By Production and Articles)

$$\phi_k = \frac{\eta_{kk}\times\frac{\bar{x_k}}{X}}{\Sigma\eta_{kk}\times\frac{x_k}{Y}}$$

Financial Outlay Preference Theorem ϕ_i

Producer Preference Theorem ϕ_k

Financial Economics under Marginal Theorem

Financial Outlay Equilibrium Distribution Coefficient (By Finance Outlay)

$$\phi_i = \frac{\eta_{ii}\times\frac{\bar{v_i}}{Y}}{\Sigma\eta_{ii}\times\frac{v_i}{Y}}$$

Objective Value System

Market Price X Quantity

Producer Economics under Marginal Theorem

Marginal Theorem = Elasticity Coefficient X Engel Coefficient

Producer Equilibrium Distribution Coefficient (By Production and Articles)

$$\phi_k = \frac{\eta_{kk}\times \text{Engel Coefficient}}{\Sigma\eta_{kk}\times \text{Engel Coefficient}}$$

Financial Outlay Preference Theorem ϕ_i

Producer Preference Theorem ϕ_k

Financial Economics under Marginal Theorem

Financial Outlay Equilibrium Distribution Coefficient (By Finance Outlay)

$$\phi_i = \frac{\eta_{ii}\times\frac{\bar{v_i}}{Y}}{\Sigma\eta_{ii}\times\frac{v_i}{Y}}$$

Objective Value System

Market Price X Quantity

Producer Economics under Marginal Theorem

Producer Equilibrium Distribution Coefficient (By Production and Articles)

$$\phi_k = \frac{\eta_{kk}\times\frac{x_k}{X}}{\Sigma\eta_{kk}\times\frac{x_k}{X}}$$

Financial Outlay Preference Theorem ϕ_i

Government (Central & Local) Preference Theorem Public, Treasury Corp. under Marginal Theorem ϕ_k

Financial Economics under Marginal Theorem

Financial Outlay Equilibrium Distribution Coefficient (By Finance Outlay)

$$\phi_i = \frac{\eta_{ii}\times\frac{v_i}{Y}}{\Sigma\eta_{ii}\times\frac{v_i}{Y}}$$

Objective Value System

Market Price X Quantity

Government (Central & Local) Public, Treasury Corp.

Finance & Service Equilibrium Distribution Coefficient (By Finance & Service)

$$\phi_k = \frac{\eta_{kk}\times\frac{\bar{x_k}}{X}}{\Sigma\eta_{kk}\times\frac{x_k}{X}}$$

Production Economic Subject

Forest Production Economic Subject	
Mining Industry Economic Subject	
Fishery Industry Economic Subject	
Agriculture Association Economic Subject	
Industry by Category Economic Subject	
Separate Producer Economic Subject	
Producer by Whole Area, by District E.S.	
Forest Production Economic Subject	
Mining Industry Economic Subject	
Fishery Industry Economic Subject	
Agriculture Association Economic Subject	
Industry by Category Economic Subject	
Separate Producer Economic Subject	
Producer by Whole Area, by District E.S.	
Forest Production Economic Subject	
Mining Industry Economic Subject	
Fishery Industry Economic Subject	
Agriculture Association Economic Subject	
Industry by Category Economic Subject	
Separate Producer Economic Subject	
Producer by Whole Area, by District E.S.	
Forest Production Economic Subject	
Mining Industry Economic Subject	
Fishery Industry Economic Subject	
Agriculture Association Economic Subject	
Industry by Category Economic Subject	
Separate Producer Economic Subject	
Producer by Whole Area, by District E.S.	
3 Public Corporations	Japan National Railway Japan Monopoly Corporation Japan Telegraphic and Telephone Corporation
5 Public Corporations	Postal Service, Saving Insurance Corporation Japan National Forestry Corporation Japan National Printing Office Corporation Japan National Mintage Bureau Japan National Alcohol Corporation
4 Public Corporations	Japan National Highway Corporation Japan National Railway Construction Corporation Japan National Housing Development Corporation Japan National Housing Corporation
Public Treasury	Various Public Treasury
State Treasury	Various State Treasury

This is the first time to reveal the technical structural constructions of the coefficient of equilibrium distribution for a Consumer with Stratified Multiple Strata.

$$\phi_i = \frac{\eta_{ji} \times \frac{\overline{v}_i}{Y}}{\Sigma \eta_{ji} \times \frac{\overline{v}_i}{Y}}$$

And also to reveal the technical structural construction of the coefficient of equilibrium distribution for a Producer.

$$\phi_k = \frac{\eta_{Bk} \times \frac{\overline{x}_k}{X}}{\Sigma \eta_{Bk} \times \frac{\overline{x}_k}{X}}$$

Explanations of the Mixed Economics of the Public Sectors are postponed to the next essay.

There are three categories of parameter appearing on a Strategic Simulation.

a. The Example of this : Coefficient of Variation, Elasticity Coefficient, Income Distribution, Production Distribution, Cosumer Value Distribution, Sales Price Distribution.

b. Those parameters which belong to the purely Objective Value System.

The examples : Consumer Engel Coefficient, Market Price x Quantity, Producer Engel Function.

c. Those parameters which belong to the consolidated Subjective Economic Value System. Examples : The Consumer Equilibrium Distribution Coefficients, the Producer Equilibrium Distribution Coefficients.

Regarding Distribution Coefficients, we may be able to categorize these parameters as :

a. Distributional Category belonging to Elasticity Coefficient or Parameters belong to the marginal theorem of decreasing utility.

b. Functional Category belong to Engel Coefficient or Parameters belonging to the equilibrium of their marginality.

11. Linkaged Parametric Simulation, Example, No. 1.

The followings are the results of the decomposition of the Income Distribution in Japan in 1959 by means of FACOM 270-20/30.

STRATIFIED MULTIPLE NORMAL POPULATIONS

XBR1	30.5	COEF1	32.0	CONS1	1174133.0
XBAR2	49.5	COEF2	25.0	CONS2	515268.7
XBAR3	95.0	COEF3	26.9	CONS3	243613.1
ERROR	0.0240				

DATA	STRATUM1	STRATUM2	STRATUM3	SUM	ERROR
10598.9	22456.8	397.9	92.1	22947.0	0.5825
145895.0	155565.5	4497.0	327.7	160390.2	0.0496
444733.0	407808.6	27185.5	1002.9	435997.1	0.0098
528284.0	407808.6	88199.3	2641.3	498649.2	0.0280
312562.0	155565.5	153932.6	5986.1	315484.2	0.0046
261342.0	23667.9	217948.6	31270.4	272886.9	0.0220
132255.0	24.2	23078.2	101139.6	124242.1	0.0302
96055.0	0.0	9.6	101118.9	101128.5	0.0264
	1172897.1	515248.7	243579.0	1931725.2	

From the foregoing computation, we have the income model under 2,000,000 Yen a year as follows :

$$\sum D_{32}^{172897}(30.5)+\sum D_{25}^{515249}(49.5)+\sum D_{27}^{243579}(95.0)$$

For the income group over 2,000,000 yen a year, the estimation of the normal population parameters are made by means

(h) Summary Table for Elasticity Coefficients by Categories, by Income Strata of Japanese Household in 1959

E.C. Categorica Expenditures \ Income Strata		$\sum_{t}^{30.5} D_{32}^{1172897}$ (30.5)	$\sum_{30.5}^{h} D_{32}^{1172897}$ (30.5)	$\sum_{t}^{49.5} D_{25}^{515249}$ (49.5)	$\sum_{49.5}^{h} D_{25}^{515249}$ (49.5)	$\sum_{t}^{95.0} D_{27}^{243579}$ (95.0)	$\sum_{95.0}^{h} D_{27}^{243579}$ (95.0)
		Lower Half	Upper Half	Lower Half	Upper Half	Lower Half	Upper Half
Cereals	η η	1.709 .585 $\sum D_{18}^{N_1}$ (3806)	3.851 .260 $\sum D_{8}^{N_1}$ (3806)	2.489 .492 $\sum D_{10}^{N_2}$ (4349)	3.537 .238 $\sum D_{7}^{N_2}$ (4349)	3.811 .262 $\sum D_{7}^{N_3}$ (4837)	6.702 .149 $\sum D_{4}^{N_3}$ (4837)
Other Food	η η	1.925 .519 $\sum D_{16}^{N_1}$ (8070)	1.025 .976 $\sum D_{31}^{N_1}$ (8070)	1.371 .701 $\sum D_{18}^{N_2}$ (10203)	.844 1.185 $\sum D_{30}^{N_2}$ (10203)	1.480 .676 $\sum D_{18}^{N_3}$ (15274)	2.960 .338 $\sum D_{9}^{N_3}$ (15724)
Housing	η η	.899 1.112 $\sum D_{38}^{N_1}$ (2365)	2.049 .488 $\sum D_{15}^{N_1}$ (2365)	1.545 .623 $\sum D_{16}^{N_2}$ (2892)	.968 1.040 $\sum D_{26}^{N_2}$ (2892)	1.038 .963 $\sum D_{41}^{N_3}$ (4426)	1.284 .779 $\sum D_{21}^{N_3}$ (4426)
Fuel & Light	η η	1.155 .860 $\sum D_{27}^{N_1}$ (1228)	1.709 .585 $\sum D_{18}^{N_1}$ (1228)	1.458 .660 $\sum D_{17}^{N_2}$ (1576)	1.088 .919 $\sum D_{23}^{N_2}$ (1576)	1.909 .524 $\sum D_{14}^{N_3}$ (2237)	2.433 .411 $\sum D_{11}^{N_3}$ (2237)
Clothing	η η	.879 1.138 $\sum D_{40}^{N_1}$ (3008)	1.419 .705 $\sum D_{22}^{N_1}$ (3008)	1.037 .964 $\sum D_{24}^{N_2}$ (4224)	.728 1.374 $\sum D_{37}^{N_2}$ (4224)	.757 1.321 $\sum D_{41}^{N_3}$ (10805)	1.284 .779 $\sum D_{21}^{N_3}$ (10805)
Miscellanecous	η η	.879 1.138 $\sum D_{40}^{N_1}$ (8053)	1.246 .803 $\sum D_{25}^{N_1}$ (8053)	.927 1.079 $\sum D_{27}^{N_2}$ (11408)	.844 1.185 $\sum D_{30}^{N_2}$ (11408)	.961 1.041 $\sum D_{28}^{N_3}$ (21814)	1.038 .963 $\sum D_{26}^{N_3}$ (21814)
Saving		.839 1.192 $\sum D_{50}^{N_1}$ (1999)	.925 1.081 $\sum D_{29}^{N_1}$ (1999)	.927 1.079 $\sum D_{27}^{N_2}$ (3029)	.696 1.437 $\sum D_{42}^{N_2}$ (3029)	.845 1.183 $\sum D_{33}^{N_3}$ (6661)	1.120 .893 $\sum D_{24}^{N_3}$ (6661)

Sources: Statistical Report NO. 85, Bureau of National Tax, Minister of Finance, Japanese Government, 1959.
1959 National Survey of Family Income and Expenditure Vo. 1, Family Income and Expenditure in all Japan, Bereau of Statistics, Office of the Prime Minister, Japan.

Notes: N_1. 1172897 N_2 515249 N_3 243579 of the table specially constructed for the purpose of finding the distribution parameters of Oligopoly, the explanation of which will be made in section (Part 3). The results are :

$$\Sigma D_{19}^{35209}(350.9) + \Sigma D_{19}^{5039}(750.0) + \Sigma D_{25}^{1092}(1500.0)$$

13. Linkaged Parametric Simulation System.

A linkaged Parametric Simulation System is a system in which all the parameters in a linkage under the equilibrium distribution coefficient system have additive nature, and therefore, interchangeably quite freely, namely, decrease of increase in their values, prices, and quantities of the basis of the deviations with equal probability densities for the rest of the others.

As has been stated before, elasticity coefficients coupled with income distributions and corresponding value distributions of the categories of goods consumed in the family, not only enable us to find an equal marginal utility relationships among the categories of goods in the household consumption in the macro-economics state, but also permit us to make parametric computation by means of simple arithmetic method.

The following conditions are given in an example of a Linkaged Parametric Simulation applied to three income strata.

The conditions :

Income Level ························ 8% up.

Cereals ································ 15% up.

Other food ···························· 12% up.

Housing································ 5% up.

Clothing .... Stays the same.

others.................................... 8% up.

Saving.................................... No change.

Elasticity Coefficients and Values of Seven Categories

7 Categories / η', η, v	i	ii	iii	iv	v	vi	vii
Upper Income Strata	η'_{P_1} η'_{v_1}	η'_{P_2} η'_{v_2}	η'_{P_3} η'_{v_3}	η'_{P_4} η'_{v_4}	η'_{P_5} η'_{v_5}	η'_{P_6} η'_{v_6}	η'_{P_7} η'_{v_7}
Lower Income Strata	η_{P_1} η_{v_1}	η_{P_2} η_{v_2}	η_{P_3} η_{v_3}	η_{P_4} η_{v_4}	η_{P_5} η_{v_5}	η_{P_6} η_{v_6}	η_{P_7} η_{v_7}
Central Value for Both Upper and Lower Income Strata	v_1	v_2	v_3	v_4	v_5	v_6	v_7

The basic allocation ratio on equal marginal utility in macro-economics state for the lower half of the income strata may be had:

$$\eta_{v1}\cdot v_1+\eta_{v2}\cdot v_2+\eta_{v3}\cdot v_3+\eta_{v4}\cdot v_4+\eta_{v5}\cdot v_5+\eta_{v6}\cdot v_6+\eta_{v7}\cdot v_7$$

The basic allocation ratio on equal marginal utility in macro-economics state for the upper half of the income strata may be had:

$$\eta'_{v1}\cdot v_1+\eta'_{v2}\cdot v_2+\eta'_{v3}\cdot v_3+\eta'_{v4}\cdot v_4+\eta'_{v5}\cdot v_5+\eta'_{v6}v_6+\eta'_{v7}\cdot v_7$$

COMPUTATION SHEET FOR I INCOME STRATA

Income Strata / 7 Categories	Lower Half Income Strata			Upper Half Income Strata		
	$\eta_{P_i}\times v_i$	$\eta_{P_i}v_i$	%	$\eta'_{P_i}\times v_i$	$\eta'_{P_i}v_i$	%
Cereals	1.709×3806	6504	17.337	3.851×3806	14657	31.845
Other Food	1.925×8070	15573	41.510	1.025×8070	8272	17.973
Housing	.899×2365	2621	6.986	2.049×2365	4846	10.529
Fuel & Light	1.155×1228	1418	3.780	1.709×1228	2099	4.561
Clothing	.879×3008	2644	7.048	1.419×3008	4286	9.273
Miscellaneous	.879×8053	7079	18.869	1.246×8053	10034	21.801
Saving	.839×1999	1677	4.470	.925×1999	1849	4.017
		37516			46025	

For the 1st income strata, 8% increase in income brings 2,033 yen increase per month while increase in prices of the items brings deficit of 571, 968, 118, 120, 644, 2421 (yen), if people don't want to cut the consumption of items of which prices rise. The balances of 2421 yen—230 yen or 338 yen will be deflated according to the basic allocation percentages.

COMPUTATION SHEET FOR II INCOME STRATA

Income Strata / 7 Categories	Lower Half Income Strata			Upper Half Income Strata		
	$\eta p_i \times v_i$	$\eta p_i v_i$	%	$\eta' p_i \times v_i$	$\eta' p_i v_i$	%
Cereals	2.489×4349	10864	18.048	3.537×4349	15382	32.173
Other Food	1.371×10203	13988	23.238	.844×10203	8611	18.011
Hou ing	1.545×2892	15283	25.389	.962×2892	2782	5.819
Fuel & Light	1.458×1576	2298	3.818	1.088×1576	6219	13.008
Clothing	1.037×4224	4380	7.276	.728×4224	3075	6.432
Miscellaneous	.927×11408	10575	17.568	.844×11408	9628	20.138
Saving	.927×3029	2807	4.663	.696×3029	2108	4.409
		60195			47805	

COMPUTATION SHEET FOR III INCOME STRATA

Income Strata / 7 Categories	Lower Half Income Strata			Upper Half Income Strata		
	$\eta p_i \times v_i$	$\eta p_i v_i$	%	$\eta' p_i \times v_i$	$\eta' p_i v_i$	%
Cereals	3.811×4837	18434	21.770	6.702×4937	32418	24.424
Other Food	1.480×15274	22606	26.697	2.960×1527	45211	34.062
Housing	1.038×4426	4594	5.425	1.284×4426	5683	4.282
Fuel & Light	1.909×2237	4270	5.043	2.433×2237	5443	4.101
Clothing	.757×10805	8179	9.659	1.284×10805	13874	10.453
Miscellaneous	.961×21814	20963	24.757	1.038×21814	22643	17.059
Saving	.845×6661	5629	6.648	1.120×6661	7460	5.620
		84675			132732	

For the second income strata, we have income increase of 3300 yen and the price increase by 3029 yen. The balance of 197 yen is to be allocated over seven categories according to the basic allocation percentage.

For the third income strata, we have inome increase of 6333 yen and the price increase by 4957 yen. The balance, 1376 yen is to be allocated over seven categories of items according to the basic allocation percentage.

ALLOCATION TABLE

7 Categories \ Income Strata	I Income Strata		II Income Strata		III Income Strata	
	Lower Half (−)	Upper Half (−)	Lower Half (+)	Upper Half (+)	Lower Half (+)	Upper Half (+)
Cereals	67	124	36	63	300	322
Other Food	161	70	46	35	367	469
Housing	27	41	50	11	75	59
Fuel & Light	15	18	8	26	69	56
Clothing	27	36	14	13	133	144
Miscelleneous	73	85	35	40	341	235
Saving	17	16	9	9	91	77

14. A Separate Producer Producing Several Products.

Scores of Oligopoly Producers Producing Categorized. Product.

1st Assumption : A Categorized Normal Distribution Model

Each member of the Oligopoly Producers is characterized by:

(1) Production Occupancy Percentages (Production Engel Coefficient)

(2) The Rank of the members of the Oligopoly.

(3) The Number of the members of the Oligopoly.

A great care is, however, to be taken to formulate the model. We use a production or a market share in the density model to find the distribution parameter. In so doing we have three assumptions:

(i) A producer producing a commodity, his production density forms one half normal distribution in macro-economics-state.

(ii) His present production or market share is supposed to have the outcome of the four factors:

Initial Conditions+Non-economic Conditions+Economic Conditions+Random Error

(iii) Assuming an ideal case what the market or production shares each producer is solely the outcome of random error.

With these three assumptions, can we find any sensible density formula to detect the producer's behaviour?

The following is the formula I have found:

$$P_i = 2\cdot \sum_{\bar{x}-\frac{\bar{x}}{N}(i)}^{\bar{x}-\frac{\bar{x}}{N}(i-1)} D_{c.v.k}(\bar{x})$$

The formula tells us immediately what the distribution parameter (in c.v.) is, as soon as you find the percentage of the producer's share his rank, and the number of his camerades competing in the market. Amount of his annual production is also another parameter (in this case, a central parameter, $\bar{x}$).

In the computation of the mathematical table for the above formula, a specially constructed probability integral tables with the central parameter, $\bar{x}=50$, and the distribution parameter in c. v. from 2 to 100. Thus the formula becomes:

$$P_i = 2\cdot \sum_{50-\frac{50}{N}(i)}^{50-\frac{50}{N}(i-1)} D_{c.v.k}(50)$$

The table has been constructed in the range of c. v. 2 to c. v.

Butter Estimate Simulation for the 35th year of Showa

No.	Income Strata Family	Rate of Increase	1	2	3	4	5	6	7	8	9	10	11
	Income Change Strata	I	6.5%	6.8%	7.1%	7.4%	7.7%	8.0%	8.3%	8.6%	8.9%	9.2%	9.5%
		II	7.0%	8.0%	9.0%	10.0%	11.0%	12.0%	13.0%	14.0%	15.0%	16.0%	17.0%
		III	8.0%	9.0%	10.0%	11.0%	12.0%	13.0%	14.0%	15.0%	16.0%	17.0%	18.0%
	Price Change	Main Food	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%	6.5%	7.0%	7.5%	8.0%	8.5%
		Second Food	3.5%	4.5%	5.5%	6.5%	7.5%	8.5%	9.5%	10.5%	11.5%	12.5%	13.5%
		Living	2.0%	2.3%	2.6%	2.9%	3.2%	3.5%	3.8%	4.1%	4.4%	4.7%	5.0%
		Light	2.0%	2.2%	2.4%	2.6%	2.8%	3.0%	3.2%	3.4%	3.6%	3.8%	4.0%
		Clothing	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%	6.5%	7.0%
		Mis.	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%	11.0%	12.0%	13.0%	14.0%	15.0%
1	I	0.5%											
	II	4.0%	9,483,657*	9,483,403	9,483,153	9,482,895	9,482,641	9,482,392	9,482,142	9,481,888	9,531,957	9,481,384	9,481,130
	III	11.0%											
2	I	1.0%											
	II	5.0%	9,560,916	9,560,769	9,560,608	9,560,441	9,560,258	9,560,125	9,559,966	9,559,806	9,961,037	9,559,486	9,559,323
	III	12.5%											
3	I	1.5%											
	II	6.0%	9,638,187	9,638,126	9,638,060	9,637,990	9,637,925	9,637,859	9,637,790	9,637,720	9,688,797	9,637,593	9,637,523
	III	14.0%											
4	I	2.0%											
	II	7.0%	9,715,462	9,715,487	9,715,519	9,715,536	9,715,565	9,715,589	9,715,618	9,715,642	9,767,223	9,715,692	9,715,724
	III	15.5%											
5	I	2.5%											
	II	8.0%	9,792,729	9,792,848	9,792,967	9,793,090	9,793,204	9,793,323	9,793,438	9,793,561	9,845,649	9,793,794	9,793,913
	III	17.0%											
6	I	3.0%											
	II	9.0%	9,870,000	9,870,209	9,870,422	9,870,627	9,870,844	9,871,053	9,871,262	9,871,495	9,924,071	9,871,901	9,872,114
	III	18.5%											
7	I	3.5%											
	II	10.0%	9,947,271	9,947,570	9,947,873	9,948,180	9,948,484	9,948,787	9,949,090	9,949,397	10,002,493	9,950,003	9,950,314
	III	20.0%											

Butter Estimate Simulation is the kindness of Mr. Hide Machihara, Analytic Center, Shionogi Pharmaceutical Co. Ltd.

* Unit 1,000 yen

Calculation on Micro-Economic System to Find a New Equilibrium Point for 10% Increase of Butter Production (1200 tons) for Upper 10 Enterprises in the 35th Year of Showa

Order	Production Distribution	Supply Prices		η_a		$\frac{x}{p}$	Supply Coefficient		Distribution Coefficient		Distribution Increased Prod.		Price Decrease New Point		Average Price Lowered	New Equilibrium Point		
		Lower Half	Upper Half	Lower Half	Upper Half		Lower Half $\eta_{si}\frac{\bar{x}_i}{p_i}$	Upper Hafl $\eta_{si}\frac{x}{p_i}$	Lower Half $\frac{\eta_s x/p}{\Sigma_{\eta s} x/p}$	Upper Half $\frac{\eta_s x/p}{\Sigma_{\eta s} x/p}$	Lower Half	Upper Half	Lower Half	Upper Half		Production Distribution	Supply Price Lower Half	Supply Price Upper Half
1	ΣD_{12}(7117)	ΣD_2 (332)	ΣD_4(332)	6.00348	3.02883	21.437	128.697	64.928	% 74.63	% 58.45	447.78	350.70	-3.340	-5.400	-4.5	ΣD_{12}(7915.48)	ΣD_2 (327.5)	ΣD_4(327.5)
2	ΣD_7 (1888)	ΣD_2 (332)	ΣD_4(332)	2.49467	1.76305	5.687	14.187	10.026	8.24	9.02	49.44	54.12	-3.485	-5.400	-4.5	ΣD_7 (1991.56)	ΣD_2 (327.5)	ΣD_4(327.5)
3	ΣD_{14}(1501)	ΣD_4 (332)	ΣD_4(332)	3.52609	3.52609	4.521	15.941	15.941	9.24	14.35	55.44	86.10	-3.480	-5.400	-4.5	ΣD_{14}(1642.54)	ΣD_4 (327.5)	ΣD_4(327.5)
4	ΣD_{18}(847)	ΣD_6 (320)	ΣD_4(320)	3.00003	4.54277	2.647	7.941	12.025	4.61	10.83	27.66	64.98	-3.485	-5.405	-4.5	ΣD_{18} (939.64)	ΣD_6(315.5)	ΣD_4(315.5)
5	ΣD_{17} (206)	ΣD_6 (320)	ΣD_5(320)	2.82207	4.27332	.644	1.817	2.752	1.05	2.48	6.30	14.88	-3.465	-5.405	-4.5	ΣD_{17} (227.18)	ΣD_6 (315.5)	ΣD_4(315.5)
6	ΣD_{20} (133)	ΣD_8 (310)	ΣD_6(310)	2.50081	3.33100	.429	1.073	1.425	.62	1.28	3.72	7.68	-3.465	-5.390	-4.5	ΣD_{20} (144.40)	ΣD_8 (305.5)	ΣD_6 (305.5)
7	ΣD_{23} (97)	ΣD_8 (310)	ΣD_6(310)	2.87356	3.82746	.313	.899	1.198	.52	1.08	3.12	6.48	-3.470	-5.410	-4.5	ΣD_{23} (106.60)	ΣD_8 (305.5)	ΣD_6(305.5)
8	ΣD_{26} (85)	ΣD_{10}(310)	ΣD_6(310)	2.59740	4.32451	.274	.712	1.186	.41	1.07	2.46	6.42	-3.455	-5.420	-4.5	ΣD_{26} (93.88)	ΣD_{10}(305.5)	ΣD_6(305.5)
9	ΣD_{30} (61)	ΣD_{10}(300)	ΣD_8(300)	2.97610	3.72018	.203	.604	.755	.35	.68	2.10	4.08	-3.475	-5.405	-4.5	ΣD_{30} (67.18)	ΣD_{10}(295.5)	ΣD_8(295.5)
10	ΣD_{34} (61)	ΣD_{12}(300)	ΣD_8(300)	2.78289	4.17899	.203	.565	.848	.33	.76	1.98	4.56	-3.500	-5.375	-4.5	ΣD_{34} (67.58)	ΣD_{12}(295.5)	ΣD_8(295.5)
TTotal	11996 t						172.436	111.084	100.00	100.00	600.00	600.00				13,196 t		

Caluculation on Macro-Economic System to Find a New Equilibrium Point for 10 Enterprises in the 35th Year of Showa

1 ~ 10	$\Sigma D_{13.2}$(11996)	$\Sigma D_{7.4}$(330)	$\Sigma D_{5.6}$(330)	4.33069	3.27450	36.352	157.429	119.035	100.00	100.00	600.00	600.00	-3,811	-5,041	-4.5	$\Sigma D_{13.2}$(13196)	$\Sigma D_{7.4}$(325.5)	$\Sigma D_{5.6}$(325.5)

Notice: Going Difficulty in Reading Between Lines, Caluculation in Elasticity Coefficient, an Abribiation Method Adopted.

100 and $N=11$.

15. Example No. 2, "Butter" Consumption Estimate Simulation for 1960.

Ref. Summary Table for Coefficients of Elasticity by Income Strata of Japanese Households in 1960.

Butter Consumption Estimates in 1960.

Equilibrium Distribution Coefficients for Other-foods

Income Strata / Equi. Dis. Coeffi.	1st Income Strata		2nd Income Strata		3rd Income Strata	
	Lower Half	Upper Half	Lower Half	Upper Half	Lower Half	Upper Half
Other Foods Distribution Coef.	.159343	.375536	.227136	.291689	.173549	.111996

Number of Linkaged Parameters:

Coefficient of Elasticity　$7\times6=42$

Engel Coefficients　$(7\times6)\div2=\frac{21}{63}$

Parameter of the mathematical means entered in Engel Coefficients amounting to 21.

16. Example NO. 3. Calculation Table for Basic Linkaged Parametric Simulation for 10% Increase of Butter Production (1200 tons) for Upper 10 Enterprises in the 35th Year of Showa.

Explanation: Inside Data of the blacked line enclosure are the data subject t o the Strategic Economic Policies of Each Member of the Oligopoly Producers. The rest of the out-side of the enclosure are calculated on the basis of the system in order to have Linkaged Parametric System (basing on a Coefficient of Equilibrium) has to be established.

Column:

(1) Ranks of the member of Oligopoly Producers.

(2) Distribution of Production.

(3) Supply Price Distribution Half Normal (Lower Half).

(4) Supply price Distribution Half Normal (Upper Half).

(5) Coefficients of Elasticity, Upper Half.

(6) Coefficients of Elasticity, Lower Half.

(7) Elimination of Price difference among the member producers.

(8) Lower Half of the Supply Coefficient.

(9) Upper Half of the Supply Coefficient.

(10) Coefficients of the Equilibution, Distribution, Lower Half.

(11) Coefficients of the Equilibrium Distribution, Upper Half.

(12) Distribution of the amount of increased production, Lower Half.

(13) Distribution of the amount of increased production, Upper Half.

(14) Decreases in Sales Prices, Lower Half.

(15) Decreases in Sales Prices, Upper Half.

(16) Average decrease in Sales prices.

(17) Production Distribution, New Equilibrium Point.

(18) Sales Prices Distribution, Lower Half.

(19) Sales Prices Distribution, Upper Half.

II. Calculation on Micro Economic System to find a New Equilibrum Point of 10% Increase of Butter Production (1,200 tons) 10 Enterprises in 1960.

Number of Linkaged Parameters to find a New Equilibrium Point of 10% Increase of Butter Production.

Coefficients of Elasticity　$2\times 10=20$

Engel Coefficients　$(2\times 10)\div 2=10$

Total Parameters　$20+10=30$

17. Example NO. 4. Calculation Table for Basic Linkaged Parametric Simulation of Oligopoly Industry , 1977. Number of Linkaged Parametric Simulation

Ⅲ. Oligopoly Industry.

Number of Linkaged Parameters to find a Strategic Simulation for the purpose of determing Production, Sales, and Prices.

Coefficients of Elasticities　$2\times 11=22$

Engel Coefficients　$(2\times 11)\div 2=\frac{11}{33}$

Explanation:

Column:

(1) Ranks of the member of Oligopoly Producers.

(2) Initials of the Makers.

(3) Production Occupancy, that is, equal to Engel Coefficients.

(4) Production Distributions.

(5) Sales Price Distributions, Lower Half.

(6) Sales Price Distributions, Upper Half.

(7) Elasticity Coefficients, Lower Half.

(8) Elasticity Coefficients, Upper Half.

(9) Elimination of Price differences among the member producers.

(10) Lower Half of the Supply Coefficients.

(11) Upper Half of the Supply Coefficients.

(12) Coefficients of the Equilibrium Distribution, Lower Half.

Oligopoly Industry
Calculation Table for Basic Linkaged Parametric Simulation, 1977

RANK	MAKER	1976 Production Occupancy %	Production Distribution 1977	Distributions Supply Prices		Elasticity Coefficients		$\bar{x}/P$	Suply (Production Salor) Coefficients		Production Equilibrium Distribution Coefficient		Effects of Price Policies *2 Comparison
				Lower Half	Upper Half	Lower Half	Upper Half		$\eta_{ni} \times \frac{\bar{x}}{P}$	$\eta_{ni} \times \frac{\bar{x}}{P}$	$\frac{\eta_{ni} \times \frac{\bar{x}}{P}}{\eta_{ni} \times \frac{\bar{x}}{P}}$	$\frac{\Sigma\eta_{ni} \times \frac{\bar{x}}{P}}{\Sigma\eta_{ni} \times \frac{\bar{x}}{P}}$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Lower (10)	Upper (11)	Lower (12)	Upper (13)	(14)
1	S	.3028970	ΣD_{23} (15077)	ΣD_2 (41.7)	ΣD_2 (41.7)	.08704	.08704	361,559	31,470	31,470	30.1%	30.1%	–.2%
2	O_1	.1617179	ΣD_{43} (8199)	ΣD_3 (38.5)	ΣD_3 (38.5)	.07594	.07594	212,961	16,172	16,172	15.4%	15.4%	–1.1%
3	M	.1496303	ΣD_{43} (7448)	ΣD_2 (39.4)	ΣD_2 (39.4)	.05067	.05067	189,036	9,578	9,578	9.1%	9.1%	–5.9%
4	K_1	.1249397	ΣD_{49} (6219)	ΣD_3 (37.0)	ΣD_3 (37.0)	.07113	.07113	168,081	11,956	11,956	11.4%	11.4%	–1.1%
5	O_2	.0625201	ΣD_{22} (3112)	ΣD_2 (36.0)	ΣD_2 (36.0)	.09104	.09104	86,444	7,870	7,870	7.5%	7.5%	+1.4%
6	I	.0481156	ΣD_{27} (2395)	ΣD_3 (37.0)	ΣD_3 (37.0)	.11108	.11108	64,730	7,190	7,190	6.9%	6.9%	+2.1%
7	T_1	.0403407	ΣD_{32} (2008)	ΣD_2 (39.0)	ΣD_2 (39.0)	.06348	.06348	51,487	3,268	3,268	3.1%	3.1%	–.9%
8	A	.0302355	ΣD_{35} (1505)	ΣD_3 (37.0)	ΣD_3 (37.0)	.08711	.08711	40,676	3,543	3,543	3.4%	3.4%	+.4%
9	K_2	.0262576	ΣD_{39} (1307)	ΣD_2 (38.0)	ΣD_2 (38.0)	.05339	.05339	34,395	1,836	1,836	1.8%	1.8%	–.8%
10	T_2	.0260969	ΣD_{45} (1299)	ΣD_7 (36.0)	ΣD_7 (36.0)	.17296	.17296	36.083	6,241	6,241	6.0%	6.0%	+3.4%
11	K_3	.0242486	ΣD_{49} (1207)	ΣD_4 (36.0)	ΣD_4 (36.0)	.16586	.16586	33,528	5,561	5,561	5.3%	5.3%	+2.9%
	Total							1,278,980	104,685	104,685	100.0%	100.0%	

*1 Distribution of Prices are somewhat uncertain.
*2 By comparing Production Occupancy % and Production Sales Equibrium Distribution Coefficients, we can detect the effects of Price Policies of the year.

(13) Coefficients of the Equilibrium Distribution, Upper Half.

(14) Effects of Price Policies Comparison.