Estimation of Per-Farm Indexes for Each Product Sector from a Farm Management Survey

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ABSTRACT: Consider a farm-management survey to be carried out on sample farmers, of which many operate in several product sectors, to provide such sector statistics, say of income due to individual sectors, from source data of no division among sectors. The present paper discusses a method of estimating the product sector quantity due to different sectors without collecting additional data of the desired division from the sample farmers. The method makes use of regression technique combined with the recently developed computing power. The results are found satisfactory enough for management scientists to make an analysis without sophisticated statistical considerations.

1. Introduction

The farm household economy survey in Japan is carried out on a sample basis with bookkeeping as the enumeration method to collect data on management. The collected data are then compiled in per-farm mean for publication. Among the statistics provided from the survey, the mean data per farm available for each product sector are only those of gross income (in thousand *yen*), production (in *kg*, except livestock and poultry number), and size of inputs, which may be area of individual crop land (in *are,* except greenhouse in square meters), livestock number, quantity of silkworm eggs (in box), etc. (see Table 1). Statistical data essential for management analysis, such as per-farm working hours, fixed capital value, expenditure, etc., are provided only for the entire farm (see Table 1). Their division into different sectors could be compiled if primary data with the required division were collected from individual farmers in the sample. But this approach is not feasible for it would burden them with a much heavier work, as they are more or less lacking in clear ideas about the proposed division. It is thus necessary to establish a new system of sector statistics for which no additional labor to the existing system of data collection at the farmer's level is needed. It is also an essential requirement that the estimates be consistent with the existing interrelated statistics which are compiled according to the conventional method of addition and multiplication.

2. Theoretical Model

The model building will be explained with the total expenditure as the regressand. Let the total expenditure y (known) be the sum of the m individual sector expenditures μ_j, $j=1..m$ (unknown) plus an overhead cost α_0, (unknown), and assume the regression of the sector expenditure μ_j to the known sector quantity x_j, namely

$$y = \alpha_0 + \Sigma \mu_j , \qquad \mu_j = \alpha_j + \beta_j x_j + e_j , \qquad E(e_j) = 0 ,$$

where α_j and β_j may be understood to be the overhead and variable costs, respectively. A particular sector might remain not operated by farmers. For the existence of a non-operating sector, we have to ensure $\mu_j=0$ for $x_j=0$, requiring the introduction of an indicator variable such that $u_j=1$ if the farm operates in the jth sector, otherwise $u_j=0$ $(x_j=0)$. Then we have

$$y = \alpha_0 + \Sigma \alpha_j u_j + \Sigma \beta_j x_j + e , \qquad e = \Sigma e_j , \qquad E(e) = 0 .$$

This may be statistically regarded as a linear regression with the observable explanatory variables, and therefore the above regression may apply, using the n sets of m observations $(x_1 .. x_m)$ as an estimate of the population mean of y consistent with the sample means of (u_j , x_j). We can thus establish the sector statistics in per-farm mean by supplementing the above regression estimates of y for individual sectors to the existing per-farm mean statistics of $(x_1 .. x_m)$. [Tsukibayashi 1994]

3. Numerical Results

The estimated per-farm mean of each sector quantity using gross income for the regressor is summarized in Table 1, indicating that the total of the estimated sector quantities and the existing ones make up a complete system of sector statistics. [Tsukibayashi 1981]

Table 1. Complete Sector Statistics in Per-Farm Mean

Sector	Working Hours	Fixed Capital Value	**Gross Income**	Expenditure	**Size of Inputs**	**Production**
Paddy	480.8	628.0	**865.0**	351.5	**56.4**	**2929.9**
Potatoes	70.7	155.8	**21.7**	9.2	**2.4**	**632.8**
Vegetables, house	133.6	81.0	**126.1**	60.1	**91.5**	**126.1**
Vegetables, open	290.4	224.1	**233.4**	145.7	**12.2**	**233.4**
Tobaccos	72.0	41.6	**71.3**	23.7	**1.8**	**50.8**
Tea	21.1	34.9	**31.9**	16.9	**0.9**	**106.2**
Oranges	67.3	195.2	**68.4**	31.3	**3.3**	**831.8**
Apples	24.3	22.3	**36.6**	11.4	**0.9**	**195.8**
Pears	19.8	8.1	**19.1**	9.3	**0.4**	**118.5**
Grapes	26.2	23.9	**27.9**	13.2	**0.6**	**68.4**
Sericulture	52.4	37.2	**45.7**	16.0	**5.8**	**20.7**
Broilers	0.9	4.7	**19.1**	16.9	**33.0**	**33.0**
Egg Laying	34.9	35.4	**90.5**	68.1	**25.5**	**381.8**
Pig Breeding	8.7	49.0	**37.9**	27.1	**0.2**	**1.8**
Pig Raising	9.5	59.3	**95.5**	71.0	**0.2**	**2.16**
Cow Raising	29.1	70.9	**57.8**	43.7	**0.1**	**0.14**
Dairy	117.1	218.5	**241.2**	140.3	**3.4**	**1810.1**
Others*	591.2	393.1	**309.4**	131.0	-	-
Fixed Comp.	-59.6 (0.030)	-197.0 (0.099)	**0.0 (0.000)**	15.6 (0.013)	-	-
Overall Mean	1990.4	2086.0	**2398.5**	1202.0	-	-

* Others = Overall Mean - Sectors' sum - Fixed Comp. Bold figures show the existing statistics available.

References

Tsukibayashi, S. (1981), "Statistical Estimation of Per-Farm Mean Indexes for Each Product Sector in Farm Management," in Japanese, *Japanese Annals of Farm Economy*, Vol.13, pp. 33-44.

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