Chapter 4
Estimation of Agricultural Production

P. C. Gupta
University of Rajasthan – Jaipur, India

ABSTRACT

The successful implementation of e-governance mainly depends on the reliability of its database, as this can be efficiently utilized to give more precise estimates of future production. These predications can be made the basis of the policy for import and export of products like food grain or other crops, which are presently growing in the agricultural fields. Knowing the previous record of the product, as auxiliary variable, one can estimate its future production. This chapter, by constructing practical situational caricatures, emphasizes that the statistical tool like ratio analysis and regression analysis may be helpful in estimating the parameters of the variable in the agriculture field. It includes five illustrations to put forth the idea of application of statistical tools to make effective policy in the field of agriculture.

INTRODUCTION

In socio-economic surveys we may be more interested in estimating the ratios such as 'per capita income or expenditure', estimation of yield per unit area or use of fertilizers/ pesticides per acre for a particular crop. These ratios will be of almost importance in agricultural surveys, we may also be interested in estimation of input/ output ratio if we are planning surveys related to industry and commerce.

The estimation of population may be based on following relation

$R=Y/X$

DOI: 10.4018/978-1-4666-5146-3.ch004

where, Y being the population total of main variable and X is the total of auxiliary variable X, whose detailed information is available from the data base (previous records).

This ratio is usually estimated by the ratio of sample means of character Y & X i.e. these estimators are predominately referred as "ratio estimator". This, however, required a high degree of positive correlation between the variables (Cochran, 1977).

The estimators of population ratio R can also be used for building up the estimators of population mean total of the main variable of our interest. E.g. Y could be production of a particular crop while X we the area put under it then R is production of that crop per unit whose information can be held from the database and its estimate the total production of that crop. If this study variable is highly positively correlated to the auxiliary variable and two are proportional linear then the ration of Y to X will be for less variable then Y alone and hence the use of variable X and estimation of population total/mean of main character Y will be quite efficient as compared to estimator which do not use any auxiliary variable.

RATIO METHOD OF ESTIMATION (RATIO ESTIMATOR)

Suppose we select a random sample of size n from N units of the population with simple random sampling without replacement and wish to estimate R the population ratio of character Y to that of auxiliary variable X.

$$R = \frac{Y}{X} = \frac{\sum_{i=1}^{N} Yi}{\sum_{i=1}^{N} Xi} = \frac{\bar{Y}_N}{\bar{X}_N}, \tag{1}$$

where $\bar{X}_N$ and $\bar{Y}_N$ are population means of characters Y & X respectively. Let the sample observations be (y_1, x_1), $(y_2, x_2)\ldots$ (y_n, x_n) and let $\bar{x}_N$ and $\bar{y}_N$ be the corresponding sampling means. We define the following

$$\begin{aligned} S_Y^2 &= \frac{1}{N-1}\left[\sum_{i=1}^{N} Y_i^2 - N\bar{Y}_N^2\right] \\ S_X^2 &= \frac{1}{N-1}\left[\sum_{i=1}^{N} X_i^2 - N\bar{X}_N^2\right] \\ S_{XY} &= \frac{1}{N-1}\left[\sum_{i=1}^{N} X_i Y_i - N\bar{X}_N\bar{Y}_N\right] \end{aligned} \tag{2}$$