

4. Application of Statistics to Agriculture.

P. C. MAHALANOBIS, Calcutta.

I shall select two topics to illustrate the importance of the application of statistics to Agriculture.

I. Field Trials.

Chief aim is to obtain reliable estimates of the amount of variation in crop yields due to differences in (i) variety, (ii) treatment (manurial), watering, etc., (iii) soil fertility, (iv) climatic and seasonal conditions, and (v) the combined effect of uncontrolled factors included under the name of "experimental" or "sampling errors".

Essential requirement is that there should be *Replication*, so that at least two (and preferably more than two) sampling units for each type of variation studied may be present in the experiment in a *random* manner.

Brief description of R. A. Fisher's method of analysis of variance; Randomized Blocks, Latin Square.

Theory of the distribution of small samples; "Student's work and Fisher's development."

Problems for future work may be considered under two heads: Problems of Application, and Problems of Statistical Theory.

(A) *Problems of application*: A few selected topics.

(1) Size of the Sampling Plot. Whether there is any dimensional effect.

(2) Most efficient (in a combined statistico-economical sense) layout for particular purposes. Limit to increase in the number of replications owing to increase in the labour (and expense) of conducting the experiment. Arrangements of sub-plots within the sampling unit.

(3) Comparison of different methods of sampling in full-scale experiments.

(4) Uniformity trials. Possibility of using results of fertility trials to correct yields in later experiments.

(5) Study of correlation between different factors in the same plant (grain and straw, size and quality, seed and quality, etc.), as affected by differential treatment.

(6) Possible extension of the method for the study of cattle feeds in their effect on yield of milk, butter, etc. All the above problems require the application of statistical methods.

(B) *Problems of theoretical statistics.*

(1) Study of the effect of relaxing the assumption of a normal distribution of variate deviations, especially for small samples and skew correlations.

(2) The interaction of different factors.

II. Crop Forecasts.

(A) Long range or pre-rainfall forecast.

(B) Post-rainfall forecast. Problem can be satisfactorily studied when reliable data for both crops and rainfall (or other meteorological variates) are available for at least 30 or 40 years. Brief description of methods for eliminating secular trend, etc.

(C) Suitable data usually not available in India.

Attempt may be made to study the differential effect of rainfall for a small number of seasons (or even in the same season) over different areas in agriculturally homogeneous tracts. For this purpose extensive crop-cutting experiments are necessary. The design (or lay-out) of the sampling operations, the size of each sample, and the number of samples required must be studied empirically. Incidentally, the question whether the rainfall data are sufficiently representative in character or not will have to be studied. It is conceivable that many areas in India would require a larger number of rainfall stations.

(D) Steps must also be taken to ensure the collection of reliable data for future use. Minimum requirements for this purpose.