A NOTE ON AN INDEX OF UTILITY OF MIXED CROPPING AND ALLOCATION OF SUCH AREAS UNDER SEPARATE CROPS : A COMMENT

By

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By using the concepts of effective area under a crop, D.N. Lal [1] has developed an index of utility of mixed cropping in a particular region or state. The total effective area under crop (1) and crop (2) are shown as

$$A_1+A_2+\left(\frac{y_{m1}}{y_1}+\frac{y_{m2}}{y_2}\right)A_m$$

where A_1, A_2 and Am are the areas under crop (1) and crop (2) and under mixed cropping consisting of a mixture of these crops. y_1 and y_2 are the yield rates per unit area of crop (1) and crop (2) when sown as pure crops. y_{m1} and y_{m2} are the yield rates per unit area of crop (1) and crop (2) when sown as mixture.

In section (4) of the above note, the author has developed the utility index of mixed cropping taking into account the input of seeds sown in the field, by considering q_1 and q_2 as the standard seed rates (per unit area) of crop (1) and crop (2) for pure crops and q_m, the quantity of mixture per unit area (standard seed rate) under mixed cropping, the mixture containing the seeds of crop (1) and crop (2) in the rotio of $\lambda_1 : \lambda_2$

where $\lambda_1, \lambda_2>0,\ \lambda_1+\lambda_2=1,\ \lambda_1 q_m<q_1\ \&\ \lambda_2 q_m<q_2$ ...(1)

Under the standard agricultural practices (standard seed rate) simultaneously $\lambda_1 q_m$ cannot be increased to q_1 and $\lambda_2 qm$ to q_2. In fact if we increase $\lambda_1 q_m$ to q_1 (but not exactly equal to q_1) then automatically $\lambda_2 qm$ should decrease to zero (not exactly equal to zero) and vice versa.

In the note it is assumed that there is proportionate increase in yield with respect to input seed within the limits of standard seed rates, and thus he considered $\lambda_1 q_m$ crop (1) on unit area of A_m gives a yield rate of y_{m1} of crop (1) while if q_1 of crop (1) is sown on the unit area of the field under single crop (1) above it is y_1. Author further hypothetically argued that if we had sown q_1 under mixed cropping on unit area of A_m the yield would have been

$$\frac{q_1}{\lambda_1 q_m} \times y_{m1}$$

It is to state here that by condition (1)

$\lambda_1 qm \neq q_1$ ($\because \lambda_1 qm < q_1$)

The author has also shown that the total effective area under crop (1) and crop (2) together

$$=A_1+A_2+\left(\frac{q_1 y_{m1}}{\lambda_1 q_m y_1}+\frac{q_2 y_{m2}}{\lambda_2 q_m\, y_2}\right)A_m$$

$$=A_1+A_2+IA_m \text{ where } I=\left(\frac{q_1 y_{m1}}{\lambda_1 q_m y_1}+\frac{q_2 y_{m2}}{\lambda_2 q_m y_2}\right)$$

and therefore he concluded that when $I \geqslant 1$, the mixed cropping can be recommended and not otherwise.

In fact the effective area under crop (1) and crop (2) should be

$$=A_1+A_2+\frac{I}{2}A_m$$

$$=A_1+A_2+I'\,A_m \text{ where } I'=\frac{I}{2}$$

since while calculating the effective area under crop (1) and (2) as $\lambda_1 q_m$ approaches to q_1, $\frac{q_1 y_{m1}}{\lambda_1 q_m y_1}$ approaches 1 and similarly as $\lambda_2 qm$ approaches to q_2, $\frac{q_2 y_{m2}}{\lambda_2 q_m y_2}$ approaches I because $\lambda_1 q_m$ approaching to q_1 means we are tending towards pure crop (1) and simultaneously if $\lambda_2 q_m$ is to approach q_2 it would mean that we are tending to pure crop (2). If the simultaneous realization of these two possibilities (*i.e.* $\lambda_1 q_m \to q_1$ and $\lambda_2 q_m \to q_2$) is plausible these should be sown on 2 unit areas of mixed crop and not on a unit area of a mixed crop as stated by the author.

Hence the mixed cropping can be recommended if $I' \geqslant 1$ and not otherwise, as against the author's claim that the mixed cropping should be recommended if $I \geqslant 1$ and not otherwise.

Similarly incase of multiple cropping (section 5)

$$I' = \frac{I}{K} = \frac{1}{K} \sum_{i=1}^{K} \frac{q_i y_{mi}}{\lambda_i q_m y_i}$$

the mixed cropping can be recommended if $I' \geqslant 1$ and not otherwise, when K are the number of crops in mixed cropping.

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REFERENCE

[1] Lal D.N. (1979) : 'A note on an index of utility of mixed cropping and allocation of such areas under separate erops.' *Jour. Ind. Soc. Agri Stat.*, **31** (3) 59-64.

A NOTE ON DISCRIMINATION AND CLASSIFICATION USING BOTH BINARY AND CONTINOUS VARIABLES

By

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The problem of discrimination between two groups and allocating the individual to one or the other, when the data consists of mixture of q binary and p continous variables has been proposed by Kranzanowski [2]. Such type of data occur frequently in many biological, agricultural and social sciences experiment. Sometimes experimenter wants to classify the observations into one of the several multivariate populations. The aim of the present paper is to derive a discriminant function from a probablistic model for mixed binary and continous variables for classifying an observation into one of several multivariate populations.

THE MODEL

Suppose p continous and q binary variables are measured on each individual. Denote the vector of binary variable by $\underset{\sim}{x}$ and that of continous variables by $\underline{y}$. The q binary variables may be expressed as a multinomial with $t=2^q$ categories. Each distinct pattern of $\underset{\sim}{x}(x_1, x_2 \ldots x_n)$ defines a category uniquely and if each x takes the value 0 or 1 categories can be numbered by writing

$$n=1+\sum_{i=1}^{q} x_i.2^{(i-1)} \qquad \ldots(2.1)$$

so that $|n|$ ranges from 1 to t. Following Olkin and Tate [3] it is assumed that y has a multivariate normal distribution with mean $\mu_R^{(n)}$ in cell n of population k. ($k=1, 2, \ldots m$; $n=1, 2, \ldots t$) and common covariance matrix Σ in all categories for all population. Let p_{kn} be apriori probability of obtaining an observation in category n, of population k. Let $\pi_1, \pi_2, \ldots \pi_m$; be m population with density function $p_1(w)$, $p_2(w)$, $\cdot\cdot p_m(w)$ respectively we divide the space of observation into m mutually exclusive and exhaustive regions $R_1, R_2 \ldots R_m$.

Allocation Rule

In case all population parameters are known, the optimum allocation rule can be derived readily from general theory of classification given by Anderson [1]. Assuming that cost of misclassification are equal, the optimum allocation rule is to allocate (x', y') to population π_j (R_j) if

$$u_{jR}^{(n)}(x) > \log \frac{p_{kn}}{p_{jn}} \forall \begin{array}{l} k=1, 2, \ldots m ; k \neq j \\ n=1, 2, \ldots t. \end{array} \quad (1)$$

Where $u_{jk}^{(n)}(x)$ is defined as

$$u_{jk}^{(n)}(x) = \{y - \tfrac{1}{2}(\mu_j^{(n)} + \mu_R^{(n)})\} \Sigma^{-1} (\mu_j^{(n)} - \mu_R^{(n)}) \quad (2)$$

Where $$n = 1 + \sum_{i=1}^{q} x_i, 2^{(i-1)}$$

Probability of misclassification $p(j/i)$ and $p(i/j)$ may be derived easily from (2). Writing

$$D_m^2 = (\mu_i^{(m)} - \mu_j^{(m)})' \Sigma^{-1} (\mu_i^{(m)} - \mu_j^{(m)}) \quad (3)$$

for the Mahalanobis squared distance between π_i and π_j conditional on the observation falling in multinomial cell m, we find that

$$p(j/i) = \sum_{m=1}^{k} p_{im} \phi\{\log(p_{jm}/p_{im}) - \tfrac{1}{2} D_m^2 / D_m\} \quad (4)$$

$$p(i/j) = \sum_{m=1}^{k} p_{jm} \phi\{\log(p_{im}/p_{jm}) - \tfrac{1}{2} D_m^2 / D_m\} \quad (5)$$

Where $\phi(x)$ is the cumulative standard normal distribution.

Estimated Allocation Rule

Generally population parameters p_{im}, $\mu_R^{(n)}$ and Σ are unknown. The only information usually available comes in the form of initial samples of sizes $n_1, n_2 \ldots n_m$ from popalation $\pi_1, \pi_2, \ldots, \pi_m$ respectively. Frequency of occurence of each possible pattern of x for each initial sample may be written in a q-way contingency table containing $t = 2^q$ cells.

Let η_{kn} denote the number of observations falling in cell n of population π_k ; $k=1, 2, ...m$; $n=1, 2, ..t$. and η_k is the total number of observations falling in population π_k. If $y_{lk}^{(n)}$ denote the vector of continous variables associated with l^{th} observation in cell n from population π_k.

Maximum likelihood estimate of $\mu_k^{(n)}$ is

$$\bar{y}_k^{(n)} = \frac{1}{\eta_{kn}} \sum_{l=1}^{\eta_{kn}} y_{lk}^{(n)} \tag{6}$$

Maximum likelihood estimate of p_{kn} is $\hat{p}_{kn} = \frac{\eta_{kn}}{\eta_k}$

and maximum likelihood estimate of Σ is

$$V = \frac{1}{\sum_{k=1}^{m} \eta_k - mn} \sum_{k=1}^{m} \sum_{n=1}^{t} \sum_{l=1}^{\eta_k} \left(y_{lk}^{(n)} - \bar{y}_k^{(n)} \right).$$

$$\left(y_{lk}^{(n)} - \bar{y}_k^{(n)} \right)'; \begin{array}{l} k=1, 2, ...m. \\ n=1, 2, ...t. \end{array}$$

REFERENCES

[1] Anderson, T.W. (1958) : *An Introduction to Multivariate Statistical Analysis* New York, John Wiley and Sons. Inc.

[2] Kranzanowski, W.J. (1975) : 'Discrimination and classification using both binary and continous variable'. *J. Amer. Stat. Assoc.* 70, 782-90.

[3] Olkin, I. and Tate, R.F. (1961) : 'Multivariate correlation Model with mixed descrete and continous variables'. *Annals. Math. Stat.* 32, (June), 448-65.