Werk

Titel: Messung der Antwortvariabilität auf Grund von Erhebungsmodellen mit Wiederholungs...

Autor: Dalenius, Tore

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Kontakt/Contact

Digizeitschriften e.V.
SUB Göttingen
Platz der Göttinger Sieben 1
37073 Göttingen

info@digizeitschriften.de

thesis of identical p-variate means for the k samples was to be tested. Hsu noted that the likelihood ratio criterion was equivalent to testing

$$W = \Pi_i (1 - \theta_i),$$

the product being taken from i=1 to the smaller of the integers p and k-1, where the distribution of the canonical roots θ_i was the same as that derived in 1939. Finally, in a second *Ann. Eugenics* paper in 1941, Hsu noted that this was a special case of the generalized regression problem for p-variate normal samples in relation to q other variates (of which one or more may be fixed or 'dummy' variates).

I doubt whether I saw these further two papers until later, being by then busy on war work; in any case, Hsu had returned to China by the time they were published, so I would not have been able to discuss them with him. Although Hsu had referred in his 1939 paper to the 1933 Wishart and Bartlett paper in *Proc. Camb. Phil. Soc.* on an analytical derivation of the generalized product-moment distribution, at no point did he refer to my subsequent *Proc. Camb. Phil. Soc.* papers in 1934 and 1938. The first of these had included the generalized regression problem, and the exact moments of the likelihood criterion for it, though not the canonical reduction (being prior to Hotelling's 1936 *Biometrika* paper on canonical correlations). The second had given the canonical reduction, including the special case of discriminant analysis. I can only conclude that Hsu was unaware of these papers, and worked independently of them; but it is curious that Fisher, who certainly knew of them and with whom I had had discussion about them (see p. 44–5 of my article in *The Making of Statisticians,* Springer-Verlag, 1982, ed. J. Gani) did not, as Editor of *Ann. Eugenics,* draw Hsu's attention to them.

Hsu himself published a beautiful little two-page derivation of the joint product-moment distribution in *Proc. Camb. Phil. Soc.* in 1939, 'communicated' by E. S. Pearson; his method has some relation with the factorization of this distribution which I had noted in 1933 (in *Proc. Roy. Soc. Edin.*) Hsu's contributions to multivariate analysis also include some interesting and pertinent results on limiting distributions, – for instance, his 1941 Biometrika paper on the limiting distribution of canonical correlations. The practical value of such results in nevertheless rather restricted in the absence of more detailed knowledge of their relevance for finite samples, as is clear from considering, say, the *exact* distribution of a single correlation coefficient obtained by Fisher in 1915.

The final paper in this collection is not by Hsu, but by W. L. Deemer and I. Olkin. Based on lectures by Hsu in North Carolina in 1947 and first published in Biometrika in 1951, it further clarified the techniques for deriving the Jacobians of certain matrix transformations occurring in multivariate analysis. The elucidation of these Jacobians had been a crucial factor in the derivation of the 1939 Fisher-Hsu distribution.

Oxford

M. S. Bartlett

H. Strecker, R. Wiegert, J. Peeters and *K. Kafka*: *Messung der Antwortvariabilität auf Grund von Erhebungsmodellen mit Wiederholungszählungen.* Vandenhoeck & Ruprecht, Göttingen–Zurich 1983, 112 p., DM 36,–.

Survey statisticians have long been concerned about non-sampling errors; they have observed, for example, that these errors may be much larger than the sampling errors. Consequently, they have devoted considerable effort to the development of methods for coping with the non-sampling errors. Much of the early development was in the nature of methods for control of specific sources of error (such as non-response, to give but one example). These methods were, and still are, used as supplements to the sample designs. This approach renders it difficult to find the right blend of controls of the sources of sampling and non-sampling errors.

Around 1950, another approach to the problem of optimum *survey* design emerged. This approach calls for integrating sampling theory with non-sampling theory; the resulting theory is nowadays referred to as 'survey models'. An important feature of a survey model is that it makes it possible to decompose the total error (as measured by the mean-square error) into components which reflect the sources of sampling *and* non-sampling errors. Estimates of these components and realistic cost functions then make it possible to strike a *reasoned* balance between all sources of errors.

The book by Dr. Strecker and his three colleagues is a contribution along these lines. Much of their work has been carried out in an applied statistics environment, viz. the National Institute of Statistics in Belgium. More specifically, the authors have addressed the problem of non-sampling errors in a census for which the data were collected by mail rather than by special enumerators; this is the way a census is typically taken in most countries in Western Europe. As a consequence, the results are 'applicable' in the best sense of this word; they are not academic constructs.

The book is divided into two major chapters, *A* and *B*. Chapter *A*, written by Strecker and Wiegert, is general in nature; it deals with survey models for estimating the response variation impairing the results of a census. In the short introduction, the authors make a distinction between three kinds of errors: non-sampling errors, random sampling errors, and response variation. Most survey statisticians would, I think, consider response variation to be just one source of non-sampling errors; certainly this view applies to the classical survey model developed by the U.S. Bureau of the Census.

In the balance of chapter A, the authors discuss three different (but related) survey models for use in the context of a census which is taken in order to provide statistics which refer to time t_0. In order to be able to assess the role of non-sampling errors in the census data, an evaluation study must be carried out. This study calls for collecting data concerning the (more important) census characteristics for a sample of those enumerated. These data cannot, as a rule, be collected *at the same time* as the census is taken, in order to avoid the event that people (remembering their responses) give the same right/wrong responses on both occasions. If the data are collected at some time t_1 after t_0, they may reflect (in addition to response variability) changes which have taken place between the two points of time. This may call for use of some adjustment method to make the data comparable. The same problem occurs if the data are collected *before* t_0. The authors consider these situations and develop three survey models corresponding to three cases:

i. the data are collected at time t_0 and no adjustment is made for change over time; this is model *a*.
ii. the data are collected at time t_1 and an adjustment is made to take into account change over time; this is model *b*.
iii. the data are collected at time t_{-1} (i. e. before t_0) and an adjustment is made for change over time.

In chapter *B*, model *c* is applied to the agricultural census of 1979 in Belgium; the application was limited to one kind of data, viz. the number of pigs. This is a characteristic which may vary considerably over time (not only at Christmastime!). While the design of the evaluation study is of interest per se, the primary value of chapter *B* is that it provides a detailed account of the estimation of the non-sampling errors.

In summary, this book is a welcome contribution to the growing literature on total survey design. I have two comments in the nature of criticism:

(1) It would be helpful for the understanding of future publications if the authors were to use terms such as 'non-sampling error' in accordance with already with already well-established practice.

(2) It would likewise be helpful if specific German terms were translated (in parentheses) into English every time they are used. One example of a term which I would like to see translated is 'Adäquationsprobleme'. Two German colleagues here (both applied mathematicians) told me they had not seen this term before! I could only guesstimate its meaning . . . . .

Providence R.I., USA

Tore Dalenius