

## LESLIE KISH: DEVELOPMENT OF STATISTICS INTERNATIONALLY

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### ABSTRACT

In “Remembering Leslie Kish”, here is a personal view of his many contributions to the development of statistics internationally. We look for characteristic features of the “Kish approach” to understand what made his contributions so special and effective: identifying what is important; formulating and answering practical questions; seeking patterns and frameworks; and above all, persisting in the promotion of good ideas. We identify areas in which his technical contributions have made the most impact on practical survey work in developing countries. A unique aspect of Leslie’s contribution is the impetus he gave to the development of a community of survey samplers world-wide.

KEY WORDS: Multi-population paradigm; the Kish approach; Statistical development

### 1. DEVELOPING STATISTICS INTERNATIONALLY

This personal presentation in honour of Leslie Kish touches upon dimensions of his impact on the development of survey sampling internationally. Leslie was a true internationalist. His concerns and interests were world-wide, yet he cherished the diversity of nations and nationalities. His justly famous Sampling Program for Foreign Statisticians (SPFS) has had students from 95 countries – proof of his wide international interests and contacts. Leslie noted that in 1963 in Latin America he could find not a single national probability sample of households south of Mexico. His work coincided with the rise of sample surveys as a major source of statistics in the diverse circumstances of rich and poor countries alike. The basic similarities in sampling methods, despite disparities in conditions, made world-wide the impact of Leslie’s *Survey Sampling* and other books and writings.

To me the chief characteristic of Leslie’s work is that *he managed to identify and answer questions which mattered in actual survey practice*. His influence goes well beyond providing good questions and good solutions, however. Its true secret is in the warm human contact – the network of shared knowledge and experience – which he developed and sustained.

But let me begin by identifying the basic ingredients of “developing statistics internationally”. What does it imply in terms of the contributions which individuals can make? We may identify five dimensions as follows.

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### Aspects in Development of Statistics Internationally

- 1 Developments of methods: improving tools of the trade and applications world-wide
- 2 Development of samplers: providing training, improving theoretical and practical skills, imparting a sense of proportion
- 3 Advising, consulting: clarifying objectives and questions, elaborating options, providing direct and specific answers
- 4 Mobilising resources: helping in (and raising funds for) the development of institutions, sustainable capability and programmes
- 5 Developing a community of samplers: promoting network of shared knowledge and experience internationally through professional associations, personal contact and better and frequent communication

1. The first is by contributing to the development of methods and their applications. The techniques and methods are relevant in so far as they contribute to the provision of better numerical information about various facets of life and reality.

2. Second, by improving the supply and level of skilled personnel. Leslie called it “developing samplers for developing countries”. Leslie was eminently practical about this. He said somewhere “I am keenly interested in teaching sampling, because it is the most cost-effective method of improving data quality with limited resources – anywhere and especially in LDC’s”.

3. Third, through advising and consulting, i.e. developing the quantity and quality of statistics available by providing direct and specific advice on the design and implementation of statistical operations. The training and consulting functions are distinct but not unrelated in the context of developing statistics internationally.

4. Four, by mobilising resources, material and intellectual. Actually, to achieve this one does not have to be a statistician, a survey methodologist or even a sampler, but has to be able to appreciate the usefulness of statistical information and have the motivation and influence (and the opportunity) to mobilise material and intellectual resources for the purpose (I think of Simon Goldberg, for instance); or one can be a brilliant statistician with all these skills (Mahalanobis, Fellegi). But one can also ‘mobilise’ without directly controlling large financial resources, achieving this through motivating, developing tools, providing training and advice: that was Leslie Kish.

5. Finally, through developing a community of samplers. In this we have an effective means of enhancing the impact of ours and others’ contribution, through receiving and passing on knowledge, by exchanging and hence improving ideas. In this, Leslie Kish remains very special, almost irreplaceable.

## 2. CHARACTERISTIC FEATURES OF LESLIE’S CONTRIBUTIONS

The many scientific contributions of Leslie Kish (three books, *Survey Sampling*, *Statistical Design for Research*, and *Sampling Methods for Agricultural Surveys*, over 70 major scientific papers, etc.) are widely known and reviewed, and need not be repeated here. Rather, the interest here is in a more basic question: I want to share an understanding of the essential features of Leslie’s approach which made his contributions so special and effective.

### **The Kish approach**

- 1 Identifying what is important ... and what is not
- 2 Formulating questions: practical, answerable; specific yet with wide application
- 3 Providing answers: simple and general (even if not “profound”); identifying options, with pros and cons
- 4 Seeking patterns, typologies, frameworks: identifying common aspects in apparent diversity, and sharpened distinctions in apparent similarity
- 5 Persistence: devising descriptive, powerful, repeatable names; expounding from different angles; expanding, adapting, improving; seeking applications; using diverse forums, opportunities; even repeating where necessary; and above all, *never giving up*.

1. Identifying what matters in practice. Looking at the chronology of Leslie’s writings, it still amazes me as to how he was always pursuing ideas and aspects which were of the greatest practical importance at the time or were to be so in the near future. The shifts in his interests reflected shifts in the situation, in practical needs and possibilities. This is seen most clearly in his increasing preoccupation with issues of comparability and multi-population design, paralleling the development of statistical needs and possibilities across national boundaries. His impatience with intricate discussions of, for example, the “finite population correction” - elegant but of little practical value – was refreshing.

2. Formulating questions, identifying and stating the underlying issues. Leslie was fond of saying that asking good questions is more important than providing good answers, and that this is the main force in the development of science.

3. Providing answers. I emphasise the plural. Leslie often gave several answers, and enumerated considerations in the choice of the right one – or better, the right oneS. Many of his statements lacked precise quantification, giving much more importance to being meaningful and useful in practice. Practice cannot have exact solutions, but we can often know in which direction we should move, can identify the “class of designs” which are more appropriate to our needs and resources. Leslie often ‘apologised’ for being insufficiently ‘profound’, but he knew well that it is better to be approximate and relevant than to be precise but irrelevant.

4. Seeking patterns, typologies, frameworks. This is by far the most characteristic feature of Leslie’s approach. He proceeded in both directions: seeking similarities and commonalties in apparent contrast; and identifying contrasts in similarities. His multi-population survey designs provide perhaps the best example of the philosophy of this approach. He contrasts 5 distinct designs, and then proceeds to identify 7 shared aspects in all those. (Incidentally, Leslie had the interesting habit of giving such ‘counts’ to situations, designs, aspects or scenarios – a style which I think was suggested to him by presentations in a similar style in China, in particular in Chinese political and especially Party publications.)

5. Simply persisting. This perhaps is the most manifest feature of the Kish approach. He not only conceived and developed ideas, but effectively communicated and actively promoted them, with persistence and energy only in proportion to their value. He worked and reworked his ideas and methods, coming at them from different angles and seeking ever more applications. He sought opportunities to repeat them, ever seeking a wider audience and converting doubters. He understood how important it was to have good names and labels. He could take rejection and refusal with uncanny self-confidence (which much less distinguished persons may easily declare as ‘insulting’), and keep “coming again” as long as it would take. As someone engaged in the practice of developing statistics, I am thankful that Leslie ensured that we listened.

### 3. CONTRIBUTIONS TO SURVEY METHODS INTERNATIONALLY

This choice from among many of Leslie's contributions can only be subjective. However, it is not arbitrary: it is based on experience in designing surveys, advising, teaching and training in a variety of situations and circumstances internationally. What particular ideas and tools developed by Leslie Kish have proved most useful in the work in developing countries?

#### Some tools with most impact on survey practice, especially in developing countries

- The popularisation of computing and analysing sampling errors and design effects
- Isolating the effect of arbitrary weights on variances
- Promotion of self-weighting against fixed-take designs
- Sample allocation in international and national surveys
- Procedures for randomly selecting persons in households
- Surveys of organisations, establishments, and other non-household units
- Sampling over time and rolling samples
- Combined uses and designs of samples and censuses
- Small domain estimation
- The multi-population paradigm to bring together diverse designs for comparisons

1. The popularisation of computing and analysing sampling errors and design effects. Leslie emphasises the need to have not only probability samples, but also measurable samples which permit in practice the computation of sampling errors from the sample itself, taking into account the actual design. He insisted on the need to compute sampling errors for diverse variables, type of estimates and subclasses (Kish, 1959, 1995). I remember his praise for the World Fertility Survey in ensuring that all 40+ WFS surveys in developing countries included information on sampling errors in their reports, and his laments about the absence of these in practically all of the 20 fertility surveys in developed countries. Leslie developed and worked untiringly to ensure widespread understanding and use of design effects, intra-cluster correlations and basic practical approaches for computing and analysing sampling errors. As noted by Frankel and King in their "A conversation with Leslie Kish", "... for decades I have been promoting methods for proper computations of sampling errors and design effects for complex (analytical) statistics for complex samples. I was careful to invent the term 'design effect' so that it wouldn't end up as 'Kish effect'." (Frankel and King, 1996.)

2. Effect of arbitrary weights on variances. Leslie's simple expression of the increase in design effect as a function of the coefficient of variation of sample weights is a powerful and widely used expression in making design choices and understanding design effects (Kish, 1965, Section 11.7). The expression helps to separate out, not exactly but in a most useful way, the contribution of arbitrary weights from those of clustering and stratification to the design effect. It helps in basic design decision such as concerning sample allocation.

3. Promotion of self-weighting designs. There has been (and still persists) a strong tradition of favouring "fixed-take designs". By this I mean a multi-stage designs in which a fixed number of ultimate units are taken from each PSU or cluster in the sample, in contrast to "self-weighting designs" in which selection probabilities of units at the last stage are determined so as to compensate for variations in probabilities at the preceding stages (Kish introduced the term 'epsem' – equal probability sampling of elements - for these latter type of designs; Kish, 1965a, Section 1.5) . All sort of reasons are given for this preference for fixed takes (such as the need to fix budgets and interviewer workloads exactly, to ensure that the planned sample size is achieved, to appear to be in 'authority and control', etc.), but many of these are often not valid. Through his own efforts and working through his former students, Leslie has had quite an influence in promoting self-weighting designs. And this links with appreciating the effects on variances of introducing arbitrary weights.

4. Sample allocation. Leslie raised this question generally and also specifically in the context of international programmes of surveys (Kish, 1976; 1987a; 1989a). He made an attempt to influence the allocation of WFS samples among countries, arguing for the need to give consideration in the WFS sample allocation to the production of regional, continental and even world estimates, and not simply to the individual national figures in this international programme. Leslie did not have much success in the particular instance of the WFS. Fortunately, there has been more attention paid to this idea in the context of the European Union labour force and other surveys.

5. Selecting persons in households. Often surveys require the random selection of one or more persons per sample household. The “Kish Method” is widely used and quoted for the purpose. Published over 50 years ago, this is a fine example of Leslie’s concern with real and important issues almost from the beginning (Kish, 1949). Its role in practical survey work has been important – it has helped avoid gender and age biases which would result from simply taking the ‘head’ or some other person in a predetermined position or with predetermined characteristics. Yet the procedure is simple, and even Leslie felt there was nothing ‘special’ about it, as he remarked to me once: “I do like something to be called ‘the Kish Method’, but I wish it referred to something more profound than this!”

6. Surveys of organisations, establishments, and other non-household units. Much discussion of sampling methods, including in textbooks on the subject, tends to be confined to the design of population-based surveys of households and persons. The theory and practice of large-scale population-based sample surveys can be said to be reasonably well established and understood. By contrast, numerous surveys with other types of units are still carried out to much poorer technical standards. This neglect is difficult to understand but is pervasive. Leslie made an important contribution towards improving the situation (Kish, 1965), but this is one practical area I wish he had followed-up more vigorously. Perhaps the wide gulf in the circumstances of developed and developing countries in this field (low ‘transferability’ and ‘portability’ in Leslie’s terminology – see below) contributed to this neglect.

7. Sampling in time and rolling samples. In survey practice there is a wide-spread lack of appreciation of the applicability of the basic principles of sampling in the time-dimension: of the fact that just as in space, it is neither necessary to have complete enumeration nor is it acceptable to have arbitrary non-probabilistic selection of the reference period for survey enumeration. Numerous surveys are still being designed ignoring these basic principles, often resulting in considerably increased costs and in lower quality. Leslie brought these issues up-front, advised, taught and insisted on these, culminating in his famous “rolling samples”, which deserve mention in their own right (for example, Kish, 1983; 1990). Central to the concept of rolling samples is the idea of asymmetrical cumulation of data, over different lengths of time for different sizes of domains. The flexibility of the rolling sample design comes from the opportunities it provides to make different tradeoffs between spatial, temporal, and subclass detail. Its first major application is the American Community Survey, an experiment to replace the ‘long form’ of the US population census (Alexander, 2002).

8. Samples and censuses. In developing countries the development of population censuses and household surveys is closely linked, and Leslie recognised and promoted these linkages in a number of publications. He noted that the census provides impetus to the development of national statistical capability and particularly of sample surveys, by mobilising resources to develop infrastructural facilities (Kish and Verma, 1986). Large-scale surveys attached to the census can provide a basis for launching continuing survey programmes. Good samples are based on sampling frames provided by census data, especially where alternative sources such as population registers are not available, as in developing countries. The census also provides auxiliary information for improved estimation. In the planning, design and implementation of the population census, careful attention needs to be paid to these varied roles of the census in relation to post-censal sample surveys. The census, in turn, uses sampling in a number of ways, for instance for evaluation and operational control, to facilitate timely processing, and to collect more detailed information on a sample basis.

9. Small domain estimation. Demands are growing everywhere, not only in developed but also in developing countries, for more timely and varied statistics for lower-level administrative units and other small domains. These estimates need to be more frequent and more up-to-date than can be provided by population censuses conducted at long intervals. At the same time, such estimates are needed in much greater detail (for small areas and population subgroups) than is possible to obtain from sample surveys of limited size. Administrative sources are often too inflexible and incomplete to provide small domain statistics and, in any case, are altogether unsuitable for statistical purposes in many developing countries. Leslie, not surprisingly, was early in appreciating the practical importance of this issue and set to work on it (Purcell and Kish, 1979; 1980). Again, the most significant of aspect of Leslie's contribution is in bringing the problem to attention and promoting a proper orientation to it. He helped clarify the issue through his classification of domains (major, minor, mini, rare) according to size category. He emphasised from the outset that "there is no single method that is best for all situations ... Great differences between countries exist in the sources and quality of data available; the scope and quality of its census; the extents, contents and sizes of its sample surveys; and especially the scope and quality of its administrative registers", yet "passive and negative attitudes are generally unjustified since every country has some resources, and ingenuity and effort can find unused resources of data."; also that "the choice between methods is more difficult because the 'best' is often not clear even after the event". Perhaps even more important is his observation that "success depends on first using better data and second on better methods. ... Good data sources are the principal means to better statistics ... [we need to] work towards the collection of other and better data [and also consider] strategies for cumulating data from samples for small areas." (Kish, 1987). As to specific methods, in the past few decades there have been major and sophisticated developments by others in the methodology of small domain estimation procedures (Ghosh and Rao, 1994; Rao, 1999). Yet in my view the basic idea of the 'structure preserving estimation' (SPREE) procedure of Purcell and Kish remains one of the most suitable for practical application in developing-country circumstances.

10. Multi-population paradigm. Leslie's multi-population paradigm, among almost all else, brings together his practical wisdom and concerns (Kish, 1994; 1999; forthcoming 2002). Around this idea, Leslie pulls together statistical treatment of a wide range of survey structures and designs (periodic surveys, multi-domain designs, cumulated samples, combined samples, and controlled observations or quasi-experimental designs), recognising their distinct features yet drawing out their essential similarity. Why seek such similarities? Firstly, because it carries "heuristic advantages, because the lessons learned from one type can often be applied to others; the mistakes fostered for one type should not be repeated in the other designs". Second, it fosters "the deliberate design of multi-population surveys, rather than merely utilise post hoc the availability of separate results". Third, it helps joint treatment, and deepens our understanding of each type of design despite its distinct features. Fourth, it brings into focus the central issue of comparability in all types of multi-population designs. Fifth, it brings out the general and consistent application of the distinction between sampling and (other) survey aspects. For comparability, the latter need to be standardised, while the former can and should be determined flexibly for efficiency. Nothing demonstrates better Leslie's synthesising approach than this multi-population paradigm.

#### **4. TRAINING AND CONSULTING**

Training and consulting constitute the two central instruments for "developing statistics internationally". They refer to two distinct types of activities, with rather distinct objectives.

Training aims at imparting knowledge on a range of tools and techniques. Good training must also impart an understanding of the pros and cons of available choices in the application of the tools and techniques under a wide range of conditions and objectives. Above all, it must impart a sense of what is important and what is not in survey practice. Its ideal method is through comparisons and contrasts among practical questions and answers.

By contrast, consultancy is essentially concerned with proposing specific solutions to specific problems. Primarily, it involves the choice and application of existing tools to solve old and new, but always specific, problems.

Looking at training and consultancy in such a contrasting way, it appears clear to me that Leslie was more of a trainer than a consultant. This appears to be so at least in the international context, though the balance may perhaps be different in relation to his work in the US. Also, by saying that Leslie was more of a teacher than an adviser, I do not mean to undervalue his consulting work, such as setting up samples and advising in Puerto Rico, Peru, Ecuador, Chile etc. in South America; or Malaysia, Thailand, South Korea, Hong Kong, Taiwan and mainland China itself in East Asia (Kish, 1989); or advising international programmes such as the World Fertility Survey (WFS) and Demographic and Health Survey (DHS) programmes, or even Statistics Canada in its Methodology Advisory Committee. Nevertheless, to appreciate Leslie as a teacher, we only have to think of the renowned SPFS. A majority of its over 400 students from 95 countries went back to their countries of origin to engage in practical survey sampling work, or took on such responsibilities internationally as consultants to the United Nations and other bodies. For many, the relative short exposure at the SPFS turned out to have a permanent effect on their orientation and career. Many of them definitely caught the “sampling bug”. I have always found this an amazing achievement, and wondered what made it possible. The fact that SPFS has been a well-designed and well-delivered training programme does not explain it fully. Leslie’s strong, and I emphasise, highly charismatic personality must have been a major factor.

But let us not make the distinction between training and consulting too sharp. The two functions overlap and share certain common objectives. As Leslie noted, a good trainer must be an adviser: one of the most effective ways of training is to base it on specific and practical issues brought to the workshop by the trainees themselves. And on the other side, a good adviser must also be a teacher: the advisor must at least explain why a particular solution (or preferably, a class of solutions) is proposed for the problem at hand, and how the problem can be seen as a particular example of a range of similar problems. In short, through the training function, good advisers must work for their own redundancy. Furthermore, it is highly desirable to include teaching and training formally and explicitly as a part of the consultant’s task. As Leslie put it, such “one-on-one or one-to-ten teaching is a fringe benefit during the weeks and months of the expert’s visit to the LDC’s .. such teaching should be brought from the fringe of the projects closer to their centre in the form of classes, formal and informal, say for 5 or even 50 students”. Being a realistic and practical person, Leslie continues, “I also propose that this training function .. be made a part of the visiting expert’s budget.” (Kish 1996).

Leslie notes these and many other of his basic views on teaching and consulting in his *Fourth Morris Hansen Lecture*. I had the opportunity to discuss many of these with Leslie personally on numerous occasions. I agreed with and admired most of what he had to say, though we had some differences. But leaving aside the details, there are two aspects of his orientation and approach which I want to bring out on this occasion of remembering Leslie Kish.

Leslie’s tenacity and persistence was much admired or at least noted by many. A most notable feature of Leslie’s personality, however, was that he combined that with exceptional openness and flexibility of his imagination. It was not an accident that he had so many young friends. He was ready to listen, and modify his views if empirical and logical evidence so warranted. For instance, I believe that in the light of changed circumstance, constraints and opportunities, he became genuinely convinced of the need for new modes of imparting training, modes to supplement if not replace the SPFS model. I refer specifically to the increased need and opportunity to shift the focus away from international courses to in-country workshops, covering a single recipient country or at the most a few neighbouring countries at a time. This is because of the general development of sample survey activity and the increased need for country specificity. The numbers needing training has escalated; the cost of sending trainees abroad has increased; and there is a greater need to train people within their own specific environments.

The second characteristic feature of Leslie’s approach is his frequent use of the tool of developing frameworks, concepts and categories as an instrument to put order in details and to deliver home their essential characteristics. Among many, I would like to refer to two such categorisations, which deserve more attention and use.

One is the distinction between sampling aspects and (other) survey aspects of design to which Leslie frequently returned. He used these concepts to clarify and elaborate issues relating to the comparability of statistics over space and time, and more specifically to develop and promote his ideas of multi-population survey designs. Along with the idea of rolling samples, issues of comparability and multi-population survey design increasingly occupied Leslie's mind in later years. The basic distinction between survey and sampling aspects is as follows (Kish 1994). To support comparisons, the survey aspects (definition of concepts, variables and populations, survey design and methods of measurement, substantive analysis, etc.) must aim at "utmost uniformity and similarity". However, in the sampling aspects (sample design, size, rate, selection methods, etc.) the designs should "allow for great flexibility and divergence".

Another useful distinction Leslie often referred to concerns what he termed 'transferability' on the one hand, and 'portability' (access) on the other (Kish, 1996). This framework is useful in clarifying the distinctions (and commonality) between training and consulting functions, and hence in the all-important search for their efficient and effective forms in developing statistics internationally. Leslie used transferability, in the sense of applicability or generality, to denote "the ease with which a method or technique can be adapted from a [donor] country to a [receiving] country or culture; also for transfer between disciplines". By contrast, portability was used to refer to "the low cost of the transportation or access to the method". He saw maths and computing, for instance, as highly transferable and mostly culture-free and hence easily portable, but methods of survey sampling as highly transferable (the basic techniques applying across countries, cultures, fields) yet not highly portable (their application requiring intimate knowledge of the local situation).

The way I find useful is to think of Leslie's distinction as between a "tool-kit" and "manufacturing", between techniques and their application. The degree of variation of each of these dimensions (i.e. the need to change and adapt them) according to circumstances is the important consideration. Training (as distinct from consulting services) suffices when both tools and applications are not sensitive to the particular circumstances or context, while consultancy is most needed when both are context sensitive. Other combinations represent the need for a mixture of training and advisory services. Less variability across circumstances or context reduces the need for in-situ training and/or consulting. Such distinctions do not necessarily apply uniformly to whole disciplines such as 'surveys' or even 'survey sampling', but can be specific to particular sets of tools, applications and sub-disciplines.

The transferability-portability framework could be developed more fully and clearly. It is important in the search for effective and efficient forms of training and consulting, both extremely important but expensive components of "developing statistics internationally". I do not know if Leslie planned to pursue these ideas further, and it would be so nice to be able to discuss and debate these with him!

## 5. A COMMUNITY OF SAMPLERS

I would like to conclude by remembering again the most unusual and uncommon aspect of Leslie Kish's contribution to the development of statistics internationally. This is his contribution towards the development of a world-wide community of sampling statisticians. It permits us to enhance the impact of our own and others' contribution. Leslie was a catalyst who brought and kept so many of us together.

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