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The Making of an Encyclopedia

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Abstract: We describe the development of the ideas for the *Encyclopedia of Statistical Sciences* and the execution of the actual work. We also take up a number of problems and the measures taken to minimize their impact are described. There is a brief description of the scope and size of the work.

Key words: Applications; history; information.

1. Introduction

The authors of this article, Norman Johnson and Samuel Kotz, are Co-Editors-in-Chief of the *Encyclopedia of Statistical Sciences,* being published by John Wiley and Sons of New York. Eight volumes, each consisting of about 500 double column pages, and a possible index volume were envisioned in the original plans. This has proved an underestimate, as we will see. We still expect the complete work will contain nine volumes, though the ninth will not be purely an index, and the size of each volume (after the first) will be greater than expected.

2. Genesis

The idea of this enterprise was born in the mind of one of the Co-Editors who reasoned along the following lines:

An outstanding characteristic of statistical methodology is its pervasiveness in many diverse fields. Statistical methodology uses many concepts and modes of thinking common to many different fields. From this follows that (i) many persons, well-trained in scientific (here used more-or-less as a synonym for "systematic") thinking, but not especially well-versed in the details of statistical methods, need to use and understand such methods in their work, and (ii) there develops a substantial amount of overlap, with workers in different fields generating essentially the same methods over and over. To quote from the original proposal sent to John Wiley & Sons in 1977, "The extremely wide range of applications of statistics; the great variety of statistical tools that use both mathematics and computer science; the diversity of methods proposed and developed for planning experiments; analysis of data; and the numerous theories that justify these methods have made it impossible for even the most diligent student to absorb a small part of the wealth of infor-

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mation available in this field. We are, consequently, witnessing tremendous duplication of research efforts. This is, to a large extent, due to the absence of a comprehensive, authoritative source where students, scholars, practitioners, and active users of statistics can easily find reliable information." In the field of statistical sciences, the need for a comprehensive and authoritative source is especially acute in view of the diversity of publication outlets. In our planning, we took note of the existence of the *International Encyclopedia of Statistics* (Free Press – Macmillan) (1978) based on up-dated articles from the *International Encyclopedia of the Social Sciences* (1968), together with some newly commissioned articles.

3. History

Wiley's, after some time for deliberation, thought sufficiently well of the proposal to take some preliminary steps. These included

i. requesting elucidation on specific points,
ii. soliciting reactions from individuals of established position,
iii. arranging a meeting, in January 1978, of a number of experts, together with responsible officials of Wiley's, an editor of an encyclopedia Wiley's had published, and, of course, ourselves, and finally
iv. commissioning a market research enquiry.

The assembled reports were deemed encouraging enough to proceed with the project as of October 1, 1978. On the basis of their experience, Wiley's then advised that we should proceed serially through the alphabet (rather than try to build the encyclopedia as a whole), and publish the work volume by volume. This seemed a reasonable decision, even though it has led to difficulties in cross-referencing the earlier volumes because of uncertainty about the contents of later volumes. Nevertheless, had we decided to wait until all manuscripts were available before commencing production, there still would not (after over eight years) be any published volumes!

Work on the first two volumes, covering A–E, started immediately. An Advisory Board would be set up when we were nearing the end of this part of the work. This postponement of the Advisory Board was agreed upon

i. to avoid delay that would ensue if many opinions had to be discussed before embarking on executive work and
ii. to better utilize our experience with A–E.

The Advisory Board was, in fact, set up in June 1979. It contained five members: Morris H. DeGroot, Robert Ferber, Martin B. Frankel, Eugene Seneta and Geoffrey S. Watson. Regrettably Bob Ferber died in October 1981. Campbell B. Read joined us as an Associate Editor in October 1980, and became an Executive Editor in 1986. He has been, and is, an indispensible partner in our enterprise. In addition to the members of the Advisory Board, several prominent statisticians have been of considerable assistance as advisors over the last six years. We appreciate their vigorous and cheerful help. Especially we want to mention Professors Jean D. Gibbons and Erich L. Lehmann, whose devotion has been far beyond the call of duty. All of our colleagues helped us to overcome many of the inevitable crises and frustrations encountered in the course of the work.

The three major encyclopedias previously published by Wiley were connected with the chemical industry (*Polymer Science and Technology* (16+2 vols.), *Chemical Technology* (14 vols.), *Industrial Chemical Analysis* (20 vols.)). So although their experience was invaluable in getting us started, they, as well as we, continued to learn and adjust as we progressed.

4. Structure

Turning to the nature and scope of the encyclopedia, the strongest impression we have is the constant increase in the magnitude

of the undertaking. A quotation from an early, informal communication from Sam Kotz, "If all goes well, we are planning to start serious work on the project in January of 1978 and hope to have all the manuscripts in our possession by the end of 1979," shows how far we were from reality!

In planning the encyclopedia, once the reasons for its existence had been accepted, the first considerations were: who is our audience – and what do they expect from the encyclopedia? We felt that many of our readers would be those who needed or encountered references to statistical methods, but who have not had formal training in these statistical methods. We could also add statisticians who need to know something about specific applications or techniques outside their own specialties. Of course, there would be others, ranging from persons motivated by idle curiosity to specialists who wished to see what sort of mess had been made by contributors on entries dealing with their own specialty.

Within this framework we developed a number of parallel and overlapping schemes of classification. This sounds as if it is not a very tidy arrangement, and indeed, it is not. It is, however, flexible and the details have changed as our experience widened.

We first assembled a word-list of potential titles for entries. It was something like an index, except that it had no cross-references. There was some intentional duplication, for example, in articles on *randomization* and even triplication, on *fiducial inference*.

For convenience we classified (very roughly) potential entries by length:

"Major": 3 500 – 4 000 + words
"Medium": 1 200 – 2 400 words
"Minor": 500 – 1 000 words
"Short": <500 words.

We originally estimated that there would be about 300 major articles, 600 medium articles, and 1 500 minor articles. In fact, the actual number of articles turned out to be about 15–20 % higher than our original estimate. In accordance with our plans, nearly all the major and medium entries have been commissioned from appropriate experts. This is also true of some of the minor articles. The remainder, and very nearly all of the short articles, have been written by ourselves (including the Executive Editor Campbell B. Read).

Although this classification by length has been convenient, it is by no means rigid. There is no ban on articles of 3 000 or 1 100 words, or even of 5 000 words, in appropriate circumstances.

From the beginning, it was apparent that entries would not be of the same mathematical or technical level. A person desiring to learn about the Radon-Nikodym theorem might reasonably expect to encounter more sophisticated mathematics than a person wanting to read about eye estimates. Or, in a different aspect, a reader of an article on statistics in crystallography should not be surprised to find some knowledge of chemistry to be necessary for full comprehension.

As our experience increased, the need for another type of classification became apparent. This classification concerned the level of generality. In an article on statistical inference, for example, one would not want to go into detail about the method of maximum likelihood; rather, the latter entry could by referred to in the former. And in the article on maximum likelihood, one would not wish to go into detail on mathematical or computational details of *specific* applications of the maximum likelihood method. We have, therefore, introduced, informally and just for practical convenience, three levels of generality. Roughly speaking, they might be termed "fields," "groups of techniques," and "specific applications," but there are many cases where these are misnomers.

Before leaving the subject of the organization of entries, we would like to emphasize

once again that all these schemes of classification are extremely flexible – in fact, untidy. Our word-list, for example, is only a general guide to what we want to include. It changes so much that we do not have a definitive list at any one time. There is a kind of "snowballing" effect. As we accumulate more entries, not only does cross-indexing become more complex, but further entries (which we must try to accommodate in later parts of the alphabet) suggest themselves to us. There will be a supplement in Volume 9 which will contain our "failures." Our "failures" are topics that either did not occur to us in time to be included in the appropriate volume or for some other reason could not be accommodated for in the volume where it would otherwise belong. (It will also contain some entries which we *did* think of, but which were received too late to be included in their proper places.)

5. Procedure

We now give a brief description of how we obtain the commissioned entries – which constitute nearly all the major and medium length ones, and a few of minor length. Having decided that an entry is suitable, we first discuss possible authors and list two or three whom we believe appropriate. We then seek to interest one of these individuals in the project. This involves, at least, a statement of title, length, fee and deadline, and often some indication of level(s). Most often a potential contributor will need further information about the nature of the article and sometimes provide valuable information about other related topics that could be included. Occasionally we get a suggestion that the proposed topic does not warrant an entry at all.

As a result of our experience with this phase of the work, we have seen

i. how dependent the success of this enterprise is upon the cooperation of many (and varied) statisticians and
ii. in general, how willingly and generously this cooperation has been vouchsafed to us.

The economics of the undertaking are such (Wiley has assured us – and we are inclined to believe them) that the fees we offer are clearly inadequate for the effort and sometimes do not even cover the typing costs alone. Yet, we have received a high proportion (about 85 %) of favorable responses, sometimes supplemented, as already indicated, by valuable additional (and unsolicited) advice. We have, of course, had a few dusty answers, though very few cast doubt on the desirability of such an encyclopedia. (One of these happened to be only the third contributor we approached; this gave us an initially pessimistic view of our chances.)

We now describe the editorial process in a little detail. When the first draft of the entry is received (usually no later than two months after the deadline), it is read by at least two of the three editors and sometimes a member of the Advisory Board or by an external referee. Nearly always there is need for revision, and we write to the author outlining our suggestions, though leaving considerable freedom of decision for adopting these suggestions. Often the suggested amendments are more in the interests of improving coherence of the encyclopedia as a whole – references to other articles, comments on bibliography, etc., rather than corrections in substance. The latter are, however, sufficiently numerous to cause considerable embarrassment. Just consider the situation. After having persuaded a person of established high reputation to work at some length on a topic, of which he is a master and we are, relatively, ignorant, for a miniscule fee, we proceed to tell him just what he has done wrong! Nevertheless, we must say that so far all contributors have treated us courteously – at least in their correspondence, although we do feel reluctant to demand second revisions.

We try not to force authors into too limited constraints. Although this is, partly, a recognition that we might very well scare off an author by insisting on uniformity of style, we also believe that much is gained by encouraging individual style and idiosyncrasies.

6. Present and Future

What is the present position? Volumes 1 and 2 were published in 1982, Volumes 3 and 4 in 1983 and Volumes 5 and 6 in 1985. Volume 7 was published in 1986. The numbers of pages of text and titles of the first and last entries in these volumes are shown below.

Volume	Number of pages	
1	480	ABAC to Circular Probable Error
2	613	Classification to Eye Estimate
3	722	Faa Di Bruno's Formula to Hypothesis Testing
4	657	Icing the Tails to Limit Theorems
5	741	Lindeberg Condition to Multitrait Multimethod Matrices
6	758	Multivariate Analysis to Plackett and Burman Designs
7	714	Plackett Distributions to Regression, Wrong

Volume 8 is now being printed and will appear in September of 1987. They contain entries from Regressogram to STP_2. Volume 9 is planned to contain entries for the remainder of the alphabet and supplement containing entries for earlier parts of the alphabets which (a) were received too late for inclusion at the proper place, or (b) are results of afterthoughts or (c) on subjects experiencing special growth during the last 8 years (such as *bootstrap*) which were inadequately discussed in earlier volumes, and Index(es).

Volume 8 will contain about 925 pages. The size of Volume 9 is as yet uncertain but it will probably be slightly larger to incorporate recent developments in the renaissance period of statistical sciences which we are fortunate to live in. It is hoped that Volume 9 will appear in 1988.

Each page contains two columns with a total of about 600 words, so that (apart from Volumes 1, 8 and 9) there are about 400 000 words per volume; and about 3 1/2 million words in all (excluding the Index(es)).

The organization of cross-references presented some problems, and we cannot claim to have found an ideal solution. We use three kinds of cross-references – related entries, grouped together at the end of an entry, an asterisk after topics mentioned in the text of the entry, for which relevant information is available in other entries, and "dummy" entries of type "X *see* Y." We have tried to ensure that (i) any entry referred to actually exists and (ii) any relevant existing entry is referred to, but we are aware that there will probably be some deficiencies. Serial publication posed the difficult situation of having to foresee the contents of later volumes while still working on the earlier volumes. Nor were we able to benefit from hindsight and insert material into the earlier volumes. Of course, there are countervailing advantages, notably in speed of publication, but also in the organization of correspondence.

The organization of the index is at present one of our major preoccupations. It seems desirable, though it may not be practicable, to have several indexes in addition to plain alphabetical ones by author and/or title. In particular, there is another form of classification – by subject matter – which we have not previously mentioned. We are not using subject matter classification in connection with production of the articles but could use it

for one set of classified indexes. At present we have 22 informal "fields" ranging from Mathematical Tools, through Computational Methods and Time Series Analysis to Applications (in four general subfields – physical science and engineering; health sciences; socio-economic topics; biological and earth sciences). Whether these will form the basis of an index is still uncertain.

7. Lessons

Looking back, there is little we wish we had done differently, given the constraints under which we had to work. Perhaps the most important lesson we have learnt is the value of flexibility. Trying to work with a specified word-list, though an idea appealing to the tidy-minded, can cause considerable distortion. We did break out of this mold, though only after encountering difficulties and frustration.

A related lesson, one still not properly learnt, is the need to temper our ambitions with realism. It is relatively easy to glance through published work – particularly in more recent issues of journals – and think "it would be wise to include that," or even worse – "we really must include this." It is much more troublesome and time-consuming to justify using extra space, or assess whether inclusions may adversely affect the balance of the work.

An aspect that we did consider in advance was the inclusion of biographies. The encyclopedia is intended to be a reference work about statistics and its applications, and not about statisticians. However, accounts of the careers of some statisticians do provide useful historical background, and it is on this basis that some biographies have been included. We realized that some omissions might seem to slight certain individuals or schools of research or training. Our choices were not made on the grounds of eminence alone. Nor did we attempt to keep any geographic or geopolitical balance. The recently published monumental book by S.M. Stigler (1986) provides a more balanced view of the history of the subject up to 1900.

8. Concluding Remarks

Finally, we would like to say that the experience has been stimulating. The stimulation and privilege of corresponding with many distinguished statisticians and workers in many fields have far outweighed the occasional frustrations and some uneasiness related to the ever increasing magnitude of the task. We cannot predict how we will feel in 1988, or whenever publication is completed (should we survive so long), but there is, we believe, reason for optimism. Whether it will have been *worthwhile*, that depends on the value of the encyclopedia's contribution to the community. Reactions to the volumes already published are considerably encouraging. We hope and believe that the encyclopedia will promote the standing of statistical methodology as a bona fide scientific discipline. This hope has been strengthened as a consequence of working on proofs of the early volumes, from which one gains a feeling for the scope and power of statistical methods and the effects of computer technology on these methods.

We will be pleased to receive comments and suggestions from readers of the *Journal of Official Statistics,* especially in regard to omissions of topics, and to organization of the Index(es).

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