



# International Federation of Classification Societies Newsletter

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President: John C. Gower

Editor: Fionn Murtagh

**The International Federation of Classification Societies**, founded in 1985, is composed of: British Classification Society, Classification Society of North America, Gesellschaft für Klassifikation, Japanese Classification Society, Société Francophone de Classification, Società Italiana di Statistica, Association des Sociétés Yougoslaves de Statistique, and Vereniging voor Ordinatie en Classificatie.

The IFCS is a non-profit, non-political scientific organization, the aims of which are to further classification research. Among other activities, the IFCS organises a biennial conference, and supports the *Journal of Classification*.

classification is considered important. This issue pays particular attention to the classification scene in the USSR. A conference took place last December at Pushchino, and reports on this meeting have been provided by a number of the participants. In addition, Boris Mirkin has kindly provided his view of the evolution of classification activities over the years in the Soviet Union. The bibliography which he provides is very useful, as a guide to people and results in Soviet classification.

Already a further overview of classification activities in another part of the world, not explicitly covered by a classification society, is planned for the next issue.

The deadline for issue number 3 will be September 27. Contributions by email, or on diskette, are preferred. Looking forward to seeing you before this next issue in Edinburgh!

## Editorial

This issue of the Newsletter precedes IFCS-91, the Third Conference of the Federation. A very comprehensive program has already been put together. A list of invited presentations appears in this issue. Many further contributed talks will be added to this. It had been feared that the Gulf War, for various reasons, could prevent potential participants from travelling to Edinburgh for this event. In the interests of safety, many employers restricted or discouraged travel by their staff, in various parts of the world. Hopefully the very welcome ending of the War will nullify the impact on IFCS-91. The conference in August promises to be a very important landmark in what might be described as "the classification calendar".

It has been the intention to make of this Newsletter a communication mechanism for the various member Societies of the Federation. News travels easily within a given Society, but - if not for this Newsletter - not between the regular member of one Society and the regular member of another. Hence many of the articles in this issue appear under the banner of the Societies.

The Newsletter is not exclusively devoted to Societies' collective concerns. Its columns are open also to the regular member of any Society, who has something important to say. A number of non-Society articles appear in this issue. More are welcome in future issues.

It is also quite clear that the member Societies of the Federation do not span all locations worldwide where

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*William H.E. Day*

On 15-19 December 1990, 98 researchers attended the International Symposium on Theory and Practice of Classification at Pushchino, a scientific town on the Oka River, near Moscow USSR. The symposium was organized by the Classification Commission of the Union of Scientific and Engineering Societies of the USSR. G. B. Bokij chaired the Organizing Committee, T. Z. Loginova was the Committee's secretary, and B. G. Mirkin organized a program having themes of epistemology, mathematics and programs, control in economy and society, and classification in specific systems. Papers were presented by 72 members of the Commission and by six researchers from Bulgaria, Canada, Germany, and USA.

The symposium was the fourth in a series about classification, others having been held at Tver (1970), Borok (1979), and Sverdlovsk (1985). It was the second for which abstracts were published, and the first to which foreign researchers were invited. The Classification Commission also organized seven-day workshops, at Pushchino, in 1984 and 1986.

At a business meeting during the symposium, members of the Classification Commission debated a plan to create a society which would apply to become a Member Society of IFCS. After much discussion, the Commission decided not to support this particular plan. The symposium also included an all-day excursion to Tula, a town famous since the sixteenth century for its manufacture of weapons, and Yasnaya Polyana, the beautiful country home of Leo Tolstoy.

The symposium featured the following plenary papers. S. A. AIVAZIAN, Y. N. BLAGOVESHCHENSKY, G. D. MESHALKIN, Classification of research situations and creation of intelligent program packages in applied statistics. H. H. BOCK, Probabilistic models in cluster analysis. G. B. BOKIJ, Optimal version of the periodic table of chemical elements. V. N. BONDARENKO, Epistemology and mathematical methods for classification of natural systems. S. M. BREKHOVISKIKH, Classification, systematics and systemology in the structure of contemporary science. S. M. BREKHOVISKIKH, Methodology of functional systematics of material objects, and processes of their creation or use. A. G. IVAKHENKO, The main principles of research and objective automatic classification. B. G. MIRKIN, M. W. YERIOMIN, CLASSMASTER package for classification and typological purposes. G. A. SATAROV, Classification and scaling in analysis of individual voting of people deputies of USSR. G. A. SATAROV, E. V. KULINSKAYA, Statistical package CLAMS 1.01 (CLAssification and Multidimensional Scaling). Yu. A. SHCHAPOVA, Classification problems in archeology. I. N. STEPANOV, The problem to classify soil structures. V.S. TIMERKAEV, Classification of states in geophysical environments. W. W. TREYER, General requirements and principles for classifying industrial products. A. Yu. VOLOGE, I. B. MUCHNICK, A. A. OSLON, Program package for typological analysis of territorial objects (TYPOLOG-TERRY).

About ten original software packages for PCs were presented. Some of these dealt with classification only: TYPOLOGIST by I.B. Muchnik; CLASSMASTER by B.G. Mirkin; CLAMS by G.A. Satarov; etc. In the near future there is a possibility that some of these packages could be available on the international market.

Seven foreigners attended the Symposium (3 from Canada, 2 from Germany, 1 from the USA, and 1 from Bulgaria). Foreign participation has not happened before. As a non-governmental body, the organizing Commission could not provide adequate accommodation and transport facilities for guests in Moscow. The situation was otherwise in Pushchino, due to the local organizer being a research institute of the Academy of Sciences, which is a governmental organization. Accommodation in Moscow was consequently on a private guest basis. The possibility of the 1995 IFCS Conference being held in Moscow seems to be excluded for these organizational reasons.

There was a rather emotional controversy between our classification "mathematicians" and "methodologists". In Russian, this latter term presumes something close to "philosopher". This was a reason for me to start some new activities separated from the "philosophers". I want to push forward computer classification matters. I use now the term "Classmetrics" to denote a science encompassing classification analysis and processing, using multivariate empirical data. I am also organizing a small bulletin on classmetrics, in Russian.

*Boris Mirkin*

It was evident that the Classification Commission has several different branches ranging from philosophical studies on classification, product description and classification, classification and documentation etc. through to mathematical and statistical clustering and data analytic methods, with applications in various branches (e.g. archeology, soils, administration and economy) and some classification and software development. Personally, I missed a large section on biological taxonomy, and I had the impression that there is no real contact with modern computer and information sciences.

The internal organization of the Commission has not become very clear to me. It seems that there are only a few persons really active, with a strong concentration at Moscow, possibly the only place for administrative support.

A lot of participants tried to get in scientific contact with the small group of foreigners, and the papers and investigations they showed to me were quite interesting, mostly in the traditional setting of statistics. Altogether, we witnessed a lot of friendliness, and a lot of resignation.

*H.H. Bock*

## Clustering in the USSR

### B.G. Mirkin

The history of developments in cluster analysis methodology in the USSR concerns the last three decades, but there were some pre-war traces of multivariate grouping in biology, social statistics, and economical geography. The following three overlapping periods of this growing area of development can be distinguished.

The first period, in the 1960s, was a time when various researchers in biology (Terentyev, 1959), geology (Voronin, 1964), linguistics (Apresian, 1966), input-output analysis (Lieybkind, 1963), sociology (Zaslavskaya and Zagoruiko (ed., 1968), image recognition (Sahlesinger, 1965; Braverman and Dorofeyuk, 1966), and some other disciplines, came to an understanding that there exists a specific kind of problem called objective classification, or pattern recognition without a teacher, or taxonomy, or automatic classification. Each of them proposed a concept and algorithms to detect "classes" (synonyms: "taxons" or "Pleiades" - Greek word for the term "cluster" - or some Russian terms. The term "cluster" was not in use).

This period resulted in the set of monographs: Arkadiev and Braverman (1971), Zagoruiko (1972), Rozin (1973), and Aivazian, Bezaeva and Staroverov (1974).

Western concepts of agglomerative algorithms and k-means (Isodata) algorithms became known in the USSR in addition to principal component analysis; the exchange algorithms and algorithms based on graph theory concepts such as "component" or "complete subgraph" were arrived at independently, as well as some of the usual criteria for classification. The two following algorithms seem to be the most worthy of note:

(1.1) FOREL ("trout" in Russian, based on a concept of "FORMal Element": Yolkina and Zagoruiko, 1966; see also Zagoruiko, 1972). This algorithm uses distances and centers of gravity. It forms the clusters consecutively, based on an a priori threshold  $R$  considered as a radius of a sphere moving with the centers of gravity of the internal cases. The initial center is the center of gravity of the whole set of the cases. Successive clusters are obtained with the same procedure, after elimination of the cases from the former clusters. Usually, the algorithm forms a small number of "big" clusters and a lot of very "small" ones; the latter are interpreted as "intermediatory" ones.

(1.2) SPECTER (Braverman and Dorofeyuk, 1966; see Arkadiev and Braverman, 1971). Case-to-case and case-to-subset distances (or similarities) are used. A chain consisting of all the cases is formed, starting from an arbitrary case, and adding step-by-step the ones which are closest to the subset corresponding to the initial interval of the chain. Then the chain is cut at the locations of "thinnest" links.

The main results of the second period were associated with creating new concepts and techniques for some kinds of application areas, and with some ideas as to possibilities for formulating mathematical or logical relations between different concepts and methods.

I can refer to two kinds of monographs (methodological

and applied) which appeared in this period. The list of methodological monographs would include the following: Braverman and Muchnik (1983), Lbov (1981), Mandel (1988), Mirkin (1980), Perekrest (1983). The applied monographs include: Aivazian and Rimashevskaja (1978), Borodkin and Kovalchenko (1978), Mirkin and Rodin (1977), Ravkin (1977), Zaslavskaya and Muchnik (1977, 1980), and Zukovskaya and Muchnik (1976). These have the feature that their applied results are not simply computational exercises, but rather are integrated into the various concrete theories themselves. Of course, some interesting results were not described in the monographs, and are available as papers.

The following original concepts and results could be noted as the most interesting ones:

(2.1) Clustering as a maximum likelihood problem for the mixture distribution model (Aivazian, Bezaeva and Staroverov, 1974). Depending on a priori hypotheses regarding parameters of the distributions, these authors generate a variety of criteria, among them the weighted variance or the determinant of the covariance matrix.

(2.2) Braverman's method of "extremal grouping of variables" (Arkadiev and Braverman, 1971; Braverman and Muchnik, 1983). This method is proposed for detecting the "best" factor structure for a case-variable table. A partition of the set of the variables, with the first principal component shown for each of the classes of the variables, is a factor structure. The problem is to search for the factor structure maximising the mean of the factor variances of the components (also there was some modification of the criterion leading to "centroid" components). A suboptimal algorithm based on the exchange method, with the number of iterations constrained, was developed. Based on this, the more general so-called "linguistic approach" was developed with a lot of applications in various fields (see, for example, Muchnik and Zaslavskaya, Eds., 1977, 1980; Zukovskaya and Muchnik, 1976; and others). The algorithms of this approach are designed to approximate the initial case-variable data matrix with "simple" block-structure matrices. The idea in even more general contexts was independently developed in Hartigan (1972) but the author of this review has never seen any reference on its computational or applied realisation.

(2.3) The logical decision functions method (Lbov et al., 1976; see Lbov, 1981; Rostovtsev, 1978; and Mirkin, 1980). Logical decision function (LDF) is a dendrogram, each of whose nodes corresponds to some subset of the set of all cases described by some logical formula (or formulae) assigned to the node. The leaves correspond to the clusters. In the simplest case the logical formula is a conjunction of elementary properties such as: "value of the variable is more than (or equal to, or not equal to) some fixed 'a'".

It is possible to construct an LDF both for the case of given clusters (pattern recognition problem) and for the case of clusters to be constructed (automatic classification). Errors of the first and second kind (Lbov), or association coefficients of the dendrogram and the variables (Rostovtsev), are taken into account in the criterion. The

LDF is constructed with a step-by-step procedure to divide the set according to elementary properties.

There are two main advantages of an LDF procedure: (1) direct interpretability, and (2) fast computation. The procedure is fast even if the number of variables is not small: most of the variables would not be involved in the LDF.

(2.4) Relational approach to qualitative data analysis has been developed since 1968 (see Mirkin, 1974, 1980). A series of distance measures between equivalence relations (sometimes classes based on more complex relations were aimed at) was proposed. The first of them was the relative symmetric difference measure which was proven to be computable using a contingency table with a formula equivalent to the complement of the Rand coefficient (proposed some time later) and 1 (Mirkin, 1969).

Some ways to construct an aggregate equivalence relation (that is, a cluster structure which is revealed) were considered, Arrow's approach (Mirkin, 1974) being one of them.

The approach to approximate a given case-to-case proximity matrix by a binary relation (or by a weighted sum of incidence matrices) from a fixed class had appeared to be much more useful. In this framework the following methods were developed:

(a) Agglomerative clustering algorithm with the total of internal proximities, each of which is decreased by a "soft" threshold value, as a criterion to be maximized (Kupershtoh, Mirkin, Trofimov, 1976; see Mirkin, 1980). The feature of this algorithm is that the criterion really does not allow all the clusters to be agglomerated, and so allows the best number of clusters to be determined;

(b) Qualitative factor analysis methods, reviewed in Mirkin (1987), for the additive clustering problem as an example; (c) Algorithms to reveal an approximating partition (or a set of overlapping subsets) with a structure (Mirkin, 1980, 1984; Braverman, Muchnik, 1983). The notion is equivalent to the block model concept developed in sociometry by Arabie and others (see Arabie and Boorman, 1978), but these algorithms seem to be more efficient.

(2.5) Clustering based on monotone systems, initiated by Mullat (1976), and continued by Muchnik and others (see, for example, Kuznetsov, 1985), proposes a series of clustering criteria (usually using max or min operations on distances to create case-to-set or set-to-set measures) which can be optimised in a global way with simple "greedy-like" algorithms.

(2.6) There were many efforts to cluster complex objects, like curves or chemical formulas, with the variables generated from the local "singularities" of the objects (see, for example, Braverman and Muchnik, 1983).

Some original concepts were proposed by Mandel (1988), but without any mathematical basis. One of them is associated with a concept of so-called dual classification which consists of "anti-clusters" including most distant (not closest!) entities. The distance between a classification and a dual classification is proposed as a criterion to be maximized.

The following two original multidimensional scaling

approaches have to be mentioned:

(2.7) Satarov's threshold models for binary data (Satarov, 1982). The simplest, conjunction threshold model, simultaneously maps the rows  $i$  and the columns  $j$  of the binary data matrix  $\{a(i,j)\}$  into the same  $k$ -dimensional Euclidean space as points  $f(i) = (b(1), \dots, b(k))$  and  $f(j) = (c(1), \dots, c(k))$  with the property:

$$a(i,j) = 1 \text{ iff } c(s) > b(s) \text{ for all } s=1, \dots, k,$$

which has a good interpretation in pedagogy (individual  $j$  is able to resolve task  $i$  iff all his abilities are higher than the task requires). Methods for fitting the model as well as the assessment of dimensionality  $k$  were developed.

(2.8) Perekrest's topological invariant scaling methodology as a tool for typology-making (Perekrest, 1983) is based on nonlinear transformations of initial variables to approximate the case-to-case similarity structure. The methodology may be considered as a generalisation of the usual metric scaling approach to create and study some analytical (and so theoretical) expressions as the results of the scaling procedure to make typologies.

There have been developed also a variety of convenient modifications for some western MDS methods (see, for example, Popechitelev and Romanov, 1985; Terehina, 1986).

The third period is being continued now. Its main features, in the author's opinion, are as follows. First, general concepts are developed; and, second, big program packages are worked out.

The following ideas seem to be examples of the general constructions:

(3.1) A clustering procedure to generate a variety of clustering algorithms (FOREL and SPECTER also), generalizing the "dynamic clouds" approach of Diday et al. (1979) was described in Aivazian, Buchshtaber and others (1989).

(3.2) (Bi)Linear models for approximation of rectangular or square data matrices allowing for a variety of clustering criteria, to relate them to each other both for quantitative and qualitative and mixed data (Mirkin, 1980, 1990).

(3.3) Abstract clustering models based on set-to-set and set-to-value abstract classes of functions were analysed (Sapir, 1985; Muchnik, 1990). These models generalize some kinds of graph-theoretic and discrete algorithms and allow general clustering algorithms to be created for various data types.

(3.4) Functional scaling approach as the most general approach to approximate the data with some "structures" belonging to a fixed class of structures (Aven, Muchnik, Oslon, 1989). The approach has been generalized for some other concepts (Perekrest, 1983; Mirkin, 1980) and for a variety of data analysis problems, not only clustering or scaling.

(3.5) Fuzzy clustering problems in the convex programming framework, using arbitrary constraints on belongingness functions, were analysed (see, for example, Baumann, 1988), with widespread application of the duality concepts.

As to the program packages, it is possible to indicate the following which were described in monographs: OTEX

(Zagoruiko et al., 1986), PPSA (Yeniukov, 1986), SAISI (Parring and Tiit, 1986), SITO (Alexandrov and Gorski, 1989), as well as TYPOLOGIST (Oslon, 1990), SYG-AMD (Yeniukov and Vylegzanin, 1990), CLASSMASTER (Mirkin, Yeriomin, 1991), and ISCAD (Bourdaev, 1989) which were described in the Proceedings of the Pushchino Symposium on Theory and Practice of Classifications (1990) only, and not yet in monographs.

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### Japanese Classification Society

The JCS annual research meeting was held in the afternoon of December 25, 1990 in the Institute of Statistical Mathematics. Speakers and presentations were as follows:

- M. Tsukamoto, A. Ootaki, "Implementation of graphics function appended to the CART (Classification And Regression Trees) program".
- N. Nakamura, N. Ohsumi, "Generalization of flexible method in hierarchical clustering and its features".
- T. Imaizumi, "A multidimensional scaling method for analyzing similarity matrix".
- S. Iwatsubo, "Similarity coefficients for the classification from 3-way binary data".
- Y. Sato, "Cluster analysis using a simulated annealing algorithm".
- M. Mizuta, Y. Baba, "Fitting smooth curves to branching data".
- Y. Yoshinaga, S. Tatsunami, N. Nagasumi, "Analysis of eating practices and extraordinary eating behaviour in women students by using quantification method".
- H. Hida, T. Tasaki, M. Goto, "Measures for goodness-of-fit in logistic models".
- M. Miyai, "On the criteria of acknowledgements in Minamata (methyl mercury) disease".

A list of the Executive Committee Members of our society in the first Newsletter was the past one. The following list is effective till spring, 1991:

- Choichiro Asano (Kyushu University)
- Syuichi Iwatsubo (National Center for University Entrance Examination)
- Shoichi Ueda (Ryukoku University)
- Noboru Ohsumi (Institute of Statistical Mathematics)
- Atsushi Ohtomo (Japan Women's University)
- Tadakazu Okuno (Science University of Tokyo)
- Masashi Goto (Shionogi Kaiseki Center)
- Seiroku Sakai (Daito Bunka University)
- Masaaki Taguri (University of Chiba)
- Yutaka Tanaka (Okayama University)
- Tomoyuki Tarumi (Okayama University)
- Toshiro Tango (Tokyo Metropolitan Institute of Medical Science)
- Kikuo Nomoto (National Language Research Institute)
- Toshiro Haga (Science University of Tokyo)
- Masami Hasegawa (Institute of Statistical Mathematics)
- Yasumasa Baba (Institute of Statistical Mathematics)
- Chikio Hayashi (University of the Air)
- Masakatsu Murakami (Institute of Statistical Mathematics)
- Keiji Yajima (Science University of Tokyo)
- Haruo Yanai (National Center for University Entrance Examination)
- Kazumasa Wakimoto (Okayama University)

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### Société Francophone de Classification

- ☐ The Board of Directors of the SFC is as follows:
  - President: P. Cazes (Pres: 1991, Vice-Pres: 1992)
  - Vice-President: E. Diday (Vice-Pres: 1991, Pres: 1992-1993, Vice-Pres: 1994)
  - Secretary: P. Bertrand 1991-1992
  - Treasurer: M. Touati 1991-1992
- ☐ Representatives to IFCS Council (4 years):
  - Ch. Perruchet 1991-1994
  - I.C. Lerman 1991-1994
- ☐ Council of the SFC
  - Jambu, Locquin, Laché, Goujet, Schmit (1991-1992)
- ☐ Preparations are underway for hosting IFCS'93. The choice of organizer is to be made in March.

### 3rd Conference of the International Federation of Classification Societies, Edinburgh, 6-10 August, 1991: Draft Scientific Programme

#### Plenary Speakers

- E. Diday: 'From data to knowledge'  
 N. Ohsumi: 'A comparison of hierarchical clustering algorithms based on space-distorting properties with suggested improvements'  
 D. Pregibon: 'Interactive graphics in clustering and classification'

#### Special Invited Speakers

- Y. Dodge: 'Mathematical programming in cluster analysis - computational complicity vs optimality'  
 R. Dubes: 'Intrinsic dimensionality in exploratory data analysis'  
 B. Everitt: 'Finite mixtures as models for clustering'  
 Gafrikova: 'New median unbiased and interval rank estimators of error rates'  
 J. Gower: 'Aspects of approximating a symmetric matrix'  
 L. Lebart: 'Discriminant analysis using textual data'  
 J. Mielniczuk: 'Grade estimation of separation measures'  
 P. Sneath: 'Confidence and uncertainty in dendrograms'

#### Invited Sessions

- Cluster Analysis (Chair: B. Everitt)  
 F. Critchley: 'Bijections, dissimilarities, ultrametrics, prefilters,... and much much more!'  
 B. Fichet: 'Dimensionality and sphericity in L1 displays'  
 W. Heiser: 'Clustering of variables to optimize the fit of a low dimensional Euclidean model'

- Computing/Software developments (Chair: F. Murtagh)  
 M. Cooper: 'Comparisons of neural networks for clustering with k-means non-hierarchical clustering'  
 F. Murtagh: 'Neural networks for classification - a short assessment'  
 S. Openshaw & C. Wymer: 'An evaluation of three neural net classifiers on census enumeration district data for Britain'  
 P. Willett: 'Clustering in chemical structures and the calculation of structural similarities'

- Diagnostic keys (Chair: R. Payne)  
 M. Aron: 'Selecting an optimal test set in the presence of mixes of discrete and continuous data'  
 R. Pankhurst: 'Current advances in identification by computer'  
 R. Payne: 'Methods of selecting batches of tests for identification keys and diagnostic tables'

- New developments in multidimensional data analysis (Chair: W. Heiser)  
 P. Groenen: 'The tunnelling method for global

optimization in multidimensional scaling: some new results'

- I. van der Lans: 'Optimal scaling of (nominal/ordinal) multiplicative variables with partially ordered metric information'  
 D. Nierop: 'Reflected variables: their use in discriminant analysis'  
 P. Verboon: 'Generalized Procrustes analysis with iterative reweighting to achieve resistance'

- Permutation methods in distance analysis (Chair: W. Heiser)  
 R. van Blokland: 'The use of permutation tests in distance models for ranking'  
 L. Hubert: 'Permutation procedures for assessing directional data based on a cosine measure of proximity'  
 J. Meulman: 'Permutation tests for the distance approach to multivariate analysis'

- Consensus theory (Chair: W. Day)  
 J-P. Barthelemy: 'Formal approaches to consensus in mathematical taxonomy'  
 B. Leclerc: 'Medians for various metrics - some common properties'  
 R. Powers: 'Independence conditions for consensus functions defined on n-trees'

- Consensus data sequences (Chair: W. Day)  
 W. Bains: 'The direction of mutation - implications for sequence matching matrix and consensus generation'  
 F. McMorris: 'Consensus data sequences: theoretical considerations'  
 D. Sankoff: 'A one-pass approach to finding a compatible set of regions matched to consensus inventory elements'

- Clustering of longitudinal data (Chair: A. Mineo)  
 A. Carlier: 'Clustering of categories in a sequence of contingency tables indexed by time'  
 M. Chiodi: 'The clustering of longitudinal multivariate data when growth curves have different shapes and different time lags'  
 G. Marchetti: 'On the classification approach to the estimation of transition probabilities'

- Probabilistic models in cluster analysis (Chair: H. Bock)  
 H. Bock: 'Optimum partitions of R<sup>#</sup>P'  
 G. Celeux & G. Govaert: 'Practical behaviour of the penalized classification maximum likelihood criterion for clustering small samples'  
 M. Windham: 'Consistent statistical models in cluster analysis'

- Graphical representations and analysis of qualitative and symbolic data (Chair: H. Bock)  
 I. van Mechelen: 'Representation of binary methods by Boolean methods'



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Diagnosis (Chair: A. Gammerman)

A. Gammerman: 'Computational models of diagnostic reasoning'

S. Muggleton: 'Inductive logic programming'

H. Lenz: (no title)

For further details and Registration Form, apply to:

Dr D. Wishart  
IFCS-91 Conference  
Heriot-Watt University  
Conference Office  
Edinburgh EH14 4AS  
Scotland

### SIS - Italian Classification Society

The meeting on Classification and Data Analysis, held in Pescara at the G. D'Annunzio University on 11-12 October 1990, and sponsored by S.I.S. (Società Italiana di Statistica), provided a useful opportunity for all statisticians working in this field to get together.

The subjects discussed interested many scholars, including those working in different fields. This is shown by the 120 people who attended the meeting and by the 20 submitted papers.

In the round table on "Classification and Data Analysis: Methods, Software and Applications", chaired by Prof. Alfredo Rizzi, an interesting discussion was carried out, mainly on the problems of today's characterization of data analysis. Nowadays certainly there is a tendency to deviate more and more from the traditional doctrine of the French School which is based on a geometric-algebraic approach to statistical methodology. Furthermore the importance of the inferential aspects has been revalued. As a consequence of this the use of probabilistic or non-probabilistic models has become more important in data analysis, because it allows the information that can be obtained from a data matrix to be shown.

The main conclusion that can be drawn from such a discussion is that statistical methodology will be intended in the future as a strategy of analysis which could allow the maximum of available information to be obtained, through the combination of methods and techniques, even of different kinds. Furthermore the importance of computational aspects which are fundamental to data analysis has been underlined. The necessity of studying new packages aimed at overcoming all restrictions of present software has been evidenced. All in all the future prospects of research in data analysis can be summarized mainly in the importance of the inferential aspects, in the problem of the stability of results and in the study of three-way matrices.

An International Workshop on Multidimensional Data Analysis - a Meeting of the Dutch and Italian Schools - will be held in Anacapri, Italy on September 30 - October 4 1991. The Workshop aims to gather representative experts on multidimensional data analysis from the Netherlands and Italy as well as researchers from other countries. Key lectures will be provided by Dutch and Italian invited speakers. Researchers who are interested in giving a contribution or to participate are cordially invited to apply. Sponsorship is by CNR and Dipartimento di Matematica e Statistica, Università degli Studi di Napoli "Frederico II". The Scientific Programme Committee consists of: N.C. Lauro, A. Rizzi, P.G.M. van der Heijden and J.L.A. van Rijkevorsel. The Scientific and Organizing Secretariat consists of L. D'Ambra, S. Balbi and R. Siciliano.

Registration fee, including proceedings volume, coffee breaks and social program, is Lit. 700.000. University members are entitled to 50% reduction. Preliminary registration and submission of an abstract should be carried out by February 27th. The final contributed paper, and payment of the registration fee, is due by May 31st.

#### Topics and Invited Speakers

##### Linear multivariate analysis

(J.M.F. ten Berge and R. Leoni)

##### Analysis of three-way data

(P.M. Kroonenberg, A. Rizzi)

##### Classification and multidimensional scaling

(C.J.F. ter Braak, A. Mineo)

##### Non-linear multivariate analysis

(J.L.A. van Rijkevorsel, R. Coppi)

##### Analysis of contingency tables

(P.G.M. van der Heijden, R. Siciliano)

##### Non-symmetric data analysis

(A.Z. Israëls, L. D'Ambra, N.C. Lauro)

##### Analysis of time and/or space dependent data

(J.H.L. Oud, M. Coli)

Information: MDA Workshop, Dipartimento di Matematica e Statistica, Università di Napoli "Frederico II", Via Partenope, 36, I-80121 Napoli, Italy. Email: dmsna@icnucevm. Fax: + 39 81 7646181.



## Classification Society of North America

The Classification Society of North America begins its twenty third year of development with 446 dues-paying members from 28 countries. Most members have university affiliations but almost 25 percent are in government, industry, and private business. Members have identified over 25 professional specialities with area of interest ranging from cluster analysis to numerical taxonomy to statistics to computer software, which underscores the interdisciplinary nature of the Society.

Each year, members receive two issues of the *Journal of Classification*, a well-respected, archived technical publication with methodological orientation and an issue of the *Classification Literature Automated Search Service*, an indexed bibliography of recent literature. Members also receive five issues of the *CSNA Newsletter*, featuring Society news, brief overviews of technical topics, and capsule book reviews.

The most recent annual election brought Professor Peter Bryant, University of Colorado, and Professor Melvin Janowitz, University of Massachusetts, to the Board of Directors of CSNA. Professor William Day, Memorial University of Newfoundland, was elected Secretary/Treasurer.

The 1991 annual meeting of the Society will be held jointly with the annual meeting of the Psychometric Society at the Cook Campus Center of Rutgers University, New Brunswick, NJ from June 13 to June 16, 1991. Professor Phipps Arabie is the local host. The meeting includes invited speakers, technical sessions, and business meetings.

The Society actively seeks interaction with other member societies of IFCS. Its newsletters regularly carry announcements of activities from member societies. CSNA looks forward to participating in the Third Conference of the IFCS in Edinburgh in August, 1991. Members of CSNA will present a one-day short course on cluster analysis the day before IFCS-3 begins.

*Richard Dubes, President, CSNA (dubes@cps.msu.edu)*

## British Classification Society

The Spring Meeting of the Society is entitled "Classification in Psychiatry and Psychology". It will be held at the Institute of Psychiatry, Denmark Hill, London SE5 8AF on 30 April starting at 14.30. The programme is as follows:

- B. S. Everitt: 'A review of the statistical approaches to classification used in psychiatry and psychology'
- P. Bebbington: 'The psychiatrist's approach to classification'
- G. Dunn: 'The classification of depression'
- H. Eysenck: 'The taxonomy of personality'

*Dr S. E. Hitchcock, Secretary, BCS.*  
*Email: se\_hitchcock@uk.ac.open.acs.vax*

## Gesellschaft für Klassifikation (GfKl), the German Classification Society

□ The GfKl will hold its 15th Annual Conference at the University of Salzburg (Austria) on February 25-27, 1991; the local organizer is Prof. Hans Goebel, Director of the Institute for Romanistics at Salzburg.

The scientific program includes about 100 plenary or contributed papers, a lot of software presentations and special (tutorial) courses. The topics are grouped into three main sections:

**A. Data analysis and clustering methods:** analysis of contingency tables, correspondence analysis, scaling methods, lattice-theoretic methods for binary data, spatial clustering, classification using neural networks, clustering of symbolic or bibliographic data etc. (about 45 papers);

**B. Information sciences and data bases:** conceptual networks, formal concept analysis, text analysis, thesauri and retrieval systems, expert systems for data analysis and decision support, library classification and indexing (about 30 papers);

**C. Applications:** Sessions on "Information and data analysis in criminology and law" (3 Sessions), "Classification and data analysis in marketing" (3), "Data analysis in linguistics and dialectometry" (3), "Sequence analysis and biological taxonomy" (3), "Data analysis in archeology" (2), "Classification in medicine" (1) and "Geographical variation and spatial methods" (2).

A selection of the papers will be published in a *Proceedings volume* in the end of 1991. Information: Prof. Dr. H. Goebel, Institut für Romanistik, Universität Salzburg, Akademiestr. 24, A-5020 Salzburg, phone (662) 8044-4450, -4451.

□ The Working Group on "Concept analysis" (Begriffsanalyse, AG-BA) of the GfKl will organize a **conference on "Data and concepts"** at Darmstadt on February 21-23, 1991. The papers are supposed to discuss the interrelationship between real facts, objects, and data, on the one hand, and conceptual thinking, on the other hand. The participants will include scientists from information and cognitive science. Special tutorial courses will provide information on topics like "conceptual scaling" or "conceptual knowledge systems". Information: Prof. Dr. R. Wille, Fachbereich Mathematik, Technische Hochschule Darmstadt, Schlossgartenstr. 7, D-6100 Darmstadt.

□ The *Proceedings of the 14th Annual Conference of the GfKl at Darmstadt (March 12-14, 1990)* have just been published by Springer-Verlag with the title: **Classification, Data Analysis, and Knowledge Organization** (with H.H. Bock, P. Ihm as editors). The volume (with 393 pages) comprises 50 selected papers which are organized in the following (sub-)sections: I: Classification and clustering methods (6 papers); Statistical and probabilistic aspects of clustering and classifications (4); Statistical, geometrical and algebraic methods for data analysis (8). II:

Modelling, representation, and organization of conceptual knowledge (4); Data bases, expert systems, information retrieval, and library systems (5); Terminology and classification (4). III: Classification, systematics and evolution in biology (4); Classification and documentation in medicine (4); Data analysis in the archeological and historical sciences (7); Classification in industry: Coding systems and commodity descriptions (4). Subject Index.

*H.H. Bock*

### **Software Package Report: Finding Groups in Data**

Peter J. Rousseeuw, U.I.A., Vesaliuslaan 24, B-2650 Edegem, Belgium

This is a combination of a book and a set of seven programs for cluster analysis. The title of the book is "Finding Groups in Data: An Introduction to Cluster Analysis" by Leonard Kaufman and Peter J. Rousseeuw (1990), John Wiley (Series in Applied Probability and Statistics), New York, ISBN 0-471-87876-6. The book was written for the general user, who may not have a mathematical or statistical background. It has been organized in a way that even an occasional user of cluster analysis can read only the part which is needed. The first chapter discusses the various types of data (including binary variables and dissimilarity matrices) and helps to choose a clustering method. The remaining six chapters each cover a single clustering method, and can be read independently of one another. All chapters follow a common format. The first half of each chapter gives a short description of the clustering method, explains how to use it, and analyzes some examples. The second half of the chapter (which may be skipped without loss of understanding) then discusses the algorithm and its implementation, and related methods in the literature. The book has also been used successfully in the classroom.

The seven programs are for DOS PC's, but their Fortran source code is very portable (all routines have passed the PFORT verifier). The input is carried out by a simple interactive dialogue, and the output is restricted to standard printer graphics. The programs are:

DAISY: computes a dissimilarity matrix between objects characterized by variables (asymmetric binary, symmetric binary, nominal, ordinal, interval, ratio, or mixed) or similarities. It also computes correlation-based dissimilarities between variables.

PAM (Partitioning Around Medoids): carries out a k-medoid (sometimes called "k-median") partitioning of objects characterized by interval-scaled variables or a dissimilarity matrix (possibly obtained from DAISY).

CLARA (Clustering Large Applications): uses a new

algorithm to partition a set of objects having interval-scaled variables. CLARA does not store the inter-object distances, allowing it to deal with large data sets with thousands of objects.

FANNY (Fuzzy Analysis): a new program for fuzzy clustering, which is a robust alternative to fuzzy k-means. It can handle objects with interval-scaled variables, or dissimilarity input.

AGNES (Agglomerative Nesting): constructs the well-known group average linkage hierarchy. (In the book, this choice is extensively motivated.) AGNES applies to objects with interval variables and to dissimilarities.

DIANA (Divisive Analysis): computes a divisive hierarchy by means of a variant of the MacNaughton-Smith method. Methods of this type are not available in customary statistical packages. DIANA handles data with interval variables (which it uses in a polythetic way) or dissimilarities.

MONA (Monothetic Analysis): computes a divisive hierarchy for data characterized by binary variables.

Rather than making a package with as many clustering methods as possible, leaving the user with a bewildering multitude of methods to choose from, our approach has been to select a few methods that together can deal with a majority of applications. This selection was partly subjective as it was based on our practical experience, but there were also two general criteria: (a) Whenever possible, we selected methods that cannot only analyze data consisting of measurements but also dissimilarity data, to achieve greater applicability; (b) All the selected methods are of the L1 type, which means that they minimize sums of dissimilarities (rather than sums of squared dissimilarities, as in the usual L2 methods). This yields much more robust results, especially when outliers are present.

Some of the clustering methods are new, such as CLARA and FANNY. Also, the clusterings are accompanied by graphical displays: the partitions are represented by means of silhouettes (Rousseeuw 1987, *Journal of Computational and Applied Mathematics* 20, pp. 53-65), and the hierarchies by banners (which are variants of icicle plots). The programs and displays have been adapted to easily compare analyses of the same data set obtained from several programs (in the outputs, the ranking of the objects and the numbering of the clusters are as compatible as possible across the programs).

The programs (costing US\$200, including mailing and handling) can be ordered from L. Kaufman, STOO, Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium.

**Meeting Announcement: DISTANCIA '92 RENNES, FRANCE, JUNE 22-26, 1992**

The meeting is organized by the European Network of Laboratories "Mathematical Structures for Dissimilarity Analysis".

Conference President: G. Le Calve (Rennes, France),  
H. Bacelar-Nicolau (Lissabon, Portugal)  
F. Costa-Nicolau (Aveiro, Portugal)  
F. Critchley (Warwick, Great Britain)  
B. Fichet (Marseille, France)  
W. Heiser (Leiden, Netherlands)  
J. Meulman (Leiden, Netherlands)  
B. van Cutsem (Grenoble, France)

**PURPOSE**

The notions of distance, dissimilarity, and metric arise in many scientific fields as tools of analysis, as modes of representation, or as targets for approximation. Moreover, these concepts are also used in different parts of mathematics, such as geometry, graph theory, probability theory, and mathematical statistics. The aim of the DISTANCIA '92 meeting is to bring together all those who are interested in the study of distance, in order to exchange knowledge and experience, and to discuss new insights and techniques.

From this perspective we would like to solicit contributions to this meeting on the mathematical properties of distances and dissimilarities, on the methodologies in which they play a fundamental role, and on those applications in which the introduction of distance gives rise to interesting problems. More particularly, papers are welcomed that cover one or more of the following topics:

*Theoretical aspects:* study of the mathematical structures induced by dissimilarities, their geometric properties, their representation, and their approximation, including embedding problems and the linear algebra of distance matrices;  
*Methodological aspects:* study of the behaviour of optimization methods and algorithms for dimension reduction and distance fitting, their stability and robustness properties, their efficiency, and their validation, including choice of model and comparison of methods;

*Areas of application:* special interest extends to areas of application that inherently give rise to distances between structured objects, of either a discrete or a continuous nature. Examples include the analysis of genetic distances and image processing.

**KEYWORDS**

*Theory:* Metric spaces (for example: Euclidean, city-block, Minkowski, Hamming, ultrametric, digital metric), dissimilarity spaces, distances between functions, distances between processes, distances between partitions, graph theory, combinatorics, ordered sets, geodesics, differential geometry, optimality of algorithms, computational complexity.

*Methodology:* Principal coordinates analysis, multidimensional scaling, discriminant analysis, unfolding, classification,

clustering, hierarchical trees, additive trees, segmentation, seriation, consensus grouping, consensus ranking, asymmetric dissimilarity, quadratic assignment methods, distance models for rankings, minimal distance tests and estimates, methods for geodesic inference, spatial statistics.

*Areas of application:* Image processing, pattern recognition, signal detection, string editing, time warping, stimulus generalization, ordination of plant communities, genetics, conformation of molecules.

**INFORMATION**

Distancia'92  
S. Joly  
6 Avenue Gason Berger  
35043-Rennes Cedex  
France  
Tel 99.33.51.55  
Fax 99.33.51.75  
E-mail DISTANC@UHB.FR

**Meeting Announcement: MULTIDIMENSIONAL ANALYSIS OF CATEGORICAL DATA: APPLIED DUAL SCALING**

The twelfth annual workshop on dual scaling is slated for May 27 and 28 this year. As before, this will be an introductory and expository workshop on scaling analysis of contingency tables, multiple-choice data, sorting data, paired comparison data, rank-order data, successive categories (rating) data and multi-way data. It would be appreciated if you could draw attention of those who you consider may benefit from this workshop. I would be happy to answer any questions you may have. I can be reached at S\_NISHIS@UTOROISE.BITNET or (416) 923-6641, extension 2696.

Shizuhiko Nishisato

P.S. The book *Analysis of Categorical Data: Dual Scaling and Its Applications* by S. Nishisato (University of Toronto Press, 1980) is now out of print, but some copies will be made available for C\$35, during the workshop, together with some 40 pages of additions, which were incorporated in its Russian translation, to be published this spring by Finansy i Statistika Publisher in Moscow.

DATES	May 27, 1991 (9:00-17:00) May 28, 1991 (9:00-17:00)
PLACE	The Ontario Institute for Studies in Education (OISE), 252 Bloor Street West, Toronto, Ontario, Canada M5S 1V6
TOPICS	Dual Scaling for Exploratory Data Analysis

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Analyzing categorical, qualitative data...necessary basics  
Optimal analysis and interpretations...an imaginative look  
Easy illustrative examples...a working knowledge with  
real data

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(2) Complete package of handouts
- LEADER** Professor Shizuhiko Nishisato  
(Ph.D., University of North Carolina,  
Chapel Hill), OISE and University of  
Toronto
- APPLICATION** Send to the Department of Measure-  
ment, Evaluation and Computer Appli-  
cations, OISE (see address above):  
(1) your name, (2) affiliation and title,  
(3) mailing address, e-mail address?,  
(4) telephone number, (5) payment
- REFUND** No refund once the workshop begins;  
full refund until then
- INQUIRIES** Telephone: (416) 923-6641, Extension  
2696.  
E-mail:  
S\_NISHIS@UTOROISE.BITNET  
Fax: (416) 926-4725, attention: Dual  
Scaling Workshop (MECA)

**ACCOMMODATION** Apply directly to Victoria Univer-  
sity (416) 585-4524, single \$40, double \$58/night, with  
breakfast, as soon as possible, and not later than April 27,  
1991. Or, else, please find your own accommodations.

#### WHO WILL BENEFIT?

This workshop (12th annual) is for those engaged in  
analysis of survey data, market segmentation, evaluation  
of qualitative data, questionnaire construction and  
analysis, classification problems with nonmetric data,  
multidimensional analysis of preference, judgement,  
taste, values and attitudes, program evaluation, and  
analysis of non-numerical data. The workshop assumes  
no prior knowledge of Dual Scaling, Correspondence  
Analysis, Optimal Scaling, or Homogeneity Analysis, but  
will present a wide spectrum of appropriate analytical  
tools for data analysis practitioners and researchers.

Sponsored by The Statistical Consulting Service and  
Department of Measurement, Evaluation and Computer  
Applications (OISE).

#### Meeting Announcement: First International Conference on Document Analysis and Recognition

Saint-Malo, France, September 30 - October 2 1991

This conference intends to provide an international forum  
for the development and the dissemination of new ideas,  
basic research and issues concerning practical applications  
of both on-line and off-line processing in the domains of  
automatic analysis and recognition of documents. It is the  
first of a series which will be held every two years in  
conjunction with the International Workshop on Frontiers  
in Handwriting Recognition.

Information: AFCET, 156 Bd. Péreire, F-75017 Paris,  
France. Tel: +33 1 47662419, Fax: +33 1 42679312.

#### Results of the elections to the IFCS Council

In the Federation's elections, a total of 19 members of the  
Council, including 13 Member representatives, returned  
ballots.

William H. E. Day (from CSNA) was elected as Vice-  
President of the IFCS. Professor Day will serve one year  
(1991) as Vice-President, then two years (1992 and 1993)  
as President, and one further year (1994) as Vice-Presi-  
dent.

Three Additional members of the Council were elected.  
J. Douglas Carroll (from CSNA) and Gilbert Saporta  
(from SFC) will serve for a four-year term (1991 to 1994),  
while Allan D. Gordon (from BCS) will serve for 1991 and  
1992, which is the remainder of Prof. Day's term who was  
one of the Additional members of the Council before his  
election to the Vice-Presidency. The fourth Additional  
member of the Council is Edwin Diday (from SFC), whose  
term of office expires at the end of 1992.

Fionn Murtagh (from CSNA, GfK1 and SFC) was  
unanimously elected to the office of Publication Officer of  
the IFCS for a four-year term (1991 to 1994).

We thank all the candidates for their willingness to  
participate in these elections which are so important to the  
Federation. We are also grateful to the Council Members  
who have completed their term of office: Professor Robert  
R. Sokal, President of the IFCS in 1988-89 and Vice-  
President in 1987 and 1990; Professors Ludovic Lebart  
(1986-90) and Geert de Soete (1989-90) who served as  
Additional Members of the Council.

*Pierre Legendre, IFCS Secretary-Treasurer, January  
24, 1991*