

## ONE-DAY CRICKET MATCHES AND CUSUMS

by Peter Thakurdas

CUSUMS are fast becoming the simplest way of watching performance and checking whether targets are being met.

One interesting CUSUM application was in the 2nd innings of the NZ vs India 1-Day Cricket match. The particular match in the example below had a breath-taking finish and was held at the MCG in Melbourne, Australia, on 23rd January, 1986.\*

India had completed the 1st innings with an impressive 238 runs for 8 wickets. NZ batsmen were chasing a total of 239 runs from 50 overs, which translates to a target run rate of 4.78 runs per over.

The CUSUM, in simple recursive equation form, is:

$$C(j) = C(j-1) + (R(j) - T)$$

where:  $C(j)$  is the CUSUM in the  $j$ 'th over.

$C(0) = 0$ , ie. the initial value of the CUSUM.

$R(j)$  is the runs scored in the  $j$ 'th over.

$T$  is the CUSUM Target or reference value. ( $T=4$ )

For ease of mental arithmetic and plotting, I chose an integer reference or target rate of 4 runs per over (ie. set  $T = 4$ ). I found I could plot the CUSUM quite easily while watching the match on TV.

Figures 1 and 2 are plots of the runs,  $R(j)$ , and CUSUM,  $C(j)$ , respectively. (The original graphs were of course drawn by hand).

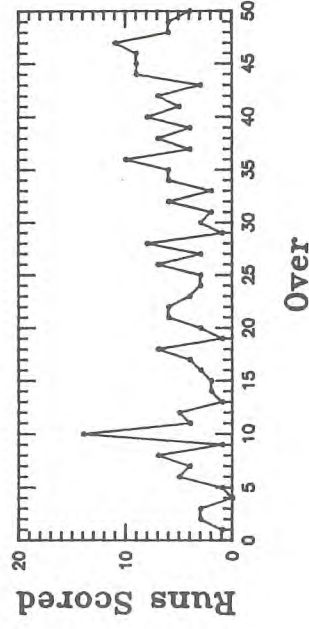
To interpret the CUSUM plot, bear in mind that the SLOPE represents the run rate. Dramatic changes in slope correspond to dramatic changes in run rate. Use the protractor in Figure 2 to convert the CUSUM slope to a local average run rate. I could get an idea of the required run rate at any time by looking at the slope from the latest CUSUM point to NZ's goal, marked by an "X".

Note how clearly the 34th over shows up as a change point on the CUSUM plot. Some may recall, this was when India's bowlers Ravi Shastri and Yadav were in the tail end of their overs and NZ batsmen Martin Crowe and John Reid were taking advantage of this. From then on, NZ maintained a high run rate (6.7). NZ batsmen, Jeff Crowe and Jeremy Coney, helped maintain the high run rate in the final 7 overs to clinch victory from India with only one ball of the match to spare.

Another interesting observation on the CUSUM plot was a temporary drop in the run rate whenever a new batsman entered the game or a new set of bowlers began their overs.

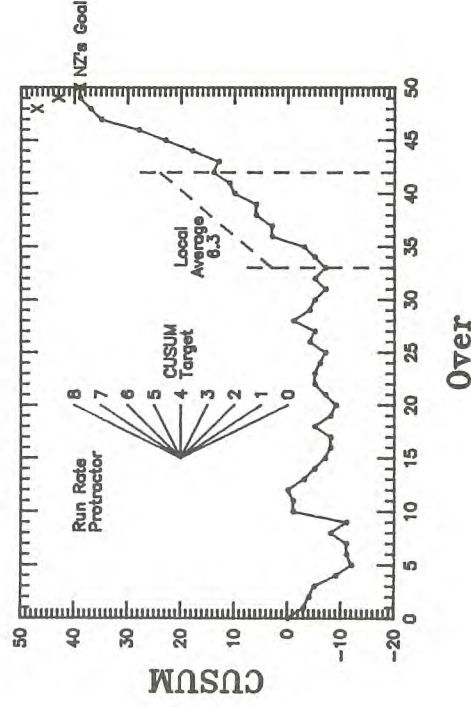
Both of these observations are not nearly as clear in Figure 1, (ie. the plot of runs scored in each over). Figure 2 exemplifies the effectiveness of the CUSUM plot for presentation of time series data.

Figure 1. NZ vs India (NZ Run Rate) 23 January 1986



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Figure 2. NZ vs India (NZ Run Rate) 23 January 1986



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## BOOK REVIEW

by John H. Maindonald

"Directory of Statistical Microcomputer Software", 1985 edition, by W. A. Woodward, A. C. Elliott and H. L. Gray. Marcel Dekker, Inc., New York. Price \$US54 (outside USA).

Microcomputer statistical packages are in much the state of the mainframe packages of ten years ago. There is great variety, and the quality is uneven. Most are untested, and there have been few reviews that are based on the experience of competent statistical users. This volume catalogues much of what is available, but will

be of limited help in choosing between rival packages. Most of the space is taken up with lists of features that summarise responses to a questionnaire sent out in 1983 and 1984 to statistical software developers. There has been no attempt at the daunting task of providing critical evaluations of the 140 packages. The modest information which it does provide is welcome.

In a few cases references are given to "reviews". Alas, a "review" is often an uncritical description that has appeared in a popular computing magazine, such as "Interface Age" or "Popular Computing". By contrast BMDPC and MINITAB claim no reviews, even though their mainframe versions have featured in several comparative reviews undertaken by recognised statistical professionals. It is likely that there are similar anomalies in the features listed.

It is interesting to look at the computer systems used by the 140 listed packages. The older "8-bit" style of microcomputer, such as the Apple II (with 49 packages offered), the Tandy Model III etc. (21 packages), and various CP/M machines (31 packages), have largely given way to the IBM PC and its lookalikes (109 packages). These are usually claimed (not quite accurately) as "16-bit" machines, and run either the PC-DOS or (in the case of lookalikes) the MS-DOS operating system. Most major manufacturers are now offering or planning to offer this style of machine. Software developers that have a continuing interest in their product and wish to get it widely used must soon provide a PC-DOS or MS-DOS version. Even if your use will be on an Apple II or Tandy Model III you may be wise to restrict your attention to packages for which a PC-DOS or MS-DOS version is available.

What of machines that belong to the "avante-guard" of microcomputing? The Apple Macintosh is mentioned once only. Much of what is available has appeared too recently for inclusion in this volume. Package developers require time to learn how to make good use of any innovative machine. The Commodore Amiga now offers an attractive alternative to the Macintosh, and is certain to seduce some current Macintosh devotees. It is too soon to look for scientific and statistical software for the Amiga, or to assess its place in the market.

The UNIX operating system caters for the high end of the microcomputer range. Three packages that run under UNIX get a mention.

Who will use this directory? I am glad to have it on my shelf, mainly as a contribution to the taxonomy of statistical packages. It will be useful in finding the very small number of packages that cater for some specific requirement, for example "Life Table and Survival Analysis." But I do not find it very helpful in discriminating between the large number of packages that cater for a variety of elementary analyses. Readers must search with some care to discover which packages are good prospects for processing survey data.

Given the limited information available from such volumes as this, how should users choose a statistical package? My first preference is for reputable packages, widely used by statistical professionals, that have been carried across from conventional computers. For these packages it is usually possible to find critical comparative reviews, which may not however be entirely relevant to the most recent version or to the microcomputer version. The speed of the microcomputer version should be checked—it may run slowly. The user interface is unlikely to be up to the standard of Lotus 1-2-3, but then most of the statistical packages written specifically for micros are no better in this respect. So far there's little that does for statistics

what electronic spreadsheets do for row and column calculations. What little there is merits, if it's alright in other respects, our support.

In all instances I'd like to be assured that packages have been written by or under the supervision of a statistical professional. Unfortunately the Directory does not list names of the people primarily involved in developing the package, or give references to papers or books they have written that might give some clue of their knowledge and competence. No slot was provided where the vendor might list a small number of published technical references explaining the statistical methodology, the guiding motives of the package developers, algorithms used, etc. Where a newsletter is published that allows users to exchange comments and ideas, details would have been helpful. Examination of the newsletter will provide clues to the quality of the package.

The best statistical packages bring a wide range of statistical analyses, some part of current statistical practice and some yet to be devised, within the scope of one of a small number of conceptual frameworks. Such conceptual frameworks are, in their turn, embodied in a statistical language. ANOVA in Genstat, and GLM's in GENSTAT and GLIM, are perhaps the best examples. EDA, as incorporated e.g. in MINITAB or in 'S', is another. The result is a marvellous power and economy of thought and language, revealing connections between what were formerly seen as disparate analyses, and suggesting extensions to or variations of intended analyses. Presumably it was hoped that the request to describe: "the unique and most important features of your product, i.e. what makes it distinctive..." would elicit comments in these terms. I'd like to add the question: "What concepts and major themes unify your program and make it a powerful tool for statistical analysis?" Indicate how these are reflected in the command language."

The only diagnostics that feature in the questionnaire are regression residuals, and some analyses (EDA routines and skewness and kurtosis) that are often used for diagnostic purposes. Information on any diagnostic routines ought to be requested under each category of analysis. Other questions I think should have been asked relate to:

- (1) Testing procedures; what basis is there for confidence that answers will be correct?
- (2) What sources were used for numerical and other algorithms?

The authors list as sources of reviews *The American Statistician*, *The Statistical Software Newsletter* (published by the International Association for Statistical Computing), such popular computing magazines as *Byte*, and *The Capitol PC Users' Group*. An extensive bibliographic source for reviews is promised for the 1986 Directory. I conclude with my own list of other sources of information (which owes something to a list that Ivor Francis presented at the 1984 NZSA conference).

Sources of information on microcomputer statistical software:  
Cable, D. and Rowe, B. (1985), *Software for Statistical and Survey Analysis*. Study Group on Computers in Survey Analysis, 32pp. (c/o D. Cable, Central Statistical office, Great George Street, London SW1P 3AQ.)

Carpenter, J., Deloria, D. and Morganstein, D. (April 1984): Statistical Software for Microcomputers. (A Comparative Analysis of 24 Packages.) *Byte* 9:4 234-264.

MSU Development Working Papers (Dept. Agric.

- Economics, Agric. Hall, Michigan State University, East Lansing, Michigan 48824-1039, U.S.A.)
- Paper 12: Kelly, V., Stevens, R. D., Stillwell, T. and Weber, M.T., (1983): An Annotated Directory of Statistical and Related Microcomputer Software for Sociometric Data Analysis.
- Paper 15: Pease, J. W., Lepage, R., with others (1984): An Evaluation of Selected Microcomputer Statistical Programs.
- Siegel, J. B. (1985). *Statistical Software for Microcomputers*. (A Guide to 40 Programs). North-Holland, Amsterdam.
- Victor, N. (1984). Computational Statistics-Tool or Science (with discussion). *Statistical Software Newsletter* 10, 105-125.
- (The *Statistical Software Newsletter* is an official publication of the International Association for Statistical Computing. In addition to such papers as the above, see particularly the section on 'News about Statistical Software Systems'. The address for membership or subscriptions is: Int. Stat. Inst., IASC, 428 Prinses Beatrixlaan, NL-2270 AZ Voorburg, Netherlands.)
- Wetherill, G. B. and Curram, J. B. (1985): The Design and Evaluation of Statistical Software for Microcomputers. *The Statistician* 34, 491-427.
- Woodward, W. A. and Elliott, A. C. (1983): A Survey of Statistical Packages on Microcomputers. *Computational Statistics and Data Analysis* 1, 191-200.

## INTERNATIONAL STATISTICAL INSTITUTE— 45TH BIENNIAL SESSION 12-22 AUGUST, 1985

by **Garry E. Dickinson**

The centenary meeting of the ISI was attended by 800 registrants at the RAI Congress Centre in Amsterdam. The format of the conference was two three-hour sessions a day. Most of these sessions had five streams of papers in parallel. Two of these streams were usually invited lectures on a single topic, each lecture lasting perhaps 45 minutes, and at the end a prepared discussion. These invited lectures were preprinted, the verbal presentation and discussion being translated into French and English as required. By contrast the three contributed paper streams were grouped more loosely, the papers lasted only 20 minutes and there was little discussion and no translation. Contributed paper preprints were limited to two small pages each. Some sessions were reserved for special plenary sessions and for business meetings of the ISI.

The topics covered were wide ranging with economic, social, mathematical, computational, ethical, medical, environmental and industrial statistics being the more prominent. The problem was to decide which stream to attend, and likewise to move from one to another in mid-session without causing too much disruption. I found the invited sessions had more meat in them than did the contributed ones. Most of the papers have now arrived back from Amsterdam and copies are available. Detailed contents of each session can be obtained from me.

An interesting addition to the paper sessions were the demonstrations of personal computer hardware and software. The most interesting was one put on by Barbara Diskin of the U.S. Bureau of the Census demonstrating the software they have developed for processing censuses and surveys on IBM PC and similar computers. They have got an integrated package for

data capture, editing and tabulation and we will explore its possibilities now that more documentation has arrived. Another software demonstration was provided by the Netherlands statistical office who have developed an external trade system based on PC's linked to a mainframe. Its functionality did not seem to be any greater than CASPER. On the other hand western european countries have massive problems in recording trade with the multiplicity of border crossing points. These are made worse by current attempts to cut down on documentation inside the EEC; it is always statistical data that is seen as the most easily discarded.

One peripheral activity of the conference was a group convened by Larry Cox of the U.S. Bureau to exchange information on confidentiality techniques and applications. The first meeting of the group, to which I was invited was attended by people from seven or eight statistical offices. We agreed to continue the circulation of ideas through the group, or network as it will now be called. Initial membership is being restricted to official agencies mainly for practical reasons of size but also because confidentiality techniques need to have some sort of protection themselves.

To summarise one's reaction to such a large and diverse conference is not easy. I went mainly to papers on official statistics. Within that area my general conclusions are that the Department of Statistics is well up with the play in such things as directories, some aspects of survey processing such as computer aided coding, and dissemination. Areas where we lag behind include some uses of advanced technology such as graphics, data acquisition as exemplified by such things as computer aided interviewing, and in the general area of quality assurance and reporting data quality. Use of database techniques to make processing more responsive to change is another area where we can move more quickly. The advance of "expert systems" for system development needs watching.

## DEADLINE FOR NEXT ISSUE

The deadline for submitted material for the April, 1986 issue of this newsletter is **April 1**. Please send all notices of seminars, news items, letters-to-the-editor, etc. to...

John Reynolds,  
Newsletter Editor,  
AMD/DSIR,  
P.O. Box 1335,  
Wellington.

The deadline for "News and Announcements" for the May, 1986 issue of *The New Zealand Statistician* is **May 1**.

## APOLOGIA

The editor of *The New Zealand Statistician* wishes to apologize to authors and subscribers for the very late appearance of Volume 20, No.2 (he finds it too painful to repeat its nominal and actual publication dates). The Christmas shutdown and a large dollop of annual leave are largely to blame. The editor is currently reading, and recommends to all other dyed-in-the-wool procrastinators, R. Alec MacKenzie's "The Time Trap".

## ACTION AT AMD AUCKLAND by Jocelyn Dale



Photo: Mavis Lessiter, DSIR

John Mairdonald from AMD at Mount Albert tries to conjure up a new staff member. Other AMD Auckland staff look on: from left Stephen Barnett, Jocelyn Dale, Chris Triggs and Peter Thakurdas.

Another staff member has since appeared, in the form of David Whitaker of the Operational Research Group.

In the background is the woollen wall mural which is

the focal point of AMD's new suite of offices at Mt Albert Research Centre. Textile designer Maude Cook, who recently designed a floor rug for the New Zealand Embassy in Beijing, China, was commissioned to design and make it for AMD. Entitled "In Search of...", the mural symbolises our research: the paths we go along and the various resources that are involved.

## ISI SECTION ON OFFICIAL STATISTICS

The International Statistical Institute has established a new section named: International Association for Official Statistics (IAOS).

The objectives of the Association shall be to promote the understanding and advancement of official statistics and related subjects, and to foster the development of effective and efficient official statistical services through international contacts among individuals and organizations including users of official statistics as well as research institutes.

The IAOS is an international association which is thus open to all those who are interested in official statistics in the broadest sense: the membership is not to be restricted to official statisticians but in particular academic statisticians and others using official statistics are also encouraged to join the IAOS.

The annual membership dues for 1986 and 1987 are fixed at 35 Swiss francs. Those enlisted as members and having paid the 1986 dues before June 1, 1986, will be designated as IAOS Founder Members. UNESCO coupons may be used for dues payments.

Further information and application forms may be obtained from the ISI Permanent Office, 428 Prinses Beatrixlaan, P.O. Box 950, 2270 AZ Voorburg, The Netherlands.

## CALL FOR PAPERS 37th Annual Conference of the

### New Zealand Statistical Association (Inc.)

Time: Tuesday, June 24 to Wednesday, June 25, 1986.

Venue: Hugh MacKenzie Building, Victoria University of Wellington.

If you wish to present a paper contact:

Garry Dickinson  
Department of Statistics  
Private Bag  
Wellington. Telephone: (04) 729-119

A one-day **MEDICAL STATISTICS** conference will be held on Thursday, June 26 at the same venue. To present a paper contact:

Colin Cryer  
Dept of Community Health  
Clinical School  
Wellington Public Hospital  
Private Bag  
Wellington Telephone: (04) 855-959

## WELLINGTON REGIONAL MEETING

A lunchtime meeting was organised by Bill Armstrong, Dairy Board, early in February. About 20 turned up to hear Bill speak on the need for more meetings, Kelly Mara (AMD, DSIR) address the question "Why statisticians should support NZOQA?", David Harte (Biometrics Section, MAF) advertise his CUSUM program, which is written in BASIC and available for free, and, Elizabeth Viggers (Biometrics Section, MAF) describe some of the statistics training material provided by MAF.

More lunchtime meetings are planned. For further information contact: Bill Armstrong, NZ Dairy Board, Box 417, Wellington (Telephone: (04) 724-399).

## ECONOMETRICS AND TIME SERIES MEETING

A one-day meeting with the theme "Current Issues in Econometrics and Time Series Analysis" was held in Wellington recently. The meeting was jointly organised by the NZ Association of Economists and the NZ Statistical Association and about 100 attended.

The two keynote speakers were Professor C. W. G. Granger (University of California) whose many contributions to time series and econometrics are well known, and, Professor D. E. A. Giles (University of Canterbury) whose research interests include pretesting model specification.

Speakers were:

Robin W. Harrison, Economics Dept., University of Canterbury,

"The Reserve Bank Econometric Model: An

Analysis of Alternative Estimation Techniques"

Alistair G. Gray, Department of Statistics, Wellington,

"An Iterated Logarithm Law for ARIMA Models"

Peter J. Thomson, Mathematics Dept., Victoria

University of Wellington,

"Spectral Estimation of ARMA Processes"

Clive W. J. Granger, Dept. of Economics, University of California, San Diego, La Jolla

"Developments in the Study of Co-integrated Economic Variables"

R. Jonathon Lermitt, Ministry of Energy, Wellington,

"Determination of Electricity Price Elasticities—A

Time Series Cross-Sectional Approach"

William B. Bolstad, Dept. of Mathematics, University of Waikato,

"An Efficient Algorithm for the Seemingly Unrelated Regression Model with Known Contemporaneous Covariances"

David E. A. Giles, Economics Department, University of Canterbury,

"Pretest Estimation in Economic Modelling".

## OVERSEAS CONFERENCES

### Eighth Australian Statistical Conference

To be held at the University of Adelaide from 25-29 August, 1986. The main topics for the conference are:

- (i) Analysis of Spatial Data
- (ii) Topics in Earth Sciences
- (iii) Mathematical Genetics
- (iv) Local Conditional Inference
- (v) Medical Statistics

There will also be sessions in nearest-neighbour methods in field trials, teaching of statistics, quality control and statistical computing. For a copy of the first circular write to:

Dr D. J. Street,  
Conference Secretary,  
Waite Agricultural Research Institute,  
Private Bag No. 1,  
Glen Osmond,  
South Australia, 5064,  
Australia.

## International Association for Statistical Computing, COMPSTAT'86

This meeting is to be held in Rome, Italy, September 1-5, 1986. For further information write to COMPSTAT'86, Dipartimento di Statistica Probabilite e Statistica Applicata, Universita degli studi di Roma, 'La Sapienza', I-00185 Rome, Italy.

## Bernoulli Society—First World Congress

This meeting is to be held in Tashkent, USSR, September 8-15, 1986. For further information contact S.Kh. Sirajidinov, Institute of Mathematics of the Uzbek SSR Academy of Sciences, Hodjaev F., 29 Tashkent, 700143, USSR.

## International Symposium on Probability and Bayesian Statistics

To be held in Innsbruck, Austria from September 23-26, 1986, this symposium is in honour of Bruno de Finetti's 80th birthday. For further information write to Professor R. Viertl, Institut fur Statistik und Wahrscheinlichkeitstheorie, Technische Universitat Wien, A-1040 Wien, Austria.

## Second International Conference on Quantitative Genetics

To be held in Raleigh, North Carolina during the first week of June, 1987. The conference is planned to survey advances in Quantitative Genetics since the First International Conference held in Ames, Iowa in 1976.

The programme will include sessions in: Animal Breeding, Ecology, Evolution, Forestry, Human Genetics, Molecular Genetics, Plant Breeding, Mathematical and Statistical Aspects.

The conference will form part of the Centenary Celebrations of North Carolina State University and will also provide an opportunity to mark the 65th birthday of C. Clark Cockerham and recognize his contributions to Quantitative Genetics.

For further information write to:

Dr B. S. Weir,  
Department of Statistics,  
North Carolina State University,  
Box 8203,  
Raleigh, NC 27695-8203,  
USA.

## American Statistical Association/Biometric Society

The 1987 joint meeting is to be held August 17-20, in San Francisco, California. For further information write to ASA, 806 15th Street, N.W., Washington DC, 20005, USA.

### MOVING?

Members are requested to notify the Treasurer, NZSA, P.O. Box 1731, Wellington of any change of address in order that newsletters and journals (and subscription reminders) can continue to be despatched to them.

### FAMOUS MISSING VALUES AND NON-RESPONSES, No.3

#### "Tizard admits census evasion

Statistics Minister Bob Tizard, while exhorting every New Zealander to co-operate with his department and fill out the census form accurately on March 4, had to admit he had erred in the past himself.

At a special Beehive press conference yesterday to publicise what he termed an important 'stock take' of New Zealand society, Mr Tizard confessed he had inadvertently failed to stand up and be counted during the last census in 1981.

The department had made a valiant effort to get its man. It delivered one form to Mr Tizard's Wellington flat, and one to his beach house.

'I wasn't in either at the time,' he told the assembly of statistics officials. 'I don't think they ever got back.'"  
*The Dominion*, Saturday, February 15, 1986.

### 26th SUMMER RESEARCH INSTITUTE OF THE AUSTRALIAN MATHEMATICAL SOCIETY—TIME SERIES CONFERENCE

The 26th Summer Research Institute of the Australian Mathematical Society was held at the Australian National University from January 20 to February 7, 1986. The second week of the institute consisted of an international Time Series Conference. This well-attended and highly successful conference also provided an opportunity to mark the 65th birthday of Professor E. J. Hannan. At the official conference dinner, Professor Hannan was presented with a copy of his festschrift containing contributed papers from the international Time Series research community.

Keynote speakers at the conference included:

H. Akaike (ISM, Tokyo) "Use of Linear Statistical Models in the Analysis of Time Series"  
E. Parzen (Texas A and M) "Asymptotic Distribution of Linear Rank Statistics from Stationary Time Series"  
R. H. Jones (University of Colorado) "Unequal Spacing in Longitudinal and Spatial Data"  
G. Tunncliffe-Wilson (University of Lancaster) "The Use of Marginal Likelihood in Time Series Regression Models"  
C. W. J. Granger (University of California) "Models that Generate Trends"  
M. Deistler (IEOR, Vienna) "Linear Errors-in-Variables Systems"  
P. Robinson (London School of Economics) "Adaptive and Semi-Adaptive Methods for Time Series"  
B. D. O. Anderson (ANU, Canberra) "Multivariate Dynamic Errors-in-Variables Models"  
J. Rissanen (IBM, California) "Stochastic Complexity and Prediction"

Other speakers included: M. A. Cameron, M. L. King, V. Solo, P. J. Thomson, and G. S. Watson.

### AUDIO-VISUAL PRESENTATION FROM AMD AUCKLAND

An eight-minute tape/slide show, introducing the work of the Auckland substation of Applied Mathematics Division, DSIR, has been prepared by Jocelyn Dale. Several recent projects are described, from airport queues to kiwifruit and whiteware. Formal mathematics is little in evidence. Alice Worsley, formerly of IZB, is the narrator. Aimed at potential clients, the show is available for borrowing from AMD Auckland or Wellington: a deposit (\$25 for educational institutions) is required. How about using it in your next open day or careers evening to help say "Applied mathematics is interesting and challenging!"?

### Victoria University of Wellington New Zealand

#### LECTURESHIP IN STATISTICS

Applications are invited for a lectureship in statistics in the Department of Mathematics from men and women with a proven ability in statistics or applied probability. The successful applicant will be expected to play a full part in the Department's teaching, research and consulting activities in the general area of statistics and operations research.

The Department offers undergraduate and postgraduate courses in pure, applied and numerical mathematics as well as probability, statistics and operations research. The group in statistics and operations research works closely with the research/consulting staff of the VUW Institute of Statistics and Operations Research and contributes to the Institute's postgraduate teaching programme.

Professor D. Vere-Jones is responsible for probability and statistics in the Department of Mathematics. The current research interests of the Department's statisticians include stochastic point processes, applications of stochastic processes in geophysics, time series analysis, multivariate analysis, statistical computing and data analysis, population models, biometrics, decision theory and statistical inference. The University's main computers comprise an IBM 4341, a VAX 11/780, a VAX 11/750 and a Facom M150F. A wide spectrum of statistical packages is available on these machines. In addition the Department and the Institute have a number of microcomputers and an AT&T 3B2/400+ minicomputer.

Through the Institute, the group in statistics and operations research has good contacts with their colleagues in other University departments. Close links also exist with the groups in statistics and operations research in the Applied Mathematics Division of the Department of Scientific and Industrial research, which is located on the University Campus, and other Government departments.

Enquiries concerning academic aspects of this position may be made to Professor D. Vere-Jones, Department of Mathematics.

For conditions of appointment and method of application, prospective applicants should write to the Administrative Assistant (Appointments), Victoria University, Private Bag, Wellington, New Zealand.

Commencing salary will be within the range of NZ\$28,000-35,000 and the position is available from 1 February 1987.

Closing date for applications is 18 July, 1986.



## Reading a library copy of this newsletter? Or a workmate's copy?

Then it's time you joined New Zealand's only association for professional, academic and student statisticians.

Advantages of membership include...

- ★ Four issues of this newsletter per year
- ★ Annual Conference—a chance to meet other NZ statisticians, stats students, and, overseas speakers
- ★ A subscription to *The New Zealand Statistician*
- ★ Invitations to occasional regional meetings, software displays and workshops.

The NZ Statistical Association is a sponsor of the Survey Appraisals Committee, is affiliated to the Royal Society of NZ and the International Statistical Institute, and participates in curricula reviews of secondary and tertiary institutions.



### MEMBERSHIP APPLICATION FORM

The Secretary,  
New Zealand Statistical Association, Inc.,  
P.O. Box 1731, Wellington.

I hereby apply to join the New Zealand Statistical Association, Inc.

Name: ..... Occupation: .....

Address: .....

.....

I enclose:

Membership subscription (\$15 regular, \$7.50 student, \$30 Corporate) .....

Signature: .....Date:.....

Membership will commence at April 1st, 1985. The first Statistician you receive will be Volume 20, No. 1.

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Readers who are currently members of the association are asked to encourage colleagues to join. Increased membership will enable the association to expand its activities.