



GEOSTATISTICAL ASSOCIATION OF AUSTRALASIA

NEWSLETTER NO. 10

DECEMBER, 1999

PRESIDENTS ADDRESS

The GAA had a successful third quarter, with two events on statistics.

In October was the conference on Conditional Simulation, organised by the W.H. Bryan Centre, which was extremely well attended. The opener to the conference was a GAA sponsored symposium on Evaluation of Recoverable Reserves: The Simulation Approach, ably chaired by Snowden Associates and MRT. A highlight was being able to present Life Memberships to Dr Daniel Guibal and Dr Harry Parker in person during the Conference Dinner.

In December, a co-sponsored workshop with the Statistics Society was held, and again had a good rollup.

I would like to extend my thanks to those persons and organisations who expended so much time and effort on the organisation for the above events., including Roussos Dimitrakopoulos of the W.H. Bryan Centre, Ian Lipton from MRT Consultants, Ian Glacken of Snowden Associates, Jane Speijers, President of the Statistical Society, and Jodie Thompson, Data Analysis Australia.

Wishing all members a safe and prosperous Year 2000,
John Henstridge, President, 1999-2000.

MEETING DETAILS

Next Meeting of the GAA is the
**Annual Get-Together,
Drinks and Barbeque**

**5 p.m. Sunday, 20th February ,
Scout Hall, Pelican Point, Perth.**

Further details will be advised by email.

HAVE YOU PAID?

1999-2000

**MEMBERSHIPS ARE
OVERDUE!**

It's Time!

The payments for membership dues for the 1999-2000 year are now well overdue, as the membership year is the same as the financial year.

Most members have been notified by email that cheques and money orders, made payable to the Geostatistics Association of Australasia are more than acceptable.

The Association's address is

P.O. Box 1719,
West Perth,
WA 6872

Subscriptions rates are:

- ◆ for Full Members \$35,
- ◆ for Associate Members, \$15,
- ◆ for Student Members, \$5.

Please ensure your dues are up to date, as the society is very dependent on your contributions to help make a viable organisation.

If you have moved, now is the time to advise us of your new address and email contact.

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**THE TOP TEN REASONS
TO
BECOME A STATISTICIAN**

1. Deviation is considered normal.
2. They feel complete and sufficient.
3. They are "mean" lovers.
4. Statisticians do it discretely and continuously.
5. They are right 95% of the time.
6. They can legally comment on someone's posterior distribution.
7. They may not be normal but they are transformable.
8. They never have to say they are certain.
9. They are honestly significantly different and.....
10. No one wants their jobs.

LETTER TO THE EDITORS

The following letter was sent in to the Editors, and we would like to start a discussion on the question posed.

Please email any comments or answers to either editor.

The next newsletter will contain a sample of the discussion.

All letters to the Editor must contain the name and contact email of the writer if they are to be published, no anonymous contributions please!

Dear Editors,

I would very much appreciate your opinion on the question of unfolding. This approach attempts to unfold a deposit by translating all results to a defined plane. Variography is then conducted upon the unfolded results and these variogram parameters are then applied as the weighting mechanism in whatever kriging method that is selected. If in the case of a subhorizontal banana shaped deposit, would this unfolding method result in distorted variogram parameters? or do you consider this a valid approach? It seems to me only an angular tolerance of 90 degrees would pick up a similar number of pairs to the unfolding approach. Would domaining be a preferable approach for the sections of the deposit that have contrasting directions of anisotropy? or would this create discontinuities where the domains join?

Any help on the topic would be appreciated.

Dean O'Keefe, Member.

PETROLEUM GEOSTATISTICS

As part of the Australian Society for Exploration Geophysicists (ASEG) conference in March, 2000, a short course is being presented by Loz Darmon, of Flagship Geosciences, USA. The course will be entitled "Practical Reservoir Statistics for the Petroleum Industry, and will be a one day practical introduction to the basic concepts of Reservoir Geostatistics and how such techniques can be applied to oil and gas industry data. The course is intended for a broad spectrum of professionals.

Venue is the WACA, the course runs from 9 am to 5 pm, and costs \$350, which includes morning/afternoon



Applied Mining Geostatistics
Models, Methods and Reality in Ore Reserves and Grade Control
October 16 – 20, 2000

Michel Dagbert, Geostat Systems Int., Canada and
Roussos Dimitrakopoulos, The University of Queensland, Australia

Optimisation in Mine Design
Principles, Practices and New Advances
May 24 – 26, 2000

Jeff and David Whittle, Whittle Programming Pty, Ltd, Australia

Mineral Project Evaluation Techniques
and Applications
July 24 – 28, 2000

Michel Bilodeau, McGill University, Canada

Practical Sampling and Enhance Grade Control
October 23-24, 2000

Roussos Dimitrakopoulos, The University of Queensland, Australia and
Michel Dagbert, Geostat Systems Int., Canada

Geostatistical Simulations for the Mining Industry
Risk Assessment and Profitability in Ore Reserves, Grade Control
and Mine Planning

October 26 – 27 & April 6 – 7 (RSA), 2000

Roussos Dimitrakopoulos, The University of Queensland, Australia

GIS:

Decision Support Systems for Mineral Exploration
October 2-6, 2000

Graeme Bonham-Carter, Geological Survey of Canada, Canada

Prediction of Undiscovered Mineral Deposits:
Quantitative Methods for Target Identification and Risk Management
December 4-5, 2000

Donald Singer, US Geological Survey of USA, and
Roussos Dimitrakopoulos, The University of Queensland, Australia

Computer Workshop on Coal Seam Characterisation and Risk Assessment
Resources, Coal Quality and Mine Planning
December 7 – 8, 2000

Roussos Dimitrakopoulos, Brett Larkin, Shuxing Li,
The University of Queensland, Australia

Some papers published recently by Australian geostatistics practitioners.

Handy Hints For Variography, J. Coombes

<http://www.snowdenau.com/techno/visor/papers/>

The intention of this paper is to provide the user with a few essential and handy hints for variogram analysis. So often one is faced with the task of analysing the spatial continuity of a data set or with the task of generating a resource model using geostatistical techniques. However, practical guidelines for completing these tasks are few and far between and, even though one may attend a geostatistics course, time lapses between exposure to geostatistical techniques and actual application of the techniques to real situations is generally large enough for the handy hints of variography to be lost in the never-never land of memories. In addition to providing practical guidelines, this paper serves as a port for expressing revolutionary variogram modelling techniques which the author believes would ease the task, and in the process enhance the quality, of variogram modelling.

Interactive Analysis and Modelling of Semi-Variograms, G. S. Thomas

www.snowdenau.com/techno/visor/papers/

Variography is one of the most time-consuming and user-demanding aspects of geostatistics. Difficulties in visualising and interpreting variography results have been major factors inhibiting the more general application of geostatistical techniques in ore reserve estimation. Such problems are compounded when non-parametric approaches to variography (such as indicator variography) are employed to investigate the spatial behaviour of mineralisation at a range of grade values. This paper outlines some of the new techniques and tools that have been developed to assist in the generation, analysis and modelling of three-dimensional variograms, with a view to producing high-quality models for use in indicator kriging and conditional simulation. Emphasis is placed on determining whether the low, medium and high grades exhibit similar patterns of mineralisation continuity and whether the directions of that continuity vary with changing grade values. <http://>

Variability and uncertainty in spatial, temporal and spatiotemporal crop-yield and related data, A. B. McBratney, B. M. Whelan and T. M. Shatar

www.novartisfound.org.uk/catalog/210abs.htm

Application of the theories of precision agriculture to the practicalities of broad-acre farming relies on successful handling of the ramifications of uncertainty in information, i.e. information pertaining to the spatial and temporal variation of those factors which determine yield components and/or environmental losses. This paper discusses the uncertainty of yield and related variables as measured by their spatial and temporal variance. The magnitude of these two components gives a suggestion as to the appropriate scale of management. Simultaneous reporting on spatial and temporal variation is rare and the theory of these types of process is still in its infancy. Some brief theory is presented, followed by several examples from the Rothamsted classic experiments, yield-monitoring experiments in Australia, a long-term barley trial in Denmark, and a soil moisture monitoring network. It is clear that annual temporal variation is much larger than the spatial variation within single fields. This leads to the conclusion that if precision agriculture is to have a sound scientific basis and ultimately a practical outcome then the null hypothesis that still remains to be seriously researched is: 'given the large temporal variation in yields relative to the scale of a single field, then the optimal risk aversion strategy is uniform management.'

Characterisation of Ore Types and Beneficiation Behaviour using Normative Minerals, I.T. Lipton, W.J. Shaw and A.E. Waltho.

www.mrtconsulting.com.au/bibliography

A study based on predicting lump and fines proportions of manganese and iron ores.

Change of Support for Recoverable Resource Estimation, S. Khosrowshahi, R.L. Gaze and W.J. Shaw.

www.mrtconsulting.com.au/bibliography

The paper is a review of the existing change of support models, and proposes an alternative.

**International Symposium on Geostatistical Simulations in the Mining Industry,
Thursday 28 and Friday 29 October 1999**

The ISGSM Symposium was held at the Hyatt Regency in Perth and was organised by the WH Bryan Mining Geology Research Centre in Brisbane and supported by the Geostatistical Association of Australasia. Both the AusIMM and AIG sponsored this important symposium which drew overseas speakers from South Africa, France, UK, USA, Canada and Japan. It was well attended with a total of more than 90 delegates. The symposium was the "brain-child" of Roussos Dimitrakopoulos of BRC, who also took care of most of the organisation. He was assisted by the Organising Committee consisting of Lyn Bloom (Edith Cowan University), Marcelo Godoy (Bryan Research Centre) and Ian Glacken (Snowden Associates). Roussos asked Louis Voortman (Resource Service Group) to take care of the Closing Remarks on behalf of the GAA. Below is an overview of his observations.

Jean-Michel Rendu, Vice-President, Newmont Gold, USA, was the Keynote Speaker who set the scene with a presentation emphasising the use of conditional simulation as a tool for assessing different project risks. He stressed the need for an integrated "holistic" approach to assess real project risks and the need for "flexible solutions". Other overseas speakers were André Journel, Danie Krige, Harry Parker, Peter Dowd, Christian Lantuejoul and Tetsuya Shoji. Snowden Associates and MRT had organised a pre-symposium discussion on conditional simulation with André Journel which proved to be an interesting "curtain-raiser" for the symposium. RSG had brought Professor Danie Krige to Perth so that he was able to partake in the discussions on the use of simulation methods and the debate on when to best make use of a kriging or simulation approach.

The symposium highlighted the use of various conditional simulation techniques, and discussed complex Fourier series, multiple realisations, co-simulation of correlated variables, simulation of misclassification, and the use of kriging methods also for local estimates. In addition, the importance of the data quality, the provision of "simulation audit trails", the assessment of risk attached to prediction or forecast of cash flow analysis and the need for very fast algorithms were addressed.

The panel discussion at the end of the symposium could, according to some delegates, perhaps have been even more useful if it had taken place at an earlier stage during the symposium. A degree of concern was voiced that conditional simulation methods have not yet been fully proven to work in practice. A strong opinion was expressed for the need to list, discuss and report all possible project risks "as a standard" in all our geostatistical reports. It was not unexpected that, at a gathering like this, we again heard the opinion that we still need, somehow, to better convince companies that they can improve performance by using new technology. Louis summed up the the general feeling after the congress that "we should go away in the knowledge that what we should be doing, is providing mine management with practical answers on uncertainty". The opinions voiced by most speakers, overseas as well as from Australia, have certainly emphasised this aspect. The symposium ended on a positive note: conditional simulation is a new tool but provided it is used correctly, this tool promises to provide at least a significant part of the answer.





GAA Annual Get Together

Sunday, February 20th, 2000

**The venue: Scout Hall, Pelican Point, Perth.
(watch your email for a bitmap location guide)**

The time: 5 pm for Sundowners

The area is safe for swimming.

A light meal and drinks will be on hand, provided by the GAA and prepared by the current Committee as thanks for the support from members during 1999.

Please tear off the acknowledgement below, and return to the GAA secretary by February 10th, or advise preferences by email.



_____ - will be attending the GAA function.

There will be _____ adults and _____ children in my party.

During the function, I would like to drink

- beer
- red wine
- white wine
- vegetarian

I would like a vegetarian option for my meal



Spatial Information and Data Analysis Workshop

a special report by John Henstridge, Data Analysis Australia.

The Geostatistical Association of Australasia and the Statistical Society of Australia (W.A. Branch) jointly held the Spatial Information and Data Analysis Workshop on Friday 26 November 1999 at the University of Western Australia. During the workshop, links were established between the two professional bodies, providing an ideal atmosphere for the 76 delegates to share their knowledge of and experiences with spatial information and data analysis. Workshop presentations focussed on environmental applications of spatial data in the morning session and mining applications in the afternoon.

The keynote speaker was Professor Noel Cressie, originally from Fremantle, from the State University of Ohio. In his first talk Professor Cressie gave a convincing argument for using geostatistics, GIS tools and hierarchical spatial models to manage large spatial data sets. This warmed the audience up for his talk in the afternoon session in which Professor Cressie summarised *covariance matching constrained kriging*, an extension of *constrained kriging* that offered some of the benefits of conditional simulation at substantially less cost. Not surprisingly, a lively discussion ensued with proponents of conditional simulation.

Delegates also appreciated the presentations of invited speakers which highlighted the applications of spatial statistics in agricultural field experiments (Katia Stefanova of Agriculture WA), the monitoring of salinity in regional Western Australia (Harri Kiiveri of CSIRO) and mining (John Henstridge of Data Analysis Australia and Daniel Guibal of SRK Consulting).

Other issues challenging delegates included the need for geostatisticians to broaden their statistical expertise to the *human environment*. There is concern that technological advances in GIS used in the *human environment* are occurring at a greater rate than the development of robust statistical techniques in the same arena. Derek Milton of Geographic Business Systems spoke of the issues facing organisations now that geographical data was a reality.

A very different approach to spatial statistics was given by Professor Adrian Baddeley of the University of Western Australia. The emphasis was on geometry, considering issues such as fault lines in coal mines. While methods such as conditional simulation were used, the details were very different from traditional geostatistics.

The workshop was considered a success by delegates with many links established and strengthened.

The Statistical Society of Australia (W.A. Branch) and the Geostatistical Association of Australasia sincerely thank Louis Voortman, Dr John Henstridge, Ms Jodie Thompson and Dr Robin Milne for organising the workshop.



The Australian Institute of Geoscientists has recently advised the GAA that the University of Adelaide is to drop its third year unit on geostatistics from the geology/geophysics curriculum. Given the importance of geostatistics to the mining industry in particular, this is of grave concern. A copy of a form letter which can be posted to the Department of Geology and Geophysics at Adelaide University is outlined below. Electronic copies can be obtained from the GAA secretary or the newsletter editors. Please write, and ensure that the subject is kept on the geoscience curriculum.

Professor Stewart Greenhalgh
Department of Geology and Geophysics
The University of Adelaide
Adelaide, SA. 5005

Re. Geostatistics as a third-Year Subject

Dear Sir,

We regard it with concern that your department is considering removal of the subject of geostatistics from the curriculum of third-year geology and geophysics.

Geostatistics, while not concerned with geological process or development of geophysical techniques, is a very important exploration assessment tool. For years, Adelaide University has been producing graduates with knowledge in the concept and technique of geostatistics, which is highly regarded by the industry.

As the usage of personal computer has gained popularity, and geostatistical software available, the background knowledge of geostatistics is a vital asset to explorationists. An academic organisation should not disregard such a requirement, and it is responsibility of university as an educational institution to enhance future employment opportunity of students.

Regarding the industry requirement in geology graduates, removal of geostatistics from the curriculum is regarded as a regressive move, and we ask you and your curriculum committee to reconsider this matter.

Yours faithfully, [insert name]

*Why density is always such a problem in doing
the reserve...*

- ◆ • Another physical property is the mineral's density, that is noted by shining light through the rock
- ◆ • The specific gravity of a rock can be measured on the Moah Scale, which is a scale working from minerals with a low gravitation to minerals with a high gravitation
- ◆ • Specific Gravity is the weight, mass or density of a mineral in the Earth's atmosphere
- ◆ • A mineral is weighed using a laboratory scale; it is then submerged in water for a few seconds. After being taken out of the water it is reweighed: the increase in weight marks the specific gravity of the



GEOSTATS REVIEWS

Spatial Statistics for Remote Sensing, Volume 1, edited by Alfred Stein, Freek van der Meer and Ben Gorte

Hardcover, 325 pp (November, 1999). Kluwer Academic Publishers, ISBN0-7923-5978-X

This book treats statistical issues that are of relevance in spatial studies for remote sensing. It consists of contributions by international experts in this field. A brief overview of basic statistics is given, followed by physical aspects of remote sensing. Spatial statistics addresses classification of images by supervised and unsupervised procedures, estimation of spatial structures by variograms, interpolation, simulation, sampling and issues of scale. Geographical information systems allow the integration of remote sensing with other sources of information, concentrating on the concept of the pixel. Attention is also given to decision support for a wide variety of possible and important decisions. A single data set is used throughout the book. This book therefore provides an overview of the state of the art of spatial statistics for remote sensing, highlighting new frontiers in this rapidly developing field of science.

New Methods of Geostatistical Analysis and Graphical Presentation, Distributions of Populations over Territories by Roberto Bachi

Hardcover, 494 pp, (October, 1999), Kluwer Academic Publishers and The Israel Academy of Science and Humanities ISBN 0-306-45544-7

The chief aim of this book is to present the reader with an integrated system of methods dealing with geographical statistics ('geostatistics') and their applications. It sums up developments based on the vast experience accumulated by Professor Bachi over several decades of research. Interest in the quantitative locational aspects of geography and in the common ground of geography and statistics has grown rapidly, involving an ever-increasing spectrum of scientific disciplines ... the present volume will fill a genuine need – as a textbook, as a reference work, and as a practical aid for geographers, applied statisticians, demographers, ecologists, regional planners, economists, professional staff of official statistical agencies, and others.

The Physicist, the Chemist, and the Statistician

Three professors (a physicist, a chemist, and a statistician) are called in to see their dean. Just as they arrive the dean is called out of his office, leaving the three professors there. The professors see with alarm that there is a fire in the wastebasket.

The physicist says, "I know what to do! We must cool down the materials until their temperature is lower than the ignition temperature and then the fire will go out."

The chemist says, "No! No! I know what to do! We must cut off the supply of oxygen so that the fire will go out due to lack of one of the reactants."

While the physicist and chemist debate what course to take, they both are alarmed to see the statistician running around the room starting other fires. They both scream, "What are you doing?"

To which the statistician replies, "Trying to get an adequate sample size."

The Biologist, the Statistician, the Mathematician, and the Computer Scientist

A biologist, a statistician, a mathematician, and a computer scientist are on a photo-safari in Africa. They drive out into the savannah in their jeep, stop, and scour the horizon with their binoculars.

The biologist: "Look! There's a herd of zebras! And there, in the middle: a white zebra! It's fantastic! There are white zebras! We'll be famous!"

The statistician: "It's not significant. We only know there's one white zebra."

The mathematician: "Actually, we know there exists a zebra which is white on one side."

The computer scientist: "Oh no! A special case!"



GEOSTATS REVIEWS

Geoenv I : Geostatistics for Environmental Applications : Proceedings of the Geostatistics for Environmental Applications Workshop, Lisbon, Portugal.

Hardcover - 516 pages (August 1997) Kluwer Academic Publishers; ISBN: 0792345908

This book contains selected contributions from the geoENV96 – First European Conference on Geostatistics for Environmental Applications, held in Lisbon in November 1996. This is the first of a geoENV series of biennial planned books. The series is intended to show the state of the art of geostatistics in environmental applications with new cases, results and relevant discussions from leading researchers and practitioners around the world. New and important theoretical and practical developments of geostatistics in the environmental field were compiled from three main areas: i. Hydrology, Groundwater and Groundwater Contamination ii. Soil Contamination and Site Remediation iii. Air Pollution, Ecology and Other Applications . The book presents a set of geostatistical tools and approaches used to successfully resolve a variety of specific problems in environment modelling, especially those resulting from the typical scarcity of spatial sampling, the time component of very dynamic systems, the modelling of various systems of contaminants, the uncertainty assessment of health cost functions, etc. Prominent topics concerning methodological tools and methods, stochastic simulation techniques, models of integrating soft information (seismic and remote sensing images), inverse modelling of groundwater flow, neural network classification, change of support and up-scaling are also included in this book.

Geoenv II – Geostatistics for Environmental Applications: Proceedings of the Second European Conference on Geostatistics for Environmental Applications held in Valencia (Spain) from November 18-20 1998

Hardcover - 584 pages (June 1999), Kluwer Academic Publishers, ISBN 0-7923-5783-3

This book contains selected contributions from the geoENV98 – the Second European Conference on Geostatistics for Environmental Sciences, held in Valencia, Spain in November 1998. This second book of the geoENV series illustrates the developments on geostatistics as applied to the environmental sciences which have occurred during the past two years. It also presents practical applications which will be of interest to both researchers and practitioners. The book starts with three keynote papers on ecology, climatology and soil science, followed by forty-three contributions. The contents of the book are eminently practical. The objective of the editors was to compile a set of papers in which the reader could perceive how geostatistics is applied within the environmental sciences. A few selected theoretical contributions are also included. The papers are organized in the following seven main areas : Air pollution, Climatology, Ecology, Hydrogeology, Soil Science, Theory , Other applications , presenting applications varying from particle matter analysis, noise exposure sampling, space-time modeling of ozone levels, downscaling of precipitation, kriging with categorical external drift, analysis of fish abundance, combining variograms and radio-telemetry in ecology, kriging radionuclide deposition, mapping of soil contamination, network design for soil monitoring, inverse modeling in hydrogeology, groundwater transport modeling, coastal evolution mapping to spatial modeling of cancer

GAA

MEMBERSHIP

There are 4 types of membership:

- ◆ Ordinary Member
- ◆ Associate Member
- ◆ Student Member
- ◆ Corporate Member

Only ordinary members have full voting rights.

Corporate membership is by invitation of the Executive Committee.

The current makeup of the Society is: 7 honorary life members, 105 ordinary members, 7 associate members, and 2 student members.

Membership forms are available by post or email, contact GAA Secretary, P.O. Box 1719, West Perth WA 6872, email bateleur@ormen.com.au

Membership fees are:

- \$35 member
- \$15 associate
- \$5 student

any articles for the newsletter?

please pass on to editors or GAA secretary