GAA

GEOSTATISTICAL ASSOCIATION OF AUSTRALASIA

NEWSLETTER NO. 8 JUNE, 1999

INCOMING PRESIDENTS ADDRESS

The Geostatistical Association of Australiasia is now in its third year. Its achievements have been impressive for a small organisation, a reflection on the enthusiasm of the members and committee. We must ensure that this enthusiasm is transformed into a long term productive organisation.

To that end I see the challenge of the next year is to extend our membership and activities in a number of areas. I would like to see better links with spatial statisticians working in areas other than mining. I would like to see statisticial issues in mining other than classical geostatistics being covered. I would like to see a mix of the theory and the applications that make this an applied subject. I would like to see more case studies - successes and failures - so the professional experience of our members can be shared.

I have no doubts that with the commitment displayed by members in the past years we have a good future.

John Henstridge, President, 1999.

MEETING DETAILS

Next Meeting of the GAA is on

Monday, June 28th, starting at 5:30 pm sharp

Top Lecture Theatre, 9th Floor, Minerals House, 100 Plain Street

Presentation by Mark Murphy, Anaconda Nickel NL on the Murrin Murrin Project

Inside This Issue

SOCIETY PRESENTATIONS

JUNE

Mark Murphy, Anaconda Nickel. Mark will be completing the second part of his talk on the Murrin Murrin nickel project.

JULY

Danny Kentwell, SRK . Danny's talk will be on elements of sequential gaussian fractal simulation.

AUGUST

Louis Voortman, RSG and Ute Miller, Edith Cowan

The talk aims to detail approaches to uniform conditioning, the process being the basis for disjunctive kriging.

SEPTEMBER

Pierre Goovaerts, guest lecturer, sponsored by Edith Cowan and Snowden Associates, will be speaking on statistics and environmental science

OCTOBER

The GAA sponsored conference at the Perth Hyatt

Uncertainty Models, Risk Analysis and Optimisation of Mining Operations

NEWSLETTER EDITORIAL TEAM

steve hyland
ravensgate
raven@omen.com.au

stella searston
bateleur minerals
bateleur@omen.com.au

gaa secretariat
p.o. box 1719
west perth wa 6872
bateleur@omen.com.au

GAA SPONSORS 1998

ARGYLE DIAMONDS

DATA ANALYSIS AUSTRALIA

DATAMINE

EMC

SRK

GREAT CENTRAL MINES

KCGM

MIM EXPLORATION

MRT

RESOURCE SERVICE GROUP

SNOWDEN ASSOCIATES

[Superposition] a very simple concept ... continued to confuse many geologists of the past as it was firstly believed that the rocks were placed in some form of alphabetical order.

Did you hear the one about the statistician?

Probably....

97.35% of all statistics are made up

MRT WORKSHOP

The Course

A workshop course for mining professionals interested in improving profitability on mine sites by optimising grade control.

Theory, practical exercises and case histories are presented. Participants develop a comparative methodology to assess the costs and benefits of their own grade control systems. A broad range of commodities and mining styles, both open pit and underground, is discussed.

The course requires some preliminary preparation and the structure involves interaction between participants as they analyse their own operations.

The Course Syllabus

Topics to be covered will include:

- Grade control sampling theory and practice
- Cut-off grade determination and boundary definition
- Delineation of mineable ore blocks
- Statistical principles affecting grade estimation techniques
- Estimation of tonnes and grades, including impacts of dilution and ore loss
- Comparisons between open pit and underground grade control systems
- Practical mining of ore blocks, stockpile control and misclassification
- Reconciliation between ore reserves, grade control and production
- Optimising mineable ore blocks and sampling patterns using conditional simulation

The Course Fees

The cost of the course is $1500. Extensive course notes are provided that follow the presentations. Preliminary reading is also available.

This highly practical course has become a worldwide benchmark for mining personnel interested in grade control.

A new format has been introduced so that the course can be constantly updated and new principles and techniques can be examined. Every course addresses the issues currently facing the participants and examines the impact of best practices on current operations .

The Course Dates

The next courses are scheduled to run in Perth on 7 - 10 September 1999 and in Brisbane on 11 - 14 October 1999. Customised in-house courses can be run as required.

The Contacts

Perth office: ☎ (08) 9316 2710, 🖷: (08) 9316 1791

Brisbane office: ☎ (07) 3229 1633 🖷 (07) 3229 6120

www.mrtconsulting.com.au

WH BRYAN MINING GEOLOGY RESEARCH CENTRE 1999

Professional Development Seminars for the Mining Industry

"LEARNING FROM THE EXPERTS MAKES THE DIFFERENCE !!!"

APPLIED MINING GEOSTATISTICS:
Models, Methods and Reality in Ore Reserves and Grade Control

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

August 23-27, 1999

MINERAL PROJECT EVALUATION TECHNIQUES AND APPLICATIONS

Michel Bilodeau, McGill University, Canada

July 26-30, 1999

PRACTICAL SAMPLING FOR FEASIBILITY STUDIES AND GRADE CONTROL

Charles Rose, Charles Rose Consultants, USA

October 11-13, 1999

GEOSTATISTICAL SIMULATIONS FOR THE MINING INDUSTRY:
Tools for Enhancing Metal Recovery and Mine Profitability

Roussos Dimitrakopoulos
The University of Queensland, Australia
(Brisbane and Perth)

October 25-27, 1999

GIS:
Decision Support Systems for Mineral Exploration

Graeme Bonham-Carter, Geological Survey of Canada, Canada

November 8-12, 1999

PREDICTION OF UNDISCOVERED MINERAL DEPOSITS:
Models and Quantitative Methods for Target Identification and Risk Management

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

November 15-16, 1999

COMPUTER WORKSHOP ON COAL GEOSTATISTICS:
Resources, Coal Quality and Mine Planning

Roussos Dimitrakopoulos, The University of Queensland, Australia

December 6-7, 1999

Seminars will be held in Brisbane unless another location is indicated

For Registration and further information please contact:

WH Bryan Mining Geology Research Centre,
The University of Queensland, Brisbane, 4072, Qld. Australia
Telephone: 61 7 3365 3473
Fax: 61 7 3365 7028
E-mail: brc@mailbox.uq.edu.au
URL: www.minmet.uq.edu.au/~bryan

The President's Cruise

The annual GAA Social Event, a dinner and dance function on board the MV Captain Cook, took place on Friday, 19th March. About 40 people were wined and dined in style during a leisturely cruise from the Barrack Street jetty to Fremantle Harbour and back. Special guests for the evening included Dr Dominique Francois Bon-Garcon of MRDI in San Francisco, and Mr Bill Turner, director of Anvil Mining in Perth. Many thanks to Louis Voortman for MC'ing the night, (and for all of the Abba and seventies disco numbers).

1999 GAA Committee

President: John Henstridge, Data Analysis Australia
Treasurer: Sjoerd Duim, Minproc
Secretary: Stella Searston, Bateleur Minerals
Committee Members:
Lyn Bloom, Edith Cowan University
Brian Davis, Geologica
Mike Humphreys, SRK
Steve Hyland, Ravensgate
Mark Murphy, Anaconda Nickel
John Vann, SRK
Louis Voortman, RSG
Corresponding Members:
Craig Moulton, Rio Tinto - Pilbara Region
Alan Miller, KCGM - Kalgoorlie Region

JORC CODE 1999

The 1999 JORC Code takes effect in September of this year. Copies of the code will be sent to all AIG members in the June '99 newsletter, and a copy will be placed on the AIG website at *www.aig.asn.au* once all three parent bodies have approved the code. Unfortunately for AusIMM members, at the time of going to press there was as yet no word from the Melbourne secretariat on publication dates or acceptance of the code.

GEOSTATISTICAL FALLACIES

mike humphreys, senior associate geostatistics, SRK

A single estimation method can be applied in every case..... All estimation methods make assumptions of one kind or another – mostly with regards to the nature of grade transition (smooth, nuggety, etc). Application of a method whose assumptions do not fit your deposit can lead to gross distortion of grade-tonnage curves. There are a number of tests available (Deutsch and Lewis[1], Rivoirard[2], Humphreys[3]) that can be used to avoid applying the wrong technique for a given deposit. You should always make sure that you have information regarding the assumptions behind your applied method (e.g. Vann and Guibal[3], Glacken and Blackney[3]).

Choose the upper cut as the 97.5 percentile..... There is no single approach for selecting (or applying) an upper cut that has been accepted or proven best. Every approach involves great subjectivity. If the data at the 97.5 percentile isn't an outlier, why should it be cut? If it is, why not cut at the 95th percentile? A number of different approaches should be used, rather than relying on one. Plots of cv (standard deviation divided by the mean) versus the number of data removed or upper cut applied are useful tools.

Log probability plots clearly show values at which to implement cuts or the presence of two populations..... One thing that applies to both is that any deviations from a straight line (which is what you are looking for in the log probability plot) may be due only to the population not being lognormal – which is the usual case. Two populations should result in deviation but the reverse implication does not hold. Other tools (e.g. histograms) should be used to confirm the conclusions made. Log probability plots cannot be used as the sole basis for decisions.

[1] Deutsch and Lewis. Advances in the practical implementation of indicator geostatistics: Appendix A: A Test for the Validity of Parametric Methods. 23rd APCOM Proceedings.

[2] Rivoirard, 1994. Introduction to disjunctive kriging and non-linear geostatistics. Clarendon Press (Oxford), 181pp.

[3] In the "Beyond Ordinary Kriging: Non-linear geostatistical methods in practice" symposium proceedings, October 1998 for the Geostatistical Association of Australasia.

WHATS ON IN GEOSTATS IN '99

Models, Methods and Reality in Ore Reserves and Grade Control

August 23-27, WH Bryan Centre, Brisbane, Qld

Grade Control and Reconciliation

September 7-10, MRT Short Course, Perth WA and October 11-14, Brisbane Qld.

Geostatistical Simulations for the Mining Industry,

October 25-27 1999, W.H. Bryan Centre, Qld

Uncertainty Models, Risk Analysis and Optimisation of Mining Operations

October 28-29, 1999, Hyatt Regency, Perth WA

Computer Workshop on Coal Geostatistics

December 6-7, W.H. Bryan Centre, Qld

HAVE YOU CHECKED OUT THIS WEBSITE?

www.geostatistics.com

Gamma Design Software's website, which deals with aspects of statistics relating to Environmental and Social Sciences. Gamma Design produce the GS+ program which does semi-variance analysis, normal probability and cumulative frequency plots, block and punctual kriging.

OR TRIED THIS ADDRESS?

http://curie.ei.jrc.it/ai-geostats.htm

A great site, with information such as details of on-line papters, and spatial statistics books; a list and discussion of geostatistics software; shareware and freeware; upcoming courses and conferences; a search function allowing you to find the addresses of people doing similar work to yourself; and in these bottom of the J-curve times, a site where jobs available in geostatistics are advertised.

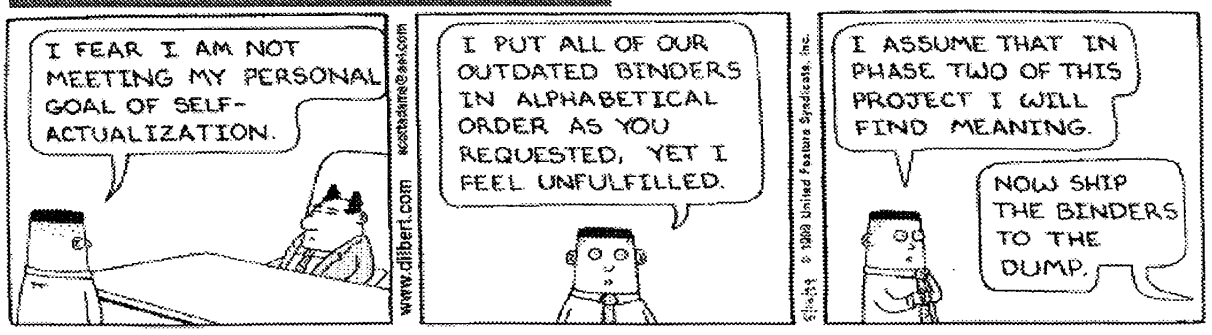
WHY SHOULD I USE KRIGING INSTEAD OF SIMPLE INTERPOLATION?

In a nutshell::

Deterministic interpolation techniques such as inverse distance and triangulation do not take into account a model of the spatial process, or the variogram. You might be able to get a map and think that you're modeling the spatial process, but then again, you might not. Furthermore, kriging allows you to quantify the quality of your predictions via the kriging variance. You can do the same for deterministic techniques, but it's quite tedious. You'd still need to model the variogram and derive the estimation weights. Another advantage of kriging is that you can take into account clustering (redundant data) and possible anisotropies much more easily than, say, inverse distance techniques. Furthermore, more advanced geostatistical techniques such as indicator kriging and simulations allow you to quantify soft" or qualitative information in a quantitative manner. To do the same using triangulation, for example, would require a lot of tedious trial and error and a lot of dummy data.

Of course, kriging implies more work. You'd need to model the variogram, which is usually time consuming. Nevertheless, the results from kriging are generally of higher quality and more realistic compared to techniques such as inverse distance and triangulation.

Geostatistics FAQ — Frequently Asked Questions
(Copyright © 1996-97, Syed Abdul Rahman Shibli, pepsi@pc.jaring.my)



WH Bryan
Mining Geology
Research Centre

International Symposium
on Geostatistical Simulation in Mining
ISGSM

October 28-29, 1999
Hyatt Regency, Perth, Australia

Geostatistical
Association of
Australasia

GEOSTATISTICAL SIMULATIONS FOR THE MINING INDUSTRY

UNCERTAINTY MODELS, RISK ANALYSIS AND OPTIMISATION OF MINING OPERATIONS

First Circular
and
Call for Papers

International
experts and practitioners
in the field discuss
mining applications
technical advances and
new issues in dealing with
orebody uncertainty,
risk prediction,
mining optimisation and
mine profitability

Themes:

Large scale industrial applications

Forum on mining industry needs and concerns

New developments and challenges

Mining is a high-risk venture where uncertainties in orebody grade and tonnage can have a major influence on profitability. During the last few years, there has been a growing recognition of the need to consider these uncertainties quantitatively as to maximise financial returns. Geostatistical simulation technologies combined with optimisation concepts allow orebody uncertainty to be considered in the feasibility, design, development and planning stages of a mining venture, as well as in the financial optimisation of operations. In the last decade, major industrial applications have demonstrated the success and value of these new technologies.

"Geostatistical Simulations for the Mining Industry" is a two-day symposium organised by the WH Bryan Mining Geology Research Centre, University of Queensland, and the Geostatistical Association of Australasia. Presenting the latest advances in orebody modelling from around the world, the symposium will feature sessions on large-scale industry applications, on new directions and methods dealing with mining uncertainty, and on related technological advances. The symposium is intended to increase industry awareness of the many uses of geostatistics in mining optimisation, to promote discussion of industry needs, and to enhance communication between professionals in the field.

International experts from both the industry and research community contributing to the symposium include (in alphabetical order):

Dr. Margaret Armstrong, Paris School of Mines, France
Dr. Jef Caers, Stanford University, USA
Prof. Roussos Dimitrakopoulos, BRC, Australia
Prof. Peter Dowd, University of Leeds, UK
Prof. Andre Journel, Stanford University, USA
Dr. Christian Lantuejoul, Paris School of Mines, France
Dr. Harry Parker, MRDI, USA
Mr. Mario Rossi, GSI, USA
Dr. Henri Sans, WMC, Australia
Dr. Georges Verly, Placer Dome, Canada

Technical Program

The program will be divided into three key themes:

I. LARGE SCALE INDUSTRIAL APPLICATIONS

- Uncertainty, Risk and Mining Operations: The Corporate View
- Resource/Reserve Definition and Drilling
- Resource Variability and Classification
- Recoverable Reserves and Uncertainty
- Feasibility and Mine Optimisation
- Mine Design and Planning
- Grade Control and Reconciliation
- Mill Feed Variability
- Issues on Large Scale Underground Mining

II. NEW DEVELOPMENTS, ALGORITHMS AND CHALLENGES

- Geostatistical Models
- Genetic Algorithms
- Neural Networks
- Multi-point Statistics
- Large and Fast Simulations
- Joint Simulation of Variables
- Data Integration
- Change Support / Scale
- Geology Modelling

III. FORUM ON MINING INDUSTRY NEEDS AND CONCERNS

- Current Technologies & Needs for the Mine Environment
- Near and Long Term Technologies
- Issues and Needs in Open Pit Mining
- Issues and Needs in Underground Mining
- Where To From Here?

Call for Papers

Papers are sought which address issues or describe novel applications, document and raise concerns or present new technical advances and research work relevant to the conference themes and technical program.

Submission Procedure and Important Dates

Prospective authors are required to submit an abstract of 300 words by June 30, 1999. They will be notified of acceptance by July 15.

Abstracts should be forwarded electronically to
E-mail: **isgsm@mailbox.uq.edu.au**
Confirmation of abstract receipt will be sent to authors.

All written material should be sent to:

ISGSM, PO Box 931, Palm Beach, Qld 4221, Australia.
Phone:+61 7 32212240; Fax:+61 7 32297797

Manuscripts

Selected reviewed manuscripts will be considered for publication in the journals: *Mathematical Geology* and *International Journal of Surface Mining*

For Further Information please contact:

isgsm@mailbox.uq.edu.au

Symposium updates will be posted on:

www.minmet.uq.edu.au/~bryan

Second Circular and Program will follow in July 1999

Sponsored by

Australian Institute of Geoscientists

The Australasian Institute of Mining and Metallurgy

GEOSTATS REVIEWS

A Diagnostic to Assess the Fit of a Variogram Model to Spatial Data by Ronald Paul Barry

The fit of a variogram model to spatially-distributed data is often difficult to assess. A graphical diagnostic written in S-plus is introduced that allows the user to determine both the general quality of the fit of a variogram model, and to find specific pairs of locations that do not have measurements that are consonant with the fitted variogram. It can help identify nonstationarity, outliers, and poor variogram fit in general. Simulated data sets and a set of soil nitrogen concentration data are examined using this graphical diagnostic. *Full paper at http://www.stat.ucla.edu/journals/jss/v01/i01/diagnostic.html*

Examining Common Problems Associated with Various Contouring Methods, Particularly Inverse-Distance Methods, Using Shaded Relief Surfaces by William L. Wingle

A common problem in geologic data analysis is incorrectly creating and interpreting (or failingto interpret) gridded contour maps. Too often, once data is contoured, the resultant map is considered to be a true representation of the surface with only minor errors. This is a poor assumption, but by using shaded-relief surface maps, many potential problems can be quickly and graphically identified. Because the visual appearance of contour maps can vary significantly by changing parameters that have nothing to do with the data being contoured, great care must be taken when using gridded maps. This paper acts as a reminder of some of the problems in contouring, and suggests that the use of shaded-relief surface maps can be a complementary method to viewing and checking gridded model data. Although shaded-relief surfaces are difficult to evaluate for specific values, they show the texture of the gridded surface in ways not easily seen in plan view contour maps or even three-dimensional contoured surfaces. Because of the common use of contour maps, it is important that those using them understand the problems, and have tools to help them identify when the gridding algorithm is creating noise not due to the field data, but due to the mathematics. *Full paper at http://www.mines.edu/fs_home/wwingle/pub/contour/*

Conditional simulation of diamond deposits by Caers, J. (1), Gelders, J. (1), Rombouts, L. (2) & Vervoort, A. (1) *1.K.U.Leuven, Dep. Civil Engineering, Mining Research Unit. 2.Terraconsult B.V.B.A.*

A new methodology is presented for the conditional simulation of a spatial point process which is observed in non-adjacent cells, representing samples taken from a precious stone deposit (diamonds are the main source for application). It involves the statistical modelling of counting distributions, the construction of non-conditional simulation and the conditioning by a variant of the simulated annealing approach. *More at http://www.bwk.kuleuven.ac.be/bwk/mining/gs2.htm*

Characterisation of Topographic Surfaces on a Triangulated Irregular Network (TIN) by Jarno Peschier,

Terrain characterisation is an important step on the route from raw landscape height data to GIS applications like and erosion and disaster damage prediction. There already exist quite a number of methods and algorithms to do this (Falcidieno and Spagnuolo , Garg and Harrison and also Burrough]) but it seemed like an algorithm that partitions a landscape stored in a Triangulated Irregular Network (TIN) directly into regions with one of nine possible curvatures (based on both plan and profile curvature) did not yet exist. This article gives such an algorithm. It uses a Voronoi diagram for interpolating curvature labels for the whole landscape from the ones calculated for certain vertices of the TIN and it runs in O(nlogn) time where n is the number of vertices in the TIN. *Full paper at http://www.jarno.demon.nl/gavh.htm*

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: 2 honorary life members, 7 associate members, 1 student member and 101 ordinary members.

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

If you know the whereabouts of the following lost members, please contact the Secretariat:

- Wayne Sharpe
- Bruce Fulton
- Oliver Bertoni
- Rod Brown

any articles for the newsletter?

please pass on to editors or GAA secretary