

# Bibliography

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Bibliography is divided into two sections:

- I. Deals with bibliographical list in the field of mathematical statistics and related fields—specially those relevant to geological sciences (this includes the references cited in the text also); and
- II. Deals with a bibliographical list relevant to geological data analysis, and geostatistical methodology as propounded by the French School.

## SECTION I

### Mathematical Statistical Methods

- Aitchison, J. and Brown, J.A.C., 1957. The Lognormal Distribution. Cambridge University Press, London, 176 p.
- Bartlett, M.S., 1946. On the Theoretical Specification of Sampling Properties of Autocorrelated Time Series. *Jrl. Royal Stat. Soc.*, **B8**, 27.
- Box, G.E.P. and Jenkins, G.M., 1976. Time Series Analysis, Forecasting and Control, Holden-Day, San Francisco, California, 575 p., 2nd Edn.
- Cooley, W. and Lohnes, P.R., 1971. Multivariate Data Analysis. Wiley and Sons, New York, 564 p.
- Cooley, J. and Tukey, S.W., 1965. An Algorithm for the Machine Calculation of Complex Fourier Series. *Math. Comp.*, **19**, 297-301.
- Cramer, H., 1945. Mathematical Methods of Statistics (First published in Sweden, Uppasala by Almqvist & Wiksells). Princeton University Press. Princeton, 579 p.
- Cressie, N.A.C., 1996. Statistics for Spatial Data. John Wiley and Sons, New York, 900 p.
- Doob, J.L., 1953. Stochastic Processes. John Wiley and Sons, New York, 654 p.
- Feller, W., 1957. An Introduction to Probability Theory and its Applications, Vol. I, 2nd Edn. Asia Publishing House, New Delhi, 461 p.
- Feller, W., 1966. An Introduction to Probability Theory and its Applications, Vol. II. Wiley Eastern Pvt. Ltd., New Delhi, 626 p.

- Hoel, P.G., 1957. Introduction to Mathematical Statistics, 2<sup>nd</sup> Edn. Asia Publishing House, 331 p.
- Jenkins, G.M. and Watts, D.G., 1968. Spectral Analysis and its Applications. Holden-Day, San Francisco, 525 p.
- Naidu, P.S., 1995. Modern Spectrum Analysis of Time Series. CRC Press, New York, 399 p.
- Papoulis, A., 1984. Probability, Random Variables and Stochastic Processes, 2<sup>nd</sup> Edition, McGraw Hill, Ind. Editions. 576 p.
- Parzen, E., 1962. Stochastic Process. Holden-Day, 324 p.
- Quenouille, M.H., 1949. Approximate Tests of Correlation in Time Series. *Jrl. Royal Stat. Soc., B11*, 68.
- Rao, C.R., 1973. Linear Statistical Inference and its Applications. Wiley Eastern Private Ltd., New Delhi, 625 p.
- Tukey, J.W., 1977. Exploratory Data Analysis, Reading, MA. Addison Wesley.
- Yaglom, A.M., 1962. An Introduction to the Theory of Stationary Random Functions. Translated from Russian by R.A. Silverman. Prentice Hall, Englewood Cliffs, NJ (as of 1973, published by Dover, New York), 235 p.

## SECTION II

### Statistics and Mathematics Applied to Geological Data Analysis, and Geostatistical Methodology

- Agterberg, F., 1970. Autocorrelation Functions in Geology. *In: Geostatistics Colloquim* (D.Merriam, ed.). Plenum Press, New York, pp 113-141.
- Agterberg, F.P., 1974. Geomathematics - Mathematical Background and Geoscience Applications. Elsevier, Amsterdam, 596 p.
- Akaike, H., 1969. Fitting Auto-regressive Models for Prediction. *Ann. Inst., Stat. Math*, **21**, 243-247.
- Akaike, H., 1970. Statistical Predictor Identification. *Ann. Inst., Stat. Math.*, **22**, 203-217.
- Armstrong, M., 1980. A Geostatistical Approach to Predicting the Washability Characteristics of Coal in Situ. Unpublished note N.687 Centre de Geostatistique, Fontainebleau, Ecole des Mines, Paris.
- Armstrong, M., 1981. Basic Geostatistics Applied to Coal. Unpublished report: C-87, Centre De Geostatistique, Fontainebleau.
- Armstrong, M., 1984. Common Problems Seen in Variograms. *Math. Geology*, **16(3)**, 305-313.
- Armstrong, M. (Ed), 1988. Basic Linear Geostatistics. Springer-Verlag (Berlin), 256 p.
- Andersen, N., 1974. On the Calculation of Filter Coefficients for Maximum Entropy Spectral Analysis. *Geophysics*, **39(1)**, 6.

- Brooker, P.I., 1975a. Avoiding Unnecessary Drilling. Australasian IMM Proceedings, No.253, pp 21-23.
- Brooker, P.I., 1975b. Optimal Block Estimation by Kriging. Australasian IMM Proceedings, No.253, pp 15-19.
- Brillouin, L., 1956. Science and Information Theory, Academic New York, pp 159-161.
- Burg, J.P., 1967. Maximum Entropy Spectral Analysis. Paper presented at the 37<sup>th</sup> Annual International Meeting; Soc. of Explo. Geophysics, Oklahoma City, Okla.
- Burg, J.P., 1968. A New Analysis Technique for Time Series Data. Paper presented at Advanced Study Institute on Signal Processing; Nato, Ensched, Netherlands.
- Clark, Isobel, 1977. Regularization of a Semi Variogram. *Computers and Geostatistics*, **3(2)**, 341-346.
- Clark, Isobel, 1979. Practical Geostatistics. Applied Science Publishers Ltd., London, 129 p.
- CPT-78, 1979. Unpublished Technical Report: Basic Introduce to Geostatistics. Fontainebleau, France.
- Cressie, N.A.C., (1996). Statistics for Spatial Data. Iowa State University, John Wiley & Sons, New York, 900p.
- David, M., 1970a. Geostatistical Ore Estimation – A Step by Step Case Study. *In: Decision Making in the Mineral Industry*. Spl. Volume no.12, CIMM. Montreal, pp 185-191.
- David, M., 1977. Geostatistical Ore Reserve Estimation. Elsevier Sci. Pub. Co., Amsterdam, 364 p.
- Davis, J.C., 1973. Statistics and Data Analysis in Geology. John Wiley and Sons, New York, 550 p.
- Dowd, P., 1971. Application of Geostatistics. Internal Report. Zinc Corporation, NBHC Broken Hill, Australia.
- Dowd, P., 1976. Application of Dynamic and Stochastic Programming to Optimise Cut-off Grades and Production Rates. *Transactions of the Institution for Mining and Metallurgy*, **85**, A21-A31.
- Durbin, J., 1960. The Fitting of Time Series Models. *Rev. Int. Inst. Statist.*, **28**, 233-244.
- Edward, J.A. and Fitelson, M.M., 1973. Notes on Maximum Entropy Processing. IEEE. Trans. Inform. Theory, IT-19, 232 p.
- Emerson, J.D. and Hoaglin, D.C. 1983. Analysis of Two-way Tables by Medians. *In: Understanding Robust and Exploratory Data Analysis*. John Wiley & Sons., New York, pp. 166-210.
- Finney, D.J., 1941. On the Distribution of a Variate whose Logarithm is Normally Distributed. *Suppl. J. Royal Stat. Soc.*, **7(2)**, 151.
- Galli, A., Beucher, H., De Fouquet, C., Dong, A., Langlais, V., Leioch, G. and Renord, D., 1987. Applied Geostatistics for the Petroleum Industry. Course Manual, Centre de Geostatistique 404 p.

- Hass, A. and Jousselin, C., 1975. Geostatistics in the Petroleum Industry. *In*: 'Geostat 75', pp 333-347.
- Hass, A. and Viallix, J.R., 1976. Krigeage Applied to Geophysics. *Geophysical Prospecting*, **24**, 49-69.
- Hannan, E.J., 1969. The Estimation of Mixed Moving Average Autoregressive Systems. *Biometrika*, **56(3)**, pp 579-593.
- Haykin, S., 1983. Non-linear Methods of Spectral Analysis, Vol. 34. Springer-Verlag, Berlin, 263 p.
- Huijbregts, Ch. and Journel, A., 1972. Estimation of Lateritic Type Ore Bodies. *In*: Procs. of the 10<sup>th</sup> Int. APCOM Symp., Johannesburg, pp 207-212.
- Huijbregts, Ch., 1973. Regionalised Variables and Application to Quantitative Analysis of spatial data. *In*: Proceedings of NATO A.S.I. 'Display and Analysis of Spatial Data'. John Wiley and Sons, London and New York, pp 38-53.
- Jaynes, E.T., 1963. New Engineering Applications of Information Theory. Intl. Proceedings of the First Symposium on Engineering Applications of Random Function Theory and Probability (eds J.L. Bogdanoff and F. Kozin). John Wiley, New York, pp 163-203.
- Jaynes, E.T., 1963. Prior Probabilities. *IEEE Trans. Systems Sci. Cybern.*, SEC-4, pp 227-241.
- Journel, A., 1973. Geostatistics in Sequential Exploration. *Mining Engineering*, Oct., 1973 pp 44-48.
- Journel, A., 1975. From Geological Reconnaissance to Exploitation—A Decade of Applied Geostatistics. *CIMM Bulletin*, June, 1975.
- Journel, A., 1977. Kriging in Terms of Projections, Mathematical Geology. *Journal of the IAMG*, **9**, 563-586.
- Journel, A. and Huijbregts, Ch. J., 1978. Mining Geostatistics. Economic Press, 600 p.
- Jowett, G.H., 1957. Statistical Analysis Using Local Properties of Smoothly Heteromorphic Stochastic Series. *Biometrika*, **44**, 454-463.
- Kanasewich, E.R., 1975. Time Sequence Analysis in Geophysics. The Univ. of Alberta Press, 364 p.
- Kim, Y.C., Myers, D.E and Knudsen, H.P., 1977. Advanced geostatistics in ore reserve estimation and mine planning (Practitioner's guide). Unpublished Report—QJBX-65(77) prepared for U.S Dept of Energy, Colorado.
- Koch, G.S. and Link, R.F. 1970. Statistical Analysis of Geological Data, Vol. 1. John Wiley and Sons, New York, 375 p.
- Koch, G.S. and Link, R.F., 1971. Statistical Analysis of Geological Data, Vol. 2. John Wiley and Sons, New York, 438 p.
- Krige, D.G., 1951. A Statistical Approach to Some Basic Mine Valuation Problems on the Witwatersrand. *Jrl. Chem., Met., and Min., Soc. of S.Afn.*, **52**, 119-139.

- Krige, D.G., 1961. Developments in the valuation of Gold Mining Properties from Borehole Results. 7<sup>th</sup> Commonwealth Mining and Met. Congress, preprint.
- Krige, D.G., 1966. Two Dimensional Weighted Moving Average Trend Surfaces for Ore Valuation. *In: Proc. of the Symp., on Mathematics, Statistics and Computer Applications in Ore Valuation.* South Afr., Inst. of Min., and Met., Johannesburg.
- Krige, D.G., 1970. The Role of Mathematical Statistics in Improved Ore Valuation Techniques in South African Gold Mines. *In: Topics in Mathematical Geology.* Consultants Bureau, New York and London.
- Krige, D.G., 1975. A Review of the Development of Geostatistics in South Africa. *In: 'Geostat 75'*, pp 279-293.
- Krige, D.G., 1976. Some Basic Considerations in the Application of Geostatistics to Gold Ore Valuation. *Jrl. of the South Afr. Inst., of Min., and Met.*, 76, pp 383-391.
- Levinson, H., 1947. The Wiener RMS (root mean square) Error Criterion in Filter Design and Prediction, *J.M.Math.Phys.*, **25**, 261-278.
- Marechal, A., 1967. The practice of transfer functions: Numerical methods and their applications. *Proc. of NATO ASI.*, Rome 1975.
- Matheron, G., 1963. Principles of Geostatistics. *Economic Geology*, **58**, 1245-1266.
- Matheron, G., 1967. Kriging or Polynomial Interpolation Procedures? *CIMM Transactions*, 70, pp 240-244.
- Matheron G., 1970. Random Functions and Their Applications in Geology. *In: Geostatistics—A Colloquim (D.Merriam, ed.).* Plenum Press, New York, pp 79-87.
- Matheron G., 1971. The Theory of Regionalized Variables and Applications. *Les Cahiers du Centre de Morphologie Mathematique.* Fasc. 5, CG Fontainebleau.
- Matheron, G., 1973. The Intrinsic Random Functions and Their Applications, *Advances in Applied Probability.* 5, pp 439-468.
- Matheron, G., 1975. A Simple Substitute for Conditional Expectation. Disjunctive Kriging, in 'Geostat 75', pp 221-236.
- Myers, D.E., 1982. Matrix Formulation of Cokriging. *Math Geology*, **14(3)**, 249-257.
- Newton, M.J., 1973. The Application of Geostatistics to Mine Sampling Patterns. *In: Proc. of the 11<sup>th</sup> Int. APCOM Symp.* Univ. of Arizona, Tucson, April 1973. D44-D58.
- Rendu, J.M., 1970. Bayesian Decision Theory Applied to Mineral Exploration and Mine Valuation, *In: 'Geostat 75'*, pp 435-445.
- Rendu, J.M., 1978. An Introduction to Geostatistical Methods of Ore Valuation. *South African Int., of Min., & Met.*, Johannesburg, 82 p.
- Royle, A.G., 1975. A Practical Introduction to Geostatistics, University of Leeds, Course Material, Leeds.

- Royle, A.G., 1977. How to Use Geostatistics for Ore Reserve Classification. World Mining, Feb., pp 52-56.
- Robinson, E., 1983. Iterative Least-Squares Procedure for ARMA Spectral Estimation. *In: Topics in Applied Physics* (Ed. Haykin, S.), Springer Verlag, N.Y.
- Sahu, B.K., 2005. Statistical Models in Earth Sciences. B.S. Publications, Hyderabad, 211 p.
- Sarma, D.D., 1970. A Statistical Study in Mining Explorations as Related to Kolar Gold Fields (India). *Geoexploration*, **8**, 19-35.
- Sarma, D.D., 1979. Statistical Appraisal of Ore Valuation (with applications to Kolar Gold Fields). Andhra University Press & Publications. Waltair, Series No. 157, 167 p.
- Sarma, D.D., 1990. Stochastic Modelling of Gold Mineralisation in the Champion Lode System of Kolar Gold Fields (India). *Math. Geology*, **22(3)**, 261-279.
- Sarma, D.D., 1995. Stochastic and Geostatistical Modelling of Gold Mineralisation in the Zone-I reef of Hutti Gold Mines, Karnataka. NGRI Tech. Rept. No. NGRI-95-Exp-185.
- Sarma, D.D., 1997. Stochastic Characterisation of Copper Mineralisation. A Case Study. *Jrl. of Geophysics*, **XIX(1)**, 53-60.
- Sarma, D.D., 1997. Geostatistical Modelling of Gold Mineralisation in the Oakley's reef of Hutti Gold Mines, Karnataka. NGRI Tech. Rept. No. NGRI-97- Exp-206.
- Sarma, D.D., 1998a. A Geostatistical Analysis of Gold Mineralisation in Oakley's Reef, Hutti Gold Mines, Karnataka, India. Procs. of the Symp. Applin. of Geophysics to Environmental and Engg. Problems (SAGEEP), held at Chicago, III, pp 257-266.
- Sarma, D.D., 1998b. Stochastic and Geostatistical Modelling of Gold Mineralisation in the Strike Reef (HW) of Hutti Gold Mines, Karnataka.
- Sarma, D.D., 1999. Stochastic and Geostatistical Modelling of Gold Mineralisation in the Strike Reef (FW) of Hutti Gold Mines, Karnataka. NGRI Tech. Rept. No. NGRI-98-Exp-230(B).
- Shannon, C.E., 1948. A Mathematical Theory of Communicaton. *Bell Syst. Tech. J.*, **27**, 379-423.
- Sichel, H.S., 1947. An Experimental and Theoretical Investigation of Bias Error in Mine Sampling with Special Reference to Narrow Gold Reefs. *Trans. Inst. Mining Met.*, **56**, 403-474.
- Sichel, H.S., 1952. New Methods in the Statistical Evaluation of Mine Sampling Data. *Trans. Inst. Min. and Met.*, March, 261-288.
- Smylie, D.E., Clarke, G.K.C. and Ulrych, T.J., 1973. Analysis of Irregularities in the Earth's Rotation. *In: Methods in Computational Physics*, Vol. 13, Academic, New York, pp 391-430.
- Sichel, H.S., 1952. New Methods in the Statistical Evaluation of Mine Sampling Data. *In: Transactions of the Institution for Mining and Metallurgy*, pp 261-288.

- Sichel, H.S., 1966. The Estimation of Means and Associated Confidence Limits for Small Samples from Lognormal Populations. *In: Proceedings of the Symposium of the South African Institute of Mining and Metallurgy, Johannesburg, preprint.*
- Sichel, H.S., 1972. Statistical Valuation of Diamondiferous Deposits. *In: Procs. of the 10<sup>th</sup> APCOM Symp, Johannesburg, pp 17-25.*
- Ulrych, T.J. and Bishop, T.N., 1975. Maximum Entropy Spectral Analysis and Auto-regressive Decomposition. *Reviews of Geophysics and Space Physics, pp 183-200.*
- Ulrych, T.J. and Ooe, M., 1970. Auto-regressive and Mixed Auto-regressive Moving Average Models and Spectra. *In: Topics in Applied Physics (Ed., Haykin, S.), Springer-Verlag, New York, pp 73-125.*
- Van den Bos, A., 1971. Alternative Interpretation of Maximum Entropy Spectral Analysis. *IEEE Trans. Inform. Theory, IT, 17, pp 493-494.*
- Walker, G., 1931. On Periodicity in Series of Related Terms, *Procs. Roy. Soc., London, Series-A, 131, pp 518-532.*
- Yule, G.U., 1927. On a Method of Investigating Periodicities in Disturbed Series in Special Reference to Wolfer's Sun spot numbers, *Phil. Trans. Roy. Soc., London, Series-A, 226, pp 267-298.*
- Tukey, J.W., 1977. *Exploratory Data Analysis, Reading, MA: Addison Wesley.*





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