REFERENCE

Baaft, E.Y. ; Schech, D.E. ; and Chatterjee, P.K. 1986. Optimizing Exploratory Drillhole Locations. in Proceedings of 13th Congress of the Council of Mining and Metallurgical Institutions. Singapore. Vol.2. The Australiasian Institute of Mining and Metallurgy. Parkville : 15-22.

Bowman, R.G. 1989. The Application of High Resolution Seismic Profiling in The Preliminary Assessment of Lignite Resources. South Island. New Zealand. The AusIMM Bulletin and Proceedings. Vol.294. No.4.

Charusiri, P. 1989. Lithophile Metallogenic Epohs of Thailand : Geological and Geochronological Investigation. An unpublished Ph.D. Thesis, Queen's University, Kingston, Ontano, Canada : 819.

Clark, I. 1976. Some Practical Computational Aspects of Mine Planning. In Guarascio. M. eds. Advanced Geostatistics in the Mining Industry. D.Reidel. Dordrecht. Netberbuds : 391-402.

Clark, I. 1979. Practical Geostatistics. Elsevier applied science. London.

Clark, I. 1980. The Semivariogram : Geostatistics. McGraw-Hill. New York. 27 pp.

Dagbert, M. ; David, M. 1986. Geostatistics for Coal Deposits. Seminar Notes. Geostat Systems International Inc. Montreal. Canada.

Davis, C.J. 1986. Narrow vein mining. the geologist's role Can. Inst. Min. Metall.. Spec. Vol. 7. : 186-195.

David, M. 1977. The Practice of Variogram Modelling. in Geostatistical Ore Reserve Estimation. Elsevier. Amsterdam : 115-174.

Davis. M.. 1976. The practice of Kriging. in Advanced Geostatistics in Mining Industry. M.Guarascio. eds. D.Reidel Publishing Co. Dordrecht Holland.

Davis, J.C. 1986. Statistics and Data Analysis in Geology. 2nd edition. John Wiley & Son.

Englund, E. 1991. Geo_EAS 1.2.1 User's Guide. Geostatistical Environmental Assessment Software user's guide. Las Vegas. Nevada 89119.

Evan, A.M. 1951. Introduction to Mineral Exploration. Blackwell Science Publishing Company. London : 396.

Gershon, M. 1986. Introduction to Geostatistics. 1986 National symposium on mining. hydrology sedimentology and reclamation. Temple University. Pennsylvania.

Gillies, A.D. ; Cawte, D.C. ; Whitchurch, K.D. ; and Just, G.D. 1987. Geostatistics for Prediction of Coal Washability Characteristics. in The Australian Institute of Mining & Metallurgy Bulletin and Proceedings. Vol.292. No.5.

Gurba, A.J. 1994. Geostatistical Assessment of Coal Quality Data. Glennies Creek Projct. MAppSc.

Isaaks, E.H. ; Srivastava, R.M. ; 1989. An Introduction to Applied Geostatistics. New York Oxford. OXFORD University Press.

John, L. ; Baxter, M.G. ; Yates . and Rowlands, A.T. 1991. Estimation of Reserves and Resources in Shear Zone Hosted Deposits. in The Australian Institute of Mining & Metallurgy Proceedings. No.2.

Journel, A. 1974. Geostatistics for The Conditional Simulation of Ore Bodies. Economic Geology. Vol.69 : 673-687.

Leartnatee. V. ; Ariyakul. C.; Hunsawek. K. ; and Limthammaporn. B. 1993. FoxPro 2.6. Se-Education Public.

Marston & Marston. 1990. Results of the Preliminary Geological Assessment of the Saba Yoi Coal Deposit. SongKhla Province. Kingdom of Thailand for Electricity Generating Authority of Thailand. Contract No. EGAT 47/2-56-5011. Vol. 1.

Microsoft corporation. 1994 . Microsoft Excel. Catapult. Inc. U.S.A.

Microsoft corporation. 1994 . Microsoft FoxPro. Catapult. Inc. USA.

Muenlek.S.; Meesuk. A.; Tongchit. P. and others. 1985. Geologic Map of Thailand 1:250000 : Changwat Narathiwat and Amphoe Takbai, sheet NB 47-8,5. Geological Survey Division, Department of Mineral Resources.

Nakapadungrat, S. ; Bungunpai. N.; Cheenkul. A. and others. 1988. Geology of Amphoe Saba Yoi (map sheet 5122 II) : Geological survey report. Department of Mineral Resources: 6-31.

Pirat, P. 1987. Kriging. in Work Shop on Geostatistics for the Tin Industry. Organized by the Seatrad Center in Co-operation with DMR. Mining and Metallurgical Engineering Prince of Songkhla University. Hat Yai. Thailand : 14-18. (in Thai)

Pornrattanapitak, P.; and Jitapunkul. S. 1985. Sin Pun Exploration Project Geological Evaluation . Progress Report No.3. Solid Fuel Geology Division. Mine Engineering Department. EGAT. Report No. 424-01-2823.

Puvichit, S. ; and Thongpenyai, Y. 1996. Introduction to Geostatistics. Faculty of Engineering. Chulalongkorn University. (in Thai)

Royal, A. ; Clark, I. ; Brooker, P.I. ; and orthers. 1980. Geostatistics . McGraw-Hill. New York. 1-6 pp.

Scott, B.C. ; and Whateley, M.K.G. 1955. Evaluation Techniqes. in Evan. A.M. (eds.). Introduction to Mineral Exploration. Blackwell Science. London : 161-202.

Snansieng. S.; Gitisan. N.; and Sripongpan. P. 1985. Geologic Map of Thailand 1:250000 : Changwat Nakhon Si Thammarat, sheet NC 47-15. Geological Survey Division, Department of Mineral Resources.

Solid Fuel Geology Division. 1990. Geological Report on Potential Exploration Stage of Southern Part of Saba Yoi Basin. Vol. I. Report No. 211-01-3204. Mine Engineering Department. Electricity Generating Authority of Thailand : 22-43.

Solid Fuel Database Centre. 1994. Natures and Properties of Coal. Report no. 702-03-3707. Solid Fuel Division. Electricity Generating Authority of Thailand : 2-10. (in Thai)

Thomas, L . 1992. Handbook of Practical Coal Geology. John Wiley&Sons. England.

Whitchurch, K.D. ; Saussders, A.D. and Just, G.D. 1987. A geostatistical approach to coal reserve classification. Pacific Rim Congress. Vol.87 : 475-482.

Yang, R. ; and Just, G.D. 1988. Application of Geostatistics to The Analysis of Seismic Data. in The Australian Institute of Mining & Metallurgy Bulletin and Proceedings. Vol.193. No.5.

APPENDIX A

METHODOLOGY OF SAMPLING AND SAMPLING PATTERN

Methodology of Sampling and Sampling Pattern

Sin Pun area

Most of coal seam intersected and recovered by core drilling were sampled and analyzed. Sampling method used in this study depended on many factors utilized during drilling such as drilling with or without wireline geophysical logging, percentage of core recovery, nature of coal seam, etc. One of the most basic sampling method used in this study is a 'ply by ply' system chich its major criterior can be summarized as follows :-

1. Sampling will be done at any changes in lithology. Depths of sample that sampled should be corresponded with depth to base inputting in computerized geophysical database.
2. Such change in lithology should be identified with geophysical logs (if available), selected depths of sampled coal from core drilling and correspondence depth from geophysical log should be adjusted before encoding into FORTRAN-format sheet, analytical from etc. If geophysical log is not available, changes in lithology at the cores derived from drilling should be very carefully identified.
3. Every change in lithology to be sampled should be exceeded 30 centimetres, if it is less than 30 centimetres such changes should not be divided into another ply.
4. Non-coal layer (parting in coal seam) with thickness exceeded 1 metre is not considered to be sampled for analysis.
5. Every core-lost interval have to be reported in the analytical form and FORTRAN-format sheet.
6. Composite ply (mix of every ply) should be sampled and analyzed.
7. If there is any intercalation i.e., coal / non-coal layer. Hard lignite / soft lignite, etc., percentage of each layer have to be reported.

Saba Yoi area

The sampling at Saba Yoi implemented guideline for sampling outlines by EGAT. The 'ply by ply' method of sampling used by EGAT is summarized as follows: -

1. Sampling will be done at any changes in lithology. Depths of each sample should corresponded with depths input in the final lithological logs and computerized geological database.
2. Such changes in lithology should be identified with geophysical logs (if available). Selected depths of samples from core drilling and corresponding depths from geophysical logs should be adjusted before encoding into FORTRAN-format sheet analytical forms, etc. If the geophysical log is not available, changes in lithology from the core should be derived very carefully.
3. If the thickness of a coal layer is more than 30 centimetres but less than 3 metres, it should be taken as one samples.
4. If the thickness of a coal layer is more than 3 meters, it should be divided into equal sized samples. Each sample thickness must not exceed 3 meters and must not be less than 1.5 meters.
5. It the thickness of a non-coal layer is more than 15 centimetres but less than 1 metre it should be taken as one sample.
6. If the thickness of a non-coal layer is more than 1 metre, a 30 centimetres sample should be taken from the top portion and the bottom portion of the layer.
7. If a core sample is less than 30 centimetres thick and is an intercalation of coal / coal or coal / non-coal layers the layers should be taken as one sample.
8. If a core sample is more than 3 metres thick and is an intercalation of coal / coal or coal / non-coal layers should be divided into equal sized samples. Each sample thickness must not exceed 3 metres and must not be less than 1.5 metres.
9. A 30 centimetres roof sample which is a contact between overburden and a main seam of coal should be taken. A 30 centimetres floor sample which is contact between underburden and a main seam of coal should be taken.

APPENDIX B

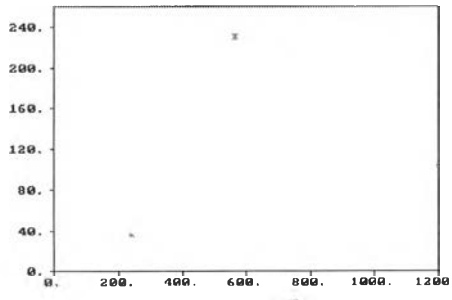
TEST OF TOLERANCE ANGLES

Test of Tolerance Angle

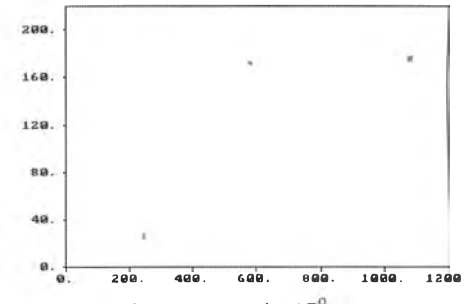
Testing tolerance angle P1 seam. Sin Pun area,

fixed direction 0^{o} , and lag spacing 400 m.

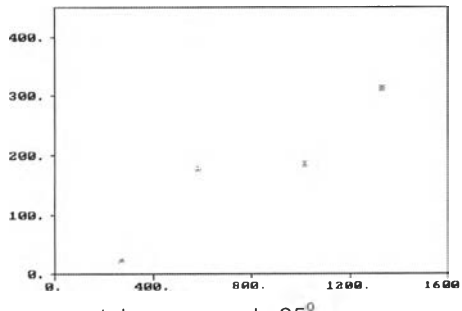
Ash Content (%)



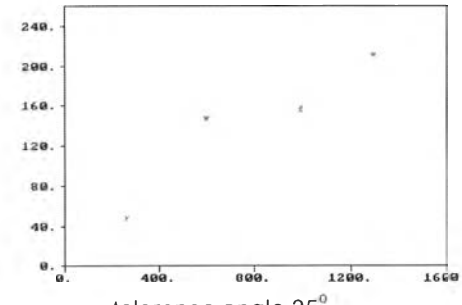
tolarence angle 5^{o}



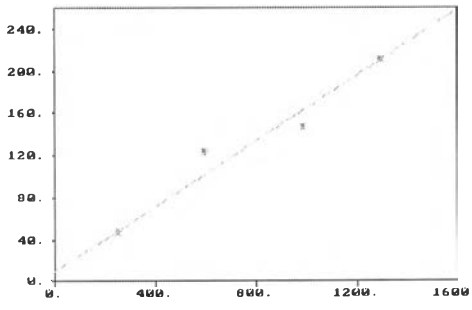
tolarence angle 15^{o}



tolarence angle 25^{o}



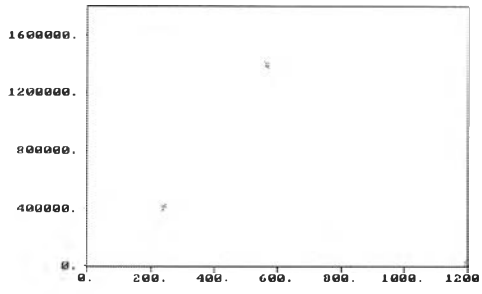
tolarence angle 35^{o}



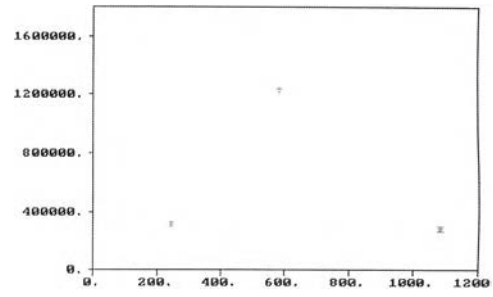
tolarence angle 45^{o}

Linear model with nugget = 10, sill = 85, R-major 550 m.

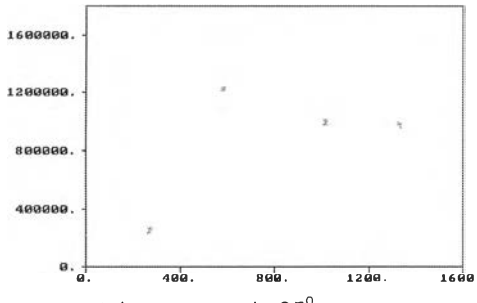
Calorific Value (kcal/kg)



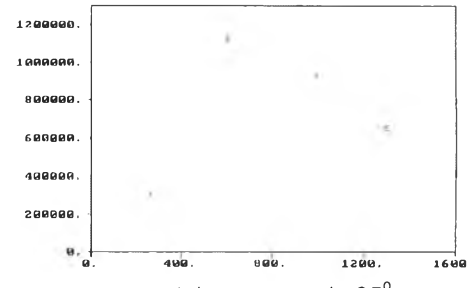
tolarence angle 5°



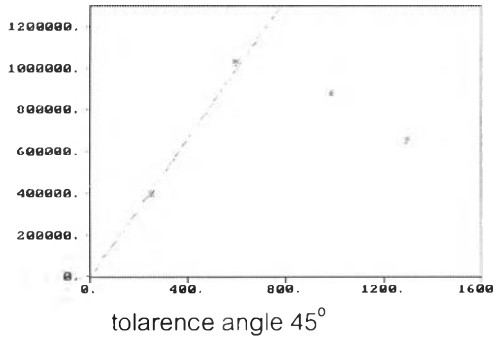
tolarence angle 15°



tolarence angle 25°



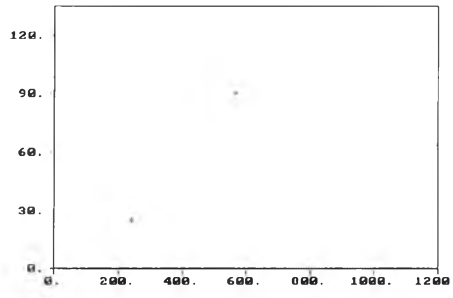
tolarence angle 35°



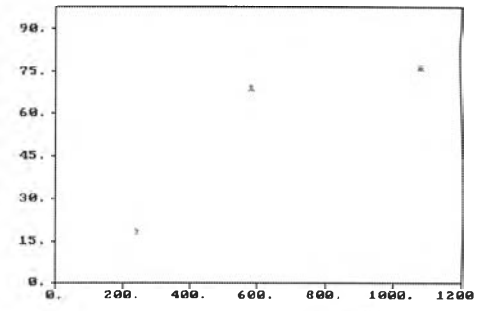
tolarence angle 45°

Linear model with nugget = 0, sill = 650000, R-major 390 m.

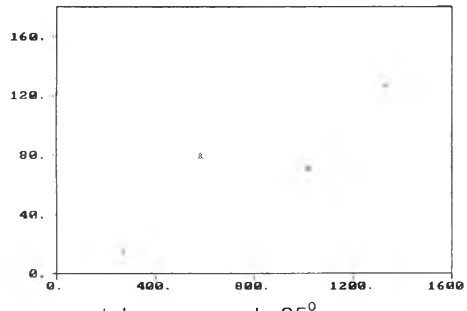
Moisture Content (%)



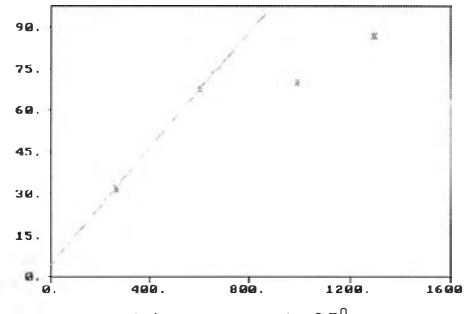
tolarence angle 5°



tolarence angle 15°



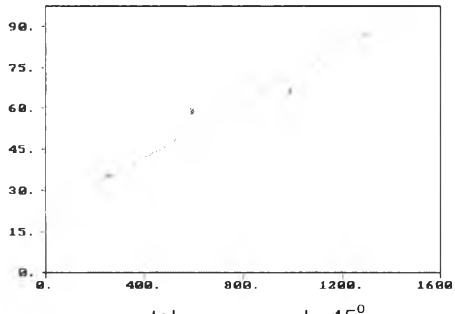
tolarence angle 25°



tolarence angle 35°

Linear model with nugget = 5, sill = 50,

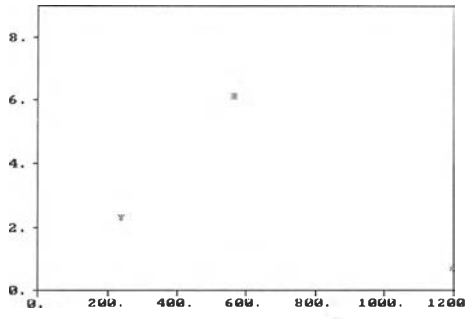
R-major 480 m.



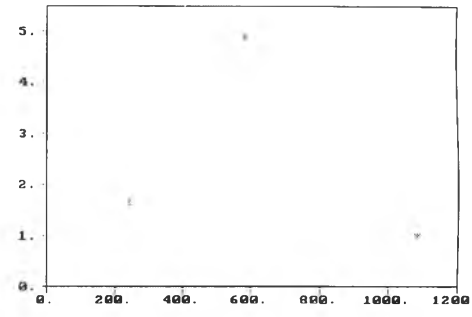
tolarence angle 45°

Linear model with nugget = 0, sill = 650000, R-major 390 m.

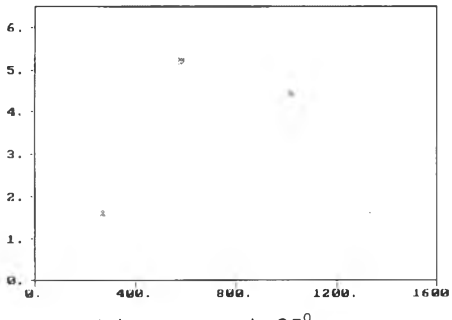
Sulphur Content (%)



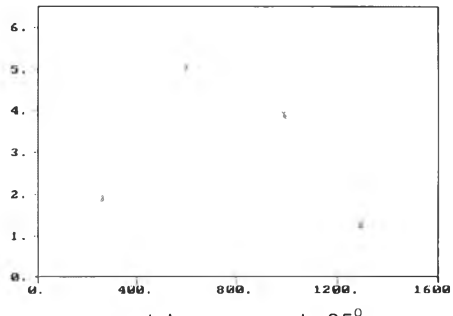
tolarence angle 5°



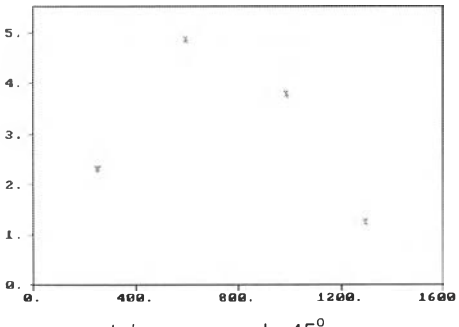
tolarence angle 15°



tolarence angle 25°

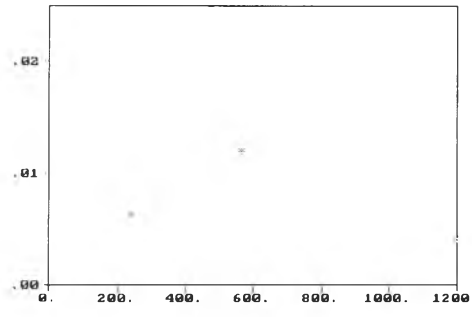


tolarence angle 35°

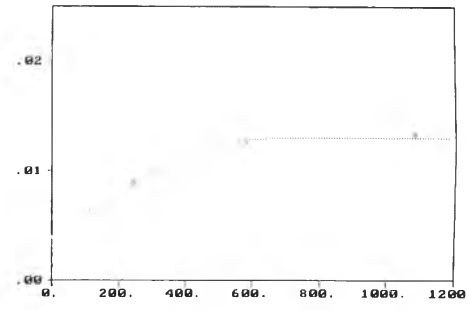


tolarence angle 45°

Density (g/cc)



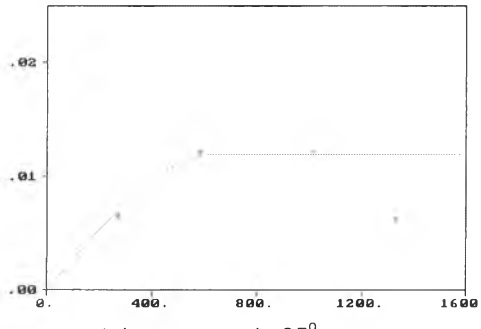
tolarence angle 5°



tolarence angle 15°

Spherical model with nugget = 0.004,

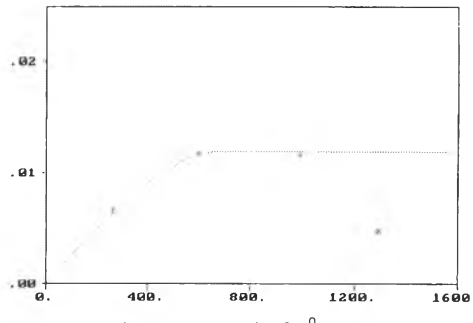
sill = 0.009, range = 650 m.



tolarence angle 25°

Spherical model with nugget = 0

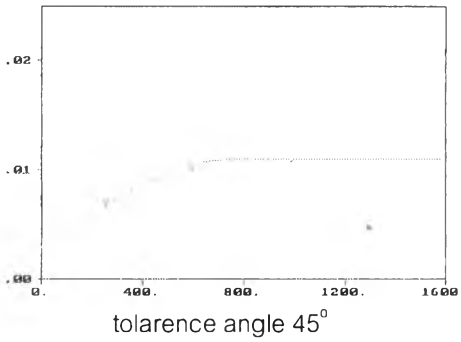
sill = 0.012, range = 650 m.



tolarence angle 35°

Spherical model with nugget = 0

sill = 0.012, range = 700 m.



tolarence angle 45°

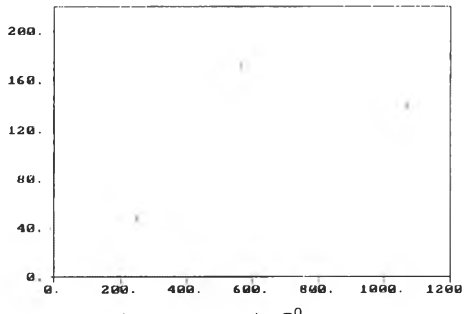
Spherical model with nugget = 0.003

sill = 0.008, range 750 m.

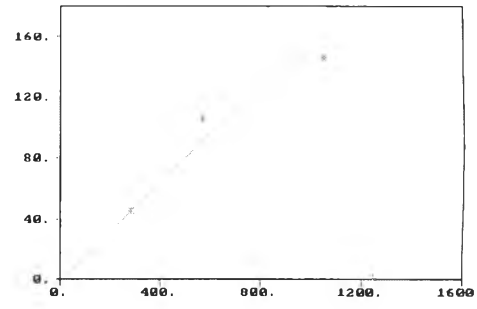
Testing tolerance angle P2 seam. Sin Pun area,

fixed direction 0^{o} , and lag spacing 400 m.

Ash Content (%),

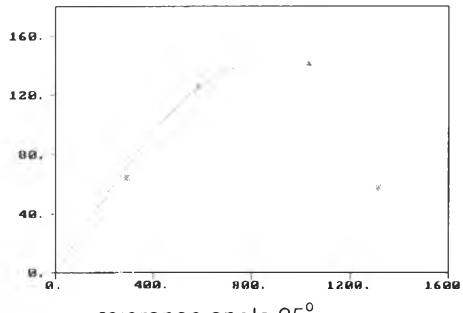


tolerance angle 5^{o}

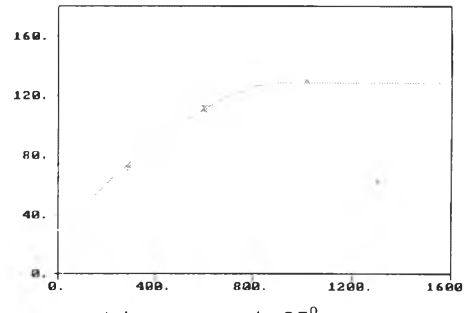


tolerance angle 15^{o}

Linear model with nugget 0, R-major = 500 m.



tolerance angle 25^{o}



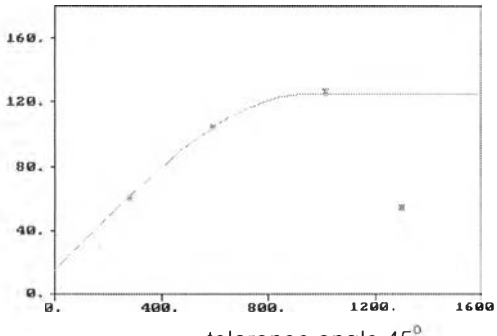
tolerance angle 35^{o}

Spherical model with nugget =, sill 140

range = 800 m.

Spherical model with nugget 30, sill = 99

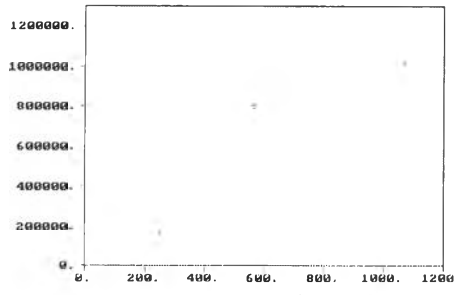
range = 950 m.



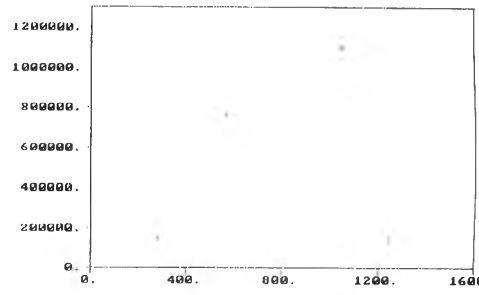
tolerance angle 45^{o}

Spherical model with nugget = 15, sill = 110, R-major 950 m.

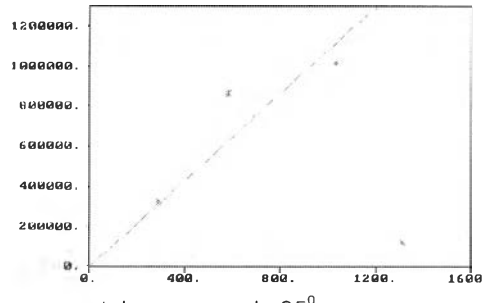
Calorific Value (kcal/kg)



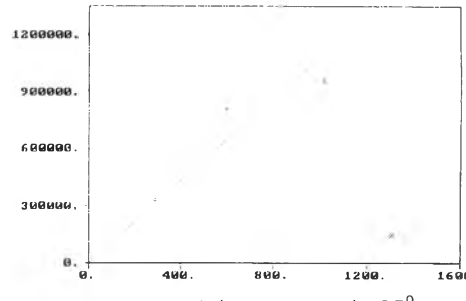
tolerance angle 5°



tolerance angle 15°



tolerance angle 25°



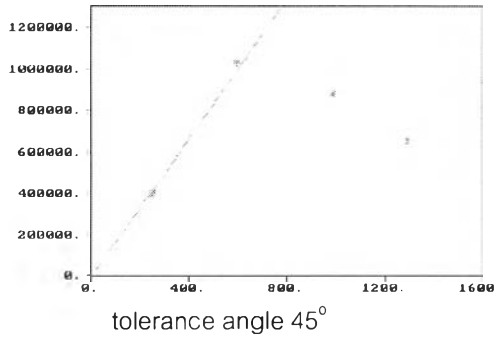
tolerance angle 35°

Linear model with nugget = 0

R-major = 500 m.

Linear model with nugget = 0

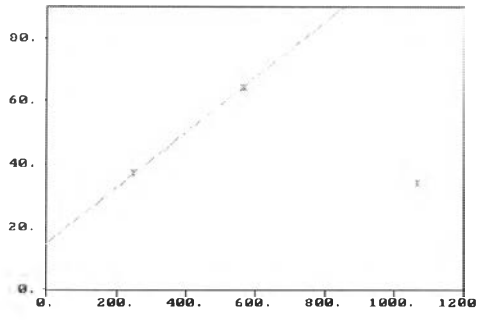
R-major = 500 m.



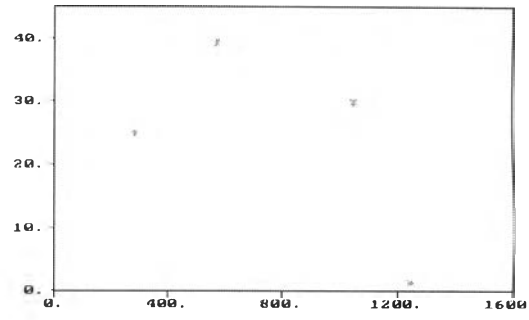
tolerance angle 45°

Linear model with nugget = 50000, R-major 450 m.

Moisture Content (%)



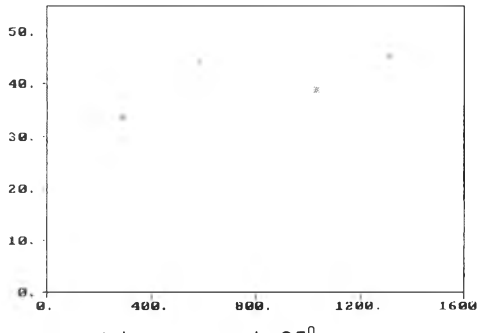
tolerance angle 5°



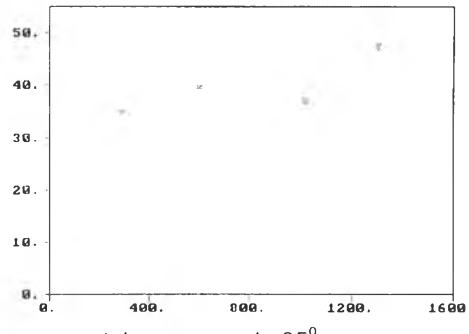
tolerance angle 15°

Linear model with nugget 15

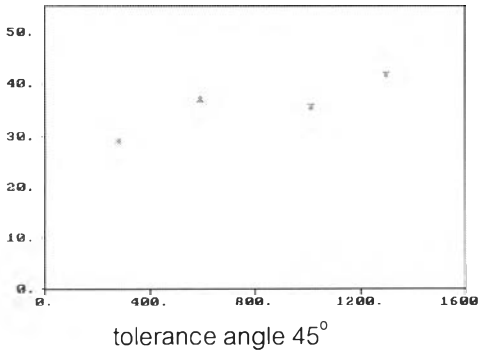
R-major = 570 m.



tolerance angle 25°

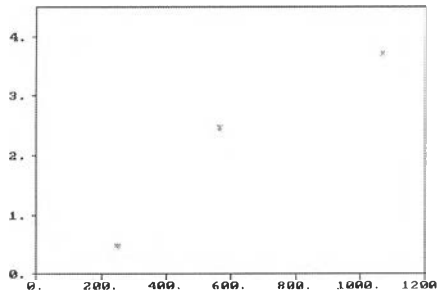


tolerance angle 35°

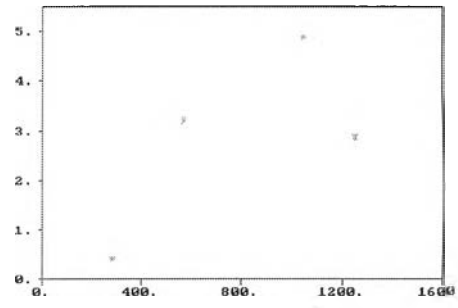


tolerance angle 45°

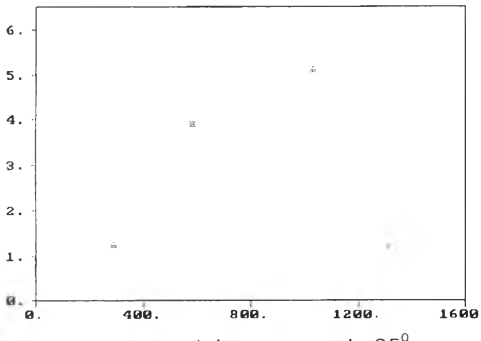
Sulphur Content (%)



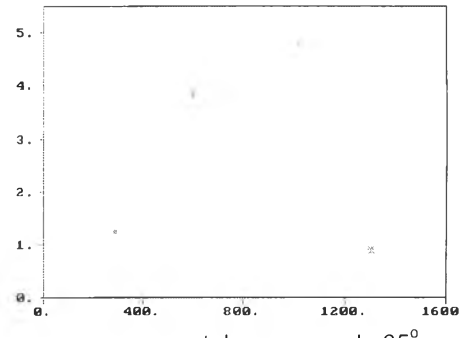
tolerance angle 5°



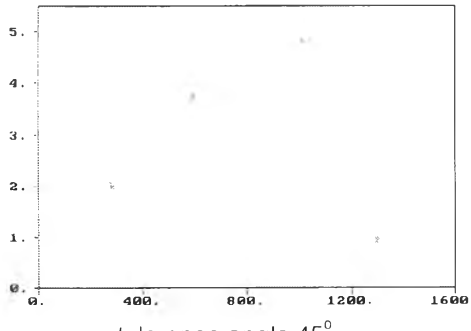
tolerance angle 15°



tolerance angle 25°

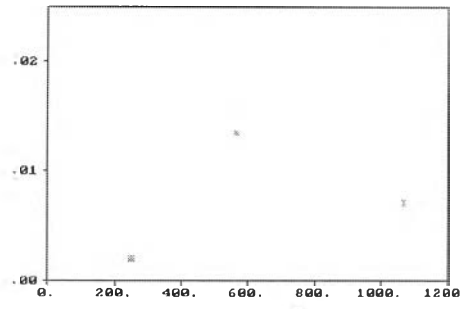


tolerance angle 35°

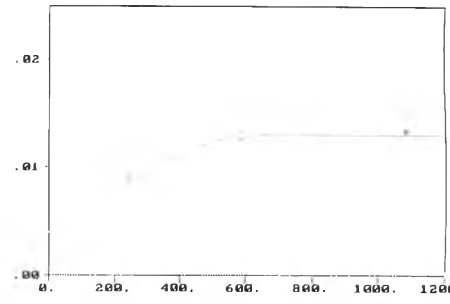


tolerance angle 45°

Density (g/cc)



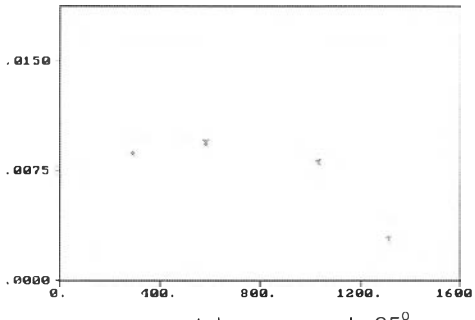
tolerance angle 5^{0}



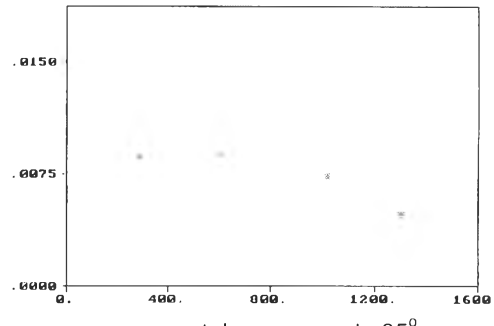
tolerance angle 15^{0}

Spherical model with nugget = 0.002,

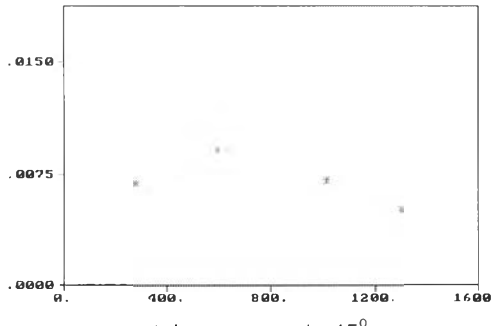
sill = 0.007, range = 550 m.



tolerance angle 25^{0}



tolerance angle 35^{0}

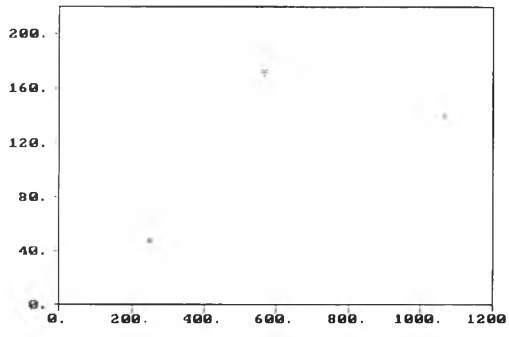


tolerance angle 45^{0}

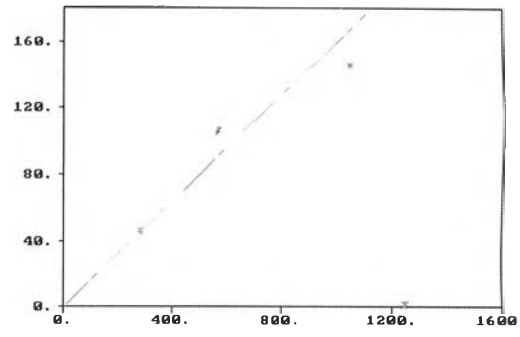
Testing tolerance angle. P3 seam. Sin Pun area,

fixed direction 0^{o} , and lag spacing 400 m.

Ash Content (%),

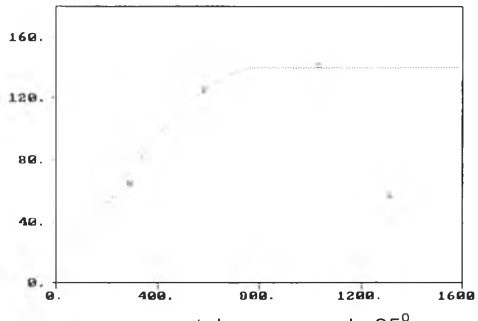


tolarence angle 5^{o}

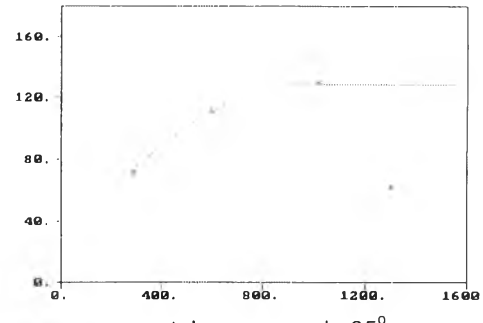


tolarence angle 15^{o}

Linear model with nugget 0, R-major = 500 m.



tolarence angle 25^{o}



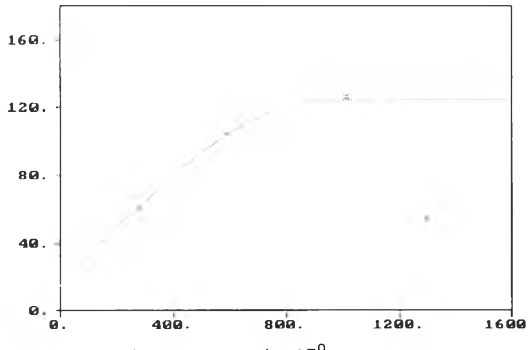
tolarence angle 35^{o}

Spherical model with nugget =, sill 140

range = 800 m.

Spherical model with nugget 30, sill = 99

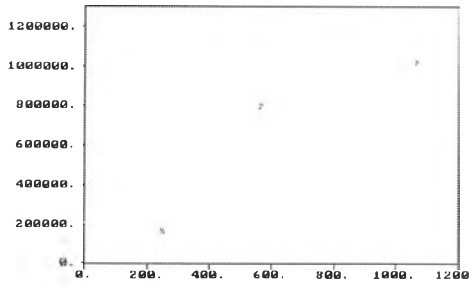
range = 950 m.



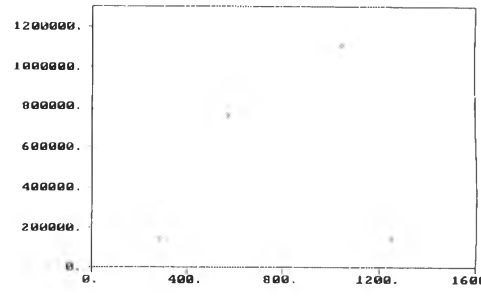
tolarence angle 45^{o}

Spherical model with nugget = 15, sill = 110, R-major 950 m.

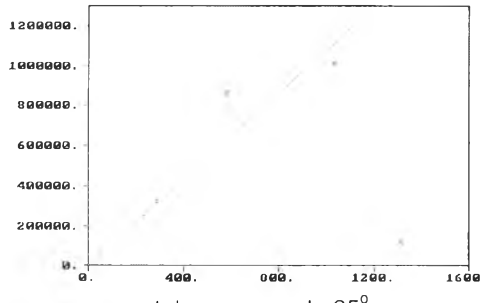
Calorific Value (kcal/kg)



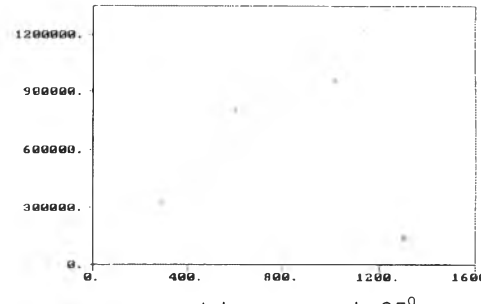
tolarence angle 5°



tolarence angle 15°



tolarence angle 25°



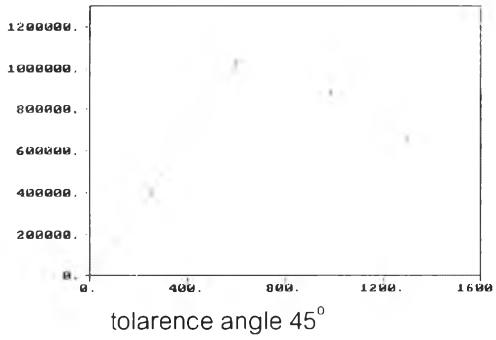
tolarence angle 35°

Linear model with nugget = 0,

R-major = 500 m.

Linear model with nugget = 0,

R-major = 500 m.

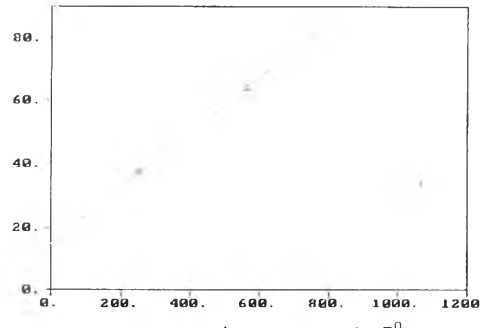


tolarence angle 45°

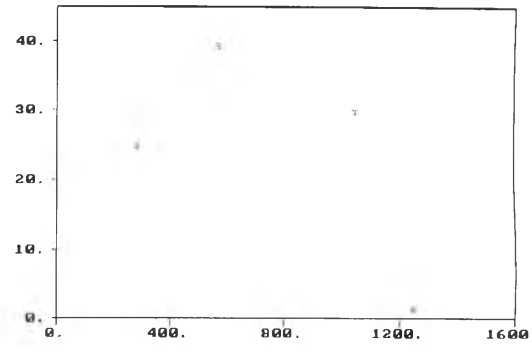
Linear model with nugget = 50000,

R-major 450 m.

Moisture Content (%)

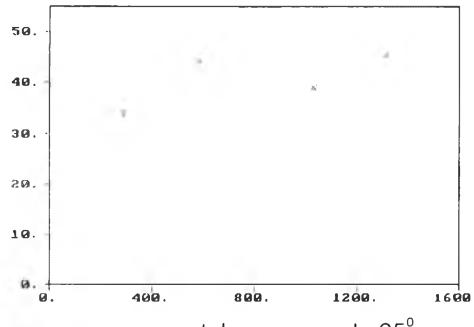


tolarence angle 5°

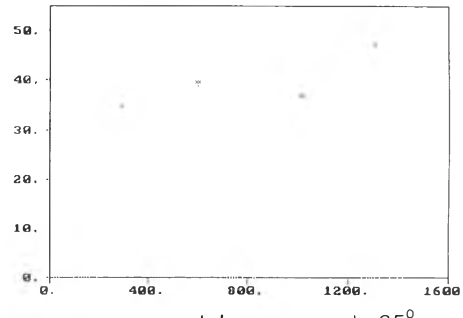


tolarence angle 15°

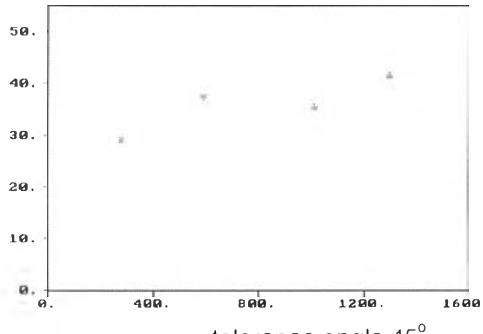
Linear model with nugget 15, R-major = 570 m.



tolarence angle 25°

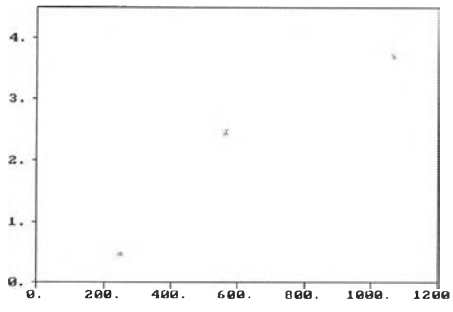


tolarence angle 35°

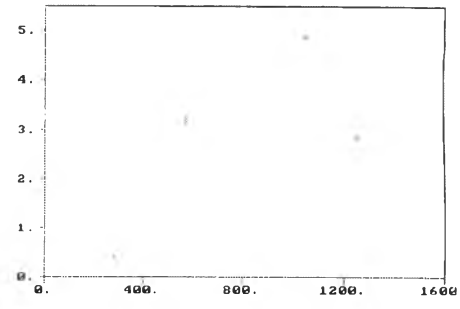


tolarence angle 45°

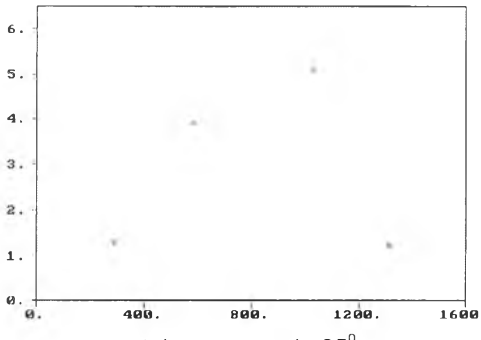
Sulphur Content (%)



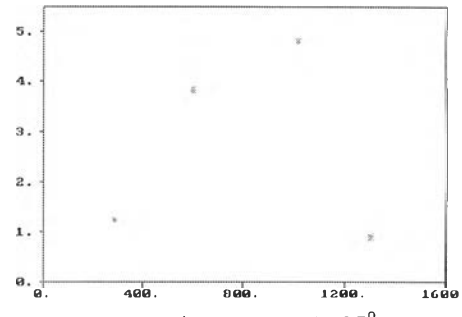
tolarence angle 5°



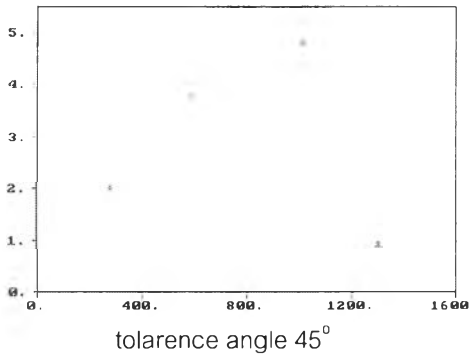
tolarence angle 15°



tolarence angle 25°

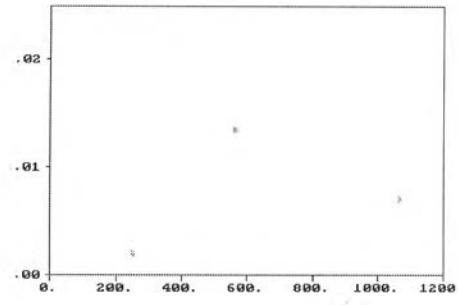


tolarence angle 35°

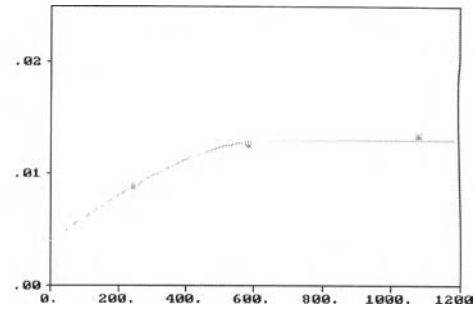


tolarence angle 45°

Density (g/cc)



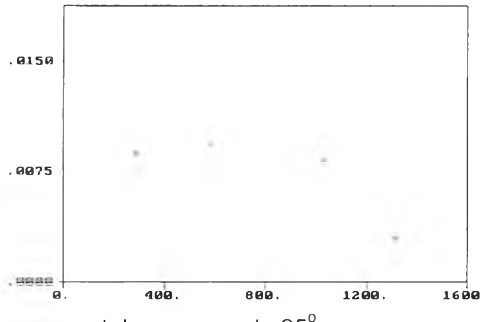
tolarence angle 5°



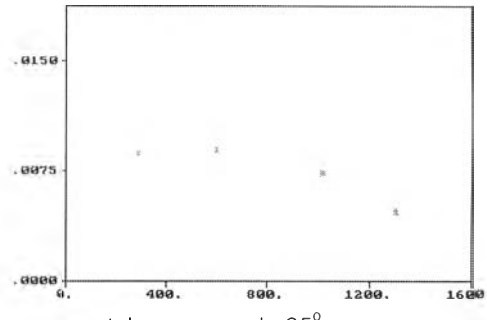
tolarence angle 15°

Spherical model with nugget = 0.002,

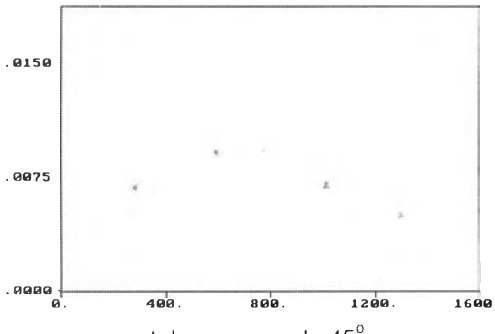
sill = 0.007, range = 550 m.



tolarence angle 25°



tolarence angle 35°

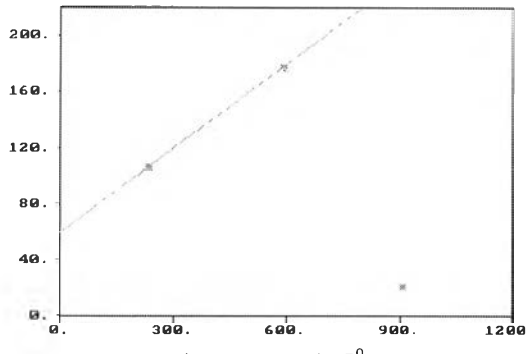


tolarence angle 45°

Testing tolerance angle P4 seam. Sin Pun area,

fixed direction 0^{o} , and lag spacing 400 m.

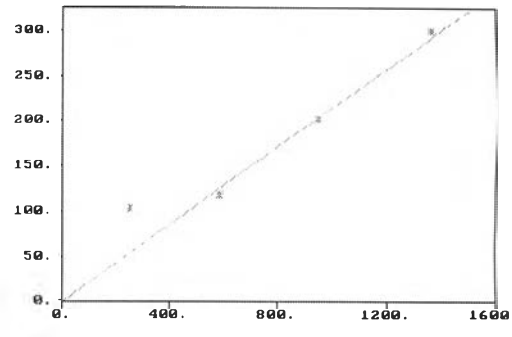
Ash Content (%),



tolerance angle 5^{o}

Linear model with nugget = 60,

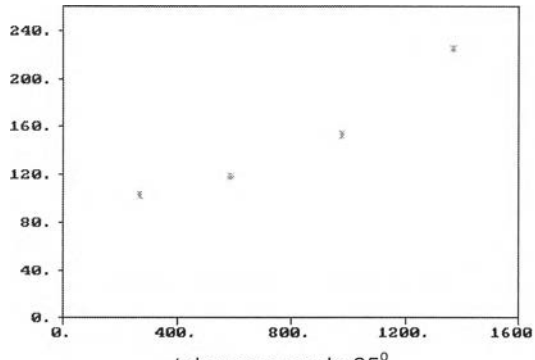
R-minor = 500 m.



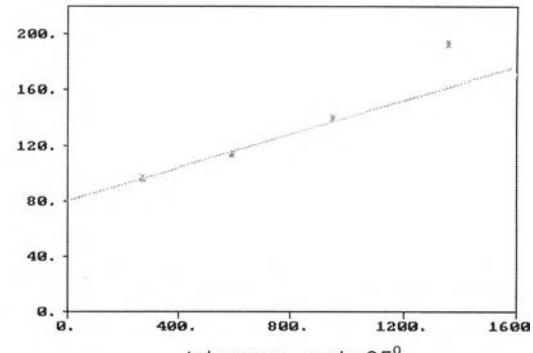
tolerance angle 15^{o}

Linear model with nugget 0,

R-minor = 560 m.



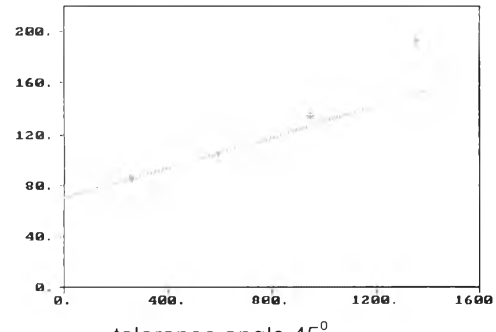
tolerance angle 25^{o}



tolerance angle 35^{o}

Linear model with nugget = 80

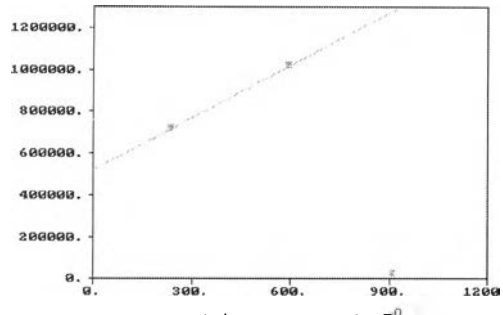
R-major = 500 m.



tolerance angle 45^{o}

Linear model with nugget = 70, R-major 500 m.

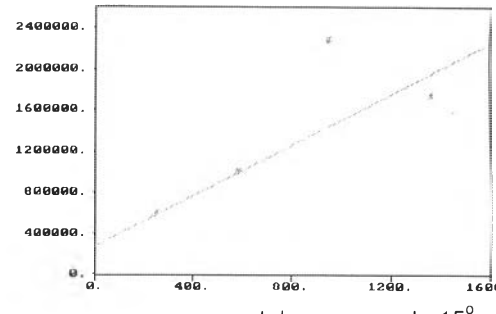
Calorific Value (kcal/kg)



tolerance angle 5^0

Linear model with nugget = 520000,

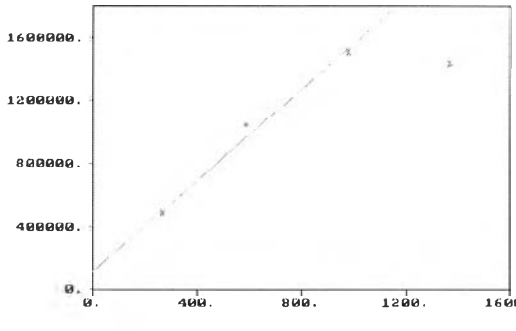
R-major = 480 m.



tolerance angle 15^o

Linear model with nugget = 280000,

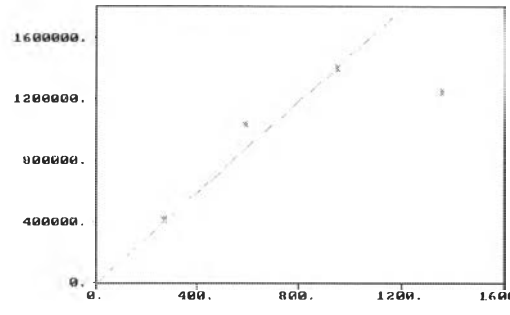
R-major = 450 m.



tolerance angle 25^o

Linear model with nugget = 120000,

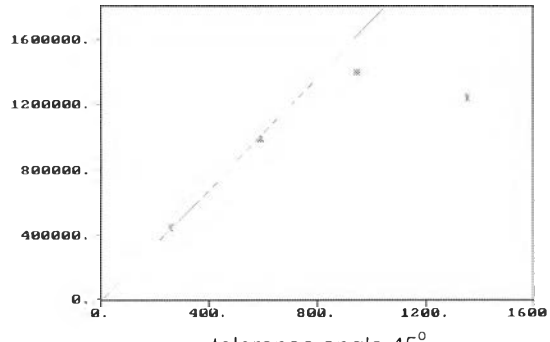
R-major =450 m.



tolerance angle 35^o

Linear model with nugget = 0,

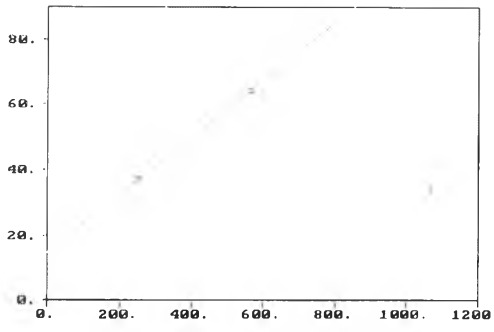
R-major = 540 m.



tolerance angle 45^o

Linear model with nugget = 0, R-major 480 m.

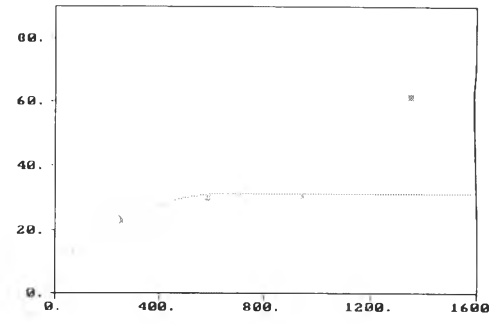
Moisture Content (%)



tolerance angle 5°

Linear model with nugget 10,

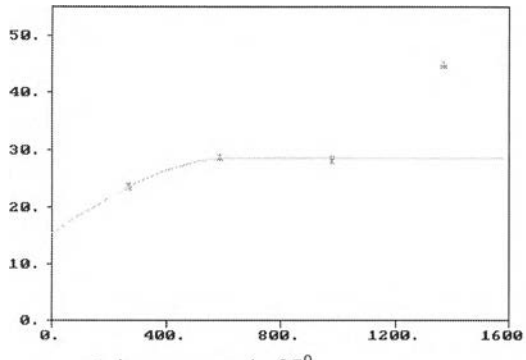
R-major = 480



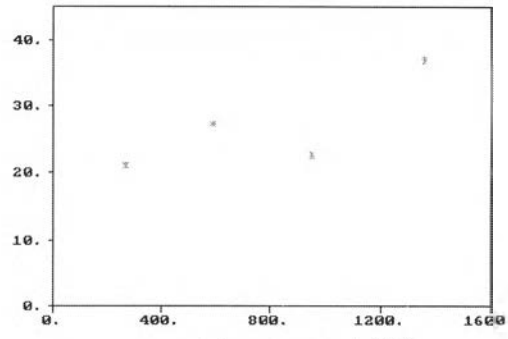
tolerance angle 15°

Spherical model with nugget 10,

sill = 21, range = 620



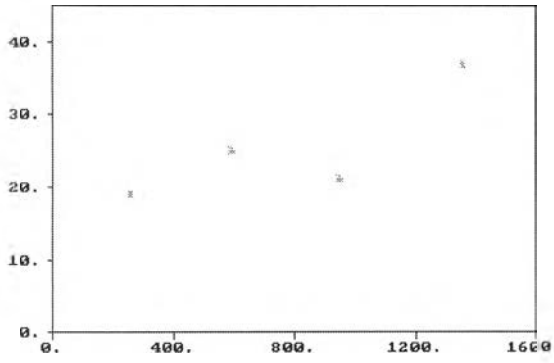
tolerance angle 25°



tolerance angle 35°

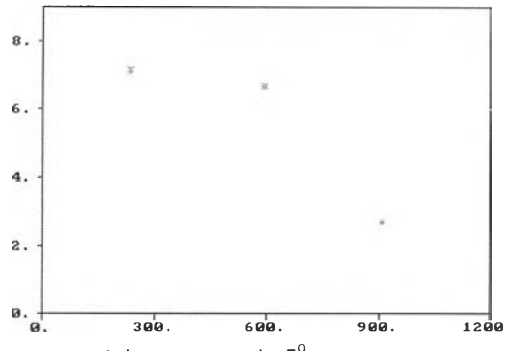
Spherical model with nugget 15.5,

sill = 13, range = 620 m.

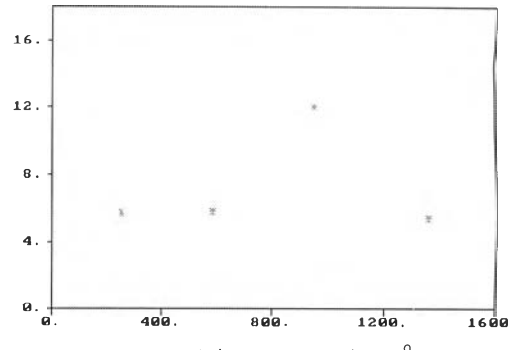


tolerance angle 45°

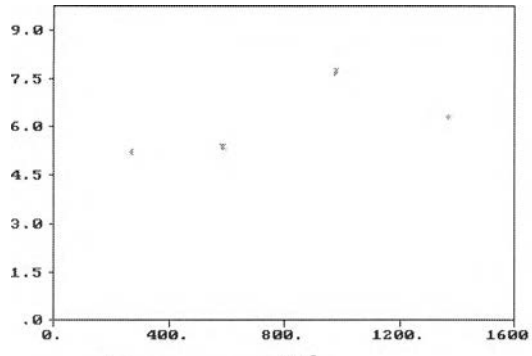
Sulphur Content (%)



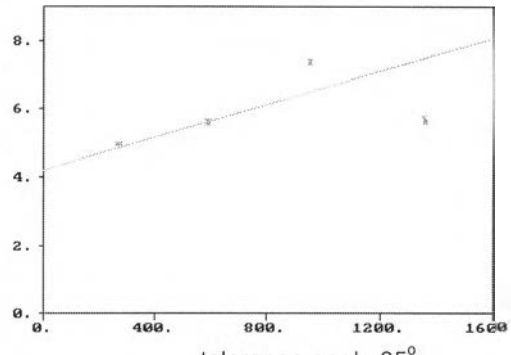
tolerance angle 5°



tolerance angle 15°



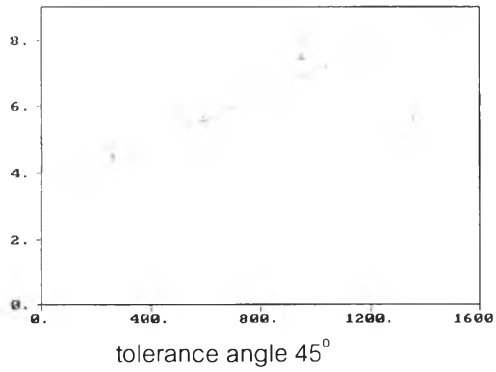
tolerance angle 25°



tolerance angle 35°

Linear model with nugget 4.2,

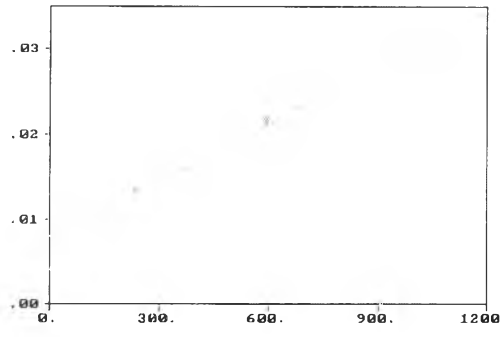
R-major = 620 m.



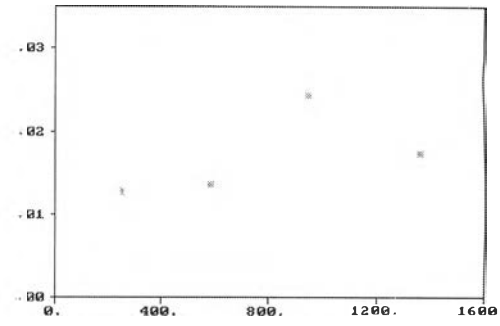
tolerance angle 45°

Linear model with nugget 3.5, R-major = 500 m.

Density (g/cc)



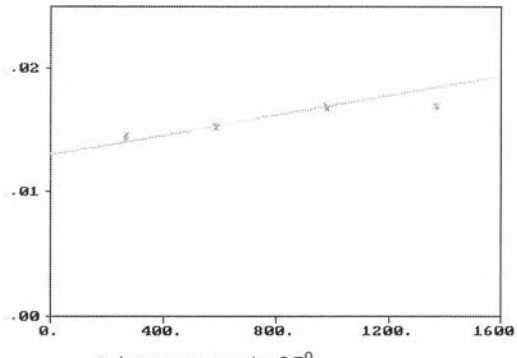
tolerance angle 5°



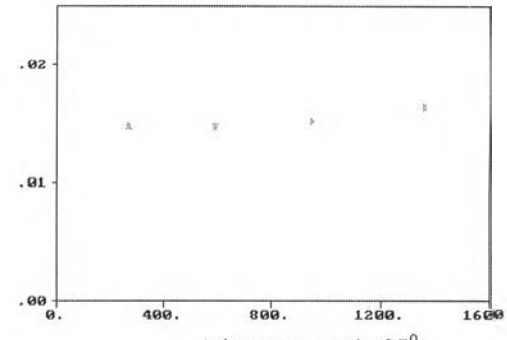
tolerance angle 15°

Linear model with nugget 0.008

R-major = 500 m.



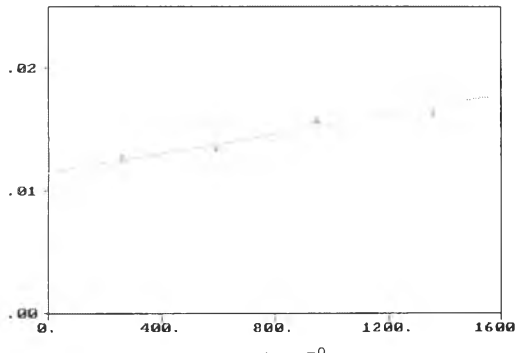
tolerance angle 25°



tolerance angle 35°

Linear model with nugget 0.013,

R-major = 500 m.



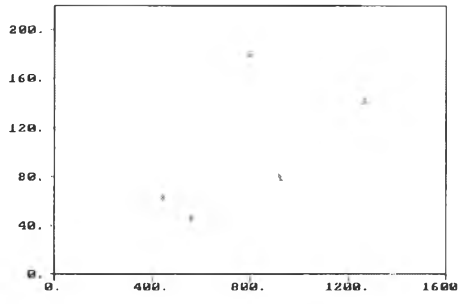
tolerance angle 45°

Linear model with nugget 0.0115, R-major = 500 m.

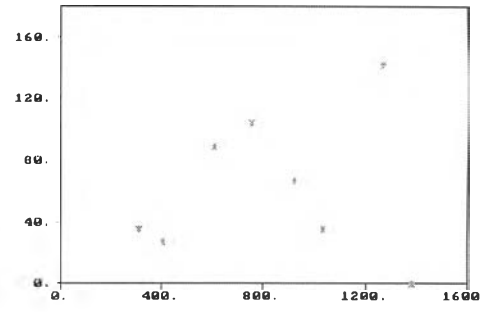
Testing tolerance angle M seam. Sin Pun area,

fixed direction 157.5° , and lag spacing 170 m.

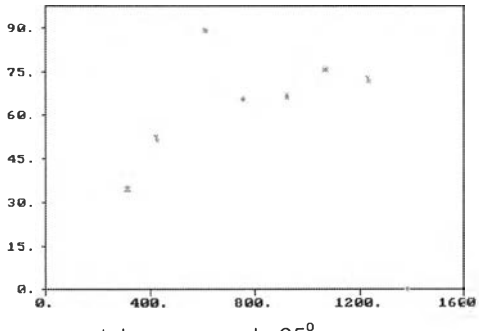
Ash Content (%)



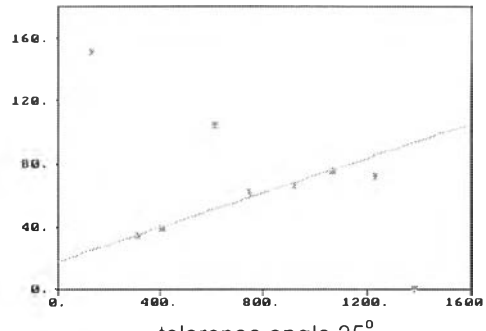
tolarence angle 5°



tolarence angle 15°



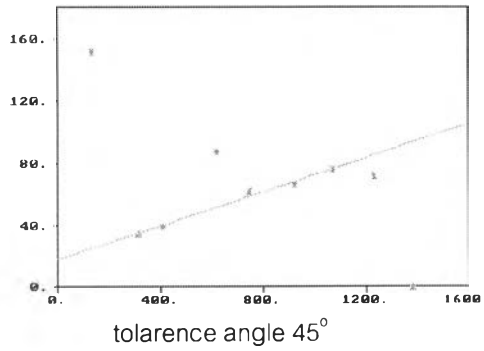
tolarence angle 25°



tolarence angle 35°

Linear model with nugget = 18,

R-major = 550 m.

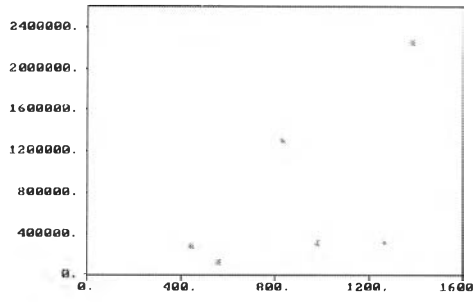


tolarence angle 45°

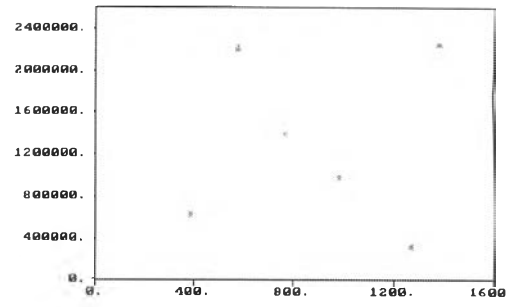
Linear model with nugget = 18, R-major = 550 m.

Calorific Value (kcal/kg)

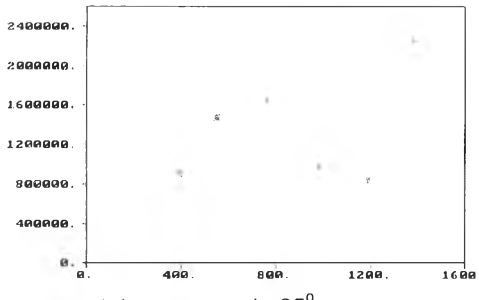
fixed direction 157.5° , and lag spacing 220 m.



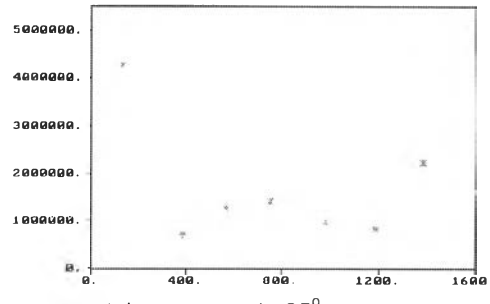
tolarence angle 5°



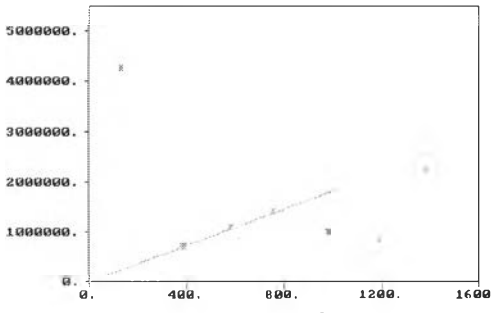
tolarence angle 15°



tolarence angle 25°



tolarence angle 35°

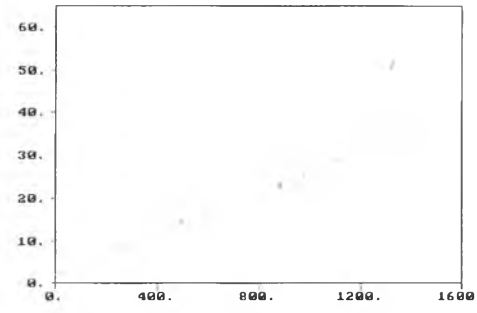


tolarence angle 45°

Linear model with nugget = 0, R-major = 400 m.

Moisture Content (%)

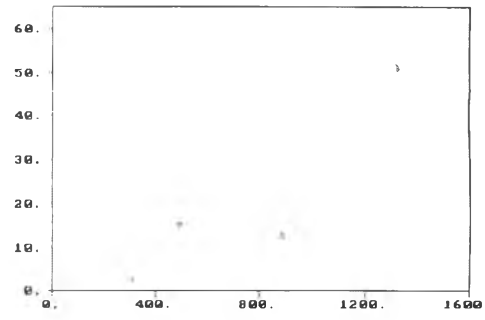
fixed direction 157.5° , and lag spacing 350 m.



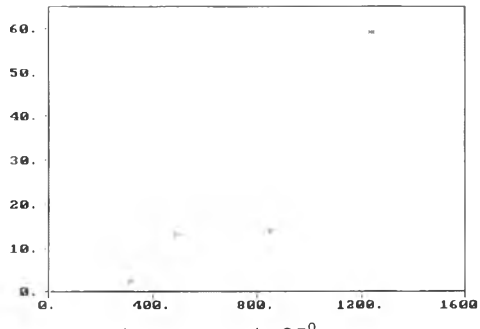
tolarence angle 5°

Linear model with nugget = 2,

R-major = 500 m.



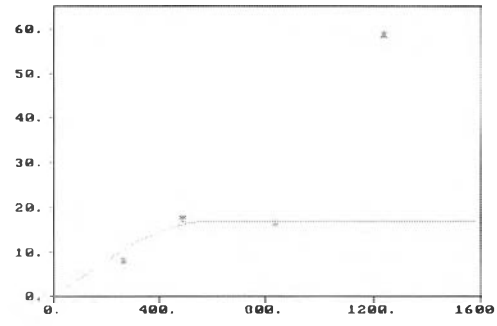
tolarence angle 15°



tolarence angle 25°

Spherical model with nugget = 0

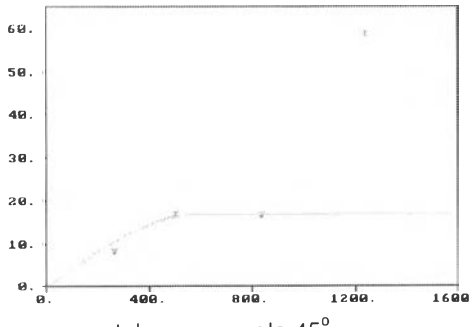
sill = 14 , range = 650 m.



tolarence angle 35°

Spherical model with nugget = 0, sill = 17

R-major 600 m.

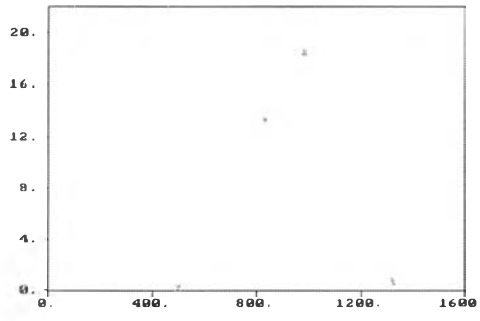


tolarence angle 45°

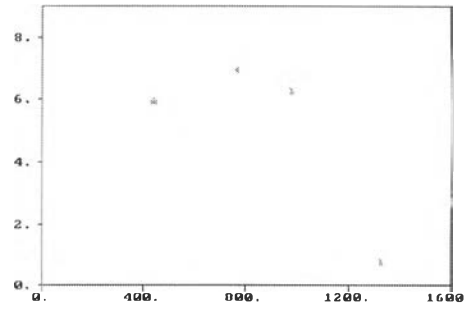
Spherical model with nugget = 0, sill = 17, R-major 600 m.

Sulphur Content (%)

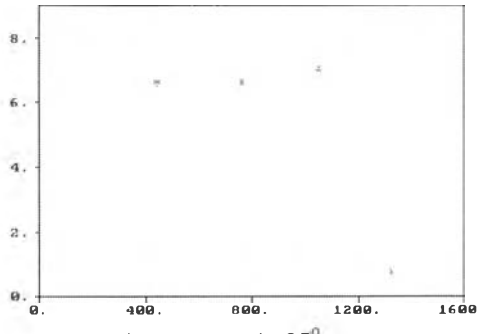
fixed direction 157.5° , and lag spacing 300 m.



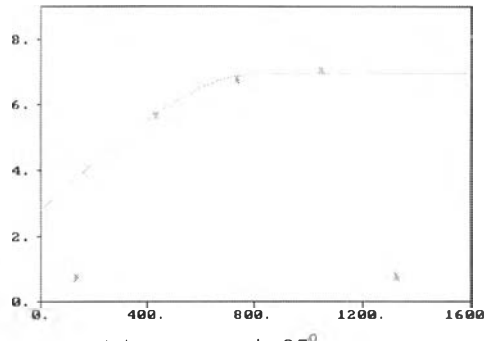
tolarence angle 5°



tolarence angle 15°



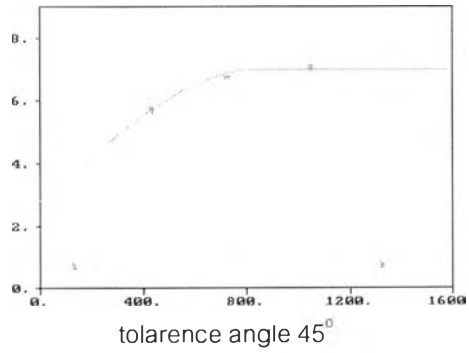
tolarence angle 25°



tolarence angle 35°

Spherical model with nugget = 2.8,

sill = 4.2, range = 850 m.

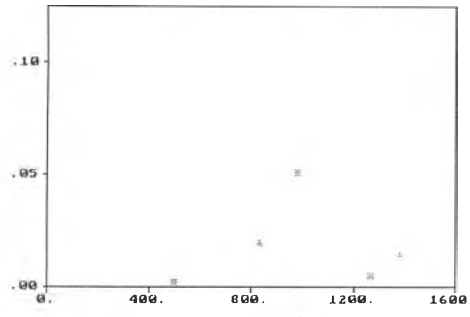


tolarence angle 45°

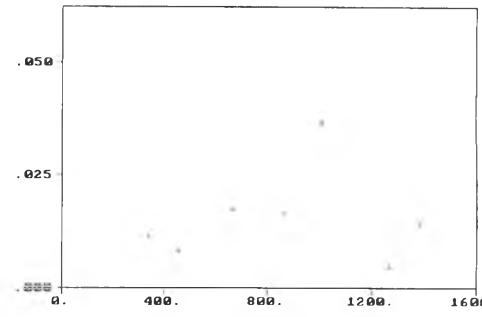
Spherical model with nugget = 2.8, sill = 4.2, range = 850 m.

Density (g/cc)

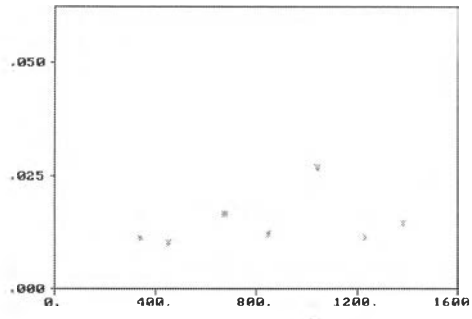
fixed direction 157.5^{0} , and lag spacing 190 m.



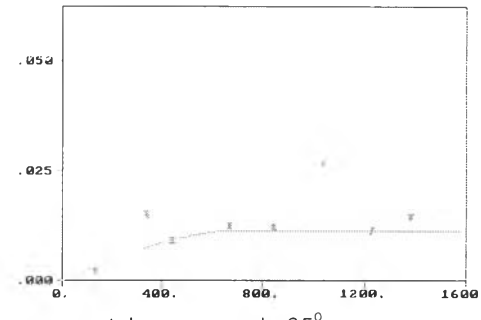
tolarence angle 5^{0}



tolarence angle 15^{0}



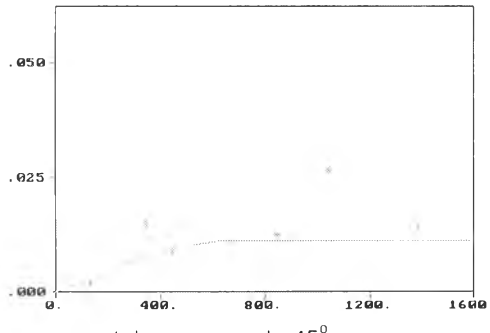
tolarence angle 25^{0}



tolarence angle 35^{0}

Spherical model with nugget = 0,

sill = 0.0115, range = 700 m.



tolarence angle 45^{0}

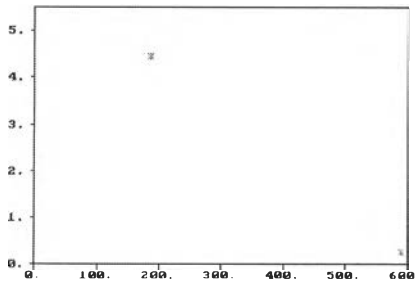
Spherical model with nugget = 0, sill = 0.0115,

range = 700 m.

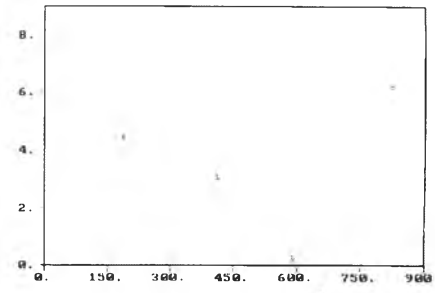
Testing tolerance angle S1 seam. Saba Yoi area,

fixed direction 90° , and lag spacing 240 m.

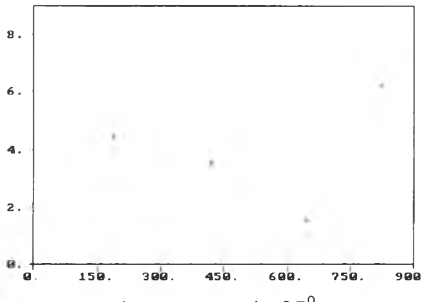
Ash Content (%)



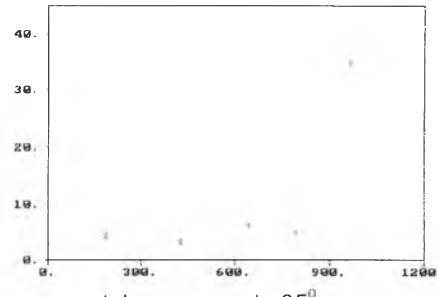
tolarence angle 5°



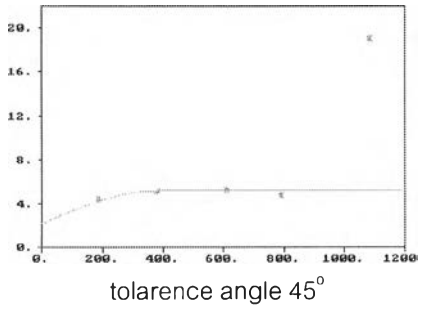
tolarence angle 15°



tolarence angle 25°



tolarence angle 35°

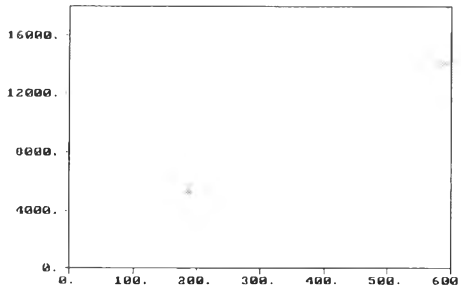


tolarence angle 45°

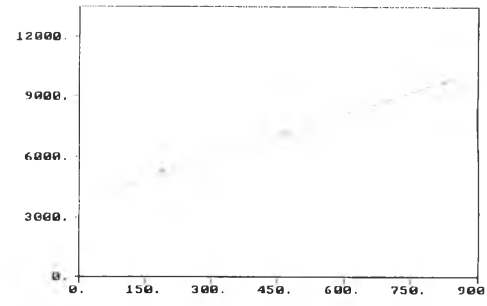
Spherical model with nugget = 2.2, sill = 3, range = 380 m.

Calorific Value (kcal/kg)

fixed direction 90° , and lag spacing 300 m.

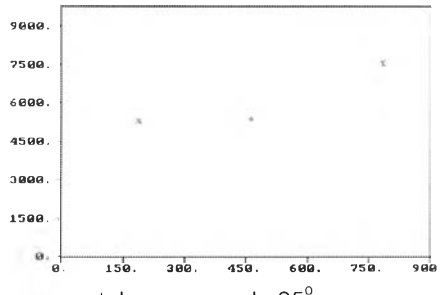


tolarence angle 5°

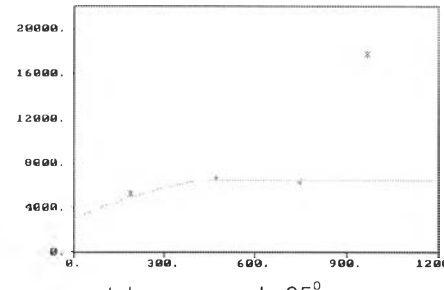


tolarence angle 15°

Linear model with nugget = 3700, sill = 4400, range = 600 m.

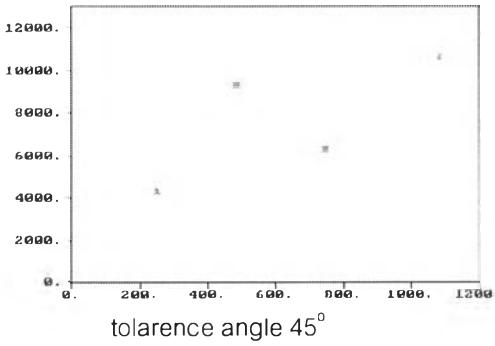


tolarence angle 25°



tolarence angle 35°

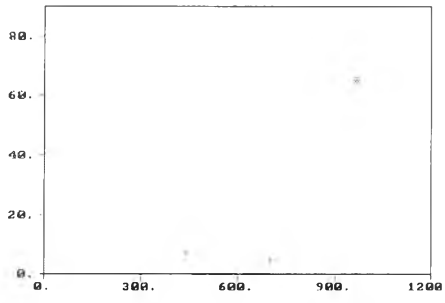
Spherical model with nugget = 3100, sill = 4400, range = 500 m.



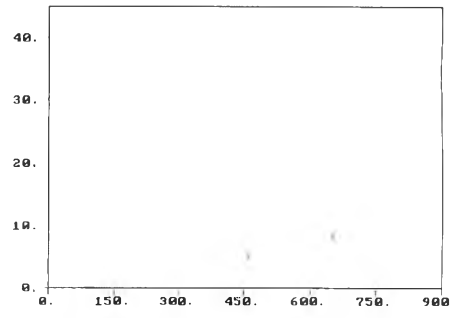
tolarence angle 45°

Moisture Content (%)

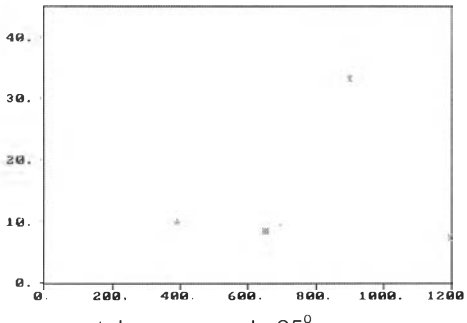
fixed direction 112.5^{o} , and lag spacing 260 m.



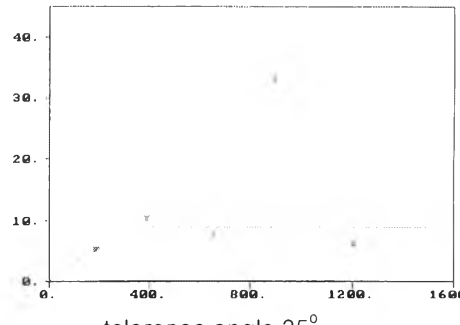
tolarence angle 5^{o}



tolarence angle 15^{o}



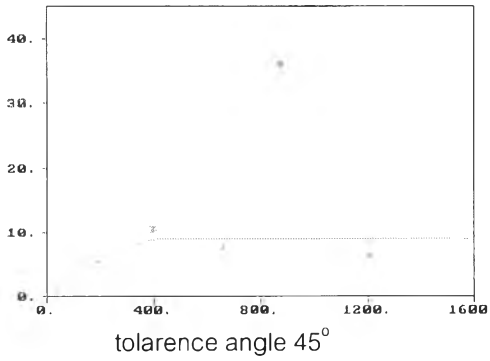
tolarence angle 25^{o}



tolarence angle 35^{o}

Spherical model with nugget = 0, sill = 9,

R-major 450 m.

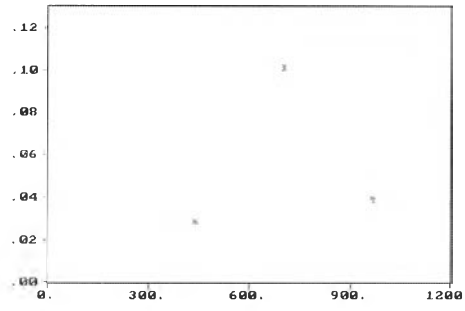


tolarence angle 45^{o}

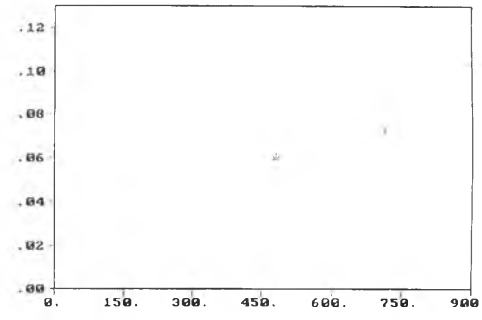
Spherical model with nugget = 0, sill = 9, R-major 450 m.

Sulphur Content (%)

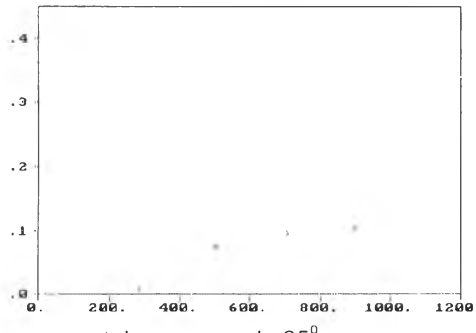
fixed direction 112.5^{o} , and lag spacing 200 m.



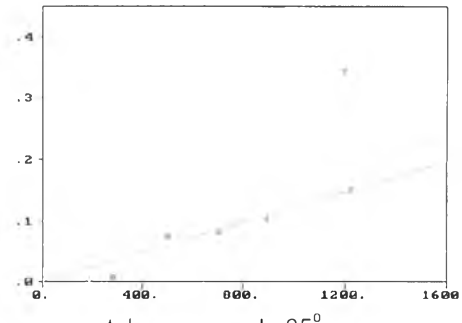
tolarence angle 5^{o}



tolarence angle 15^{o}



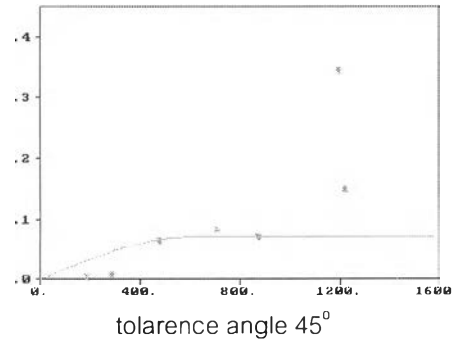
tolarence angle 25^{o}



tolarence angle 35^{o}

Linear model with nugget = 0,

R-major = 450 m.

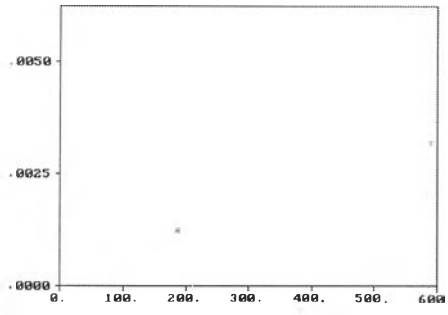


tolarence angle 45^{o}

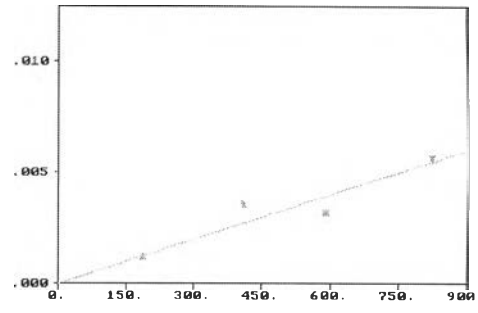
Spherical model with nugget = 0, sill = 0.07, range = 600 m.

Density (g/cc)

fixed direction 90° , and lag spacing 260 m.



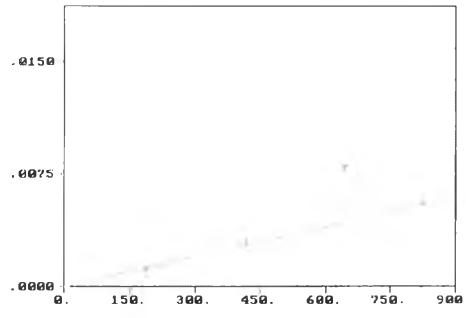
tolarence angle 5°



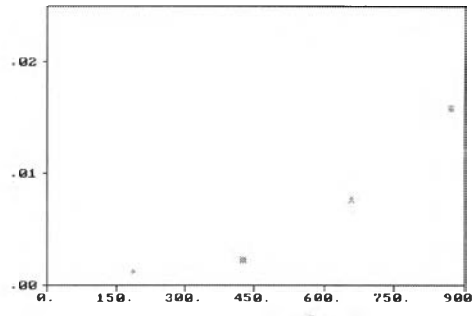
tolarence angle 15°

Linear model with nugget = 0,

R-major = 1050 m.



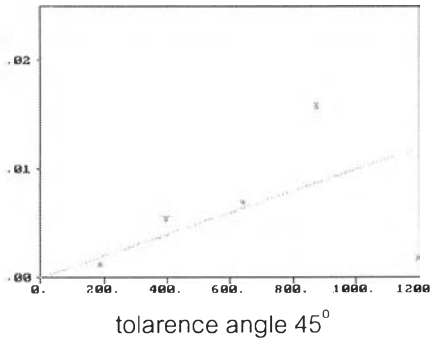
tolarence angle 25°



tolarence angle 35°

Linear model with nugget = 0

R-major = 1050 m.



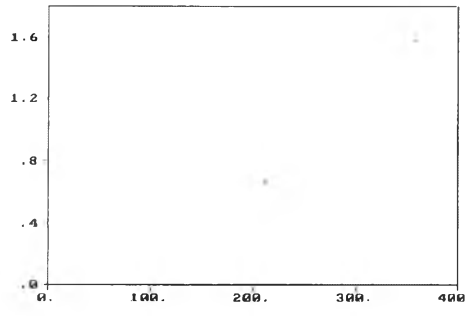
tolarence angle 45°

Linear model with nugget = 0, R-major = 700 m.

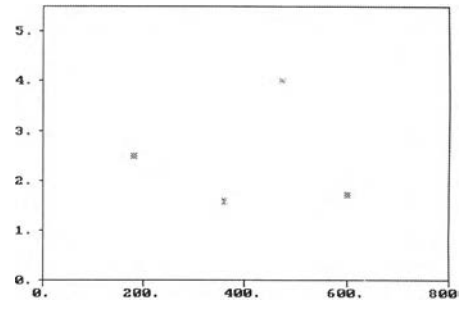
Testing tolerance angle S2 seam. Saba Yoi area,

fixed direction 67.5° , and lag spacing 130 m.

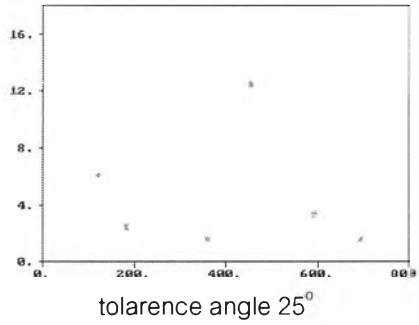
Ash Content (%)



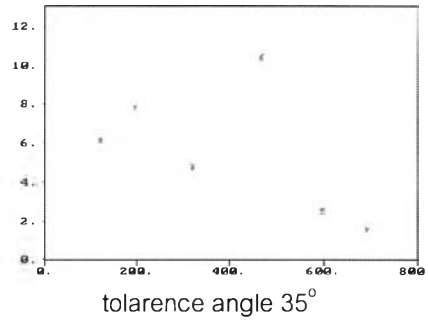
tolarence angle 5°



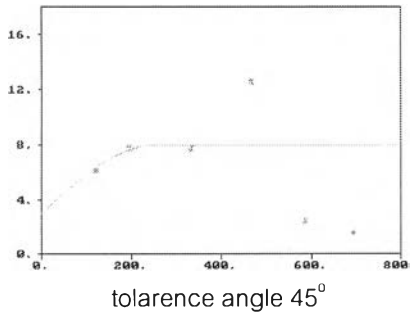
tolarence angle 15°



tolarence angle 25°



tolarence angle 35°

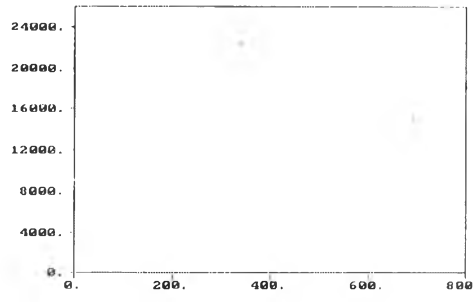


tolarence angle 45°

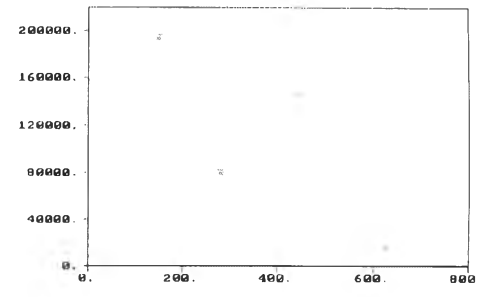
Spherical model with nugget = 3, sill = 5, range = 250 m.

Calorific Value (kcal/kg)

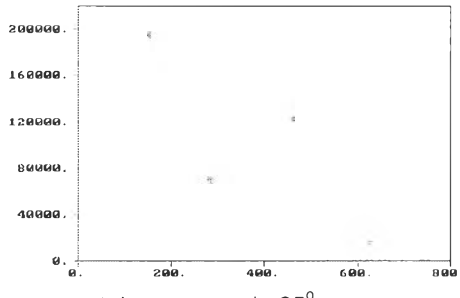
fixed direction 45° , and lag spacing 180 m.



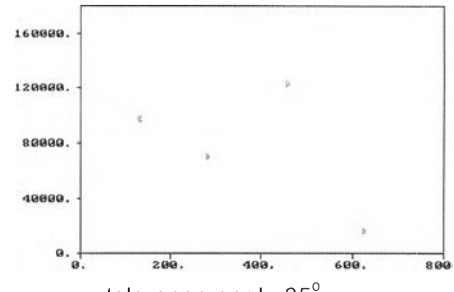
tolarence angle 5°



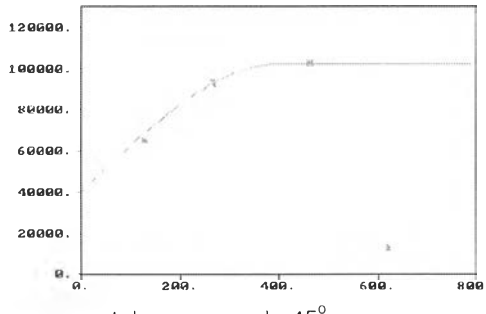
tolarence angle 15°



tolarence angle 25°



tolarence angle 35°



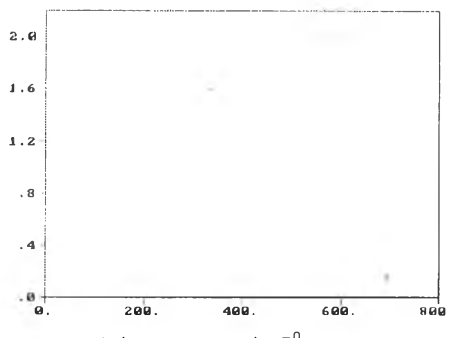
tolarence angle 45°

Spherical model with nugget = 40000, sill = 62000,

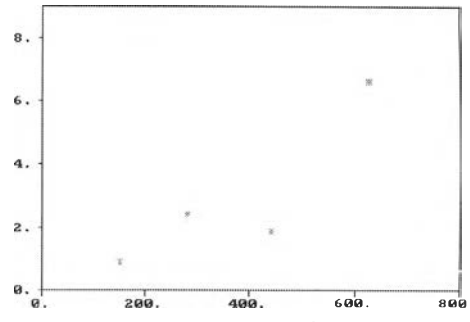
range = 400 m.

Moisture Content (%)

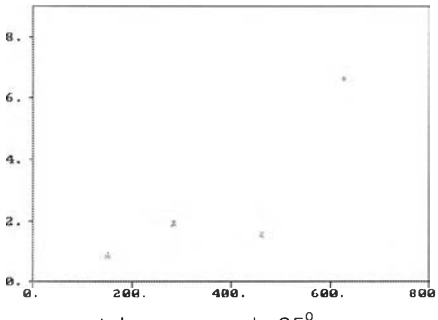
fixed direction 45° , and lag spacing 180 m.



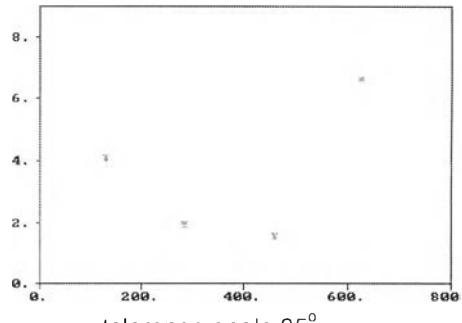
tolarence angle 5°



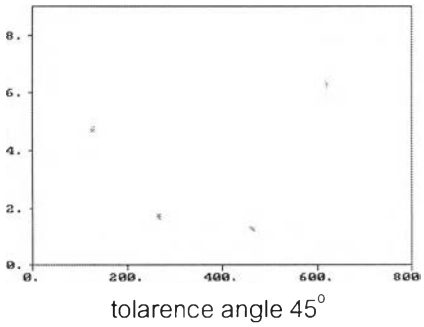
tolarence angle 15°



tolarence angle 25°



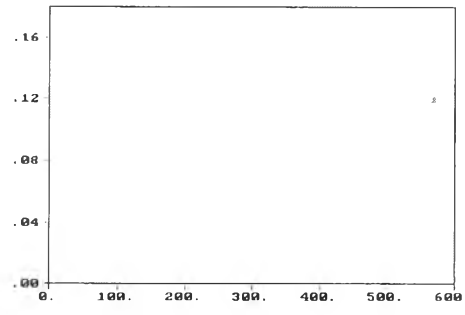
tolarence angle 35°



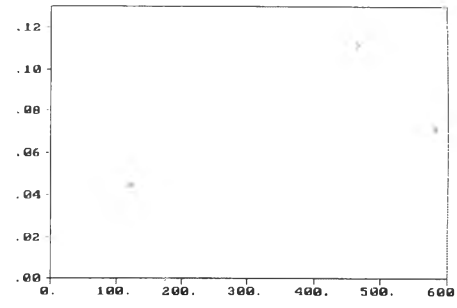
tolarence angle 45°

Sulphur Content (%)

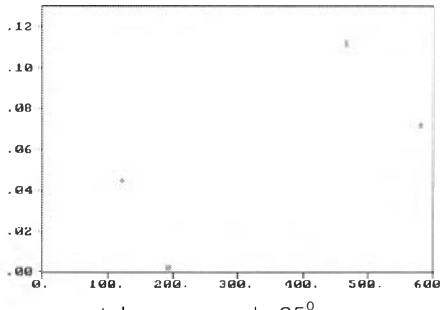
fixed direction 90^{0} , and lag spacing 160 m.



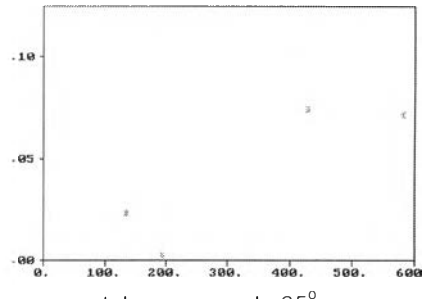
tolarence angle 5^{0}



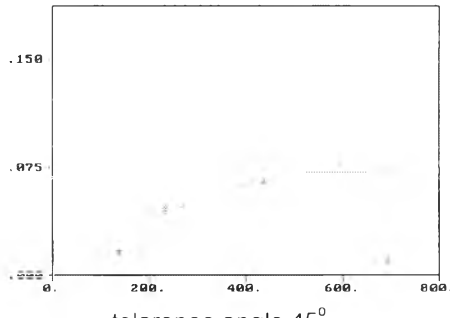
tolarence angle 15^{0}



tolarence angle 25^{0}



tolarence angle 35^{0}

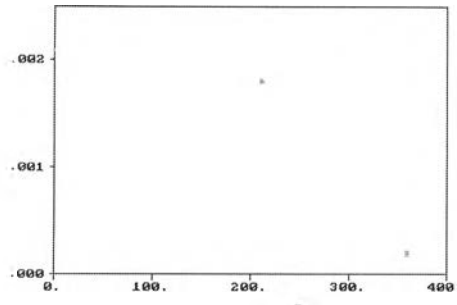


tolarence angle 45^{0}

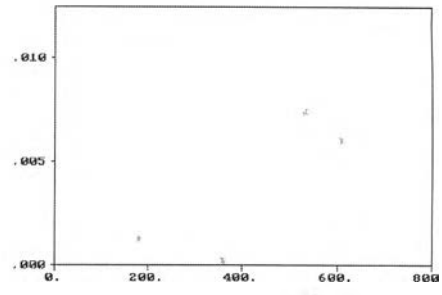
Spherical model with nugget = 0, sill = 0.072, range = 550 m.

Density (g/cc)

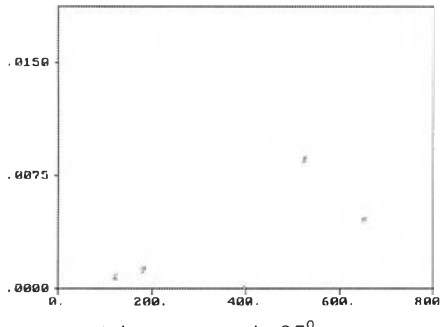
fixed direction 67.5^{0} , and lag spacing 150 m.



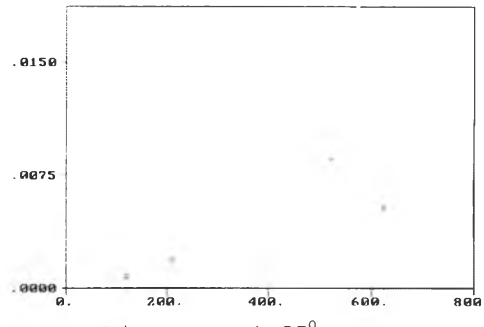
tolarence angle 5^{0}



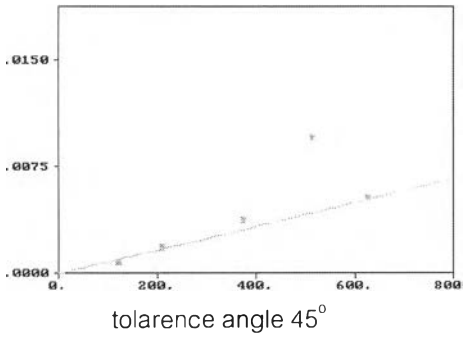
tolarence angle 15^{0}



tolarence angle 25^{0}



tolarence angle 35^{0}

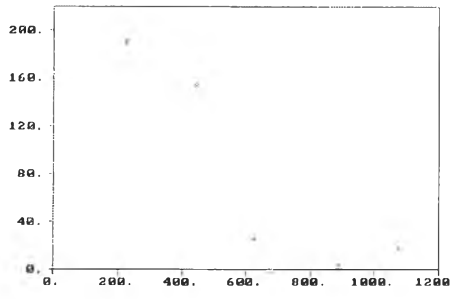


tolarence angle 45^{0}

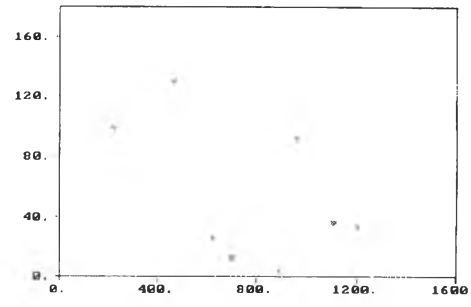
Testing tolerance angle S3 seam, Saba Yoi area,

fixed direction 67.5^{o} , and lag spacing 130 m.

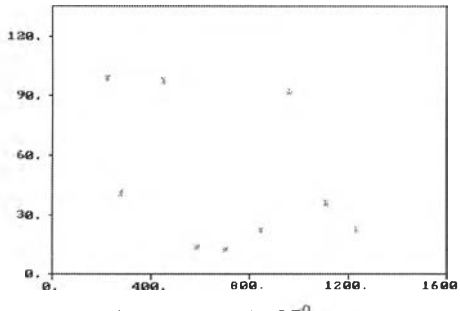
Ash Content (%)



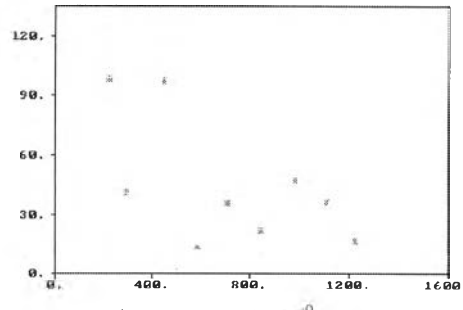
tolarence angle 5^{o}



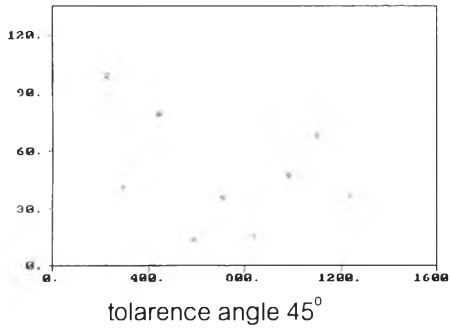
tolarence angle 15^{o}



tolarence angle 25^{o}



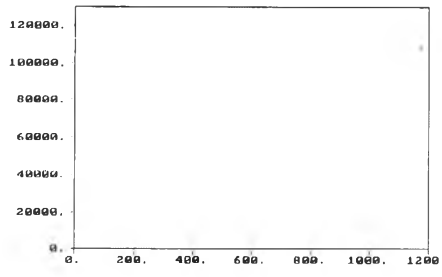
tolarence angle 35^{o}



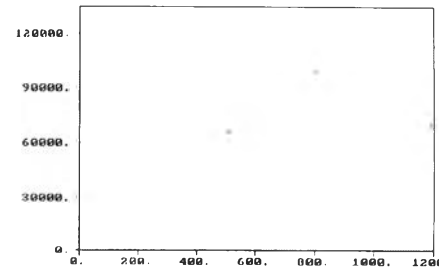
tolarence angle 45^{o}

Calorific Value (kcal/kg)

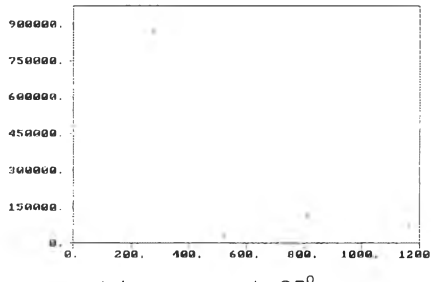
fixed direction 112.5° , and lag spacing 330 m.



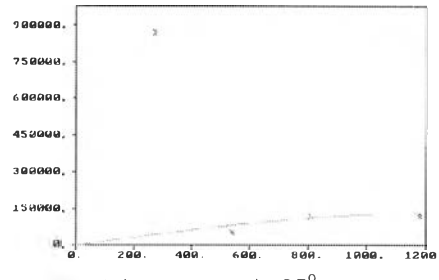
tolarence angle 5°



tolarence angle 15°



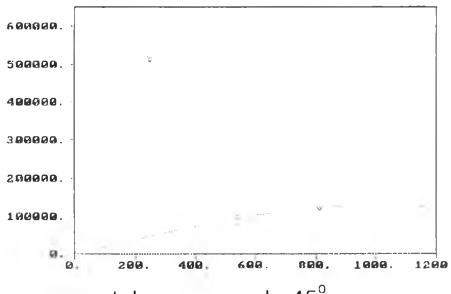
tolarence angle 25°



tolarence angle 35°

Spherical model with nugget = 0,

sill = 130000, range = 1200 m.



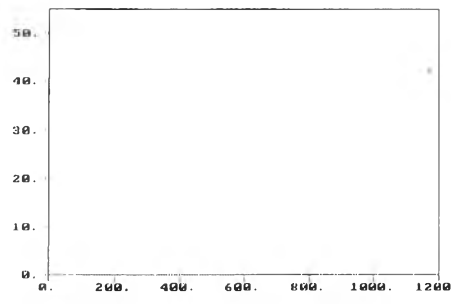
tolarence angle 45°

Spherical model with nugget = 0, sill = 130000,

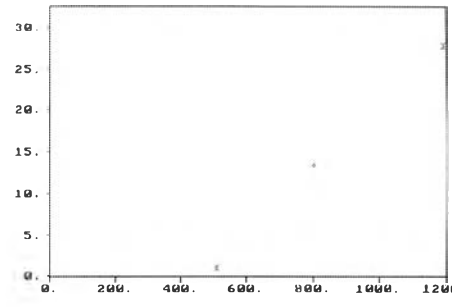
range = 1000 m.

Moisture Content (%)

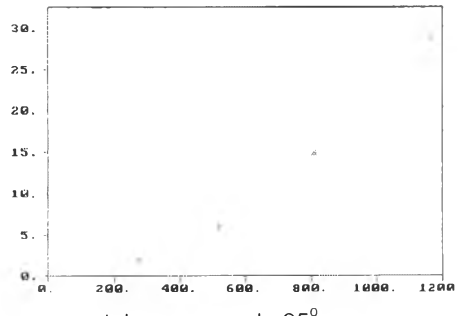
fixed direction 112.5° , and lag spacing 330 m.



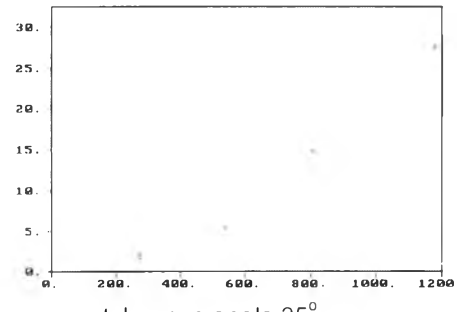
tolarence angle 5°



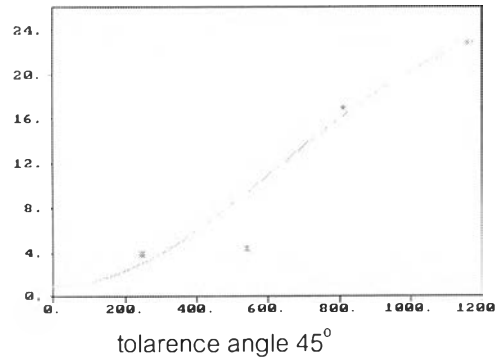
tolarence angle 15°



tolarence angle 25°



tolarence angle 35°



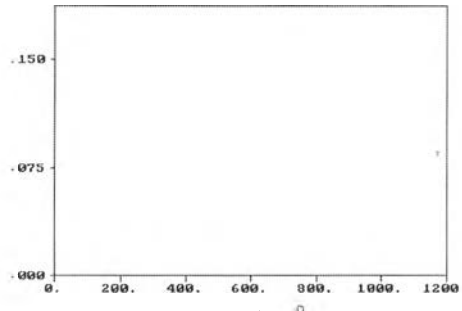
tolarence angle 45°

Gaussian model with nugget = 1, sill = 26

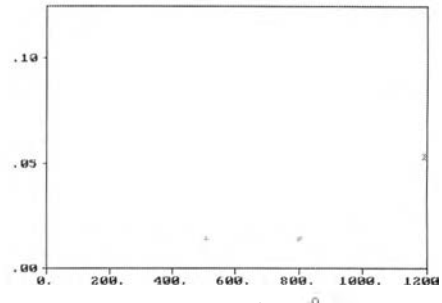
range = 1500 m.

Sulphur Content (%)

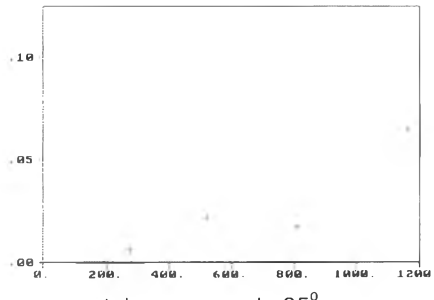
fixed direction 112.5° , and lag spacing 330 m.



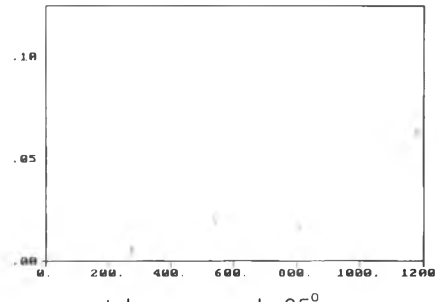
tolarence angle 5°



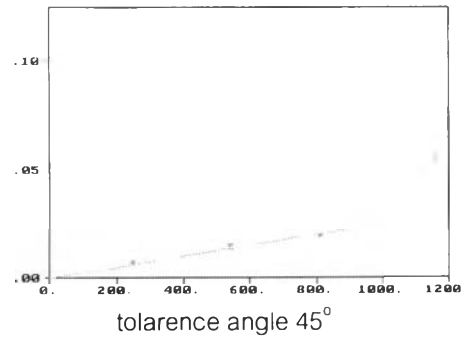
tolarence angle 15°



tolarence angle 25°



tolarence angle 35°

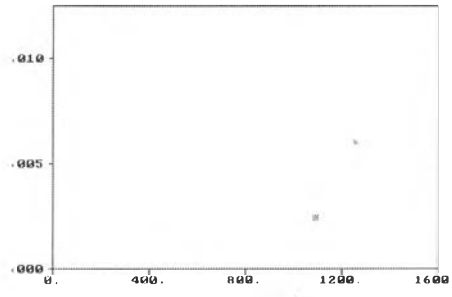


tolarence angle 45°

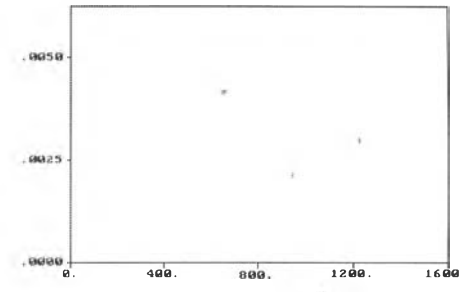
Linear model with nugget = 0, R-major = 1200 m.

Density (g/cc)

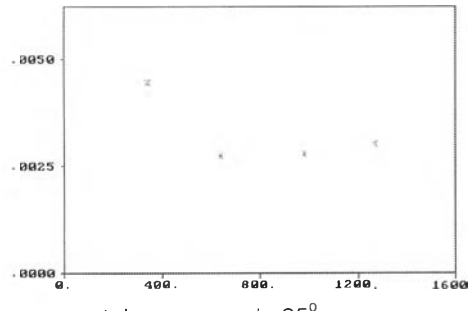
fixed direction 112.5^{o} , and lag spacing 400 m.



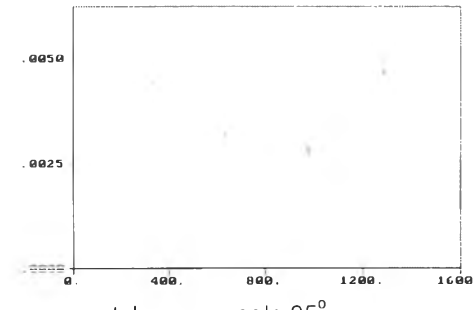
tolarence angle 5^{o}



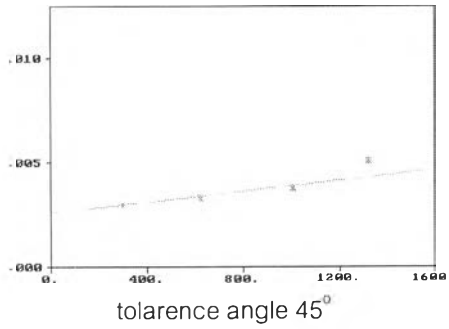
tolarence angle 15^{o}



tolarence angle 25^{o}



tolarence angle 35^{o}



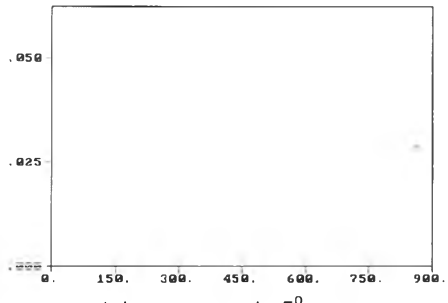
tolarence angle 45^{o}

Linear model with nugget = 0.0026, R-major = 2000 m.

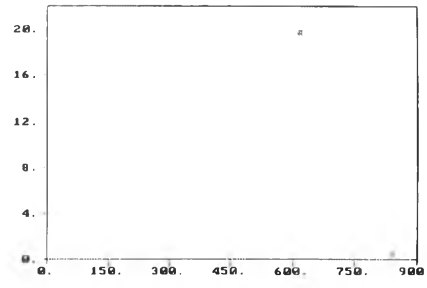
Testing tolerance angle S4 seam. Saba Yoi area,

fixed direction 112.5° , and lag spacing 350 m.

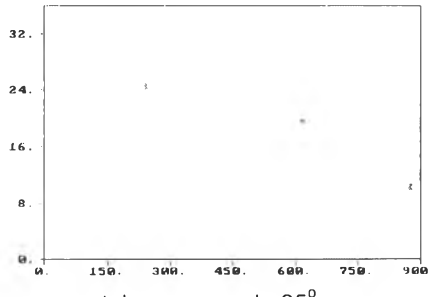
Ash Content (%)



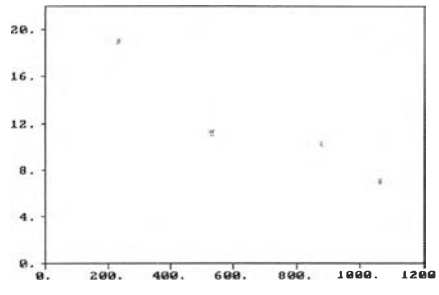
tolarence angle 5°



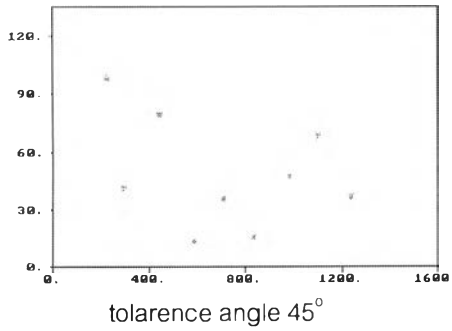
tolarence angle 15°



tolarence angle 25°



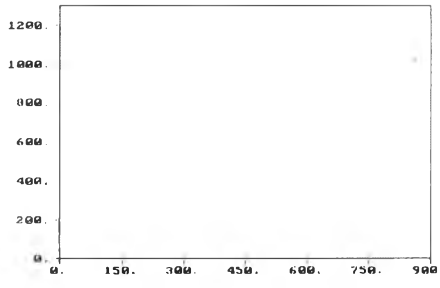
tolarence angle 35°



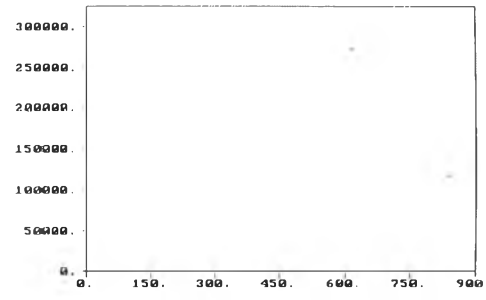
tolarence angle 45°

Calorific Value (kcal/kg)

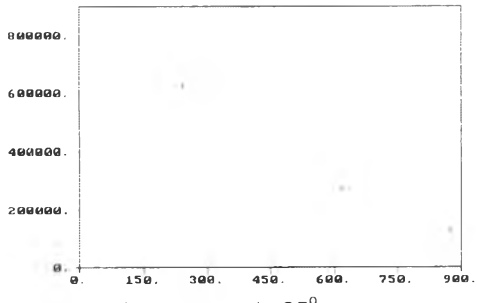
fixed direction 112.5° , and lag spacing 350 m.



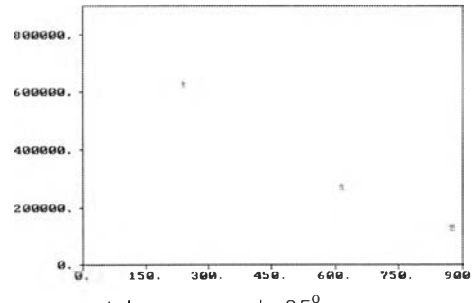
tolarence angle 5°



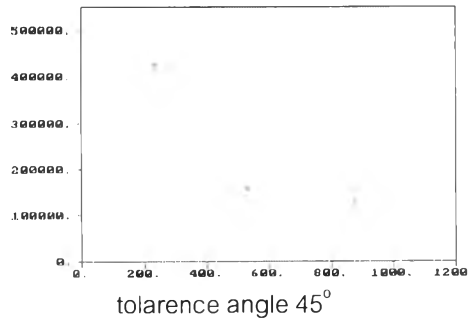
tolarence angle 15°



tolarence angle 25°



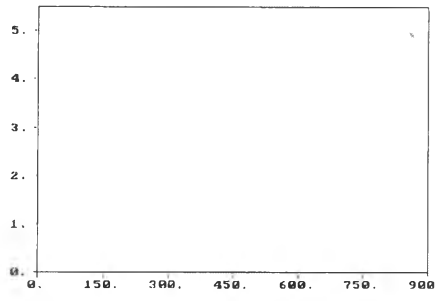
tolarence angle 35°



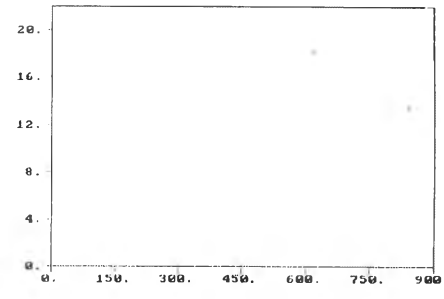
tolarence angle 45°

Moisture Content (%)

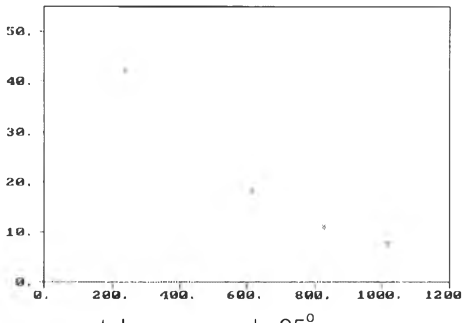
fixed direction 112.5° , and lag spacing 350 m.



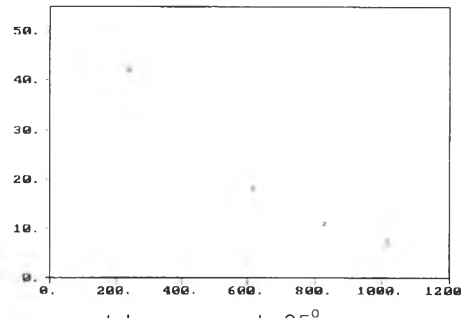
tolarence angle 5°



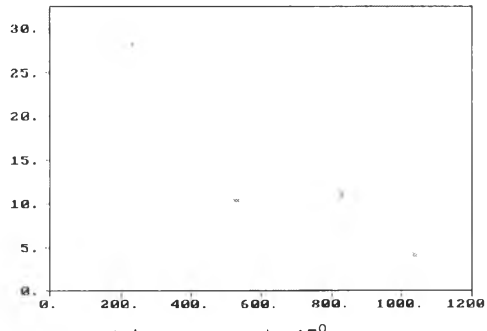
tolarence angle 15°



tolarence angle 25°



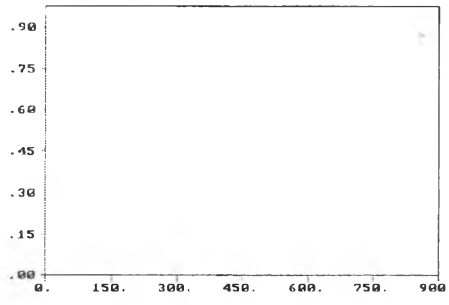
tolarence angle 35°



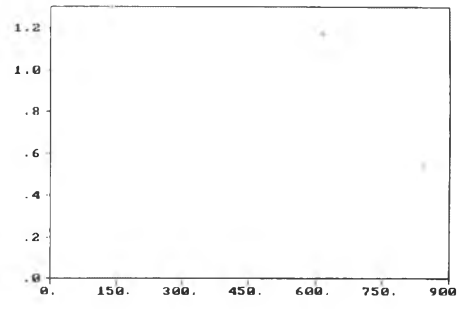
tolarence angle 45°

Sulphur Content (%)

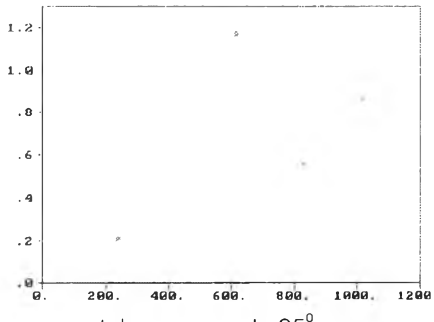
fixed direction 112.5^{0} , and lag spacing 350 m.



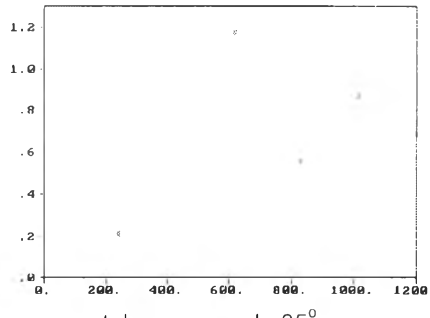
tolarence angle 5^{0}



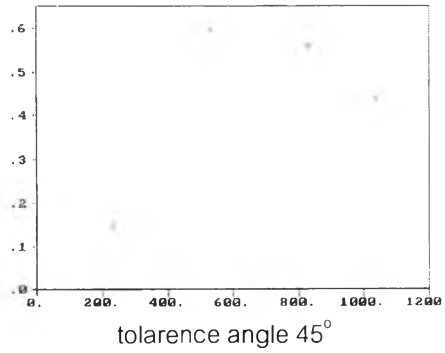
tolarence angle 15^{0}



tolarence angle 25^{0}



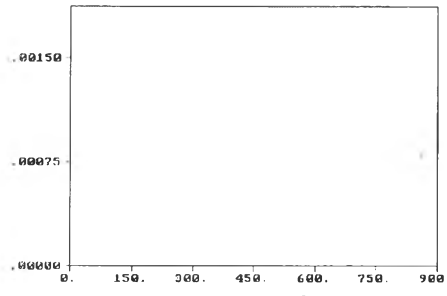
tolarence angle 35^{0}



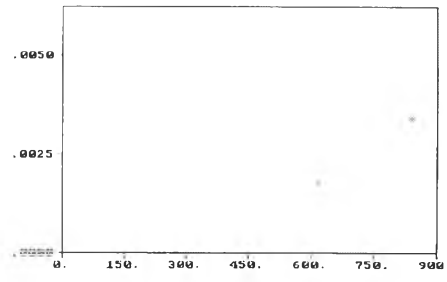
tolarence angle 45^{0}

Density (g/cc)

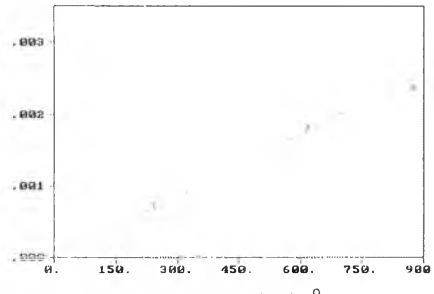
fixed direction 112.5^{o} , and lag spacing 350 m.



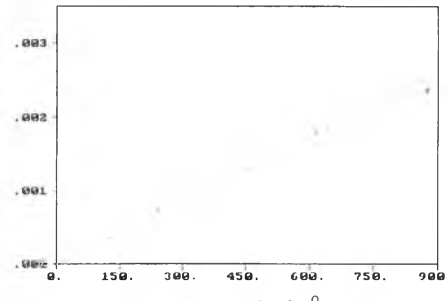
tolarence angle 5^{o}



tolarence angle 15^{o}



tolarence angle 25^{o}



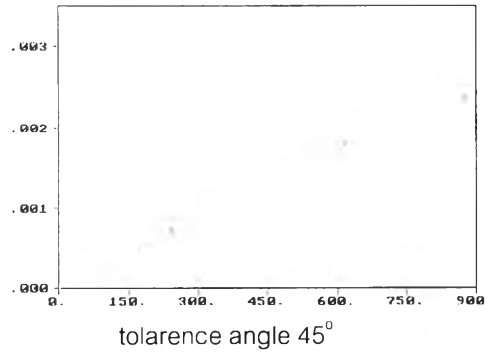
tolarence angle 35^{o}

Linear model with nugget = 0,

R-major = 700 m.

Linear model with nugget = 0,

R-major = 700 m.



tolarence angle 45^{o}

Linear model with nugget = 0.0001, R-major = 1100 m.

APPENDIX C

TEST OF DIRECTIONS

Test direction

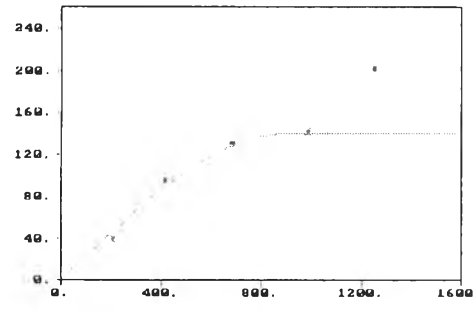
Test direction P1 seam, Sin Pun area

Ash Content (%)

Fixed tolerance 45°, lag spacing 280 m.

direction 0 °

Variogram



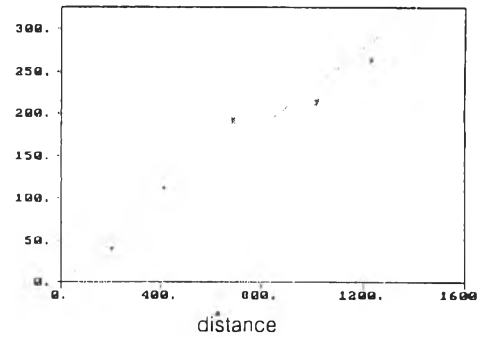
distance

Spherical model with nugget = 0, sill = 140, range = 900 m.

Pair	Avg. distance	Estimate
10	202.095	39.458
22	412.864	95.580
28	680.761	129.878
12	983.238	142.082
5	1247.529	201.813

direction 22.5 °

Variogram



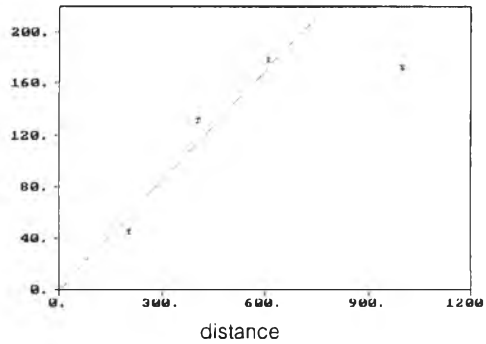
distance

Linear model with nugget = 0, R-major = 650 m.

Pair	Avg. distance	Estimate
12	205.227	39.894
21	413.627	112.583
15	684.283	192.195
6	1015.450	213.730
3	1236.246	263.227

direction 45 °

Variogram



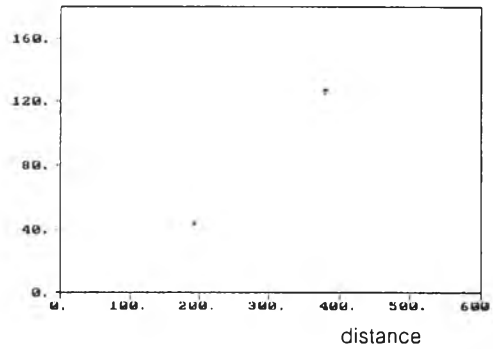
distance

Linear model with nugget = 0, R-major = 600 m.

Pair	Avg. distance	Estimate
12	201.681	45.619
14	404.419	131.571
4	606.964	178.854
1	999.388	171.866

direction 67.5 °

Variogram



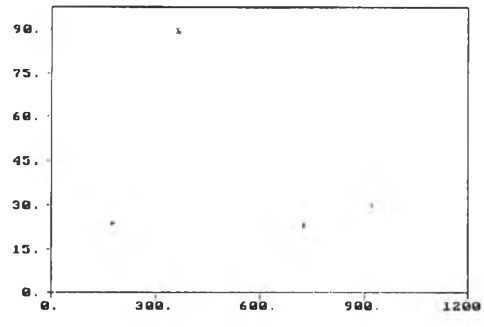
distance

Pure nugget model

Pair	Avg. distance	Estimate
9	193.237	43.757
13	379.741	126.260
1	576.746	0.490

direction 90 °

Variogram

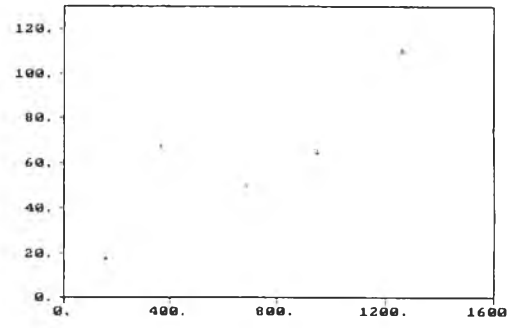


Pure nugget effect model

Pair	Avg. distance	Estimate
8	173.177	23.685
15	361.614	89.227
4	725.661	23.375
1	922.739	29.954

direction 112.5 °

Variogram

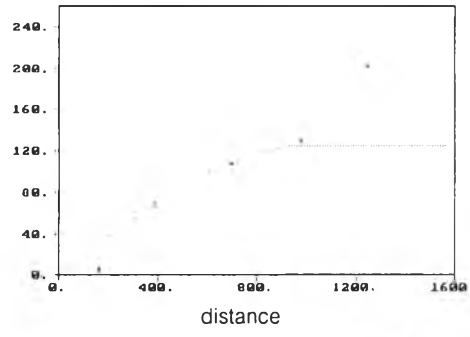


Pure nugget model

Pair	Avg. distance	Estimate
6	157.274	17.523
16	363.815	67.307
17	688.218	49.833
7	946.985	64.652
2	1264.453	109.693

direction 135 °

Variogram



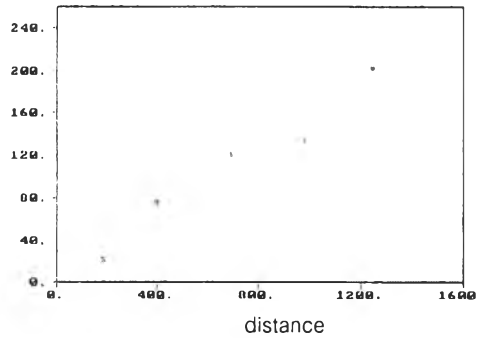
Spherical model with nugget = 0, sill = 125,

range = 1000 m.

Pair	Avg. distance	Estimate
6	164.368	6.073
23	384.580	69.529
28	679.718	107.667
12	976.851	130.256
5	1247.529	201.813

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 130,

range = 900 m.

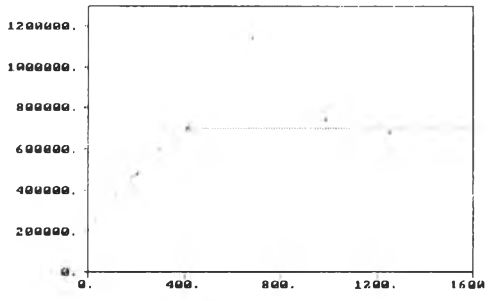
Pair	Avg. distance	Estimate
9	185.249	21.117
24	398.774	74.991
31	689.910	120.310
13	978.584	133.457
5	1247.529	201.813

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 280 m.

direction 0 °

Variogram

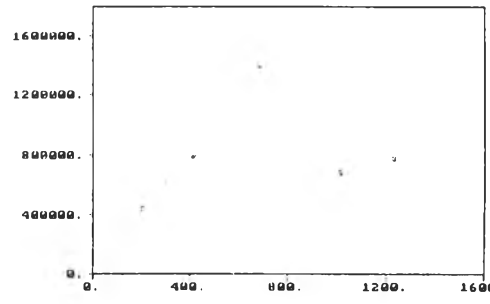


Spherical model with nugget = 200000, sill = 500000, range = 480 m.

Pair	Avg. distance	Estimate
10	202.095	483278.4
22	412.864	707707.6
28	680.761	1144777
12	983.238	745942.4
5	1247.529	1247.529

direction 22.5 °

Variogram

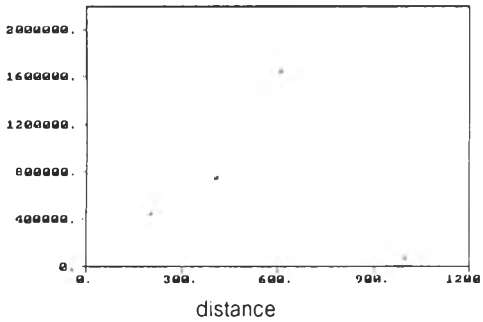


Linear model with nugget = 50000, R-major = 450 m.

Pair	Avg. distance	Estimate
12	205.227	442314.6
21	413.627	785202.6
15	684.283	1396006
6	1015.450	679398.6
3	1236.246	772892.8

direction 45 °

Variogram

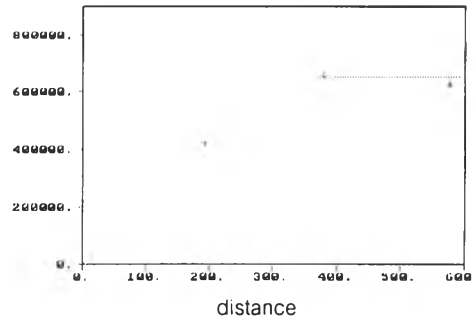


Pure nugget model

Pair	Avg. distance	Estimate
12	201.681	450035.7
14	404.419	742834.0
4	606.964	1650601
1	999.388	74112.5

direction 67.5 °

Variogram

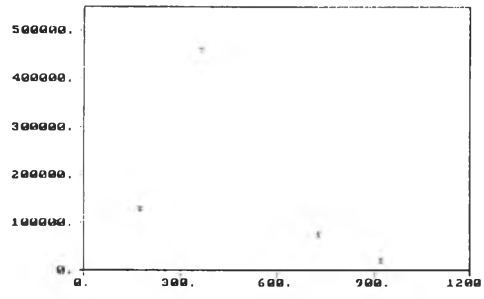


Spherical model with nugget = 0 , sill = 630000, range = 400 m.

Pair	Avg. distance	Estimate
9	193.237	418019.4
13	379.741	656952.9
1	576.746	626080.5

direction 90 °

Variogram

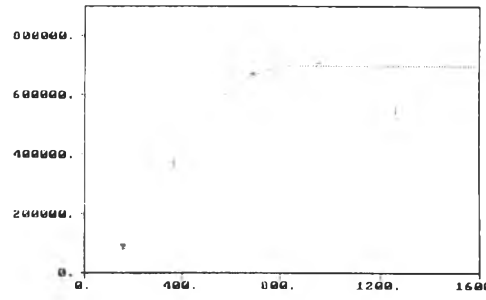


Pure nugget effect model

Pair	Avg. distance	Estimate
8	173.177	126878.2
15	361.614	458630.6
4	725.661	75810.38
1	922.739	21840.50

direction 112.5 °

Variogram



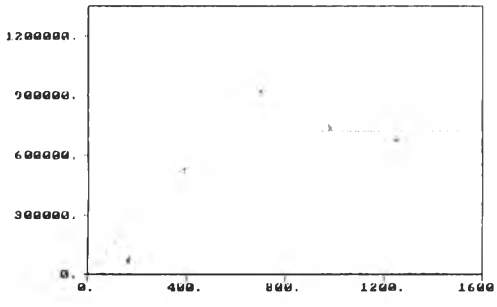
Spherical model with nugget = 0, sill = 700000

range = 850 m.

Pair	Avg. distance	Estimate
6	157.274	90005.84
16	363.815	372485.7
17	688.218	671582.6
7	946.985	699536.9
2	1264.453	549456.5

direction 135 °

Variogram



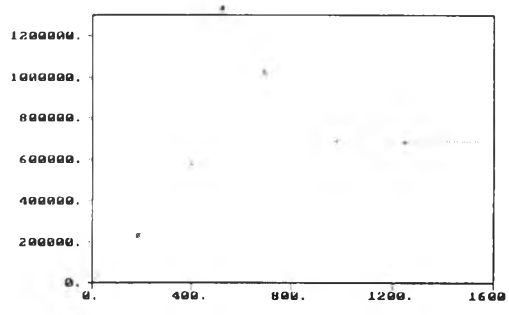
Spherical model with nugget = 0, sill = 720000,

range = 700 m.

Pair	Avg. distance	Estimate
6	164.368	74563.59
23	384.580	523884.8
28	679.718	919806.6
12	976.851	741586.4
5	1247.529	683518.3

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 690000,

range = 600 m.

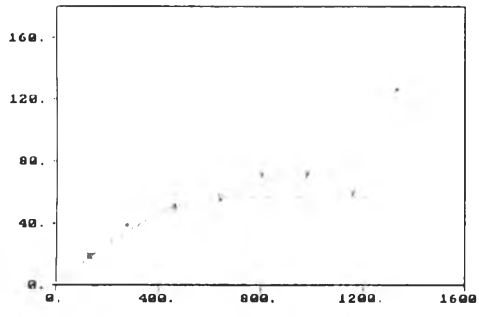
Pair	Avg. distance	Estimate
9	185.249	231737.2
24	398.774	579526.5
31	689.910	1023578
13	978.584	690242.3
5	1247.529	683518.3

Moisture Content (%)

Fixed tolerance 45°, lag spacing 180 m.

direction 0 °

Variogram



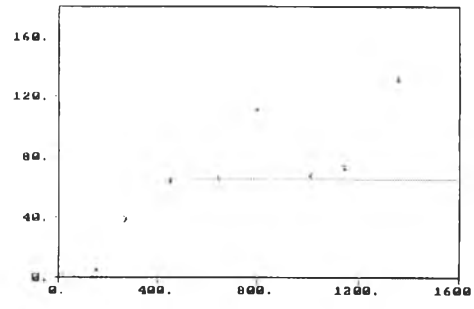
Spherical model with nugget = 2, sill = 55,

range = 650 m.

Pair	Avg. distance	Estimate
3	128.996	18.868
14	274.589	38.947
15	458.181	51.055
20	637.833	56.709
10	804.791	71.535
8	977.821	71.402
5	1161.508	59.609
2	1331.560	126.453

direction 22.5 °

Variogram



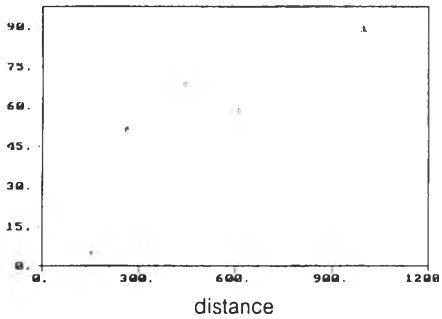
Spherical model with nugget = 0, sill = 65,

range = 550 m.

Pair	Avg. distance	Estimate
4	150.786	5.042
14	270.423	38.859
15	450.655	64.123
11	647.038	65.302
5	789.043	111.682
3	1005.434	67.699
4	1145.878	72.619
1	1358.243	131.382

direction 45 °

Variogram

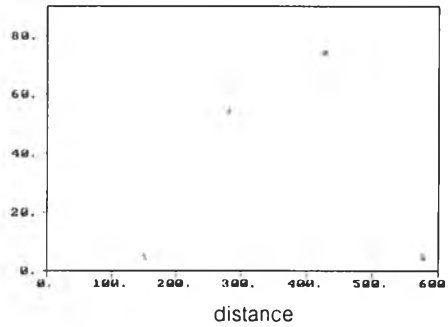


Pure nugget model

Pair	Avg. distance	Estimate
4	150.786	5.042
12	258.392	51.138
10	437.819	68.368
4	606.964	58.132
1	999.388	89.378

direction 67.5 °

Variogram

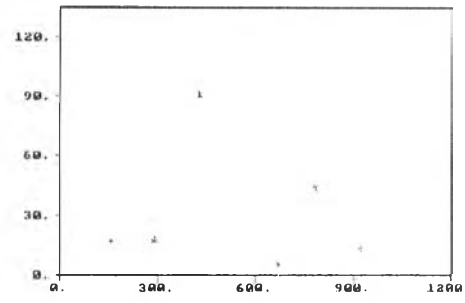


Pure nugget model

Pair	Avg. distance	Estimate
4	193.237	5.042
11	379.741	54.480
7	576.746	74.037
1	573.746	4.930

direction 90 °

Variogram

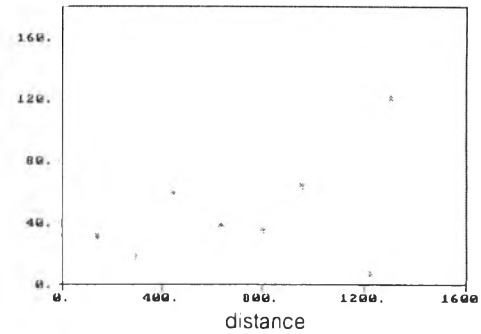


Pure nugget effect model

Pair	Avg. distance	Estimate
5	156.823	17.663
12	289.206	18.522
6	425.840	91.731
2	668.023	6.138
2	783.300	44.151
1	922.739	13.364

direction 112.5 °

Variogram

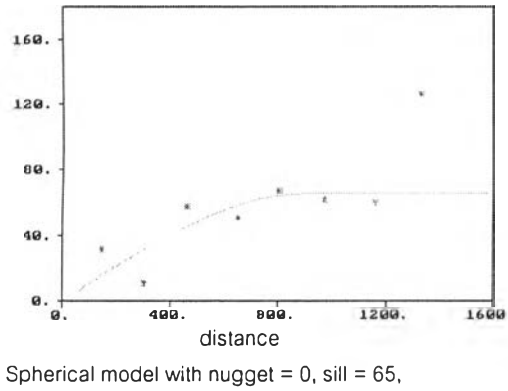


Pure nugget effect model

Pair	Avg. distance	Estimate
4	141.989	31.187
12	294.067	18.524
6	444.655	59.061
11	634.118	38.920
7	803.471	35.035
6	954.834	63.580
1	1224.031	7.566
1	1304.876	121.524

direction 135 °

Variogram

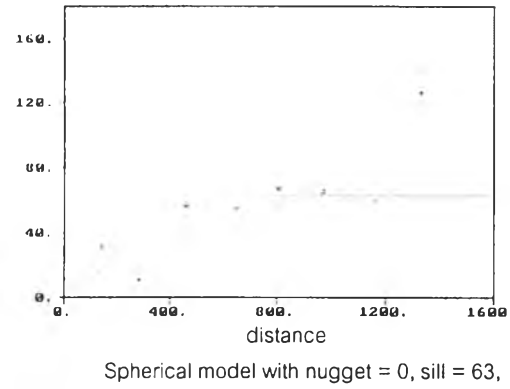


Spherical model with nugget = 0, sill = 65,
range = 900 m.

Pair	Avg. distance	Estimate
4	141.002	31.187
14	301.002	10.991
11	459.051	57.503
18	648.048	50.773
12	801.209	66.971
8	968.240	61.900
5	1161.508	59.609
2	1331.560	126.453

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 63,
range = 800 m.

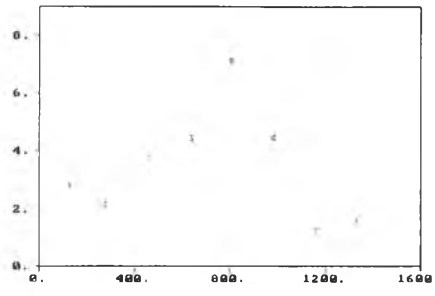
Pair	Avg. distance	Estimate
4	141.989	31.187
15	281.575	11.216
14	460.445	56.996
21	643.617	54.358
9	801.209	66.971
9	971.701	64.953
5	1161.508	59.609
2	1331.560	126.453

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 180 m.

direction 0 °

Variogram



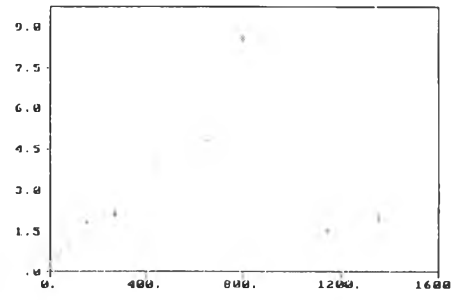
distance

Linear model with nugget = 1.7, R-major = 600 m.

Pair	Avg. distance	Estimate
3	128.996	2.806
14	274.589	2.178
15	458.181	3.800
20	637.833	4.447
10	804.791	7.129
8	977.821	4.435
5	1161.508	1.278
2	1331.560	1.638

direction 22.5 °

Variogram



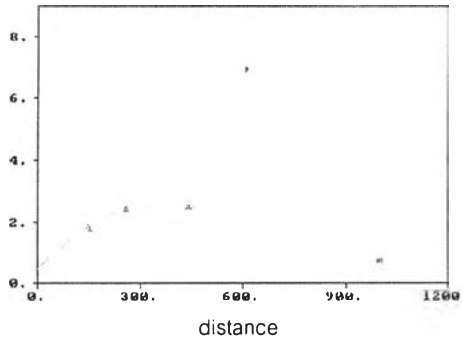
distance

Linear model with nugget = 0.4, R-major = 460 m.

Pair	Avg. distance	Estimate
4	150.786	1.825
14	270.423	2.123
15	450.655	4.028
11	647.038	4.896
5	789.043	8.536
3	1005.434	4.734
4	1145.878	1.473
1	1358.243	1.980

direction 45 °

Variogram



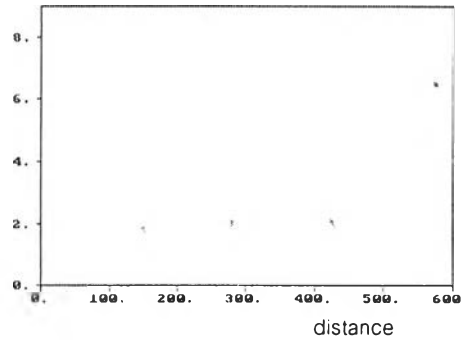
distance

Spherical model with nugget = 0.5, sill 2, range = 300 m.

Pair	Avg. distance	Estimate
4	150.786	1.825
12	258.392	2.447
10	437.819	2.495
4	606.964	6.928
1	999.388	0.720

direction 67.5 °

Variogram



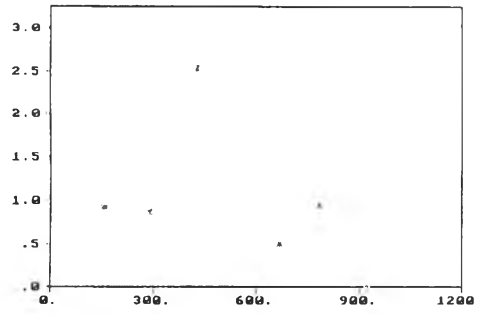
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
4	193.237	1.825
11	379.741	2.008
7	576.746	2.062
1	573.746	6.480

direction 90 °

Variogram

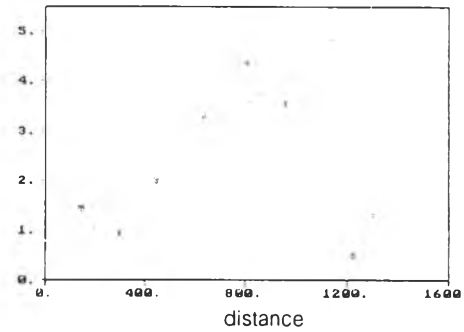


Pure nugget effect model

Pair	Avg. distance	Estimate
5	156.823	0.917
12	289.206	0.867
6	425.840	2.527
2	668.023	0.496
2	783.300	0.952
1	922.739	0.004

direction 112.5 °

Variogram



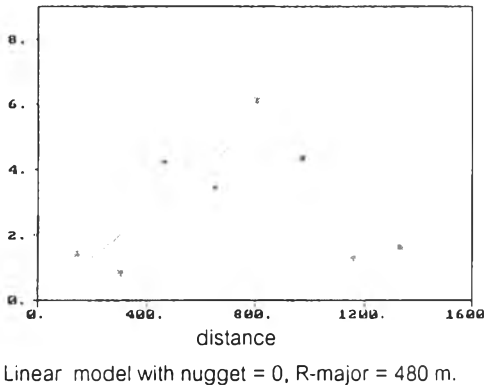
Linear model with nugget effect = 0.3,

R-major = 500 m.

Pair	Avg. distance	Estimate
4	141.989	1.425
12	294.067	0.930
6	444.655	1.956
11	634.118	3.280
7	803.471	4.359
6	954.834	3.547
1	1224.031	0.500
1	1304.876	1.296

direction 135 °

Variogram

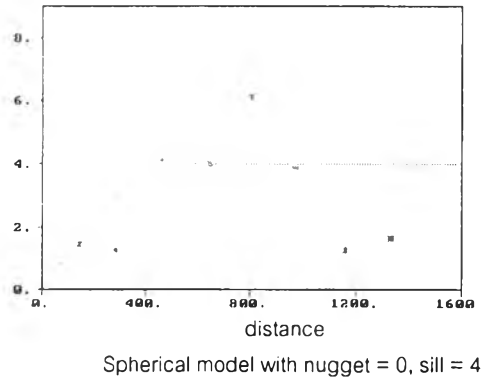


Linear model with nugget = 0, R-major = 480 m.

Pair	Avg. distance	Estimate
	141.002	1.425
14	301.002	0.824
11	459.051	4.291
18	648.048	3.456
12	801.209	6.100
8	968.240	4.346
5	1161.508	1.278
2	1331.560	1.638

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 4,

range = 500 m.

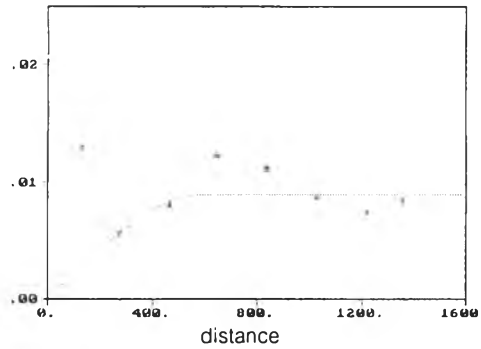
Pair	Avg. distance	Estimate4
4	141.989	1.425
15	281.575	1.254
14	460.445	4.123
21	643.617	3.974
9	801.209	6.100
9	971.701	3.943
5	1161.508	1.278
2	1331.560	1.638

Density (g/cc)

Fixed tolerance 45°, lag spacing 190 m.

direction 0 °

Variogram

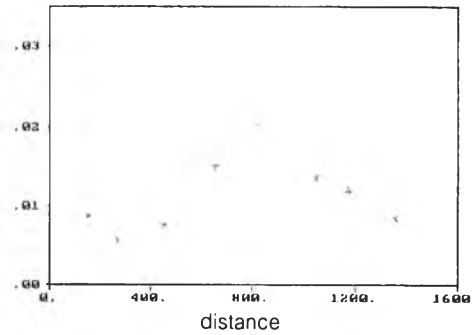


Spherical model with nugget = 0, sill = 0.009, range = 600 m.

Pair	Avg. distance	Estimate
3	128.996	0.013
14	274.589	0.006
16	465.049	0.008
20	645.705	0.012
11	834.853	0.011
8	1024.325	0.009
4	1219.850	0.007
1	1358.243	0.008

direction 22.5 °

Variogram

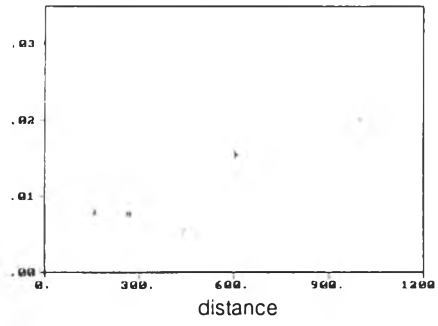


Pure nugget effect model

Pair	Avg. distance	Estimate
4	150.786	0.009
14	270.423	0.006
15	450.655	0.007
12	653.577	0.015
4	816.175	0.020
5	1049.864	0.013
2	1175.247	0.012
1	1358.243	0.008

direction 45 °

Variogram

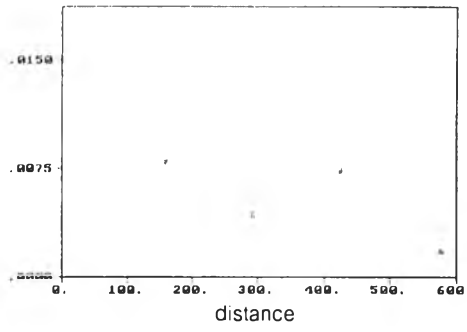


Pure nugget effect model

Pair	Avg. distance	Estimate
5	150.786	0.008
11	258.392	0.008
10	437.819	0.005
4	606.964	0.015
1	999.388	0.020

direction 67.5 °

Variogram

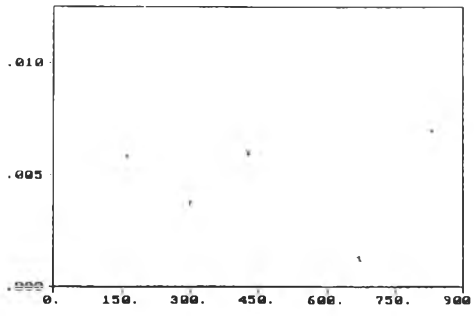


Pure nugget effect model

Pair	Avg. distance	Estimate
5	157.630	0.008
10	290.610	0.004
7	425.932	0.007
1	576.746	0.002

direction 90 °

Variogram

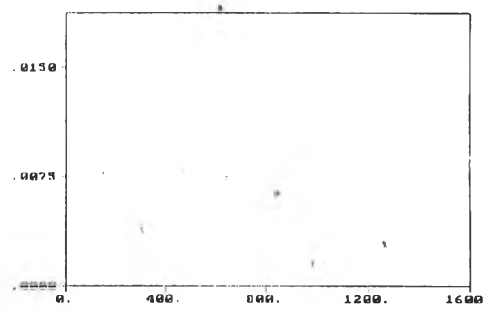


Pure nugget effect model

Pair	Avg. distance	Estimate
6	161.519	0.006
11	298.679	0.004
6	425.840	0.006
2	668.023	0.001
3	829.779	0.007

direction 112.5 °

Variogram

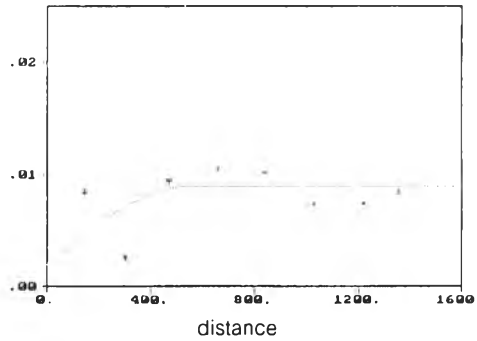


Pure nugget effect model

Pair	Avg. distance	Estimate
5	150.592	0.008
11	303.982	0.004
7	462.287	0.008
10	640.722	0.007
10	840.802	0.006
3	981.760	0.002
2	1264.453	0.003

direction 135 °

Variogram

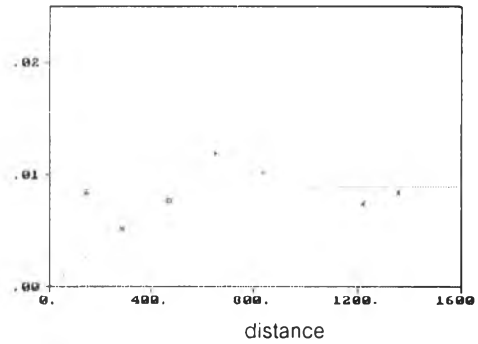


Spherical model with nugget = 0.002, sill = 0.007, range = 550 m.

Pair	Avg. distance	Estimate
4	141.989	0.008
14	301.002	0.003
12	468.137	0.009
18	656.794	0.011
14	833.766	0.010
7	1027.888	0.007
4	1219.850	0.007
1	1358.243	0.008

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 0.009, range = 700 m.

Pair	Avg. distance	Estimate
4	141.989	0.008
15	281.575	0.005
15	467.620	0.008
21	651.114	0.012
14	833.766	0.010
8	1024.325	0.009
4	1219.850	0.007
1	1358.243	0.008

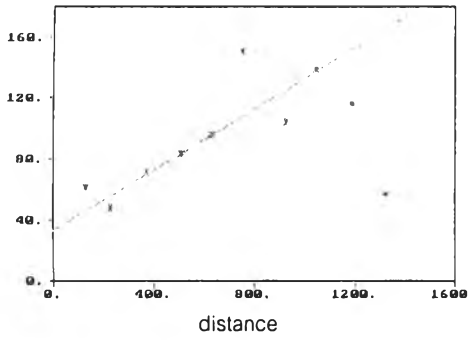
Test direction P2 seam, Sin Pun area

Ash Content (%)

Fixed tolerance 45°, lag spacing 140 m.

direction 0 °

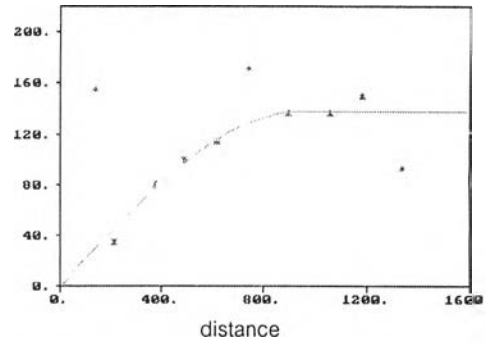
Variogram



Linear model with nugget = 33, R-major = 500 m.

direction 22.5 °

Variogram



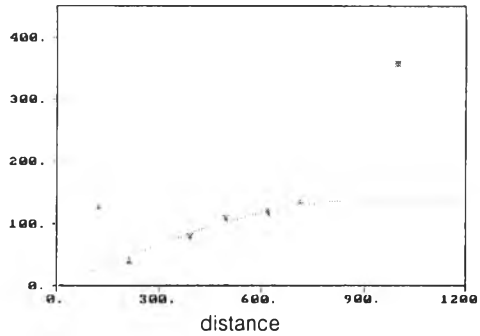
Spherical model with nugget = 0, sill = 138, range = 950 m.

Pair	Avg. distance	Estimate
1	128.553	61.051
9	224.502	48.185
22	368.164	71.067
10	504.821	83.518
16	627.748	95.779
14	749.496	150.933
8	920.869	104.465
10	1044.557	138.908
6	1189.632	116.397
6	1321.980	56.861

Pair	Avg. distance	Estimate
1	139.058	154.880
12	213.339	35.106
20	373.227	80.077
8	487.364	99.388
7	616.316	114.296
12	742.467	171.649
3	894.991	137.293
8	1059.938	137.284
4	1182.539	150.599
3	1336.168	93.140

direction 45 °

Variogram

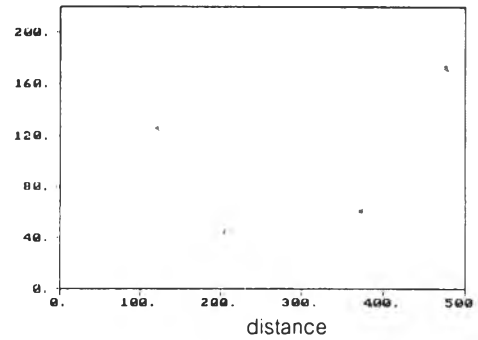


Spherical model with nugget = 0, sill = 138, range = 900 m.

Pair	Avg. distance	Estimate
2	120.623	125.188
12	212.605	40.153
10	389.293	78.955
5	493.985	107.904
4	617.789	117.453
1	713.108	135.301
1	999.388	358.316

direction 67.5 °

Variogram

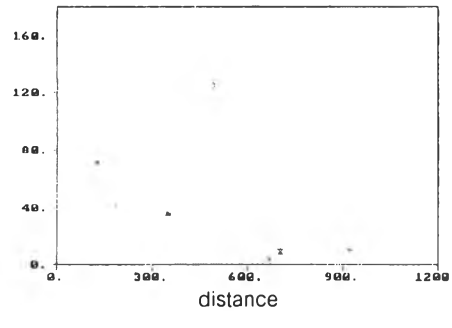


Pure nugget model

Pair	Avg. distance	Estimate
2	120.623	125.188
12	204.275	44.148
11	372.875	61.020
2	477.470	173.191

direction 90 °

Variogram

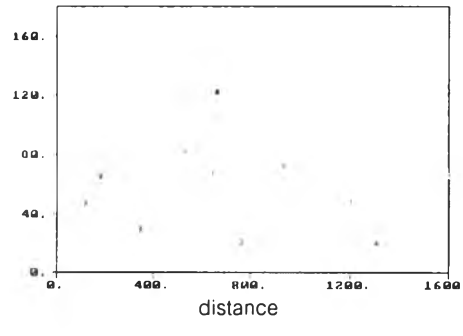


Pure nugget effect model

Pair	Avg. distance	Estimate
4	122.793	70.866
9	179.760	41.849
14	348.987	36.040
3	494.750	125.368
2	668.023	3.881
1	701.850	9.031
1	922.739	10.488

direction 112.5 °

Variogram

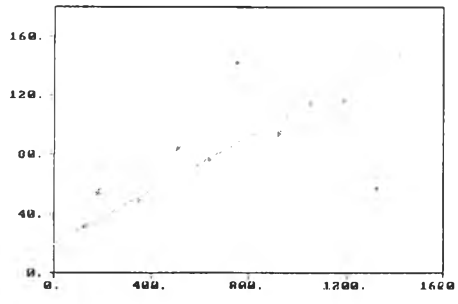


Pure nugget model

Pair	Avg. distance	Estimate
4	120.167	47.409
6	179.715	64.839
16	345.054	29.156
5	526.710	83.237
11	642.346	67.287
3	761.730	20.766
6	934.120	72.388
2	983.031	145.403
2	1203.818	47.994
3	1307.792	20.582

direction 135 °

Variogram

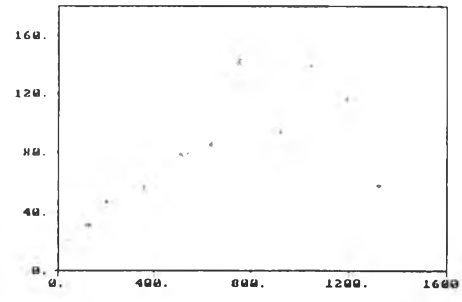


Linear model with nugget = 20, R-major = 1000 m.

Pair	Avg. distance	Estimate
3	126.160	31.380
6	181.182	54.746
26	349.711	49.172
8	507.816	83.970
14	636.347	76.459
14	748.692	141.913
9	921.077	94.023
9	1049.576	114.529
6	1189.632	116.397
6	1321.980	56.861

direction 157.5 °

Variogram



Spherical model with nugget = 15, sill = 72, range = 700 m.

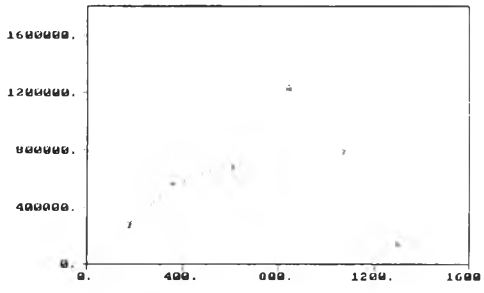
Pair	Avg. distance	Estimate
3	126.160	31.380
6	197.842	46.756
25	355.351	55.873
11	507.047	78.628
18	632.223	85.569
15	746.320	141.473
9	921.077	94.023
10	1044.557	138.908
6	1189.632	116.397
6	1321.980	56.861

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 240 m.

direction 0 °

Variogram

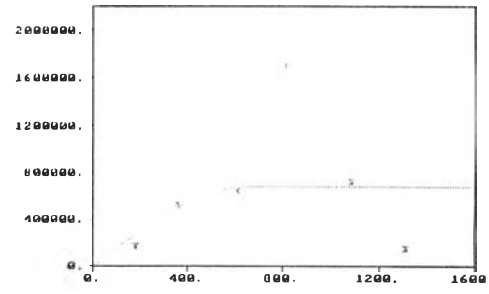


Spherical model with nugget = 0, sill = 675000, range = 600 m.

Pair	Avg. distance	Estimate
6	178.210	279064.4
27	356.274	561594.6
31	610.446	680836.4
15	840.604	1235443
15	1072.767	788247.2
8	1300.370	144180.4

direction 22.5 °

Variogram

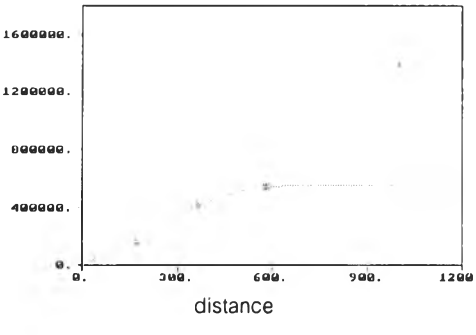


Spherical model with nugget = 0, sill = 675000, range = 650 m.

Pair	Avg. distance	Estimate
9	179.924	167096.8
26	362.723	517205.5
19	610.437	643008.8
9	813.662	1701979
11	1087.511	716157.4
4	1313.887	150657.0

direction 45 °

Variogram

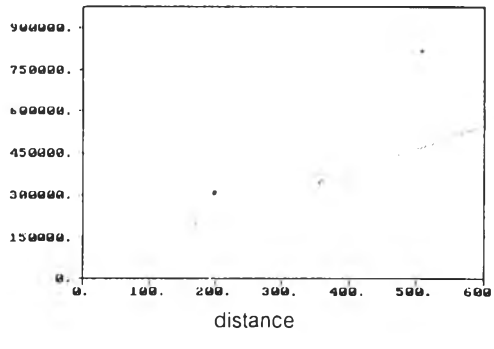


Spherical model with nugget = 0, sill = 580000, range = 650 m.

Pair	Avg. distance	Estimate
10	171.270	161408.5
15	361.280	415259.1
9	578.637	541024.8

direction 67.5 °

Variogram

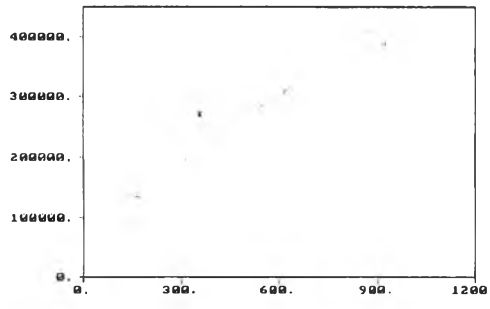


Linear model with nugget = 50000, R-major = 630 m.

Pair	Avg. distance	Estimate
11	172.034	195433.5
15	356.550	344334.000
1	508.480	815364.500

direction 90 °

Variogram



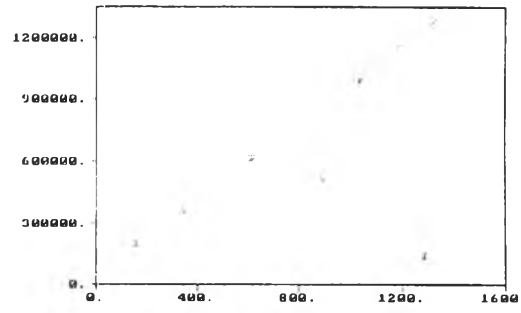
Linear model with nugget = 80000,

R-major = 800 m.

Pair	Avg. distance	Estimate
13	162.232	137148.4
15	355.485	270705.5
5	615.137	309570.2
1	922.739	388080.5

direction 112.5 °

Variogram



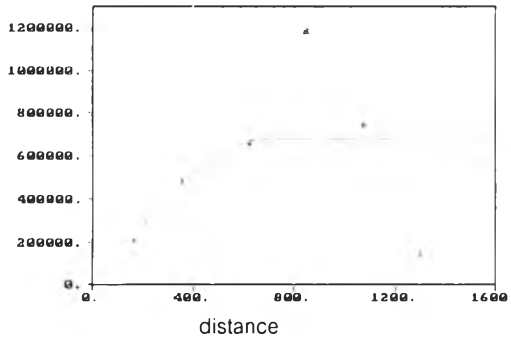
Linear model with nugget = 50000,

R-major = 700 m.

Pair	Avg. distance	Estimate
10	155.896	195344.5
16	345.054	361018.5
17	611.835	613818.6
7	886.978	514558.2
4	1032.222	986494.4
4	1286.852	137703.8

direction 135 °

Variogram



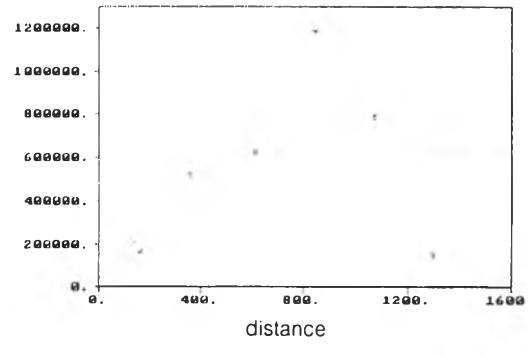
Spherical model with nugget = 0, sill = 680000,

range = 700 m.

Pair	Avg. distance	Estimate
9	162.842	204803.5
27	353.054	481287.1
27	621.918	658687.4
16	845.738	1182482
14	1078.008	745185.4
8	1300.370	144180.4

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 630000,

range = 600 m.

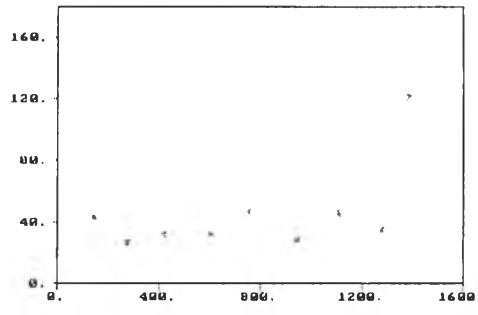
Pair	Avg. distance	Estimate
8	160.737	164611.7
27	356.682	520689.9
35	614.029	623954.8
16	845.738	1182482
15	1072.767	788247.2
8	1300.370	144180.4

Moisture Content (%)

Fixed tolerance 45°, lag spacing 170 m.

direction 0 °

Variogram



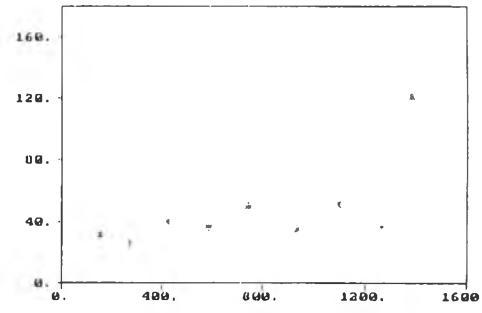
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
3	143.396	43.053
14	274.948	26.206
20	418.961	31.845
21	603.913	32.013
14	749.496	46.753
12	943.075	28.328
9	1107.264	45.387
8	1277.088	34.560

direction 22.5 °

Variogram



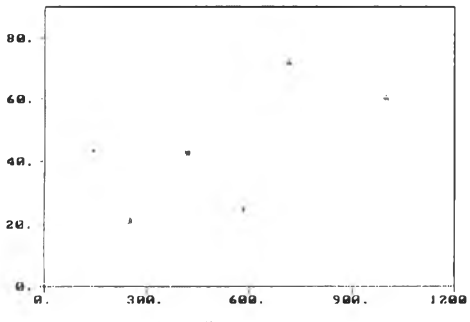
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
5	150.926	31.717
14	270.781	25.674
19	419.904	39.896
10	585.306	35.717
12	742.467	50.171
5	933.771	34.317
8	1097.721	51.054
4	1267.325	36.746
1	1383.215	121.524

direction 45 °

Variogram



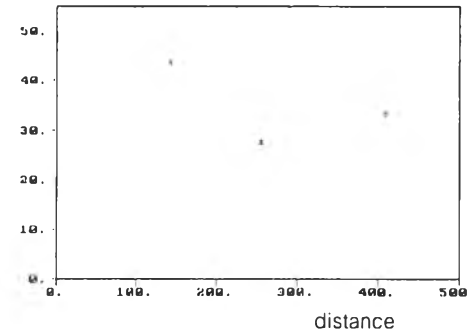
distance

Pure nugget model

Pair	Avg. distance	Estimate
6	142.803	43.495
9	250.595	21.347
12	418.346	42.772
6	582.367	24.676
1	713.108	72.240
1	999.388	60.610

direction 67.5 °

Variogram



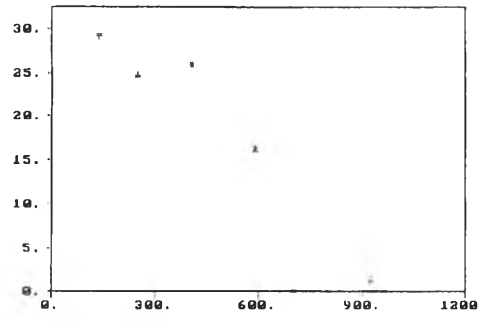
distance

Pure nugget model

Pair	Avg. distance	Estimate
6	142.803	43.495
11	254.689	27.658
10	409.072	33.155

direction 90 °

Variogram

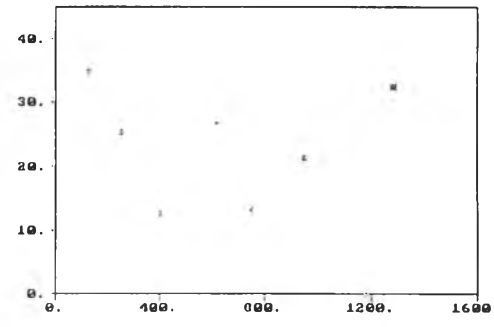


Pure nugget effect model

Pair	Avg. distance	Estimate
7	136.423	29.079
12	247.858	24.687
10	402.051	25.891
2	584.901	16.361
2	698.702	0.174
1	922.739	1.361

direction 112.5 °

Variogram

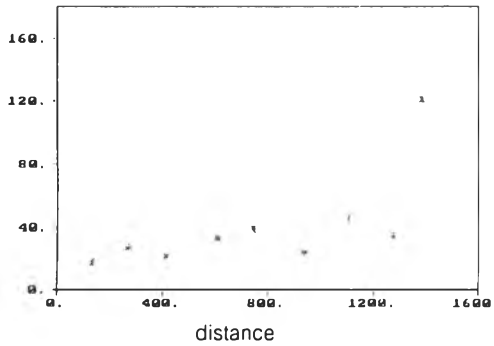


Pure nugget effect model

Pair	Avg. distance	Estimate
5	126.104	34.825
12	252.719	25.307
11	401.959	12.526
13	615.301	26.756
4	745.186	13.209
8	946.348	21.214
1	1183.606	0.058
4	1286.852	32.374

direction 135 °

Variogram

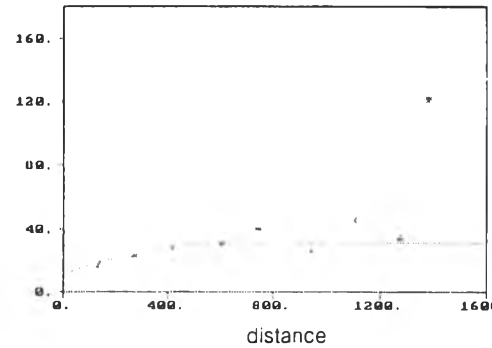


Pure nugget effect model

Pair	Avg. distance	Estimate
4	132.083	17.934
17	268.719	27.706
18	409.977	21.252
17	609.281	32.762
15	745.149	38.843
12	936.688	23.391
9	1107.264	45.387
8	1277.088	34.560
1	1383.215	121.524

direction 157.5 °

Variogram



Spherical model with nugget = 12, sill = 19,

range = 600 m.

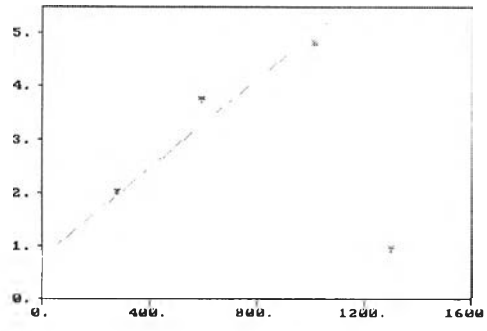
Pair	Avg. distance	Estimate
4	132.083	17.934
15	268.132	23.926
20	415.451	28.213
23	602.260	30.652
16	743.147	40.931
13	941.511	26.254
9	1107.264	45.387
8	1277.088	34.560
1	1383.215	121.524

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 400 m.

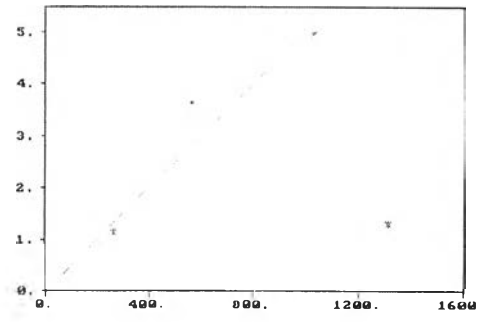
direction 0 °

Variogram



direction 22.5 °

Variogram



Linear model with nugget = 0.8, R-major = 600 m.

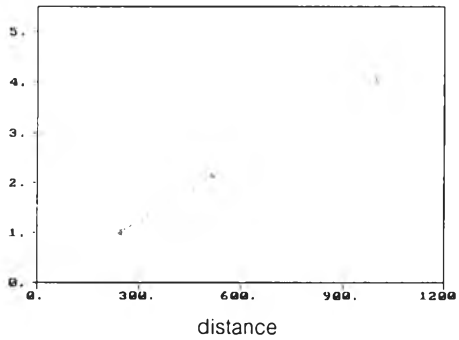
Pair	Avg. distance	Estimate
22	279.475	2.001
49	588.743	3.742
12	1013.321	4.808
8	1300.370	0.945

Linear model with nugget = 0, R-major = 600 m.

Pair	Avg. distance	Estimate
23	263.110	1.163
36	566.881	3.626
15	1031.648	4.978
4	1313.887	1.295

direction 45 °

Variogram

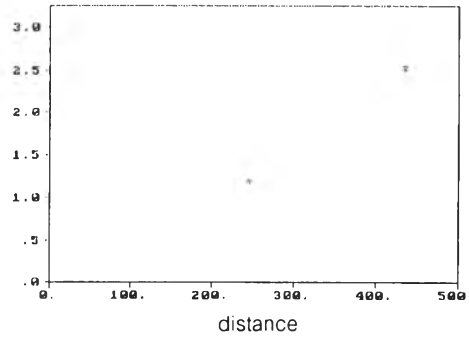


Linear model with nugget = 0, R-major = 750 m.

Pair	Avg. distance	Estimate
19	243.585	1.009
15	514.101	2.137
1	999.388	4.061

direction 67.5 °

Variogram

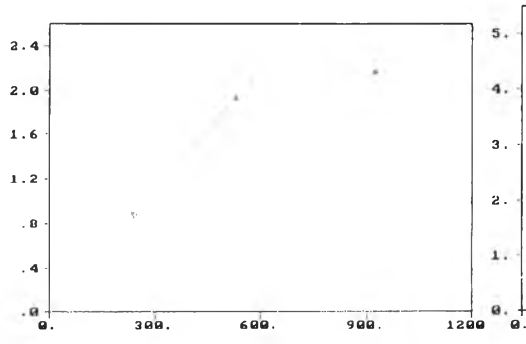


Pure nugget effect model

Pair	Avg. distance	Estimate
21	244.672	1.180
6	435.167	2.512

direction 90 °

Variogram



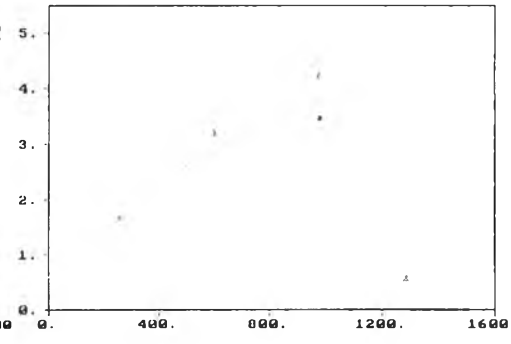
Linear model with nugget effect = 0,

R-major = 710 m.

Pair	Avg. distance	Estimate
24	239.915	0.874
9	528.781	1.930
1	922.739	2.163

direction 112.5 °

Variogram



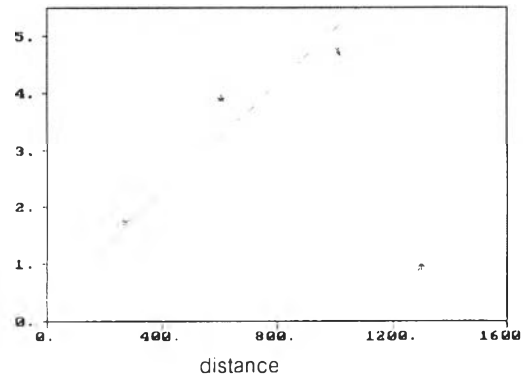
Linear model with nugget effect = 0.6,

R-major = 650 m.

Pair	Avg. distance	Estimate
23	254.559	1.664
22	600.433	3.190
9	972.710	4.231
4	1286.852	0.596

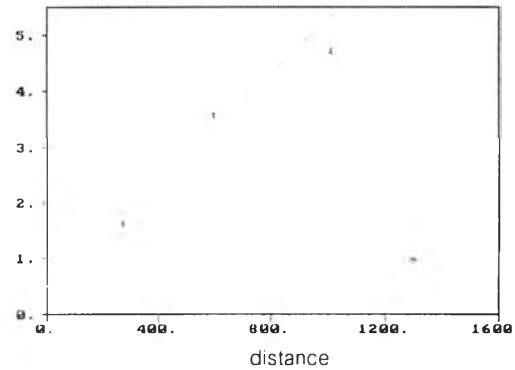
direction 135 °

Variogram



direction 157.5 °

Variogram



Linear model with nugget = 0.4, R-major = 550 m. Linear model with nugget = 0.5 , R-major = 420 m.

Pair	Avg. distance	Estimate
27	269.566	1.698
43	602.459	3.922
23	1009.988	4.726
8	1300.370	0.945

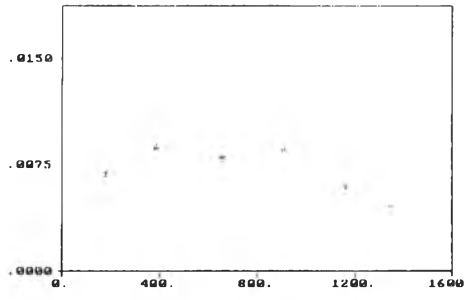
Pair	Avg. distance	Estimate
25	270.731	1.609
52	596.274	3.570
24	1009.546	4.698
8	1300.370	0.945

Density (g/cc)

Fixed tolerance 45°, lag spacing 260 m.

direction 0 °

Variogram

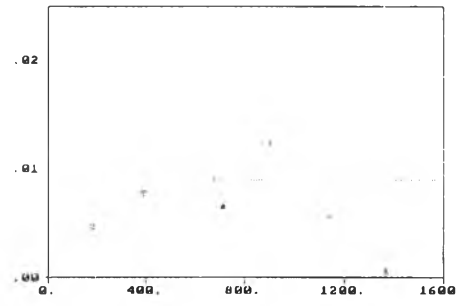


Pure nugget effect model

Pair	Avg. distance	Estimate
6	178.210	0.007
34	386.125	0.009
27	653.023	0.008
18	908.554	0.009
13	1165.071	0.006
4	1346.740	0.005

direction 22.5 °

Variogram



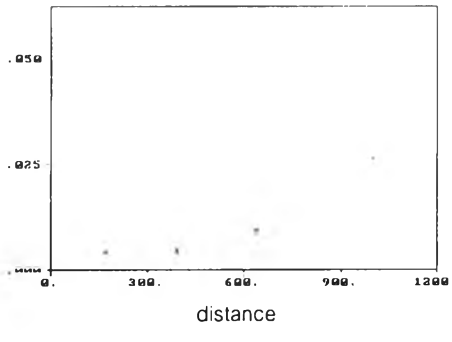
Spherical model with nugget = 0.002, sill = 0.007

range = 650 m.

Pair	Avg. distance	Estimate
9	179.924	0.005
32	388.852	0.008
16	675.156	0.009
9	902.510	0.012
10	1146.041	0.006
2	1370.729	0.001

direction 45 °

Variogram

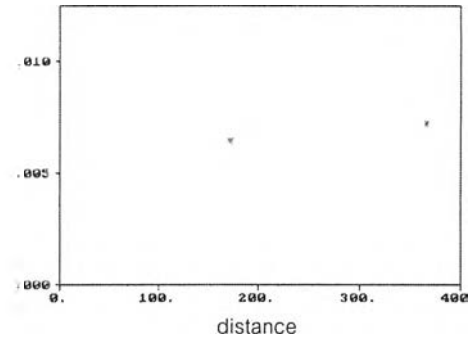


Pure nugget effect model

Pair	Avg. distance	Estimate
10	171.270	0.004
19	391.719	0.005
5	636.853	0.009
1	999.388	0.026

direction 67.5 °

Variogram

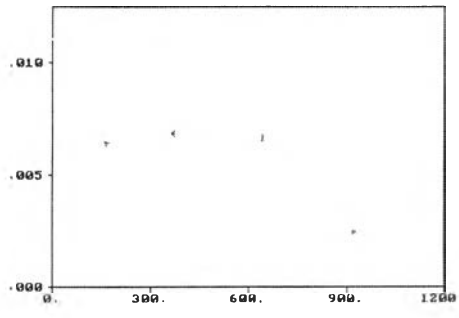


Pure nugget effect model

Pair	Avg. distance	Estimate
11	172.034	0.006
16	366.046	0.007

direction 90 °

Variogram

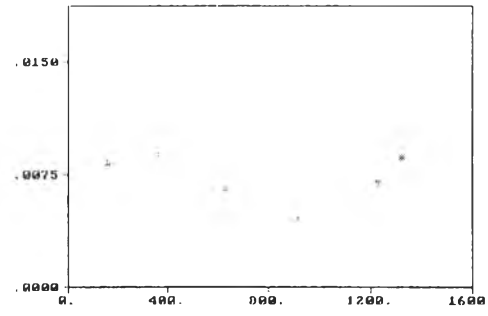


Pure nugget effect model

Pair	Avg. distance	Estimate
13	162.232	0.006
16	365.047	0.007
4	641.802	0.007
1	922.739	0.002

direction 112.5 °

Variogram

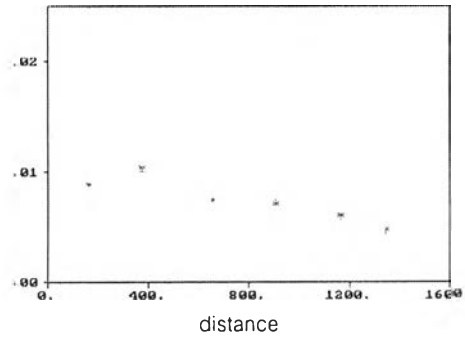


Pure nugget effect model

Pair	Avg. distance	Estimate
10	155.896	0.008
18	362.421	0.009
15	626.421	0.007
10	915.412	0.005
3	1228.503	0.007
2	1322.751	0.009

direction 135 °

Variogram

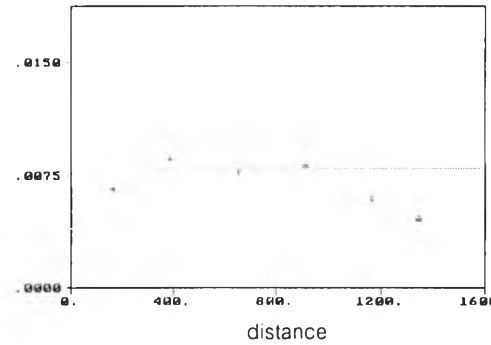


Pure nugget effect model

Pair	Avg. distance	Estimate
9	162.842	0.009
31	371.818	0.010
26	654.406	0.007
18	904.296	0.007
13	1165.071	0.006
4	1346.740	0.005

direction 157.5 °

Variogram



Spherical model with nugget = 0.004, sill = 0.0045,

range = 400 m.

Pair	Avg. distance	Estimate
8	160.737	0.007
34	385.655	0.009
31	651.575	0.008
19	909.301	0.008
13	1165.071	0.006
4	1346.740	0.005

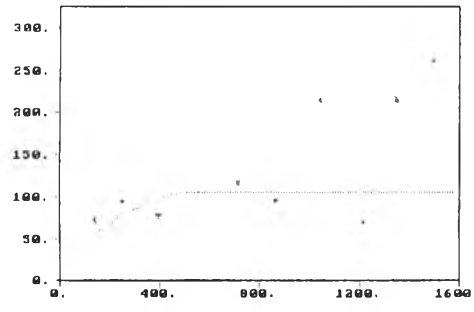
Test direction P3 seam, Sin Pun area

Ash Content (%)

Fixed tolerance 45°, lag spacing 160 m.

direction 0 °

Variogram



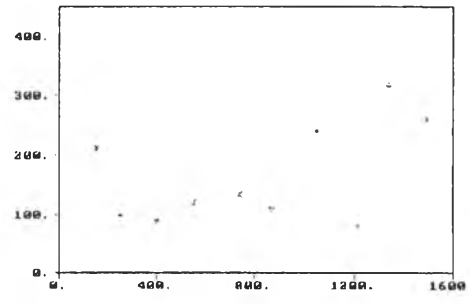
Spherical model with nugget = 25, sill = 80

range = 530 m.

Pair	Avg. distance	Estimate
4	141.170	72.750
14	251.527	94.164
12	395.015	77.193
19	552.167	105.461
15	711.916	116.526
9	862.622	95.757
6	1037.851	214.365
4	1217.677	70.143
5	1344.891	214.684
3	1497.166	260.618

direction 22.5 °

Variogram

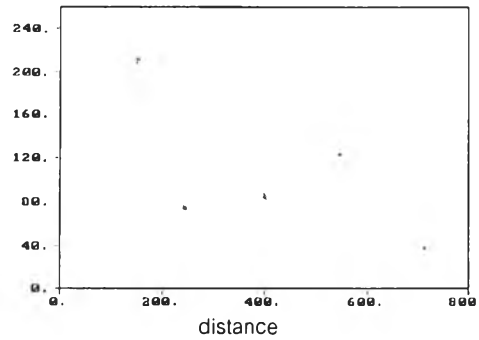


Pure nugget effect model

Pair	Avg. distance	Estimate
4	151.442	210.414
14	249.065	99.692
13	399.298	87.004
14	552.360	119.416
10	737.860	133.062
5	867.405	108.283
5	1049.578	240.777
3	1215.559	79.539
3	1341.012	318.898
3	1497.166	260.618

direction 45 °

Variogram

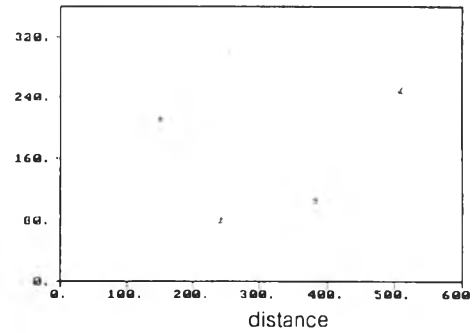


Pure nugget model

Pair	Avg. distance	Estimate
4	151.442	210.414
11	243.212	74.244
8	399.630	84.550
5	544.941	123.391
1	713.108	37.411

direction 67.5 °

Variogram

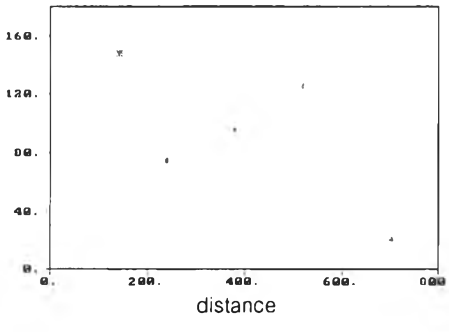


Pure nugget model

Pair	Avg. distance	Estimate
4	151.442	210.414
9	241.552	80.723
7	382.704	105.606
1	508.480	248.868

direction 90 °

Variogram

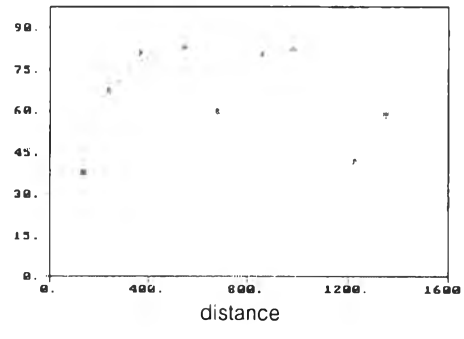


Pure nugget effect model

Pair	Avg. distance	Estimate
5	122.793	147.992
11	140.782	74.094
8	378.488	96.145
2	518.896	125.815
3	703.127	20.758

direction 112.5 °

Variogram

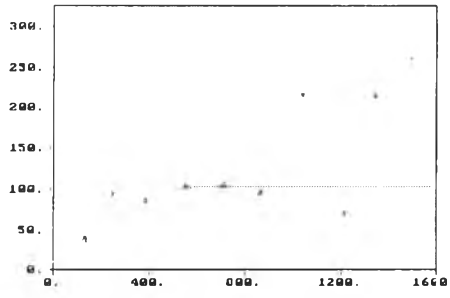


Spherical model with nugget = 38, sill = 44, range = 500 m.

Pair	Avg. distance	Estimate
5	132.565	37.861
11	241.110	67.059
7	368.172	80.633
7	542.276	83.365
8	676.190	59.943
4	856.643	80.100
1	979.218	82.304
1	1224.031	41.953
2	1350.709	58.363

direction 135 °

Variogram

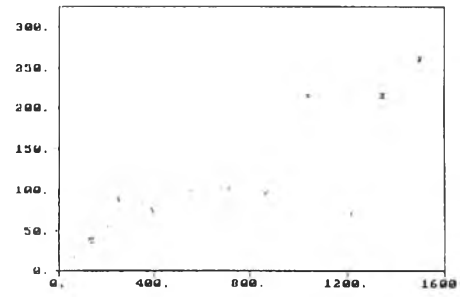


Spherical model with nugget = 10, sill = 92, range = 600 m.

Pair	Avg. distance	Estimate
5	132.565	37.861
14	247.414	94.047
12	380.920	84.923
16	550.266	102.402
17	710.295	104.280
9	862.622	95.757
6	1037.851	214.365
4	1217.677	70.143
5	1344.891	214.684
3	1497.166	260.618

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 100, range = 530 m.

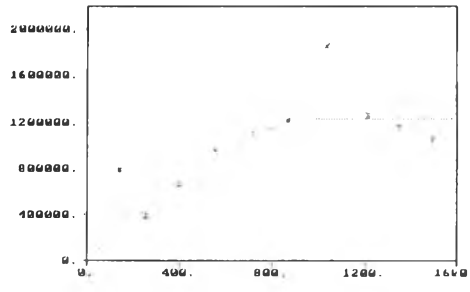
Pair	Avg. distance	Estimate
5	132.565	37.861
16	247.822	87.927
13	391.473	73.556
20	551.024	100.326
18	710.451	100.565
9	862.622	95.757
6	1037.851	214.365
4	1217.677	70.143
5	1344.891	214.684
3	1497.166	260.618

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 160 m.

direction 0 °

Variogram

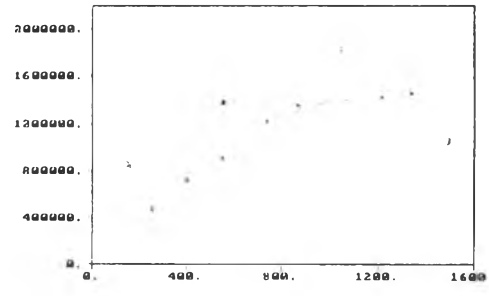


Spherical model with nugget = 0, sill = 1220000, range = 1000 m.

Pair	Avg. distance	Estimate
4	141.170	778395.8
14	251.527	385234.8
12	395.015	660438.3
19	552.167	960292.0
15	711.916	1109240
9	862.622	1214229
6	1037.851	1857476
4	1217.677	1257289
5	1344.891	1153768
3	1497.166	1050868

direction 22.5 °

Variogram

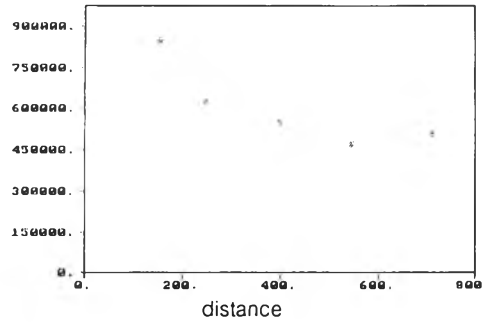


Spherical model with nugget = 0, sill = 1400000, range = 1100 m.

Pair	Avg. distance	Estimate
4	141.442	85001.9
14	249.065	471704.3
13	399.298	714697.4
14	552.360	903144.7
10	737.860	1213576
5	867.405	1347064
5	1049.578	1821739
3	1215.559	1422592
3	1341.012	1451514
3	1497.166	1050868

direction 45 °

Variogram

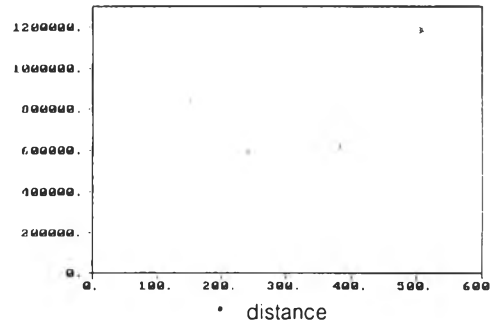


Pure nugget model

Pair	Avg. distance	Estimate
4	151.442	850011.9
11	243.212	625103.4
8	399.630	549325.1
5	544.941	468235.6
1	713.108	507024.5

direction 67.5 °

Variogram

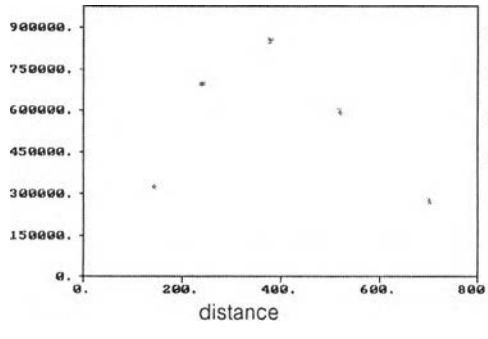


Pure nugget model

Pair	Avg. distance	Estimate
4	151.442	850011.9
9	241.552	589146.1
7	382.704	620740.6
1	508.480	1184261

direction 90 °

Variogram

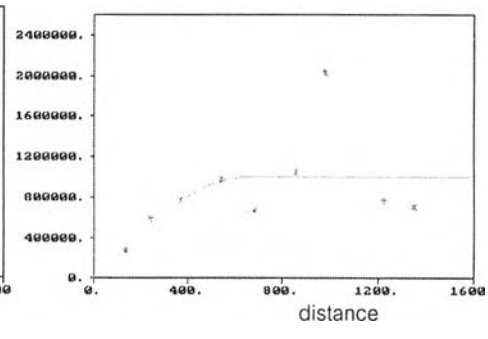


Pure nugget effect model

Pair	Avg. distance	Estimate
5	122.793	325125.9
11	140.782	694029.4
8	378.488	850848.8
2	518.896	594339.3
3	703.127	273087.7

direction 112.5 °

Variogram

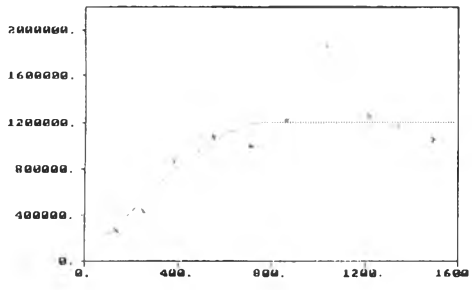


Spherical model with nugget = 0, sill = 1000000, range = 650 m.

Pair	Avg. distance	Estimate
5	132.565	267833
11	241.110	583977.4
7	368.172	777283.1
7	542.276	970028.7
8	676.190	665262.6
4	856.643	1048184
1	979.218	2036162
1	1224.031	761378
2	1350.709	707149

direction 135 °

Variogram

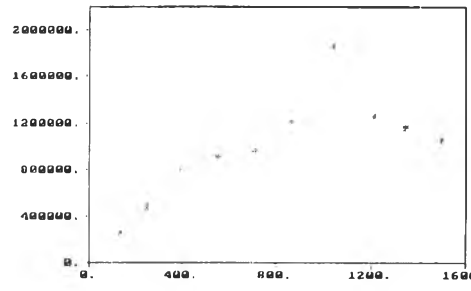


Spherical model with nugget = 0, sill = 1200000, range = 800 m.

Pair	Avg. distance	Estimate
5	132.565	267833
14	247.414	439390.9
12	380.920	861454
16	550.266	1068316
17	710.295	997108
9	862.622	1214229
6	1037.851	1857476
4	1217.677	1257289
5	1344.891	1153768
3	1497.166	1050868

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 960000, range = 650 m.

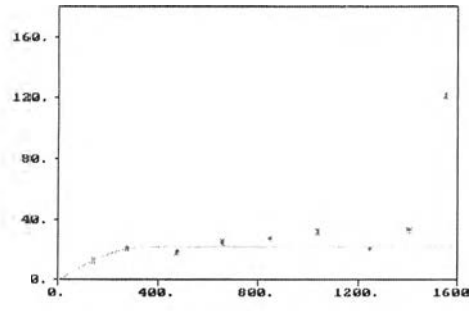
Pair	Avg. distance	Estimate
5	132.565	267833
16	247.822	482831
13	391.473	798989.6
20	551.024	912498.3
18	710.451	969881.1
9	862.622	1214119
6	1037.851	1857476
4	1217.677	1257289
5	1344.891	1153768
3	1497.166	1050868

Moisture Content (%)

Fixed tolerance 45°, lag spacing 190 m.

direction 0 °

Variogram



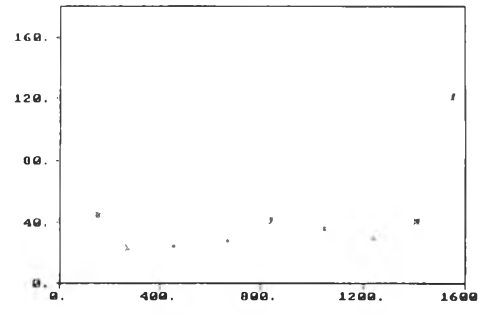
Spherical model with nugget = 0, sill = 22

range = 350 m.

Pair	Avg. distance	Estimate
4	141.170	12.704
18	275.716	21.352
19	472.179	18.639
20	656.835	24.902
12	843.673	27.576
6	1037.851	31.462
6	1248.996	20.393
5	1407.871	32.686
1	1553.327	121.524

direction 22.5 °

Variogram

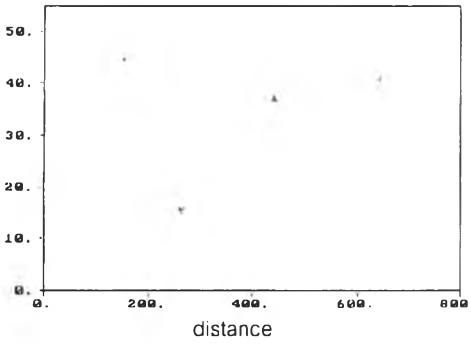


Pure nugget effect model

Pair	Avg. distance	Estimate
4	151.442	44.531
17	267.598	22.994
18	455.867	24.254
13	667.244	27.441
8	837.187	41.081
5	1049.578	35.333
4	1241.268	29.693
4	1410.704	40.587
1	1553.317	121.524

direction 45 °

Variogram

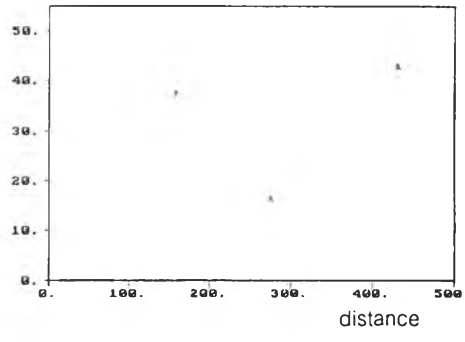


Pure nugget model

Pair	Avg. distance	Estimate
4	151.442	44.531
13	262.398	15.373
9	441.527	37.182
3	641.756	40.761

direction 67.5 °

Variogram

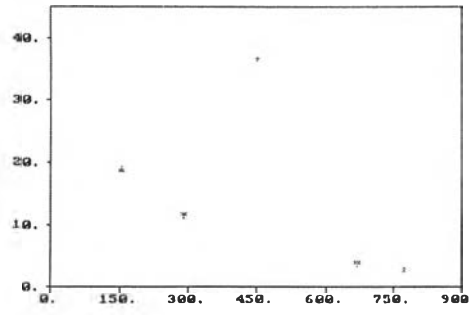


Pure nugget model

Pair	Avg. distance	Estimate
5	157.089	37.397
11	275.219	16.567
5	430.858	43.073

direction 90 °

Variogram

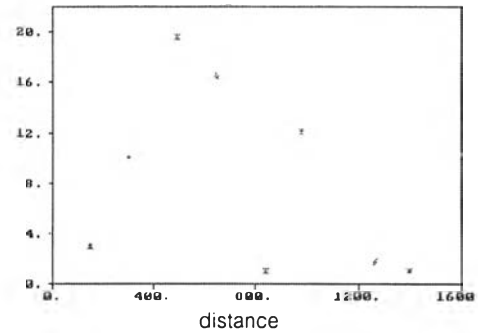


Pure nugget effect model

Pair	Avg. distance	Estimate
8	153.103	18.948
12	289.911	11.468
6	447.267	36.552
2	668.023	3.676
1	773.336	2.904

direction 112.5 °

Variogram

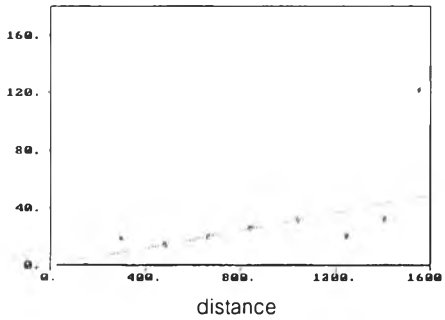


Pure nugget effect model

Pair	Avg. distance	Estimate
8	147.968	3.035
13	299.435	10.080
7	492.770	19.554
9	644.286	16.518
5	839.982	1.033
1	979.218	12.103
2	1264.453	1.794
1	1396.542	1.080

direction 135 °

Variogram

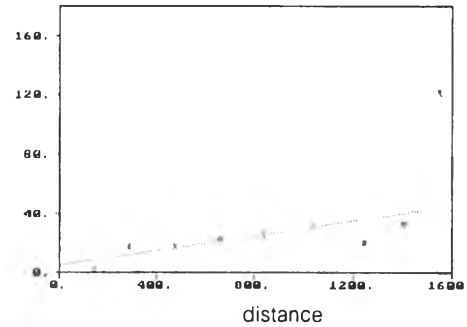


Linear model with nugget = 0, R-major = 720 m.

Pair	Avg. distance	Estimate
8	147.968	3.035
17	295.920	18.947
16	480.079	14.925
19	660.394	20.164
13	838.262	25.678
6	1037.851	31.462
6	1248.996	20.393
5	1407.871	32.686
1	1553.327	121.524

direction 157.5 °

Variogram



Linear model with nugget = 5, R-major = 800 m.

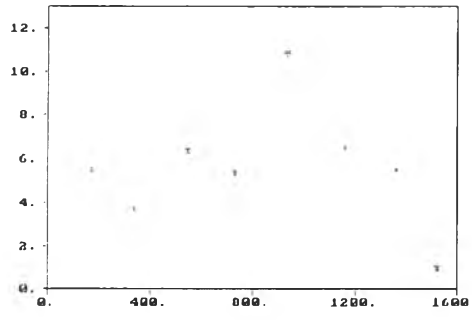
Pair	Avg. distance	Estimate
7	143.437	2.202
19	284.969	17.880
20	475.035	17.904
22	657.852	22.973
13	838.262	25.678
6	1037.851	31.462
6	1248.996	20.393
5	1407.871	32.686
1	1553.327	121.524

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 210 m.

direction 0 °

Variogram

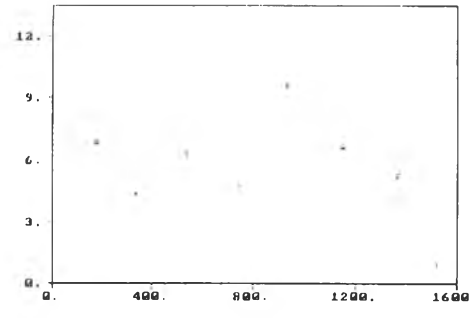


Pure nugget effect model

Pair	Avg. distance	Estimate
8	171.444	5.465
21	334.034	3.709
19	541.722	6.368
20	729.628	5.375
8	932.530	10.800
7	1160.827	6.516
6	1361.497	5.494
2	1523.485	0.934

direction 22.5 °

Variogram

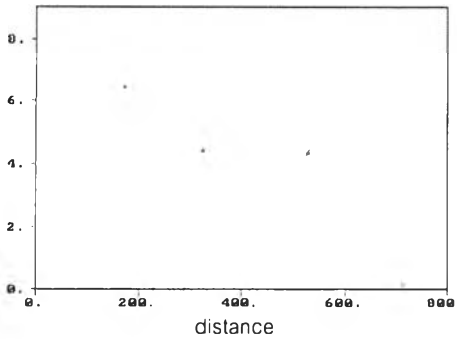


Pure nugget effect model

Pair	Avg. distance	Estimate
8	176.580	6.873
21	332.595	4.376
15	532.069	6.283
13	744.455	4.766
5	933.793	9.564
6	1150.293	6.666
4	1366.891	5.205
2	1523.485	0.934

direction 45 °

Variogram

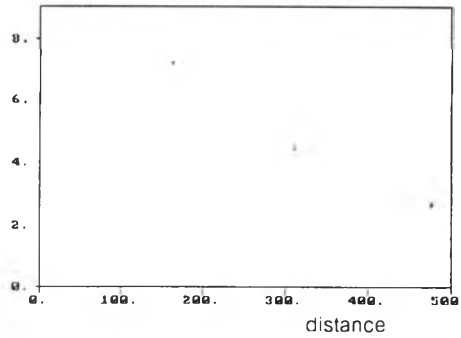


Pure nugget model

Pair	Avg. distance	Estimate
7	171.122	6.439
15	322.255	4.422
6	528.527	4.362
1	713.108	0.192

direction 67.5 °

Variogram

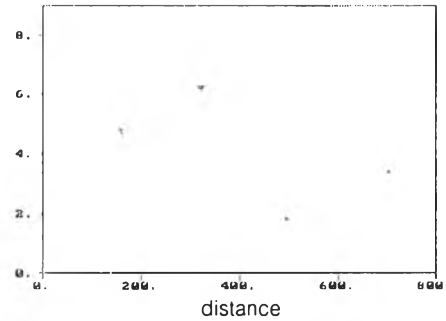


Pure nugget model

Pair	Avg. distance	Estimate
6	162.689	7.178
13	310.467	4.483
2	477.470	2.656

direction 90 °

Variogram

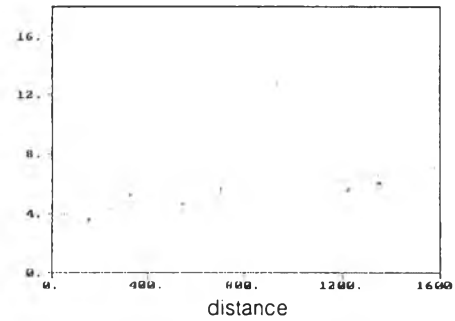


Pure nugget effect model

Pair	Avg. distance	Estimate
9	157.279	4.763
14	320.543	6.211
3	494.750	1.791
3	703.127	3.389

direction 112.5 °

Variogram



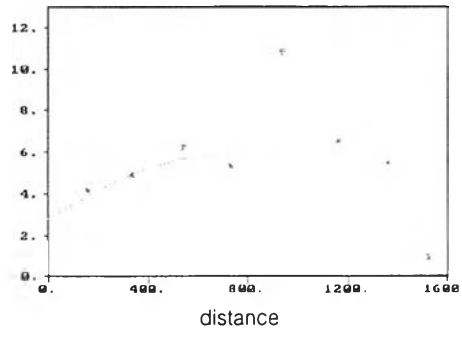
Linear model with nugget = 3.8,

R-major = 2000 m.

Pair	Avg. distance	Estimate
9	152.714	3.512
14	322.701	5.211
7	542.276	4.590
10	702.404	5.570
3	930.426	12.860
1	1224.031	5.611
2	1350.709	6.071

direction 135 °

Variogram



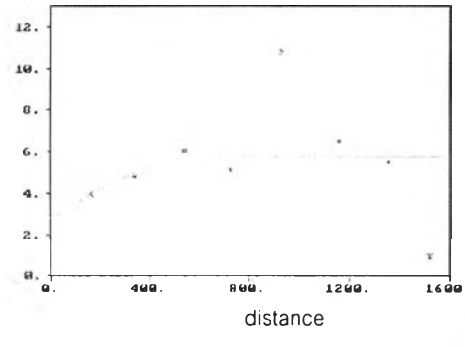
Spherical model with nugget = 2.8, sill = 3,

range = 650 m.

Pair	Avg. distance	Estimate
10	158.921	4.152
20	333.424	4.927
16	537.862	6.263
22	726.765	5.340
8	932.530	10.800
7	1160.827	6.516
6	1361.497	5.494
2	1523.485	0.934

direction 157.5 °

Variogram



Spherical model with nugget = 2.8, sill = 3,

range = 650 m.

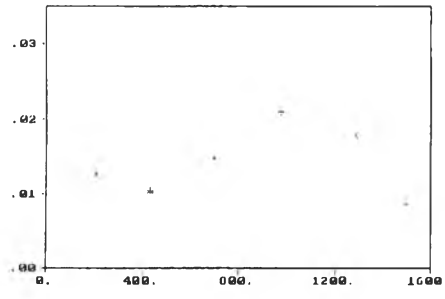
Pair	Avg. distance	Estimate
11	164.630	3.957
22	339.374	4.844
20	541.101	6.053
23	726.172	5.116
8	932.530	10.800
7	1160.827	6.516
6	1361.497	5.494
2	1523.485	0.934

Density (g/cc)

Fixed tolerance 45°, lag spacing 210 m.

direction 0 °

Variogram

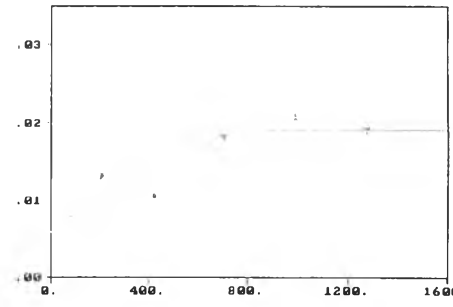


Pure nugget effect model

Pair	Avg. distance	Estimate
14	205.415	0.013
27	430.487	0.010
27	695.280	0.015
11	974.120	0.021
9	1288.351	0.018
3	1497.166	0.009

direction 22.5 °

Variogram

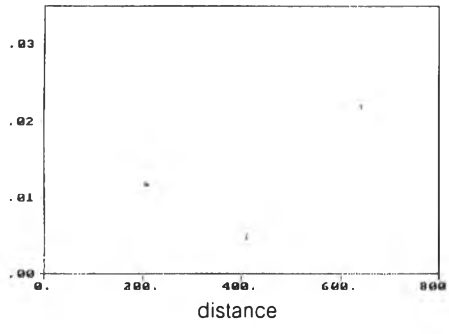


Spherical model with nugget = 0.006, sill = 0.013, range = 850 m.

Pair	Avg. distance	Estimate
14	205.889	0.013
21	419.124	0.011
15	705.307	0.018
13	990.505	0.021
5	1278.286	0.019
6	1497.166	0.009

direction 45 °

Variogram

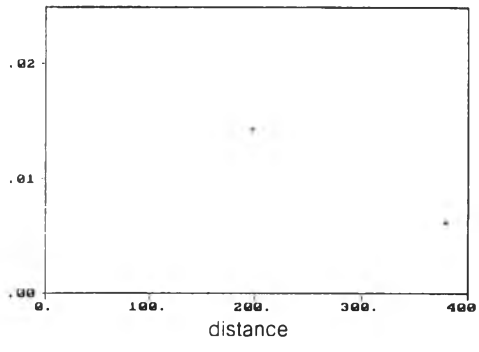


Pure nugget model

Pair	Avg. distance	Estimate
13	205.523	0.012
13	409.145	0.005
3	641.756	0.022

direction 67.5 °

Variogram

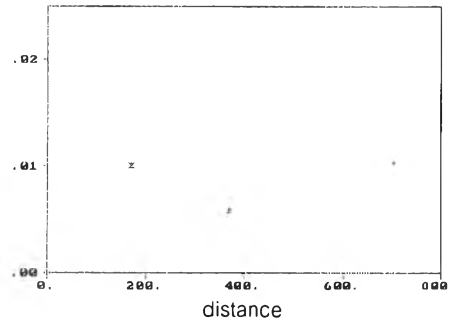


Pure nugget model

Pair	Avg. distance	Estimate
11	197.312	0.014
10	379.671	0.006

direction 90 °

Variogram

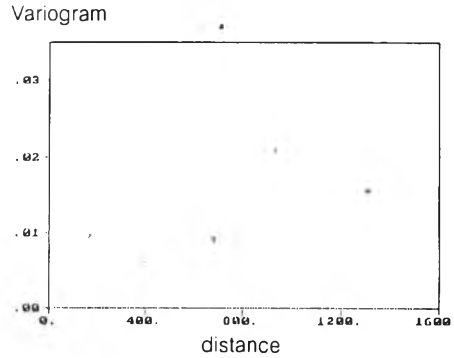


Pure nugget effect model

Pair	Avg. distance	Estimate
11	168.906	0.010
15	368.626	0.006
3	703.127	0.010

direction 112.5 °

Variogram

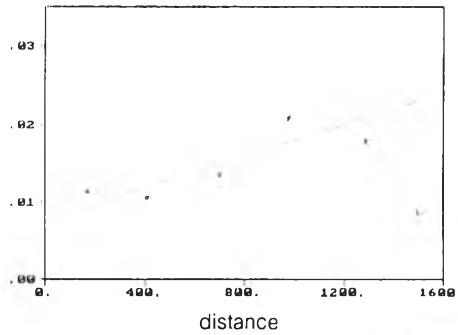


Pure nugget effect model

Pair	Avg. distance	Estimate
11	162.304	0.010
17	392.615	0.006
12	682.202	0.009
3	930.426	0.021
3	1308.483	0.015

direction 135 °

Variogram

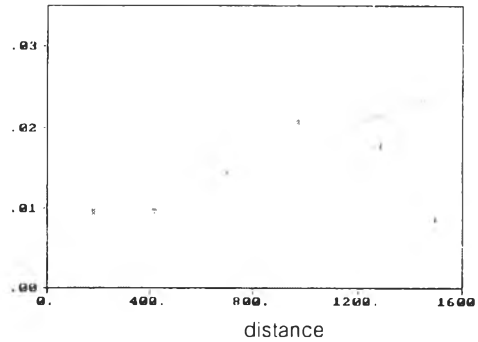


Linear model with nugget = .008, R-major = 1000 m.

Pair	Avg. distance	Estimate
12	171.833	0.011
29	408.057	0.011
27	702.099	0.014
11	974.120	0.021
8	1288.351	0.018
3	1497.166	0.009

direction 157.5 °

Variogram



Linear model with nugget = .006, R-major = 1000 m.

Pair	Avg. distance	Estimate
14	183.096	0.010
32	417.370	0.010
30	696.065	0.014
11	974.120	0.021
9	1288.351	0.018
3	1497.166	0.009

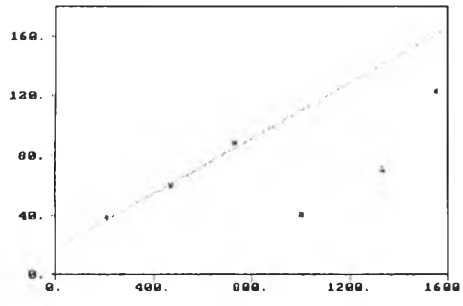
Test direction P4 seam, Sin Pun area

Ash Content (%)

Fixed tolerance 45°, lag spacing 300 m.

direction 0 °

Variogram

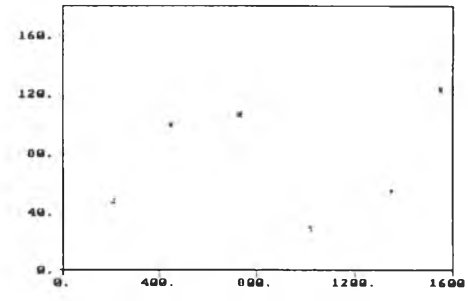


Linear model with nugget = 18, R-major = 500 m.

Pair	Avg. distance	Estimate
16	205.906	38.304
25	468.901	59.881
36	728.901	88.639
10	1001.407	40.687
16	1332.735	71.109
1	1553.327	123.402

direction 22.5 °

Variogram

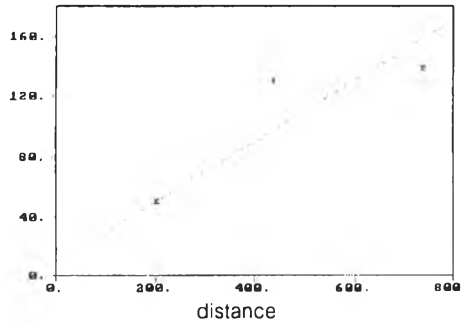


Pure nugget model

Pair	Avg. distance	Estimate
15	208.201	46.978
19	445.170	99.348
22	728.641	106.307
7	1020.456	28.858
10	1353.127	54.603
1	1553.327	123.402

direction 45 °

Variogram

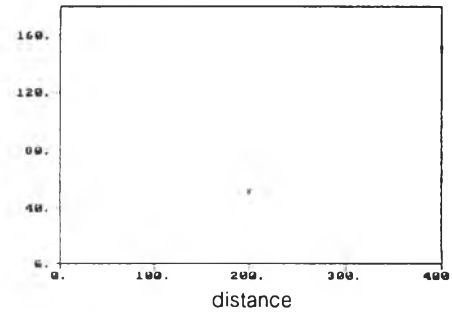


Linear model with nugget = .008, R-major = 1000 m.

Pair	Avg. distance	Estimate
15	201.274	50.352
10	437.233	130.439
3	738.052	138.530

direction 67.5 °

Variogram

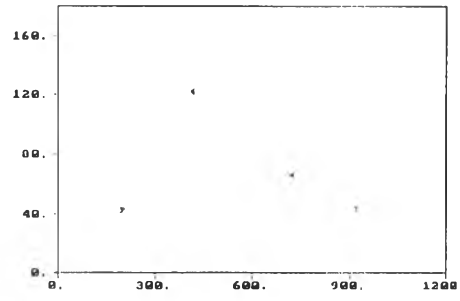


Pure nugget model

Pair	Avg. distance	Estimate
15	199.864	50.979
7	399.793	150.303

direction 90 °

Variogram

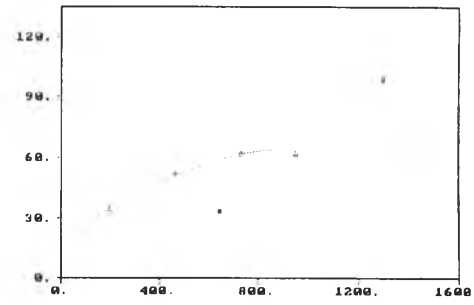


Pure nugget effect model

Pair	Avg. distance	Estimate
16	197.775	42.671
10	412.242	122.188
5	720.899	66.070
1	922.739	43.338

direction 112.5 °

Variogram

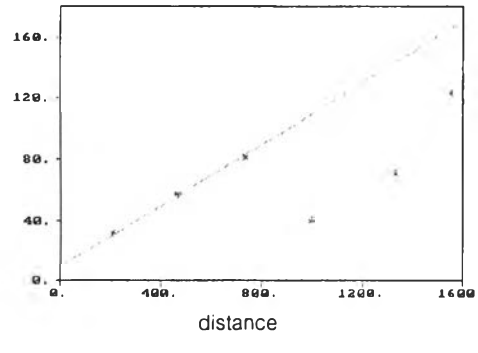


Spherical model with nugget = 20, sill = 44
range = 900 m.

Pair	Avg. distance	Estimate
17	196.229	34.761
16	460.280	51.956
19	727.097	62.241
4	948.403	62.050
6	1298.749	98.620

direction 135 °

Variogram

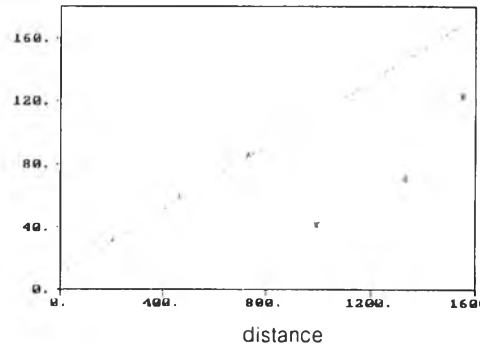


Linear model with nugget = .10, R-major = 500 m.

Pair	Avg. distance	Estimate
17	202.340	31.784
25	458.015	56.581
38	727.126	81.730
11	994.255	40.928
16	1332.735	71.109
1	1553.327	123.402

direction 157.5 °

Variogram



Linear model with nugget = 10, R-major = 500 m.

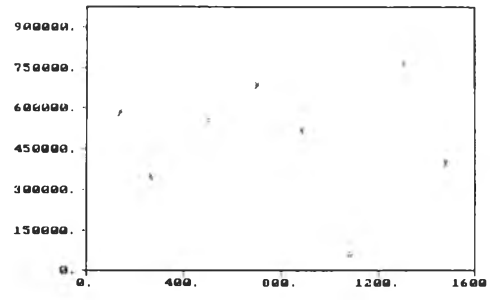
Pair	Avg. distance	Estimate
17	203.584	31.231
28	465.149	59.528
41	727.925	85.886
11	994.255	40.928
16	1332.735	71.109
1	1553.327	123.402

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 200 m.

direction 0 °

Variogram

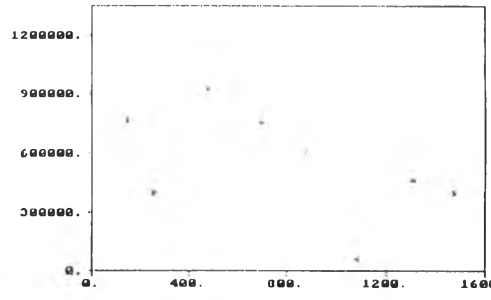


Pure nugget effect model

Pair	Avg. distance	Estimate
5	133.583	583673.9
15	261.789	347007.3
21	495.240	557917.3
28	698.144	683654.9
14	884.217	519502.3
4	1081.858	61686.75
13	1304.982	766113.1
4	1478.081	398308.8

direction 22.5 °

Variogram

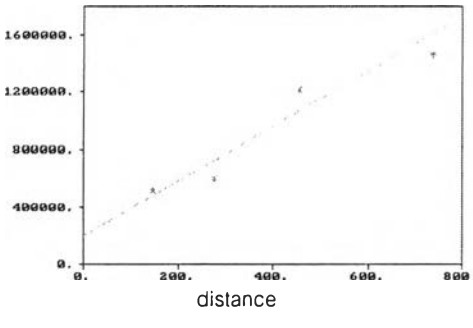


Pure nugget effect model

Pair	Avg. distance	Estimate
4	147.380	764528.3
15	255.813	397137
15	476.968	926132.9
17	697.182	750123.6
8	874.220	603637.8
4	1081.858	61686.75
7	1310.325	467318.8
4	1478.081	398308.8

direction 45 °

Variogram

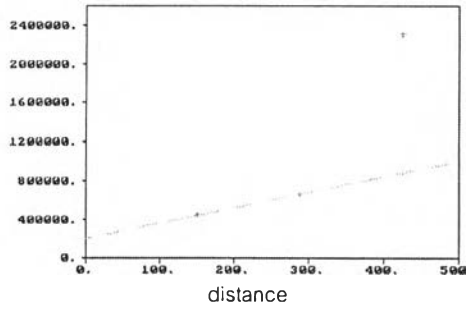


Linear model with nugget = 200000, R-major = 420 m.

Pair	Avg. distance	Estimate
6	146.119	518642.3
12	276.812	594546.8
7	456.141	1214220
3	738.052	1454384

direction 67.5 °

Variogram

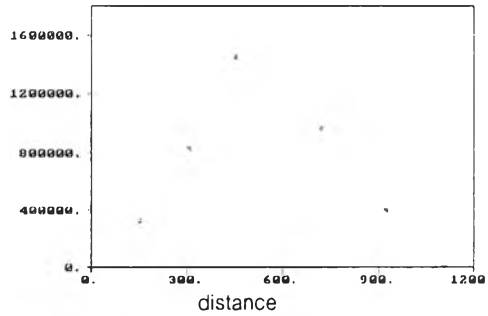


Linear model with nugget = 200000, R-major = 500 m.

Pair	Avg. distance	Estimate
7	150.913	450724.6
12	288.707	662244.9
3	425.212	2302065

direction 90 °

Variogram

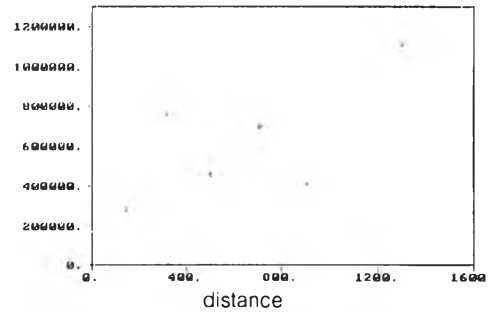


Pure nugget effect model

Pair	Avg. distance	Estimate
9	152.059	323903.3
12	306.495	823898.2
5	448.071	1451109
5	720.899	962848.3
1	922.739	396940.5

direction 112.5 °

Variogram

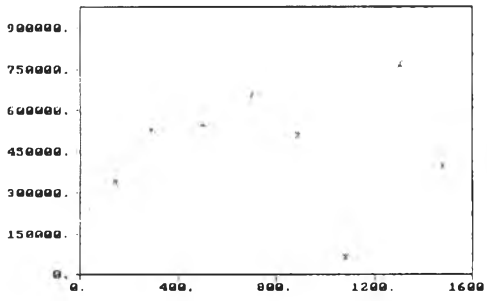


Linear model with nugget = 170000, R-major = 550 m.

Pair	Avg. distance	Estimate
10	144.693	277538.7
12	313.965	761236.2
11	498.715	461801.0
16	706.277	700279.9
7	901.145	405838.7
6	1298.749	1114707

direction 135 °

Variogram



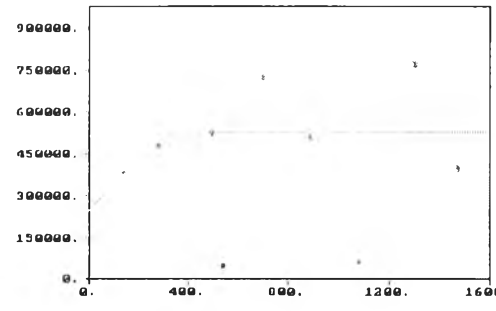
Spherical model with nugget = .200000, sill 350000

range = 400 m.

Pair	Avg. distance	Estimate
8	144.967	340205.7
15	285.535	530488.5
19	497.232	551172.0
30	697.946	653114.1
15	886.785	511331.5
4	1081.858	61686.75
13	1304.982	766113.1
4	1478.081	398308.8

direction 157.5 °

Variogram



Spherical model with nugget = 250000, sill = 280000

range = 450 m.

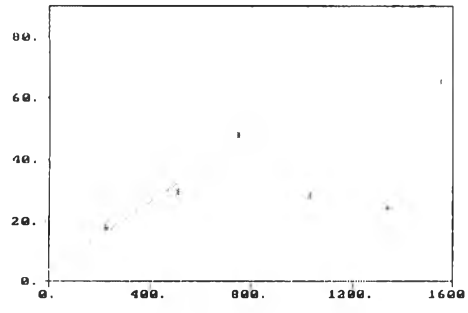
Pair	Avg. distance	Estimate
7	140.008	382632.5
15	276.019	476330.0
23	494.120	524591.8
33	701.592	725956.9
15	886.785	511331.5
4	1081.858	61686.75
13	1304.982	766113.1
4	1478.081	398308.8

Moisture Content (%)

Fixed tolerance 45°, lag spacing 310 m.

direction 0 °

Variogram

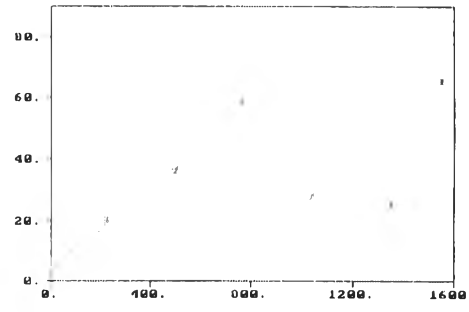


Linear model with nugget = 4, R-major = 450 m.

Pair	Avg. distance	Estimate
19	221.867	18.129
26	508.284	29.400
33	748.910	47.693
10	1032.843	28.169
15	1339.982	24.162
1	1553.327	65.437

direction 22.5 °

Variogram

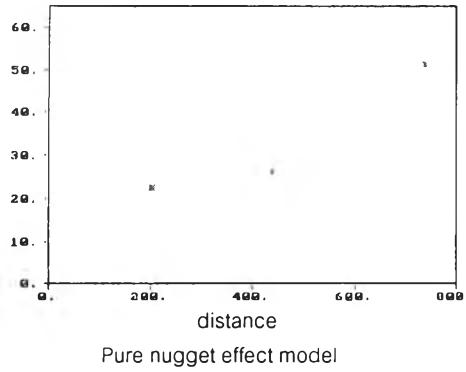


Linear model with nugget = 4, R-major = 450 m.

Pair	Avg. distance	Estimate
18	224.666	20.042
20	498.666	36.466
19	763.352	59.119
6	1038.921	27.943
10	1353.127	25.051
1	1553.327	65.437

direction 45 °

Variogram

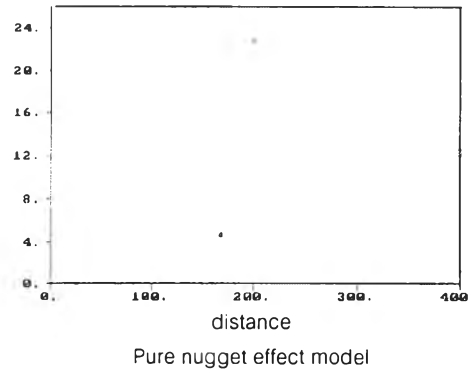


Pure nugget effect model

Pair	Avg. distance	Estimate
15	201.274	22.496
10	437.233	26.409
3	738.052	51.089

direction 67.5 °

Variogram

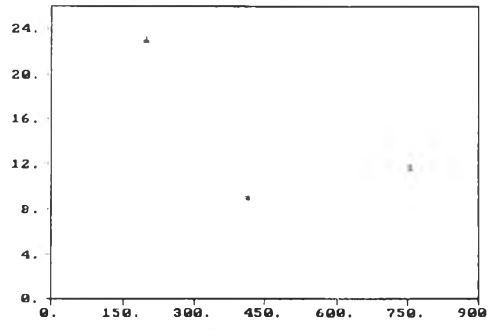


Pure nugget effect model

Pair	Avg. distance	Estimate
15	199.864	22.896
7	399.793	12.263

direction 90 °

Variogram

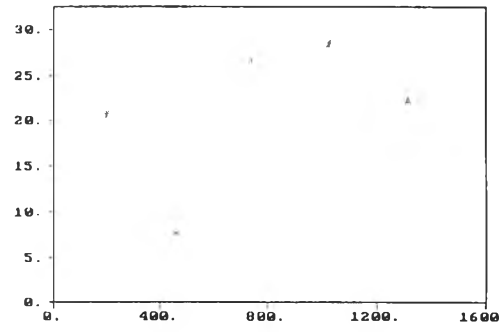


Pure nugget effect model

Pair	Avg. distance	Estimate
16	197.775	23.010
10	412.242	8.984
6	754.539	11.754

direction 112.5 °

Variogram

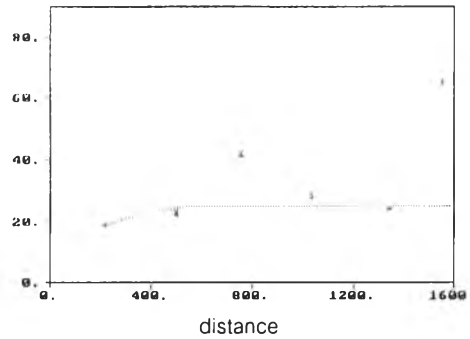


Pure nugget effect model

Pair	Avg. distance	Estimate
17	196.229	20.698
16	460.280	7.808
20	736.879	26.502
4	1023.726	28.507
5	1313.692	22.385
6	1298.749	28.177

direction 135 °

Variogram



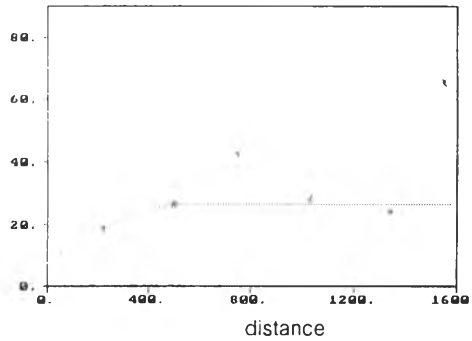
Spherical model with nugget = 12, sill 13

range = 600 m.

Pair	Avg. distance	Estimate
20	218.039	18.759
26	498.672	22.698
36	750.753	41.668
10	1032.843	28.169
15	1339.982	24.162
1	1553.327	65.437

direction 157.5 °

Variogram



Spherical model with nugget = 8, sill = 18.5

range = 550 m.

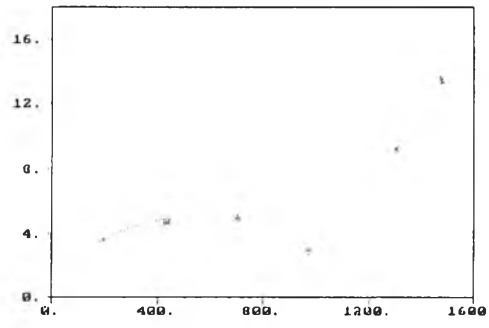
Pair	Avg. distance	Estimate
20	319.096	18.459
29	501.354	26.497
39	749.776	42.393
10	1032.843	28.169
15	1339.982	65.437
1	1553.327	33.033

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 280 m.

direction 0 °

Variogram



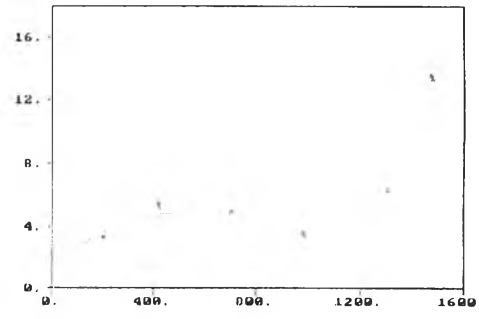
Spherical model with nugget = 2.3, sill = 2.6

range = 500 m.

Pair	Avg. distance	Estimate
14	194.571	3.665
23	431.566	4.749
37	702.174	53021
13	970.679	2.885
13	1304.982	9.248
4	1478.081	13.482

direction 22.5 °

Variogram



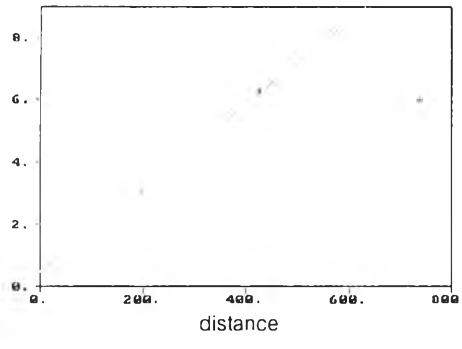
Spherical model with nugget = 1.8, sill = 3,

range = 500 m.

Pair	Avg. distance	Estimate
14	202.604	3.292
18	419.662	5.343
22	705.277	4.900
9	983.118	3.579
7	1310.325	6.318
4	1487.081	13.482

direction 45 °

Variogram

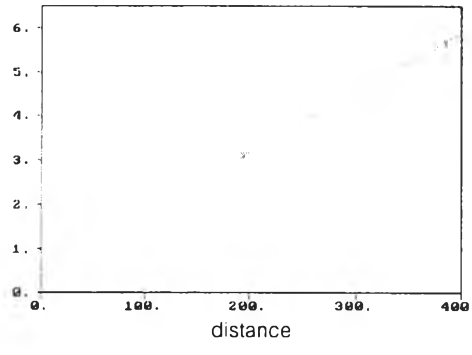


Linear model with nugget = 0.5, R-major = 410 m.

Pair	Avg. distance	Estimate
14	196.961	3..095
11	423.816	6.265
3	738.052	6.027

direction 67.5 °

Variogram

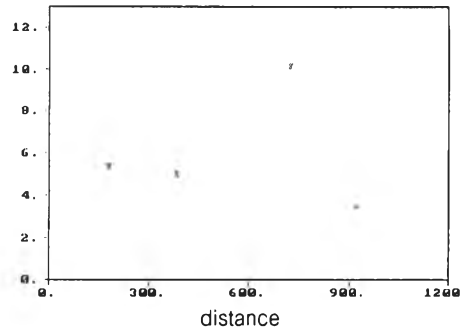


Linear model with nugget = 0.5, R-major = 410 m.

Pair	Avg. distance	Estimate
14	193.451	3.092
8	386.024	5.651

direction 90 °

Variogram

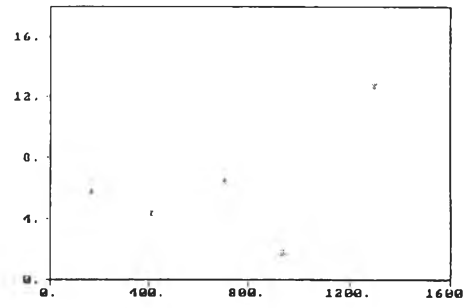


Pure nugget effect model

Pair	Avg. distance	Estimate
13	177.020	5.371
13	383.505	4.973
5	720.899	10.101
1	922.739	3.485

direction 112.5 °

Variogram

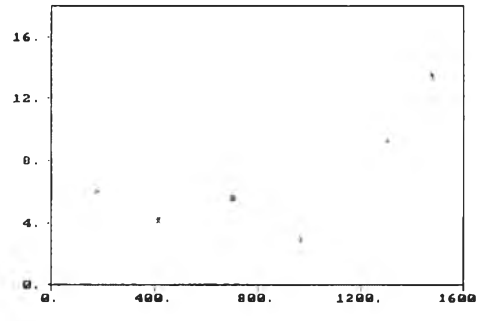


Pure nugget effect model

Pair	Avg. distance	Estimate
13	168.369	5.774
18	408.760	4.316
20	703.701	6.424
5	938.701	1.754
6	1298.749	12.666

direction 135 °

Variogram

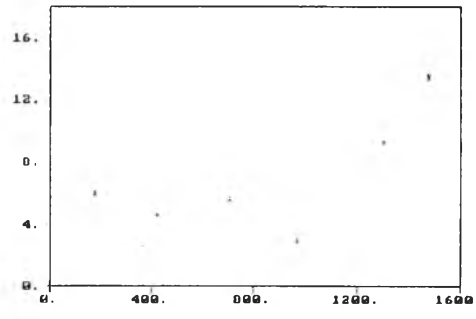


Pure nugget effect model

Pair	Avg. distance	Estimate
13	176.600	5.986
25	409.984	4.198
39	701.815	5.595
14	967.255	2.927
13	1304.982	13.482
4	1487.081	33.033

direction 157.5 °

Variogram



Pure nugget effect model

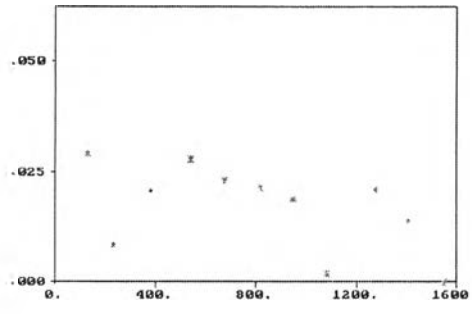
Pair	Avg. distance	Estimate
13	178.226	5.988
28	422.264	4.595
42	704.404	5.626
14	967.255	2.948
13	1304.982	9.248
4	1478.081	13.482

Density (g/cc)

Fixed tolerance 45°, lag spacing 150 m.

direction 0 °

Variogram

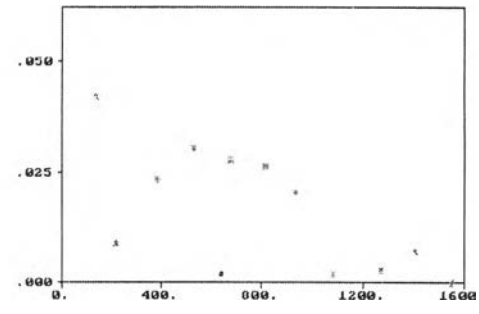


Pure nugget effect model

Pair	Avg. distance	Estimate
4	128.885	0.029
12	231.579	0.009
11	379.377	0.021
14	537.653	0.028
22	673.879	0.023
14	815.365	0.022
6	947.773	0.019
4	1081.858	0.002
9	1274.708	0.021
7	1407.341	0.004
1	1553.327	0.000

direction 22.5 °

Variogram

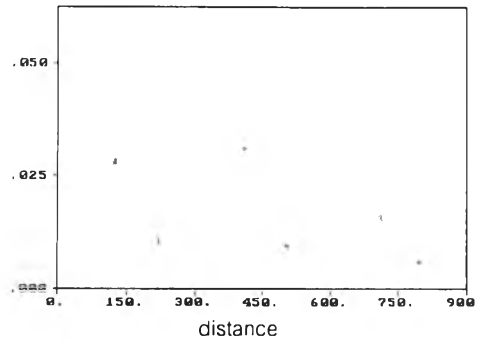


Pure nugget effect model

Pair	Avg. distance	Estimate
2	137.299	0.074
13	219.109	0.009
11	383.318	0.023
8	530.217	0.030
14	678.186	0.028
8	816.937	0.026
3	938.587	0.021
4	1081.858	0.002
4	1269.106	0.003
6	1409.141	0.007
1	1553.327	0.000

direction 45 °

Variogram

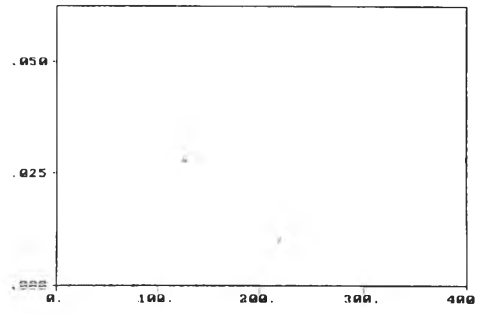


Pure nugget effect model

Pair	Avg. distance	Estimate
3	125.595	0.028
12	220.193	0.011
7	409.105	0.031
3	502.866	0.009
2	709.067	0.016
1	796.022	0.006

direction 67.5 °

Variogram

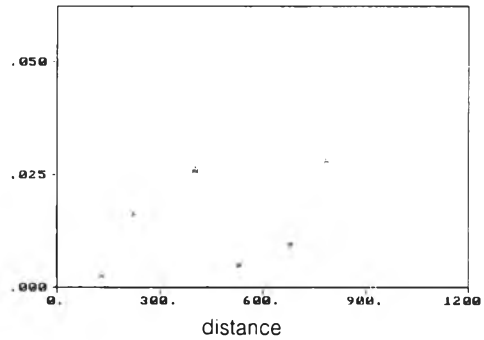


Pure nugget effect model

Pair	Avg. distance	Estimate
3	125.595	0.028
12	218.431	0.010
7	399.793	0.028

direction 90 °

Variogram

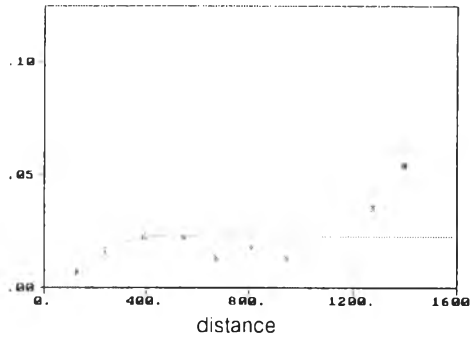


Pure nugget effect model

Pair	Avg. distance	Estimate
4	129.587	0.003
12	220.504	0.016
9	399.235	0.026
1	529.311	0.005
3	679.298	0.009
2	783.300	0.028
1	922.739	0.000

direction 112.5 °

Variogram

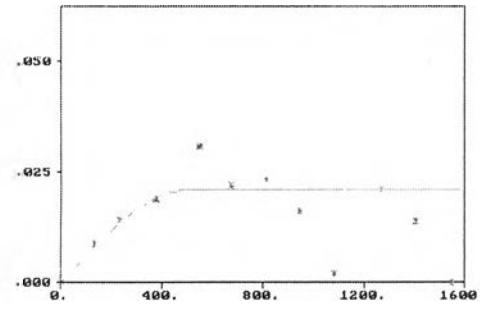


Spherical model with nugget = 0, sill = 0.023
range = 450 m.

Pair	Avg. distance	Estimate
6	126.549	.007
11	234.236	.017
9	394.419	.023
7	544.959	.022
11	669.875	.013
8	805.777	.018
4	948.403	.013
5	1279.190	.036
1	1396.542	0.54

direction 135 °

Variogram



distance

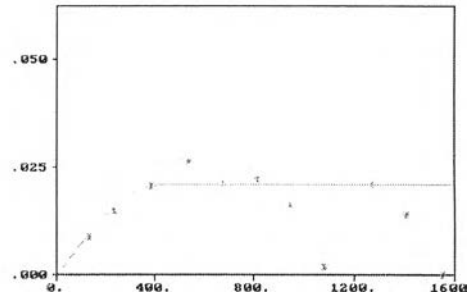
Spherical model with nugget = 0, sill = 0.021

range = 500 m.

Pair	Avg. distance	Estimate
5	131.421	0.009
12	231.890	0.014
13	377.117	0.019
12	545.655	0.031
23	671.526	0.022
15	812.379	0.023
7	944.196	0.016
4	1081.858	0.002
9	1274.708	0.021
7	1407.341	0.014
1	1553.327	0.000

direction 157.5 °

Variogram



distance

Spherical model with nugget = 0, sill = 0.021

range = 420 m.

Pair	Avg. distance	Estimate
5	131.421	0.009
12	233.653	0.015
13	382.132	0.021
15	537.097	0.026
25	674.529	0.021
16	811.357	0.022
7	944.196	.0.016
4	1081.858	0.002
9	1274.708	0.021
7	1407.341	0.014
1	1553.327	0.000

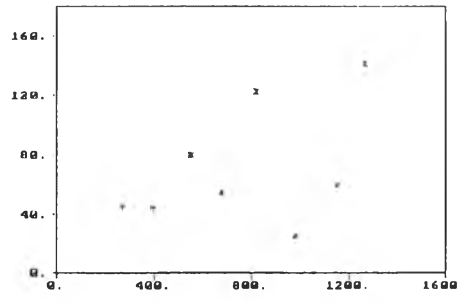
Test direction M seam, Sin Pun area

Ash Content (%)

Fixed tolerance 45°, lag spacing 170 m.

direction 0 °

Variogram

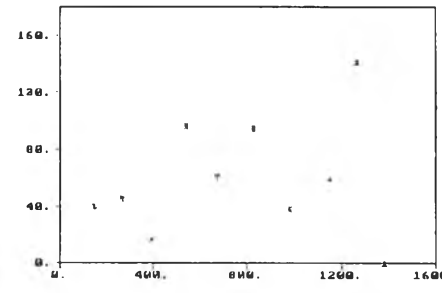


Pure nugget effect model

Pair	Avg. distance	Estimate
2	268.280	44.931
8	395.046	43.456
3	545.554	79.493
5	673.429	54.520
3	817.962	123.101
3	978.564	25.212
2	1150.490	59.199
1	1267.046	141.624
1	1383.215	0.146

direction 22.5 °

Variogram

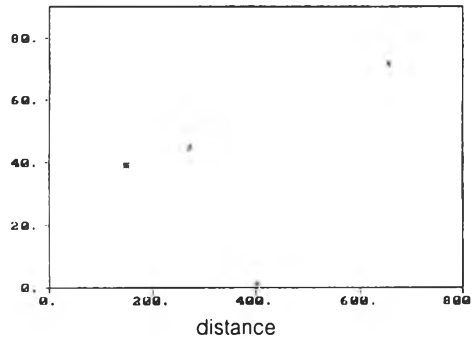


Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	39.250
2	268.280	44.931
7	395.610	16.647
2	540.643	96.630
4	672.276	60.427
2	828.335	94.401
2	977.760	37.761
2	1150.490	59.199
1	1267.046	141.624
1	1383.215	0.146

direction 45 °

Variogram

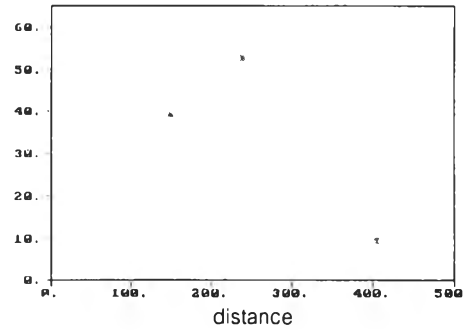


Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	39.250
2	248.280	44.931
3	400.705	1.186
3	657.367	71.640

direction 67.5 °

Variogram

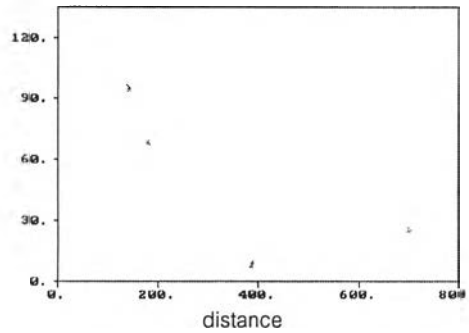


Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	39.250
3	238.746	52.691
4	404.880	9.495

direction 90 °

Variogram

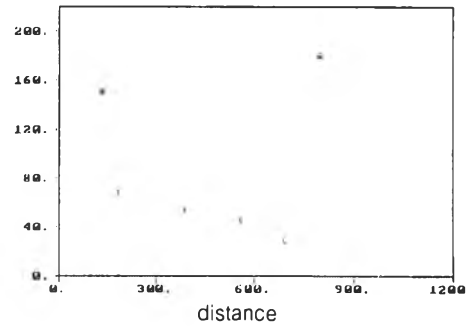


Pure nugget effect model

Pair	Avg. distance	Estimate
2	140.059	95.054
1	179.679	68.211
4	386.554	8.705
1	701.850	25.490

direction 112.5 °

Variogram

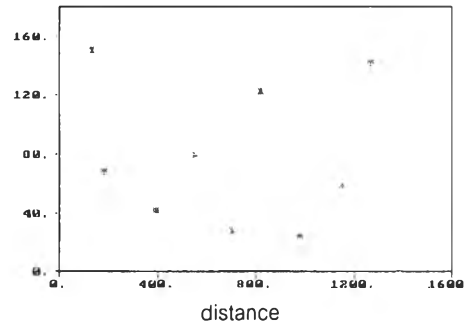


Pure nugget effect model

Pair	Avg. distance	Estimate
1	131.256	150.858
1	179.679	68.211
5	387.462	53.187
1	555.375	45.220
2	689.946	28.190
1	797.216	180.500
1	980.171	0.115

direction 135 °

Variogram

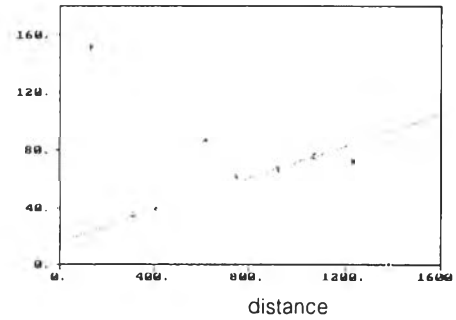


Pure nugget effect model

Pair	Avg. distance	Estimate
1	131.256	150.858
1	179.679	68.211
9	389.385	42.101
3	545.554	79.493
3	698.964	27.724
3	817.962	123.101
3	978.564	25.212
2	1150.490	59.199
1	1267.046	141.624
1	1383.215	0.146

direction 157.5 °

Variogram



Linear model with nugget = 16, R-major = 450 m.

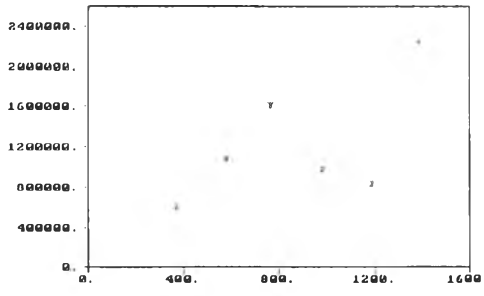
Pair	Avg. distance	Estimate
1	131.256	150.858
1	309.798	34.778
8	408.197	39.008
5	617.077	86.997
5	744.872	61.844
3	921.584	66.612
2	1068.218	75.621
2	1232.005	71.621
1	1383.215	0.146

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 220 m.

direction 0 °

Variogram

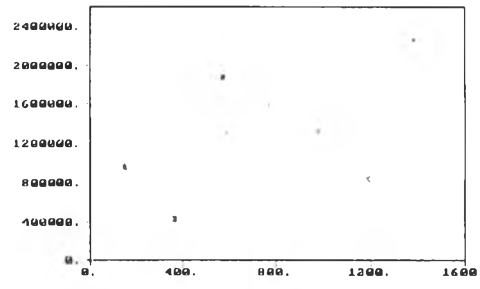


Pure nugget effect model

Pair	Avg. distance	Estimate
10	369.693	600695.1
5	579.131	1080064
6	760.339	1607030
3	978.564	985897.7
3	1189.342	839694.3
1	1383.215	2251442

direction 22.5 °

Variogram

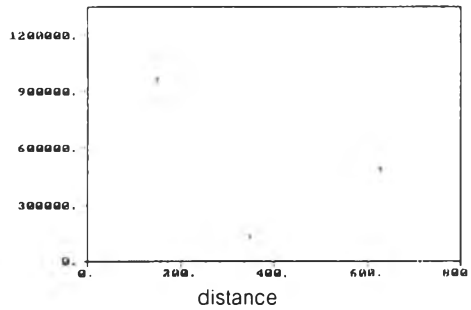


Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	963272
9	367.315	423128.5
4	585.070	1318202
4	771.694	1599103
2	977.760	1323216
3	1189.342	839694.3
1	1383.215	2251442

direction 45 °

Variogram

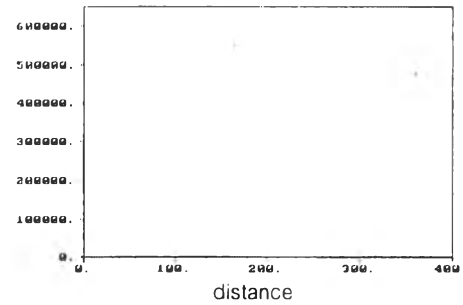


Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	963272
5	347.735	133101
2	629.498	488688.3
1	713.108	2112.5

direction 67.5 °

Variogram

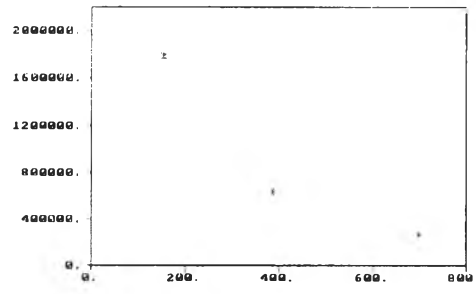


Pure nugget model

Pair	Avg. distance	Estimate
2	164.271	547942.3
6	238.746	475732.3

direction 90 °

Variogram

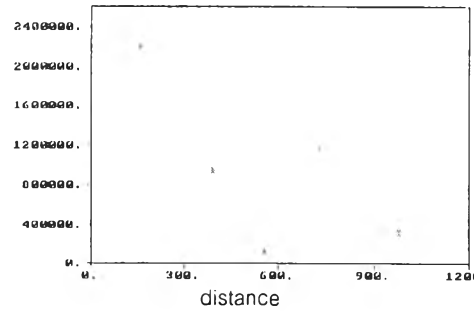


Pure nugget effect model

Pair	Avg. distance	Estimate
3	153.266	1787335
4	386.554	636192.4
1	701.850	269378

direction 112.5 °

Variogram

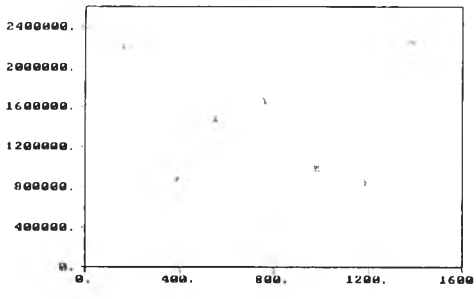


Pure nugget effect model

Pair	Avg. distance	Estimate
2	155.467	2199367
5	387.462	948712.8
1	555.375	127512.5
3	725.703	1171716
1	980.171	311260.5

direction 135 °

Variogram

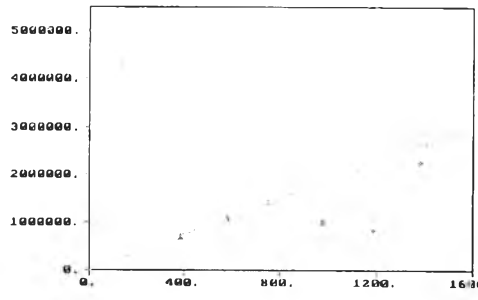


Pure nugget effect model

Pair	Avg. distance	Estimate
2	155.467	2199367
9	389.385	876246.2
3	545.554	1474314
6	758.463	1651574
3	978.564	985897.7
3	1189.342	839694.3
1	1383.215	2251442

direction 157.5 °

Variogram



Linear model with nugget = 0, R-major = 400 m.

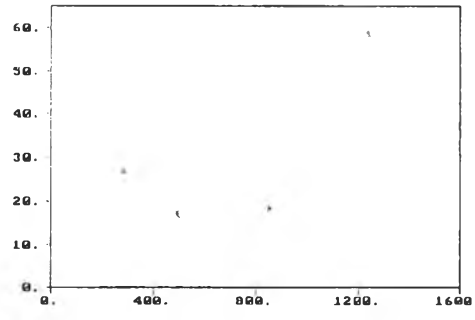
Pair	Avg. distance	Estimate
1	131.256	4266121
8	385.883	712165.9
5	579.131	1080064
7	751.984	1415937
3	978.564	985897.7
3	1189.342	839694.3
1	1383.215	2251442

Moisture Content (%)

Fixed tolerance 45°, lag spacing 350 m.

direction 0 °

Variogram

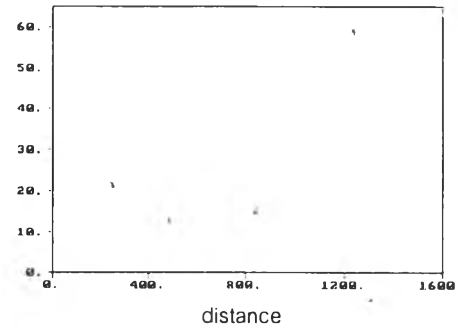


Pure nugget effect model

Pair	Avg. distance	Estimate
3	282.119	26.796
13	494.174	17.110
8	852.461	18.319
4	1237.810	58.680

direction 22.5 °

Variogram

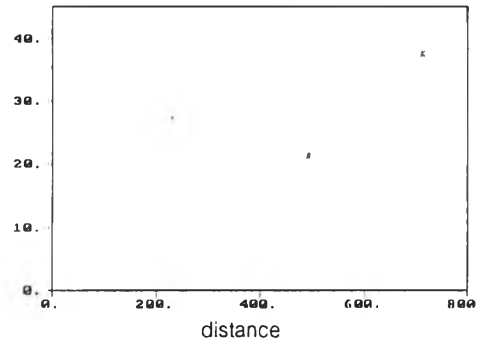


Pure nugget model

Pair	Avg. distance	Estimate
4	248.805	21.222
10	479.976	12.775
6	840.383	15.057
4	1237.810	58.680

direction 45 °

Variogram

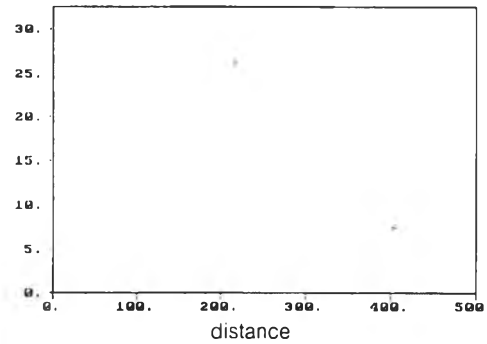


Pure nugget model

Pair	Avg. distance	Estimate
3	228.474	27.368
5	492.222	21.497
1	713.108	37.498

direction 67.5 °

Variogram

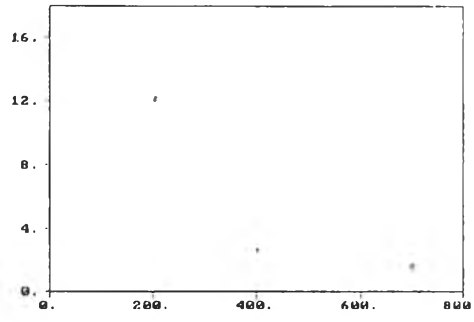


Pure nugget model

Pair	Avg. distance	Estimate
4	216.275	26.120
4	404.880	7.537

direction 90 °

Variogram

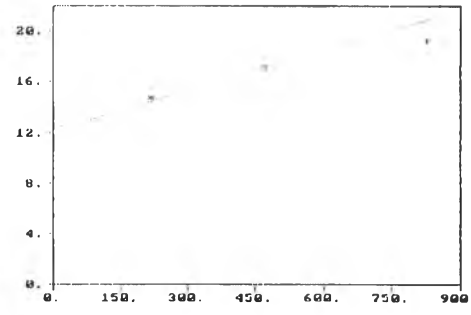


Pure nugget effect model

Pair	Avg. distance	Estimate
4	201.419	12.059
3	400.113	2.590
1	701.850	1.584

direction 112.5 °

Variogram

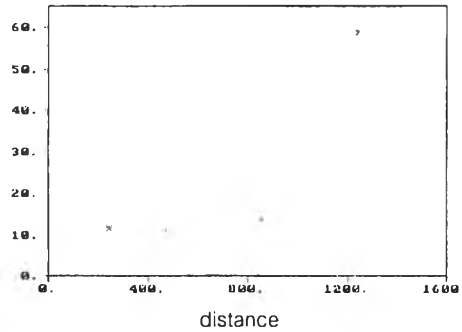


Linear model with nugget = 12.2, R-major = 480 m.

Pair	Avg. distance	Estimate
3	218.938	14.578
6	470.808	17.073
3	826.412	19.265

direction 135 °

Variogram

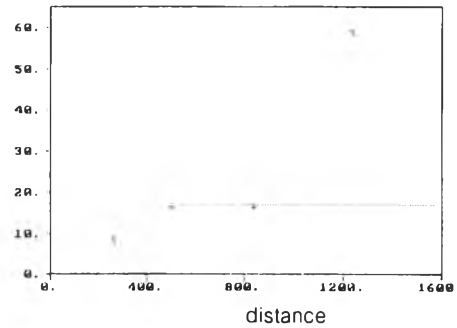


Pure nugget effect model

Pair	Avg. distance	Estimate
4	241.653	11.630
11	469.409	11.155
8	851.053	13.830
4	1237.810	58.680

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 17,

range = 600 m.

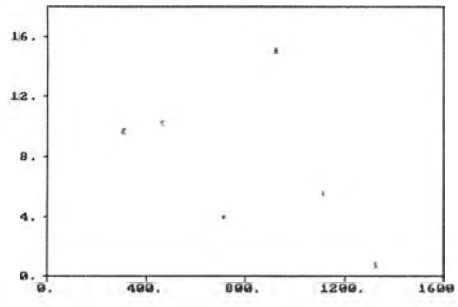
Pair	Avg. distance	Estimate
3	262.311	8.047
12	500.424	16.671
9	835.726	16.460
4	1237.810	58.680

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 200 m.

direction 0 °

Variogram



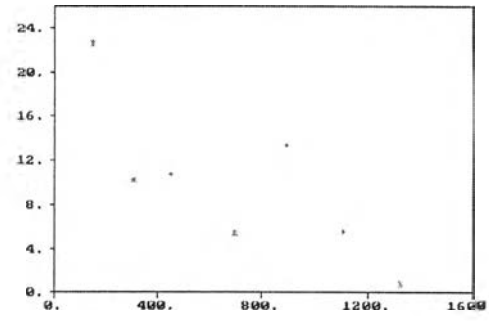
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
4	303.204	9.644
9	457.864	10.215
7	708.507	3.978
3	921.584	15.052
3	1111.133	5.528
2	1325.130	0.769

direction 22.5 °

Variogram



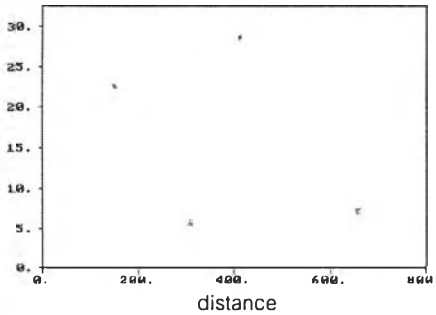
distance

Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	22.579
4	307.269	10.213
7	451.149	10.778
5	696.858	5.500
2	892.291	13.367
3	1111.133	5.528
2	1325.130	0.769

direction 45 °

Variogram



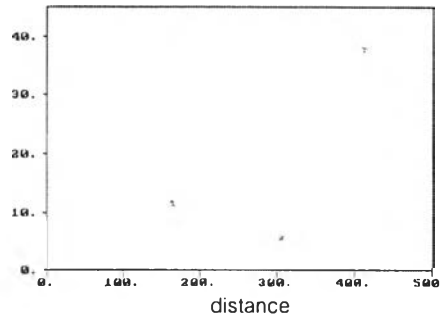
distance

Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	22.579
3	306.426	5.706
2	409.698	28.523
3	657.368	7.151

direction 67.5 °

Variogram



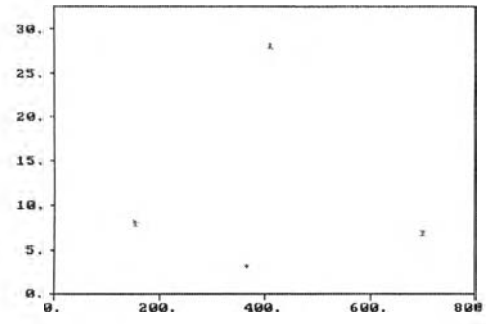
distance

Pure nugget model

Pair	Avg. distance	Estimate
2	164.271	11.626
3	306.426	5.706
3	412.268	37.726

direction 90 °

Variogram

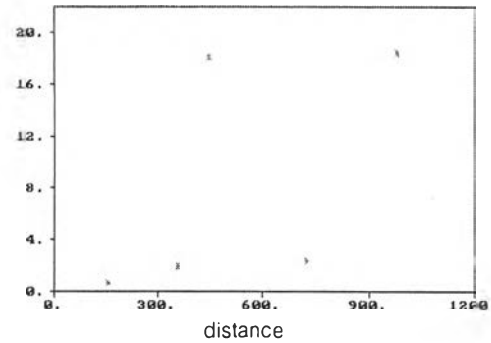


Pure nugget effect model

Pair	Avg. distance	Estimate
3	153.266	7.999
2	364.298	3.116
2	408.810	28.074
1	701.850	6.845

direction 112.5 °

Variogram

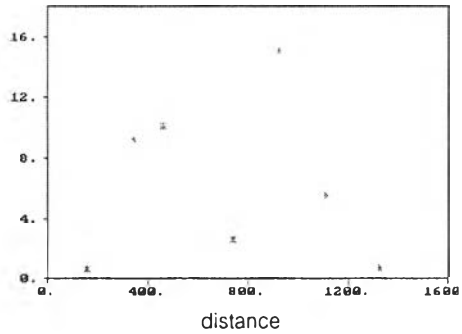


Pure nugget effect model

Pair	Avg. distance	Estimate
2	155.467	0.708
2	356.167	1.978
4	445.088	18.161
3	725.703	2.397
1	980.171	18.422

direction 135 °

Variogram

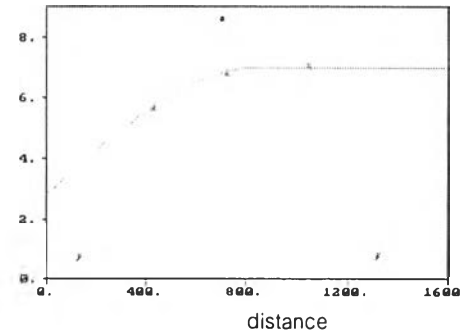


Pure nugget effect model

Pair	Avg. distance	Estimate
2	155.467	0.708
3	340.711	9.230
9	457.666	10.116
5	737.859	2.648
3	921.584	15.052
3	1111.133	5.528
2	1325.130	0.769

direction 157.5 °

Variogram



Spherical model with nugget = 2.8, sill = 4.2, range = 850 m.

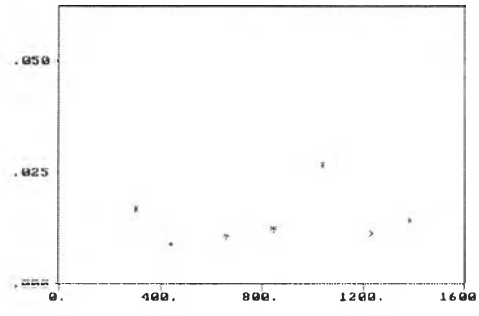
Pair	Avg. distance	Estimate
1	131.256	0.744
11	429.429	5.691
9	724.765	6.807
5	1047.334	7.034
2	1325.130	0.769

M Seam, Density (g/cc)

Fixed tolerance 45°, lag spacing 190 m.

direction 0 °

Variogram



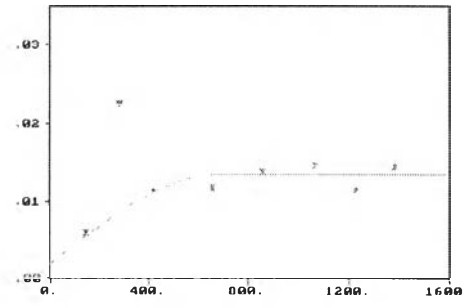
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
4	303.204	0.017
8	440.945	0.009
6	660.020	0.011
4	844.246	0.012
3	1038.869	0.027
2	1232.005	0.012
1	1383.215	0.014

direction 22.5 °

Variogram



distance

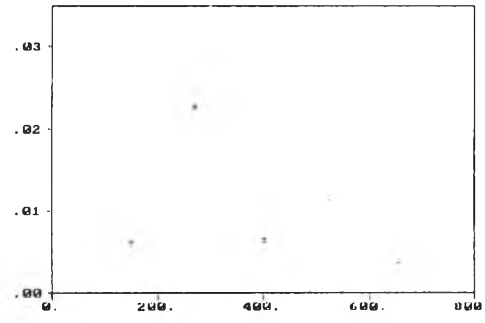
Spherical model with nugget = 0.002, sill = 0.0115

range = 700 m.

Pair	Avg. distance	Estimate
1	148.862	0.006
3	282.119	0.022
7	421.113	0.011
5	656.415	0.012
3	859.923	0.014
2	1068.218	0.015
2	1232.005	0.012
1	1383.215	0.014

direction 45 °

Variogram



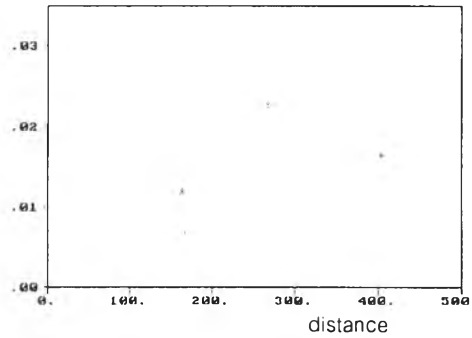
distance

Pure nugget model

Pair	Avg. distance	Estimate
1	148.862	0.006
2	268.280	0.023
3	400.705	0.006
3	657.368	0.004

direction 67.5 °

Variogram



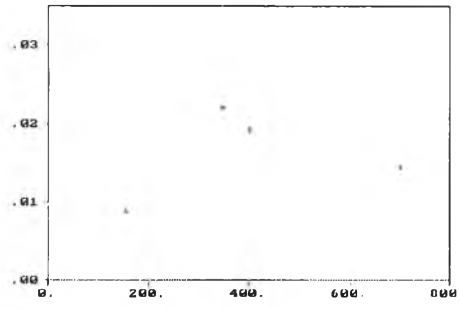
distance

Pure nugget model

Pair	Avg. distance	Estimate
2	164.271	0.012
2	268.280	0.023
4	404.880	0.016

direction 90 °

Variogram

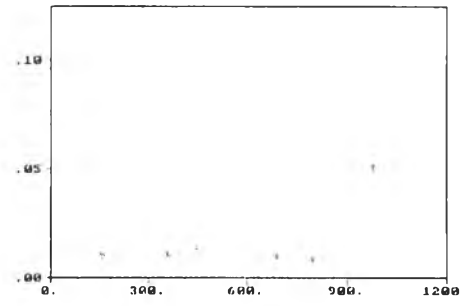


Pure nugget effect model

Pair	Avg. distance	Estimate
3	153.266	0.009
1	345.878	0.022
3	400.113	0.019
1	701.850	0.014

direction 112.5 °

Variogram

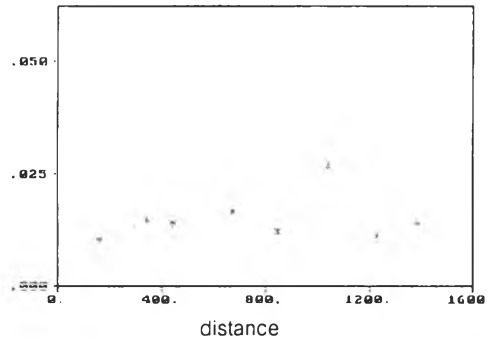


Pure nugget effect model

Pair	Avg. distance	Estimate
2	155.467	0.010
2	356.167	0.011
4	445.088	0.013
2	689.946	0.010
1	797.216	0.008
1	980.171	0.051

direction 135 °

Variogram

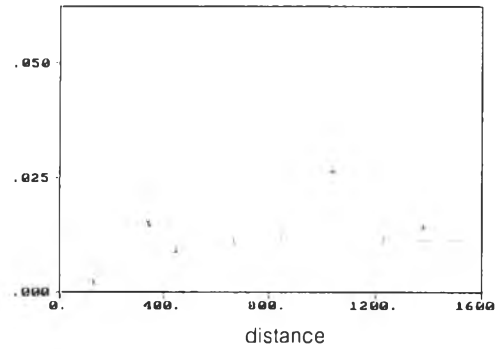


Spherical model with nugget = 0.005, sill = 0.011, range = 500 m.

Pair	Avg. distance	Estimate
2	155.467	0.010
3	340.711	0.015
8	440.753	0.014
4	672.466	0.017
4	844.246	0.012
3	1038.869	0.027
2	1232.005	0.012
1	1383.215	0.014

direction 157.5 °

Variogram



Spherical model with nugget = 0, sill = 0.0115, range = 700 m.

Pair	Avg. distance	Estimate
1	131.256	0.002
3	340.711	0.015
7	444.088	0.009
7	665.995	0.011
4	844.246	0.012
3	1038.869	0.027
2	1232.005	0.012
1	1383.215	0.014

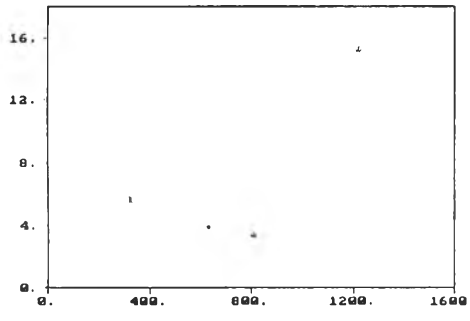
Test direction S1 seam, Saba Yoi area

Ash Content (%)

Fixed tolerance 45°, lag spacing 240 m.

direction 0 °

Variogram



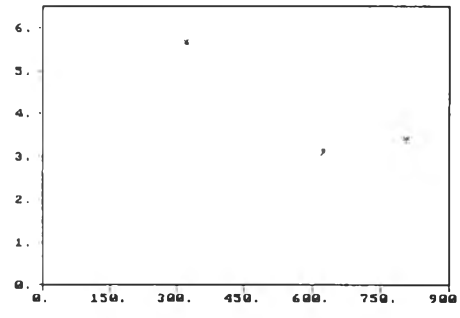
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
5	321.700	5.653
8	632.001	3.915
3	806.957	3.386
1	1221.472	15.235

direction 22.5 °

Variogram



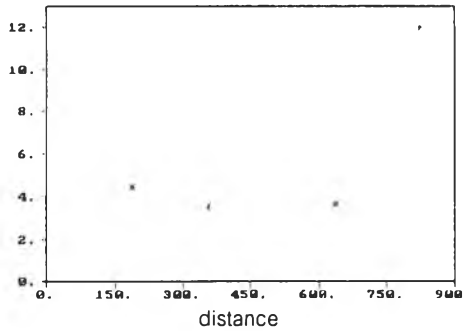
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
5	321.700	5.653
9	622.504	3.104
3	806.957	3.386

direction 45 °

Variogram



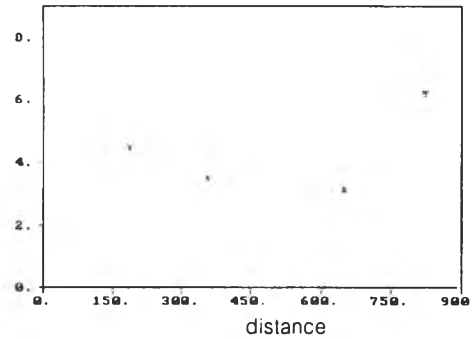
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	4.440
5	356.217	3.518
6	637.687	3.662
1	821.607	11.956

direction 67.5 °

Variogram



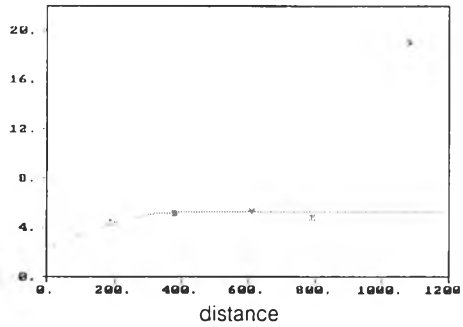
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	4.440
5	356.217	3.518
6	650.970	3.145
2	823.425	6.190

direction 90 °

Variogram

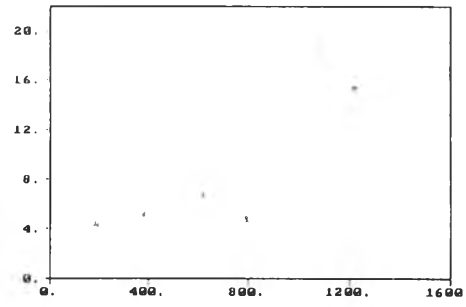


Spherical model with nugget = 2.2, sill = 3
range = 380 m.

Pair	Avg. distance	Estimate
1	186.733	4.440
6	377.978	5.137
7	609.168	5.308
3	790.560	4.841
2	1082.398	18.989

direction 112.5 °

Variogram

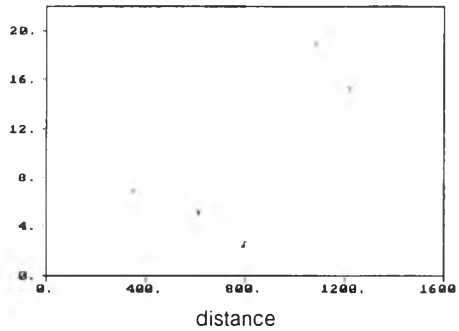


Pure nugget model

Pair	Avg. distance	Estimate
1	186.733	4.440
6	377.978	5.137
6	619.609	6.756
3	790.860	4.841
2	1082.398	18.989
1	1221.472	15.235

direction 135 °

Variogram

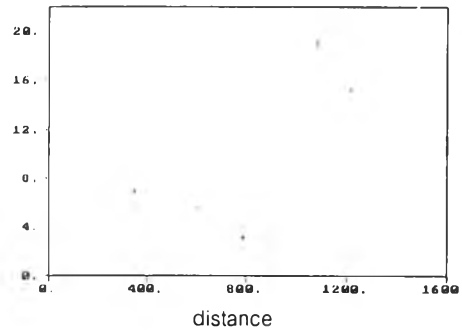


Pure nugget effect model

Pair	Avg. distance	Estimate
6	349.213	6.916
9	610.451	5.167
5	794.369	2.545
2	1082.398	18.989
1	1221.472	15.235

direction 157.5 °

Variogram



Pure nugget effect model

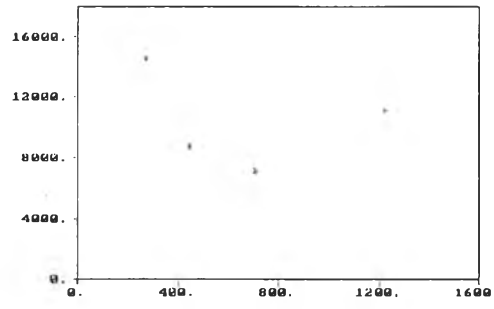
Pair	Avg. distance	Estimate
6	349.213	6.916
9	601.596	5.512
4	786.650	3.075
2	1082.398	18.989
1	1221.472	15.235

Calorific Value (Kcal/Kg)

Fixed tolerance 45°, lag spacing 300 m.

direction 0 °

Variogram



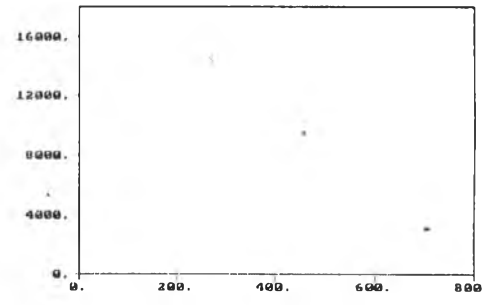
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
2	267.273	14533.25
5	441.299	8761.900
9	704.926	7098.722
1	1221.472	11100.500

direction 22.5 °

Variogram



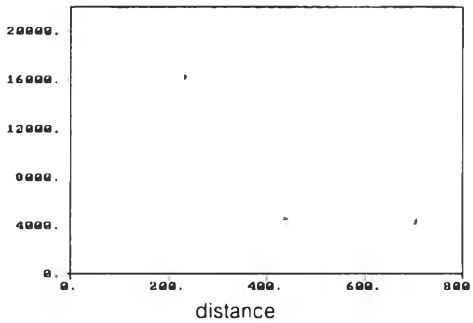
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
2	267.273	14533.25
6	457.197	9488.583
9	706.019	3119.111

direction 45 °

Variogram



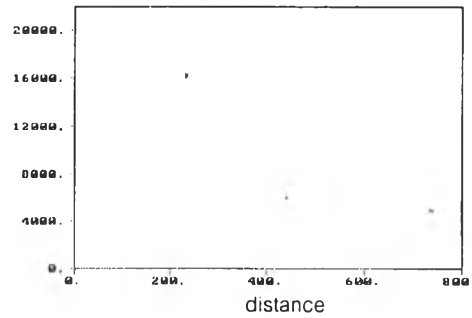
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
2	232.965	16224.500
6	437.682	4465.333
5	704.706	4372.300

direction 67.5 °

Variogram



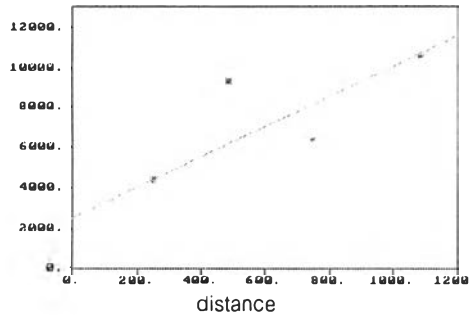
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
2	186.733	16224.5
6	356.217	6000.583
6	737.662	4968.917

direction 90 °

Variogram

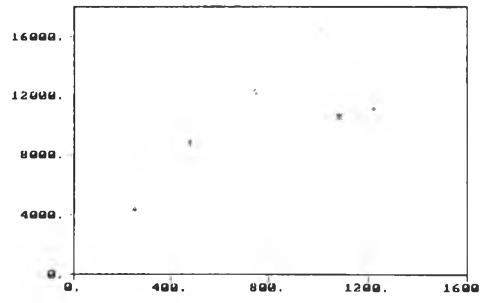


Linear model with nugget = 2500, R-major = 530 m.

Pair	Avg. distance	Estimate
3	251.306	4373.667
8	483.221	9295.063
6	745.279	6332.917
2	1082.398	10600

direction 112.5 °

Variogram

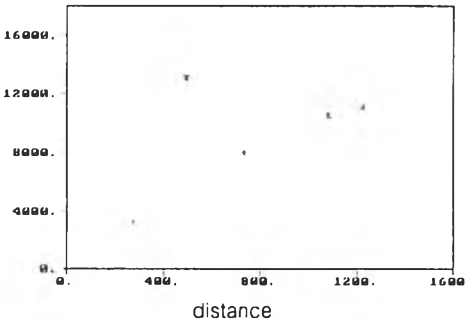


Linear model with nugget = 500, R-major = 440 m.

Pair	Avg. distance	Estimate
3	186.733	4373.667
7	377.978	8748.357
6	619.609	12302.33
2	790.860	10600.0
1	1221.472	11100.5

direction 135 °

Variogram

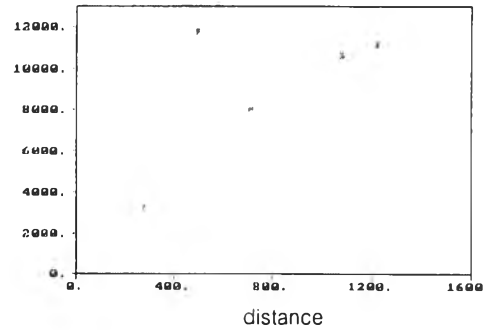


Pure nugget effect model

Pair	Avg. distance	Estimate
3	274.177	3246.167
7	492.311	13054
10	729.248	8002.45
2	1082.398	10600
1	1221.472	11100.5

direction 157.5 °

Variogram



Pure nugget effect model

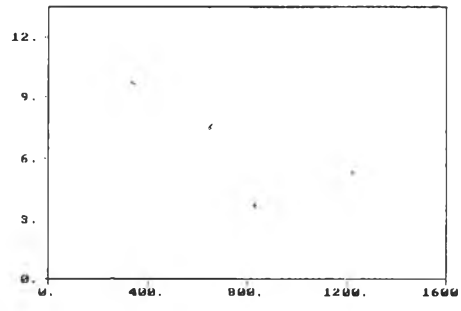
Pair	Avg. distance	Estimate
3	274.177	3246.167
7	491.954	11738.07
9	710.004	8008.056
2	1082.398	10600.000
1	1221.472	11100.500

Moisture Content (%)

Fixed tolerance 45°, lag spacing 260 m.

direction 0 °

Variogram

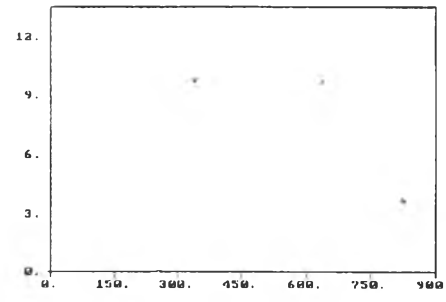


Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.076
4	338.287	9.724
9	647.601	7.531
2	824.182	3.681
1	1221.472	5.314

direction 22.5 °

Variogram

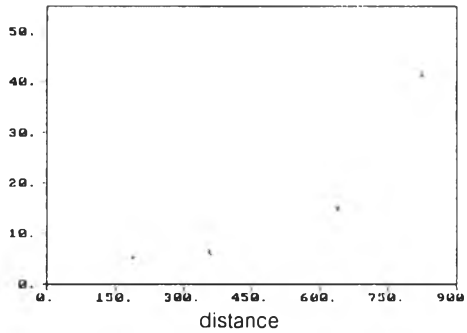


Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.076
4	338.287	9.724
10	637.504	9.669
2	824.182	3.681

direction 45 °

Variogram

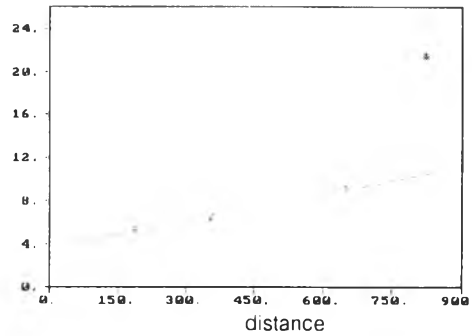


Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	5.346
5	356.217	6.449
6	637.687	15.027
1	821.607	41.587

direction 67.5 °

Variogram

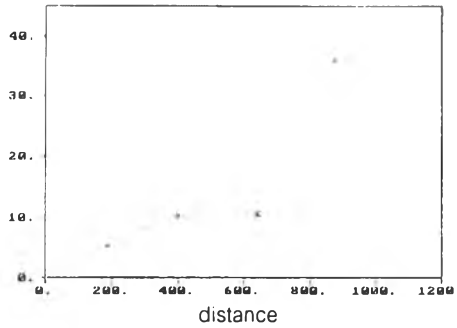


Linear model with nugget = 3.6, R-major = 600 m.

Pair	Avg. distance	Estimate
1	186.733	5.346
5	356.217	6.449
6	650.970	9.144
2	823.425	21.418

direction 90 °

Variogram



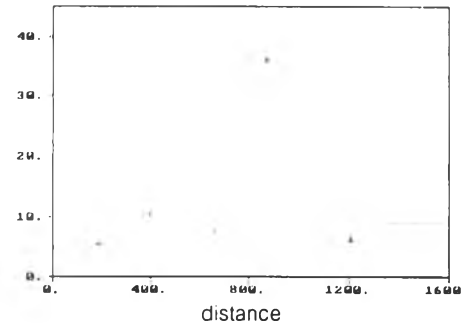
Spherical model with nugget = 0, sill = 11

range = 550 m.

Pair	Avg. distance	Estimate
1	186.733	5.346
7	395.786	10.427
7	871.984	10.683
3	1195.694	36.053
2	1082.398	7.566

direction 112.5 °

Variogram



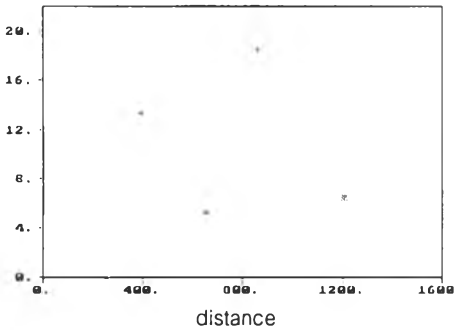
Spherical model with nugget = 0, sill = 9

range = 450 m.

Pair	Avg. distance	Estimate
1	186.733	5.346
7	395.786	10.427
6	656.791	7.645
3	871.984	36.053
2	1208.583	6.440

direction 135 °

Variogram

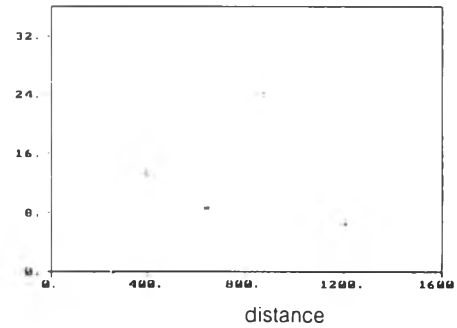


Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.076
6	390.428	13.273
10	648.966	5.240
4	860.678	18.483
2	1208.583	6.440

direction 157.5 °

Variogram



Pure nugget effect model

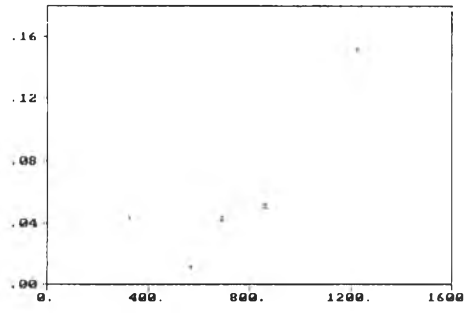
Pair	Avg. distance	Estimate
1	255.349	0.076
6	390.428	13.273
10	640.996	8.770
3	872.489	24.228
2	1208.583	6.440

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 200 m.

direction 0 °

Variogram

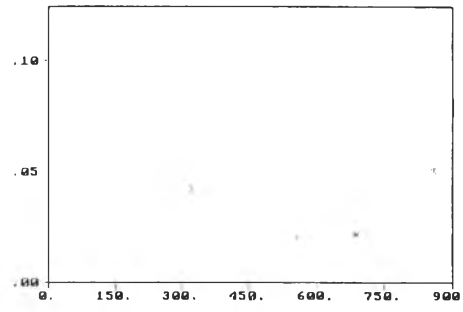


Pure nugget effect model

Pair	Avg. distance	Estimate
5	321.700	0.043
2	566.272	0.011
8	685.584	0.042
1	859.664	0.051
1	1221.472	0.151

direction 22.5 °

Variogram

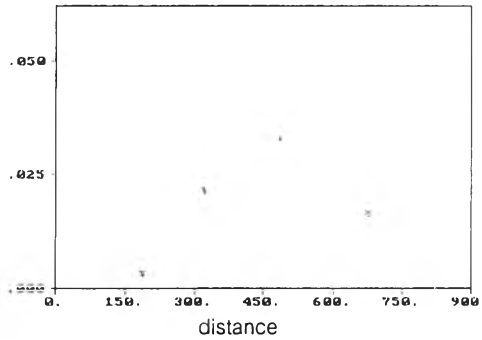


Pure nugget effect model

Pair	Avg. distance	Estimate
5	321.700	0.043
3	556.410	0.020
8	686.814	0.022
1	859.664	0.051

direction 45 °

Variogram

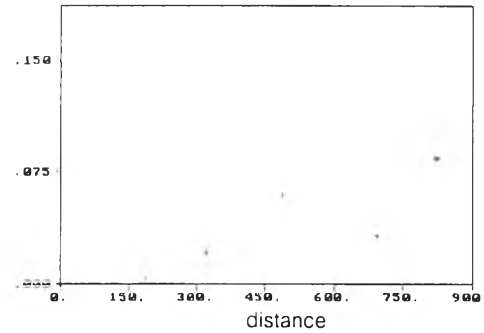


Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	0.003
3	319.777	0.021
4	486.489	0.033
4	675.481	0.016
1	821.607	0.000

direction 67.5 °

Variogram

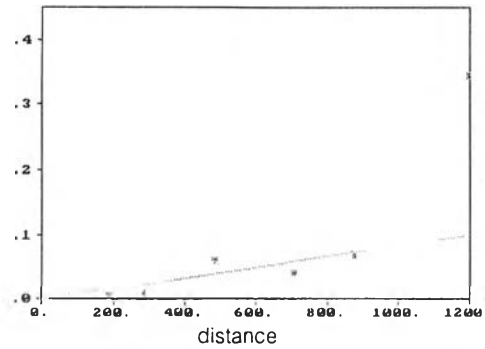


Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	0.003
3	319.777	0.021
4	487.114	0.060
4	823.425	0.033
2	823.425	0.084

direction 90 °

Variogram

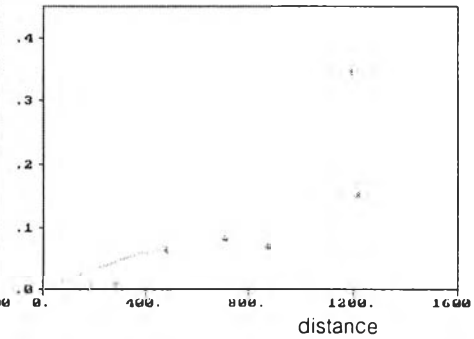


Linear model with nugget = 0, R-major = 600 m.

Pair	Avg. distance	Estimate
1	186.733	0.003
2	283.592	0.008
8	483.221	0.060
4	706.206	0.042
3	871.984	0.069
1	1195.694	0.344

direction 112.5 °

Variogram

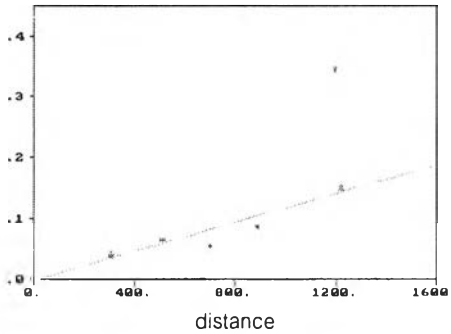


Spherical model with nugget = 0, sill = 0.07
range = 600 m.

Pair	Avg. distance	Estimate
1	186.733	0.003
2	283.592	0.008
7	475.583	0.063
4	703.746	0.083
3	871.984	0.069
1	1195.694	0.344
1	1221.472	0.151

direction 135 °

Variogram

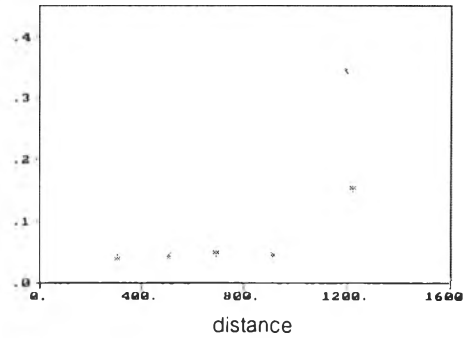


Linear model with nugget = 0, R=major = 600 m.

Pair	Avg. distance	Estimate
4	304.088	0.042
6	508.726	0.062
8	700.946	0.055
3	884.670	0.086
1	1195.694	0.344
1	1221.472	0.151

direction 157.5 °

Variogram



Pure nugget effect model

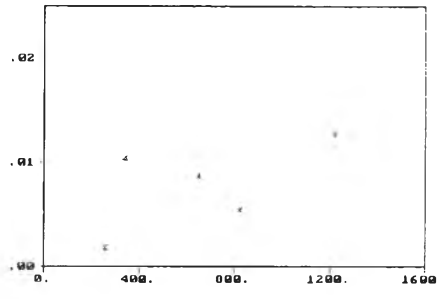
Pair	Avg. distance	Estimate
4	304.088	0.042
6	508.309	0.044
8	691.296	0.047
2	914.383	0.045
1	1195.694	0.344
1	1221.472	0.151

Density (g/cc)

Fixed tolerance 45°, lag spacing 260 m.

direction 0 °

Variogram



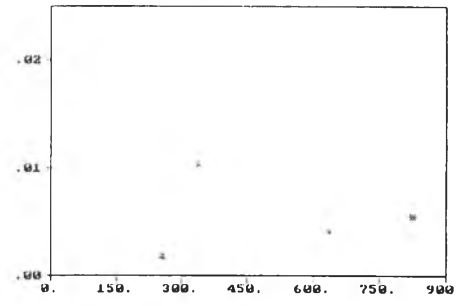
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.002
4	338.287	0.010
9	647.613	0.009
2	824.182	0.006
1	1221.472	0.013

direction 22.5 °

Variogram



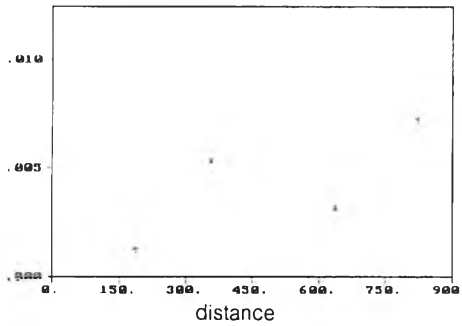
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.002
4	338.287	0.010
10	637.504	0.004
2	824.182	0.006

direction 45 °

Variogram



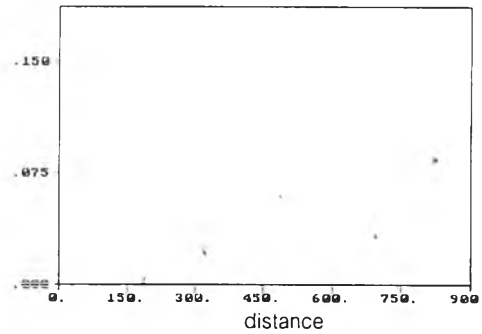
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	0.003
3	319.777	0.021
4	486.489	0.033
4	675.481	0.016
1	821.607	0.000

direction 67.5 °

Variogram



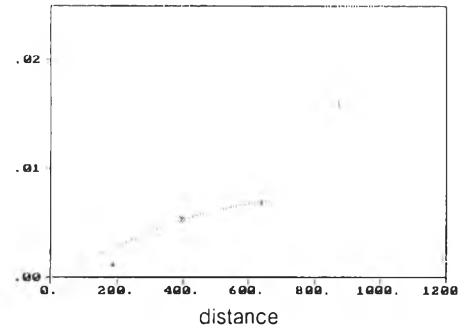
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	0.001
5	356.217	0.005
6	637.687	0.003
1	821.607	0.007

direction 90 °

Variogram

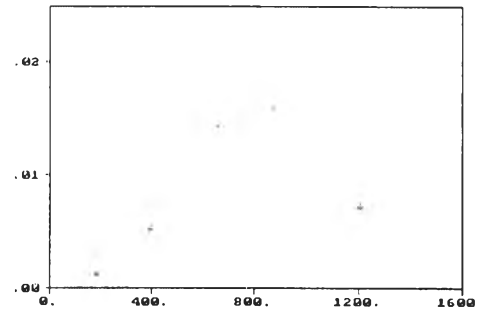


Spherical model with nugget = 0, sill = 0.007
range = 700 m.

Pair	Avg. distance	Estimate
1	186.733	0.001
7	395.786	0.005
7	641.039	0.007
3	871.984	0.016
1	1195.694	0.002

direction 112.5 °

Variogram

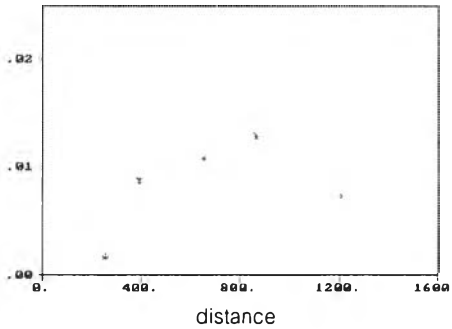


Pure nugget effect model

Pair	Avg. distance	Estimate
1	186.733	0.001
7	395.786	0.005
6	656.791	0.014
3	871.984	0.016
2	1208.583	0.007

direction 135 °

Variogram

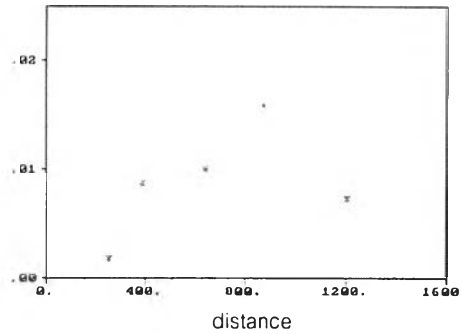


Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.002
6	390.428	0.009
10	648.966	0.011
4	860.678	0.013
2	1208.583	0.007

direction 157.5 °

Variogram



Pure nugget effect model

Pair	Avg. distance	Estimate
1	255.349	0.002
6	390.428	0.009
10	640.966	0.010
3	872.489	0.016
2	1208.583	0.007

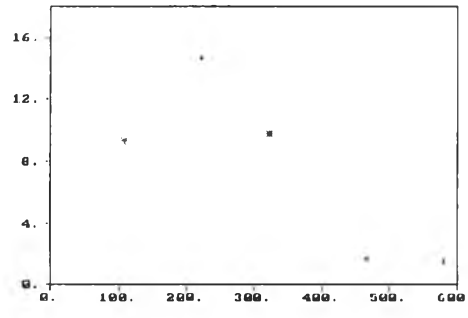
Test direction S2 seam, Saba Yoi area

Ash Content (%)

Fixed tolerance 45°, lag spacing 130 m.

direction 0 °

Variogram

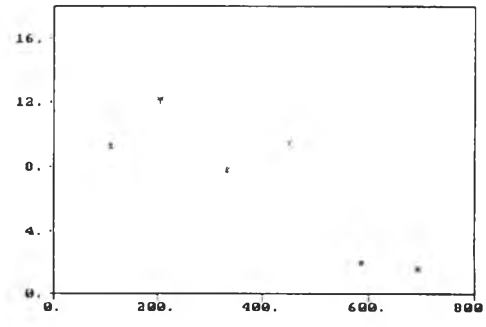


Pure nugget effect model

Pair	Avg. distance	Estimate
1	108.283	9.288
3	220.705	14.649
3	322.238	9.773
3	467.056	1.650
3	580.569	1.553

direction 22.5 °

Variogram

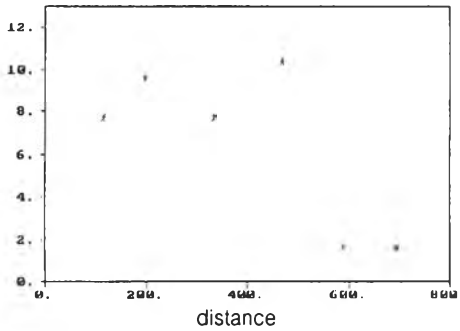


Pure nugget effect model

Pair	Avg. distance	Estimate
1	108.283	9.288
4	203.249	12.067
4	331.459	7.726
4	449.634	9.536
4	587.731	1.965
1	693.731	1.584

direction 45 °

Variogram

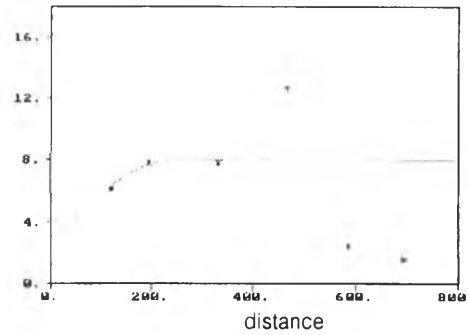


Pure nugget effect model

Pair	Avg. distance	Estimate
2	114.666	7.724
4	195.821	9.567
4	331.459	7.726
4	467.802	10.385
5	589.136	1.618
1	693.731	1.584

direction 67.5 °

Variogram

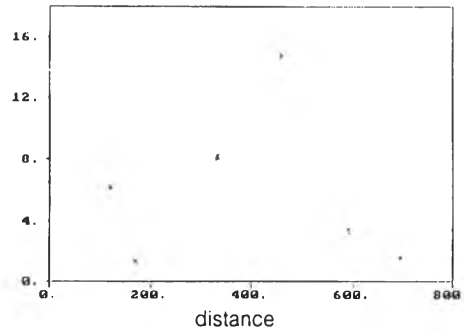


Spherical model with nugget = 3, sill = 5, range = 250 m.

Pair	Avg. distance	Estimate
1	121.048	6.160
4	194.650	7.831
4	331.459	7.726
5	465.715	12.625
6	585.756	2.446
1	693.731	1.584

direction 90 °

Variogram

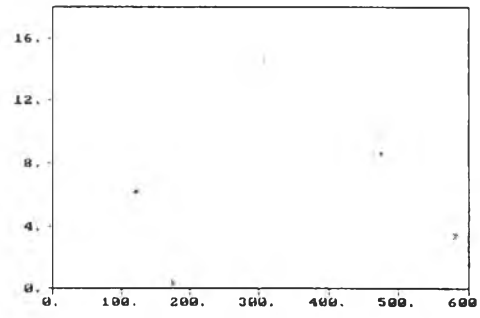


Pure nugget effect model

Pair	Avg. distance	Estimate
1	121.048	6.160
4	168.740	1.341
2	332.434	8.109
4	455.712	14.773
3	590.942	3.340
1	693.731	1.584

direction 112.5 °

Variogram

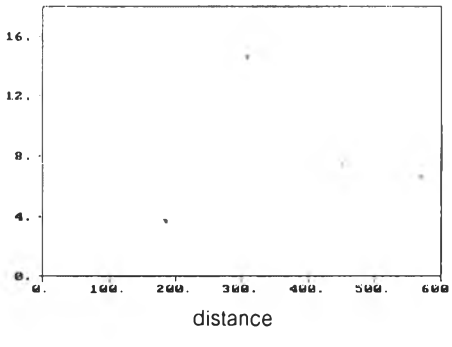


Pure nugget model

Pair	Avg. distance	Estimate
1	121.048	6.160
3	174.693	0.347
1	305.747	14.634
3	475.460	8.633
2	581.805	3.410

direction 135 °

Variogram

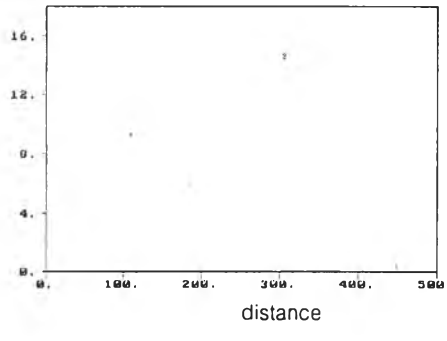


Pure nugget effect model

Pair	Avg. distance	Estimate
3	184.597	3.680
1	305.747	14.634
3	450.935	7.500
1	598.853	6.588

direction 157.5 °

Variogram



Pure nugget effect model

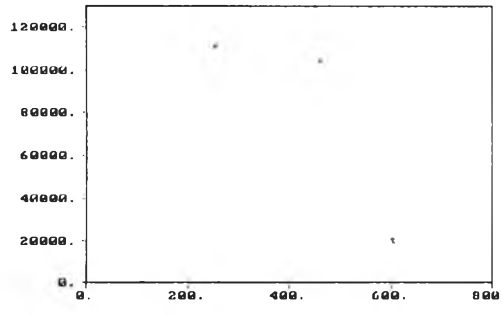
Pair	Avg. distance	Estimate
1	108.283	9.288
3	186.158	5.995
1	305.747	14.634
2	447.720	0.459

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 180 m.

direction 0 °

Variogram

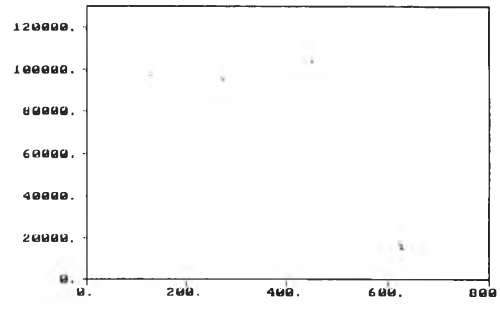


Pure nugget effect model

Pair	Avg. distance	Estimate
1	108.283	578
5	252.847	110819.9
5	460.297	104165.8
2	602.993	20245

direction 22.5 °

Variogram

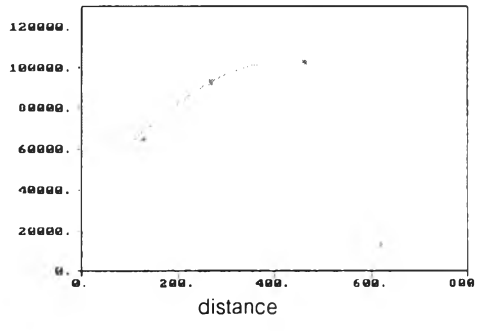


Pure nugget effect model

Pair	Avg. distance	Estimate
2	129.582	97633
6	270.559	95518.66
6	449.809	103639.5
4	627.233	16357

direction 45 °

Variogram

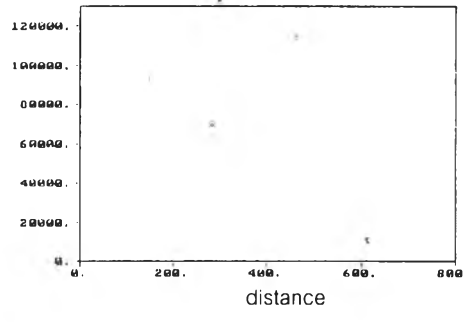


Spherical model with nugget = 40000, sill = 62000, range = 400 m.

Pair	Avg. distance	Estimate
3	126.737	65142.67
6	265.607	92681.34
6	461.921	102521.5
5	620.738	13366.5

direction 67.5 °

Variogram

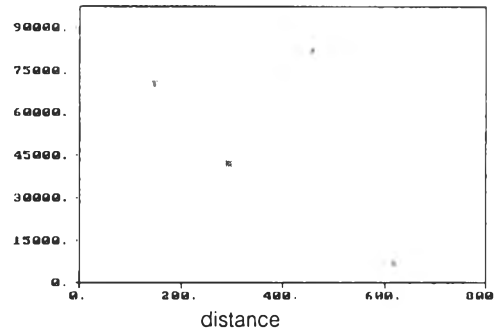


Pure nugget effect model

Pair	Avg. distance	Estimate
3	149.382	93240.66
5	282.549	70257.6
7	461.270	114020.2
6	612.091	11168.83

direction 90 °

Variogram

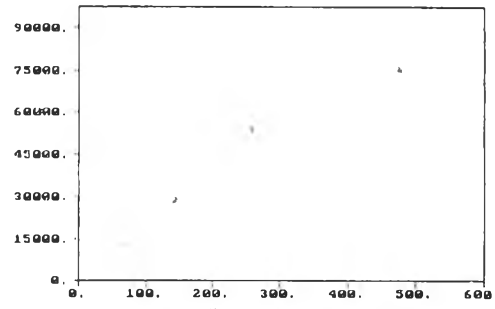


Pure nugget effect model

Pair	Avg. distance	Estimate
4	146.238	69962.5
3	291.974	42173.67
4	455.712	81743.38
4	616.639	6630.75

direction 112.5 °

Variogram

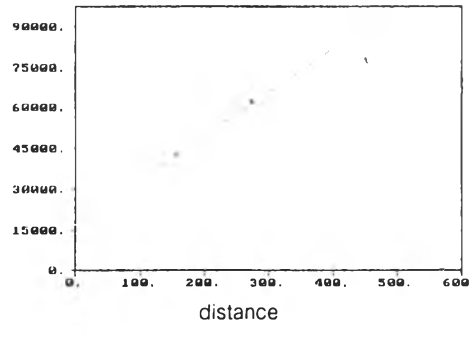


Linear model with nugget = 0, sill = 400 m.

Pair	Avg. distance	Estimate
3	144.691	28387.330
2	258.400	53754.250
3	475.160	75321.840
2	581.805	792.500

direction 135 °

Variogram

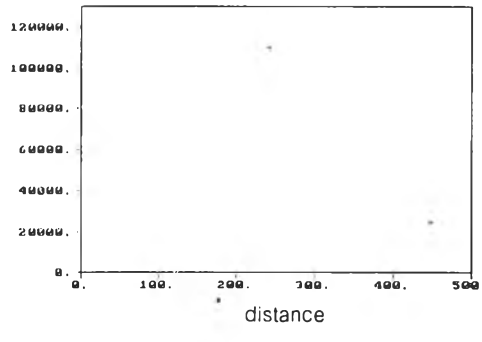


Linear model with nugget = 17000, R-major = 400 m.

Pair	Avg. distance	Estimate
2	156.513	42500.00
2	273.256	62266.25
3	450.935	77557.84
1	568.853	180.500

direction 157.5 °

Variogram



Pure nugget effect model

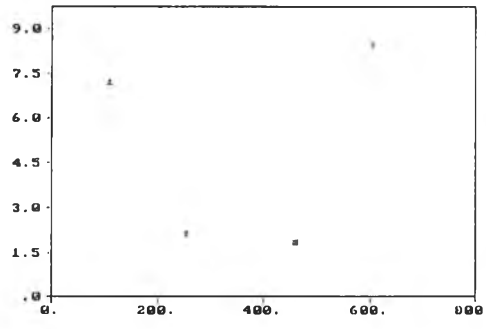
Pair	Avg. distance	Estimate
2	122.545	353.000
3	242.471	109777.5
2	447.720	24830.50

Moisture Content (%)

Fixed tolerance 45°, lag spacing 180 m.

direction 0 °

Variogram

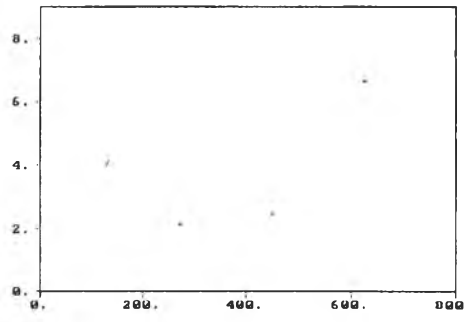


Pure nugget effect model

Pair	Avg. distance	Estimate
1	108.283	7.220
5	252.847	2.144
5	460.297	1.821
2	602.993	8.426

direction 22.5 °

Variogram

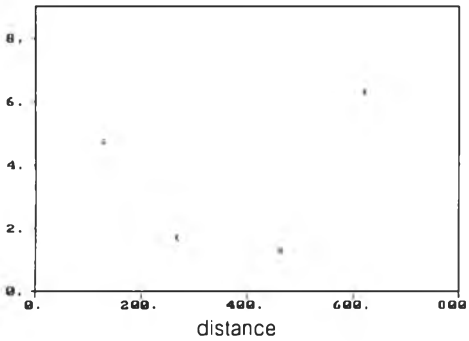


Pure nugget effect model

Pair	Avg. distance	Estimate
2	129.582	4.052
6	270.559	2.147
6	449.809	2.452
4	627.233	6.628

direction 45 °

Variogram

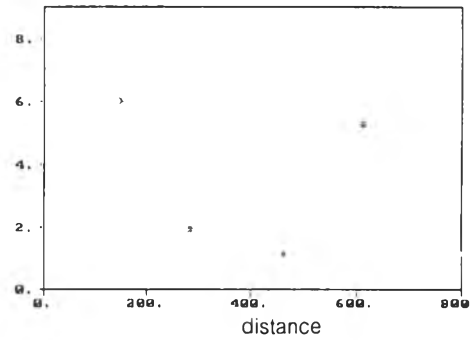


Pure nugget effect model

Pair	Avg. distance	Estimate
3	126.737	4.755
6	265.607	1.706
6	461.921	1.296
5	620.738	6.314

direction 67.5 °

Variogram

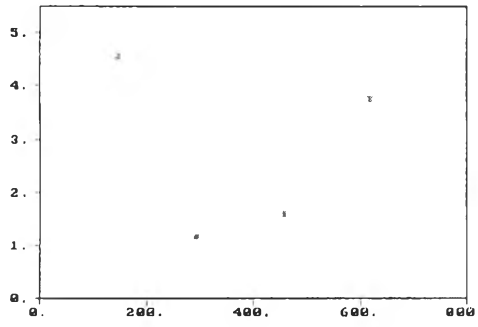


Pure nugget effect model

Pair	Avg. distance	Estimate
3	149.382	6.030
5	282.549	1.939
7	461.270	1.147
6	612.091	5.294

direction 90 °

Variogram

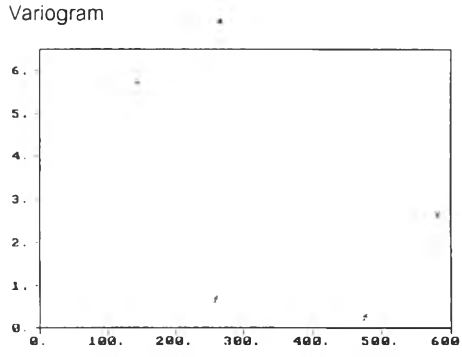


Pure nugget effect model

Pair	Avg. distance	Estimate
4	146.238	4.533
3	291.974	1.170
4	455.712	1.594
4	616.639	3.728

direction 112.5 °

Variogram

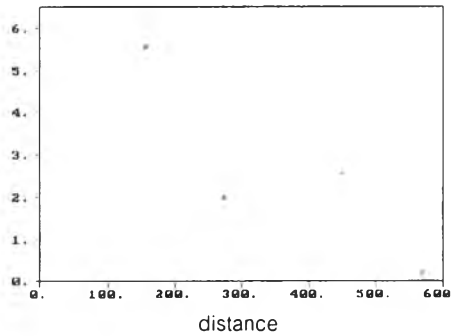


Pure nugget effect moedel

Pair	Avg. distance	Estimate
3	144.691	5.749
2	258.400	0.674
3	475.160	0.256
2	581.805	2.624

direction 135 °

Variogram

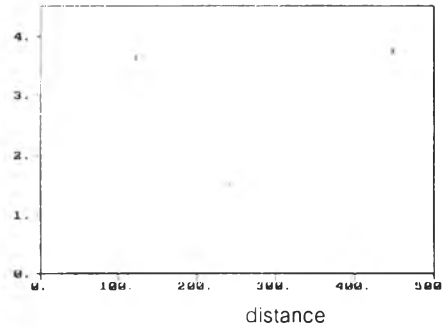


Pure nugget effect model

Pair	Avg. distance	Estimate
2	156.513	5.544
2	273.256	1.997
3	450.935	2.569
1	568.853	0.192

direction 157.5 °

Variogram



Pure nugget effect model

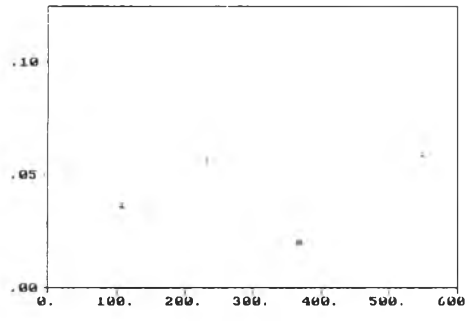
Pair	Avg. distance	Estimate
2	122.545	3.631
3	242.471	1.512
2	447.720	3.727

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 160 m.

direction 0 °

Variogram

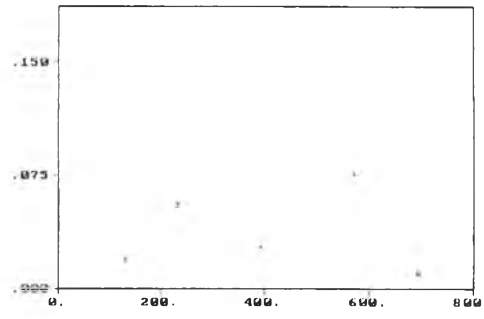


Pure nugget effect model

Pair	Avg. distance	Estimate
1	108.283	0.036
4	232.041	0.056
3	367.264	0.020
5	548.350	0.059

direction 22.5 °

Variogram

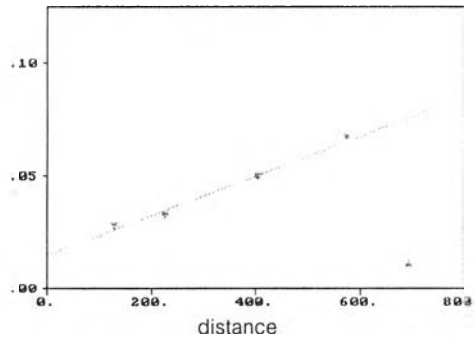


Pure nugget effect model

Pair	Avg. distance	Estimate
2	129.582	0.019
4	232.041	0.056
6	392.099	0.028
5	571.330	0.076
1	693.731	0.011

direction 45 °

Variogram

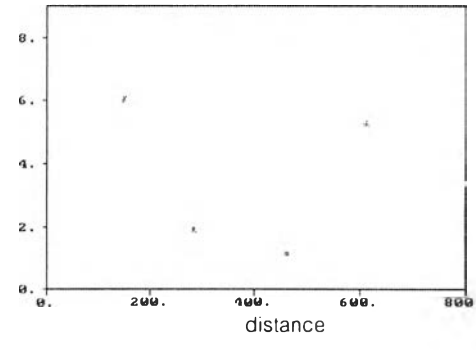


Linear model with nugget = 0.015, R-major = 400 m.

Pair	Avg. distance	Estimate
3	126.737	4.755
6	265.607	1.706
6	461.921	1.296
5	620.738	6.314

direction 67.5 °

Variogram

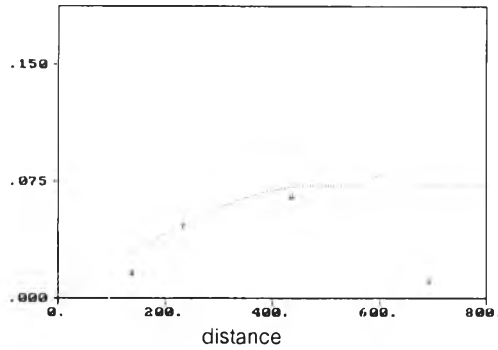


Pure nugget effect model

Pair	Avg. distance	Estimate
3	126.737	0.028
4	224.613	0.033
6	404.212	0.050
6	575.235	0.067
1	693.731	0.011

direction 90 °

Variogram



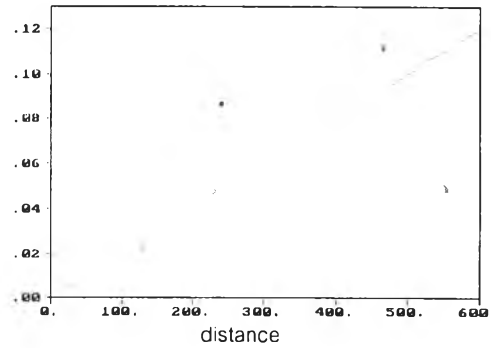
Spherical model with nugget = 0, sill = 0.072

range = 480 m.

Pair	Avg. distance	Estimate
3	136.246	0.016
3	231.006	0.047
5	436.394	0.066
3	590.942	0.077
1	693.731	0.011

direction 112.5 °

Variogram

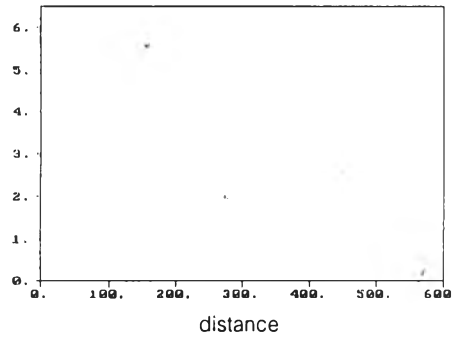


Linear model with nugget = 0, R-major = 450

Pair	Avg. distance	Estimate
2	128.928	0.023
3	231.006	0.047
2	465.583	0.112
3	552.641	0.049

direction 135 °

Variogram

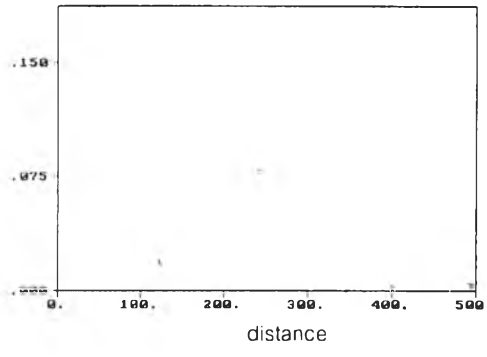


Pure nugget effect model

Pair	Avg. distance	Estimate
1	136.808	0.000
3	240.910	0.077
2	429.246	0.045
2	531.583	0.062

direction 157.5 °

Variogram



Pure nugget effect model

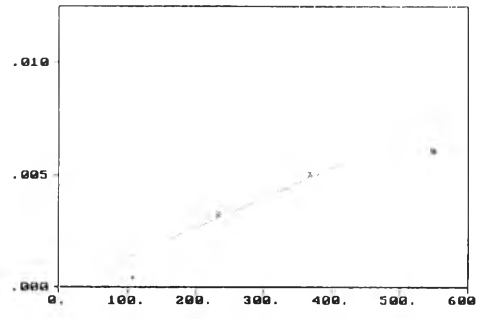
Pair	Avg. distance	Estimate
2	122.545	0.018
3	242.471	0.079
1	401.314	0.002
1	494.314	0.003

Density (g/cc)

Fixed tolerance 45°, lag spacing 150 m.

direction 0 °

Variogram

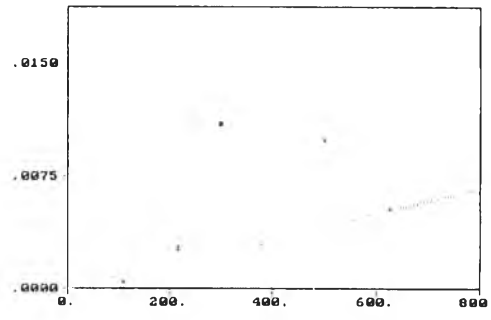


Linear model with nugget = 0, R-major = 450 m.

Pair	Avg. distance	Estimate
1	108.283	0.000
4	232.041	0.003
3	367.264	0.005
5	548.350	0.006

direction 22.5 °

Variogram

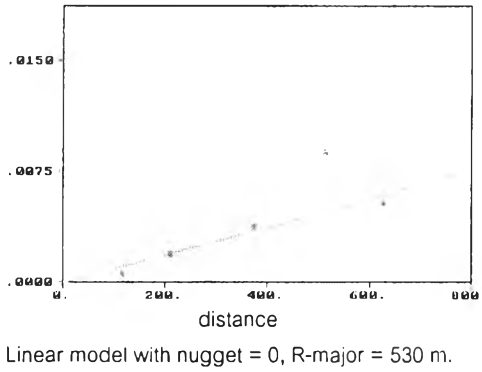


Linear model with nugget = 0, R-major = 480 m.

Pair	Avg. distance	Estimate
1	108.283	0.000
5	215.809	0.003
5	378.809	0.003
3	500.001	0.010
4	627.233	0.005

direction 45 °

Variogram

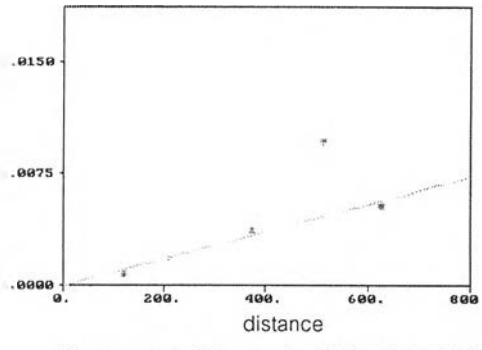


Linear model with nugget = 0, R-major = 530 m.

Pair	Avg. distance	Estimate
2	114.666	0.001
5	209.866	0.002
4	373.229	0.004
5	513.712	0.009
4	627.233	0.005

direction 67.5 °

Variogram

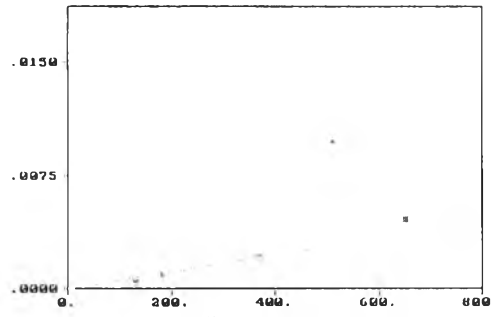


Linear model with nugget = 0, R-major = 550 m.

Pair	Avg. distance	Estimate
1	121.048	0.001
5	208.930	0.002
4	373.299	0.004
7	513.540	0.010
4	627.233	0.005

direction 90 °

Variogram

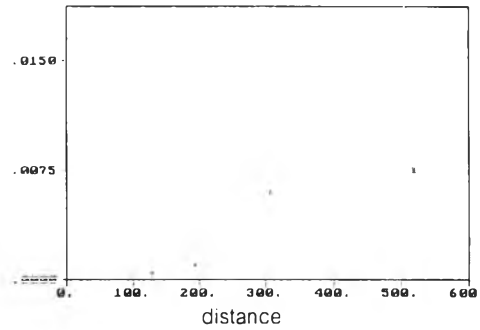


Linear model with nugget = 0, R-major = 700 m.

Pair	Avg. distance	Estimate
2	128.928	0.000
3	179.384	0.001
3	365.999	0.002
5	510.666	0.010
2	651.473	0.005

direction 112.5 °

Variogram

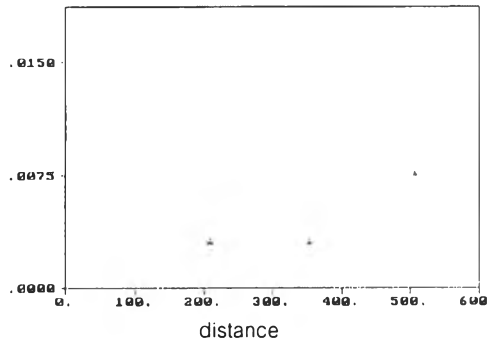


Pure nugget effect model

Pair	Avg. distance	Estimate
2	128.928	0.000
2	193.635	0.001
1	305.747	0.006
5	517.818	0.008

direction 135 °

Variogram

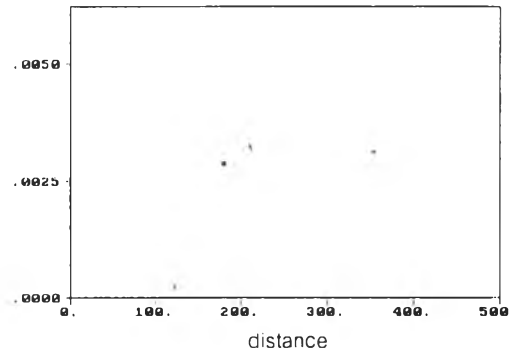


Pure nugget effect model

Pair	Avg. distance	Estimate
1	136.808	0.000
2	208.491	0.003
2	353.436	0.003
3	506.844	0.008

direction 157.5 °

Variogram



Pure nugget effect model

Pair	Avg. distance	Estimate
2	122.545	0.000
2	210.833	0.073
2	353.436	0.003
1	494.314	0.000

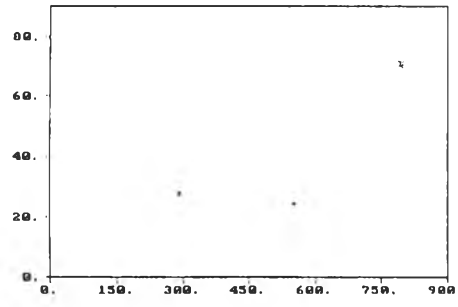
Test direction S3 seam, Saba Yoi area

Ash Content (%)

Fixed tolerance 45°, lag spacing 320 m.

direction 0 °

Variogram

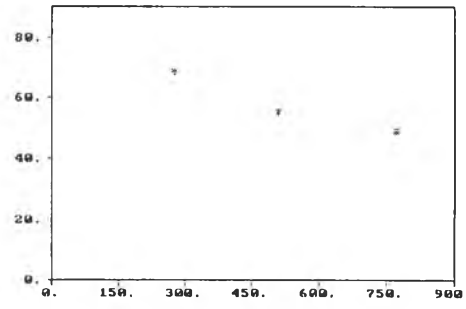


Pure nugget effect model

Pair	Avg. distance	Estimate
3	292.660	27.588
5	551.440	24.198
8	793.510	70.736

direction 22.5 °

Variogram

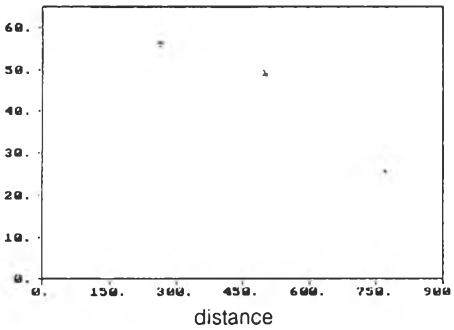


Pure nugget effect model

Pair	Avg. distance	Estimate
4	276.212	68.466
6	508.063	55.213
8	769.787	49.096

direction 45 °

Variogram

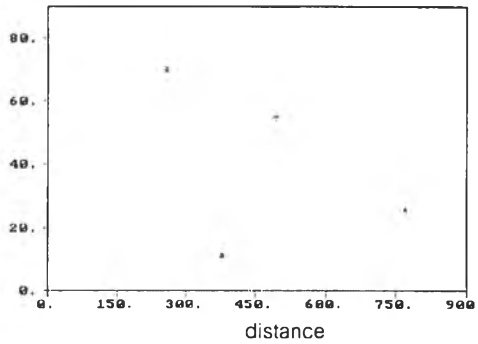


Pure nugget model

Pair	Avg. distance	Estimate
5	264.251	55.936
9	498.906	49.141
6	770.822	25.551

direction 67.5 °

Variogram

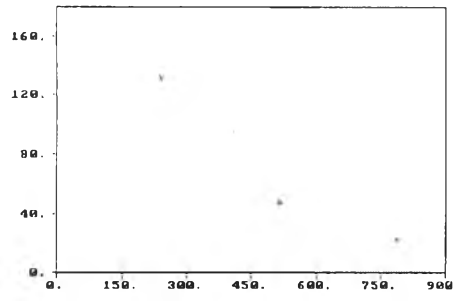


Pure nugget model

Pair	Avg. distance	Estimate
4	257.345	69.909
8	493.777	54.615
6	769.068	25.779

direction 90 °

Variogram

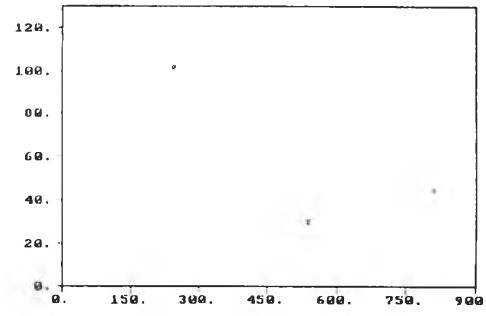


Pure nugget effect model

Pair	Avg. distance	Estimate
3	239.665	131.309
10	513.588	47.616
8	7886.148	22.685

direction 112.5 °

Variogram

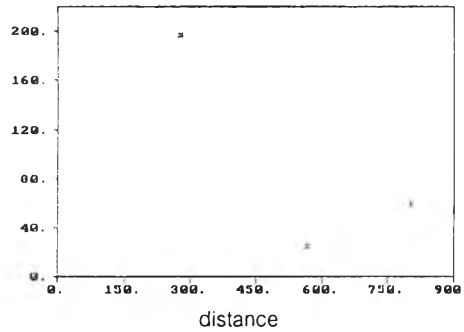


Pure nugget effect model

Pair	Avg. distance	Estimate
2	246.065	101.413
9	538.301	29.541
8	809.871	44.324

direction 135 °

Variogram

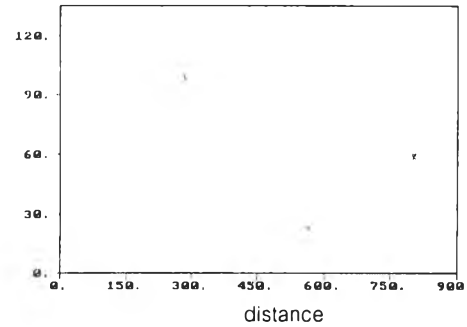


Pure nugget effect model

Pair	Avg. distance	Estimate
1	275.721	197.011
6	567.155	25.813
10	801.233	59.406

direction 157.5 °

Variogram



Pure nugget effect model

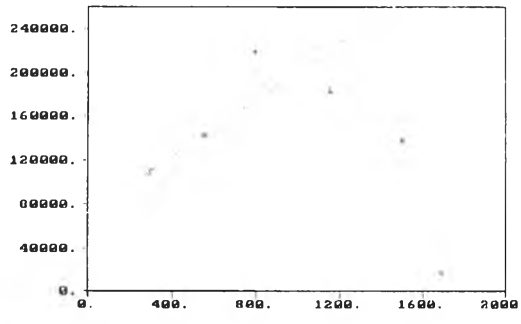
Pair	Avg. distance	Estimate
2	283.798	98.528
7	563.267	22.889
10	802.286	59.269

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 330 m.

direction 0 °

Variogram

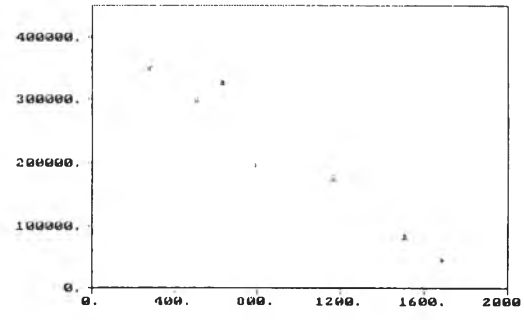


Linear model with nugget = 72000, R-major = 700 m.

Pair	Avg. distance	Estimate
3	292.660	109331.3
5	551.440	142525.7
8	793.510	218887.9
10	1152.831	182944.7
3	1503.181	137875.2
1	1687.233	17260.83

direction 22.5 °

Variogram

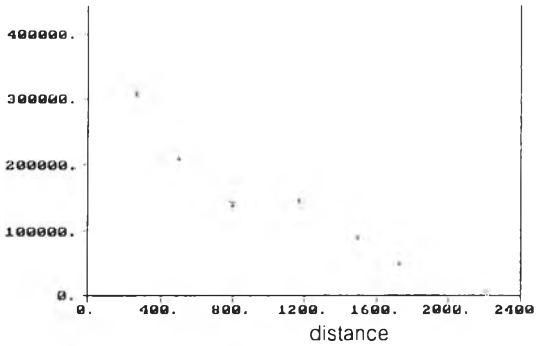


Pure nugget effect model

Pair	Avg. distance	Estimate
4	276.212	348970.7
6	508.063	299571.8
9	791.178	194917.1
10	1164.164	175940.1
5	1509.137	83622.02
2	1687.021	45590.48

direction 45 °

Variogram

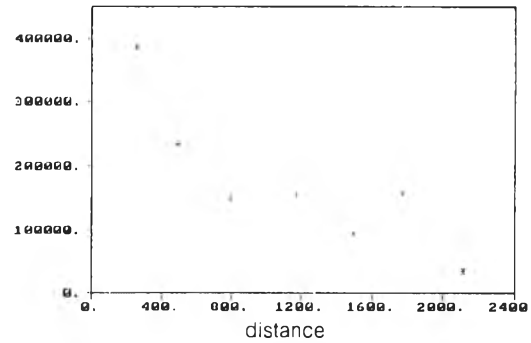


Pure nugget model

Pair	Avg. distance	Estimate
5	264.251	309862.6
9	498.906	210010.6
7	798.177	139139.4
11	1166.348	145915.0
7	1493.487	90157.43
5	1728.781	49193.05
1	2212.484	3874.643

direction 67.5 °

Variogram

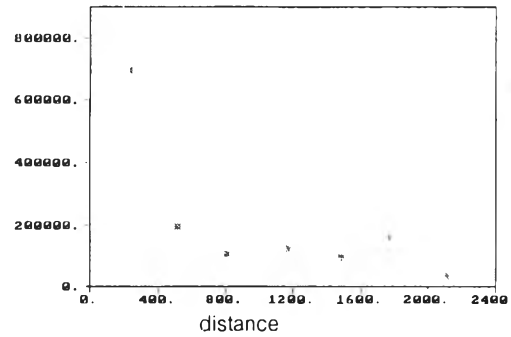


Pure nugget model

Pair	Avg. distance	Estimate
4	257.345	384734.1
8	493.777	235813
7	796.673	150390.1
11	1167.368	1549.48.1
9	1497.405	94010.16
6	1768.074	158316
2	2112.986	35103.84

direction 90 °

Variogram

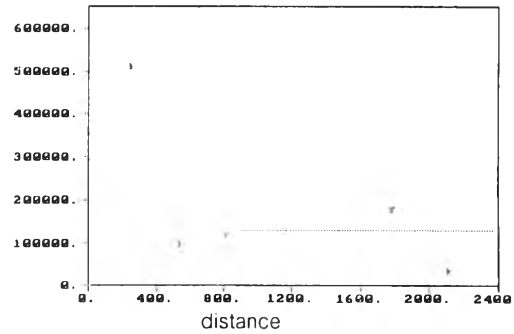


Pure nugget effect model

Pair	Avg. distance	Estimate
3	239.665	696350.3
10	513.588	195663.9
9	805.721	106260.4
11	1170.387	123701.2
7	1485.09	93223.14
6	1768.074	158316.0
2	2112.986	35106.84

direction 112.5 °

Variogram

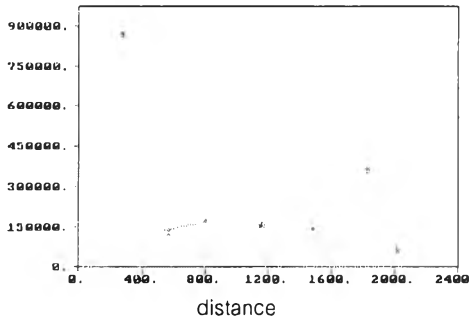


Spherical model with nugget = 0, sill = 130000, range = 1000 m.

Pair	Avg. distance	Estimate
2	246.065	510581.1
9	538.301	96870.68
8	809.871	119149.1
11	1160.084	130069.0
5	1471.897	129615.5
5	1784.327	175195.2
2	2112.986	35106.84

direction 135 °

Variogram

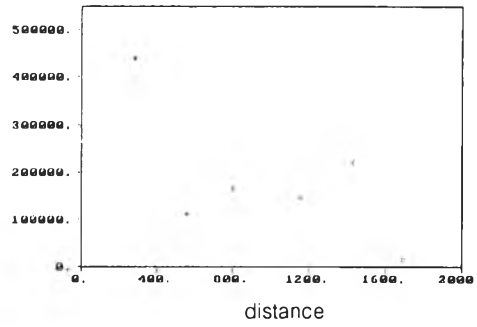


Spherical model with nugget = 0, sill = 160000, range = 800 m.

Pair	Avg. distance	Estimate
1	275.721	867731.9
6	567.155	129862.0
10	801.233	173347.1
10	1157.274	158509.5
3	1483.589	145028.5
2	1825.886	360595.9
1	2013.487	66339.03

direction 157.5 °

Variogram



Pure nugget effect model

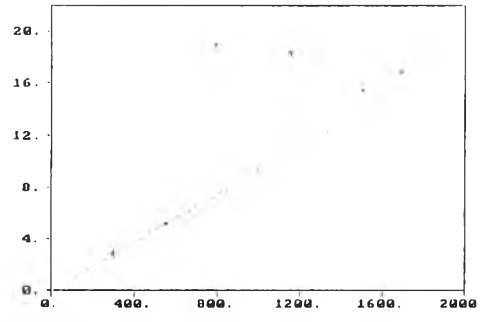
Pair	Avg. distance	Estimate
2	283.798	439054.3
7	563.267	111823.3
10	802.286	165471.6
10	1156.152	148573.1
1	1428.527	220096.2
1	1687.233	17260.83

Moisture Content (%)

Fixed tolerance 45°, lag spacing 330 m.

direction 0 °

Variogram

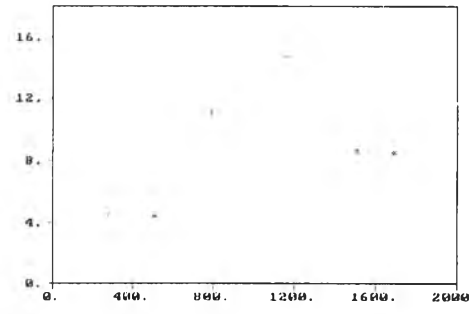


Linear model with nugget = 0, R-major = 430 m.

Pair	Avg. distance	Estimate
3	292.660	2.877
5	551.440	5.155
8	793.510	18.970
10	1152.831	18.254
3	1503.181	15.359
1	1687.233	16.878

direction 22.5 °

Variogram

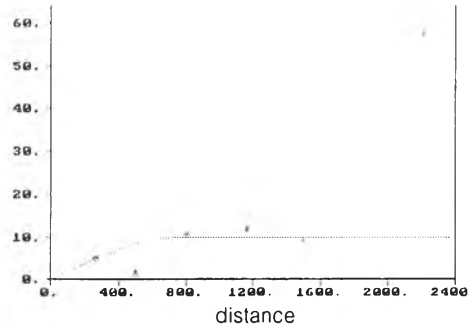


Pure nugget effect model

Pair	Avg. distance	Estimate
4	276.212	4.501
6	508.063	4.472
9	791.178	11.072
10	1164.164	14.639
5	1509.137	8.684
2	1687.021	8.457

direction 45 °

Variogram



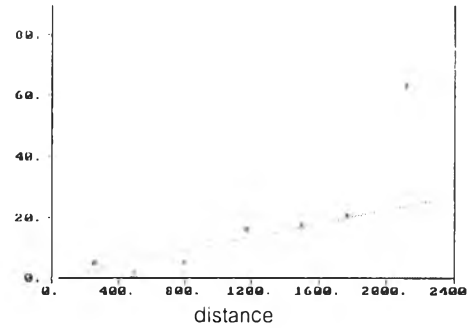
Spherical model with nugget = 0, sill = 10

range = 800 m.

Pair	Avg. distance	Estimate
5	264.251	4.784
9	498.906	1.704
7	798.177	10.357
11	1166.348	11.899
7	1493.487	9.466
5	1728.781	9.874
1	2212.484	57.459

direction 67.5 °

Variogram

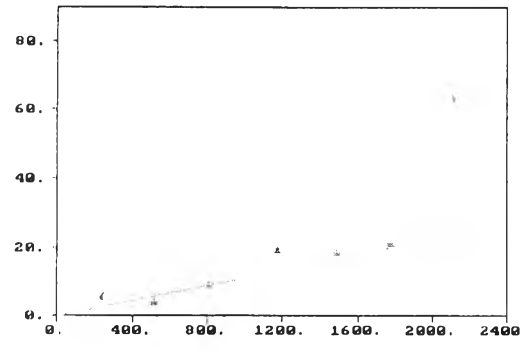


Linear model with nugget = 0, R-major = 800 m.

Pair	Avg. distance	Estimate
4	257.345	5.254
8	493.777	1.628
7	796.673	5.584
11	1167.368	16.096
9	1497.405	17.438
6	1768.074	20.683
2	2112.986	63.128

direction 90 °

Variogram

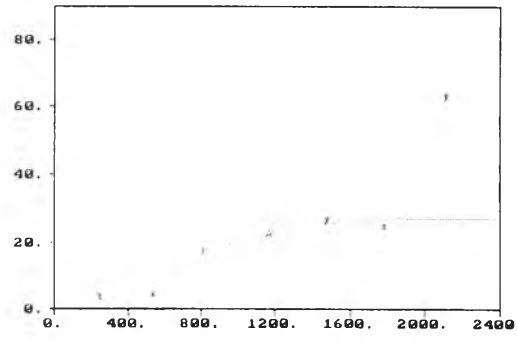


Linear model with nugget = 0, R-major = 800 m.

Pair	Avg. distance	Estimate
3	239.665	5.711
10	513.588	4.153
9	805.721	9.270
11	1170.387	19.444
7	1485.09	18.461
6	1768.074	20.683
2	2112.986	63.128

direction 112.5 °

Variogram

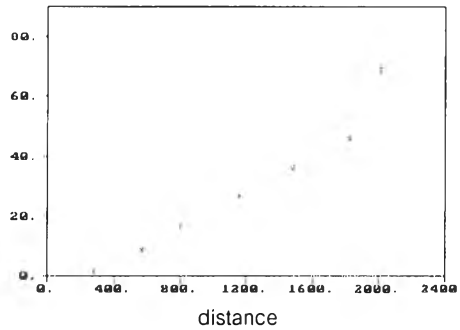


Gaussian model with nugget = 1, sill = 26, range = 1500 m.

Pair	Avg. distance	Estimate
2	246.065	3.880
9	538.301	4.498
8	809.871	16.943
11	1160.084	22.731
5	1471.897	26.377
5	1784.327	24.812
2	2112.986	63.128

direction 135 °

Variogram

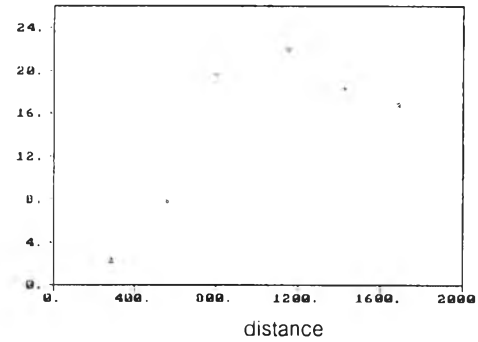


Pure nugget effect model

Pair	Avg. distance	Estimate
1	275.721	1.843
6	567.155	8.663
10	801.233	16.269
10	1157.274	26.554
3	1483.589	36.346
2	1825.886	45.804
1	2013.487	68.796

direction 157.5 °

Variogram



Pure nugget effect model

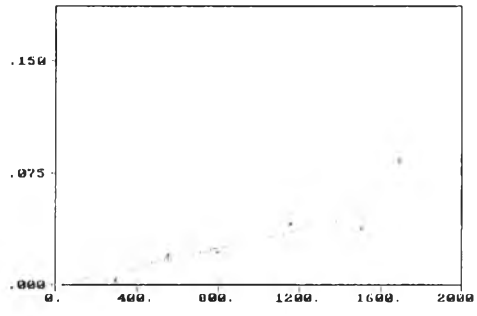
Pair	Avg. distance	Estimate
2	283.798	2.374
7	563.267	7.755
10	802.286	19.610
10	1156.152	21.937
1	1428.527	18.362
1	1687.233	16.878

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 330 m.

direction 0 °

Variogram



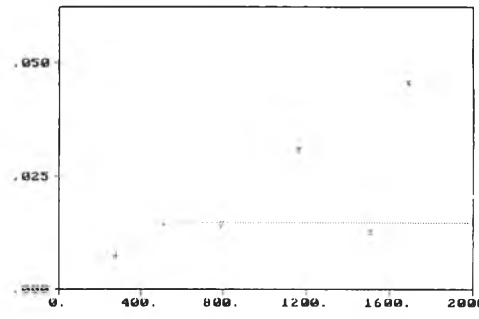
distance

Linear model with nugget = 0, R-major = 800 m.

Pair	Avg. distance	Estimate
3	292.660	0.004
5	551.440	0.021
8	793.510	0.023
10	1152.831	0.042
3	1503.181	0.039
1	1687.233	0.084

direction 22.5 °

Variogram



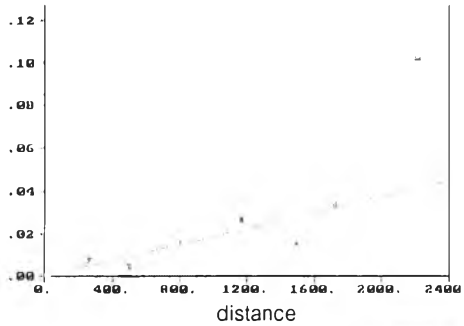
distance

Spherical model with nugget = 0, sill = 0.015, range = 650 m.

Pair	Avg. distance	Estimate
4	276.212	0.008
6	508.063	0.015
9	791.178	0.014
10	1164.164	0.031
5	1509.137	0.013
2	1687.021	0.046

direction 45 °

Variogram



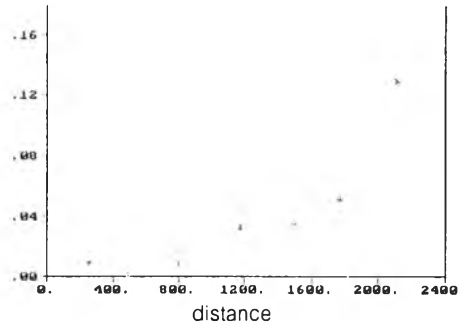
distance

Linear model with nugget = 0, R-major = 800 m.

Pair	Avg. distance	Estimate
5	264.251	0.008
9	498.906	0.004
7	798.177	0.016
11	1166.348	0.027
7	1493.487	0.015
5	1728.781	0.033
1	2212.484	0.101

direction 67.5 °

Variogram



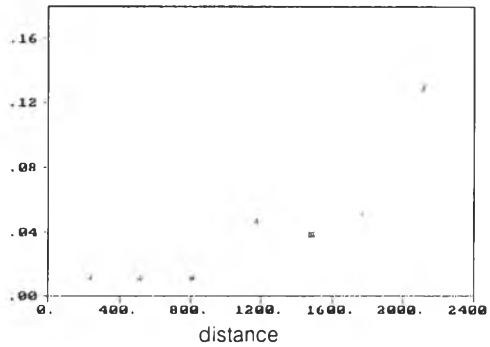
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
4	257.345	0.009
8	493.777	0.002
7	796.673	0.009
11	1167.368	0.032
9	1497.405	0.035
6	1768.074	0.052
2	2112.986	0.129

direction 90 °

Variogram



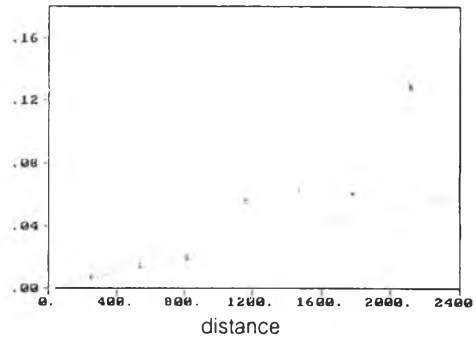
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
3	239.665	0.012
10	513.588	0.012
9	805.721	0.011
11	1170.387	0.046
7	1485.09	0.038
6	1768.074	0.052
2	2112.986	0.129

direction 112.5 °

Variogram



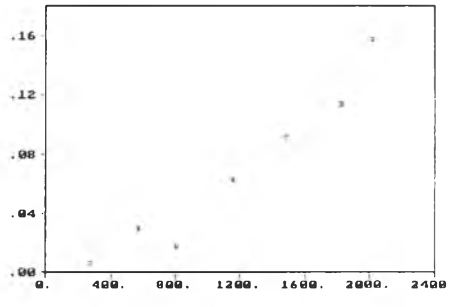
distance

Linear model with nugget = 0, R-major = 1200 m.

Pair	Avg. distance	Estimate
2	246.065	0.007
9	538.301	0.015
8	809.871	0.020
11	1160.084	0.056
5	1471.897	0.064
5	1784.327	0.061
2	2112.986	0.129

direction 135 °

Variogram



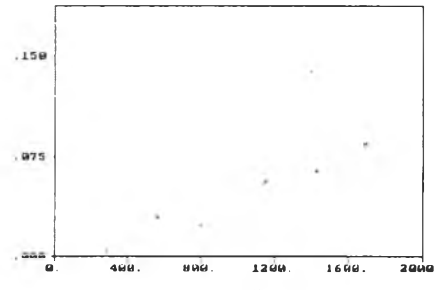
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
1	275.721	0.006
6	567.155	0.030
10	801.233	0.018
10	1157.274	0.063
3	1483.589	0.092
2	1825.886	0.114
1	2013.487	0.157

direction 157.5 °

Variogram



distance

Pure nugget effect model

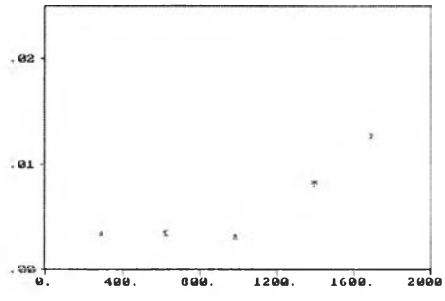
Pair	Avg. distance	Estimate
2	283.798	0.005
7	583.267	0.029
10	802.286	0.023
10	1156.152	0.057
1	1428.527	0.065
1	1687.233	0.084

Density (g/cc)

Fixed tolerance 45°, lag spacing 400 m.

direction 0 °

Variogram



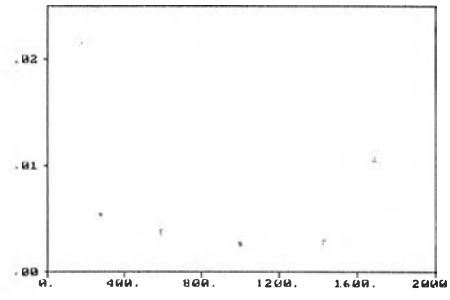
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
3	292.660	0.003
8	619.326	0.004
12	987.188	0.003
6	1390.377	0.008
1	1687.233	0.013

direction 22.5 °

Variogram



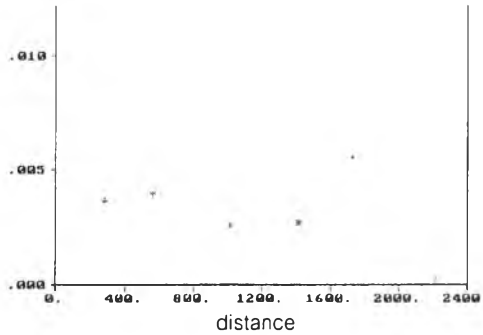
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
4	276.212	0.005
10	588.725	0.004
12	1004.136	0.003
8	1427.429	0.003
2	1687.021	0.011

direction 45 °

Variogram



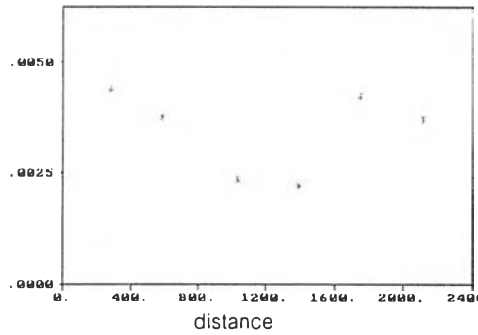
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
6	286.741	0.004
11	564.164	0.004
11	1018.939	0.003
11	1413.482	0.003
5	1728.781	0.006
1	2212.484	0.000

direction 67.5 °

Variogram



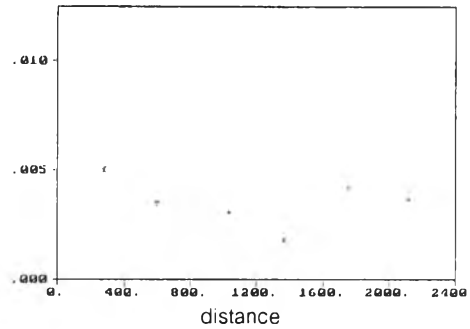
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
5	285.714	0.004
11	587.715	0.004
9	1027.402	0.002
13	1393.785	0.002
7	1746.169	0.004
2	2112.986	0.004

direction 90 °

Variogram

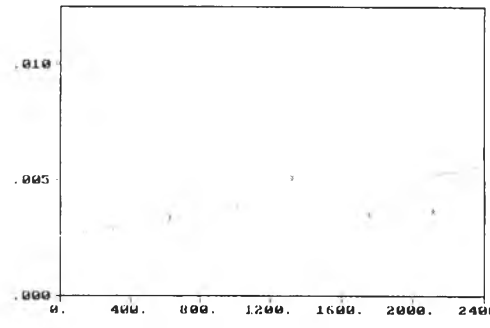


Pure nugget effect model

Pair	Avg. distance	Estimate
4	279.547	0.005
14	599.553	0.003
10	1027.868	0.003
11	1360.993	0.002
7	1746.169	0.004
2	2112.986	0.004

direction 112.5 °

Variogram

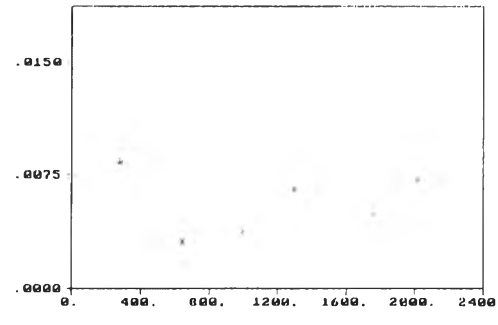


Linear model with nugget = 0.0026,
R-major = 1600 m.

Pair	Avg. distance	Estimate
3	297.107	0.003
12	621.758	0.003
10	1007.531	0.004
9	1321.528	0.005
6	1756.956	0.004
2	2112.986	0.004

direction 135 °

Variogram

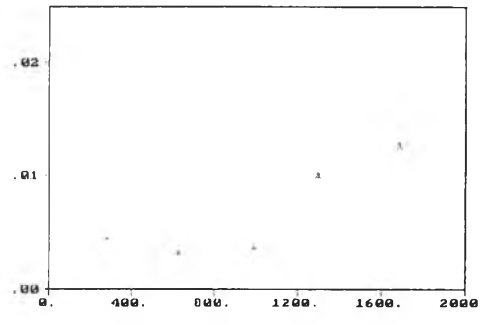


Pure nugget effect model

Pair	Avg. distance	Estimate
1	275.721	0.008
11	649.321	0.003
11	992.419	0.004
6	1294.148	0.007
3	1755.504	0.005
1	2013.487	0.007

direction 157.5 °

Variogram



Pure nugget effect model

Pair	Avg. distance	Estimate
2	283.798	0.004
11	625.770	0.003
13	990.640	0.004
4	1298.496	0.010
1	1687.233	0.013

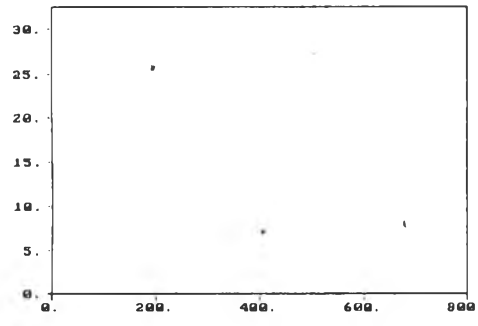
Test direction S4 seam, Saba Yoi area

Ash Content (%)

Fixed tolerance 45°, lag spacing 300 m.

direction 0 °

Variogram

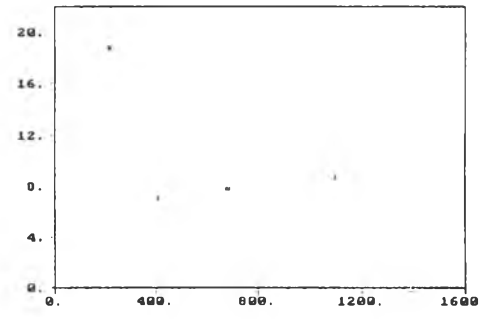


Pure nugget effect model

Pair	Avg. distance	Estimate
3	194.638	25.615
1	406.119	7.031
1	679.070	7.920

direction 22.5 °

Variogram

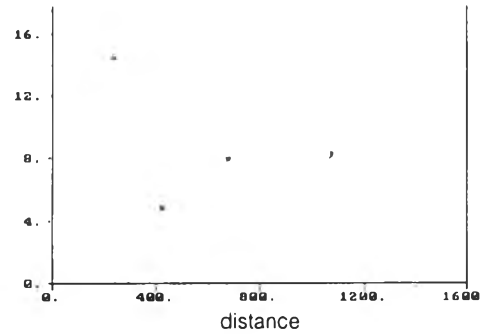


Pure nugget effect model

Pair	Avg. distance	Estimate
5	213.401	18.769
1	406.119	7.031
1	679.070	7.920
3	1097.673	8.685
1	1396.244	0.000

direction 45 °

Variogram

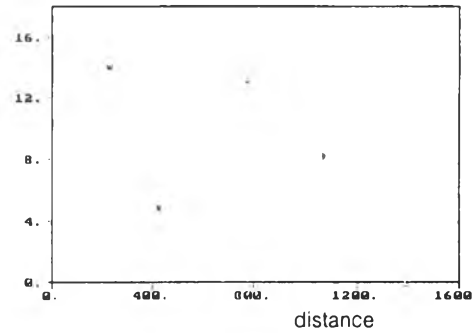


Pure nugget effect model

Pair	Avg. distance	Estimate
6	231.908	14.531
2	423.453	4.827
1	679.070	7.920
5	1073.965	8.202
1	1396.244	0.000

direction 67.5 °

Variogram

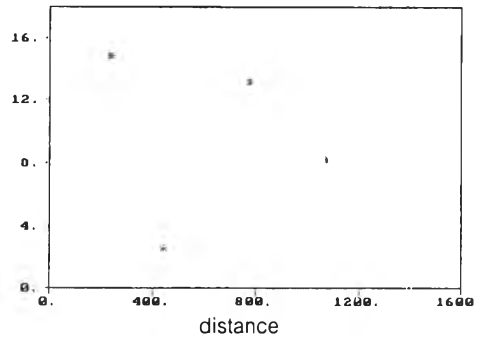


Pure nugget effect model

Pair	Avg. distance	Estimate
4	226.473	13.963
2	423.453	4.827
4	775.550	13.137
5	1073.965	8.202
1	1396.244	0.000

direction 90 °

Variogram

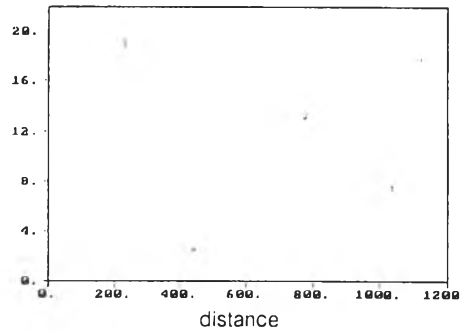


Pure nugget effect model

Pair	Avg. distance	Estimate
5	236.322	14.818
1	440.787	2.622
4	775.550	13.137
5	1073.965	8.202
1	1396.244	0.000

direction 112.5 °

Variogram

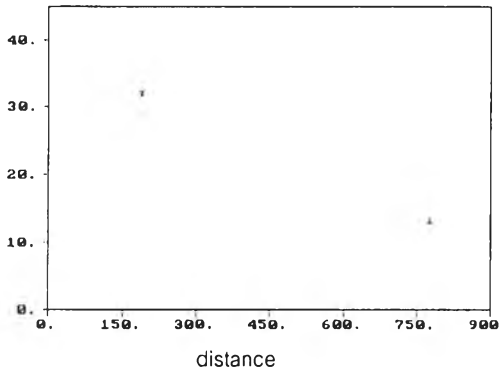


Pure nugget effect model

Pair	Avg. distance	Estimate
3	232.840	19.030
1	440.787	2.622
4	775.550	13.137
2	1038.402	7.477

direction 135 °

Variogram

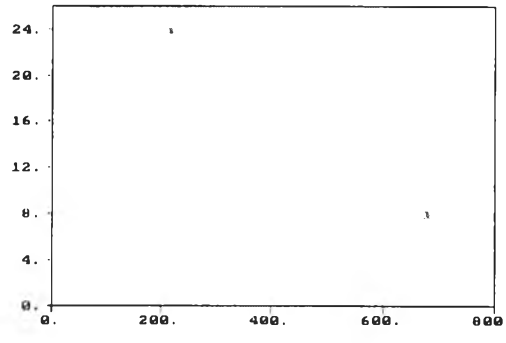


Pure nugget effect model

Pair	Avg. distance	Estimate
2	187.040	31.873
4	775.550	13.137

direction 157.5 °

Variogram



Pure nugget effect model

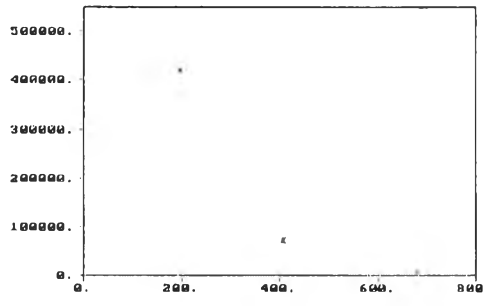
Pair	Avg. distance	Estimate
4	214.909	23.771
1	679.070	7.920

Calorific Value (kcal/kg)

Fixed tolerance 45°, lag spacing 300 m.

direction 0 °

Variogram

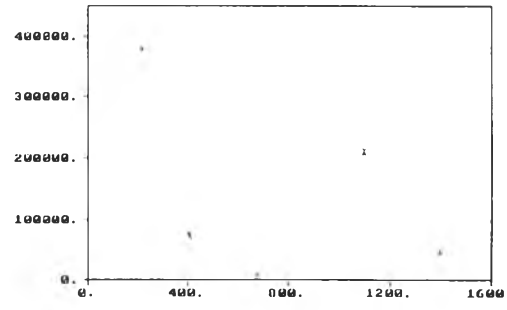


Pure nugget effect model

Pair	Avg. distance	Estimate
3	194.638	419680.8
1	406.119	73451.74
1	679.070	7775.039

direction 22.5 °

Variogram

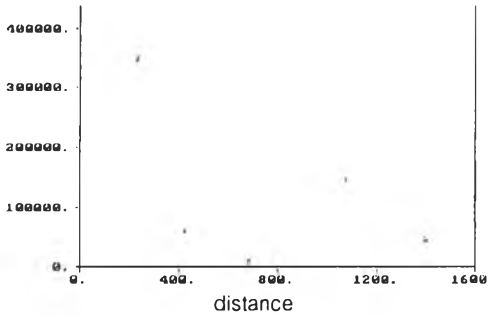


Pure nugget effect model

Pair	Avg. distance	Estimate
5	213.401	377914.6
1	406.119	73451.74
1	679.070	7775.039
3	1097.673	210783.5
1	1396.244	46095.59

direction 45 °

Variogram

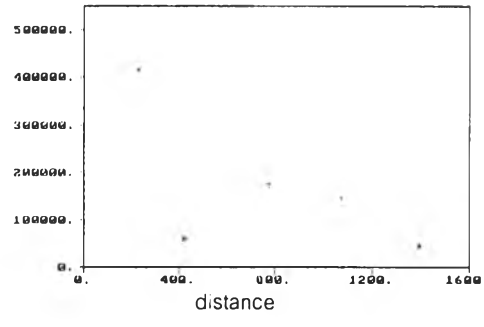


Pure nugget effect model

Pair	Avg. distance	Estimate
6	231.908	347494
2	423.453	60610.04
1	679.070	7775.039
5	1073.965	145451.2
1	1396.244	46095.59

direction 67.5 °

Variogram

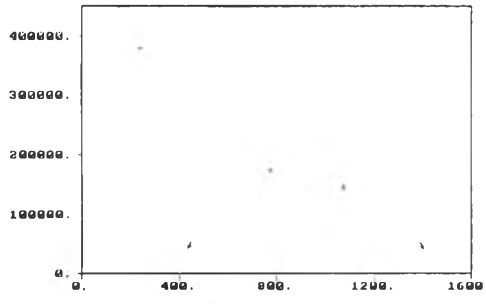


Pure nugget effect model

Pair	Avg. distance	Estimate
4	226.473	415089.9
2	423.453	60610.04
4	775.550	172949.9
5	1073.965	145451.2
1	1396.244	46095.59

direction 90 °

Variogram



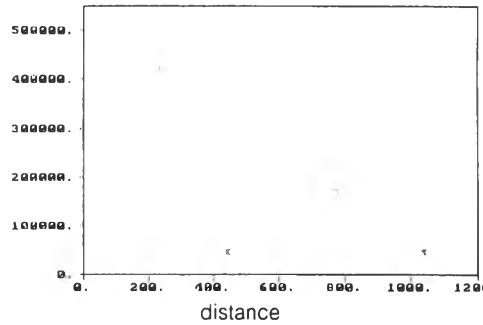
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
5	236.322	380009.6
1	440.787	47768.34
4	775.550	172949.9
5	1073.965	145451.2
1	1396.244	46095.59

direction 112.5 °

Variogram



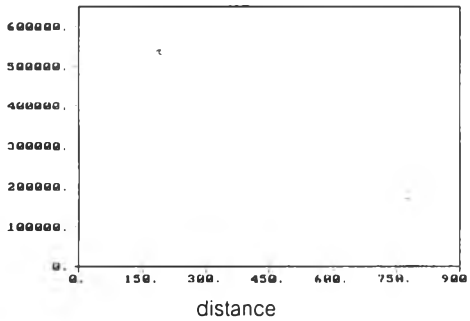
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
3	232.840	423172.3
1	440.787	47768.34
4	775.550	172949.9
2	1038.402	47452.66

direction 135 °

Variogram



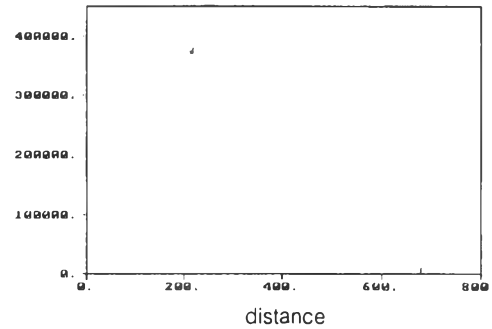
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
2	187.040	537063.2
4	775.550	172949.9

direction 157.5 °

Variogram



distance

Pure nugget effect model

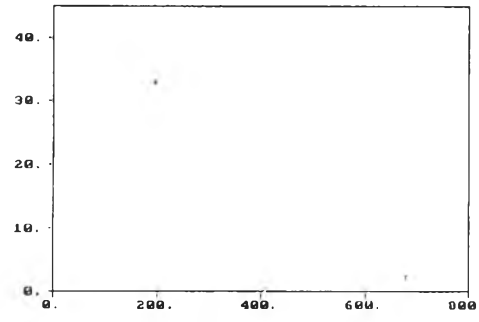
Pair	Avg. distance	Estimate
4	214.909	374682.6
1	679.070	7775.039

Moisture Content (%)

Fixed tolerance 45°, lag spacing 300 m.

direction 0 °

Variogram

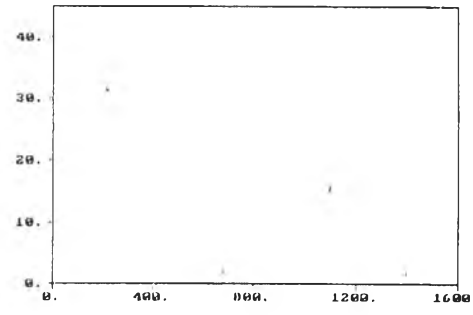


Pure nugget effect model

Pair	Avg. distance	Estimate
3	194.638	32.963
1	406.119	0.289
1	679.070	2.081

direction 22.5 °

Variogram

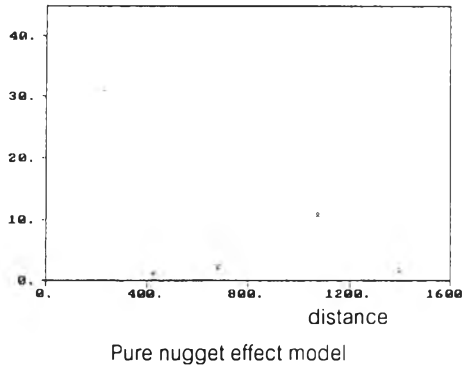


Pure nugget effect model

Pair	Avg. distance	Estimate
5	213.401	31.516
1	406.119	0.289
1	679.070	2.081
3	1097.673	15.527
1	1396.244	1.730

direction 45 °

Variogram

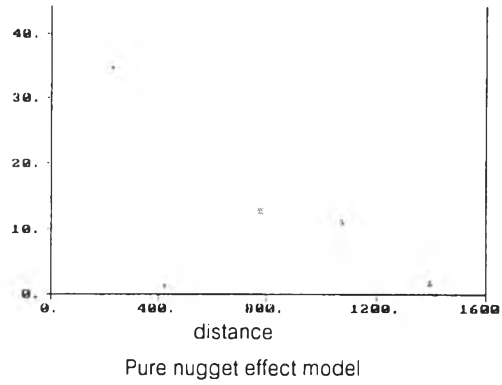


Pure nugget effect model

Pair	Avg. distance	Estimate
6	231.908	31.117
2	423.453	1.279
1	679.070	2.081
5	1073.965	10.958
1	1396.244	1.730

direction 67.5 °

Variogram

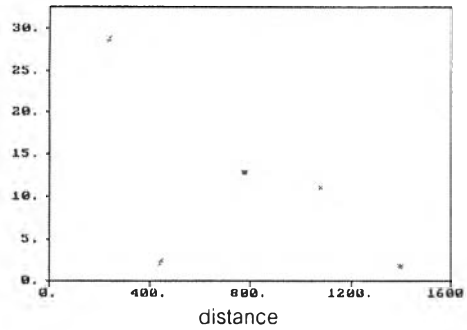


Pure nugget effect model

Pair	Avg. distance	Estimate
4	226.473	34.729
2	423.453	1.279
4	775.550	12.786
5	1073.965	10.958
1	1396.244	1.730

direction 90 °

Variogram

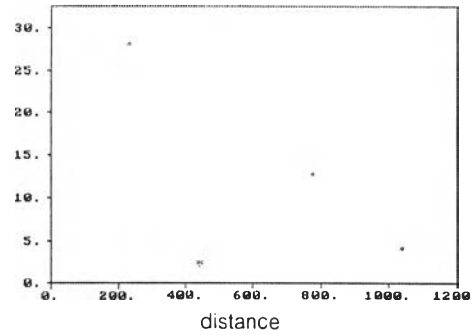


Pure nugget effect model

Pair	Avg. distance	Estimate
5	236.322	28.619
1	440.787	2.268
4	775.550	12.786
5	1073.965	10.958
1	1396.244	1.730

direction 112.5 °

Variogram

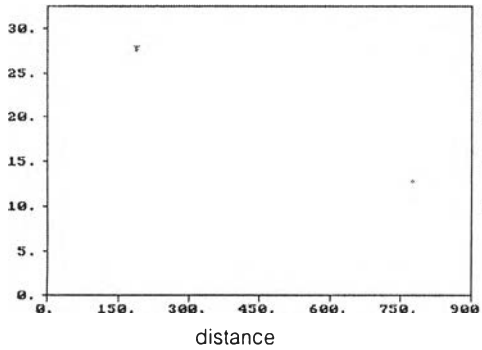


Pure nugget effect model

Pair	Avg. distance	Estimate
3	232.840	28.134
1	440.787	2.268
4	775.550	12.786
2	1038.402	4.105

direction 135 °

Variogram

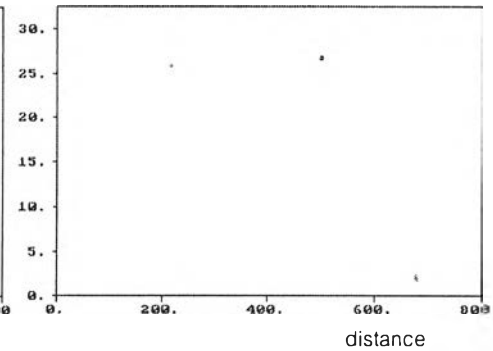


Pure nugget effect model

Pair	Avg. distance	Estimate
2	187.040	27.641
4	775.550	12.786

direction 157.5 °

Variogram



Pure nugget effect model

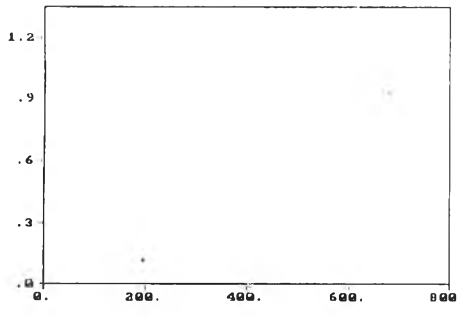
Pair	Avg. distance	Estimate
4	214.909	25.767
1	679.070	2.081

Sulphur Content (%)

Fixed tolerance 45°, lag spacing 300 m.

direction 0 °

Variogram

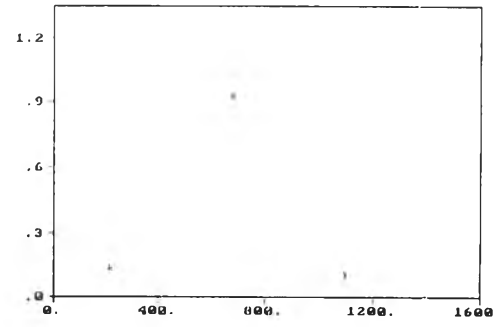


Pure nugget effect model

Pair	Avg. distance	Estimate
3	194.638	0.120
1	406.119	0.000
1	679.070	0.925

direction 22.5 °

Variogram

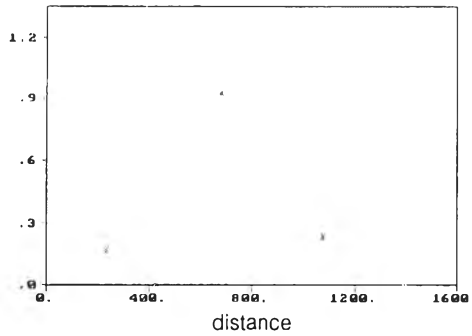


Pure nugget effect model

Pair	Avg. distance	Estimate
5	213.401	0.137
1	406.119	0.000
1	679.070	0.925
3	1097.673	0.103
1	1396.244	0.001

direction 45 °

Variogram

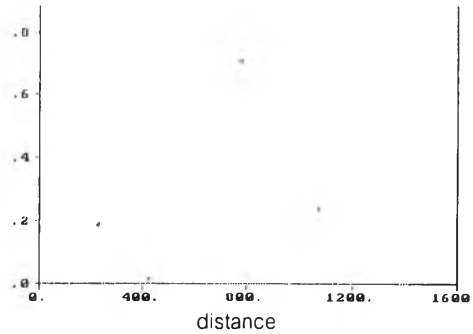


Pure nugget effect model

Pair	Avg. distance	Estimate
6	231.908	0.168
2	423.453	0.011
1	679.070	0.925
5	1073.965	0.236
1	1396.244	0.001

direction 67.5 °

Variogram

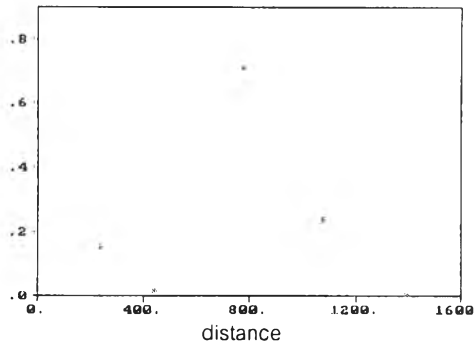


Pure nugget effect model

Pair	Avg. distance	Estimate
4	226.473	0.188
2	423.453	0.011
4	775.550	0.710
5	1073.965	0.236
1	1396.244	0.001

direction 90 °

Variogram

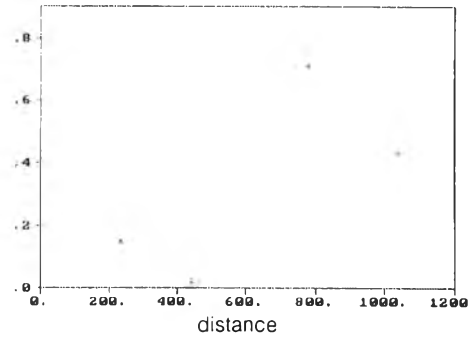


Pure nugget effect model

Pair	Avg. distance	Estimate
5	236.322	0.155
1	440.787	0.022
4	775.550	0.710
5	1073.965	0.236
1	1396.244	0.001

direction 112.5 °

Variogram

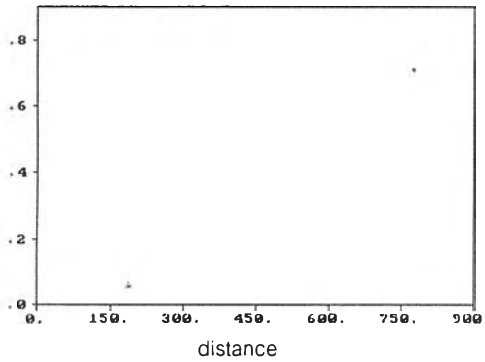


Pure nugget effect model

Pair	Avg. distance	Estimate
3	232.840	0.148
1	440.787	0.022
4	775.550	0.710
2	1038.402	0.436

direction 135 °

Variogram

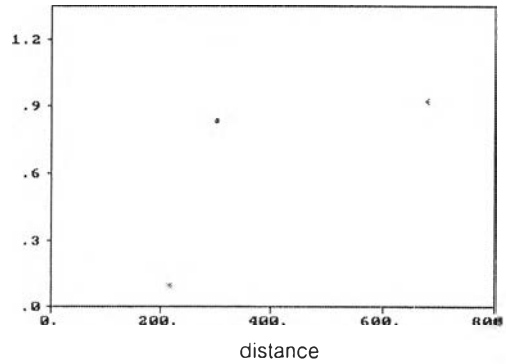


Pure nugget effect model

Pair	Avg. distance	Estimate
2	187.040	0.062
4	775.550	0.710

direction 157.5 °

Variogram



Pure nugget effect model

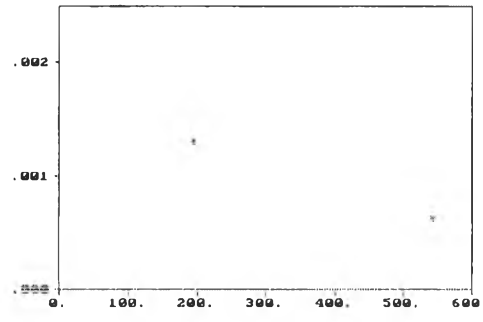
Pair	Avg. distance	Estimate
4	214.909	0.095
1	679.070	0.925

Density (g/cc)

Fixed tolerance 45°, lag spacing 350 m.

direction 0 °

Variogram



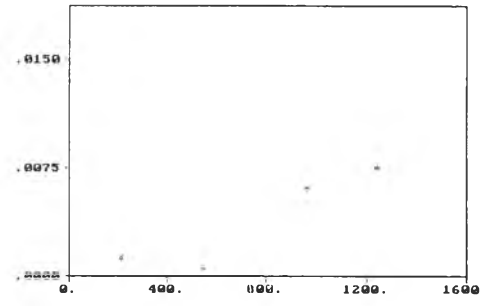
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
3	194.638	0.001
2	542.594	0.001

direction 22.5 °

Variogram



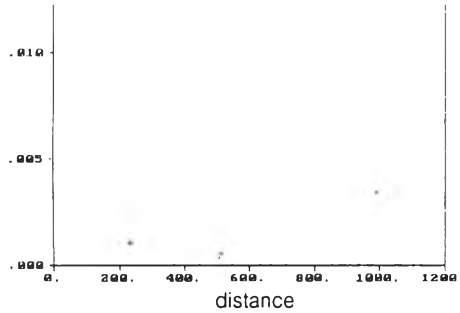
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
5	213.401	0.001
2	542.594	0.001
1	962.305	0.006
3	1242.319	0.008

direction 45 °

Variogram



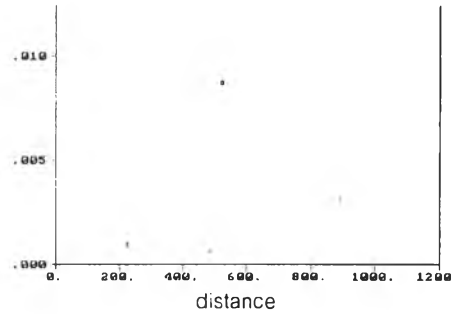
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
6	231.908	0.001
3	508.659	0.000
2	989.027	0.003
4	1197.004	0.007

direction 67.5 °

Variogram



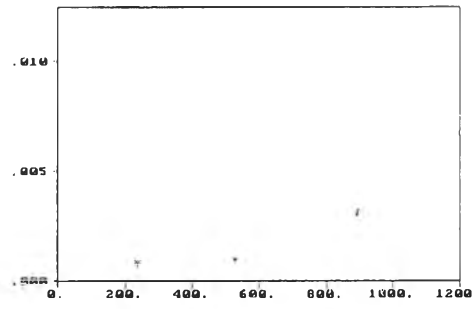
distance

Pure nugget effect model

Pair	Avg. distance	Estimate
4	226.473	0.001
3	482.914	0.001
5	892.914	0.003
4	1197.004	0.007

direction 90 °

Variogram

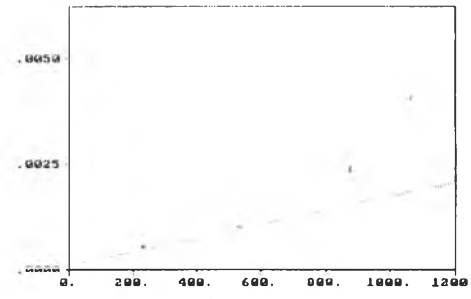


Pure nugget effect model

Pair	Avg. distance	Estimate
5	236.322	0.001
2	528.237	0.001
5	1892.914	0.003
4	1197.004	0.007

direction 112.5 °

Variogram

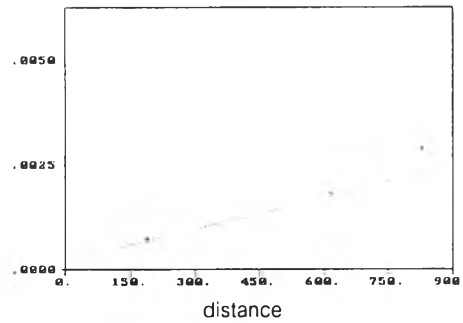


Linear model with nugget = 0.0001, R-major = 1100 m.

Pair	Avg. distance	Estimate
3	232.840	0.001
2	528.237	0.001
4	875.566	0.002
1	1061.056	0.004

direction 135 °

Variogram

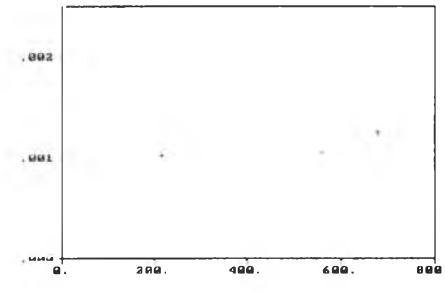


Linear model with nugget = 0.0002, R-major = 780 m.

Pair	Avg. distance	Estimate
2	187.040	0.001
1	615.688	0.002
3	828.838	0.003

direction 157.5 °

Variogram



Pure nugget effect model

Pair	Avg. distance	Estimate
4	214.909	0.001
1	679.070	0.001

APPENDIX D

PAIR RESULTS OF VARIOGRAM

Pair Result for Variogram

P1 seam, ash, lag 280 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
9	185.249	21.117
24	398.774	74.991
31	689.91	120.31
13	978.584	133.457
5	1247.529	201.813

P1 seam, cv, lag 280 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
9	185.249	231737.2
24	398.774	579526.5
31	689.91	1023578
13	978.584	690242.3
5	1247.529	683518.3

P1 seam, moisture, lag 150 m, direction 135, tolerance 45

Pairs	Avg Distance	Variogram
3	132.432	12.322
6	239.656	35.282
15	363.049	27.963
8	535.13	31.45
16	666.244	65.68
11	808.091	59.83
8	968.24	61.9
4	1145.878	72.619
2	1264.453	64.545
1	1358.243	131.382

P1 seam, Sulphur, lag 180 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
4	141.989	1.425
15	281.575	1.254
14	460.445	4.123
21	643.617	3.974
12	801.209	6.1
9	971.701	3.943
5	1161.508	1.278
2	1331.56	1.638

P1 seam, Density, lag 190 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
4	141.989	0.008
15	281.575	0.005
15	467.62	0.008
21	651.114	0.012
14	833.766	0.01
8	1024.325	0.009
4	1219.85	0.007
1	1358.243	0.008

P2 seam, ash, lag 140 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
3	126.16	31.38
6	197.842	46.756
25	355.351	55.873
11	507.047	78.628
18	632.223	85.569
15	746.32	141.473

P2 seam, ash (continue)

Pairs	Avg Distance	Variogram
9	921.077	94.023
10	1044.557	138.908
6	1189.632	116.397
6	1321.98	56.861

P2 seam, cv, lag 240 m, direction 0, tolerance 45

Pairs	Avg Distance	Variogram
6	178.21	279064.4
27	356.274	561594.6
31	610.446	680836.4
15	840.604	1235443
15	1072.767	788247.2
8	1300.37	144180.4

P2 seam, moisture, lag 170 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
4	132.083	17.934
15	268.132	23.926
20	415.451	28.213
23	602.26	30.652
16	743.147	40.931
13	941.511	26.254
9	1107.264	45.387
8	1277.088	34.56
1	1383.215	121.524

P2 seam, Sulphur, lag 400 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
25	270.731	1.609
52	596.274	3.57
24	1009.546	4.698
8	1300.37	0.945

P2 seam, Density, lag 260 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
8	160.737	0.007
34	385.655	0.009
31	651.575	0.008
19	909.301	0.008
13	1165.071	0.006
4	1346.74	0.005

P3 seam, ash, lag 160 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
5	132.565	37.861
16	247.822	87.927
13	391.473	73.556
20	551.024	100.326
18	710.451	100.565
9	862.622	95.757
6	1037.851	214.365
4	1217.677	70.143
5	1344.891	214.684

P3 seam, cv, lag 160 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
5	132.565	267833
16	247.822	482831
13	391.473	798989.6
20	551.024	912498.3
18	710.451	969881.1
9	862.622	1214229
6	1037.851	1857476
4	1217.677	1257289
5	1344.891	1153768

P3 seam, moisture, lag 190 m, direction 0, tolerance 45

Pairs	Avg Distance	Variogram
4	141.17	12.704
18	275.716	21.352
19	472.179	18.639
20	656.835	24.902
12	843.673	27.576
6	1037.851	31.462
6	1248.996	20.393
5	1407.871	32.686

P3 seam, sulphur, lag 210 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
11	164.63	3.957
22	339.374	4.844
20	541.101	6.053
23	726.172	5.116
8	932.53	10.8

P3 seam, sulphur (continue)

Pairs	Avg Distance	Variogram
7	1160.827	6.516
6	1361.497	5.194

P3 seam, density, lag 280 m, direction 22.5, tolerance 45

Pairs	Avg Distance	Variogram
14	205.889	0.013
25	419.124	0.011
18	705.307	0.018
8	990.505	0.021
6	1278.286	0.019

P4 seam, ash, lag 300 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
17	203.584	31.231
28	465.149	59.528
41	727.925	85.886
11	994.255	40.925
16	1332.735	71.109

P4 seam, cv, lag 200 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
7	140.008	382632.5
15	276.019	476330
23	494.12	524591.8
33	701.592	725956.9
15	886.785	511331.5
4	1081.858	61686.75
13	1304.982	766113.1

P4 seam, moisture, lag 310 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
20	219.096	18.459
29	501.354	26.497
39	749.776	42.393
10	1032.843	28.169
15	1339.982	24.162
1	1553.327	65.437

P4 seam, Sulphur, lag 280 m, direction 22.5, tolerance 45

Pairs	Avg Distance	Variogram
14	202.604	3.292
18	419.662	5.343
22	705.277	4.9
9	983.118	3.579
7	1310.325	6.318
4	1478.081	13.482

P4 seam, Density, lag 150 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
5	131.421	0.005
12	233.653	0.015
13	382.132	0.021
15	537.097	0.026
25	674.529	0.021
16	811.357	0.022
7	944.196	0.016
4	1081.858	0.002
9	1274.708	0.021
7	1407.341	0.014
1	1553.327	0

M seam, ash, lag 170 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
1	131.256	150.858
1	309.798	34.778
8	408.197	39.008
5	617.077	86.997
5	744.872	61.844
3	921.584	66.612
2	1068.218	75.621
2	1232.005	71.946
1	1383.215	0.146

M seam, cv, lag 220 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
1	131.256	4266121
8	385.883	712165.9
5	579.131	1080064
7	751.984	1415937
3	978.564	985897.7
3	1189.342	839694.3
1	1385.215	2251442

M seam, moisture, lag 350 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
3	262.311	8.047
12	500.424	16.671
9	835.726	16.46
4	1237.81	58.68

M seam, Sulphur, lag 200 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
1	131.256	0.744
3	340.711	9.23
8	462.699	4.363
8	921.574	4.336
3	921.584	15.052
3	1111.133	5.528
2	1325.13	0.769

M seam, Density, lag 190 m, direction 157.5, tolerance 45

Pairs	Avg Distance	Variogram
1	131.256	0.002
3	340.711	0.015
7	444.088	0.009
7	665.995	0.011
4	844.246	0.012
3	1038.869	0.027
2	1238.005	0.012
1	1383.215	0.014

S1 seam, ash, lag 240 m, direction 90, tolerance 45

Pairs	Avg. Distance	Variogram
1	186.733	4.44
6	377.978	5.137
7	609.168	5.308
3	790.86	4.841
2	1082.398	18.989

S1 seam, cv, lag 300 m, direction 90, tolerance 45

Pairs	Avg. Distance	Variogram
3	251.306	4373.667
8	483.221	9295.063
6	745.279	6332.917
2	1082.398	10600

S1 seam, moisture, lag 260 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
1	186.733	5.346
7	395.786	10.427
6	656.791	7.645
3	871.984	36.053
2	1208.583	6.44

S1 seam, sulphur, lag 200 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
1	186.733	0.003
2	283.592	0.008
7	475.583	0.063
4	703.746	0.083
3	871.984	0.069
1	1195.694	0.344
1	1221.472	0.151

S1 seam, density, lag 260 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
1	186.733	0.001
7	395.786	0.005
7	641.039	0.007
3	871.984	0.016
1	1195.694	0.002

S2 seam, ash, lag 130 m, direction 67.5, tolerance 45

Pairs	Avg. Distance	Variogram
1	121.048	6.16
4	194.65	7.831
4	331.459	7.726
5	465.715	12.625
6	585.756	2.446
1	693.731	1.584

S2 seam, cv, lag 180 m, direction 45, tolerance 45

Pairs	Avg. Distance	Variogram
3	126.737	65142.67
6	265.607	92681.34
6	461.921	102521.5
5	620.738	13366.5

S2 seam, moisture, lag 180 m, direction 45, tolerance 45

Pairs	Avg. Distance	Variogram
3	126.737	4.755
6	265.607	1.706
6	461.921	1.296
5	620.738	6.314

S2 seam,sulphure, lag 160 m, direction 90, tolerance 45

Pairs	Avg. Distance	Variogram
3	136.246	0.016
3	231.006	0.047
5	436.394	0.066
3	590.942	0.077
1	693.731	0.011

S2 seam,density, lag 150 m, direction 67.5, tolerance 45

Pairs	Avg. Distance	Variogram
1	121.048	0.001
5	208.93	0.002
4	373.229	0.004
7	513.54	0.01
4	627.233	0.005

S3 seam, ash , lag 320 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
2	246.065	101.413
9	538.301	29.541
8	809.871	44.324
11	1160.084	53.156
4	1436.187	60.252

S3 seam, cv , lag 330 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
2	246.065	510581.1
9	538.301	96870.68
8	809.871	119149.1
11	1160.084	130069
5	1471.897	129615.5

S3 seam, moisture , lag 330 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
2	246.065	3.88
9	538.301	4.498
8	809.871	16.943
11	1160.084	22.731
5	1471.897	26.377

S3 seam, sulphur , lag 330 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
2	246.065	0.007
9	538.301	0.015
8	809.871	0.02
11	1160.084	0.056
5	1471.897	0.064

S3 seam, density , lag 400 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
3	297.107	0.003
12	621.758	0.003
10	1007.531	0.004
9	1321.528	0.005

S4 seam, density , lag 350 m, direction 112.5, tolerance 45

Pairs	Avg. Distance	Variogram
3	232.84	0.001
2	528.237	0.001
4	875.566	0.002
1	1061.056	0.004

APPENDIX E

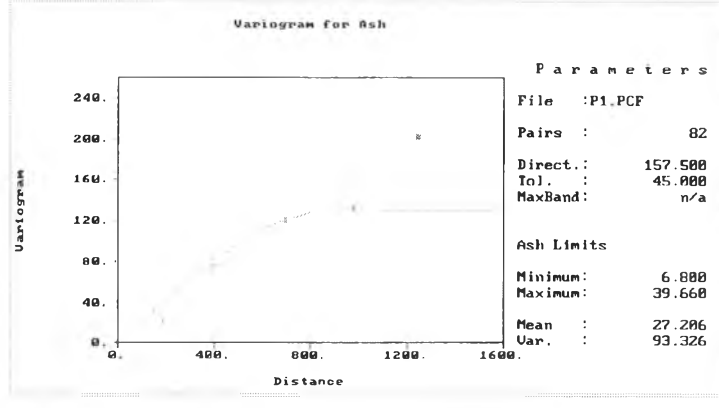
VARIOGRAM MODELS

Variogram Models

P1 seam

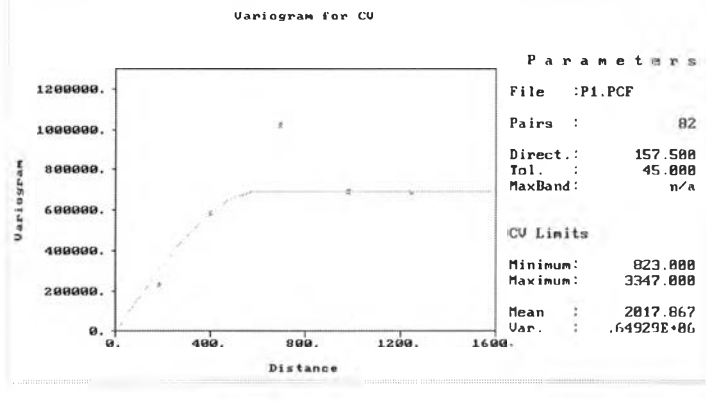
Ash Content (%)

Spherical model, nugget = 0, sill = 130, range = 900 m.



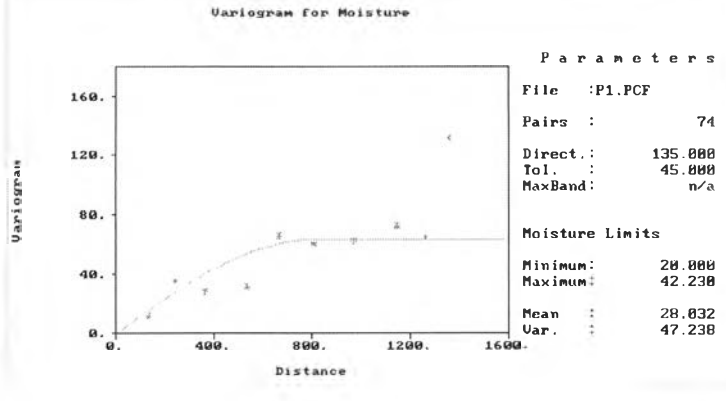
Calorific Value (kcal/kg)

Spherical model, nugget = 0, sill = 690000, range = 600 m.



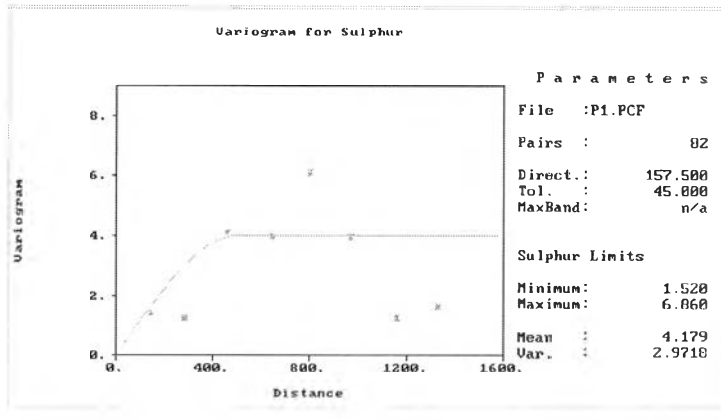
Moisture Content (%)

Spherical model, nugget = 0, sill = 63, range = 800 m.



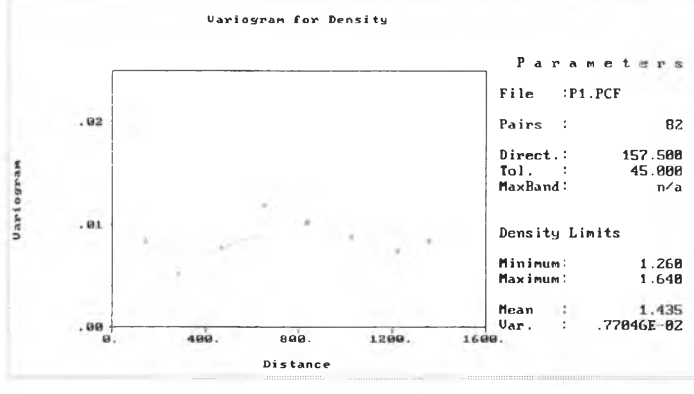
Sulphur Content (%)

Spherical model, nugget = 0, sill = 4, range = 500 m.



Density (g/cc)

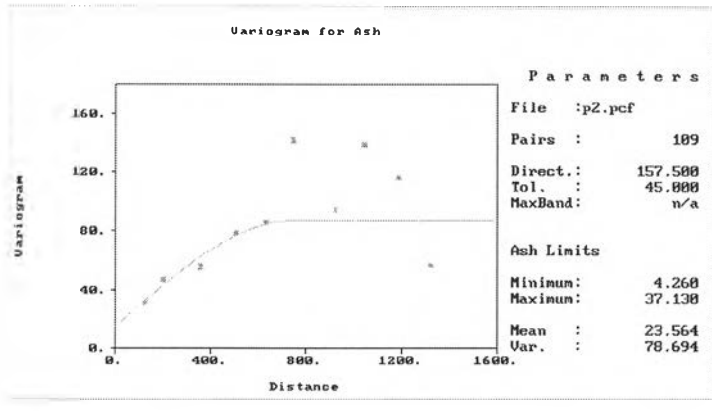
Spherical model, nugget = 0, sill = 0.009, range = 700 m.



P2 seam

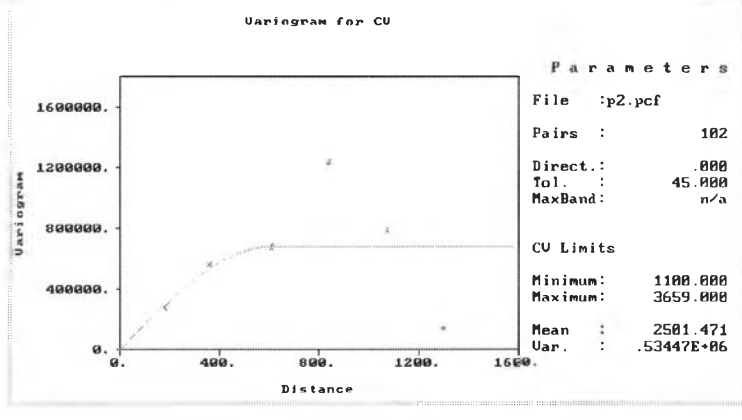
Ash Content (%)

Spherical model, nugget = 15, sill = 72, range = 750 m.



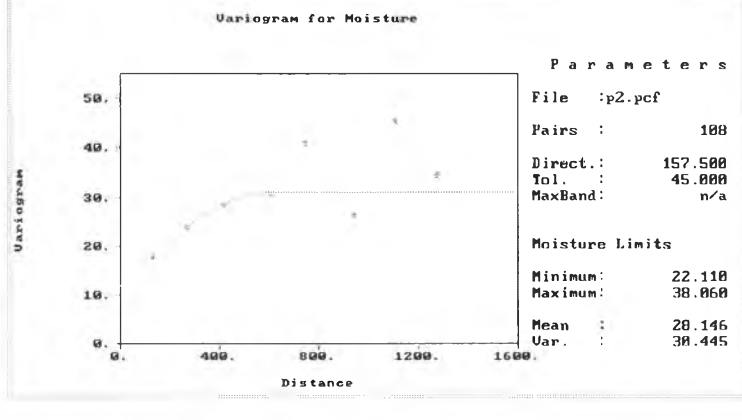
Calorific Value (kcal/kg)

Spherical model, nugget = 0, sill = 675000, range = 600 m.



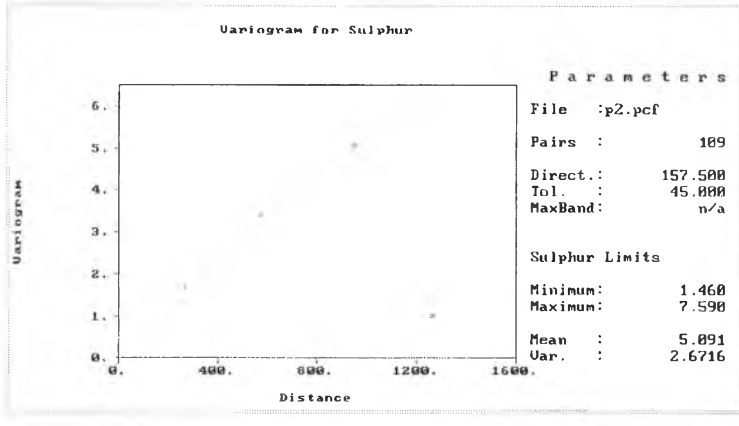
Moisture Content (%)

Spherical model, nugget = 12, sill = 19, range = 600 m.



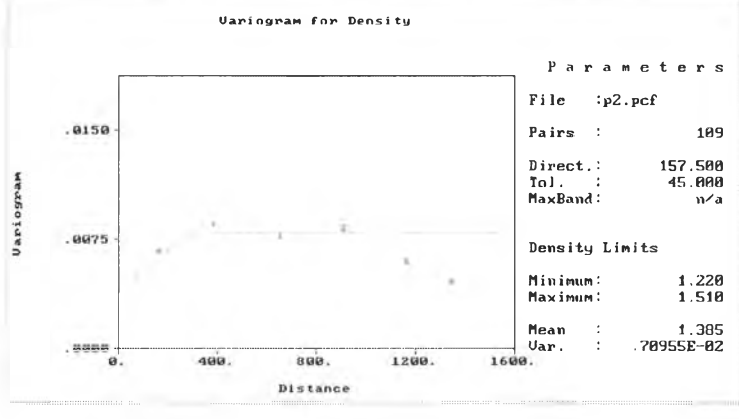
Sulphur Content (%)

Linear model, nugget = 0.5, R-major = 420 m.



Density (g/cc)

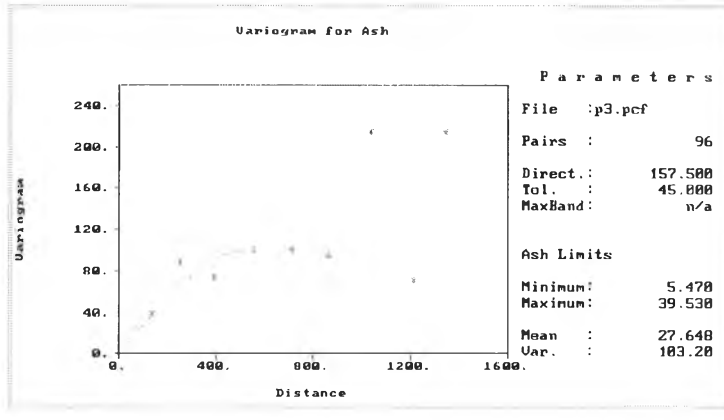
Spherical model, nugget = 0.004, sill = 0.0045, range = 400 m.



P3 seam

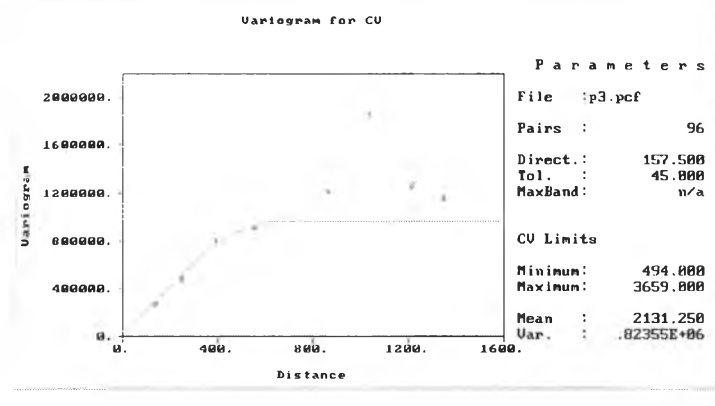
Ash Content (%)

Spherical model, nugget = 0, sill = 100, range = 530 m.



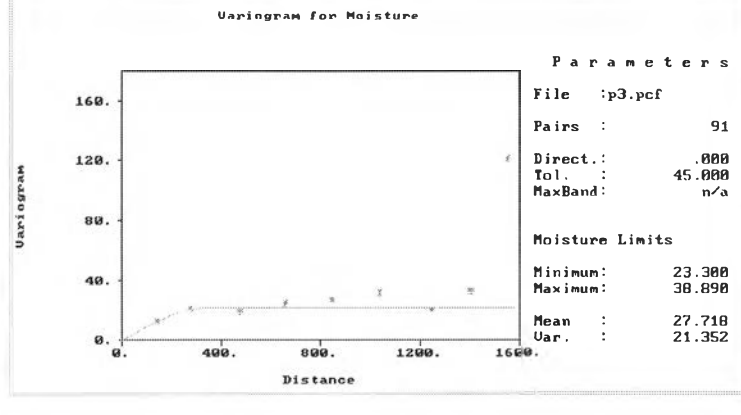
Calorific Value (kcal/kg)

Spherical model, nugget = 0, sill = 960000, range = 650 m.



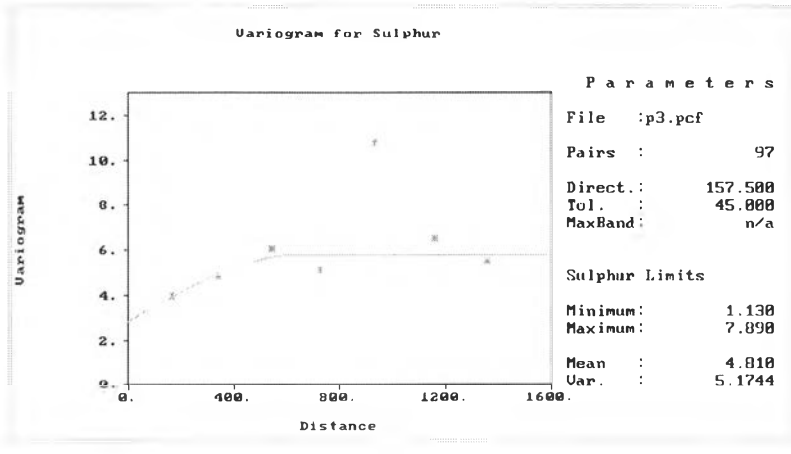
Moisture Content (%)

Spherical model, nugget = 0, sill = 22, range = 350 m.



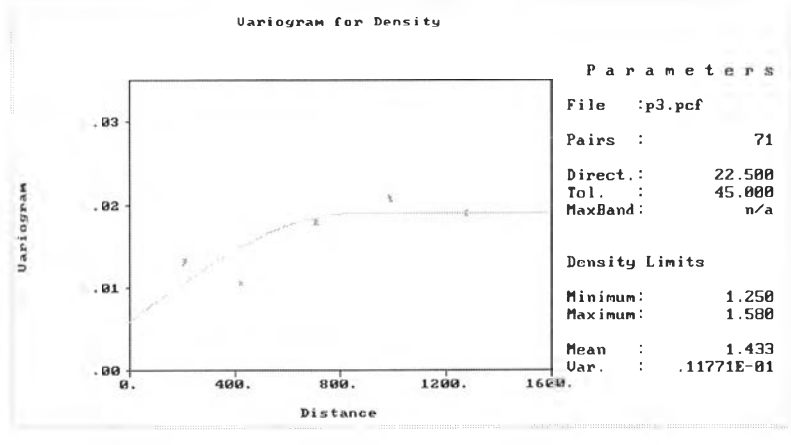
Sulphur Content (%)

Spherical model, nugget = 2.8, sill = 3, range = 650 m.



Density (g/cc)

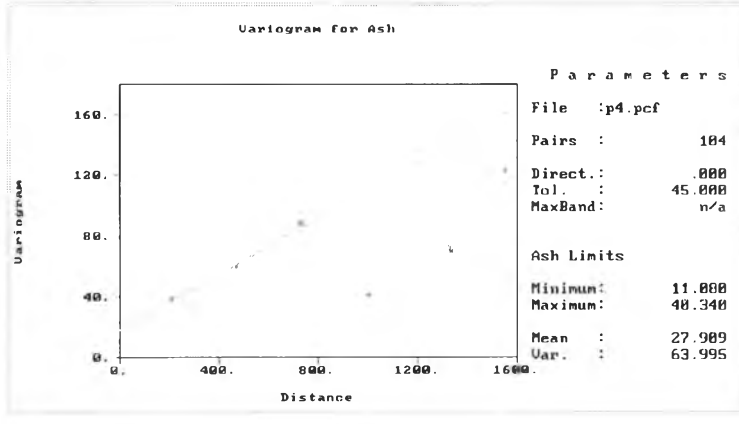
Spherical model, nugget = 0.006, sill = 0.013, range = 850 m.



P4 seam

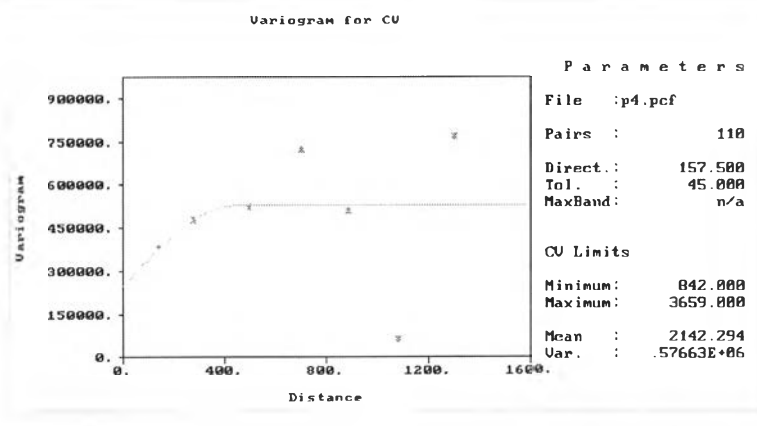
Ash Content (%)

Linear model,nugget = 18, R-major = 500 m.



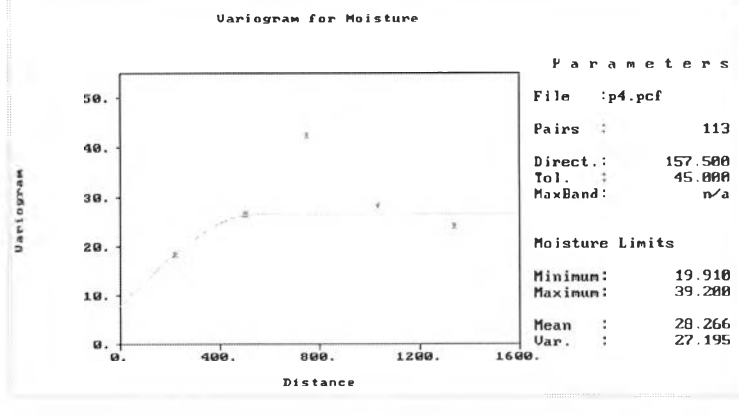
Calorific Value (kcal/kg)

Spherical model, nugget = 250000, sill = 280000, range = 450 m.



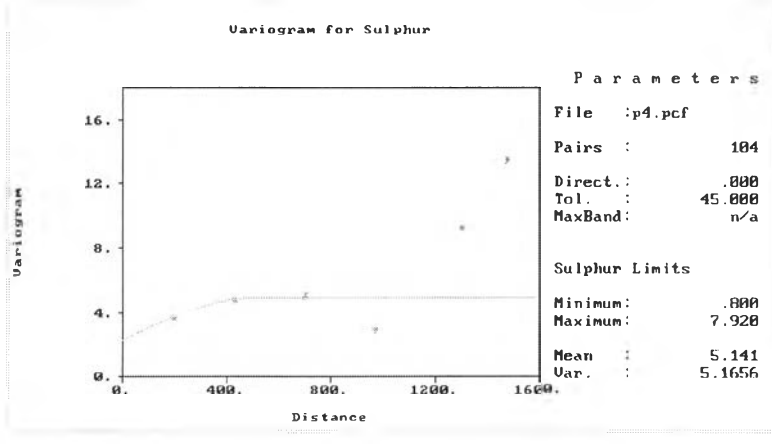
Moisture Content (%)

Spherical model, nugget = 8, sill = 18.5, range = 550 m.



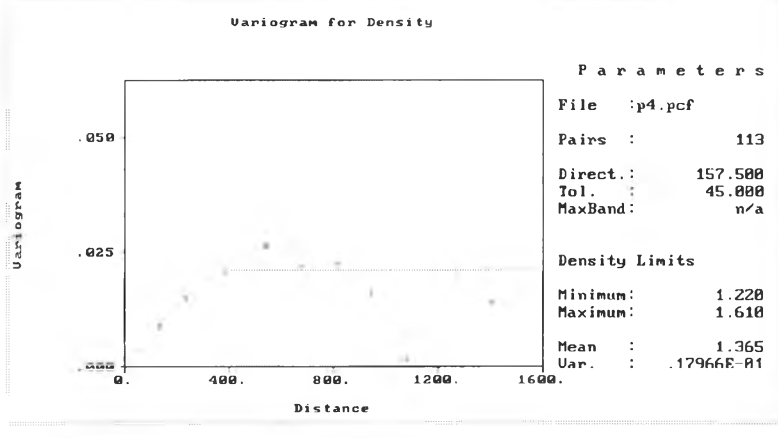
Sulphur Content (%)

Spherical model, nugget = 2.3, sill = 2.6, range = 500 m.



Density (g/cc)

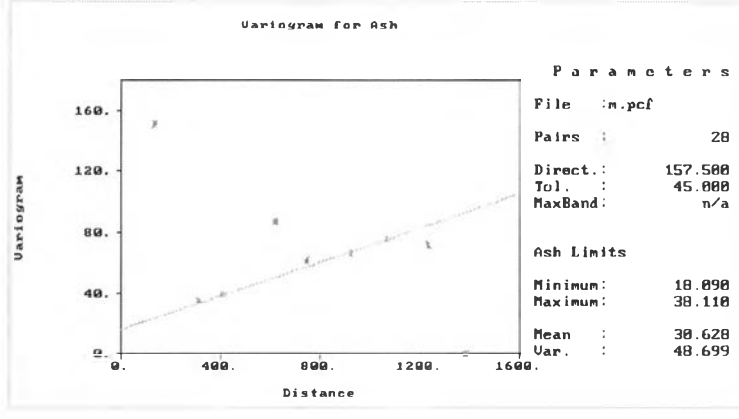
Spherical model, nugget = 0, sill = 0.021, range = 420 m.



M seam

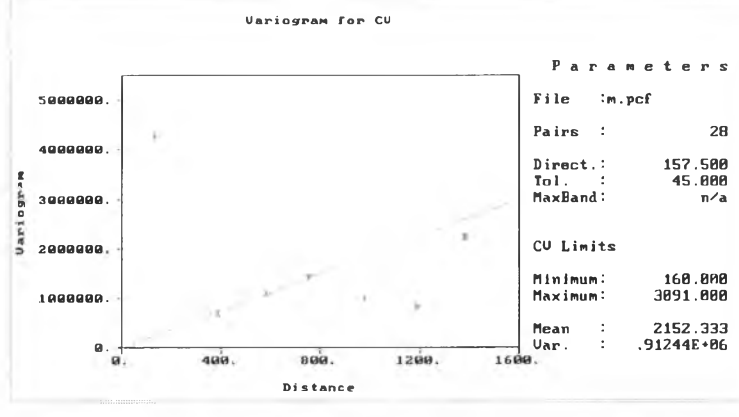
Ash Content (%)

Linear model nugget = 16, R-major = 450 m.



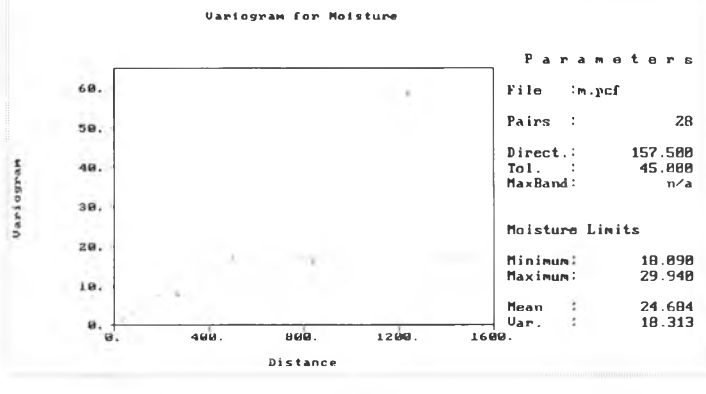
Calorific Value (kcal/kg)

Linear model, nugget = 0, R-major = 400



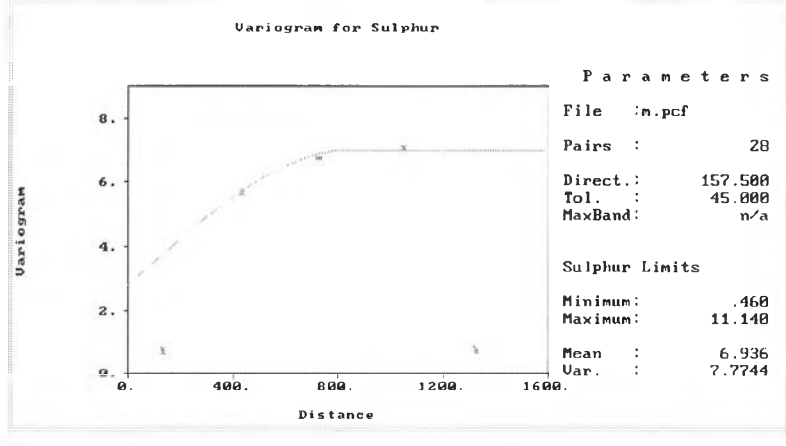
Moisture Content (%)

Spherical model, nugget = 0, sill = 17, range = 600 m.



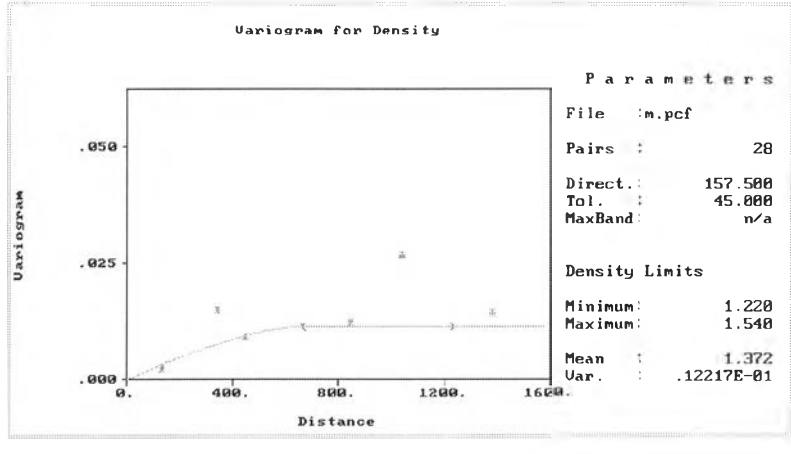
Sulphur Content (%)

Spherical model, nugget = 2.8, sill = 4.2, range = 850 m.



Density (g/cc)

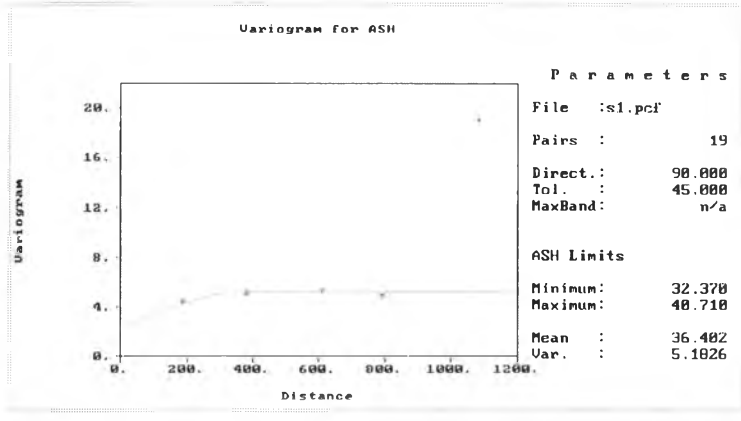
Spherical model, nugget = 0, sill = 0.0115, range = 700 m.



S1 seam

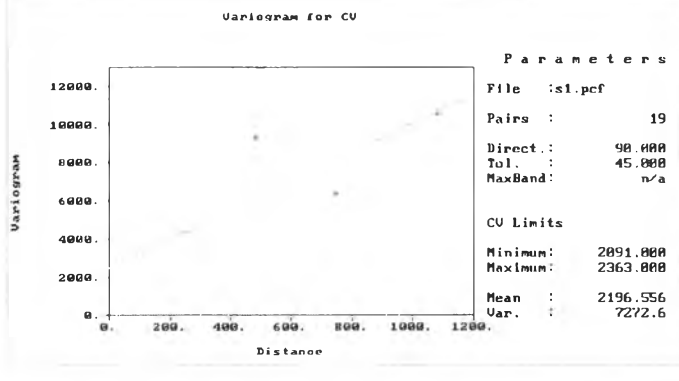
Ash Content (%)

Spherical model nugget = 2.2, sill = 3, range 380 m.



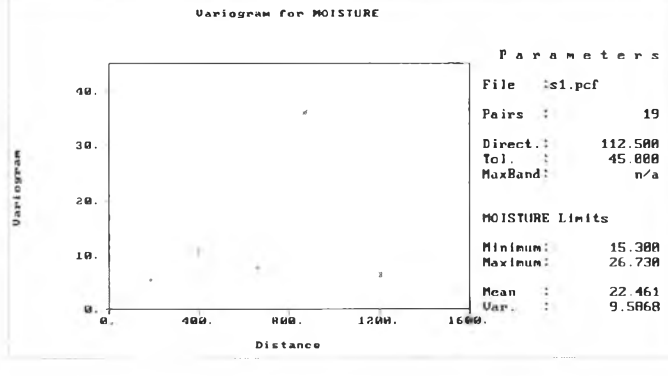
Calorific Value (kcal/kg)

Linear model, nugget = 2500, R-major = 530 m.



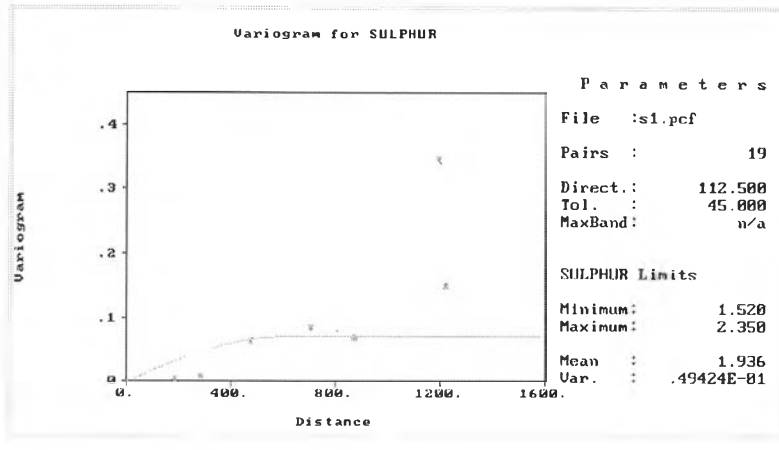
Moisture Content (%)

Spherical model, nugget = 0, sill = 9, range = 450 m.



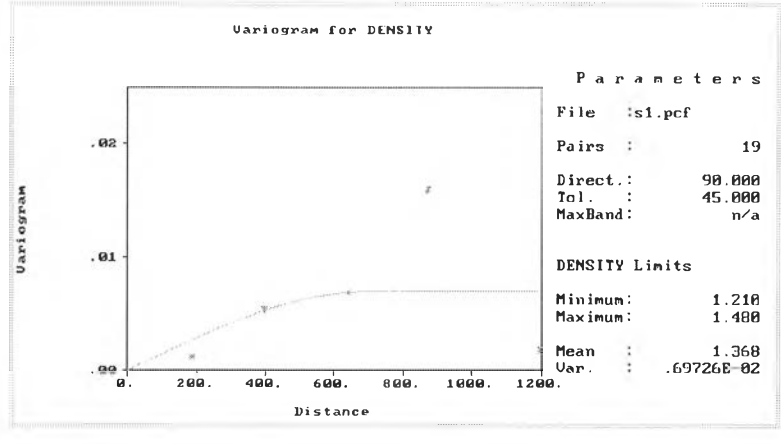
Sulphur Content (%)

Spherical model, nugget = 0, sill = 0.07, range = 600 m.



Density (g/cc)

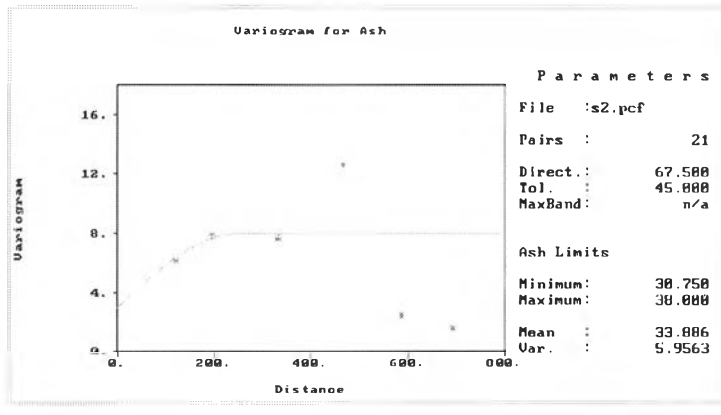
Spherical model, nugget = 0, sill = 0.007, range = 700 m.



S2 seam

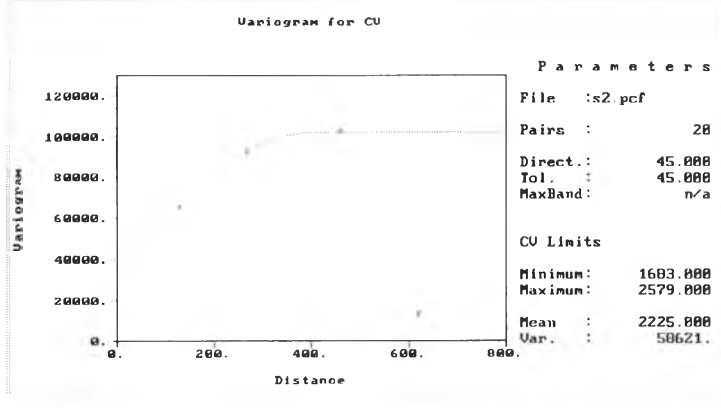
Ash Content (%)

Spherical model nugget = 3, sill = 5, range 250 m.



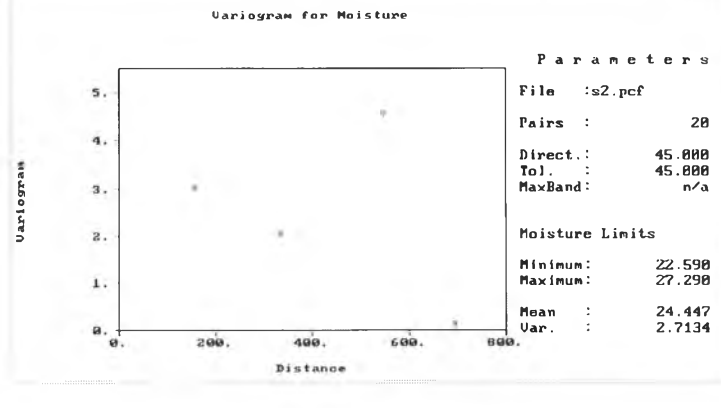
Calorific Value (kcal/kg)

Spherical model, nugget = 40000, sill = 62000, range = 400 m.



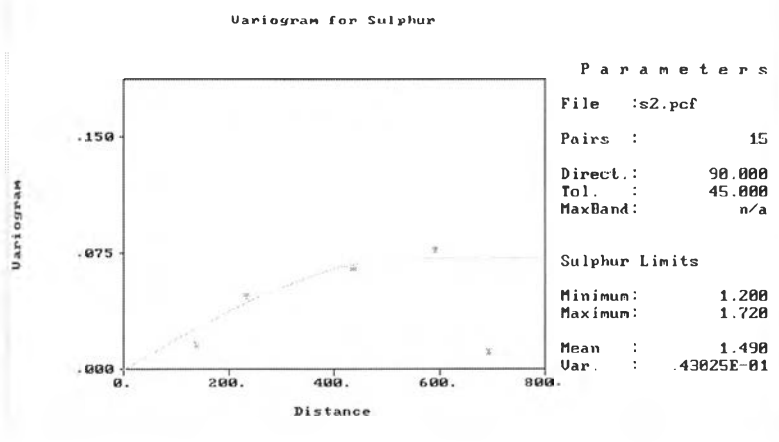
Moisture Content (%)

Pure nugget effect model with sill = 2.5



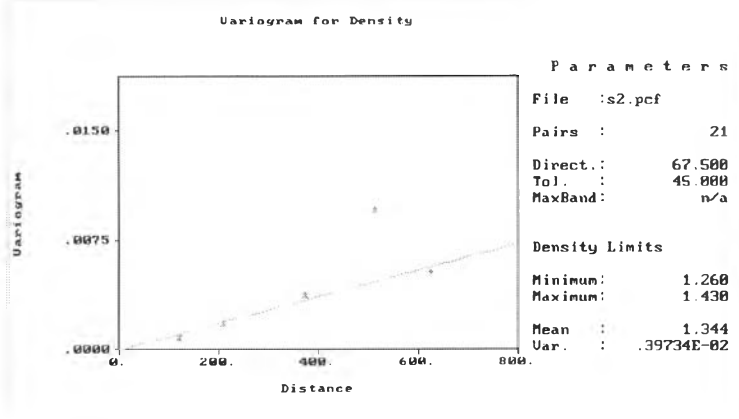
Sulphur Content (%)

Spherical model, nugget = 0, sill = 0.072, range = 550 m.



Density (g/cc)

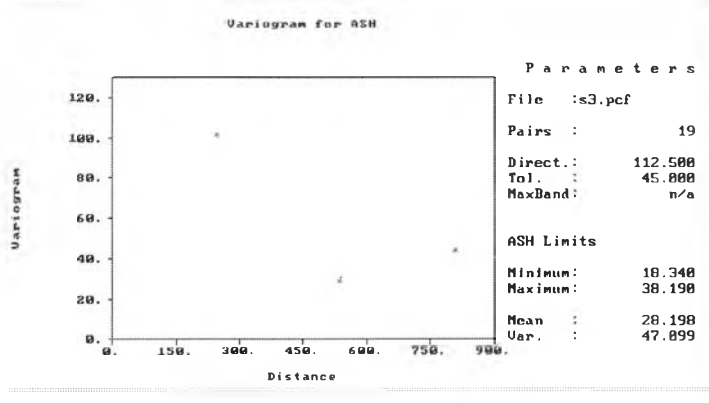
Linear model, nugget = 0, R-major =500 m.



S3 seam

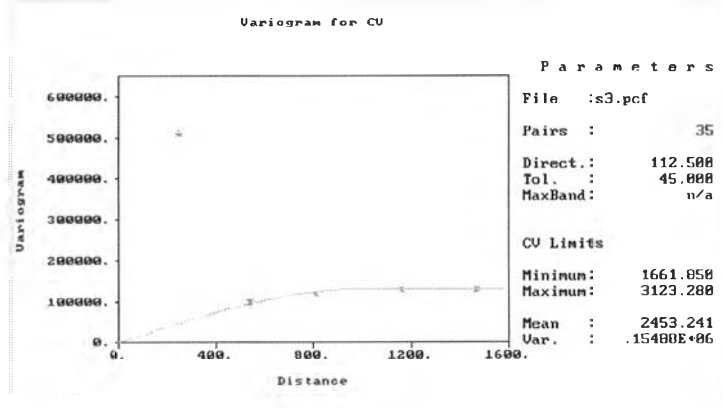
Ash Content (%)

Pure nugget effect model, sill = 40



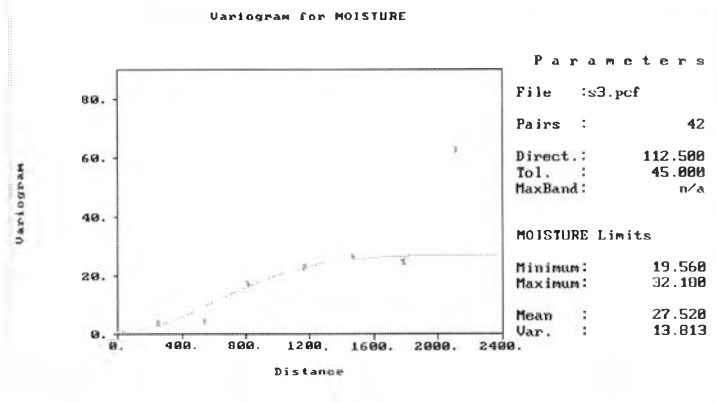
Calorific Value (kcal/kg)

Spherical model, nugget = 0, sill = 130000, range = 1000 m.



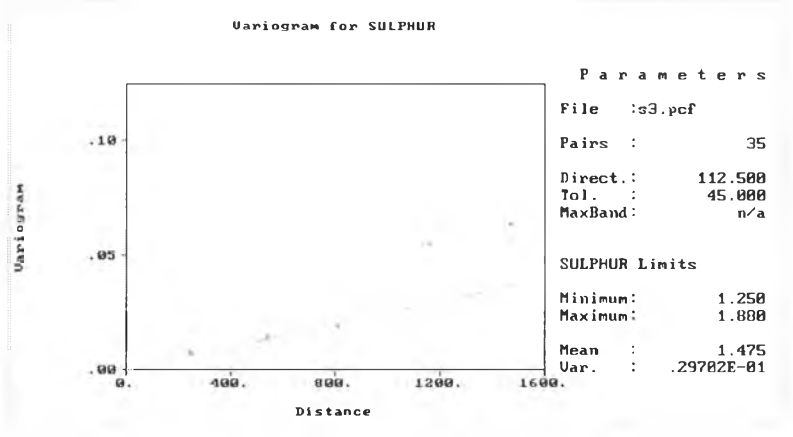
Moisture Content (%)

Gaussian model, nugget = 1, sill = 26, range = 1500 m.



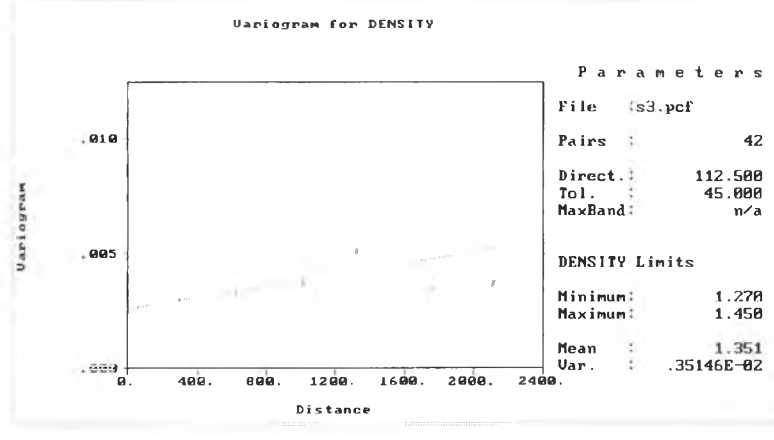
Sulphur Content (%)

Linear model, nugget = 0, R-major = 1200 m.



Density (g/cc)

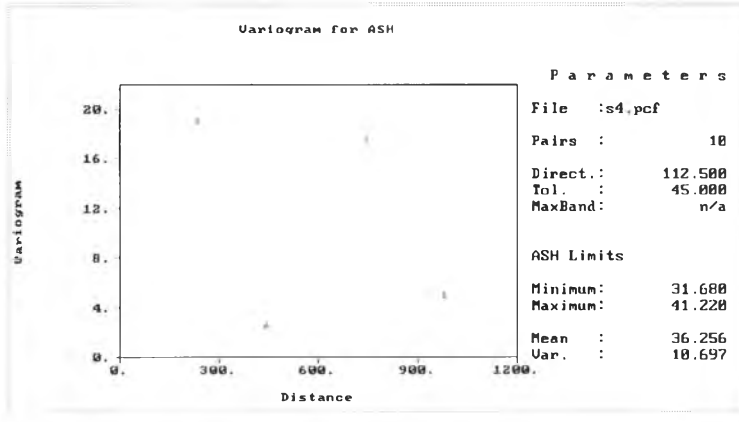
Linear model, nugget = 0.0026, R-major = 1600 m.



S4 seam

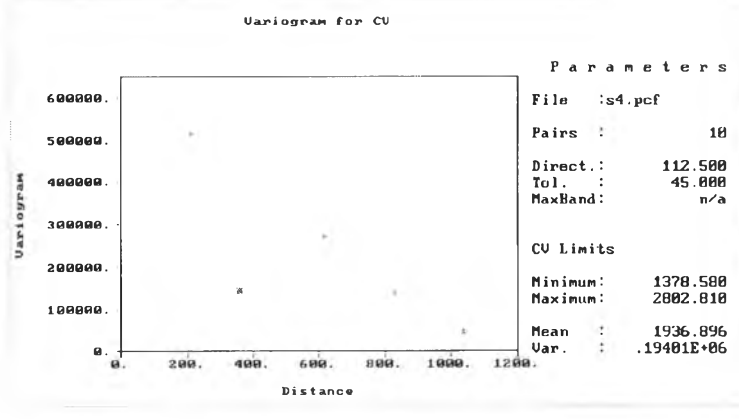
Ash Content (%)

Pure nugget model with sill = 10



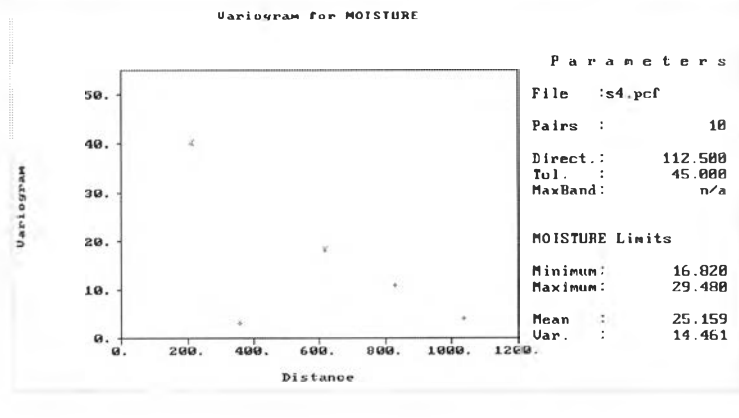
Calorific Value (kcal/kg)

Pure nugget model with sill = 190000



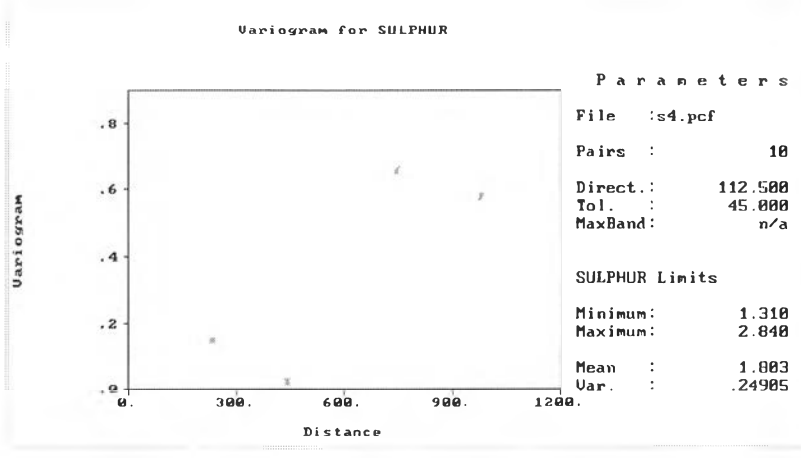
Moisture Content (%)

Pure nugget model with sill = 15



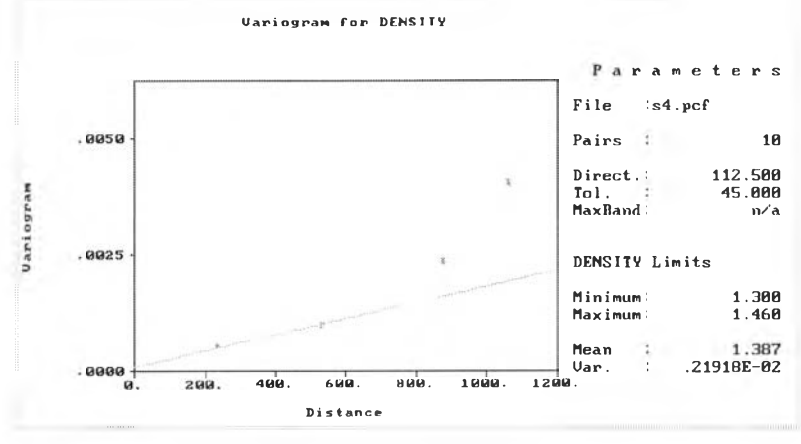
Sulphur Content (%)

Pure nugget model with sill = 0.3



Density (g/cc)

Linear model, nugget = 0.0001, R-major = 1100 m.



APPENDIX F

CROSS VARIDATION

Cross Validation

P1 seam, ash content

Spherical model with nugget effect = 0, sill = 130, range = 900 m, and R-minor =

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	6.8	13.868	-9.6	5.974	-0.84
25th %tile	16.25	21.52	-5.785	6.471	-0.751
Median	27.9	27.297	-2.876	7.278	-0.444
75th %tile	35.23	31.518	2.918	8.972	0.368
Maximum	39.66	38.426	14.72	11.425	1.505
Mean	27.206	27.244	**0.038**	8.173	**0**
Std. Dev	10	6.477	7.059	1.737	0.745

P1 seam, Calorific value

Spherical model with nugget effect = 0, sill = 690000, range = 600 m, and R-minor = 200 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1100	1664.946	-1078.222	624.067	-1.314
25th %tile	1831	2012.265	-531.629	668.647	-0.795
Median	2435	2314.044	-223.054	816.68	-0.235
75th %tile	2892	2834.565	403.786	838.339	0.59
Maximum	3659	3261.264	845	1160.37	0.984
Mean	2501	2489.927	**-11.544**	796.861	**-0.024**
Std. Dev	753.578	513.164	565.018	136.427	0.706

P1 seam, Moisture content

Spherical model with nugget effect = 0, sill = 63, range = 800 m, and R-minor =180

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	20	24.053	-15.033	4.108	-2.325
25th %tile	22.63	25.896	-7.281	4.479	-1.69
Median	25.17	25.896	0.186	4.909	0.045
75th %tile	28.86	29.36	2.711	6.344	0.401
Maximum	42.23	37.344	12.026	7.687	2.187
Mean	28.032	28.001	**-0.031**	5.59	**-0.006**
Std. Dev	7.114	4.546	7.309	1.172	1.299

P1 seam, Sulphur content (%)

Spherical model with nugget effect = 0, sill = 4, range = 500 m, and R-minor =320

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.52	2.274	-2.76	1.38	-1.382
25th %tile	2.11	2.441	-1.829	1.508	-1.213
Median	4	4.011	-0.563	1.683	-0.258
75th %tile	5.26	5.44	1.36	2.067	0.658
Maximum	6.86	6.443	2.851	2.322	1.821
Mean	4.179	4.171	**-0.008**	1.844	**0**
Std. Dev	1.784	1.429	1.742	0.317	1.023

P1 seam, Density (g/cc)

Spherical model with nugget effect = 0, sill = 0.009, range = 700 m, and R-minor = 360 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.26	1.335	-0.183	0.056	-3.244
25th %tile	1.37	1.368	-0.067	0.062	-0.693
Median	1.42	1.436	-0.004	0.07	-0.042
75th %tile	1.46	1.457	0.047	0.086	0.758
Maximum	1.64	1.565	0.108	0.104	1.533
Mean	1.435	1.44	**0.004**	0.078	**0.045**
Std. Dev	0.091	0.064	0.075	0.015	1.14

P2 seam, ash content

Spherical model with nugget effect = 15, sill = 72, range = 750 m, and R-minor =

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	4.26	12.428	-8.338	6.548	-1.118
25th %tile	15.61	18.216	-6.722	6.751	-0.688
Median	25.16	20.938	-3.456	7.526	-0.502
75th %tile	29.75	27.544	0.205	7.828	0.027
Maximum	37.13	31.689	16.423	9.766	2.164
Mean	23.564	23.573	**0.009**	7.628	**0.013**
Std. Dev	9.144	5.513	7.864	0.91	1.05

P2 seam, Calorific value

Spherical model with nugget effect = 0, sill = 675000, range = 600 m, and R-minor = 250 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1100	1639.002	-970.625	590.402	-1.272
25th %tile	1831	1918.116	-482.823	621.723	-0.773
Median	2435	2268.661	-146.979	759.91	-0.217
75th %tile	2892	2968.329	334.813	797.559	0.567
Maximum	3659	3226.813	845	1125.591	0.949
Mean	2501	2488.024	-13.446	753.657	-0.032
Std. Dev	753.578	542.7	519.159	136.825	0.692

P2 seam, Moisture content

Spherical model with nugget effect = 12, sill = 19, range = 600 m, and R-minor

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	22.11	23.968	-12.812	4.594	-2.451
25th %tile	23.05	26.052	-6.589	4.766	-1.394
Median	25.52	27.483	-0.481	4.962	-0.081
75th %tile	29.97	29.808	3.583	5.164	0.681
Maximum	38.06	32.504	9.471	6.599	1.879
Mean	28.146	28.247	0.101	5.147	0.009
Std. Dev	5.688	2.537	6.146	0.514	1.206

P2 seam, Sulphur content (%)

Linear model with nugget effect = 0.5, sill = 2, range = 420 m, and R-minor =220 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.46	3.344	-1.719	1.2	-1.129
25th %tile	3.7	4.183	-1.03	1.244	-0.829
Median	5.13	4.544	-0.158	1.357	-0.132
75th %tile	6.23	6.094	0.55	1.459	0.383
Maximum	7.59	6.727	2.279	1.972	1.595
Mean	5.091	5.182	0.004	1.415	0.001
Std. Dev	1.685	1.108	1.093	0.199	0.78

P2 seam, Density (g/cc)

Linear model with nugget effect = 0.004, sill = 0.0045, range = 400 m, and R-minor = 170 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.22	1.28	-0.159	0.082	-1.914
25th %tile	1.32	1.345	-0.075	0.085	-0.807
Median	1.36	1.365	-0.036	0.09	-0.354
75th %tile	1.44	1.392	0.014	0.1	0.171
Maximum	1.51	1.468	0.205	0.119	2.392
Mean	1.385	1.374	**-0.001**	0.095	**-0.004**
Std. Dev	0.087	0.047	0.094	0.011	1.048

P3 seam, ash content

Spherical model with nugget effect = 0, sill = 100, range = 530 m, and R-minor =

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	5.47	16.207	-18.711	6.938	-2.636
25th %tile	20.51	22.522	-8.198	7.283	-0.901
Median	27.78	27.894	-2.18	8.657	-0.209
75th %tile	36.94	30.921	7.607	9.111	-0.863
Maximum	39.53	39.258	22.424	11.798	2.59
Mean	27.647	27.887	**0.239**	8.633	**0.011**
Std. Dev	10.492	6.744	10.093	1.427	1.264

P3 seam, Calorific value

Spherical model with nugget effect = 0, sill = 960000, range = 650 m, and R-minor = 260 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	494	808.387	-914.509	662.062	-1.298
25th %tile	1492	1632.486	-859.56	689.406	-1.009
Median	2110	2200.491	-38.742	810.986	-0.439
75th %tile	2652	2665.798	626.735	885.921	0.731
Maximum	3659	2892.296	1237.163	1139.138	1.811
Mean	2131.25	2106.975	**-24.275**	816.377	**-0.016**
Std. Dev	937.259	670.193	779.577	130.749	1.02

P3 seam, Moisture content

Linear model with nugget effect = 10, sill = 11, range = 520 m, and R-minor =270

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	23.3	23.429	-8.906	3.939	-2.1
25th %tile	24.45	26.42	-2.991	3.998	-0.65
Median	26.23	27.207	0.245	4.24	0.058
75th %tile	28.34	29.901	3.145	4.372	0.62
Maximum	38.89	31.703	5.981	6.067	1.518
Mean	27.718	28.015	**0.297**	4.415	**0.046**
Std. Dev	4.772	2.298	4.416	0.576	1.034

P3 seam, Sulphur content (%)

Spherical model with nugget effect = 2.8, sill = 3, range = 650 m, and R-minor =200

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.13	1.753	-3.967	2.256	-1.504
25th %tile	2.09	3.911	-2.709	2.319	-1.144
Median	5.09	4.428	-1.185	2.389	-0.525
75th %tile	6.99	5.305	2.053	2.854	0.815
Maximum	7.89	6.97	3.991	3.406	1.765
Mean	4.81	4.57	**-0.24**	2.499	**-0.087**
Std. Dev	2.349	1.403	2.585	0.285	1.068

P3 seam, Density (g/cc)

Spherical model with nugget effect = 0.006, sill = 0.013, range = 850 m, and R-minor = 480 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.25	1.35	-0.21	0.106	-1.972
25th %tile	1.31	1.367	-0.088	0.109	-0.719
Median	1.45	1.426	-0.026	0.116	-0.215
75th %tile	1.53	1.487	0.084	0.121	0.725
Maximum	1.58	1.58	0.187	0.148	1.72
Mean	1.433	1.437	**0.004**	0.119	**0.022**
Std. Dev	0.112	0.068	0.114	0.012	1.007

P4 seam, Calorific value

Spherical model with nugget effect = 250000, sill = 280000, range = 450 m, and R-minor = 260 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	842	1424	-1281.279	695.846	-1.744
25th %tile	1424	1668.196	-915.105	708.626	-1.28
Median	2080	2239.878	-25.891	751.391	0.034
75th %tile	2543	2443.312	496.85	766.065	0.643
Maximum	3659	2576.85	1380.534	1016.397	1.655
Mean	2142.294	2175.07	**32.776**	761.409	**0.018**
Std. Dev	782.733	371.747	807.095	75.055	1.071

P4 seam, Moisture content

Spherical model with nugget effect = 8, sill = 18.5, range = 550 m, and R-minor

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	19.91	23.321	-11.721	4.89	-2.314
25th %tile	24.91	25.013	-3.164	5.019	-0.63
Median	26.51	26.85	-1.589	5.138	-0.317
75th %tile	28.41	30.409	4.374	5.792	0.889
Maximum	39.2	37.779	11.969	6.539	2.229
Mean	28.266	28.288	**0.037**	5.408	**0.003**
Std. Dev	5.375	3.876	5.975	0.503	1.128

P4 seam, Sulphur content (%)

Spherical model with nugget effect = 2.8, sill = 3, range = 500 m, and R-minor =190

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	0.8	1.035	-3.889	2.392	-1.626
25th %tile	3.25	4.031	-2.785	2.429	-0.971
Median	3.95	5.818	-0.101	2.521	-0.037
75th %tile	7.1	5.982	2.059	2.709	0.757
Maximum	7.92	7.467	5.018	3.406	1.842
Mean	5.141	5.35	**0.209**	2.622	**0.061**
Std. Dev	2.343	1.601	2.661	0.249	1.032

P4 seam, Density (g/cc)

Spherical model with nugget effect = 0, sill = 0.021, range = 420 m, and R-minor = 280 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.22	1.225	-0.178	0.109	-1.559
25th %tile	1.22	1.283	-0.148	0.115	-1.022
Median	1.27	1.319	-0.009	0.128	-0.056
75th %tile	1.46	1.389	0.063	0.14	0.468
Maximum	1.61	1.534	0.299	0.199	2.648
Mean	1.365	1.359	**-0.006**	0.134	**-0.016**
Std. Dev	0.138	0.091	0.128	0.022	1.041

M seam, ash content

Linear model with nugget effect = 16, sill = 25, R-major = 450 m, and R-minor = 240

	variable	estimate	difference	kriging std.	Zscore
Minimum	18.09	20.26	-17.37	6.132	-2.337
25th %tile	20.26	28.3	-7.165	6.481	-1.168
Median	29.77	30.379	-2.807	7.433	-0.336
75th %tile	35.5	31.681	2.431	7.648	0.375
Maximum	38.11	37.63	17.37	9.021	2.337
Mean	30.628	30.992	**0.364**	7.588	**0.029**
Std. Dev.	7.402	4.995	10.501	1.049	1.411

M seam, Calorific value

Linear model with nugget effect = 0, sill = 750000, range = 400 m, and R-minor =

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	160	160	-2921	683.452	-3.618
25th %tile	949	1482.838	-799.462	724.288	-0.768
Median	2282	2031.317	-544.683	788.637	-0.691
75th %tile	2576	2577.3	-224.345	807.416	-0.292
Maximum	3091	3081	2921	1207.555	3.618
Mean	2152.333	2151.317	**-1.017**	869.051	**0.008**
Std. Dev	1013.161	929.723	1652.738	185.76	2.038

M seam, Moisture content (%)

Spherical model with nugget effect = 0, sill = 17, range = 600 m, and R-minor =160

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	18.09	18.09	-4.076	4.377	-0.832
25th %tile	19.5	21.28	-3.463	4.57	-0.738
Median	22.42	24.588	-3.19	4.695	-0.55
75th %tile	27.78	26.259	0.68	5.115	0.129
Maximum	29.94	29.94	6.759	5.802	1.322
Mean	24.684	24.851	**0.167**	5.017	**0.026**
Std. Dev	4.539	3.465	4.047	0.522	0.815

M seam, Sulphur content (%)

Spherical model with nugget effect = 2.8, sill = 4.2, range = 850 m, and R-minor

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	0.46	5.408	-4.133	2.303	-1.56
25th %tile	6.06	5.851	-2.32	2.369	-0.908
Median	6.53	6.921	-1.329	2.454	-0.577
75th %tile	7.35	7.331	0.327	2.554	0.116
Maximum	11.14	7.852	6.871	2.813	2.9
Mean	6.936	6.876	**-0.059**	2.507	**-0.001**
Std. Dev	2.957	0.837	3.162	-0.157	1.295

M seam, Density (g/cc)

Spherical model with nugget effect = 0, sill = 0.0115, range = 700 m, and R-minor = 420 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.22	1.274	-0.246	0.091	-2.486
25th %tile	1.22	1.285	-0.16	0.092	-1.752
Median	1.33	1.324	0.003	0.099	0.03
75th %tile	1.41	1.44	0.065	0.102	0.597
Maximum	1.54	1.515	0.22	0.13	1.972
Mean	1.372	0.1385	**0.012**	0.104	**0.075**
Std. Dev	0.117	0.094	0.153	0.013	1.502

S1 seam, ash content

Spherical model with nugget effect = 2.2, sill = 3, range = 380 m, and R-minor =

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	32.37	34.77	-5.94	2.661	-1.863
25th %tile	34.77	34.9	-2.99	2.712	-0.939
Median	35.62	35.82	-0.2	3.183	-0.063
75th %tile	37.75	37.75	0.2	3.188	0.063
Maximum	40.71	39.157	4.387	3.19	1.617
Mean	36.402	36.525	**-0.382**	3.051	**-0.101**
Std. Dev	2.415	1.576	3.239	0.227	1.074

S1 seam, Calorific value

Spherical model with nugget effect = 2500, sill = 5000, R-major = 500 m, and R-minor = 210 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	2091	2093.74	-105.26	75.57	-1.393
25th %tile	2096	2093.74	-105.26	75.57	-1.393
Median	2158	2158	-100	99.388	-0.703
75th %tile	2199	2173.959	15.959	101.509	0.157
Maximum	2363	2199	103	142.251	1.036
Mean	2196.556	2163.627	**3.227**	105.311	**0.01**
Std. Dev	90.453	42.316	102.938	24.005	1.053

S1 seam, Moisture content

Spherical model with nugget effect = 0, sill = 9, range = 450 m, and R-minor =270

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	15.3	18.466	-5.564	3.097	-1.598
25th %tile	20.46	20.46	-0.397	3.482	-0.109
Median	22.84	22.128	-0.07	3.654	-0.017
75th %tile	23.73	23.57	0.182	3.731	0.059
Maximum	26.73	24.35	6.828	4.208	1.83
Mean	22.461	22.092	**0.165**	3.709	**0.03**
Std. Dev	3.284	2.165	3.341	0.358	0.922

S1 seam, Sulphur content (%)

Spherical model with nugget effect = 0, sill = 0.07, R-major = 600 m, and R-minor = 250 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.52	1.84	-0.3	0.252	-0.802
25th %tile	1.77	1.84	-0.23	0.267	-0.615
Median	1.84	1.929	-0.035	0.323	-0.113
75th %tile	2.05	2.009	0.078	0.372	0.242
Maximum	2.35	2.14	0.53	0.374	1.416
Mean	1.936	1.968	**0.032**	0.331	**0.09**
Std. Dev	0.236	0.102	0.248	0.047	0.69

S1 seam, Density (g/cc)

Spherical model with nugget effect = 0, sill = 0.007, range = 700 m, and R-minor = 200 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.21	1.27	-0.21	0.096	-1.775
25th %tile	1.27	1.35	-0.085	0.102	-0.829
Median	1.36	1.353	-0.02	0.103	-0.169
75th %tile	1.37	1.395	0.015	0.118	0.146
Maximum	1.48	1.48	0.21	0.118	1.775
Mean	1.368	1.381	**0.014**	0.111	**0.103**
Std. Dev	0.089	0.063	0.137	0.009	1.182

S2 seam, ash content

Spherical model with nugget effect = 3, sill = 5, range = 250 m, and R-minor = 130

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	30.75	32.22	-2.05	3.026	-0.592
25th %tile	31.43	32.22	-2.05	3.026	-0.592
Median	32.53	32.945	-1.315	3.464	-0.369
75th %tile	35.06	34.751	0.31	4	0.077
Maximum	38	38	4.001	4	1.265
Mean	33.886	34.266	**0.029**	3.603	**0.01**
Std. Dev	2.609	2.106	2.082	0.412	0.64

S2 seam, Calorific value

Spherical model with nugget effect = 40000, sill = 62000, range = 400 m, and R-minor = 260 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1683	2028.411	-550.589	658.744	-0.636
25th %tile	2112	2028.411	-550.589	658.744	-0.636
Median	2288	2183.588	-123.412	749.258	-0.187
75th %tile	2323	2288.948	164.54	861.598	0.191
Maximum	2579	2365.13	632.361	985.349	0.796
Mean	2225	2214.637	**-1.363**	803.432	**-0.012**
Std. Dev	258.834	133.382	379.662	110.701	0.464

S2 seam, Sulphur content (%)

Spherical model with nugget effect = 0, sill = 0.072, R-major = 550 m, and R-minor = 210 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.2	1.27	-0.235	0.192	-0.988
25th %tile	1.27	1.28	-0.19	0.207	-0.748
Median	1.42	1.5	-0.01	0.241	-0.027
75th %tile	1.69	1.662	0.042	0.321	0.175
Maximum	1.72	1.694	0.492	0.372	1.532
Mean	1.49	1.517	**-0.027**	0.281	**0.073**
Std. Dev	0.222	0.17	0.248	0.072	0.935

S2 seam, Density (g/cc)

Linear model with nugget effect = 0, sill = 0.004, range = 480 m, and R-minor = 210

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.26	1.28	-0.036	0.038	-0.772
25th %tile	1.26	1.28	-0.036	0.038	-0.772
Median	1.36	1.351	-0.011	0.046	-0.281
75th %tile	1.39	1.389	0.02	0.061	0.246
Maximum	1.43	1.4	0.029	0.081	0.677
Mean	1.344	1.357	**0.001**	0.056	**-0.012**
Std. Dev	0.067	0.047	0.25	0.017	0.488

S3 seam, ash content

Linear model with nugget effect = 10, sill = 37, range = 1000 m, and R-minor = 550

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	18.34	20.619	-17.571	4.957	-3.285
25th %tile	19.27	24.366	-7.237	5.348	-0.993
Median	28.22	26.182	-0.902	6.03	-0.131
75th %tile	31.16	29.783	2.703	6.674	-0.479
Maximum	38.19	34.458	10.2921	8.972	1.577
Mean	28.198	27.835	**-0.363**	6.325	**-0.016**
Std. Dev	7.143	4.09	7.83	1.075	1.358

S3 seam, Calorific value

Spherical model with nugget effect = 0, sill = 120000, range = 1000 m, and R-minor = 350 m.

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1661	1954.45	-520.865	280.807	-1.711
25th %tile	2117.05	2320.535	-425.354	349.003	-1.163
Median	2400.5	2429.375	-174.747	373.799	-0.597
75th %tile	2610.71	2611.96	210.21	438.324	0.429
Maximum	3123.28	2916.286	1254.436	4.89.898	3.387
Mean	2453.241	2490.171	**36.93**	402.495	**0.059**
Std. Dev	409.62	256.209	499.2	74.074	1.337

S3 seam, Moisture content

Linear model with nugget effect = 0, sill = 13, range = 800 m, and R-minor =450 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	19.56	24.45	-4.45	2.913	-0.873
25th %tile	24.2	24.927	-2.555	3.286	-0.716
Median	26.35	25.92	-0.775	3.722	-0.175
75th %tile	30.26	28.573	-0.277	4.554	-0.082
Maximum	32.181	31.229	**6**	5.099	**1.177**
Mean	27.52	27.418	**-0.102**	4.079	**-0.022**
Std. Dev	3.868	2.455	2.901	0.767	0.707

S3 seam, Sulphur content (%)

Linear model with nugget effect = 0, sill = 0.03, R-major = 1200 m, and R-minor =

	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.25	1.332	-0.37	0.101	-1.512
25th %tile	1.32	1.345	-0.105	0.121	-0.69
Median	1.43	1.432	0.014	0.149	0.094
75th %tile	1.51	1.564	0.086	0.197	0.42
Maximum	1.88	1.596	0.2	0.245	1.027
Mean	1.475	1.473	**-0.002**	0.17	**0.015**
Std. Dev	0.179	0.106	0.149	0.051	0.778

S3 seam, Density (g/cc)

Spherical model with nugget effect = 0, sill = 0.009, range = 700 m, and R-minor = 380 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.27	1.28	-0.14	0.084	-1.396
25th %tile	1.29	1.321	-0.1	0.096	-0.745
Median	1.35	1.35	-0.025	0.106	-0.215
75th %tile	1.38	1.37	0.051	0.134	0.536
Maximum	1.45	1.42	0.13	0.134	0.969
Mean	1.351	1.35	**-0.001**	0.115	**0.002**
Std. Dev	0.062	0.042	0.085	0.018	0.75

S4 seam, Density (g/cc)

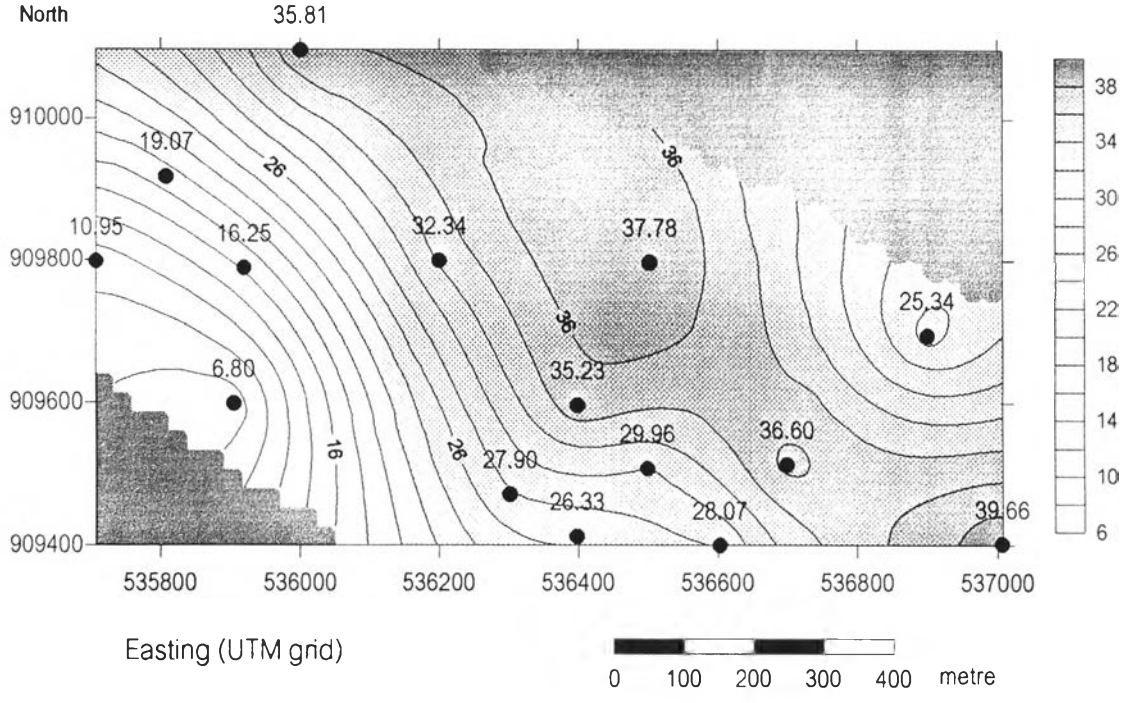
Linear model with nugget effect = 0.0001, sill = 0.0018, range = 1100 m, and R-minor = 530 m.

Value	Variable	Estimate	Difference	Kriging Std.	Zscore
Minimum	1.3	1.4	-0.057	0.019	-3.035
25th %tile	1.3	1.4	-0.057	0.019	-3.035
Median	1.39	1.406	0.029	0.027	0.751
75th %tile	1.41	1.419	0.03	0.033	0.854
Maximum	1.46	1.44	0.056	0.66	1.814
Mean	1.387	1.418	**0.016**	0.034	**0.257**
Std. Dev	0.51	0.018	0.043	0.017	1.766

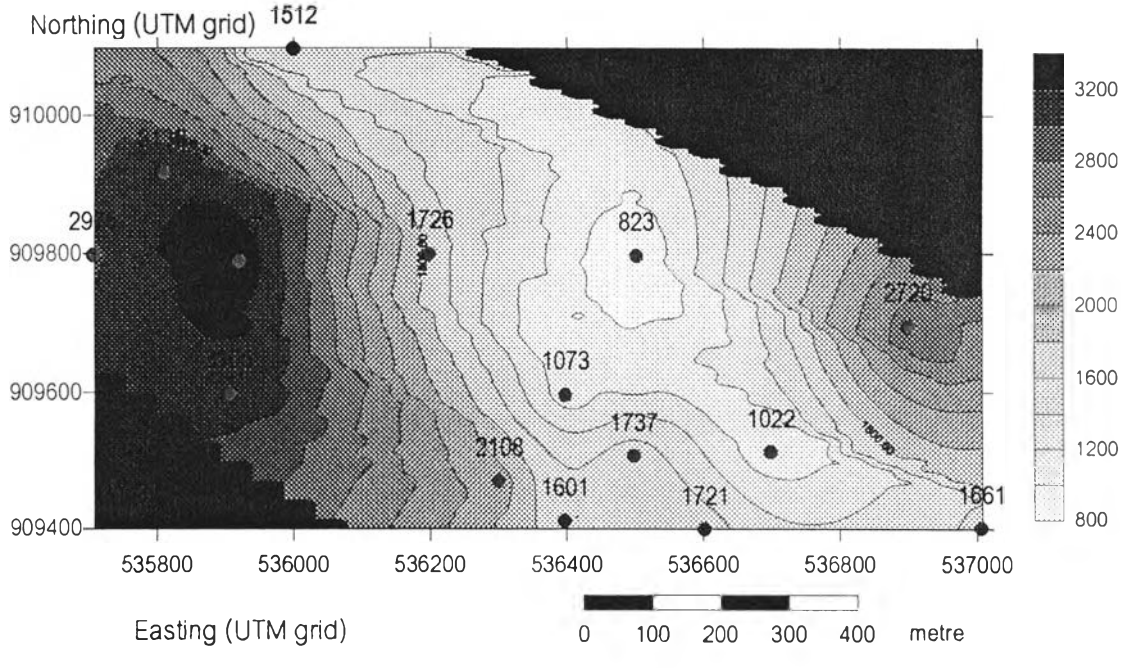
APPENDIX G

KRIGING ESTIMATION MODELS

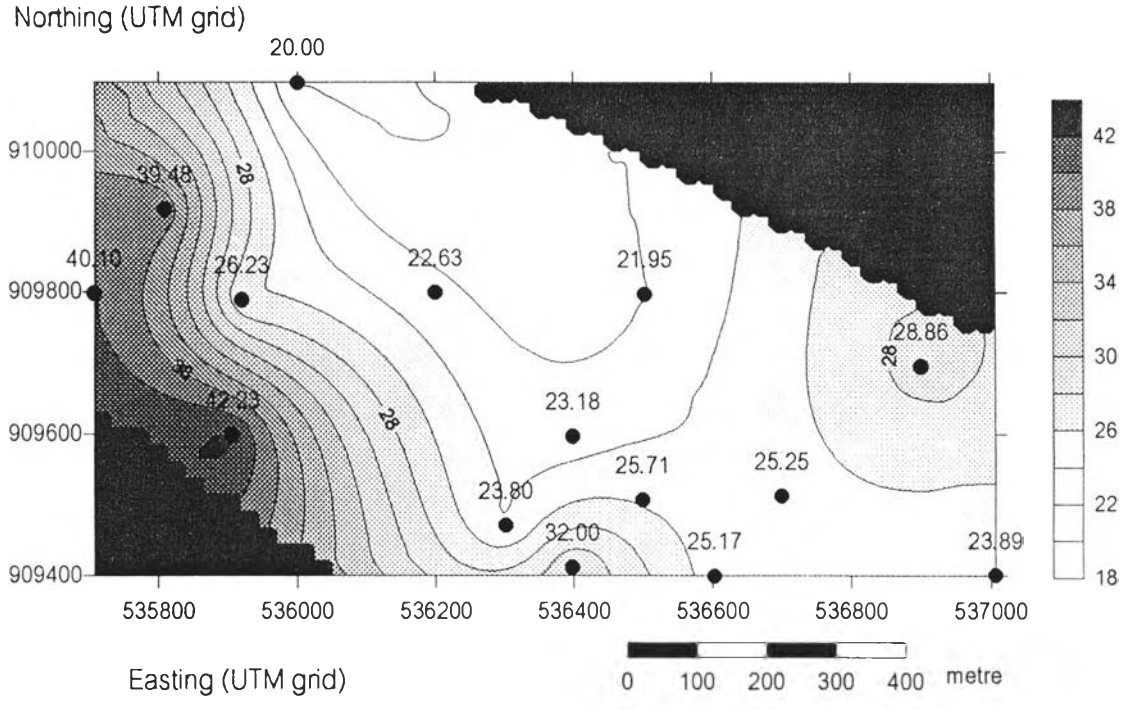
Kriging Estimation



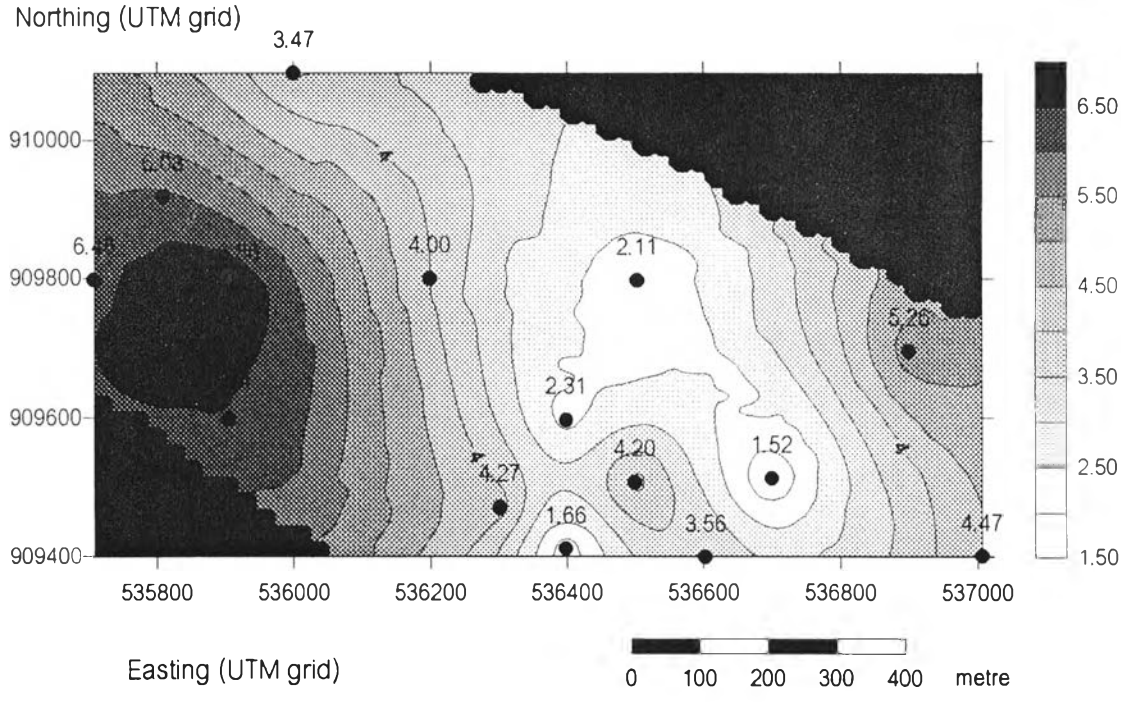
Kriging estimation for ash content (%), P1 seam, Sin Pun area.



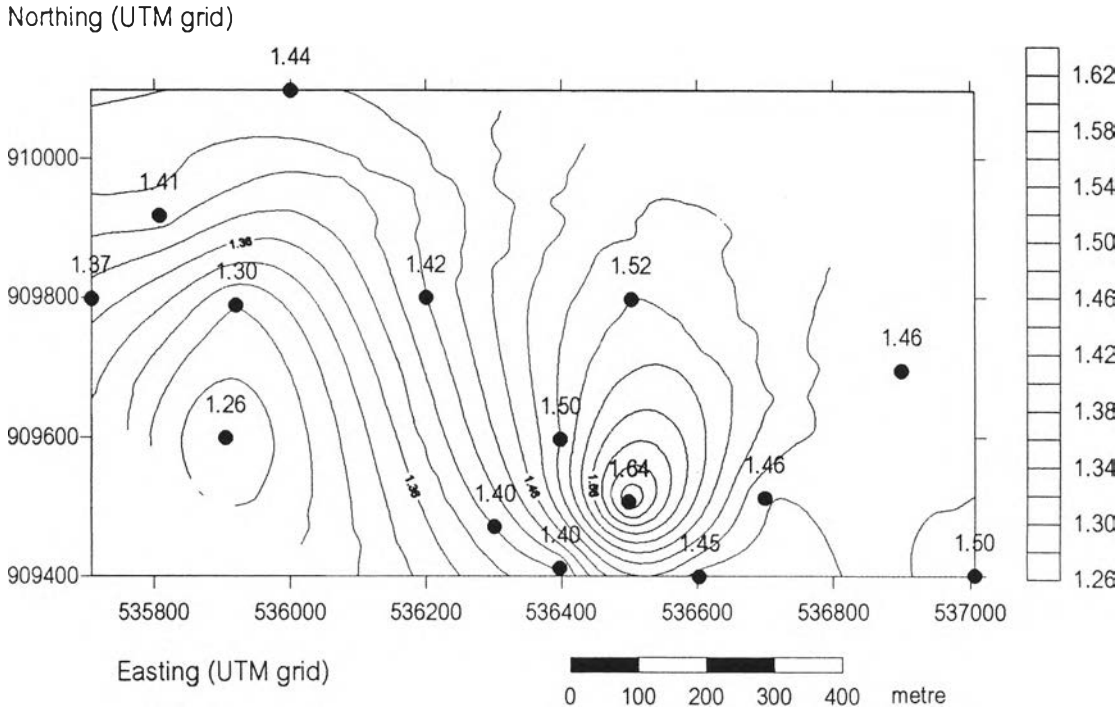
Kriging estimation for calorific value (kcal/kg), P1 seam, Sin Pun area.



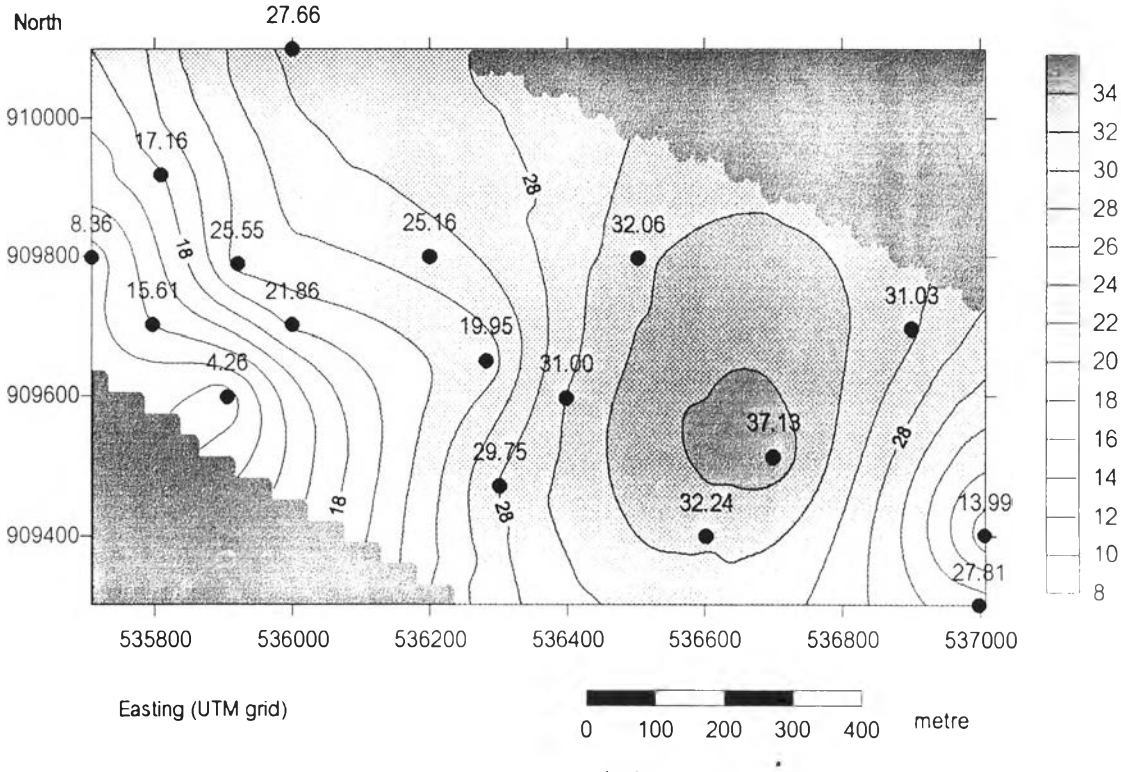
Kriging estimation for moisture content (%), P1 seam, Sin Pun area.



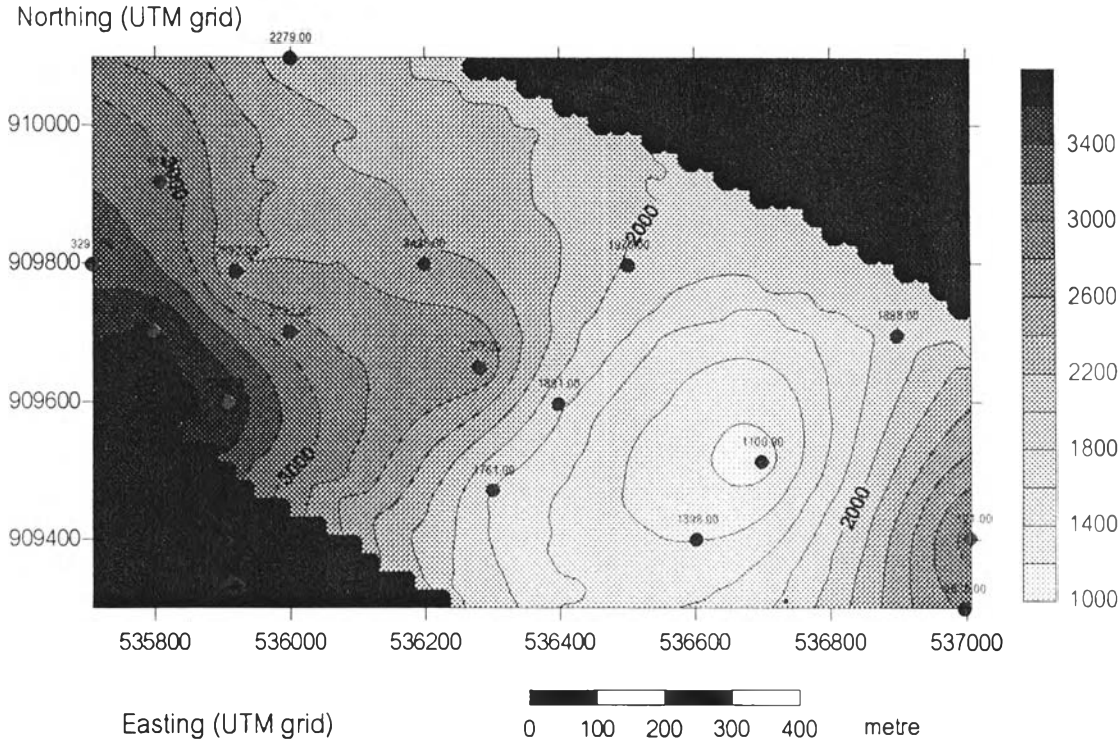
Kriging estimation for sulphur content (%), P1 seam, Sin Pun area.



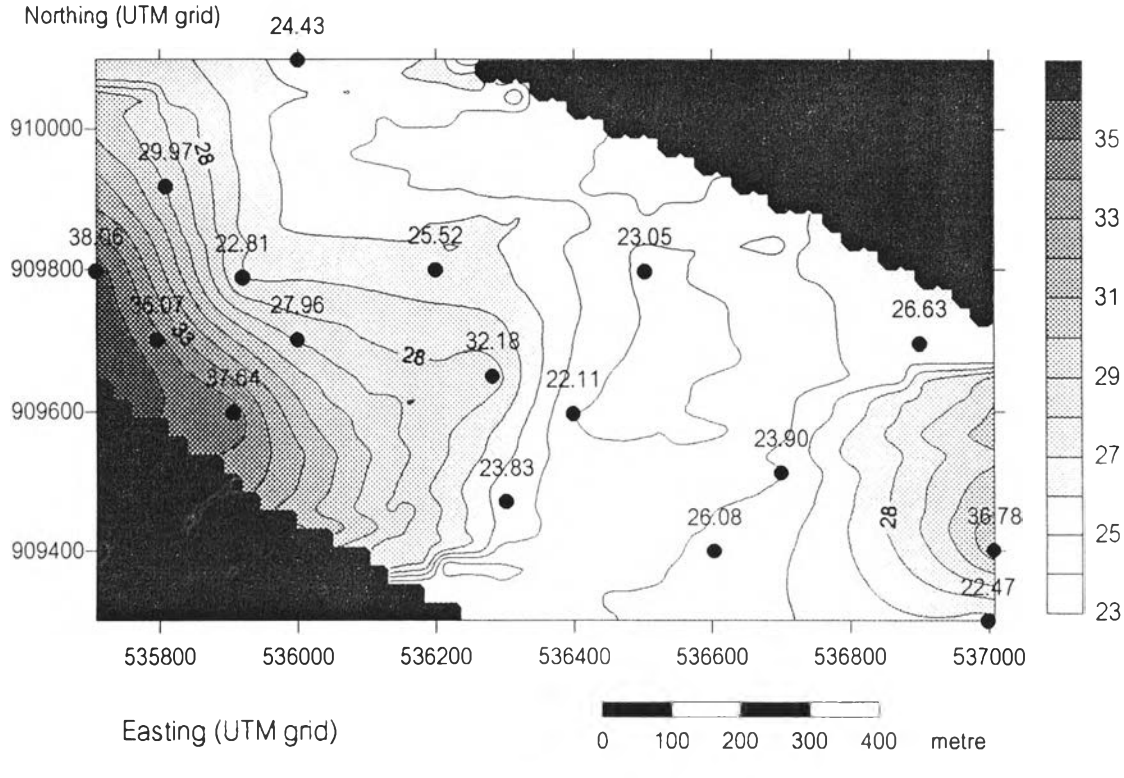
Kriging estimation for density (g/cc), P1 seam, Sin Pun area.



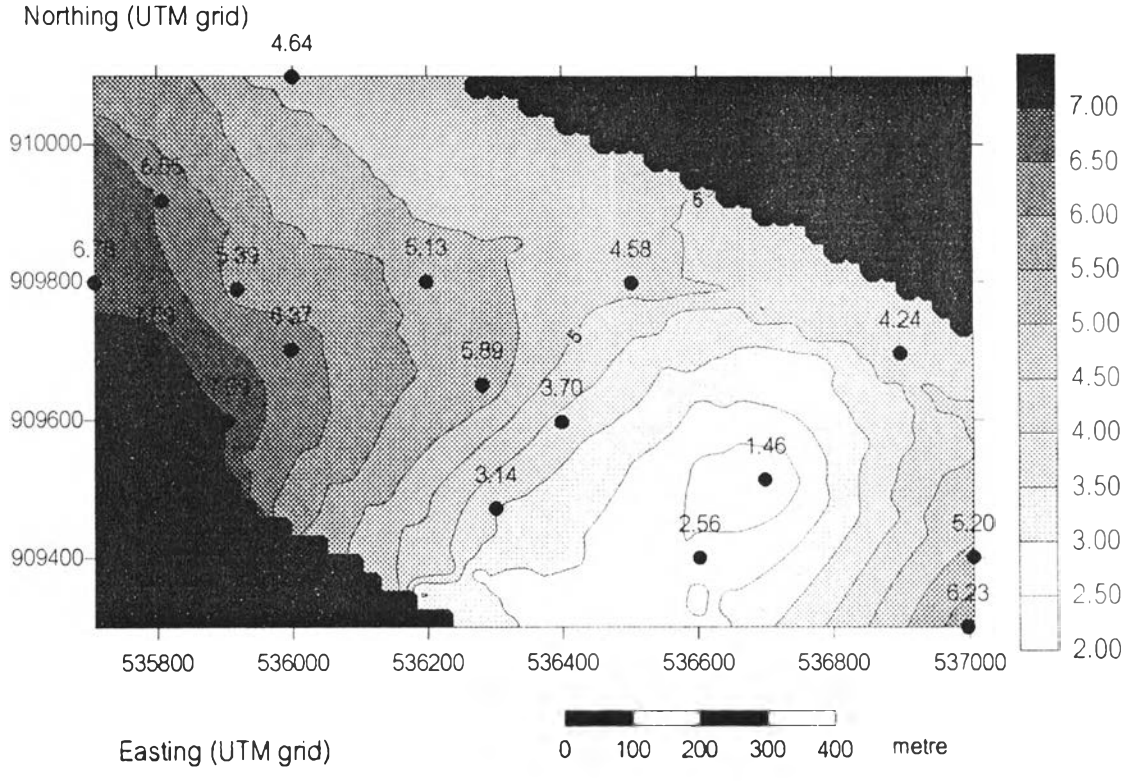
Kriging estimation for ash content (%), P2 seam, Sin Pun area.



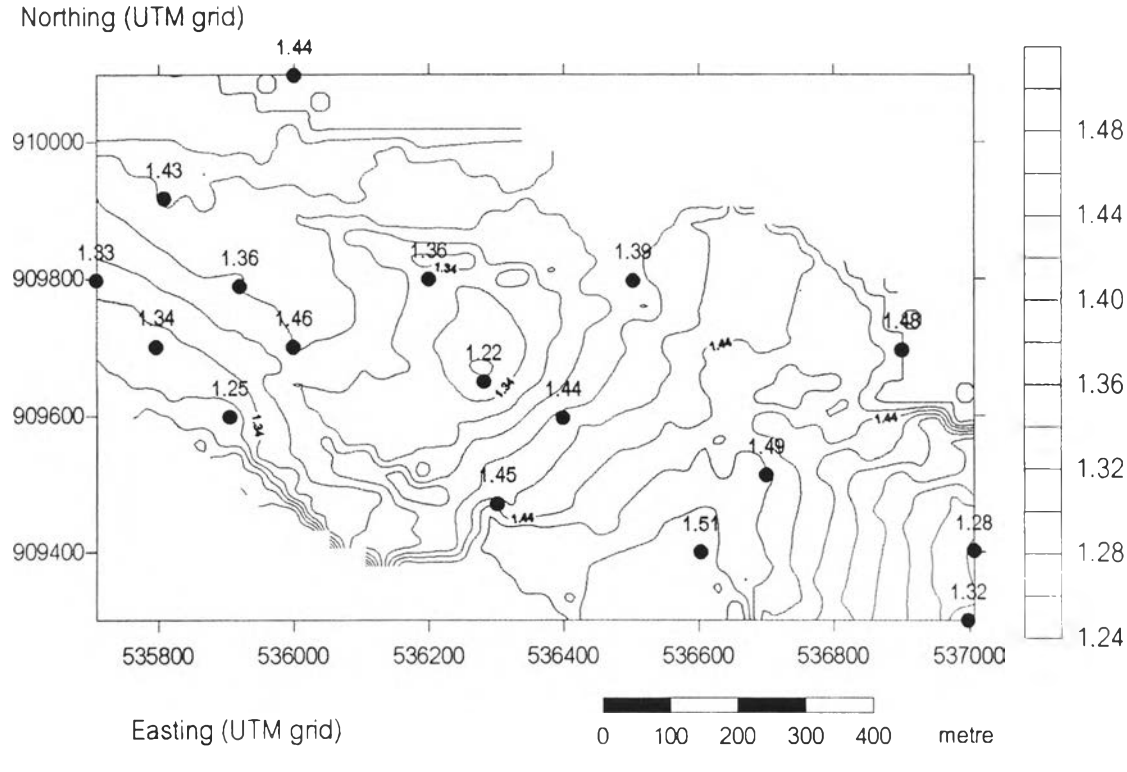
Kriging estimation for calorific value (kcal/kg), P2 seam, Sin Pun area.



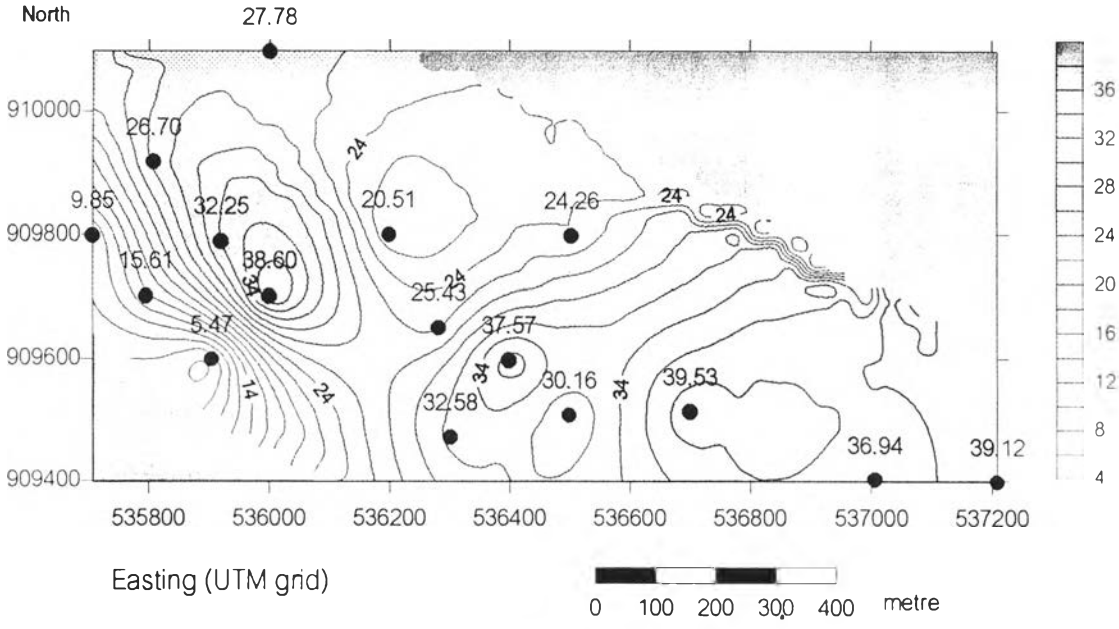
Kriging estimation for moisture content (%), P2 seam, Sin Pun area.



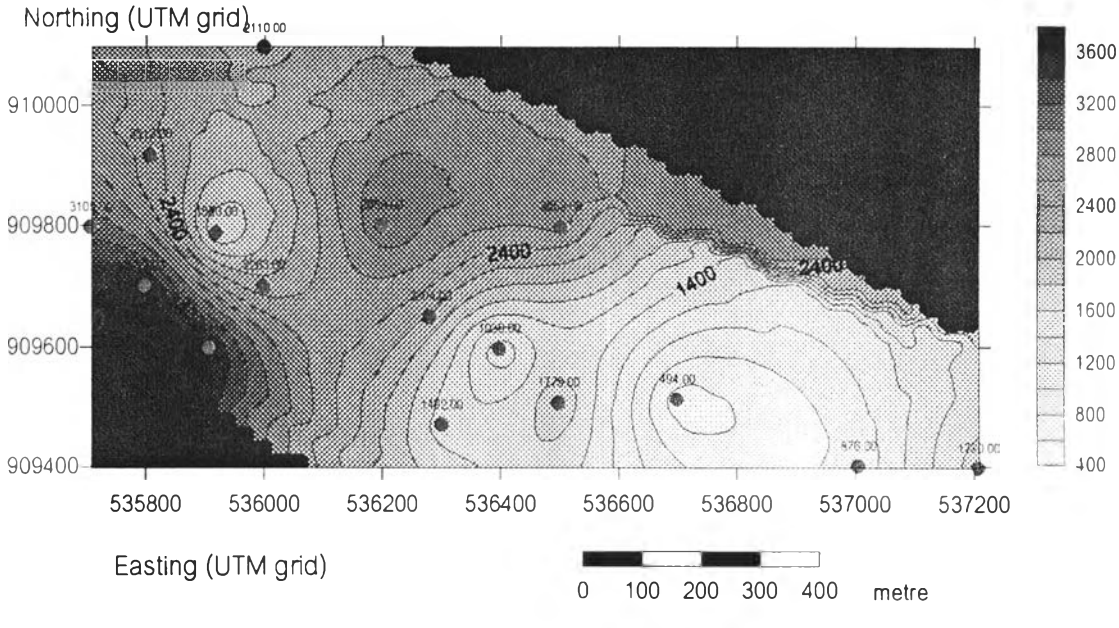
Kriging estimation for sulphur content (%), P2 seam, Sin Pun area.



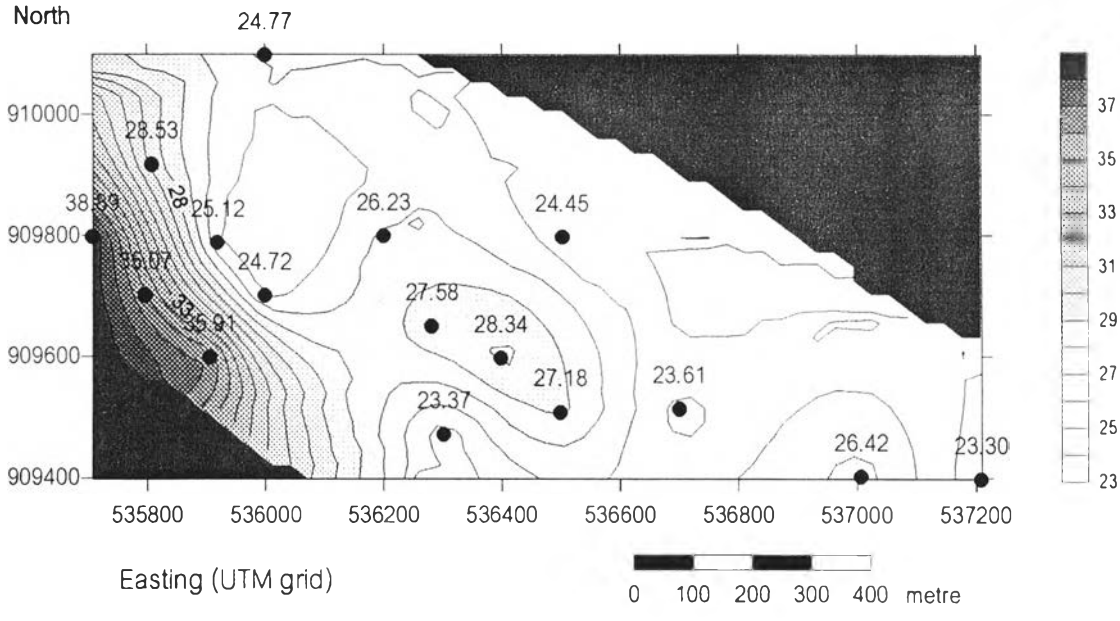
Kriging estimation for density (g/cc), P2 seam, Sin Pun area.



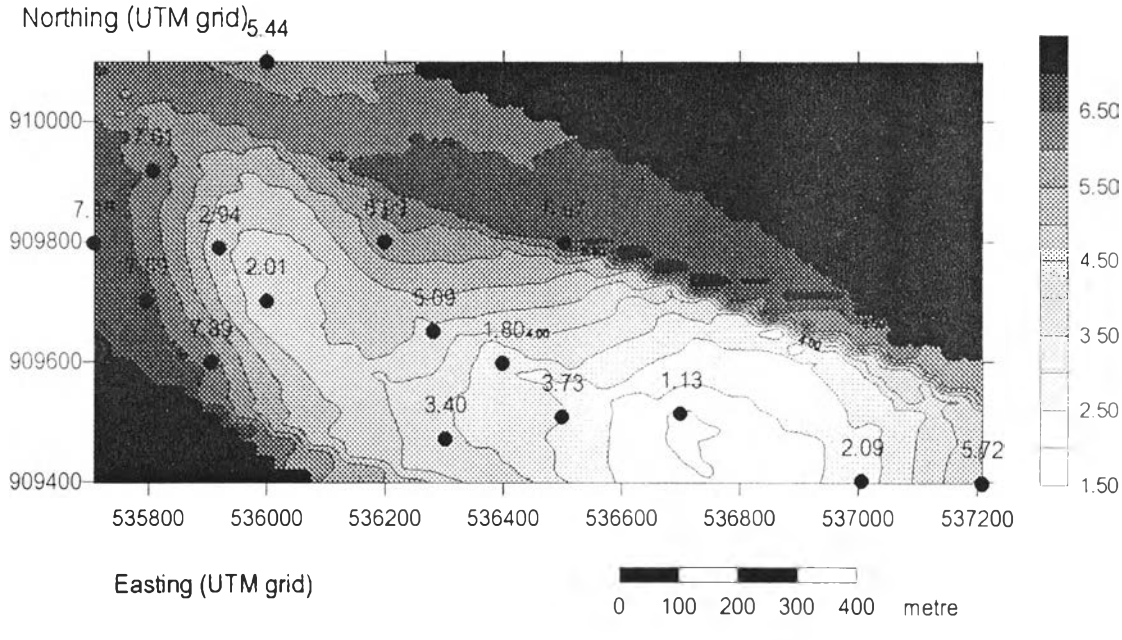
Kriging estimation for ash content (%), P3 seam, Sin Pun area.



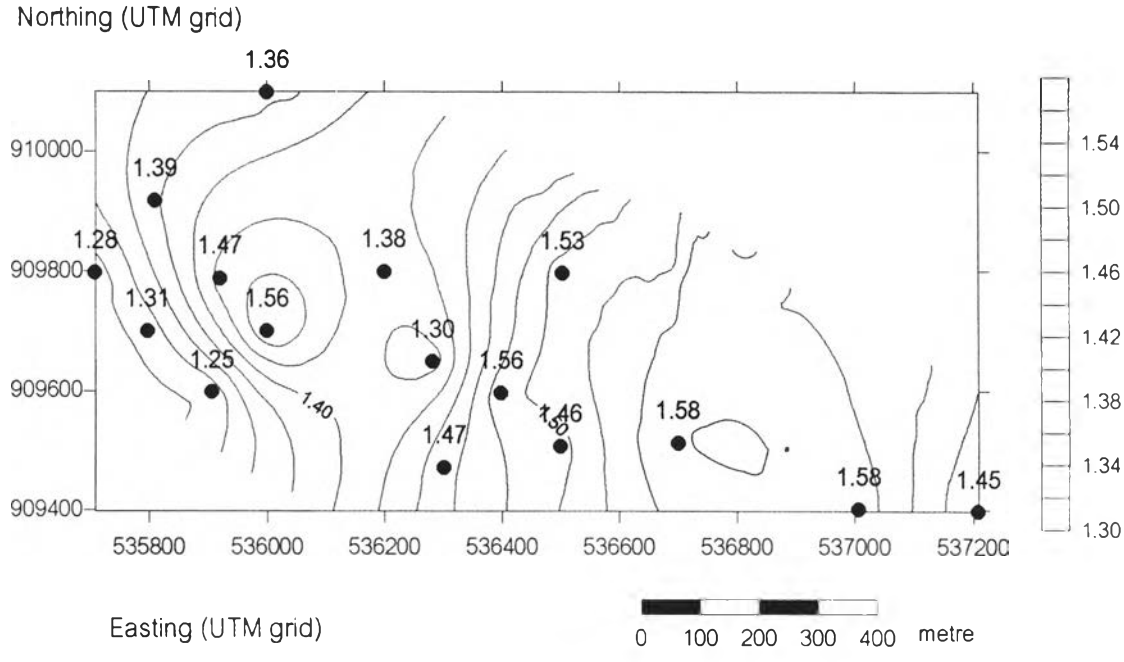
Kriging estimation for calorific value (kcal/kg), P3 seam, Sin Pun area.



Kriging estimation for moisture content (%), P3 seam, Sin Pun area.

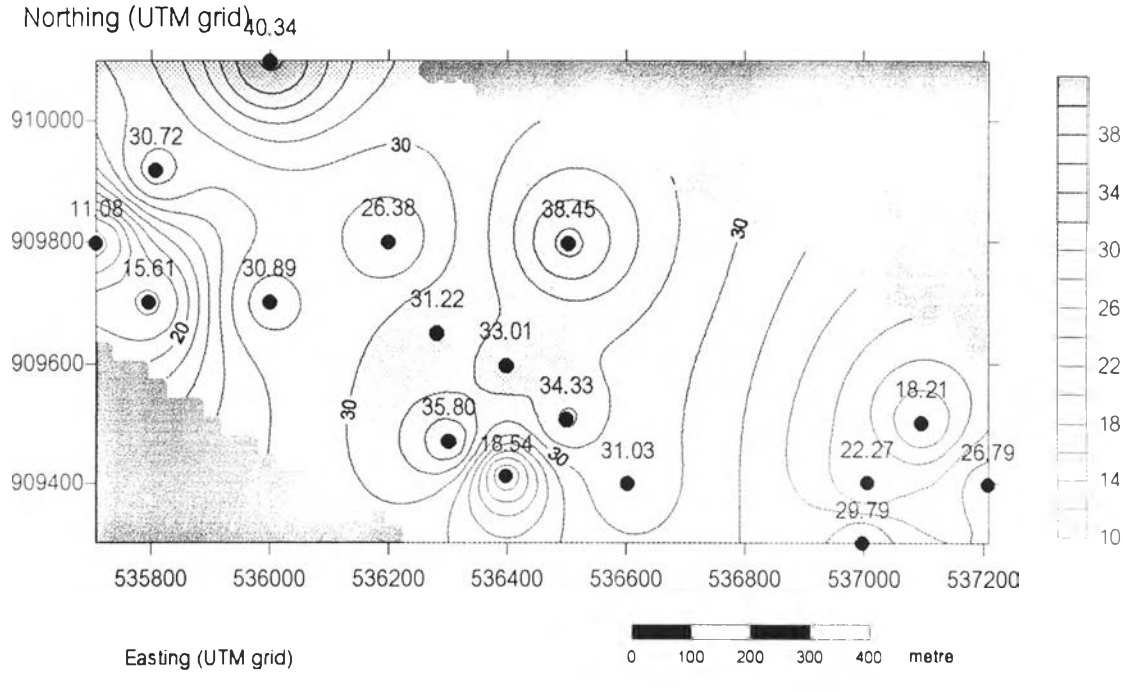


Kriging estimation for sulphur content (%), P3 seam, Sin Pun area.

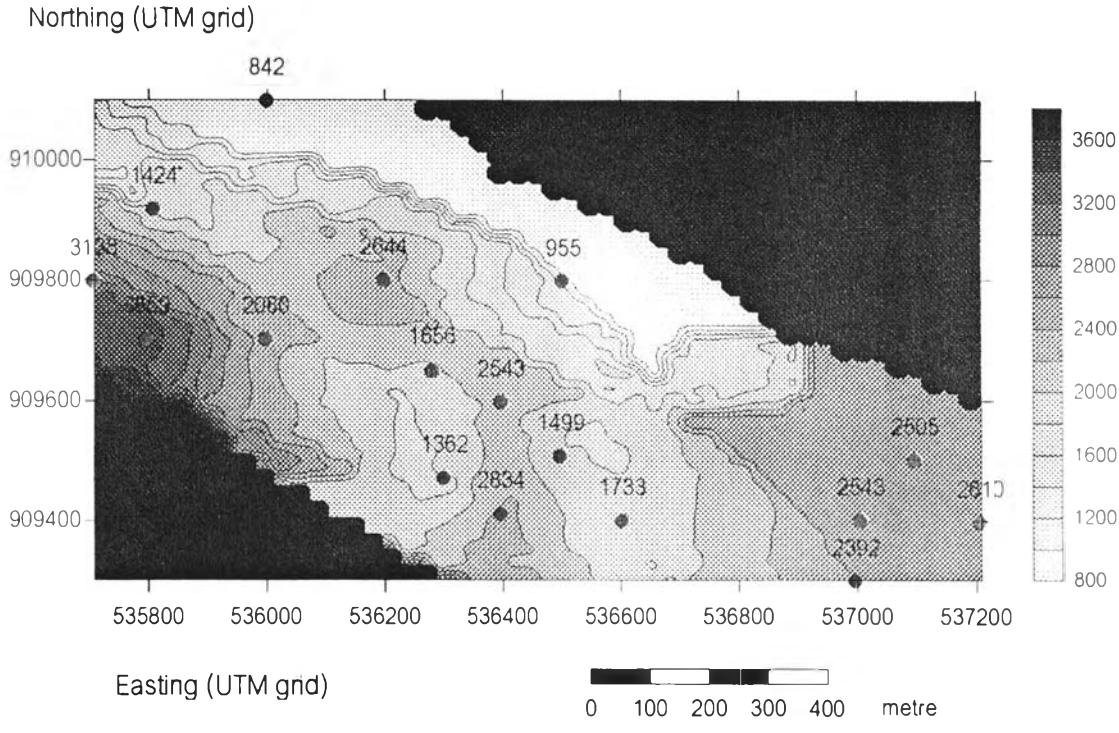


Kriging estimation for density (g/cc), P3 seam, Sin Pun area.

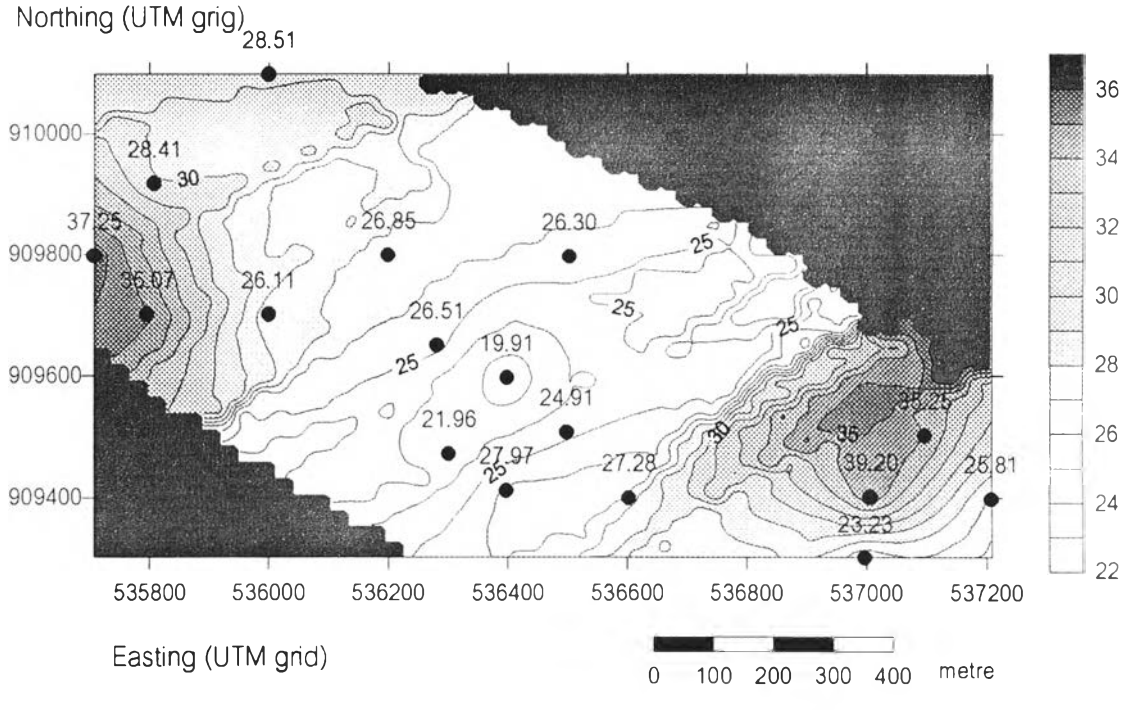
Inverse distance method for Pure nugget model



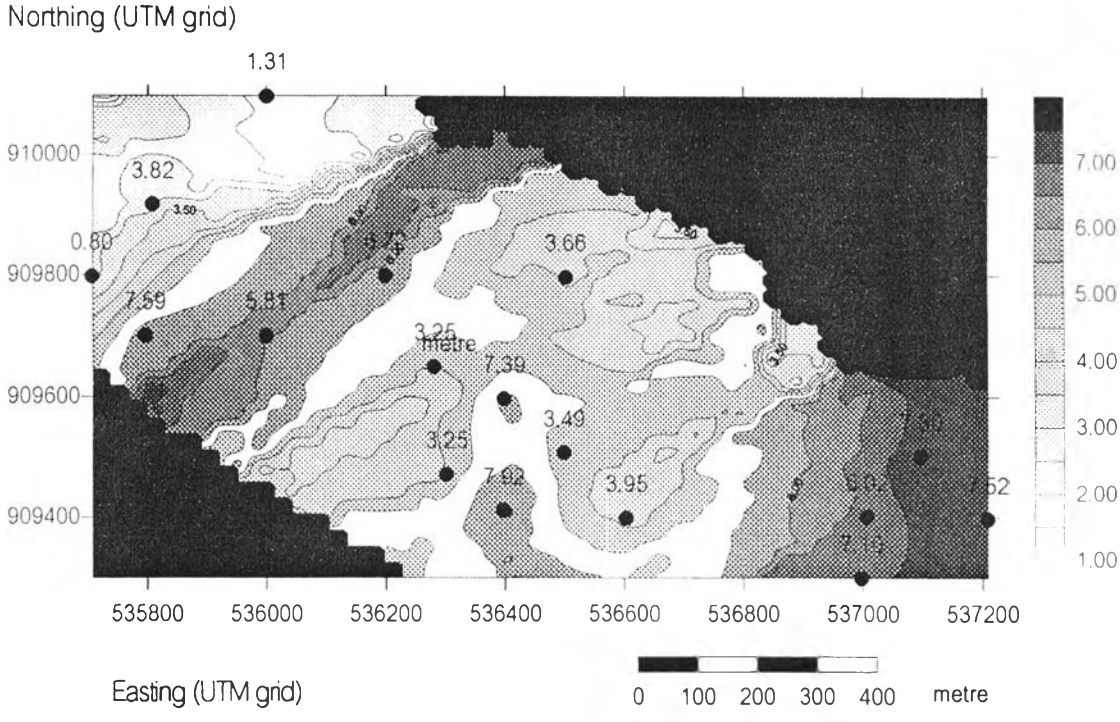
Kriging estimation for ash content (%), P4 seam, Sin Pun area.



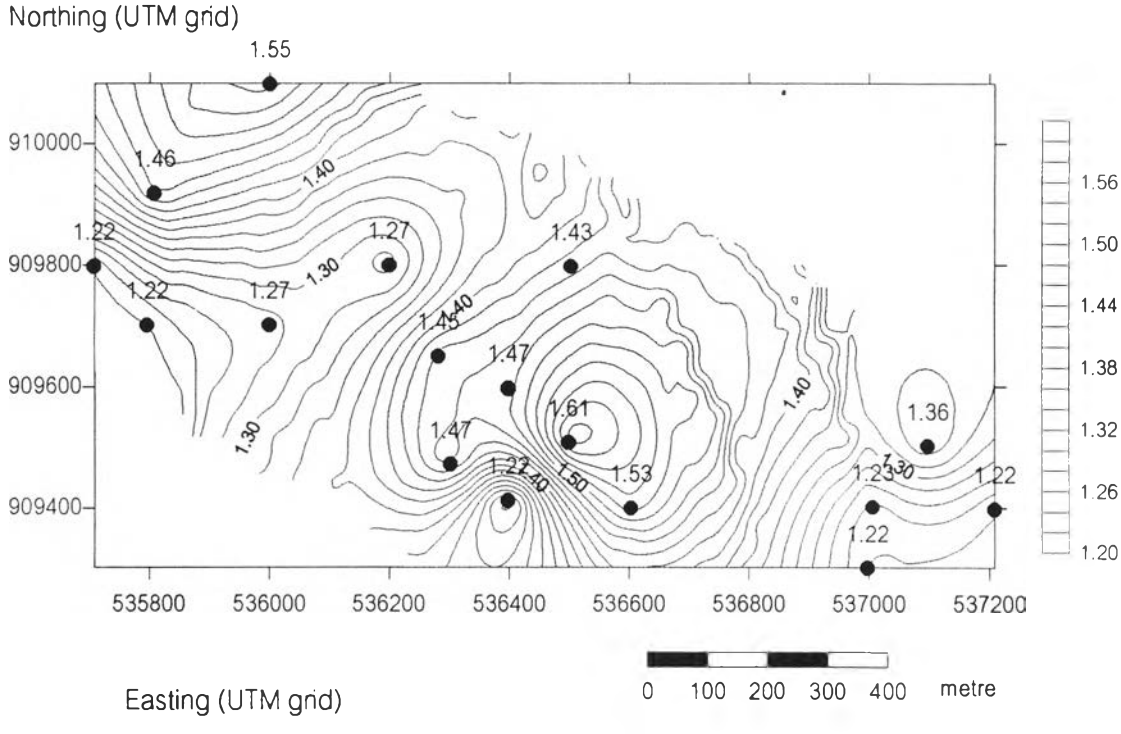
Kriging estimation for calorific value (kcal/kg), P4 seam, Sin Pun area.



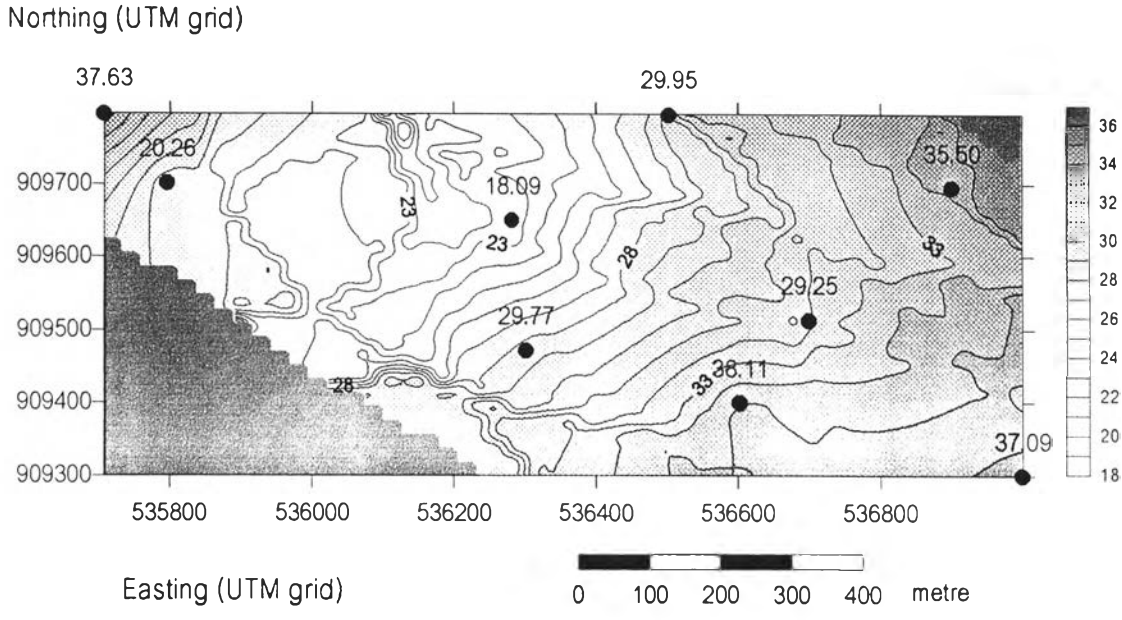
Kriging estimation for moisture content (%), P4 seam, Sin Pun area.



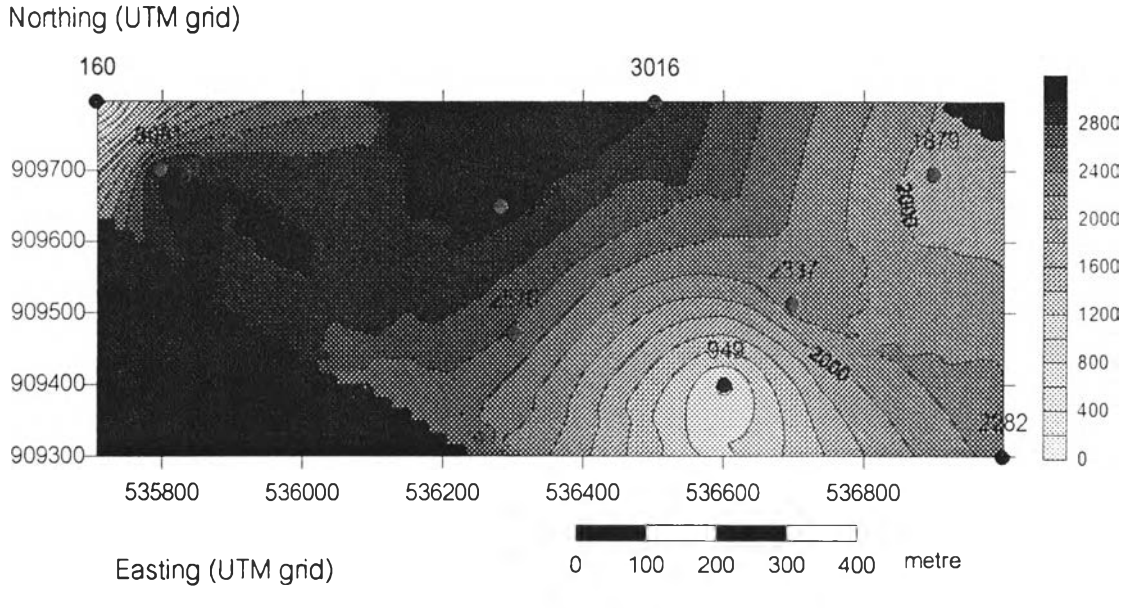
Kriging estimation for sulphur content (%), P4 seam, Sin Pun area.



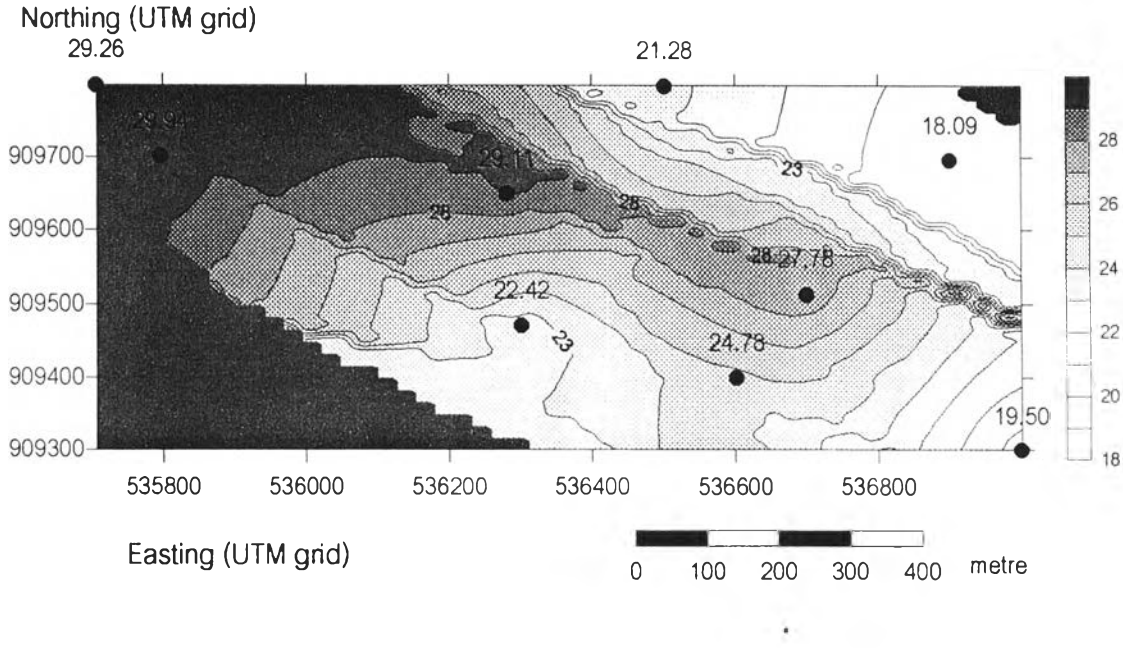
Kriging estimation for density (g/cc), P4 seam, Sin Pun area.



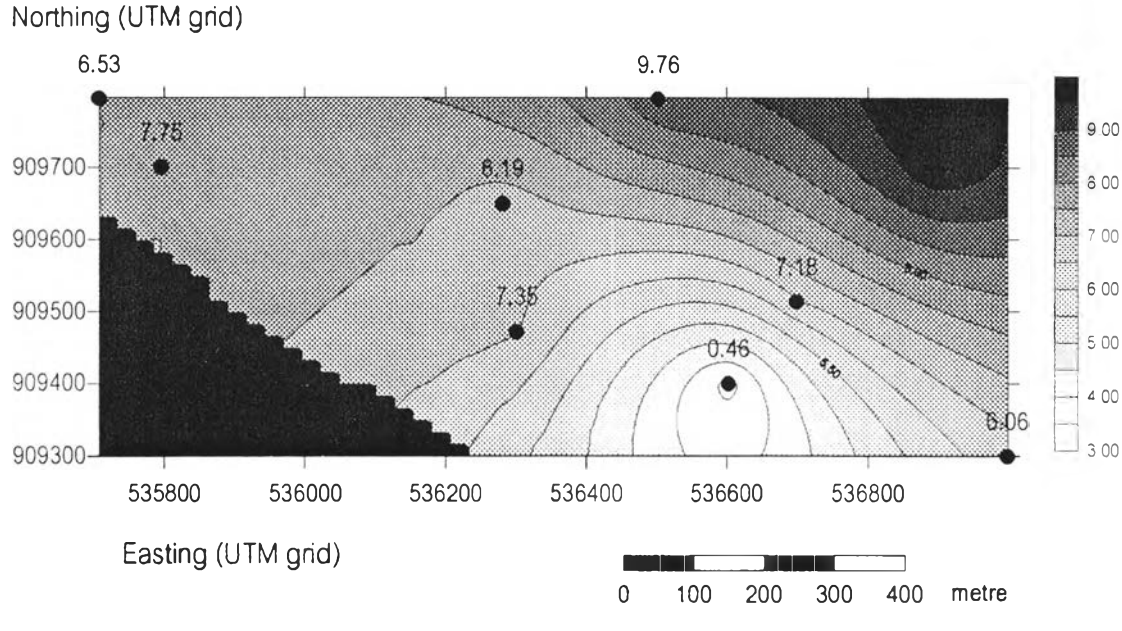
Kriging estimation for ash content (%), M seam, Sin Pun area.



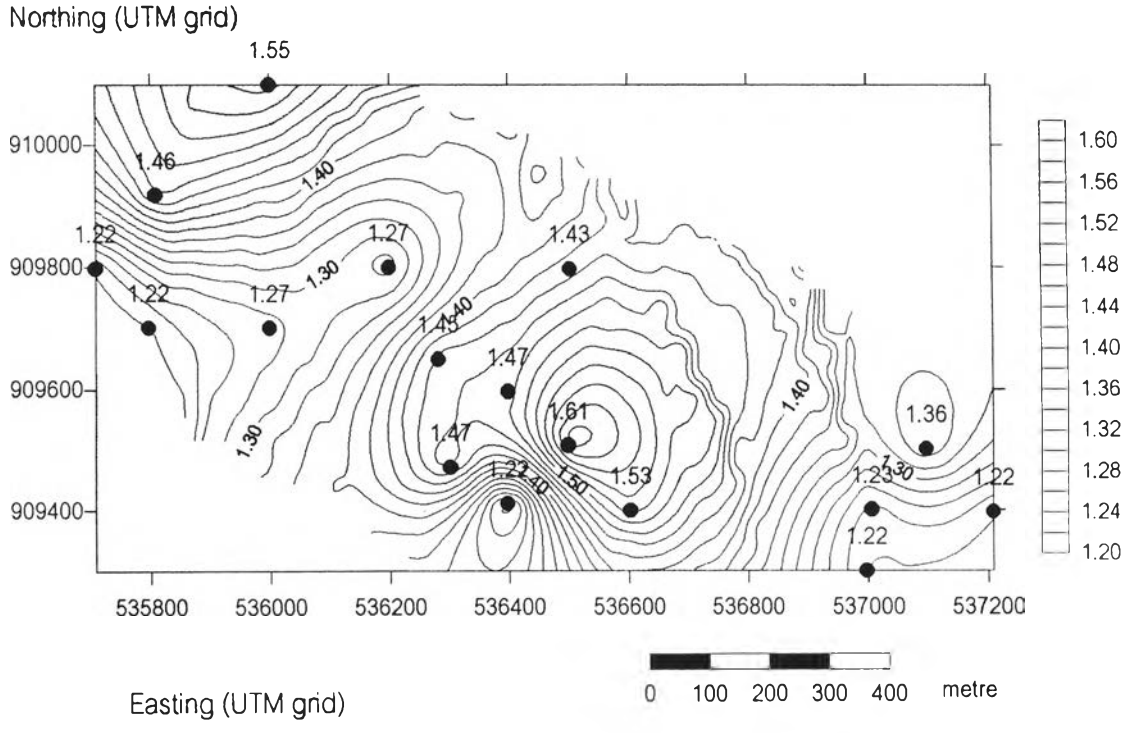
Kriging estimation for calorific value (kcal/kg), M seam, Sin Pun area.



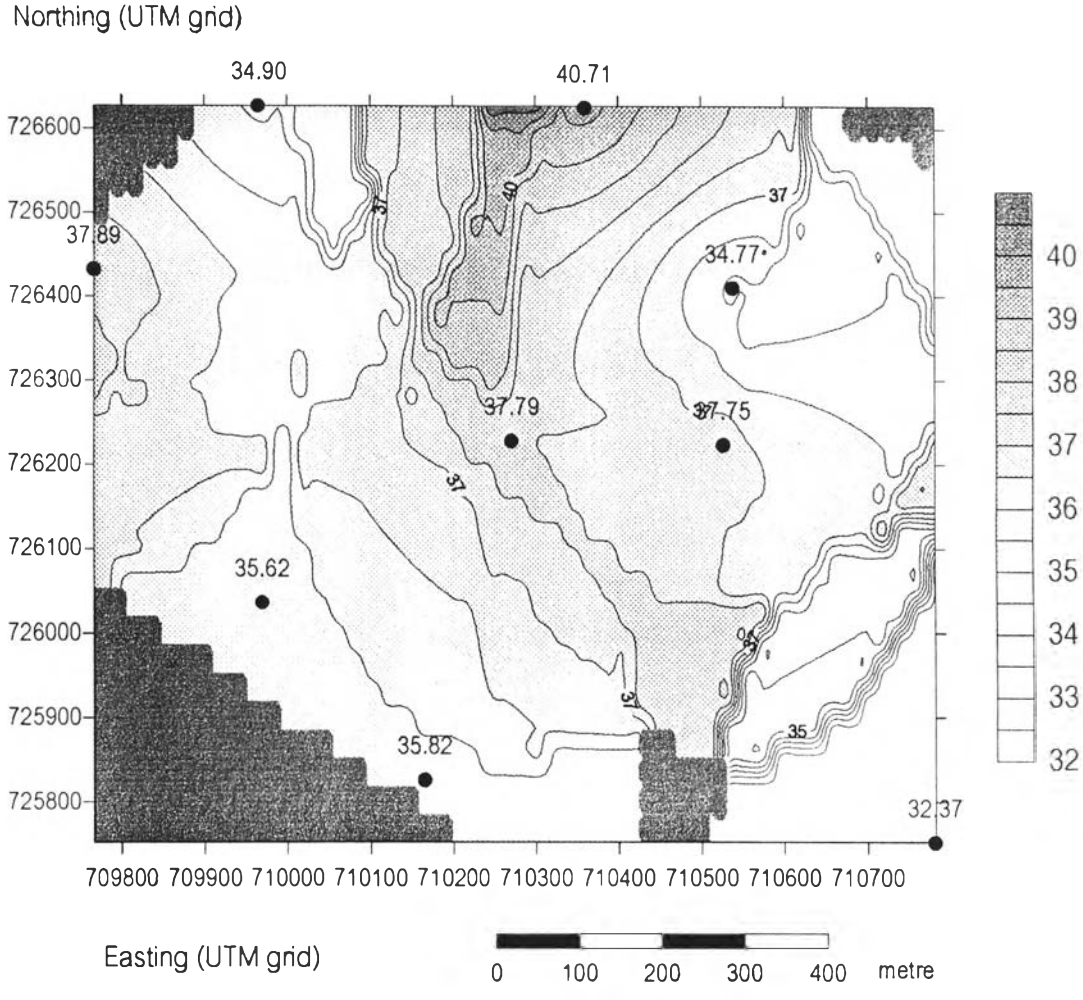
Kriging estimation for moisture content (%), M seam, Sin Pun area.



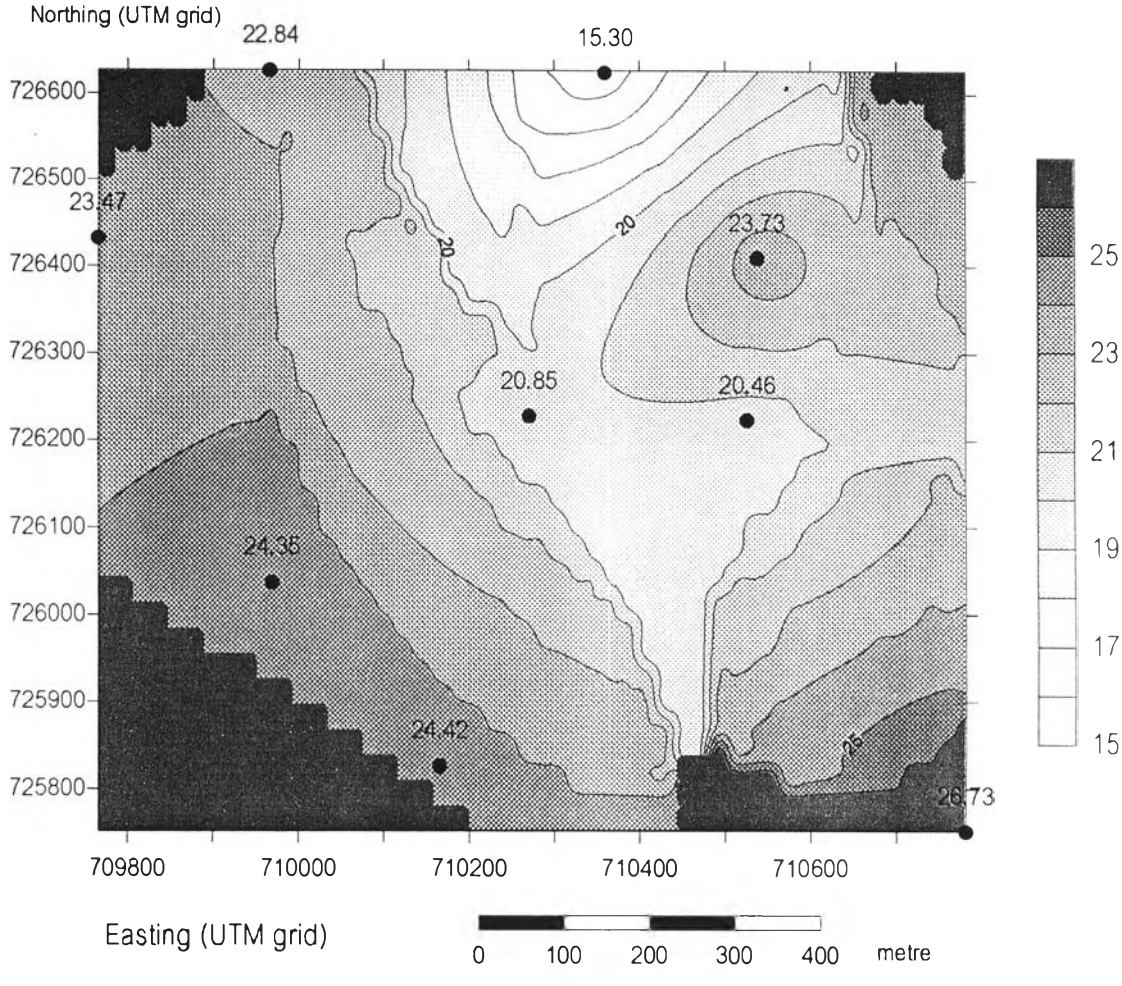
Kriging estimation for sulphur content (%), M seam, Sin Pun area.



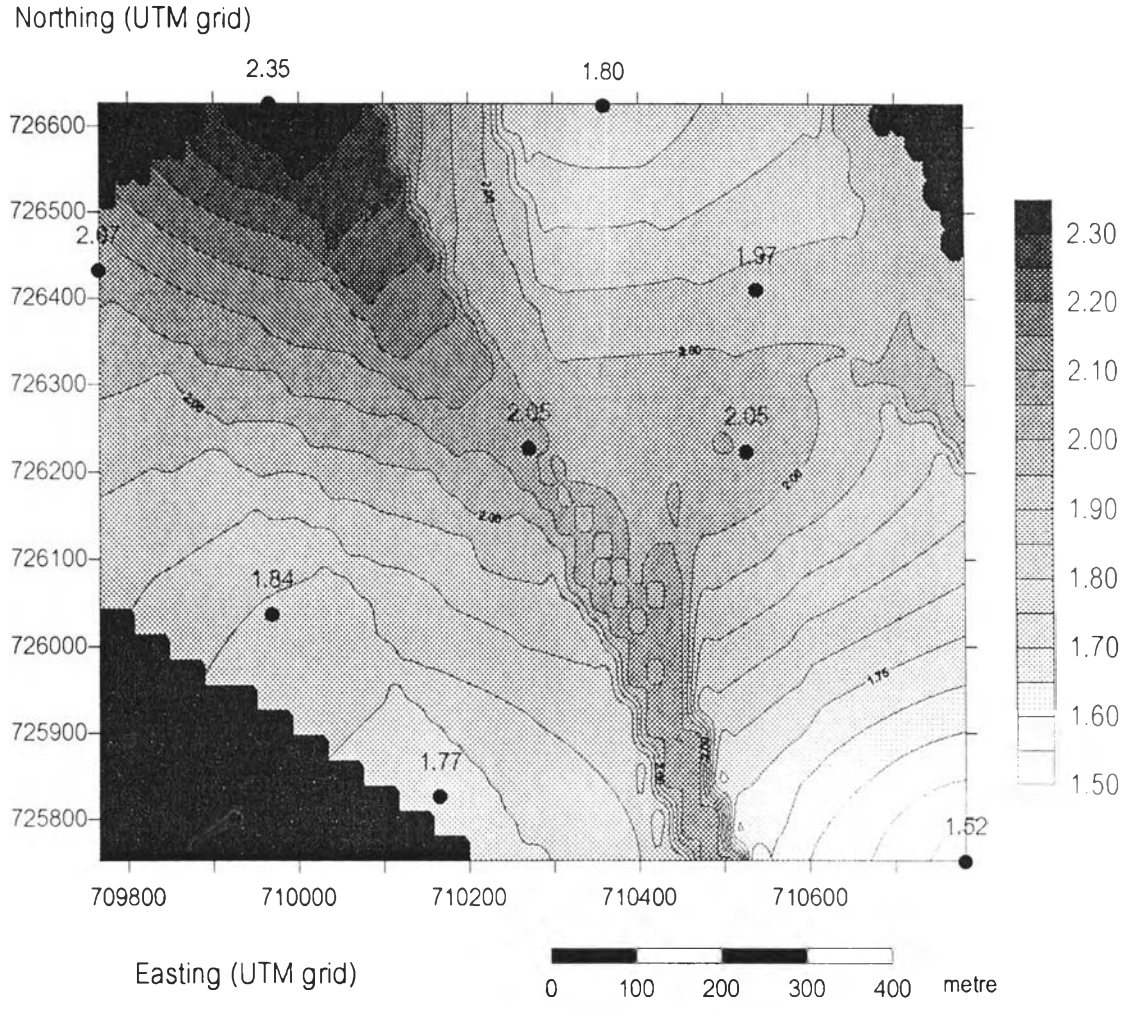
Kriging estimation for density (g/cc), M seam, Sin Pun area.



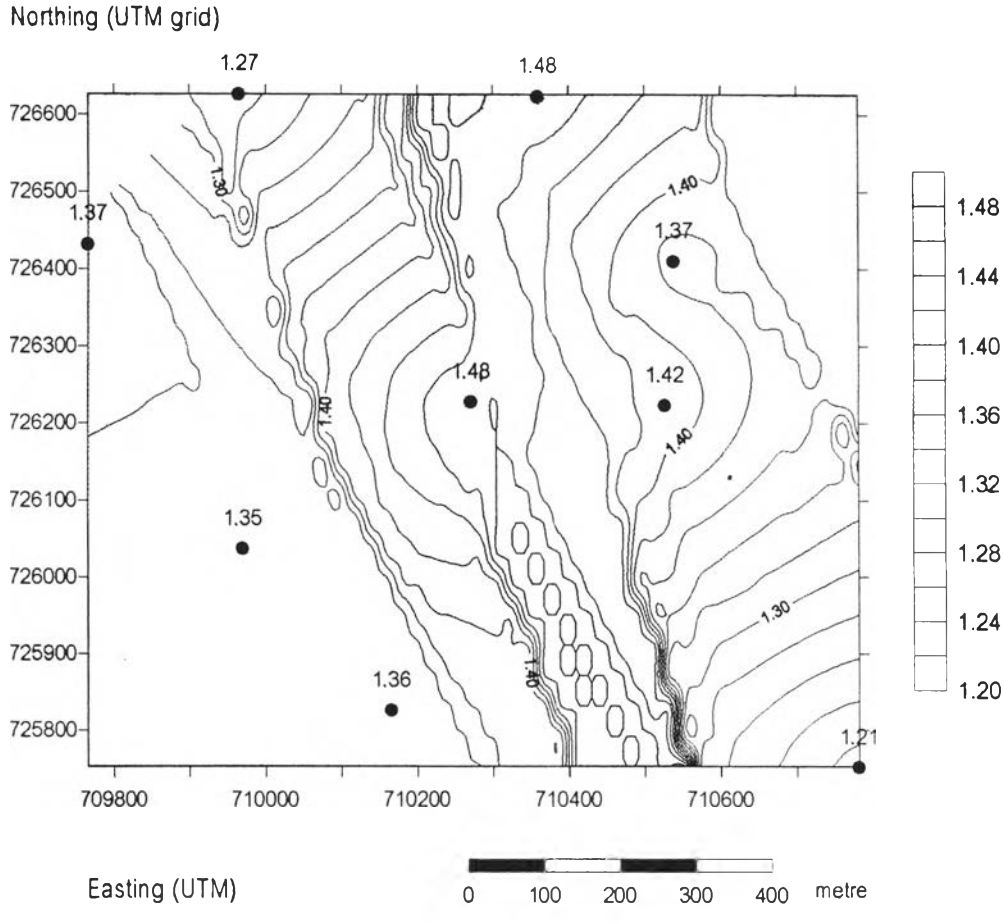
Kriging estimation for ash content (%), S1 seam, Saba Yoi area.



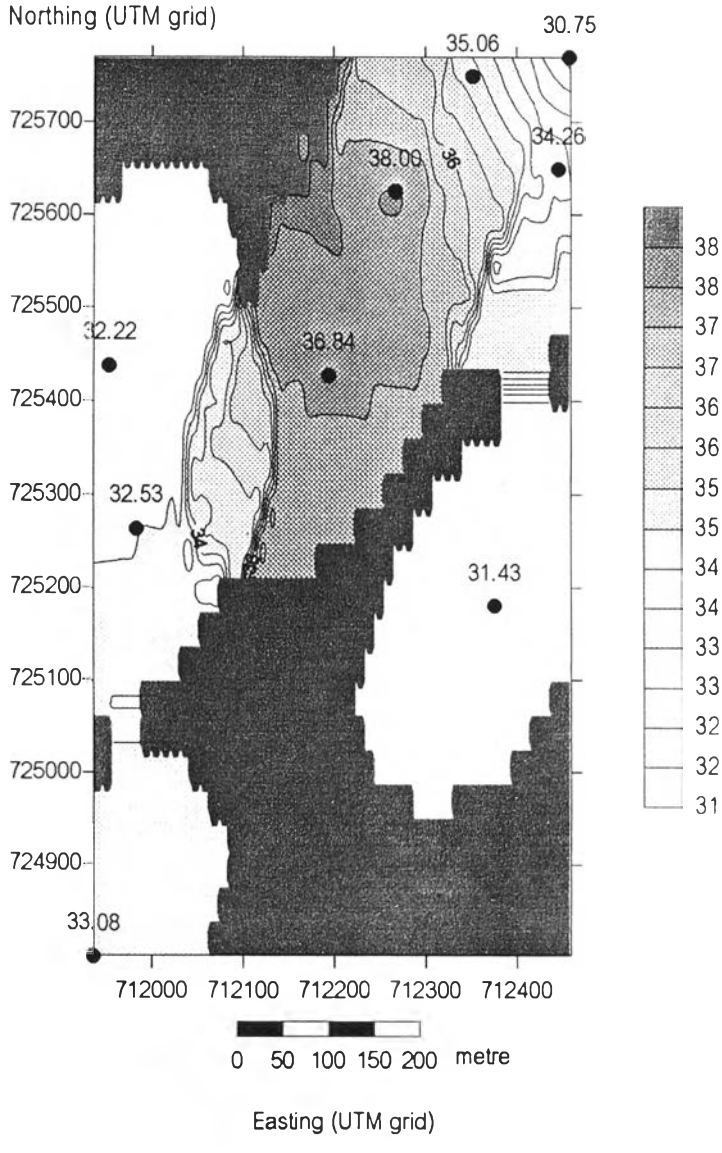
Kriging estimation for moisture content (%), S1 seam, Saba Yoi area.



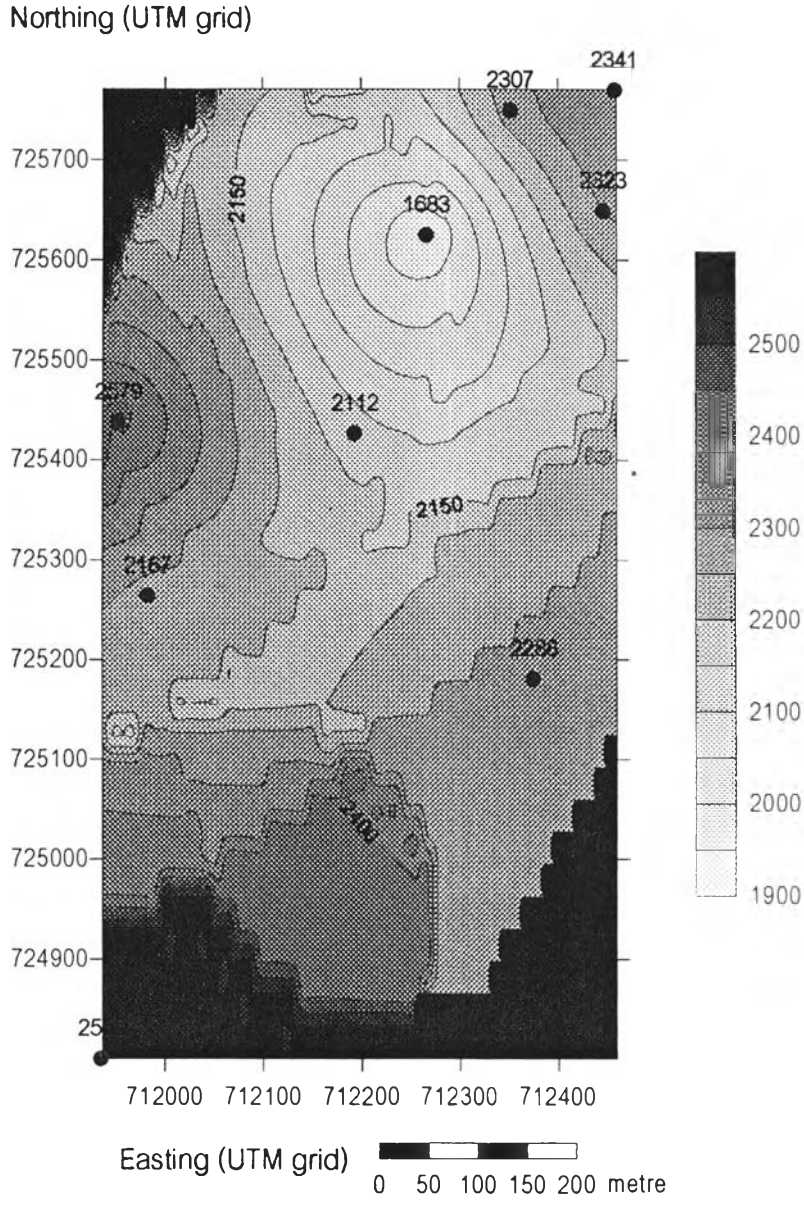
Kriging estimation for sulphur content (%), S1 seam, Saba Yoi area.



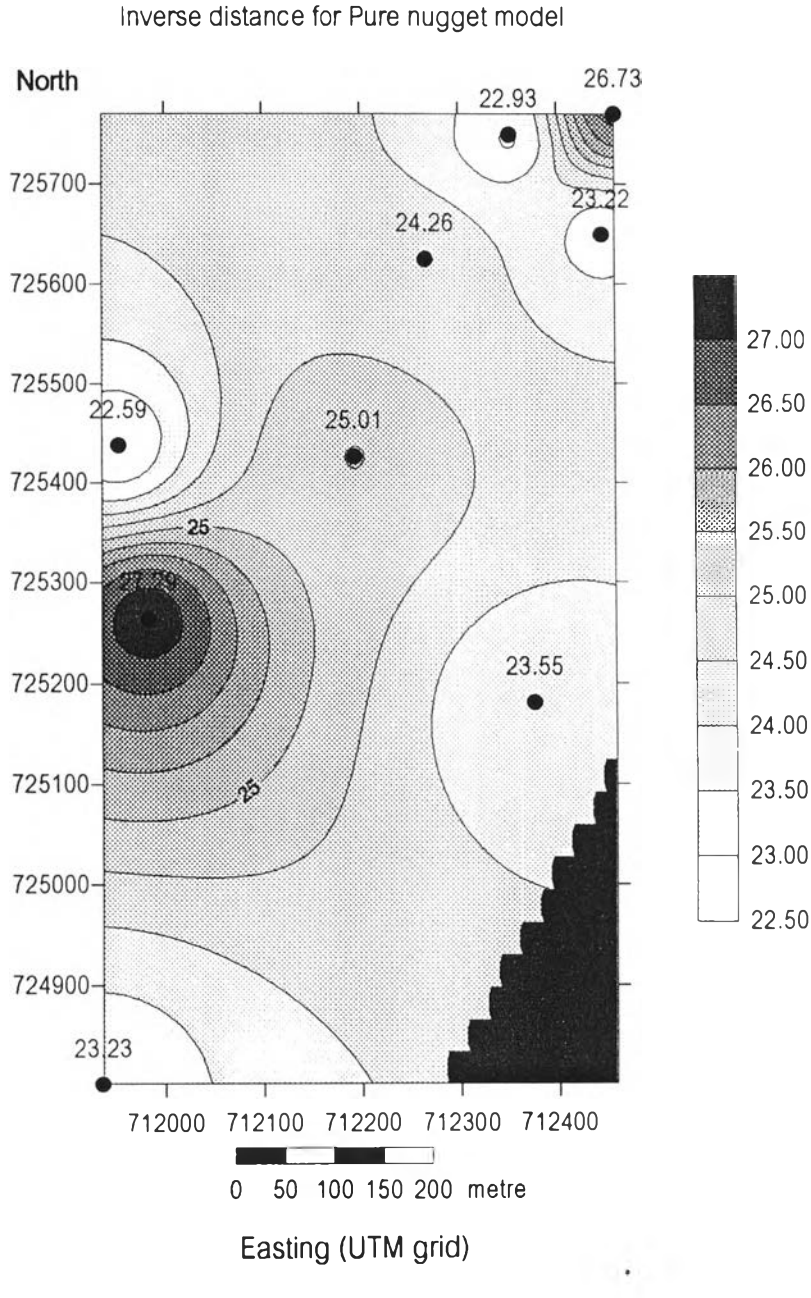
Kriging estimation for density (g/cc), S1 seam, Saba Yoi area.



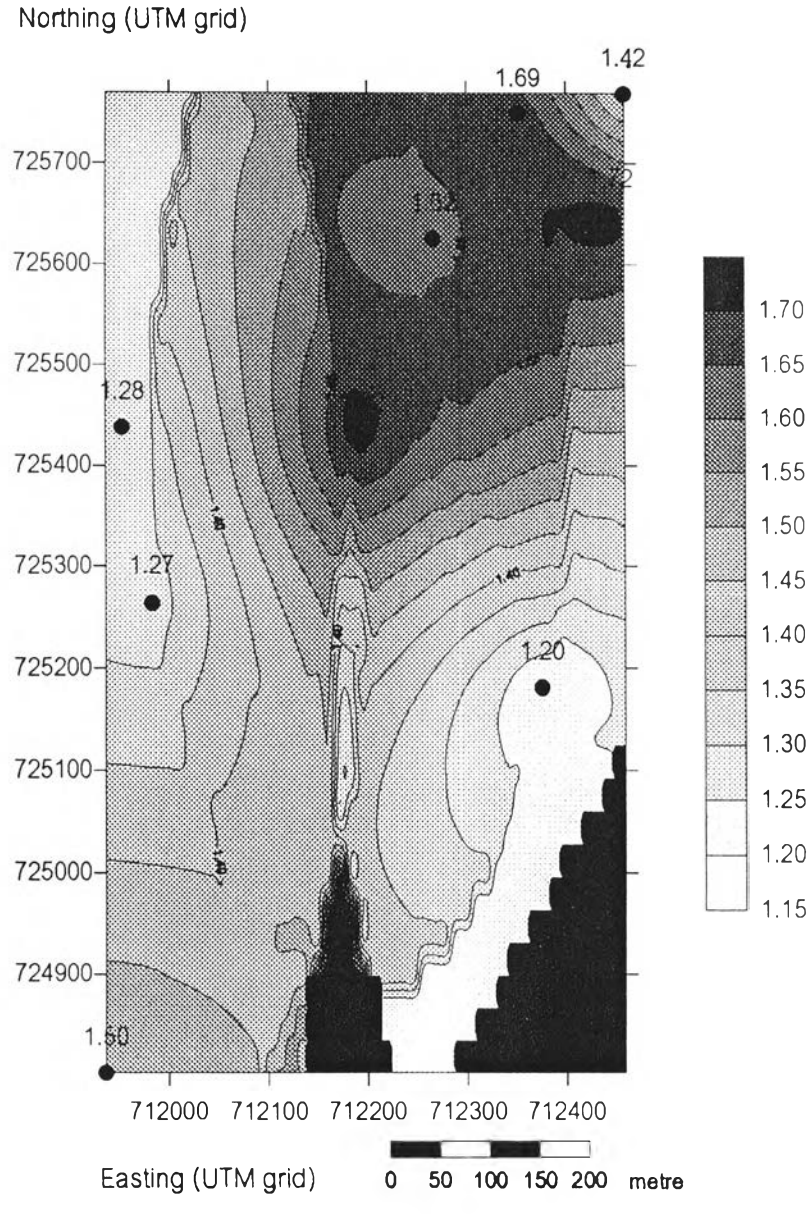
Kriging estimation for ash content (%), S2 seam, Saba Yoi area.



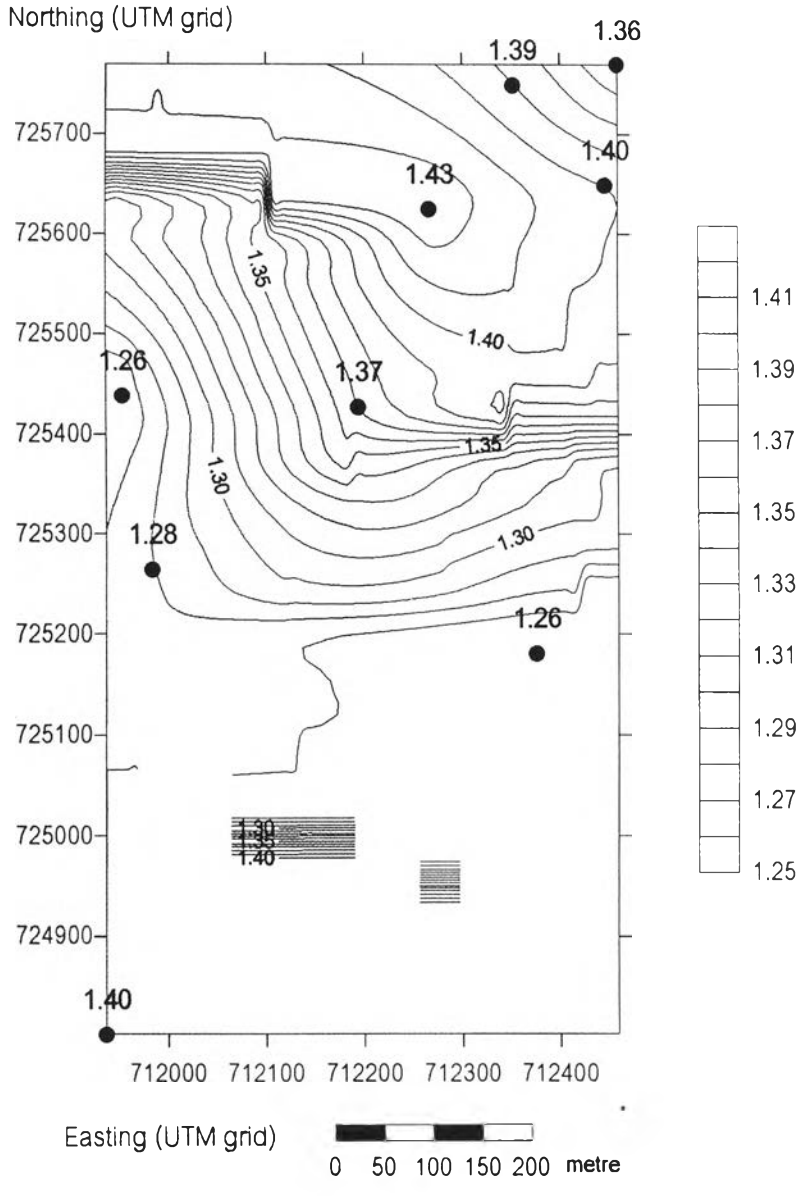
Kriging estimation for calorific value (kcal/kg), S2 seam, Saba Yoi area.



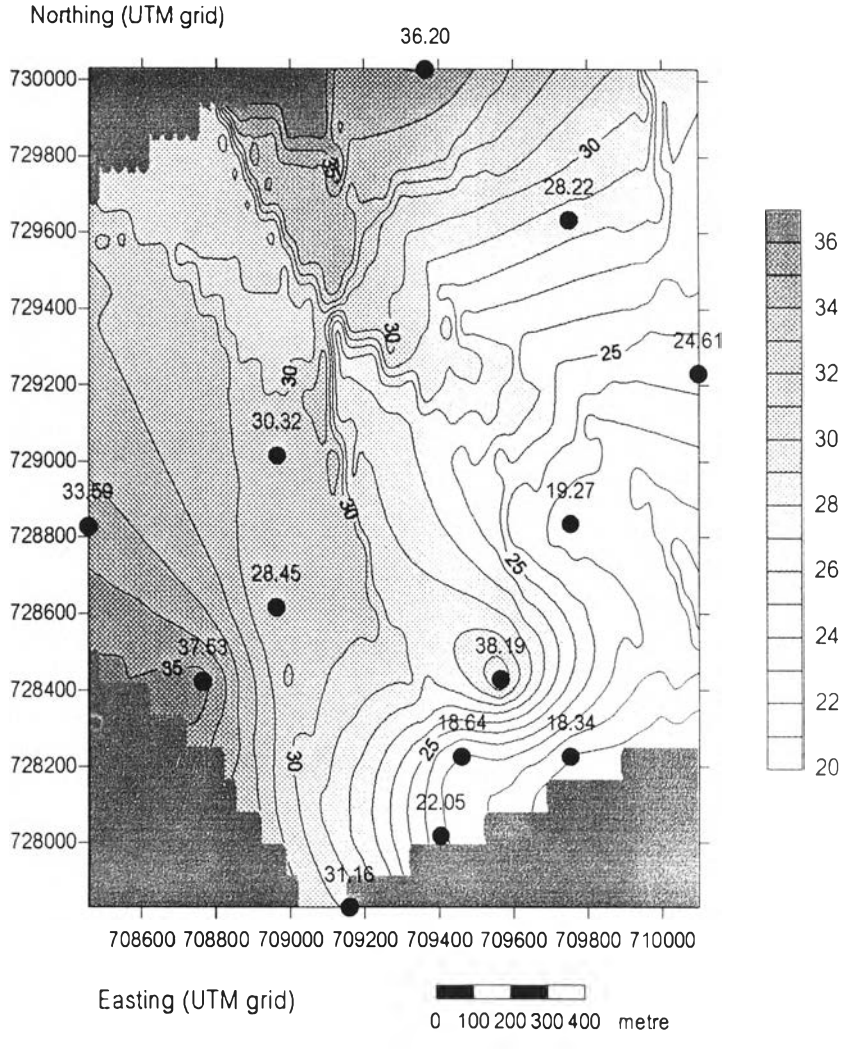
Kriging estimation for moisture content (%), S2 seam, Saba Yoi area.



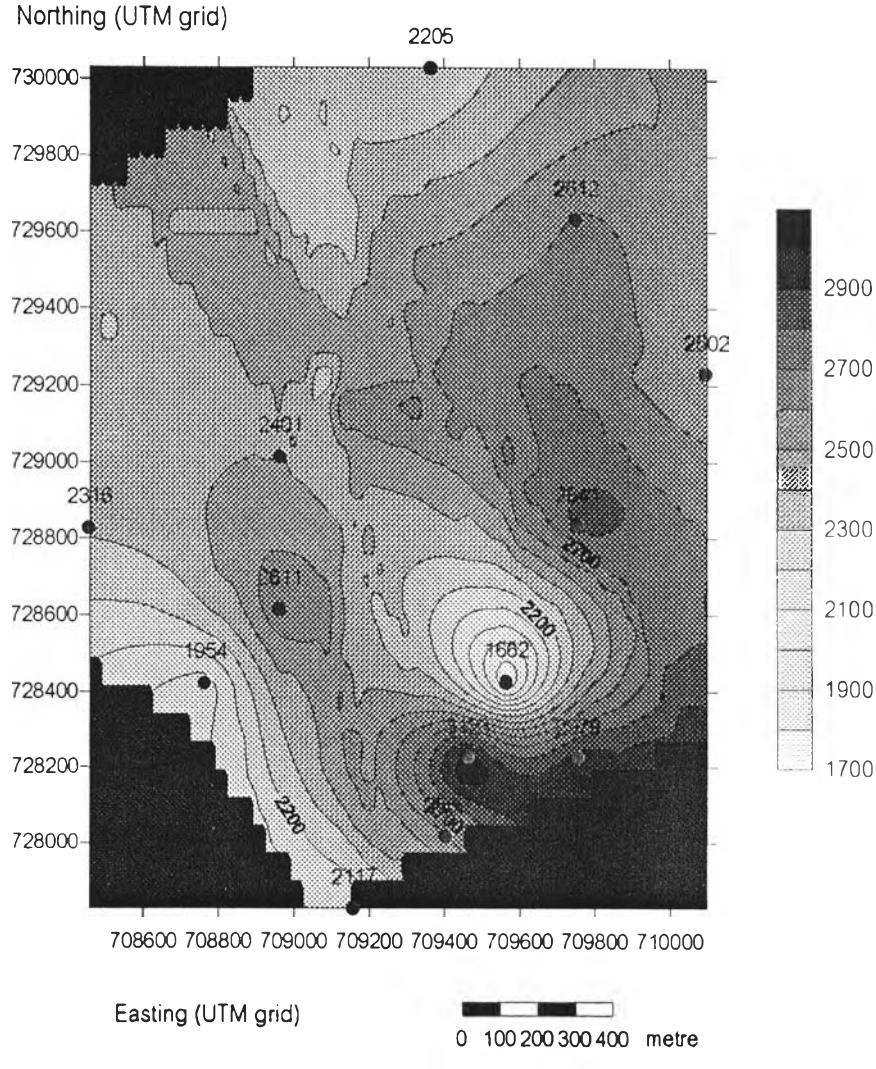
Kriging estimation for sulphur content (%), S2 seam, Saba Yoi area.



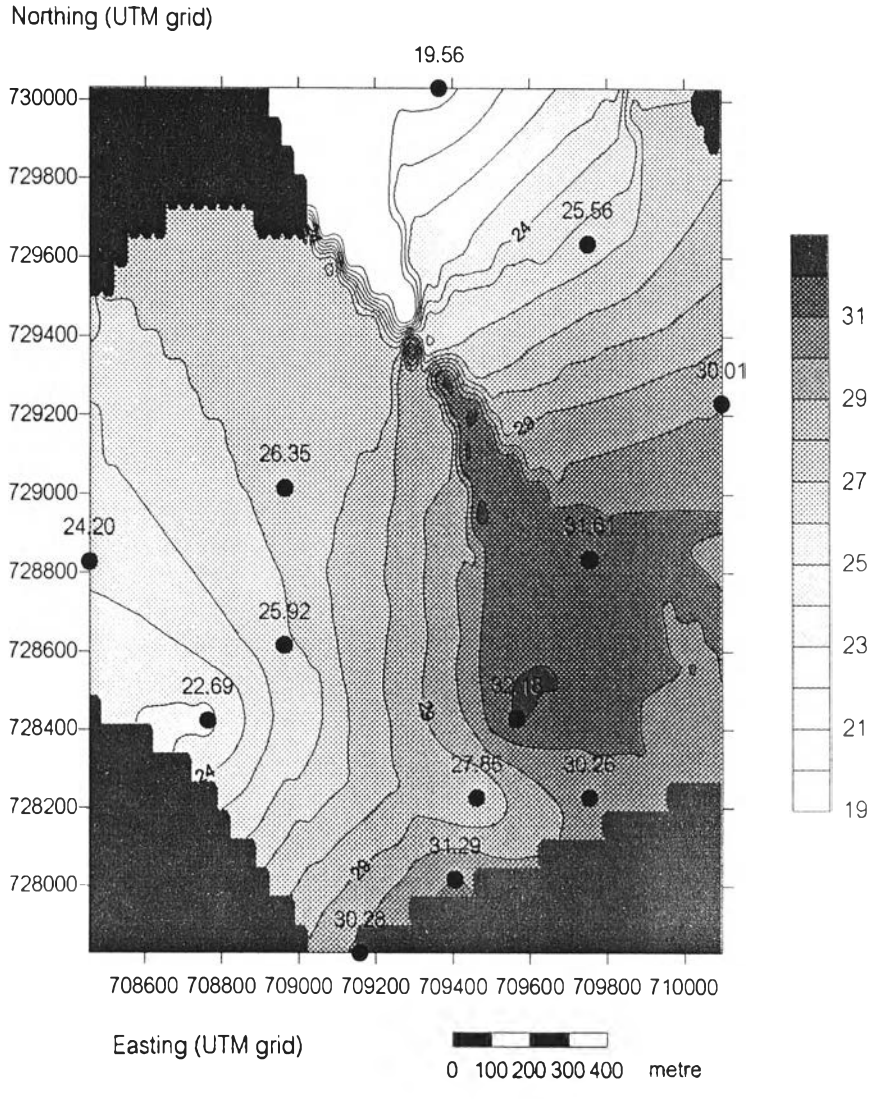
Kriging estimation for density (g/cc), S2 seam, Saba Yoi area.



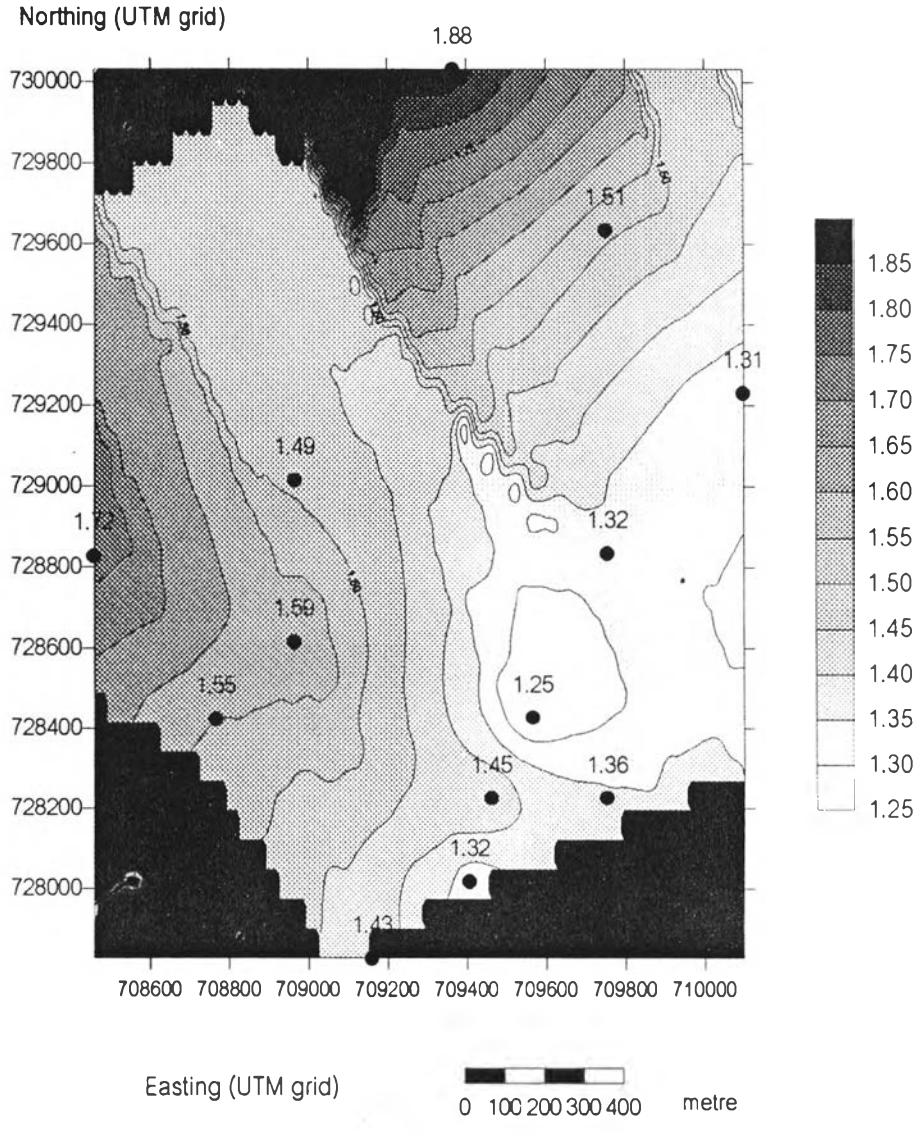
Kriging estimation for ash content (%), S3 seam, Saba Yoi area.



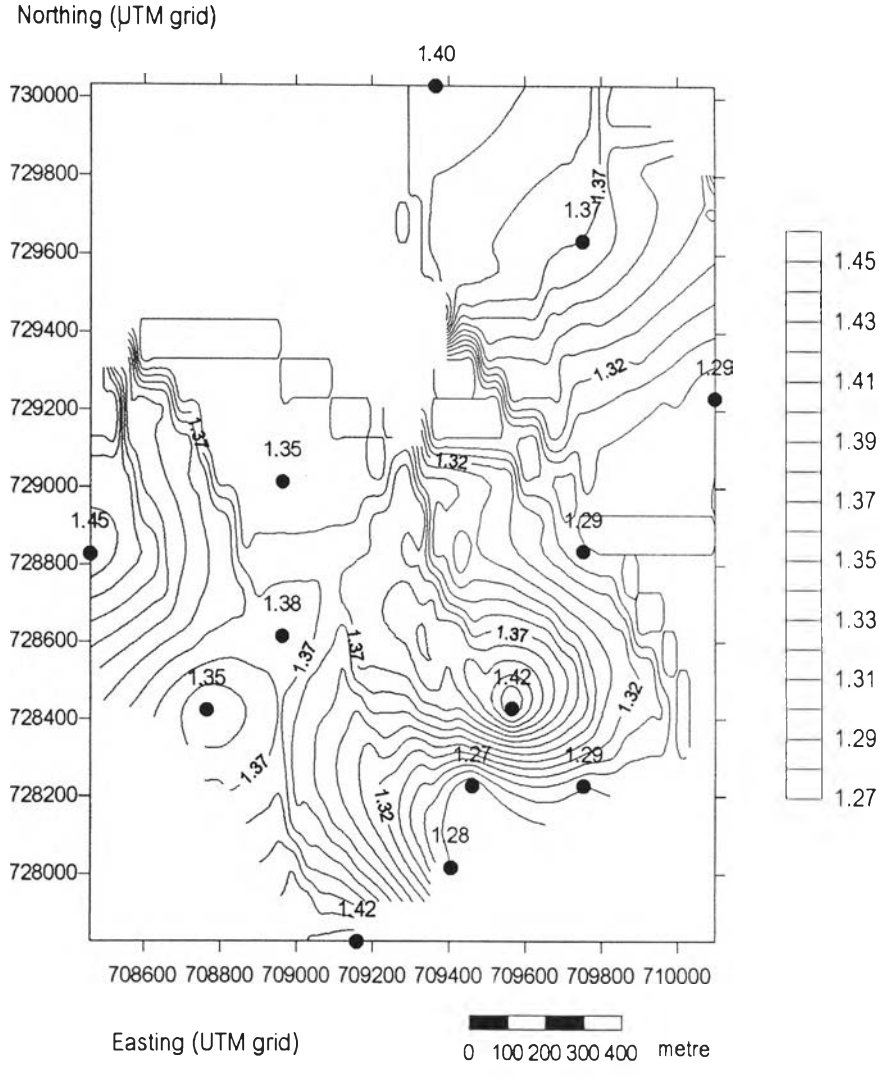
Kriging estimation for calorific value (kcal/kg), S3 seam, Saba Yoi area.



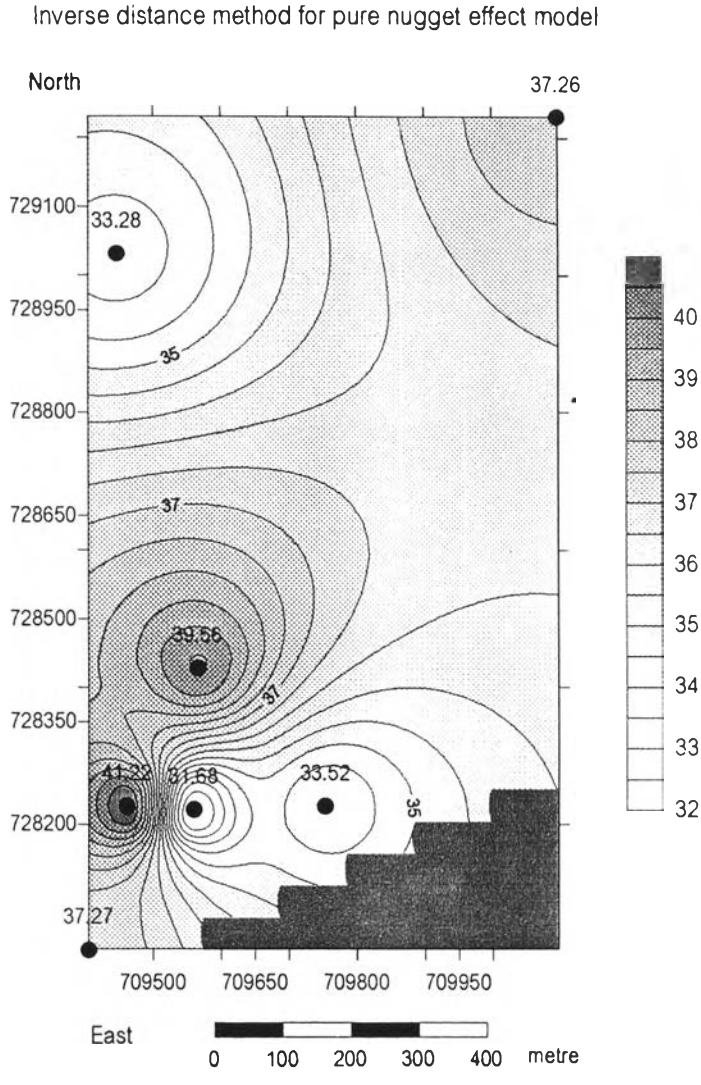
Kriging estimation for moisture content (%), S3 seam, Saba Yoi area.



Kriging estimation for sulphur content (%), S3 seam, Saba Yoi area.

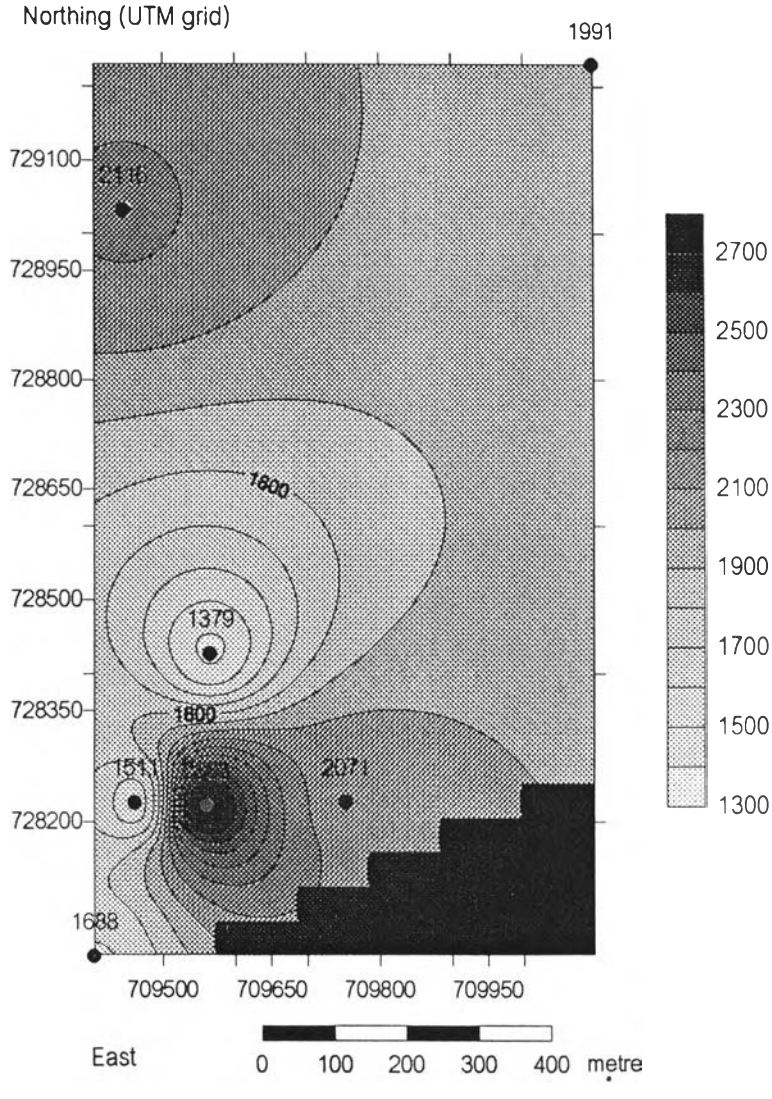


Kriging estimation for density (g/cc), S3 seam, Saba Yoi area.

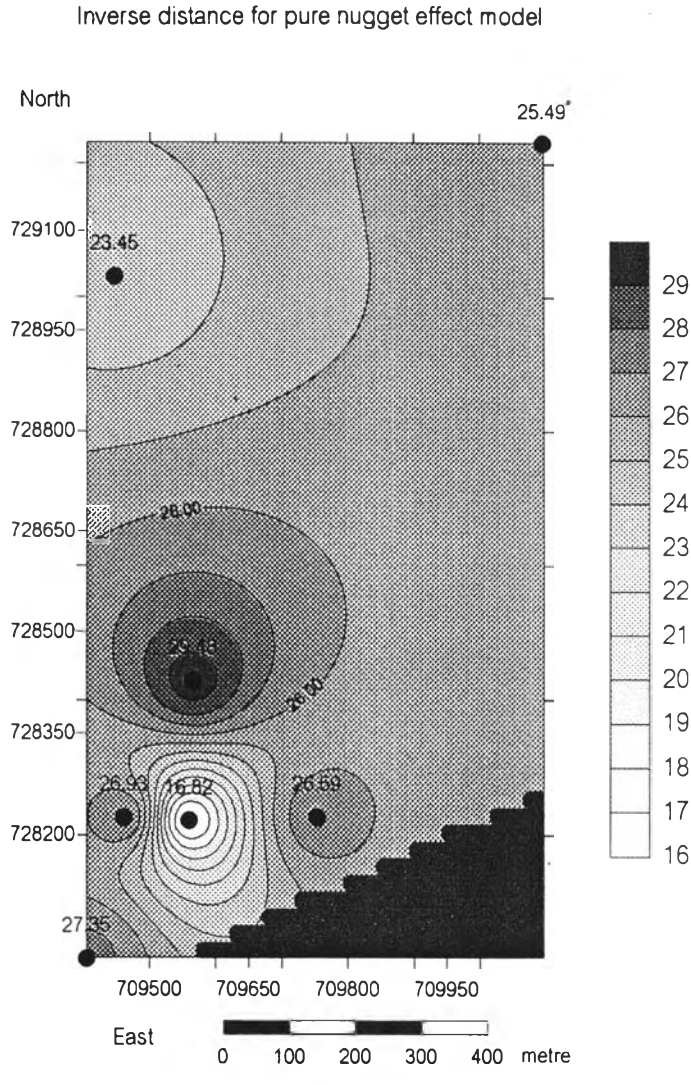


Kriging estimation for ash content (%), S4 seam, Saba Yoi area.

Inverse distance method for pure nugget effect model

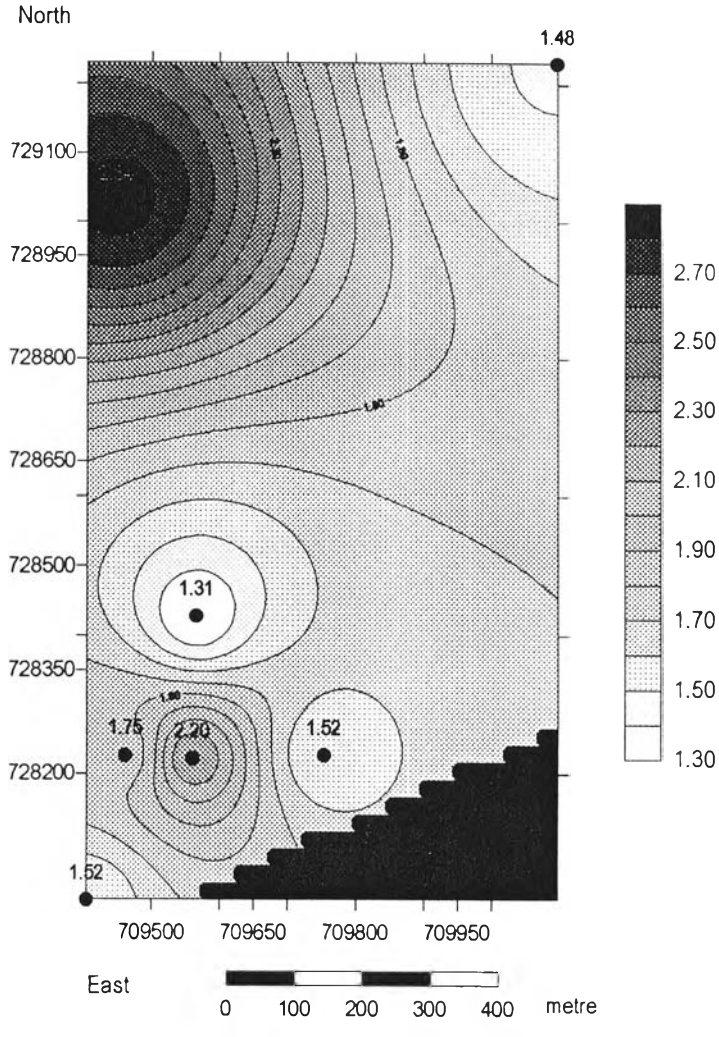


Kriging estimation for calorific value (kcal/kg), S4 seam, Saba Yoi area.

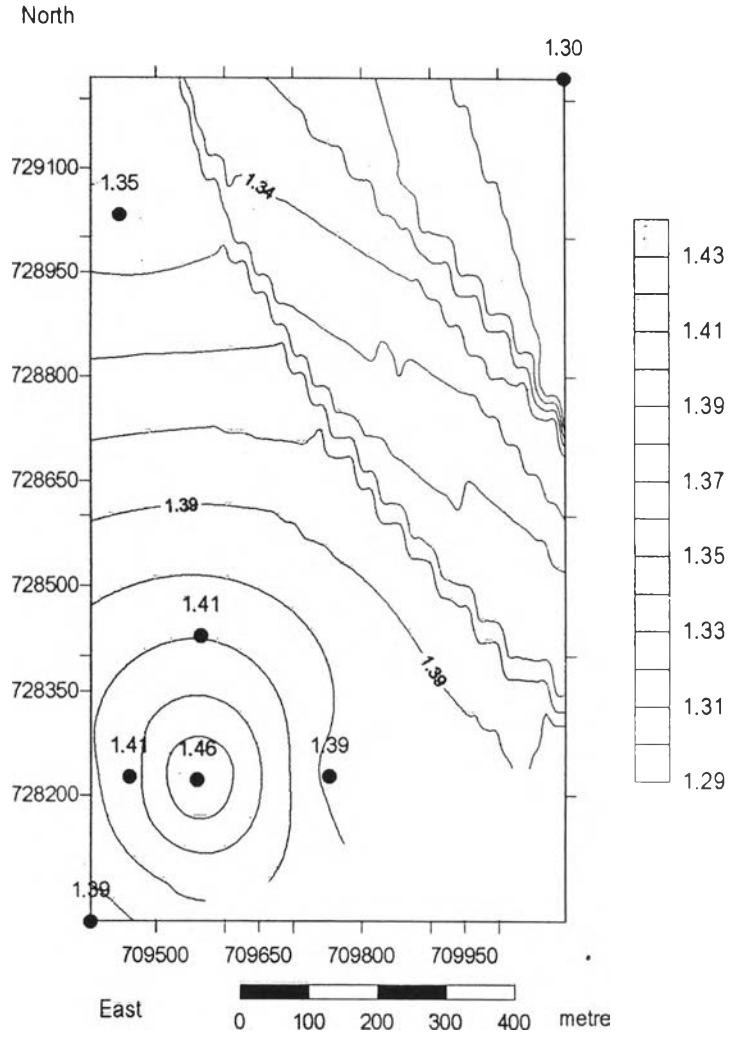


Kriging estimation for moisture content (%), S4 seam, Saba Yoi area.

Inverse distance for pure nugget effect model



Kriging estimation for sulphur content (%), S4 seam, Saba Yoi area.



Kriging estimation for density (g/cc), S4 seam, Saba Yoi area.

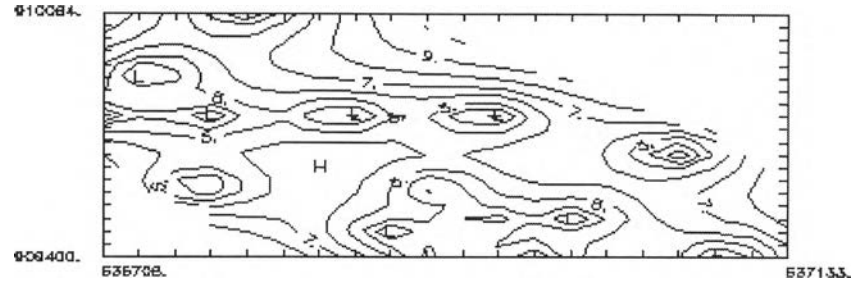
APPENDIX H

ERROR ESTIMATION MODELS

Standard Error of Estimation

P1 Seam, Sin Pun Area

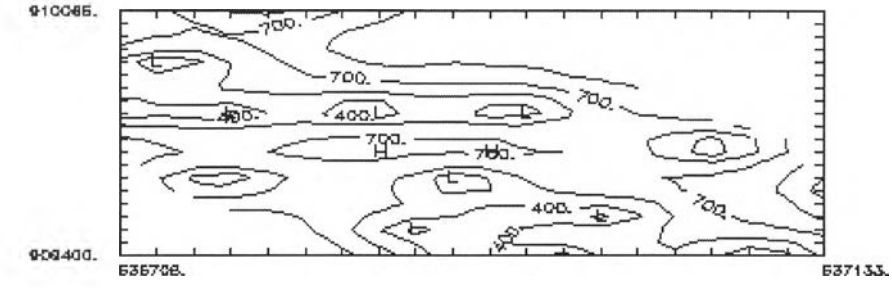
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for ash content (%).

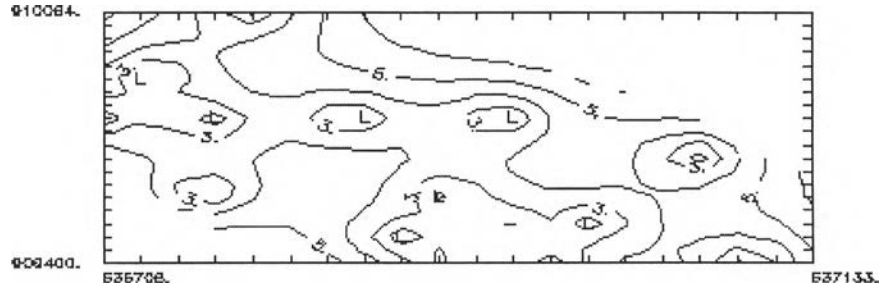
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

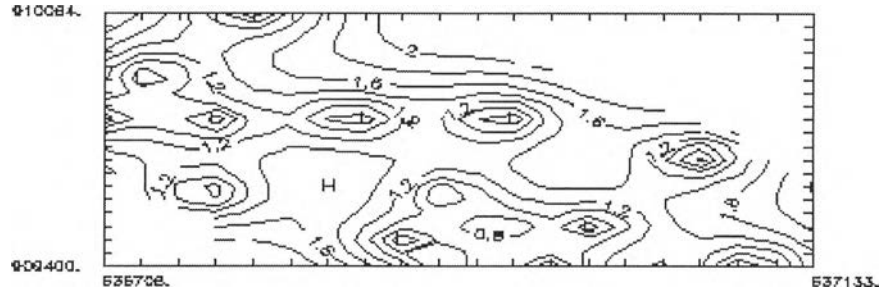
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for moisture content (%).

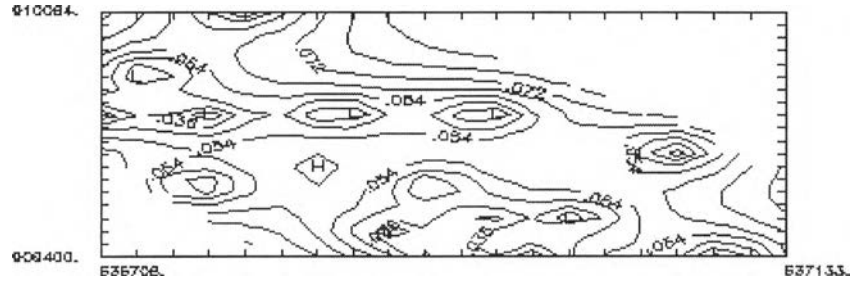
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for sulphur content (%).

Northing (UTM grid)

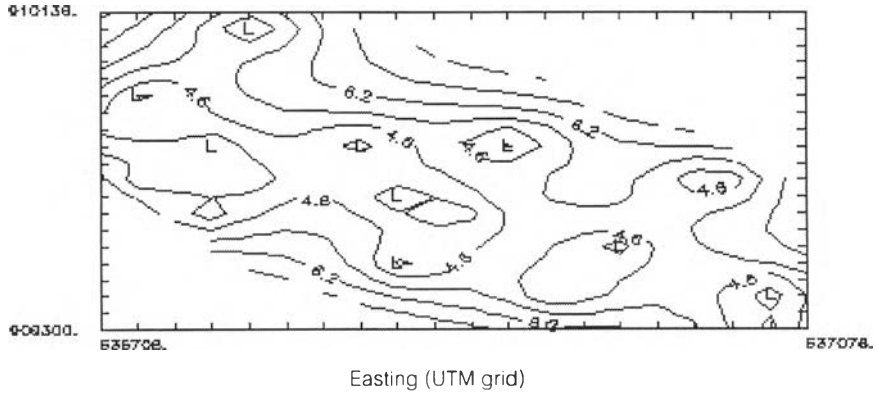


Easting (UTM grid)

Standard error of estimation for density (g/cc).

P2 seam, Sin Pun area

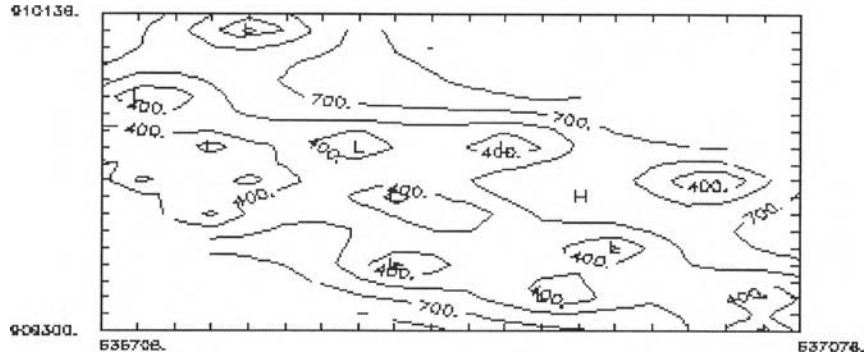
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for ash content (%).

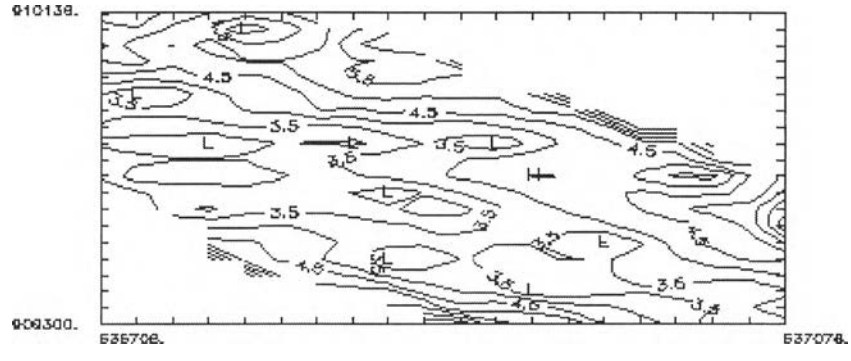
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

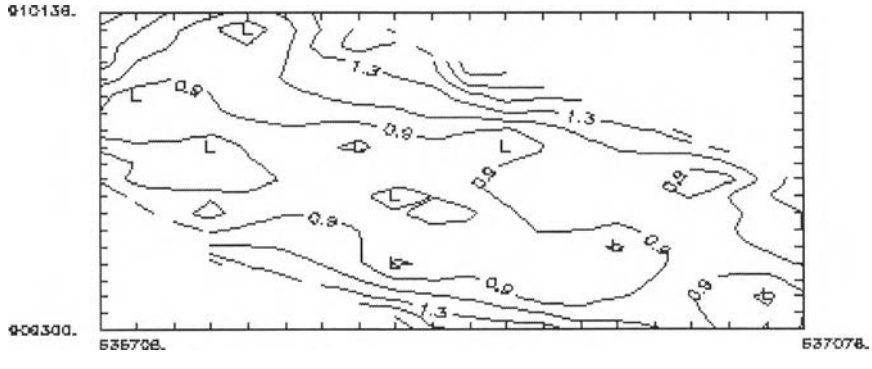
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for moisture content (%).

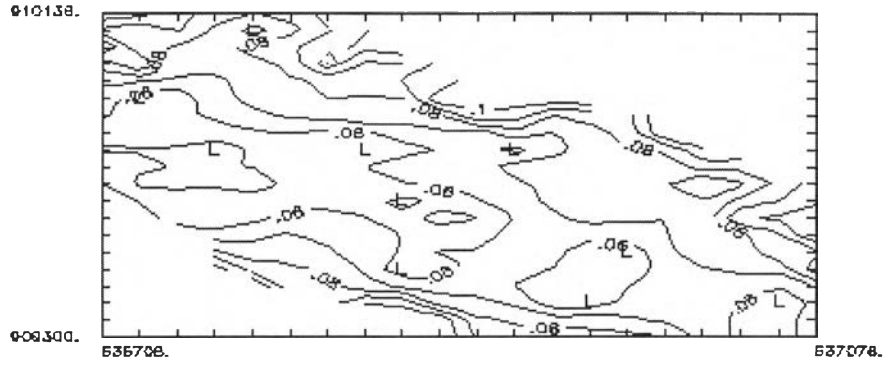
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for sulphur content (%) .

Northing (UTM grid)

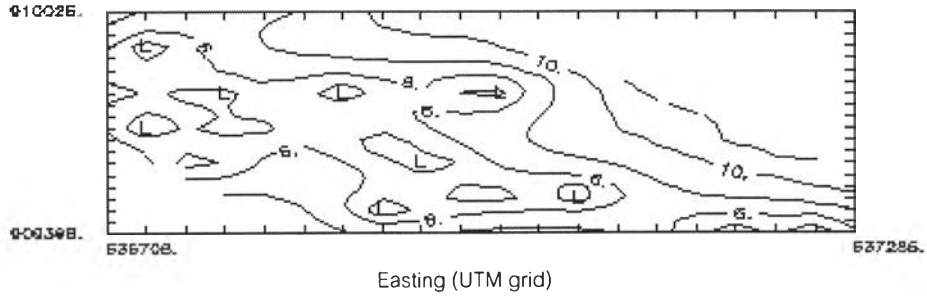


Easting (UTM grid)

Standard error of estimation for density (g/cc) .

P3 seam, Sin Pun area

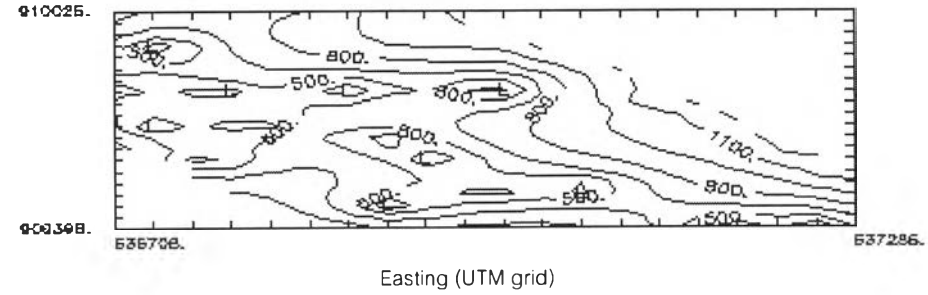
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for ash content (%).

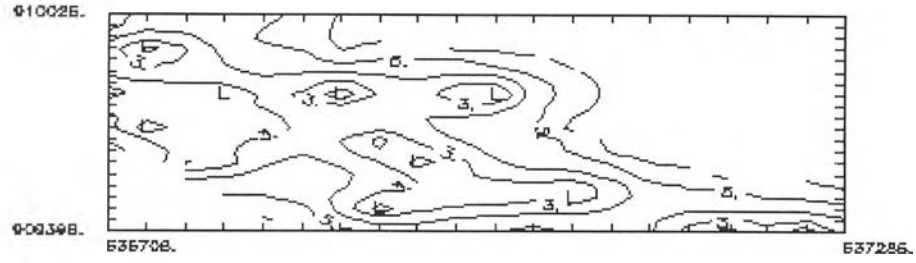
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

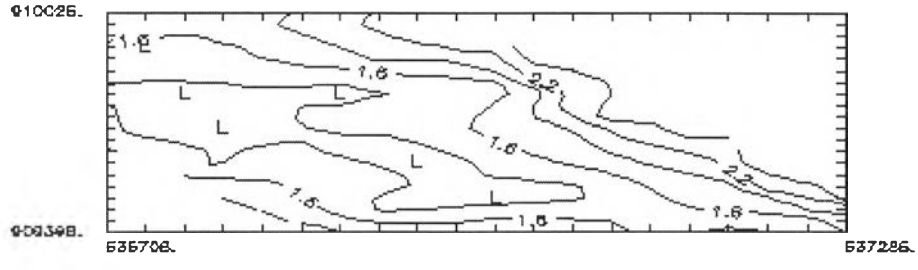
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for moisture content (%).

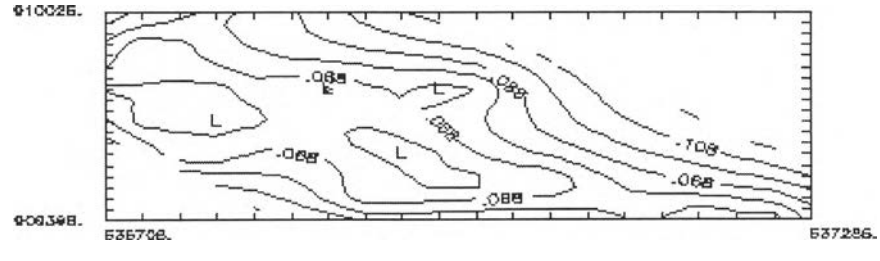
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for sulphur content (%) .

Northing (UTM grid)

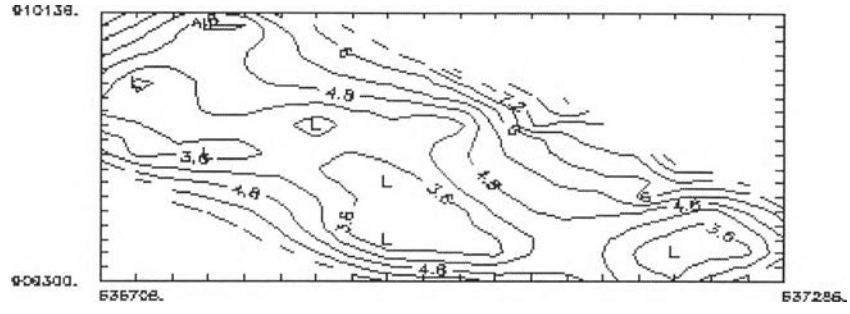


Easting (UTM grid)

Standard error of estimation for density (g/cc) .

P4 seam, Sin Pun area

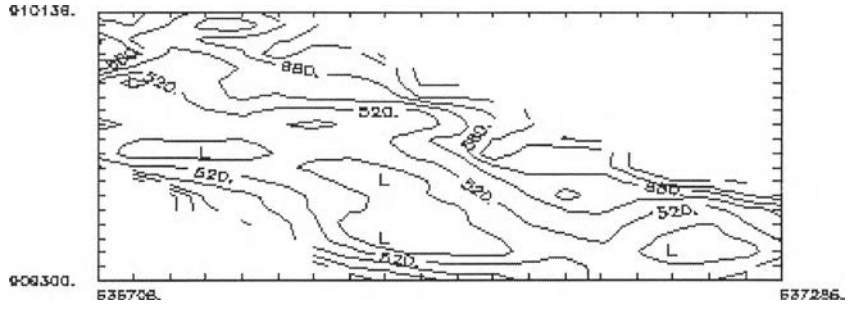
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for ash content (%).

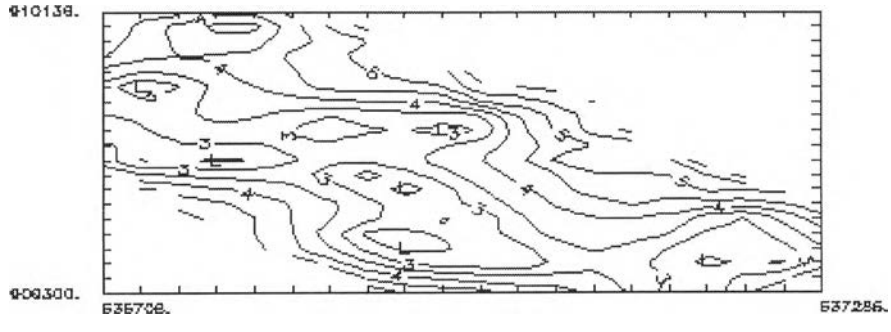
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

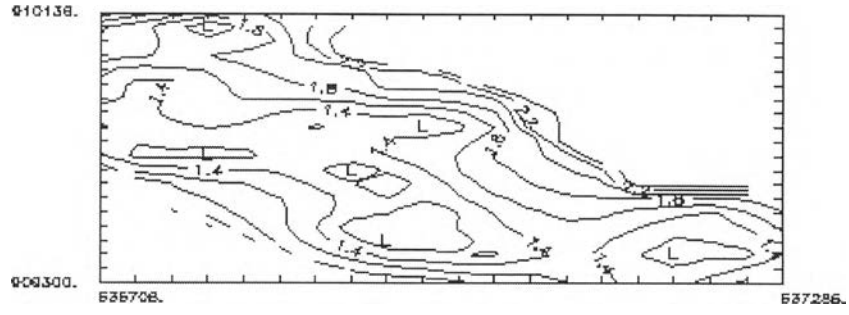
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for moisture content (%).

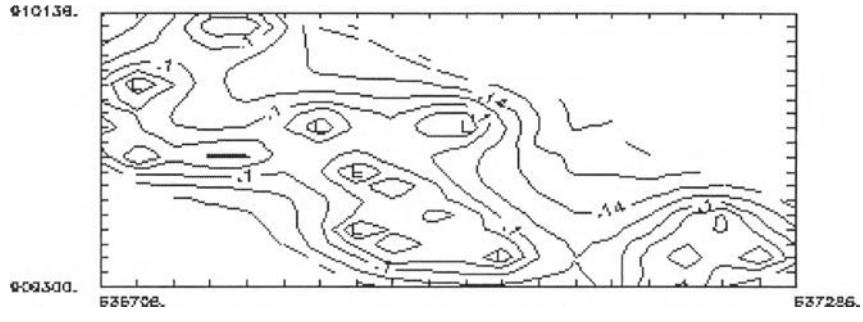
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for sulphur content (%) .

Northing (UTM grid)

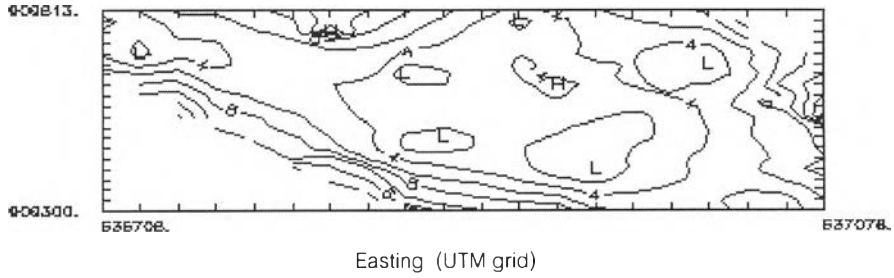


Easting (UTM grid)

Standard error of estimation for density (g/cc) .

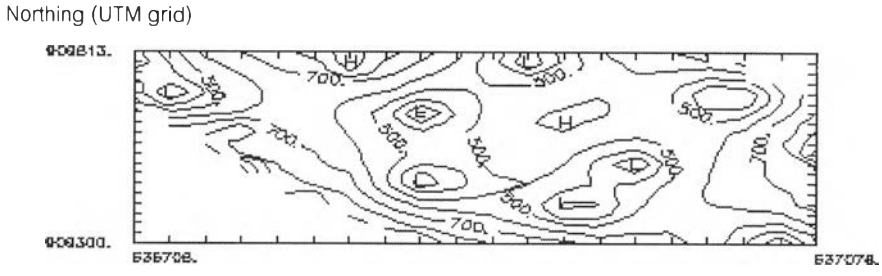
M Seam, Sin Pun Area

Northing (UTM grid)

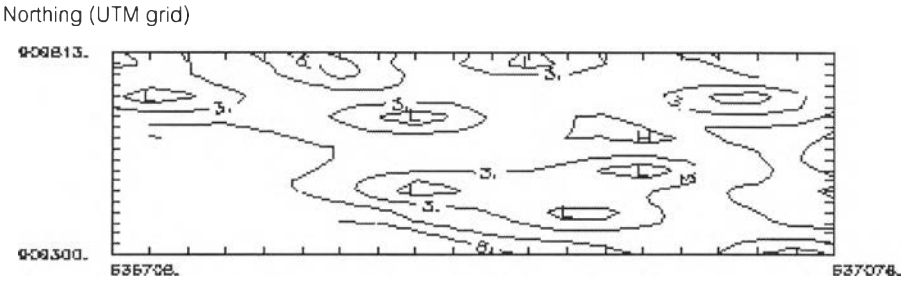


Easting (UTM grid)

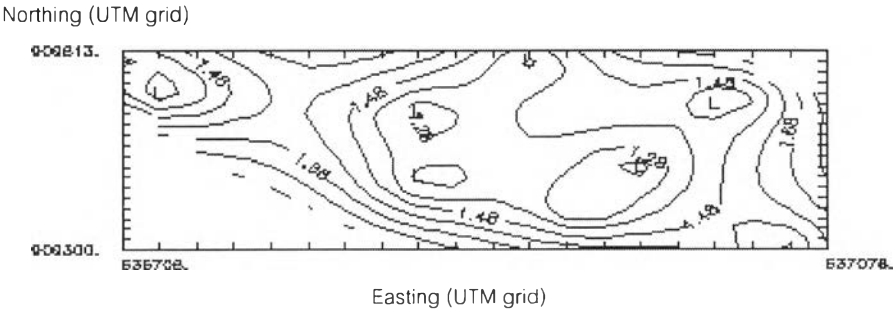
Standard error of estimation for ash content (%) .



Standard error of estimation for calorific value (kcal/kg).

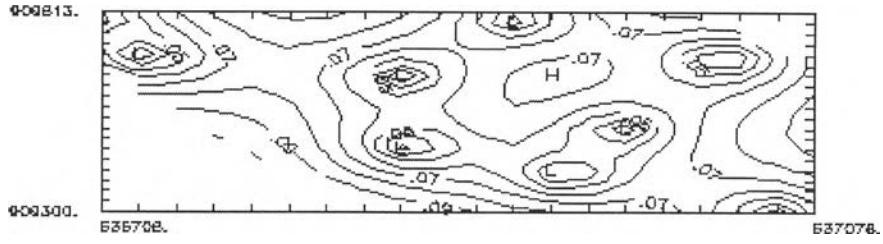


Standard error of estimation for moisture content (%).



Standard error of estimation for sulphur content (%).

Northing (UTM grid)

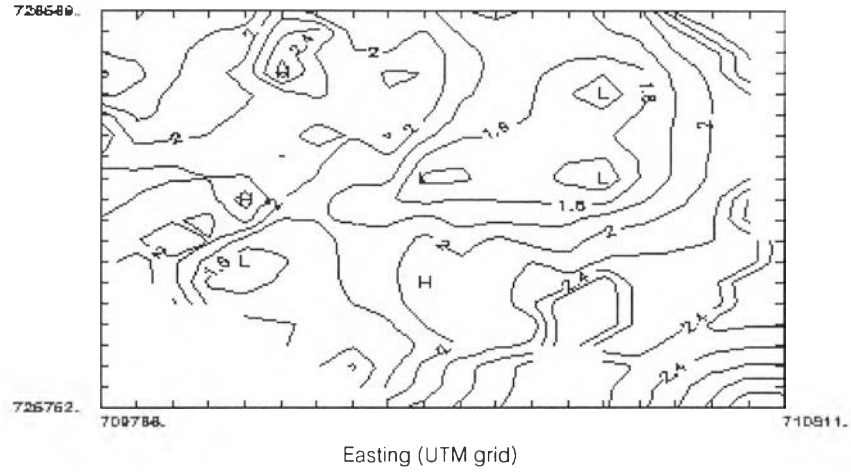


Easting (UTM grid)

Standard error of estimation for density (g/cc).

S1 Seam, Saba Yoi Area

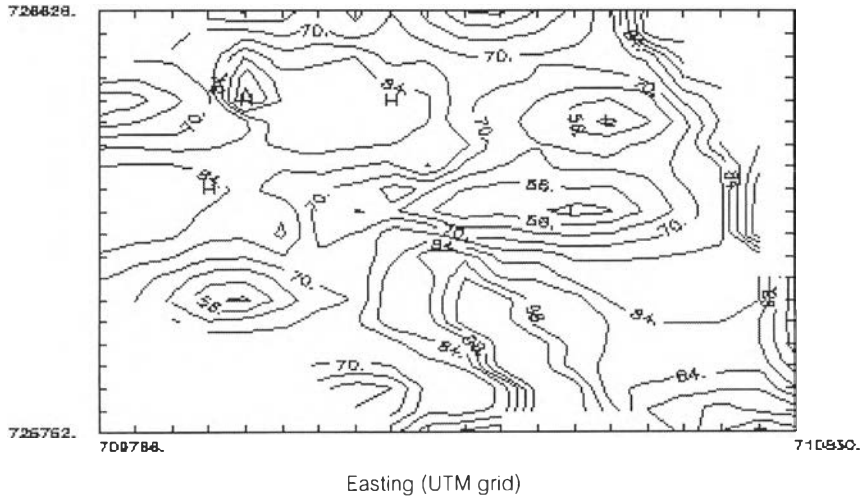
Northing (UTM grid)



Easting (UTM grid)

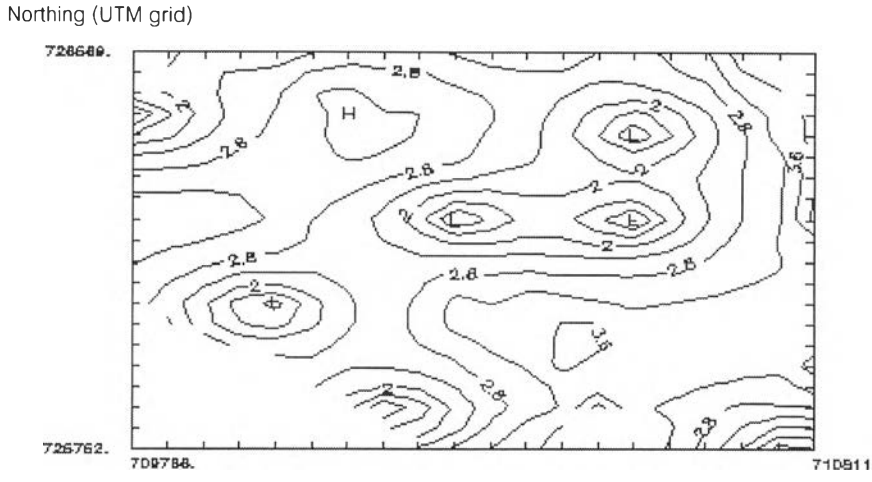
Standard error of estimation for ash content (%).

Northing (UTM grid)

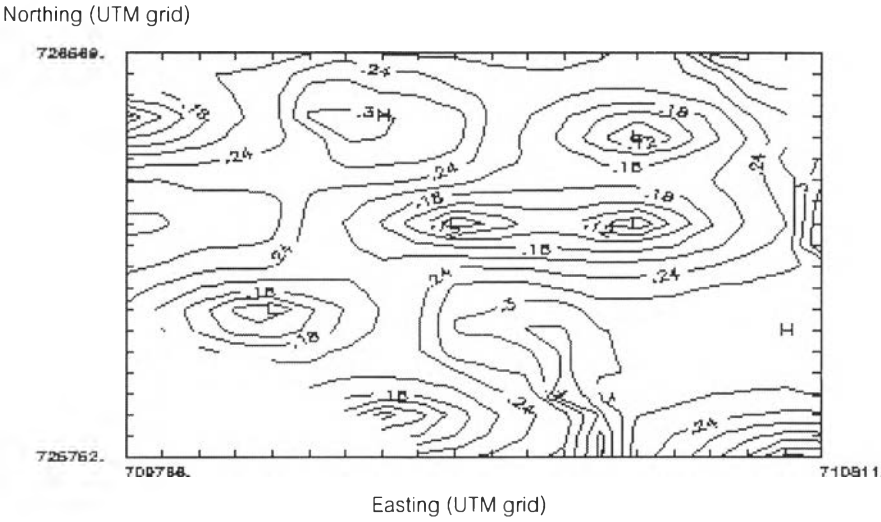


Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

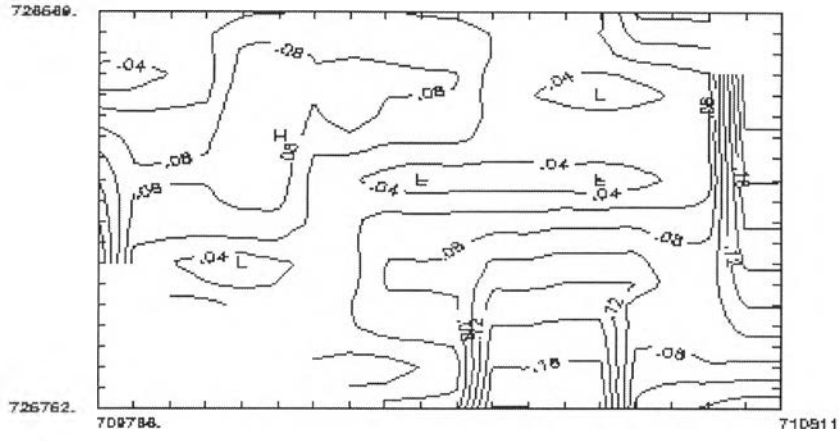


Standard error of estimation for moisture content (%).



Standard error of estimation for sulphur content (%).

Northing (UTM grid)

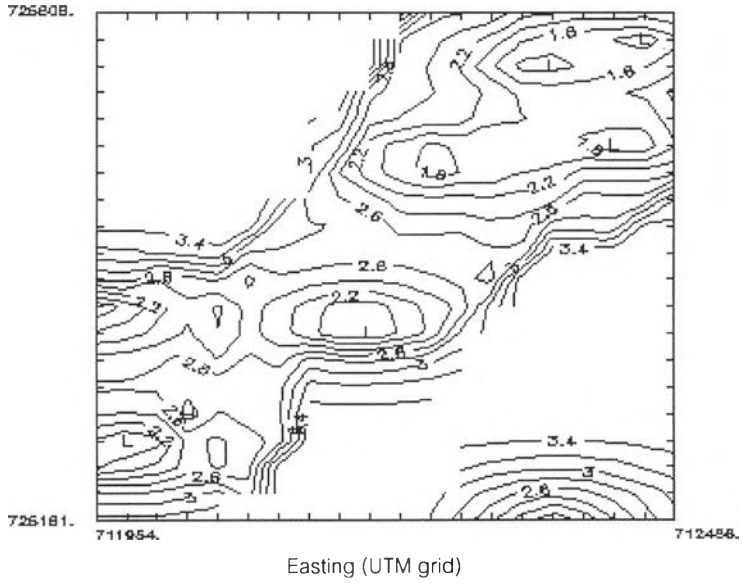


Easting (UTM grid)

Standard error of estimation for density (g/cc).

S2 Seam, Saba Yoi Area

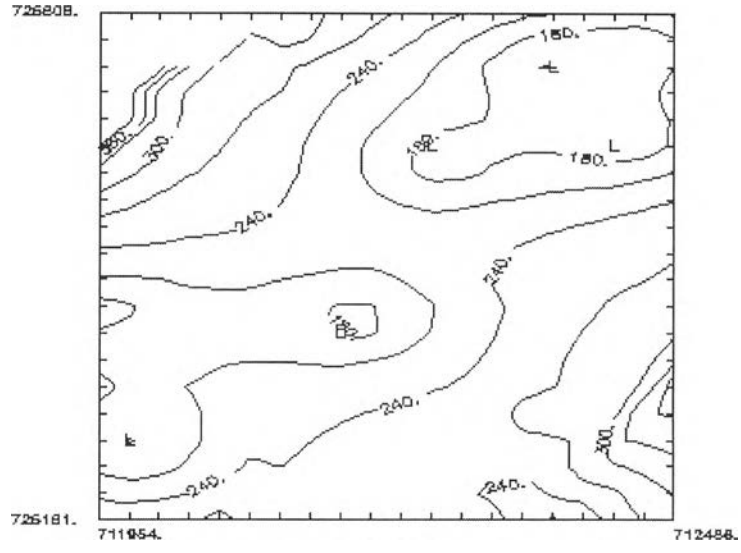
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for ash content (%).

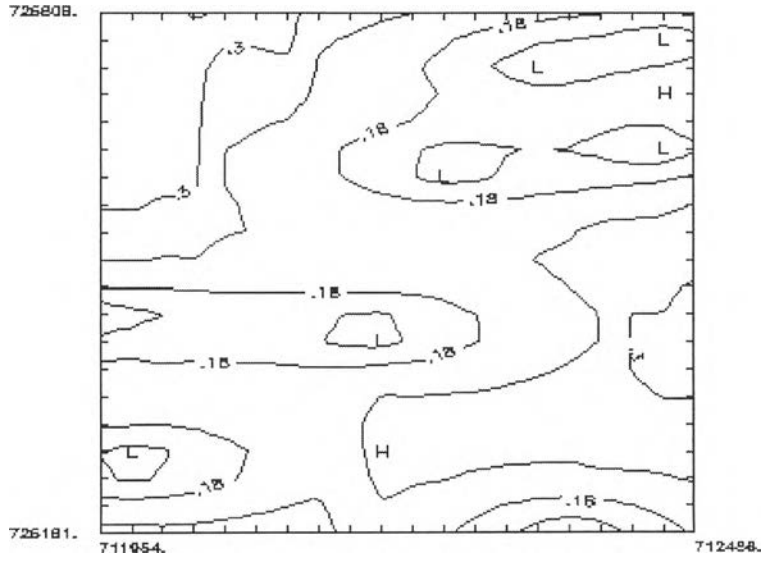
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

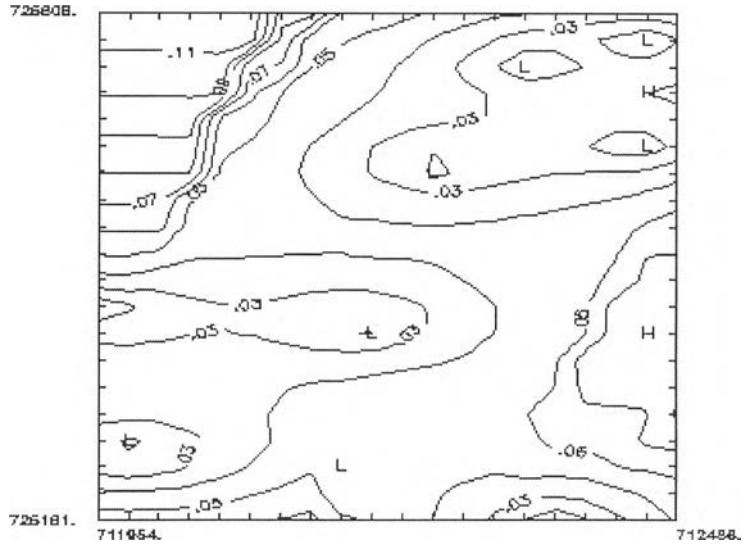
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for sulphur content (%).

Northing (UTM grid)

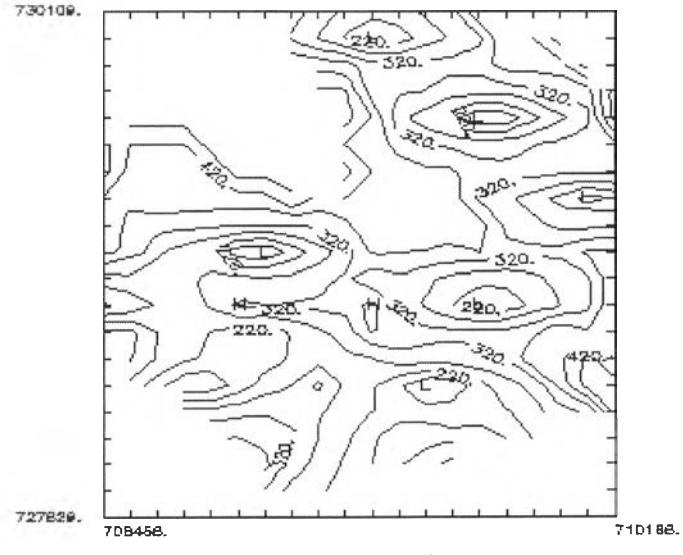


Easting (UTM grid)

Standard error of estimation for density (g/cc).

S3 Seam, Saba Yoi Area

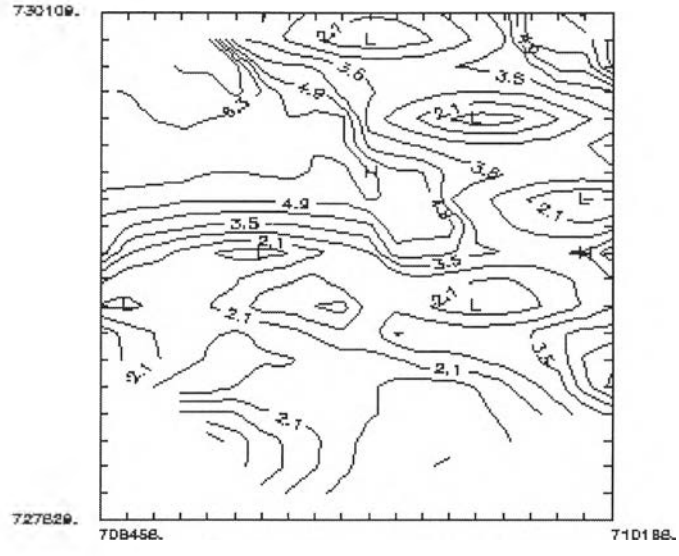
Northing (UTM grid)



Easting (UTM grid)

Standard error of estimation for calorific value (kcal/kg).

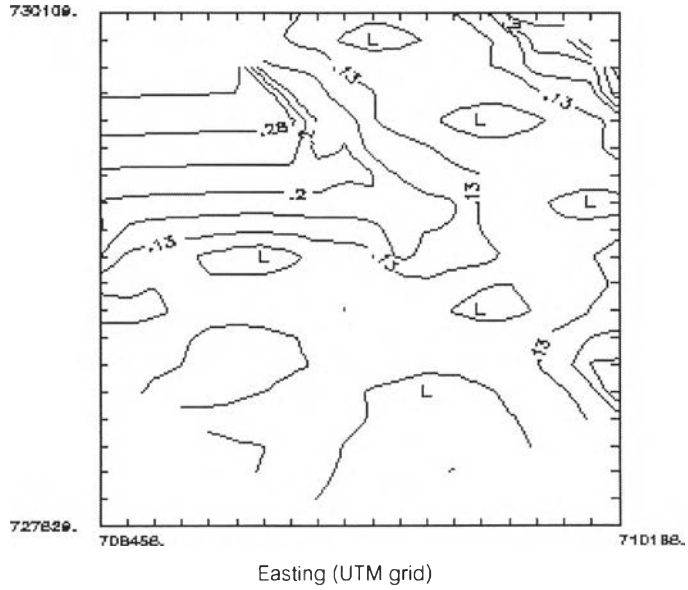
Northing (UTM grid)



Easting (UTM grid)

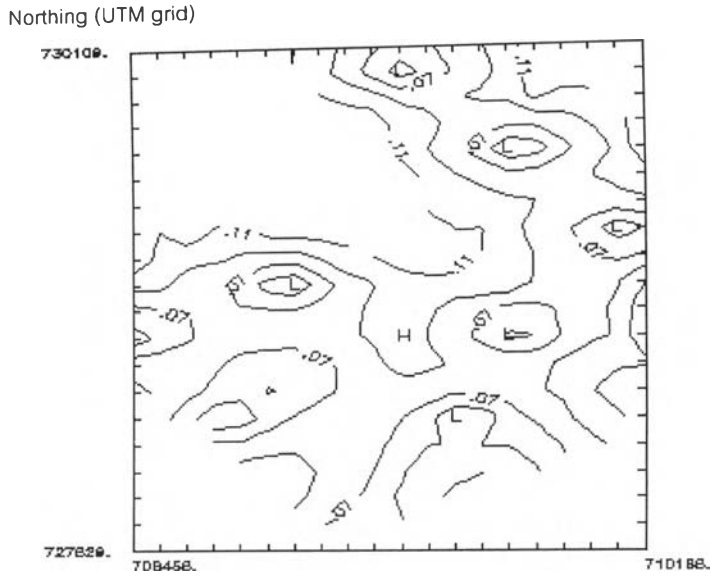
Standard error of estimation for moisture content (%).

Northing (UTM grid)



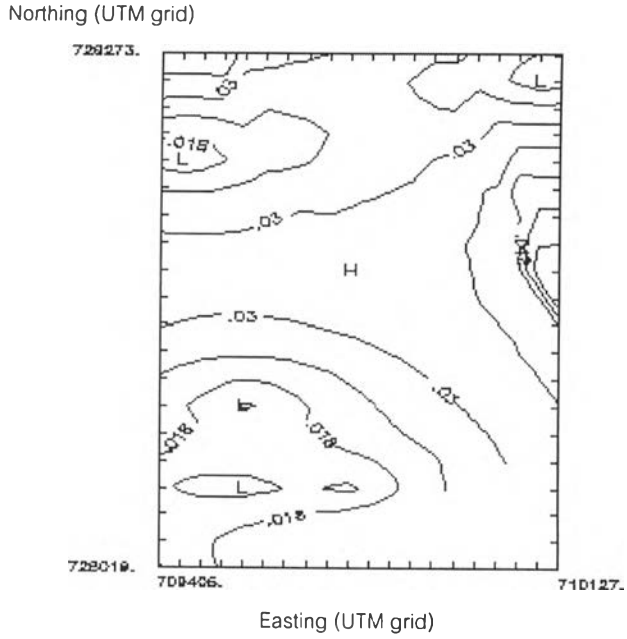
Easting (UTM grid)

Standard error of estimation for sulphur content (%).



Standard error of estimation for density (g/cc).

S4 Seam, Saba Yoi Area



Standard error of estimation for density (g/cc).

BIODATA

Ms. Bussakorn Pongorapin was born on June 22, 1969 in Bangkok. She finished her Bachelor degree at Department of Geology, Faculty of Science, Chulalongkorn University in 1995 and continue to study Master degree at the same Department in 1997.

Now she work about database processing at Geological Resources Assessment Section, Geological Investigation and Resources Assessment Department, Mining Business Development, Electricity Generating Authority of Thailand.