

## APPENDIX B. STRUCTURAL ANALYSIS

### B.1 Large Test Case Results

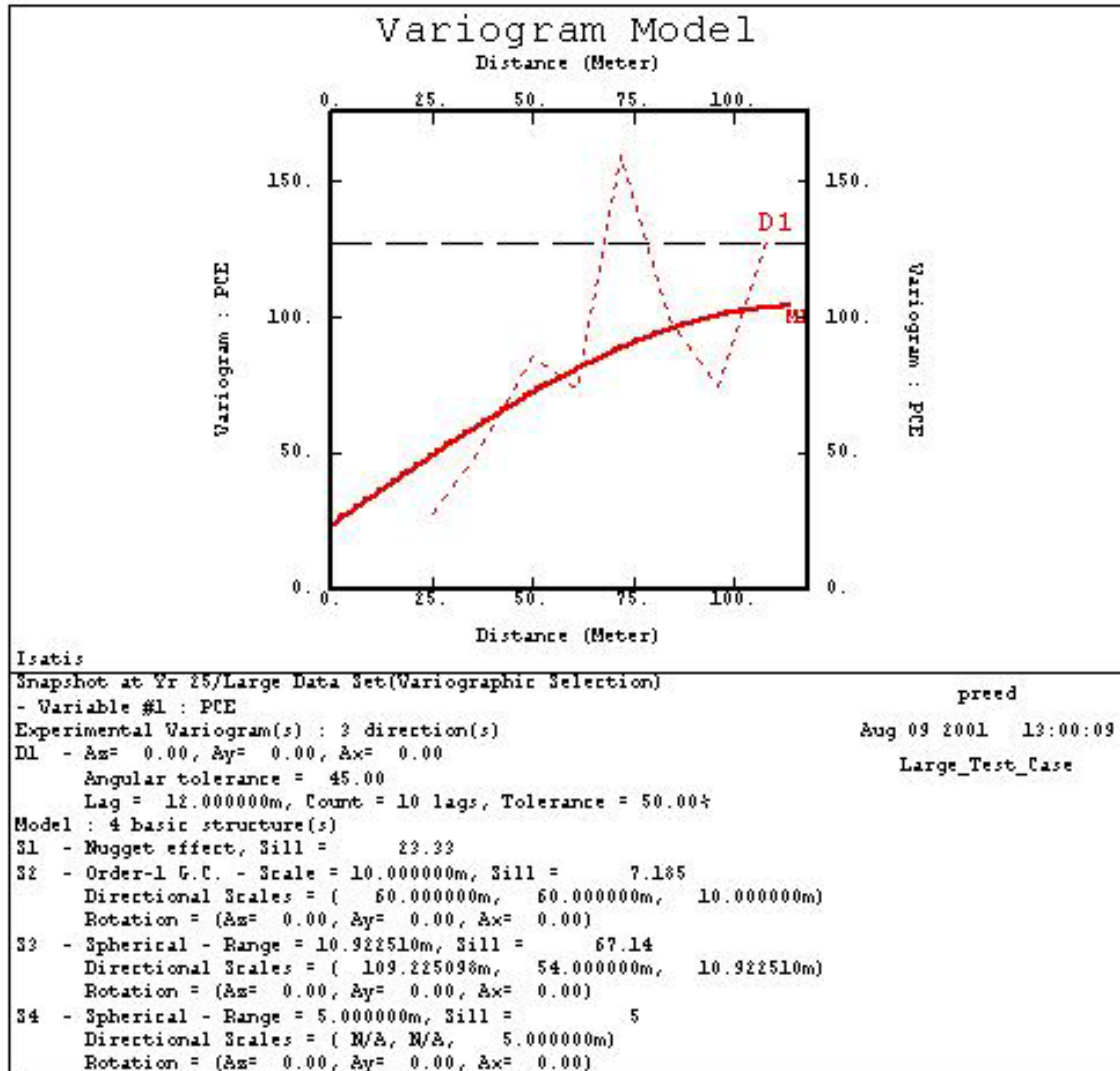


Figure B.1 Large case variogram model for the ordinary kriging system in the X-direction

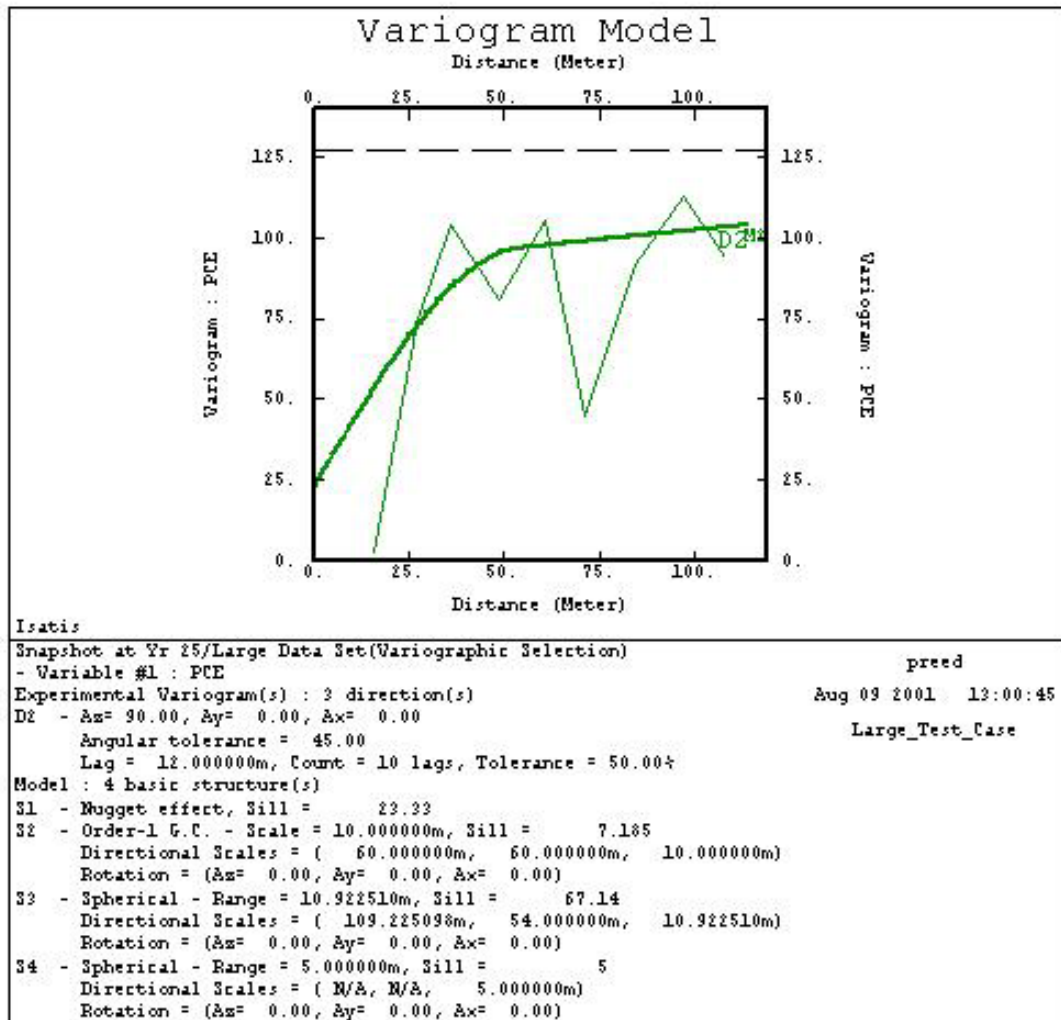


Figure B.2 Large case variogram model for the ordinary kriging system in the Y-direction

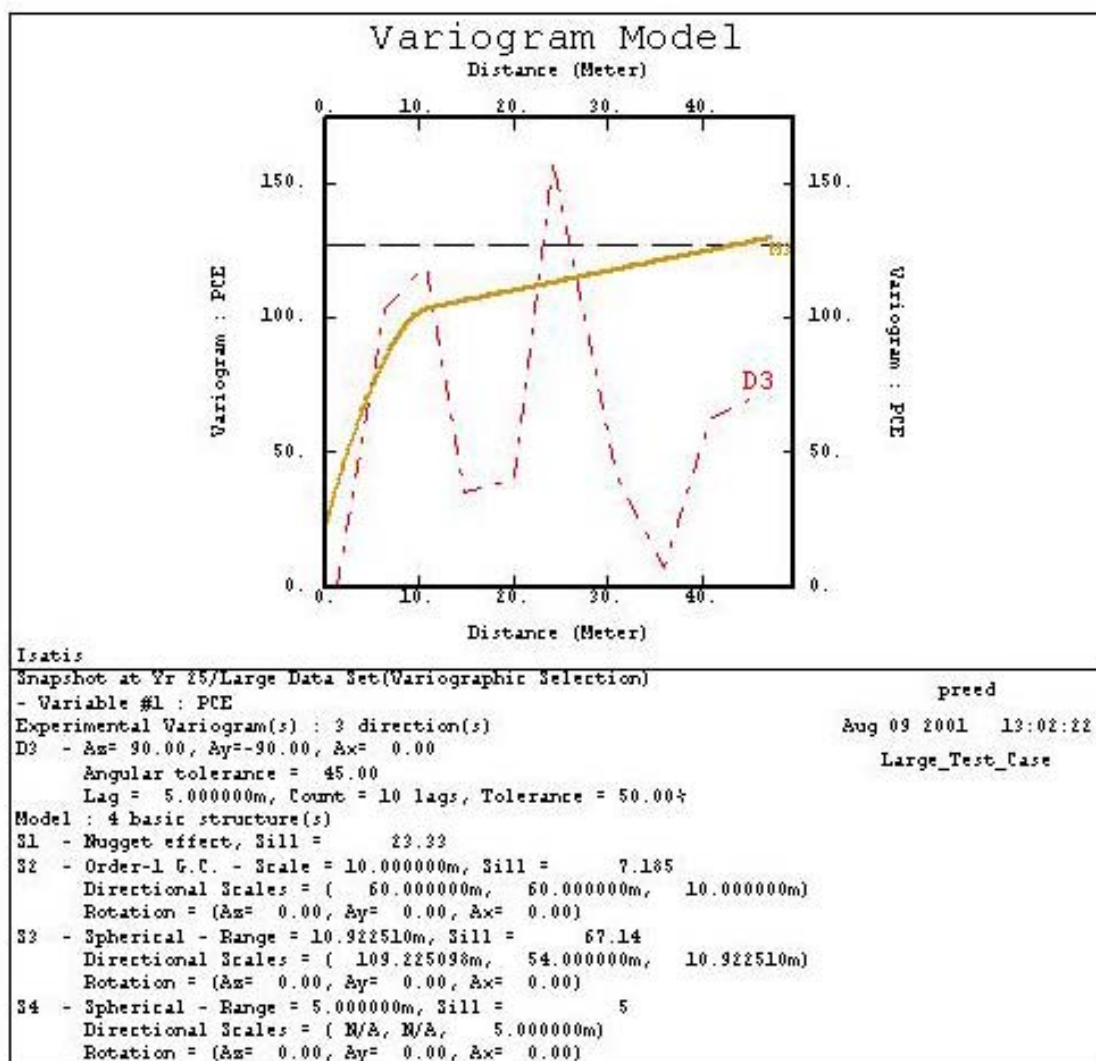


Figure B.3 Large case variogram model for the ordinary kriging system in the Z-direction

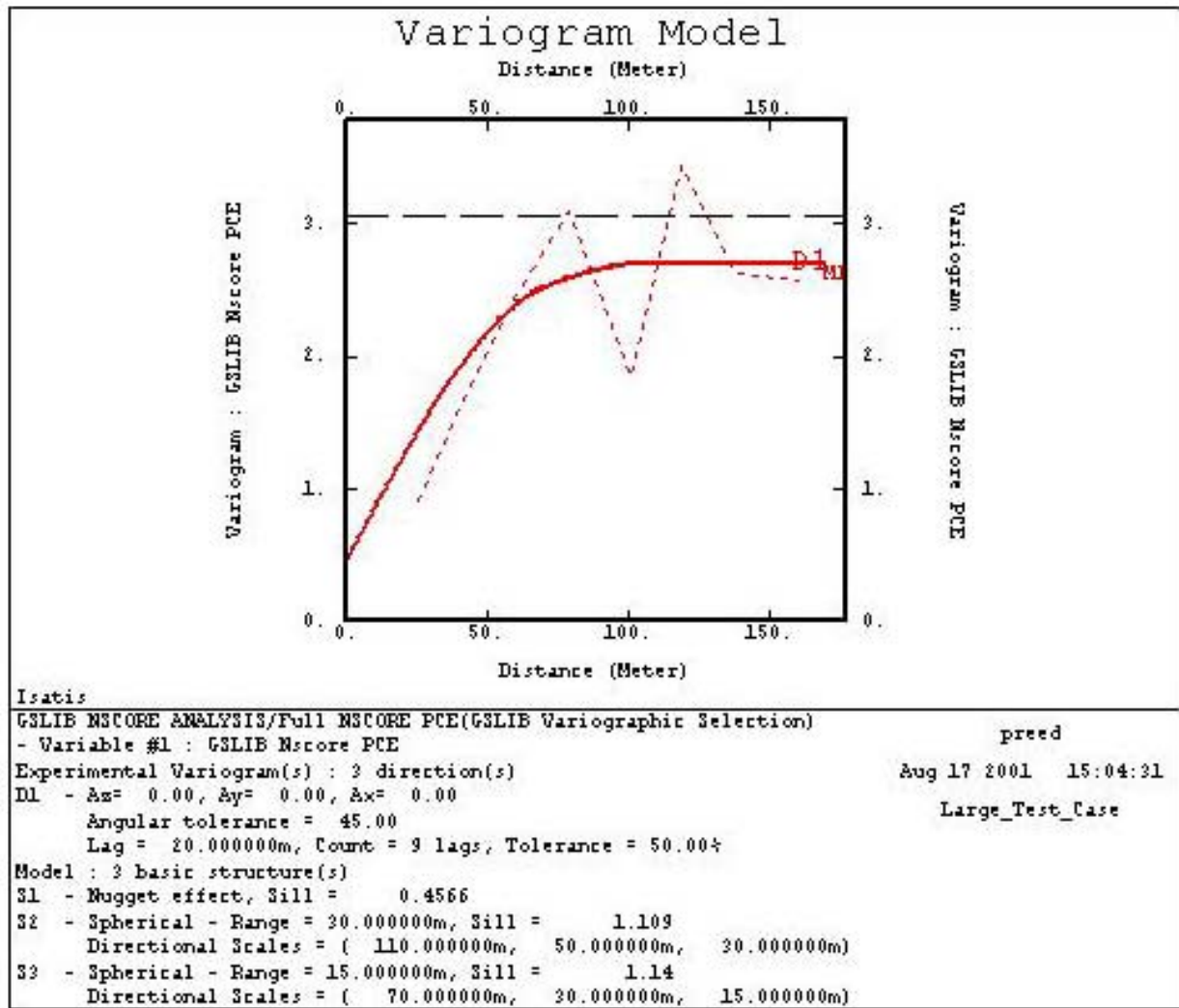


Figure B.4 Large case variogram model for the Multigaussian kriging system in the X-direction

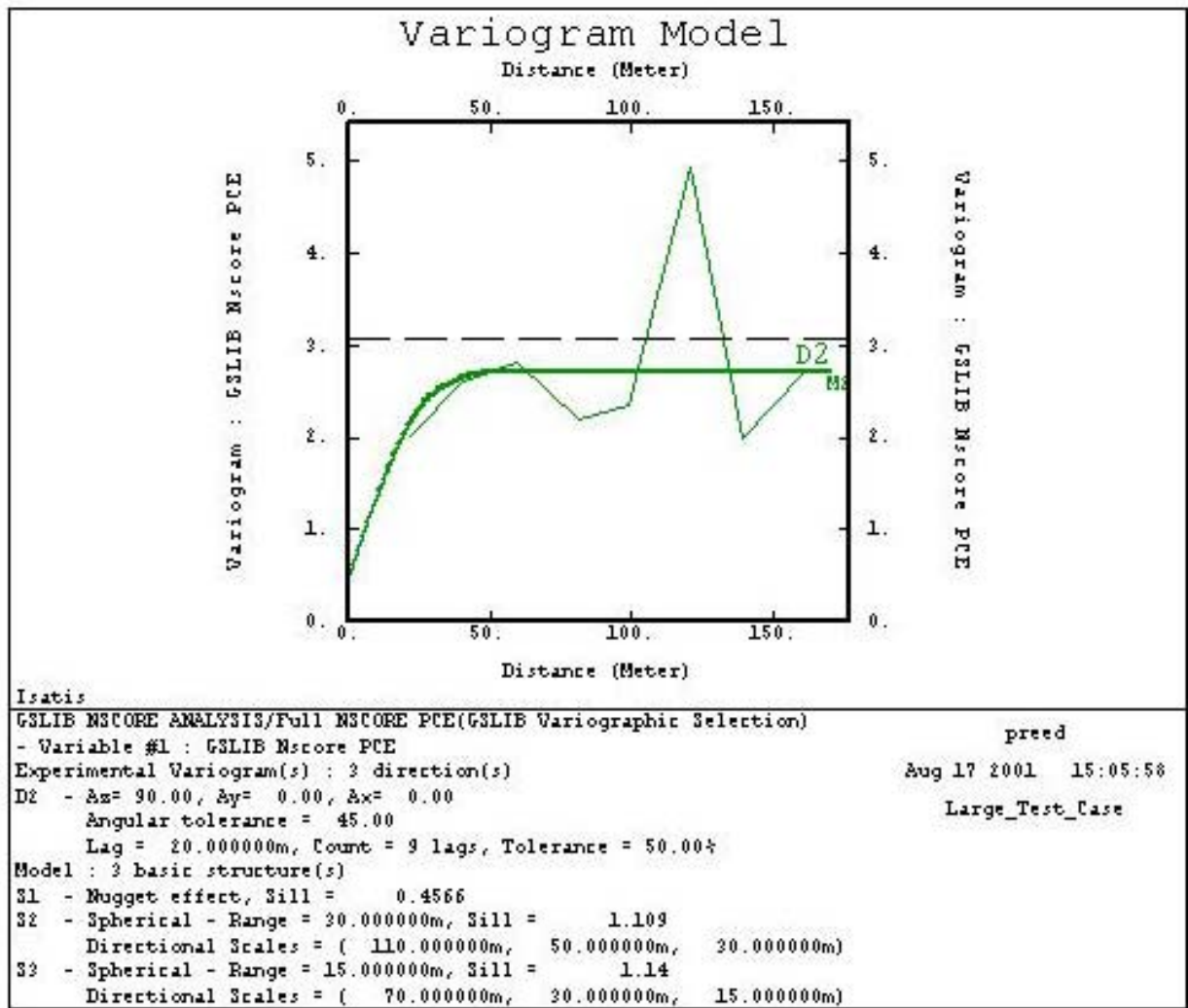


Figure B.5 Large case variogram model for the Multigaussian kriging system in the Y-direction

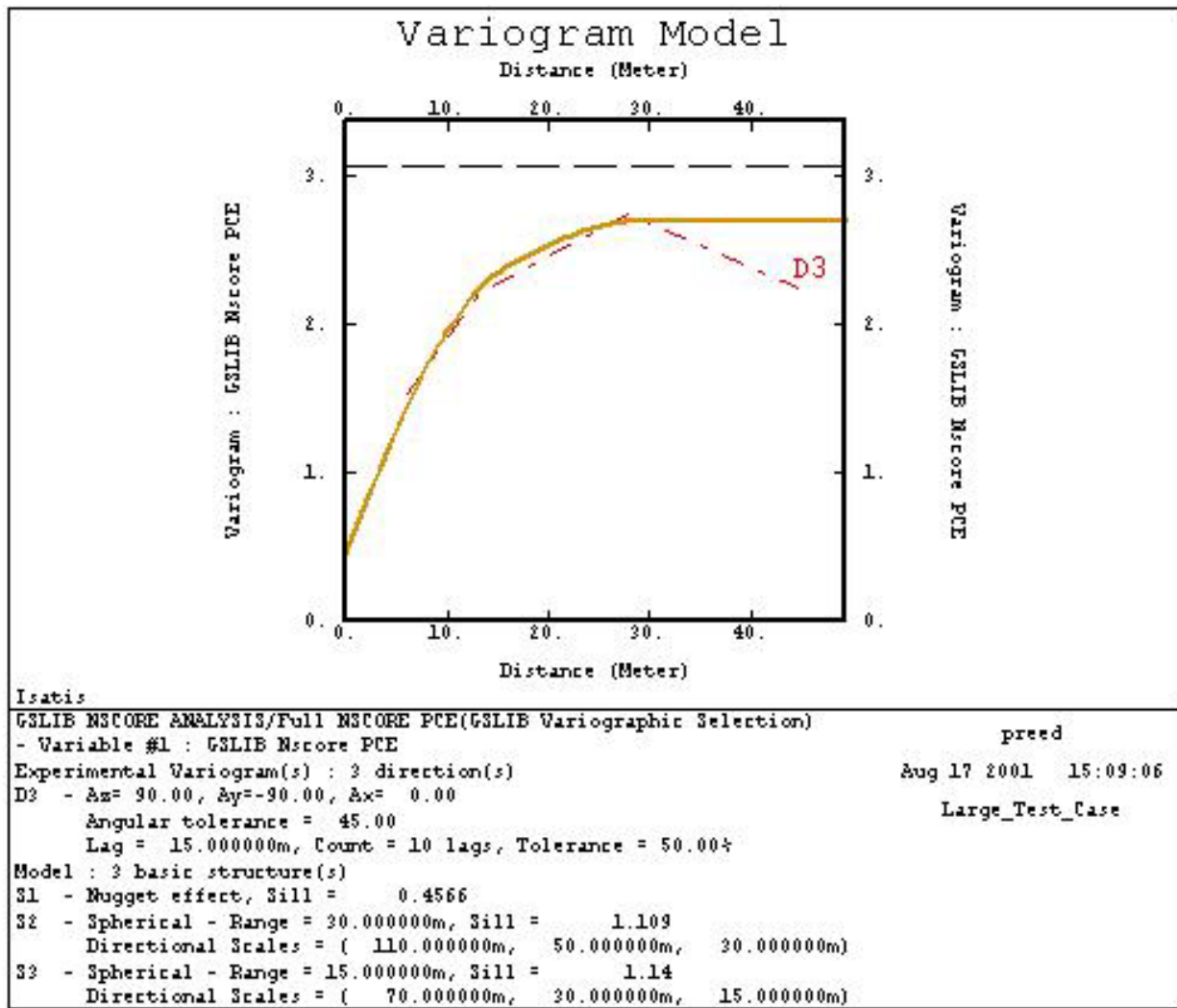


Figure B.6 Large case variogram model for the Multigaussian kriging system in the Z-direction

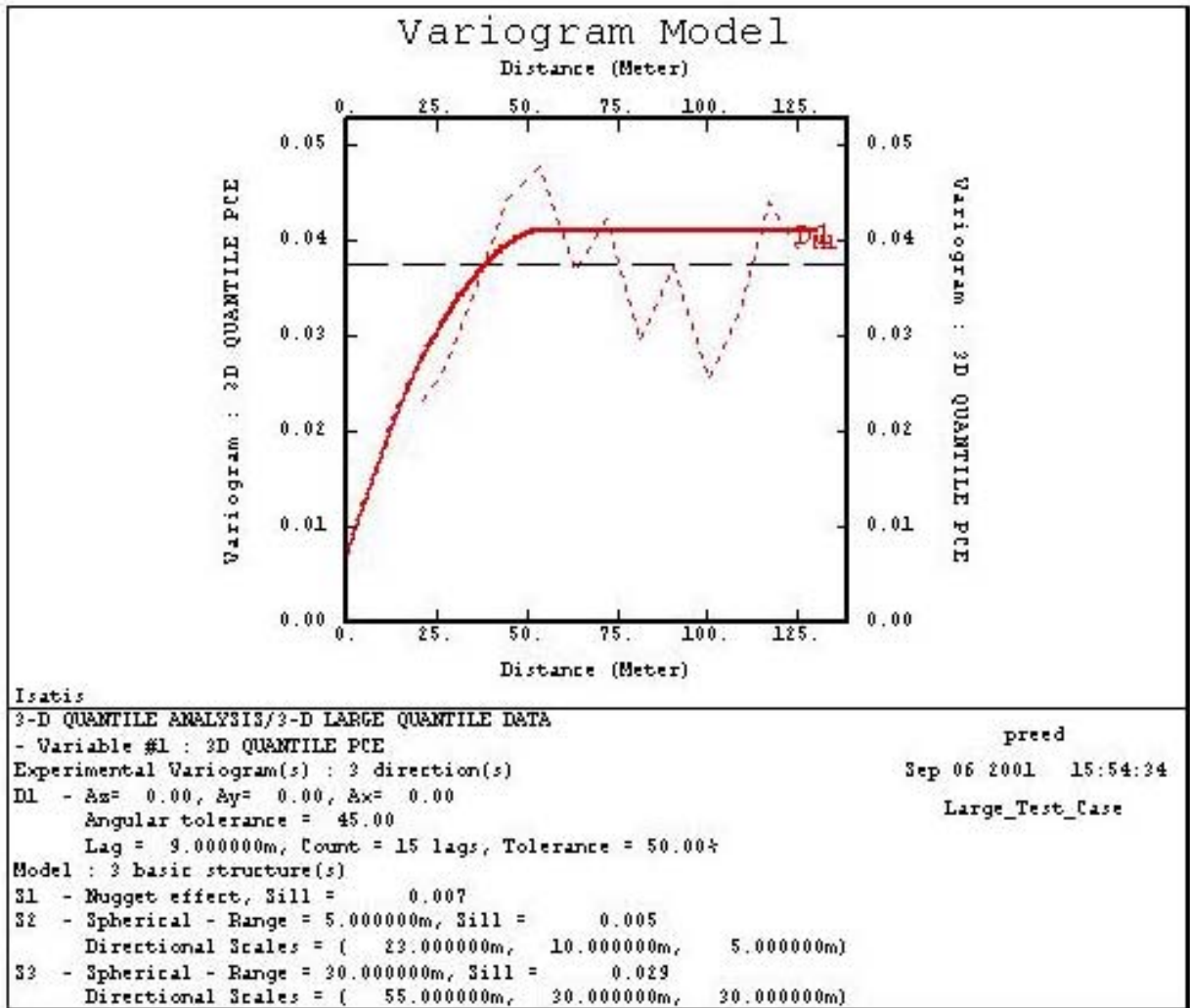


Figure B.7 Large case variogram model for the quantile kriging system in the X-direction



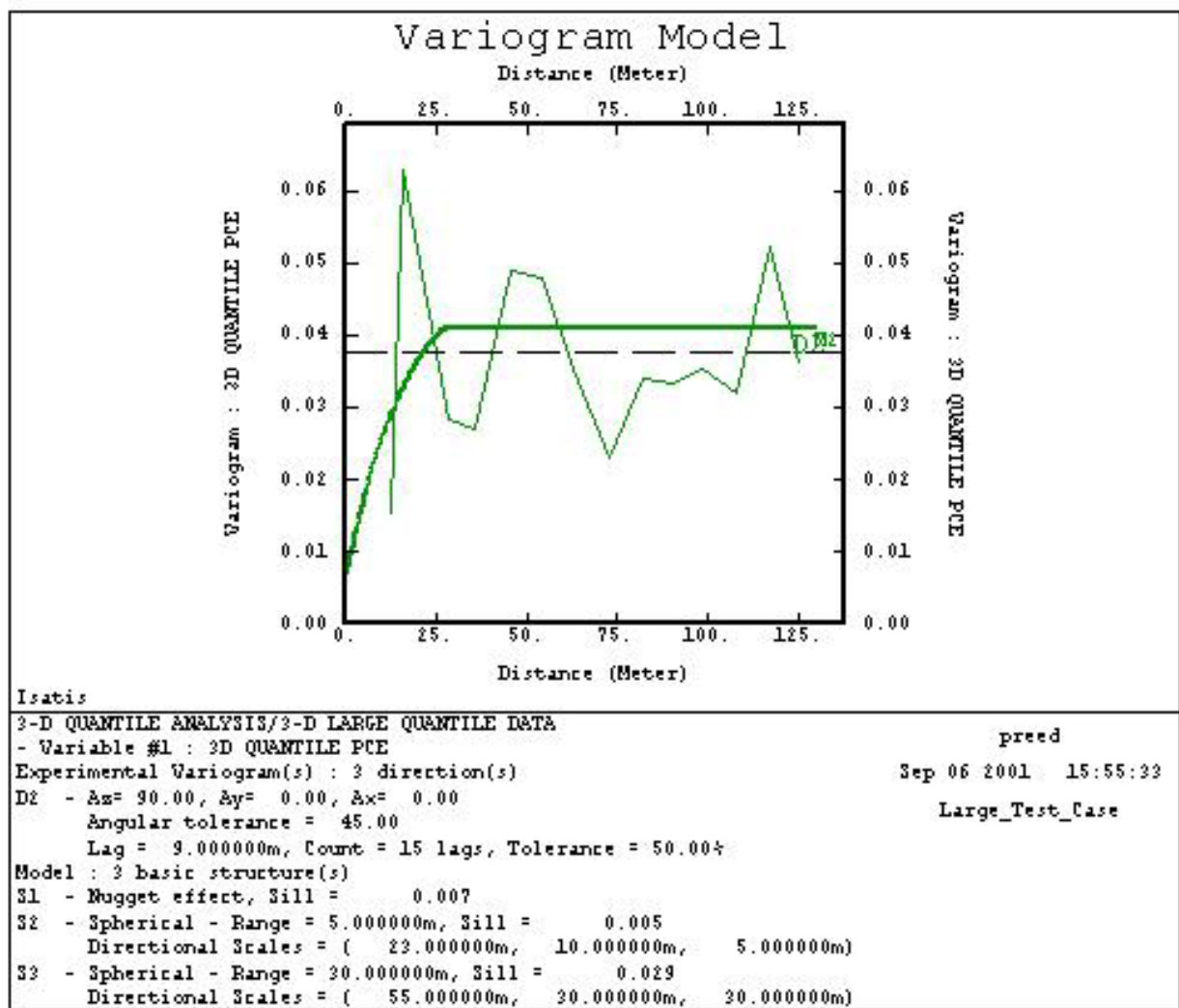


Figure B.8 Large case variogram model for the quantile kriging system in the Y-direction



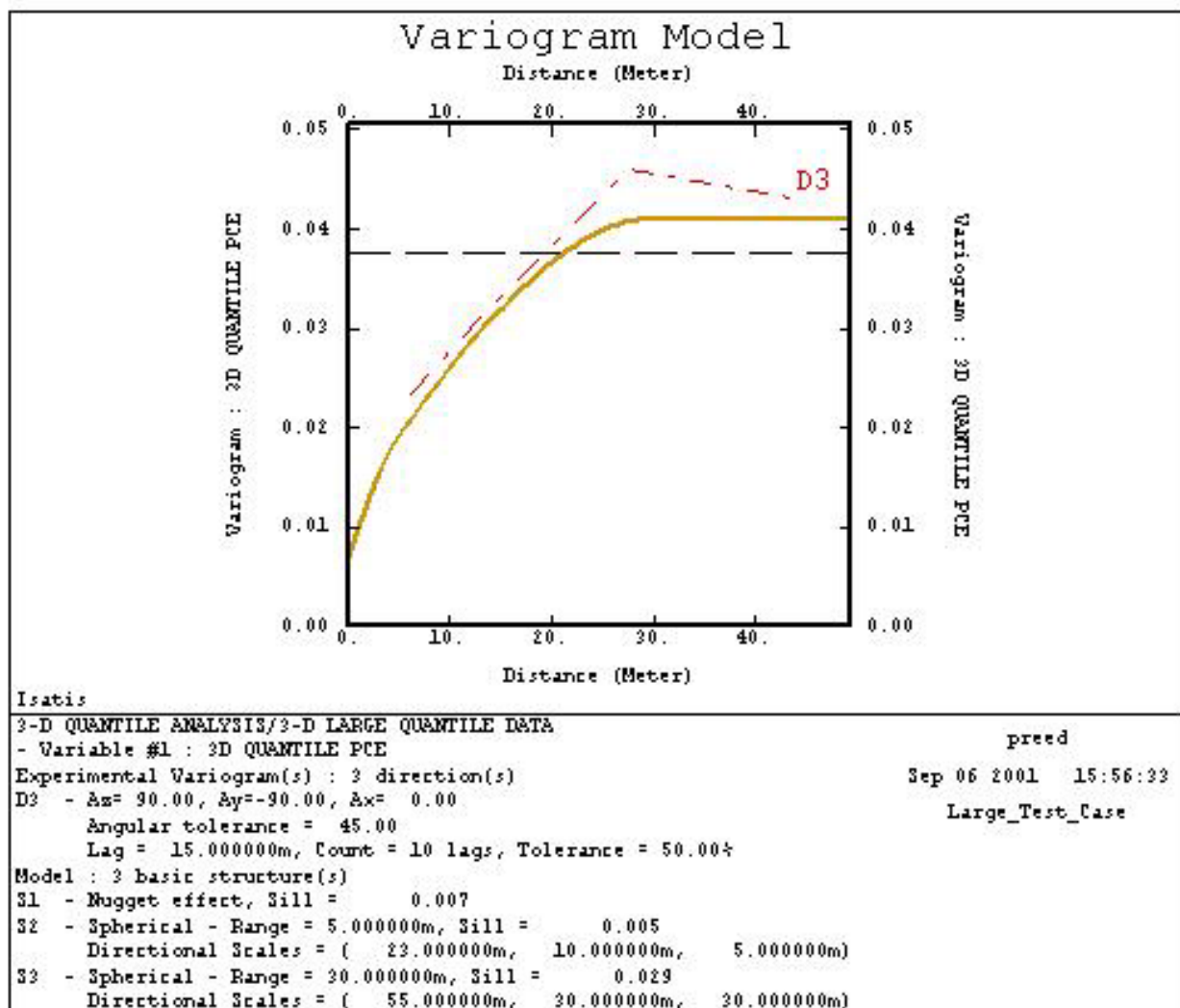


Figure B.9 Large case variogram model for the quantile kriging system in the Z-direction

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| Structure Identification |
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Data File Information:

Directory = Snapshot at Yr 25  
File = Large Data Set  
Selection = Variographic Selection

Seed File Information:

Directory = Snapshot at Yr 25  
File = Large Data Set  
Selection =  $0 < \text{PCE} < 40$   
Type = POINT (124 points)

Model Name = IRF Model-Moving Neigh

Neighborhood Name = Moving Omnidirectional Neighborhood - MOVING

Model : Covariance part

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Number of variables = 1  
Number of basic structures = 4

**S1 : Nugget effect\***

**S2 : Order-1 G.C. - Scale = 114.136788m\***

S3 : Spline G.C. - Scale = 114.136788m - C-H2 = 1.0

S4 : Order-3 G.C. - Scale = 114.136788m - C-H2 = 1.

Covariance Identification Step

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| Rank | Score   | Structure 1 | Structure 2 | Structure 3 | Structure 4 |
|------|---------|-------------|-------------|-------------|-------------|
| 1    | 1.0131  | 73.136      | 93.888      | 0           | 0           |
| 2    | 1.0131  | 71.207      | 96.422      | 1.0307      | 0           |
| 3    | 1.0131  | 72.522      | 94.645      | 0           | 0.21992     |
| 4    | 1.0253  | 141.01      | 0           | 0           | 0           |
| 5    | 0.95154 | 0           | 204.2       | 14.046      | 0           |
| 6    | 0.94059 | 0           | 206.06      | 0           | 4.8068      |
| 7    | 0.93058 | 0           | 209.67      | 0           | 0           |
| 8    | 3.7128  | 0           | 0           | 0           | 183.84      |
| 9    | 23.826  | 0           | 0           | 135.43      | 0           |

Successfully processed = 65

Written to the disk = 0

Warning: the following structures have not been saved

as their sills were almost zero for all variables:

- Discarded structure : Spline G.C. - Scale = 114.136788m - C-H2 = 1.0

- Discarded structure : Order-3 G.C. - Scale = 114.136788m - C-H2 = 1.

**\*Selected structures are in bold above**

The Model Parameter File (IRF Model-Moving Neigh) has been updated

Figure B.10 Large case Isatis output specifying the generalized covariance model for the intrinsic kriging system

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|                      Structure Identification                      |

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Data File Information:

Directory = Snapshot at Yr 25  
File = Large Data Set  
Selection = Variographic Selection

Seed File Information:

Directory = Snapshot at Yr 25  
File = Large Data Set  
Selection = 0 < PCE < 40  
Type = POINT (124 points)

Model Name = IRF Model-Moving Neigh

Neighborhood Name = Moving Omnidirectional Neighborhood - MOVING

Drift Identification Step

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Results are based on 62 measures

| Trial    | Mean Rank  | Mean of Error  | Variance of Error | Drift Trial                             |
|----------|------------|----------------|-------------------|-----------------------------------------|
| <b>9</b> | <b>6.6</b> | <b>-2.0297</b> | <b>156.13</b>     | <b>1 z z2 (selected trend function)</b> |
| 14       | 6.7        | -3.1745        | 127.26            | 1 x y z                                 |
| 13       | 6.7        | -2.7627        | 127.63            | 1 y z                                   |
| 12       | 6.9        | -2.6174        | 131.85            | 1 x z                                   |
| 8        | 7          | -2.3635        | 133.98            | 1 z                                     |
| 1        | 7.1        | -2.4211        | 142.96            | No Drift                                |
| 5        | 7.1        | -2.7578        | 138.96            | 1 y                                     |
| 2        | 7.2        | -2.6817        | 143.33            | 1 x                                     |
| 6        | 7.3        | -1.4244        | 163.45            | 1 y y2                                  |
| 11       | 7.4        | -3.2242        | 139.74            | 1 x y                                   |
| 10       | 7.6        | -1.9905        | 175.83            | 1 z z2 z3                               |
| 3        | 7.7        | -2.4304        | 164.06            | 1 x x2                                  |
| 7        | 8.2        | -0.75455       | 183.43            | 1 y y2 y3                               |
| 4        | 8.3        | -2.1522        | 181.63            | 1 x x2 x3                               |
| 15       | 8.6        | -1.8936        | 221.77            | 1 x y x2 xy y2                          |
| 16       | 9.5        | -1.1353        | 313.36            | 1 x y x2 xy y2 x3 x2y xy2 y3            |

The Model Parameter File (IRF Model-Moving Neigh) has been updated

Figure B.11 Large case Isatis output specifying the trend function for the intrinsic kriging system

## B.2 Medium Test Case Results

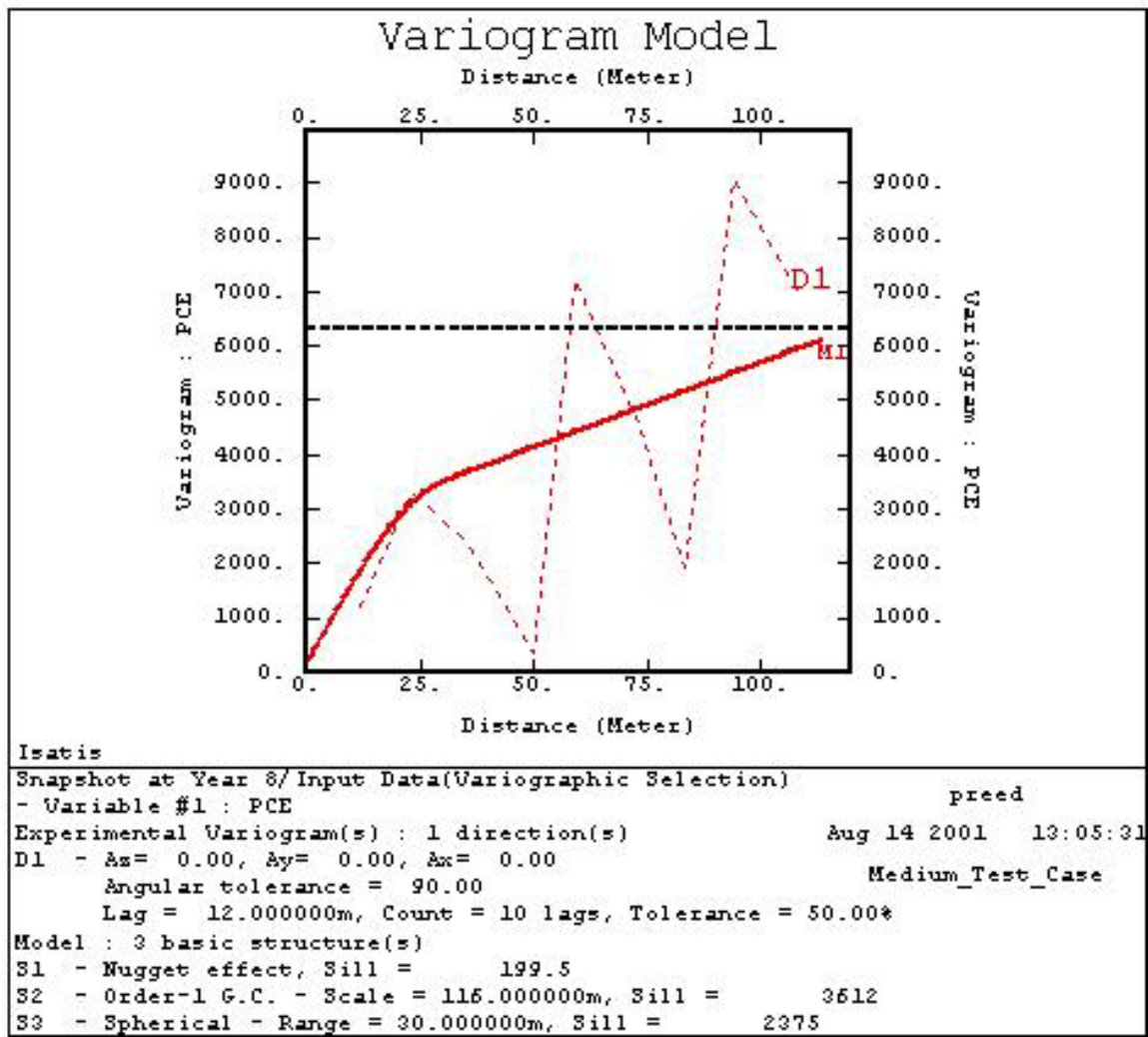


Figure B.12 Medium case isotropic variogram model for the ordinary kriging system

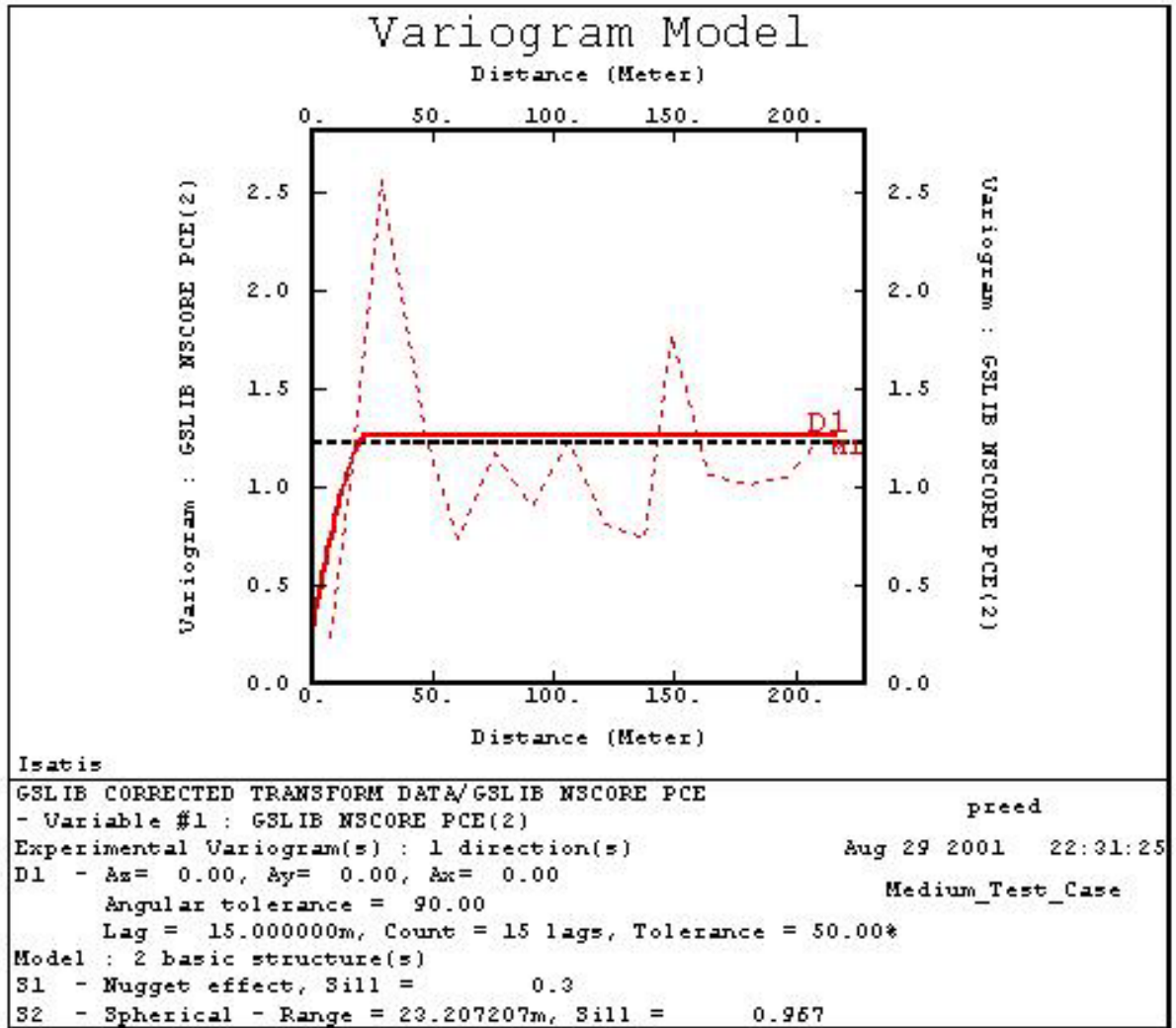


Figure B.13 Medium case isotropic variogram model for the Multigaussian kriging system

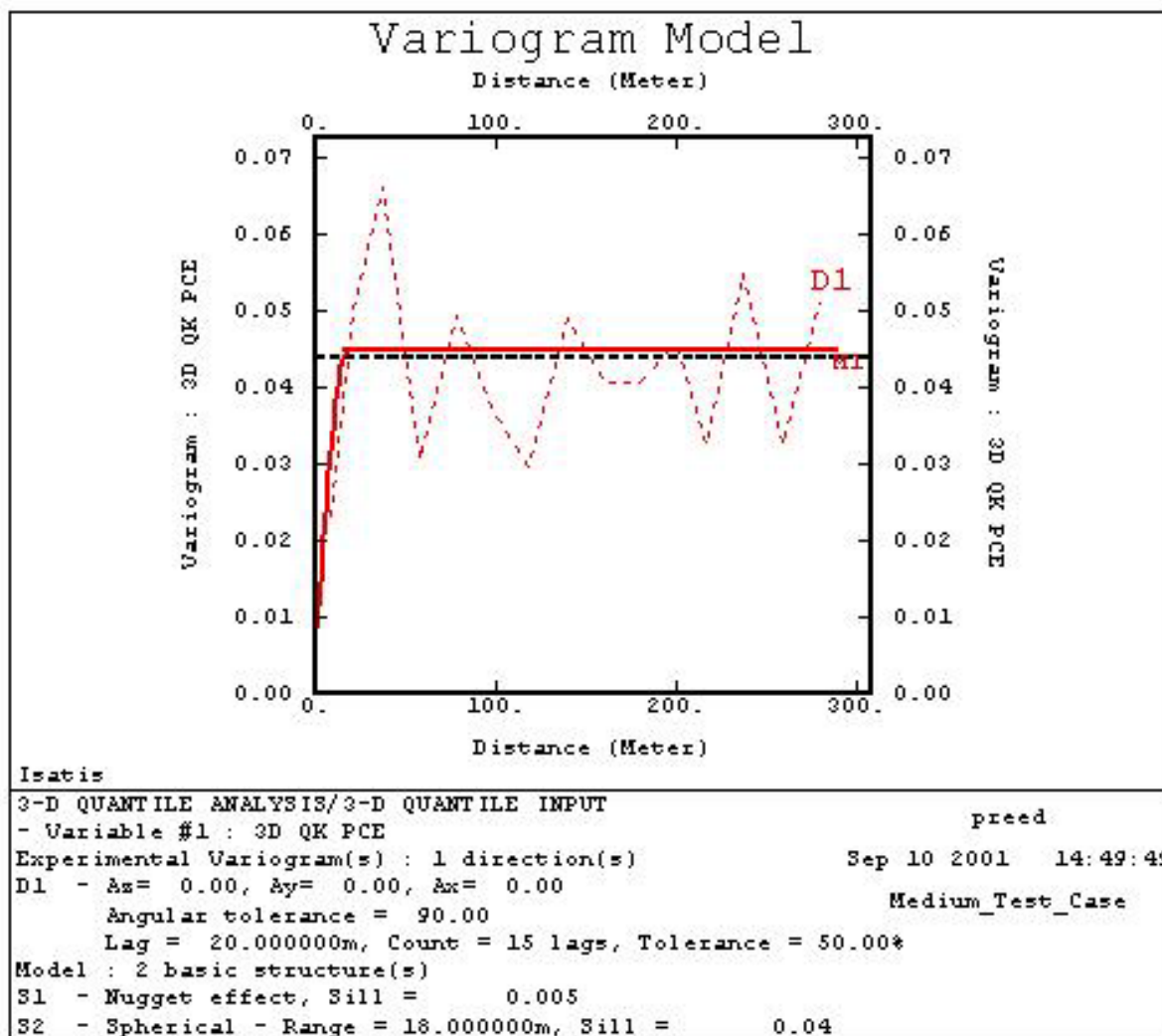


Figure B.14 Medium case isotropic variogram model for the quantile kriging system

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| Structure Identification |
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**Data File Information:**

Directory = Snapshot at Year 8  
File = Input Data  
Selection = Variographic Selection

**Seed File Information:**

Directory = Snapshot at Year 8  
File = Input Data  
Selection = Variographic Selection  
Type = POINT (58 points)

Model Name = IRF MODEL FOR VAR SEL (MOVING)

Neighborhood Name = 3-D MOVING NEIGHBORHOOD - MOVING

**Model : Covariance part**

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Number of variables = 1

Number of basic structures = 4

S1 : Nugget effect\*

S2 : Order-1 G.C. - Scale = 76.954438m

S3 : Spline G.C. - Scale = 76.954438m - C-H2 = 1.0

S4 : Order-3 G.C. - Scale = 76.954438m - C-H2 = 1.

**Covariance Identification Step**

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| Rank | Score   | Structure 1 | Structure 2 | Structure 3 | Structure 4 |
|------|---------|-------------|-------------|-------------|-------------|
| 1    | 0.86579 | 16633       | 0           | 0           | 0           |
| 2    | 0.61067 | 0           | 20362       | 0           | 0           |

Successfully processed = 52

Written to the disk = 0

**Warning: the following structures have not been saved**

**as their sills were almost zero for all variables:**

- Discarded structure : Order-1 G.C. - Scale = 76.954438m
- Discarded structure : Spline G.C. - Scale = 76.954438m - C-H2 = 1.0
- Discarded structure : Order-3 G.C. - Scale = 76.954438m - C-H2 = 1.

\*Selected structures are in bold above

The Model Parameter File (IRF MODEL FOR VAR SEL (MOVING)) has been updated

Figure B.15 Medium case Isatis output specifying the generalized covariance model for the intrinsic kriging system



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| Structure Identification |
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#### Data File Information:

Directory = Snapshot at Year 8  
File = Input Data  
Selection = Variographic Selection

#### Seed File Information:

Directory = Snapshot at Year 8  
File = Input Data  
Selection = Variographic Selection  
Type = POINT (58 points)

Model Name = IRF MODEL FOR VAR SEL (MOVING)

Neighborhood Name = 3-D MOVING NEIGHBORHOOD - MOVING

#### Drift Identification Step

Results are based on 32 measures

| Trial     | Mean Rank  | Mean of Error  | Variance of Error | Drift Trial                            |
|-----------|------------|----------------|-------------------|----------------------------------------|
| <b>13</b> | <b>5.7</b> | <b>-6.6525</b> | <b>20131</b>      | <b>1 y z (selected trend function)</b> |
| 5         | 6.1        | 0.78829        | 20090             | 1 y                                    |
| 7         | 6.7        | 1.438          | 26734             | 1 y y2 y3                              |
| 14        | 6.8        | -9.4693        | 23459             | 1 x y z                                |
| 8         | 6.8        | -4.4978        | 20824             | 1 z                                    |
| 11        | 7.1        | 1.2472         | 22715             | 1 x y                                  |
| 1         | 7.1        | 4.6045         | 19764             | No Drift                               |
| 16        | 7.3        | -24.6          | 1.0549e+005       | 1 x y x2 xy y2 x3 x2y xy2 y3           |
| 12        | 7.4        | -7.6167        | 23608             | 1 x z                                  |
| 2         | 7.8        | 2.6357         | 22335             | 1 x                                    |
| 3         | 8.1        | -3.4158        | 20599             | 1 x x2                                 |
| 4         | 8.3        | -8.7268        | 22629             | 1 x x2 x3                              |
| 10        | 8.3        | -0.30538       | 22255             | 1 z z2 z3                              |
| 9         | 8.4        | 6.5105         | 20113             | 1 z z2                                 |
| 6         | 8.6        | -1.712         | 26751             | 1 y y2                                 |
| 15        | 9.6        | 17.862         | 56174             | 1 x y x2 xy y2                         |

The Model Parameter File (IRF MODEL FOR VAR SEL (MOVING)) has been updated

Figure B.16 Medium case Isatis output specifying the trend function for the intrinsic kriging system

### B.3 Small Test Case Results

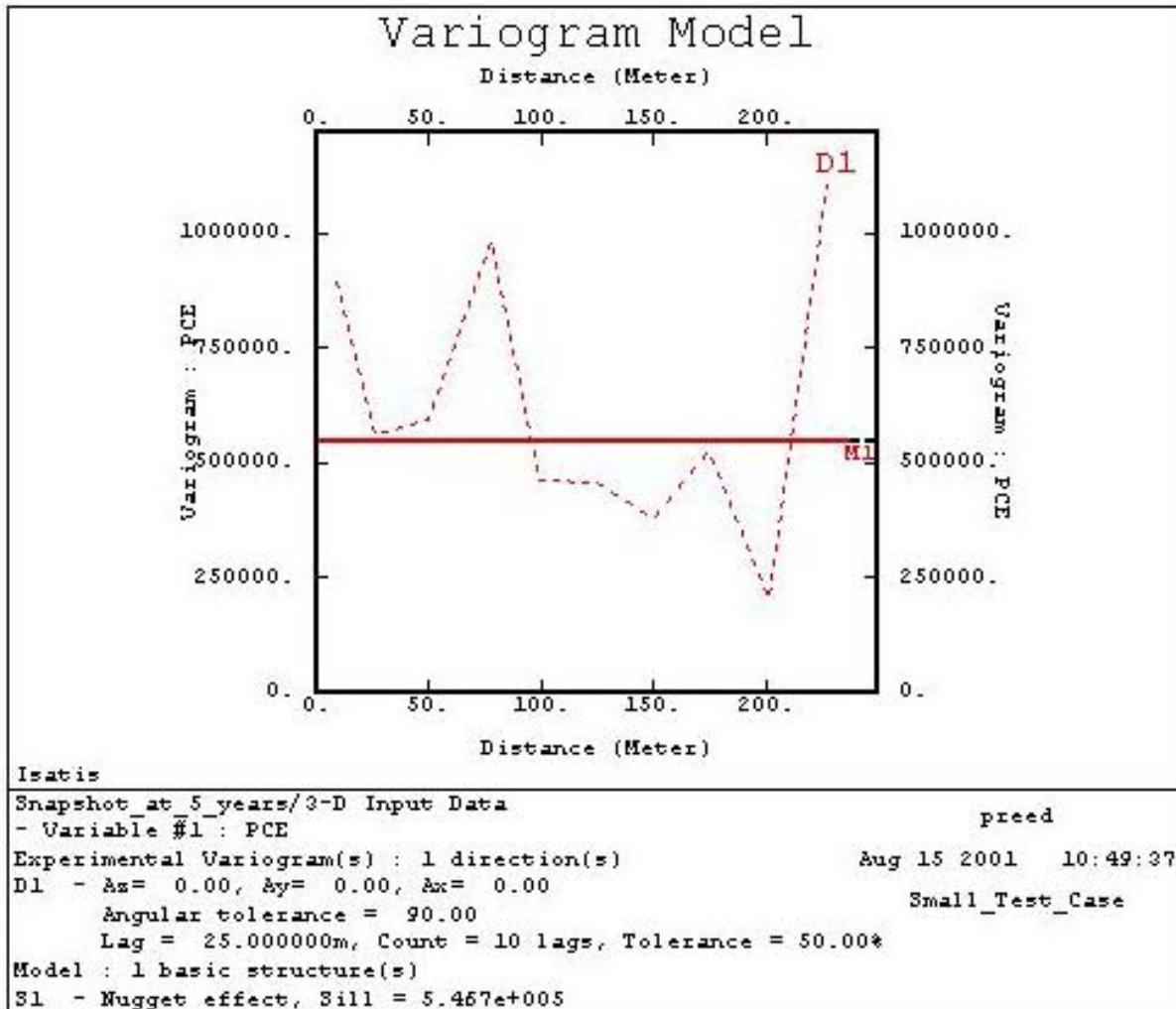


Figure B.17 Small case pure nugget variogram model for the ordinary kriging system

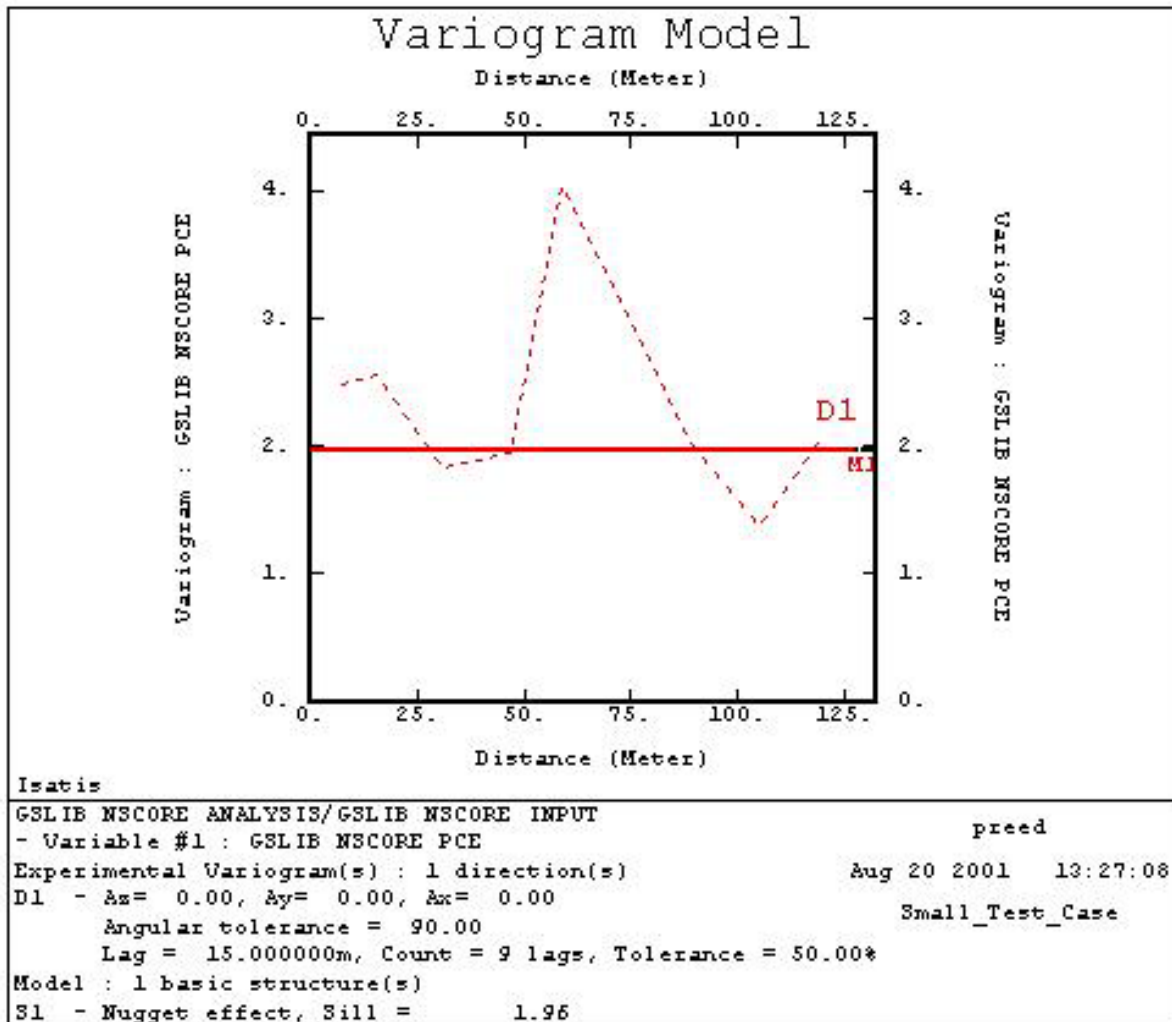


Figure B.18 Small case pure nugget variogram model for the Multigaussian kriging system

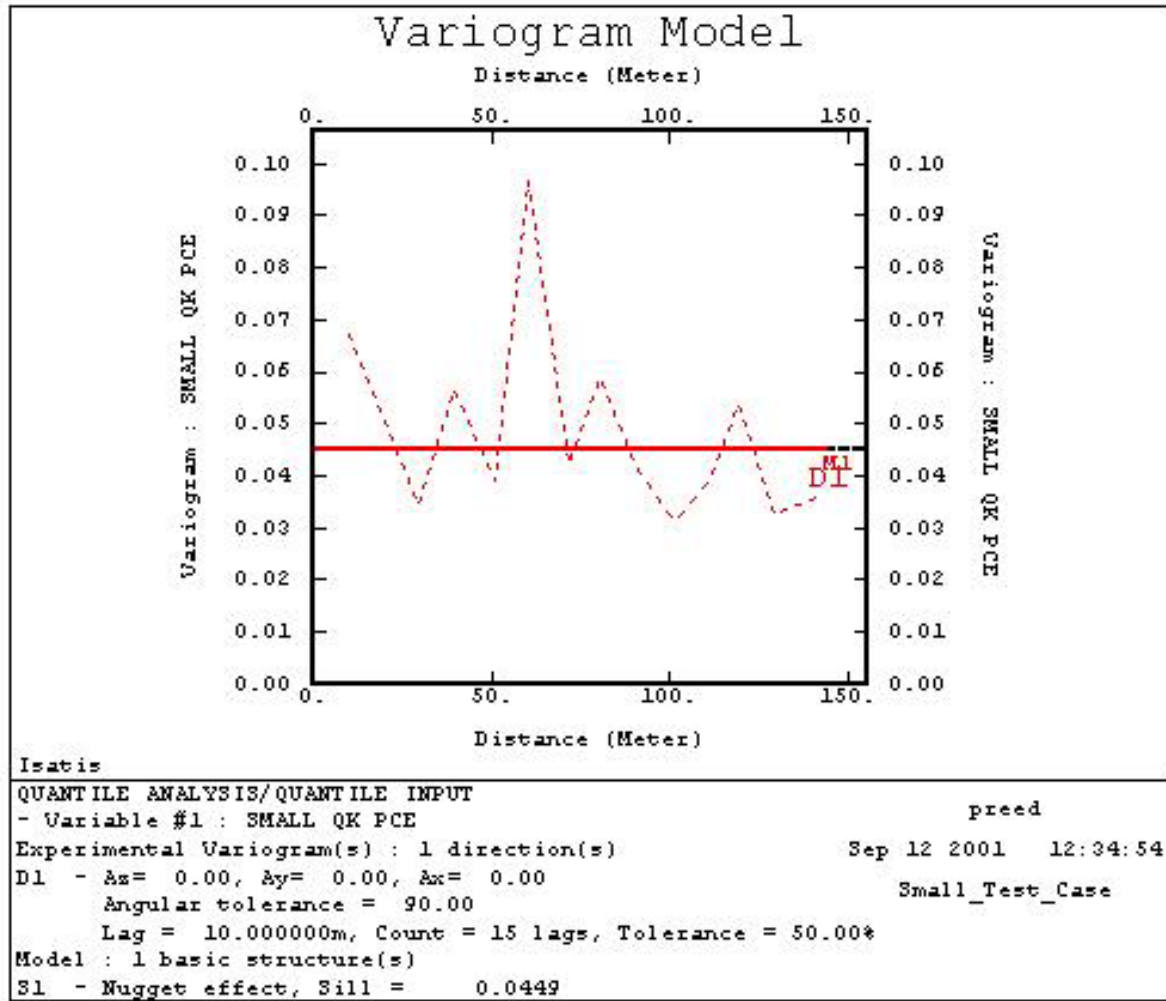


Figure B.19 Small case pure nugget variogram model for the quantile kriging system

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|                      Structure Identification                      |

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Data File Information:

Directory = Snapshot\_at\_5\_years  
File = 3-D Input Data

Seed File Information:

Directory = Snapshot\_at\_5\_years  
File = 3-D Input Data  
Type = POINT (26 points)

Model Name = 3-D IRF-k Model

Neighborhood Name = Unique - UNIQUE

Model : Covariance part

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Number of variables = 1

Number of basic structures = 4

**S1 : Nugget effect\***

S2 : Order-1 G.C. - Scale = 34.443554m

S3 : Spline G.C. - Scale = 34.443554m - C-H2 = 1.0

**S4 : Order-3 G.C. - Scale = 34.443554m - C-H2 = 1\*.**

Covariance Identification Step

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| Rank | Score   | Structure 1 | Structure 2 | Structure 3 | Structure 4 |
|------|---------|-------------|-------------|-------------|-------------|
| 1    | 1.0181  | 5.0006e+005 | 0           | 0           | 97.554      |
| 2    | 0.97794 | 5.5e+005    | 0           | 0           | 0           |
| 3    | 0.95732 | 5.3788e+005 | 0           | 307.35      | 0           |
| 4    | 1.5984  | 0           | 9.5147e+005 | 32879       | 0           |
| 5    | 1.6848  | 0           | 9.0504e+005 | 0           | 11295       |
| 6    | 2.4531  | 0           | 6.5103e+005 | 0           | 0           |
| 7    | 110.37  | 0           | 0           | 26654       | 0           |
| 8    | 356.37  | 0           | 0           | 0           | 18327       |

Successfully processed = 26

Written to the disk = 0

Warning: the following structures have not been saved

as their sills were almost zero for all variables:

- Discarded structure : Order-1 G.C. - Scale = 34.443554m

- Discarded structure : Spline G.C. - Scale = 34.443554m - C-H2 = 1.0

**\*Selected structures are in bold above**

The Model Parameter File (3-D IRF-k Model) has been updated

Figure B.20 Small case Isatis output specifying the generalized covariance model for the intrinsic kriging system

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|                      Structure Identification                      |

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Data File Information:

Directory = Snapshot\_at\_5\_years  
File = 3-D Input Data

Seed File Information:

Directory = Snapshot\_at\_5\_years  
File = 3-D Input Data  
Type = POINT (26 points)

Model Name = 3-D IRF-k Model

Neighborhood Name = Unique - UNIQUE

Drift Identification Step

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Results are based on 26 measures

| Trial    | Mean Rank  | Mean of Error | Variance of Error  | Drift Trial                             |
|----------|------------|---------------|--------------------|-----------------------------------------|
| <b>9</b> | <b>6.7</b> | <b>11.359</b> | <b>5.9871e+005</b> | <b>1 z z2 (selected trend function)</b> |
| 6        | 6.8        | -9.8004       | 6.0758e+005        | 1 y y2                                  |
| 2        | 6.8        | 0.54892       | 6.2438e+005        | 1 x                                     |
| 13       | 6.8        | 22.44         | 6.4027e+005        | 1 y z                                   |
| 1        | 6.8        | -4.3726e-014  | 5.9133e+005        | No Drift                                |
| 8        | 6.8        | 8.5282        | 6.1734e+005        | 1 z                                     |
| 12       | 7          | 7.1991        | 6.5188e+005        | 1 x z                                   |
| 11       | 7.3        | 15.081        | 6.5562e+005        | 1 x y                                   |
| 5        | 7.3        | 13.833        | 6.1646e+005        | 1 y                                     |
| 14       | 7.4        | 21.814        | 6.8002e+005        | 1 x y z                                 |
| 10       | 7.4        | 117.89        | 1.1388e+006        | 1 z z2 z3                               |
| 7        | 7.6        | -18.58        | 6.6107e+005        | 1 y y2 y3                               |
| 15       | 8          | 6.3196        | 8.0575e+005        | 1 x y x2 xy y2                          |
| 3        | 8.4        | 8.6376        | 6.5827e+005        | 1 x x2                                  |
| 16       | 9          | 137.4         | 1.0734e+006        | 1 x y x2 xy y2 x3 x2y xy2 y3            |
| 4        | 9.8        | 12.31         | 7.4213e+005        | 1 x x2 x3                               |

The Model Parameter File (3-D IRF-k Model) has been updated

Figure B.21 Small case Isatis output specifying the trend function for the intrinsic kriging system

