$\mathrm{E}\{Z\}$-Kriging

Exploring the World of Ordinary Kriging

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What is $\mathrm{E}\{Z\}$-Kriging?

- a computer program for exploring ordinary kriging;
- interactive, self-explanatory, and easy to use. Hence, 'easy kriging'
- and last but not least: it's freeware!

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Who may benefit from it?

1. Students, who need to understand those 'mysterious' kriging equations;
2. Lecturers, who want to explain kriging in an intuitive way;
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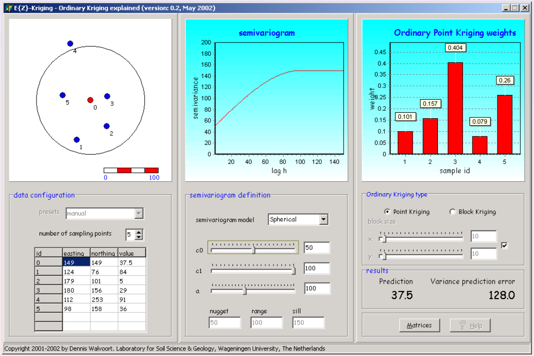
Graphical User Interface (GUI)



The GUI consists of three panels:

1. data configuration panel
2. semivariogram panel
3. kriging panel

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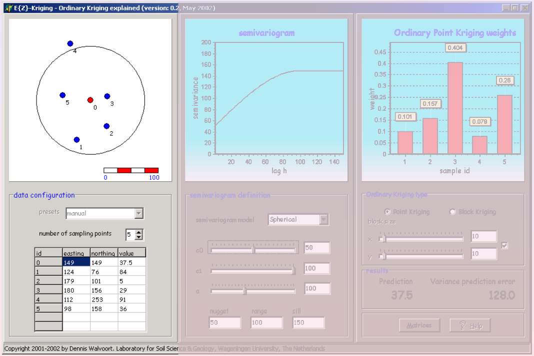

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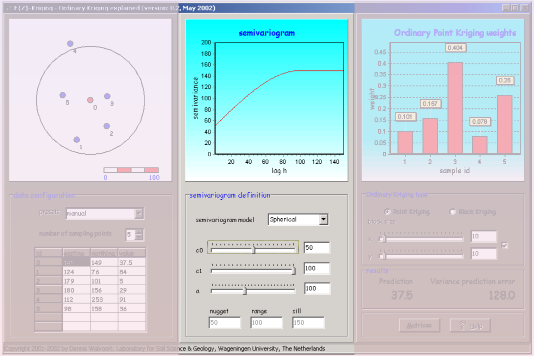

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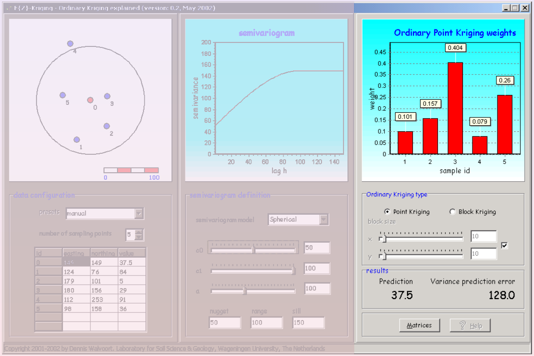

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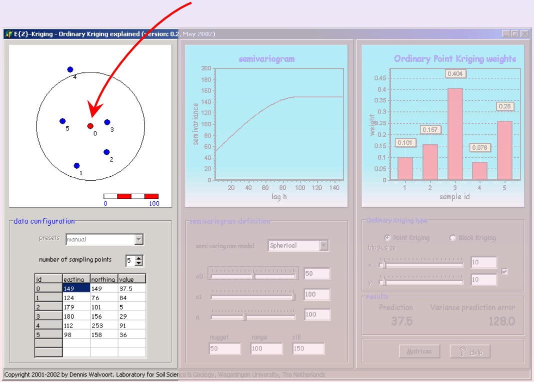
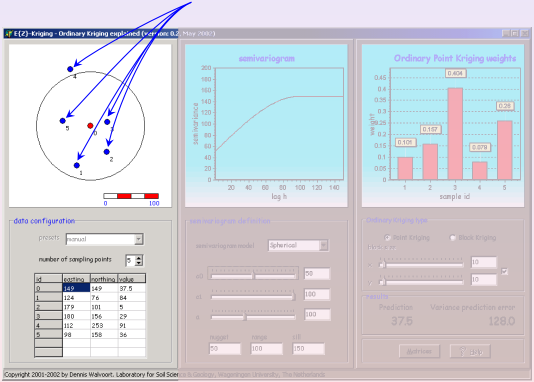


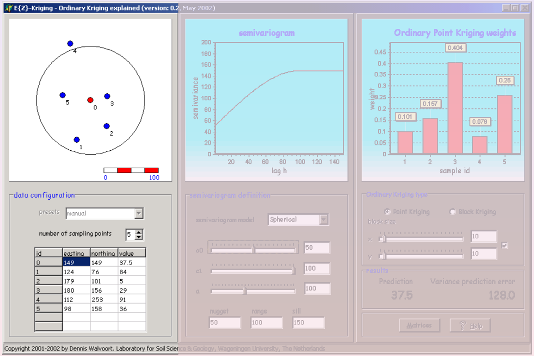
The prediction point is red and labelled 0.

Data Configuration Panel



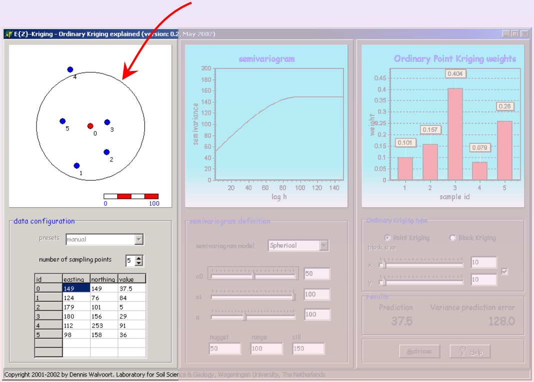
The n sampling points are blue and labelled from 1 to n.

Data Configuration Panel



The configuration of points can be changed by means of the mouse (*drag 'n' drop*).

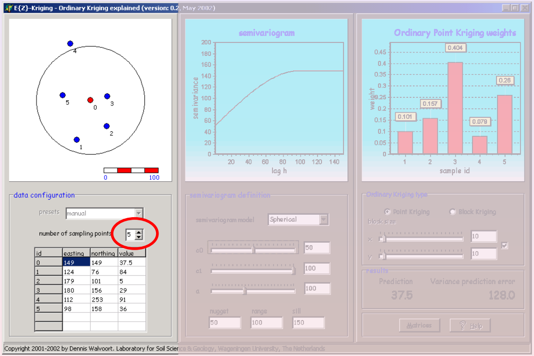
Data Configuration Panel



The range is represented by a solid circle. A dashed circle represents the *practical* range.

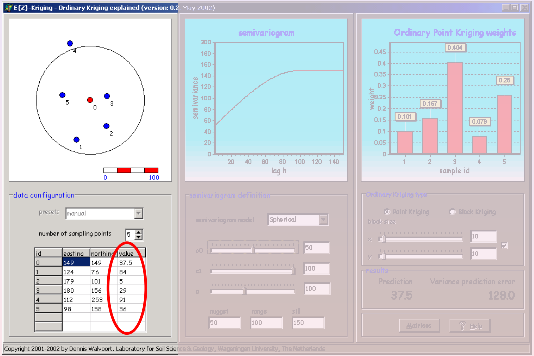
definition

Data Configuration Panel



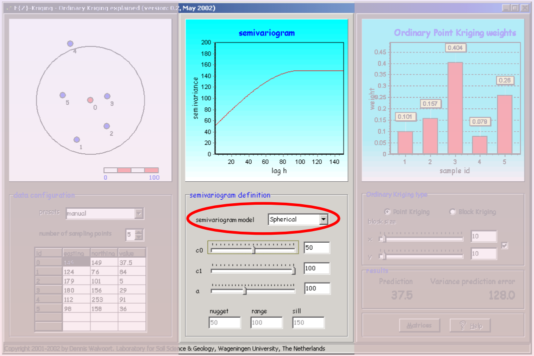
The number of sampling points has to be specified here (see ellipse).

Data Configuration Panel



The values at the sampling locations have to be entered here.

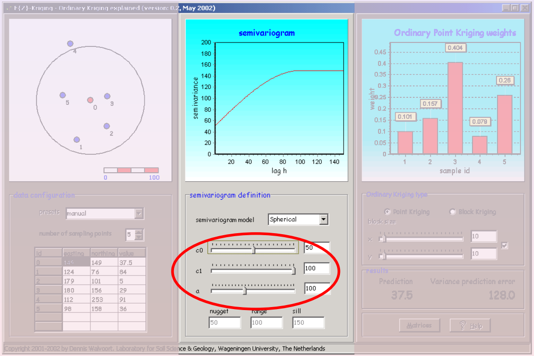
Semivariogram Panel



The following semivariogram models can be selected:

- Spherical model
  - details
- Exponential model
  - details
- Gaussian model
  - details

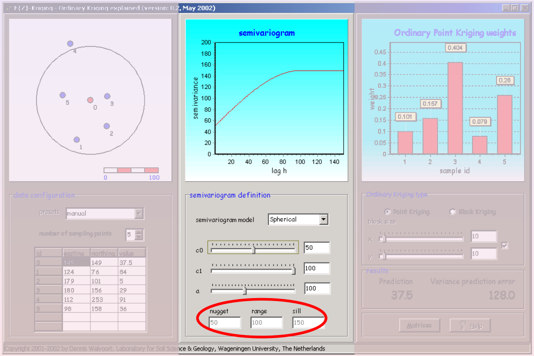
Semivariogram Panel



Use the sliders to set the semivariogram parameters:

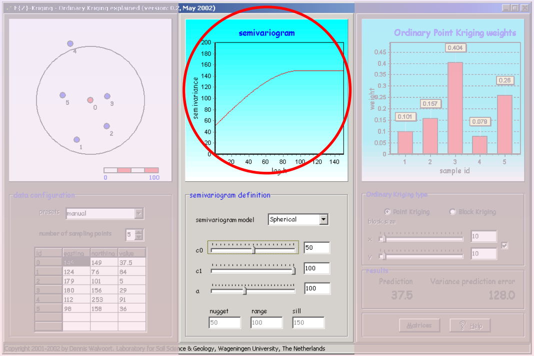
- nugget (c_0)
- partial sill (c_1)
- range parameter (a)

Semivariogram Panel



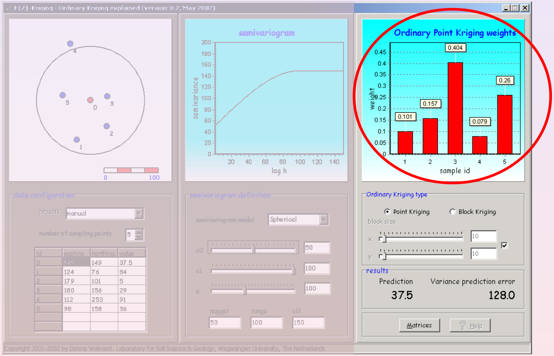
This section gives the nugget variance, the (practical) range and the sill variance $(c_0 + c_1)$.

Semivariogram Panel



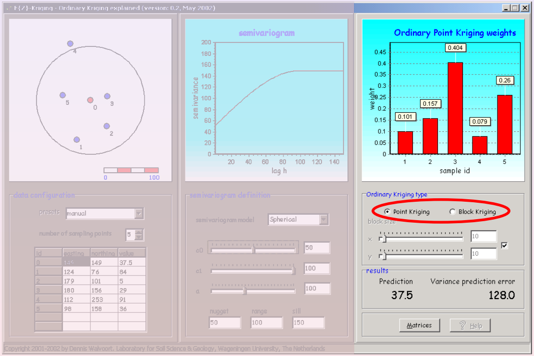
The resulting semivariogram will be shown here.

Kriging Panel



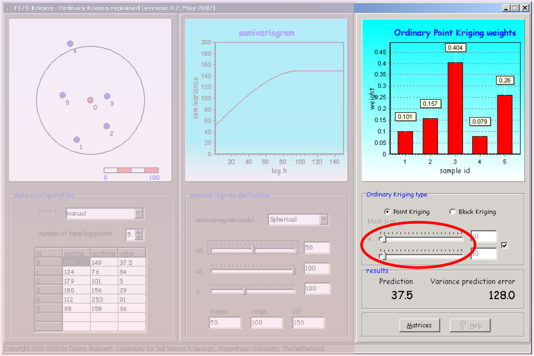
The ordinary kriging weights are shown as bars. Click on the bars for numerical values.

Kriging Panel



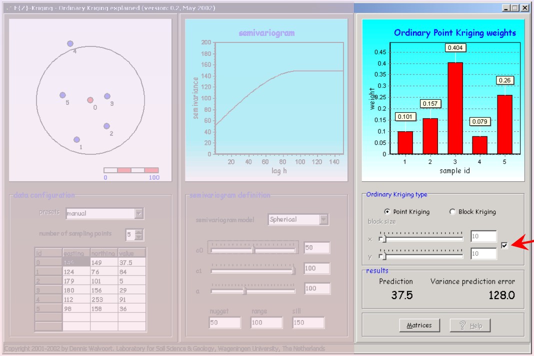
Use the radiobuttons to switch between ordinary point kriging and ordinary block kriging.

Kriging Panel



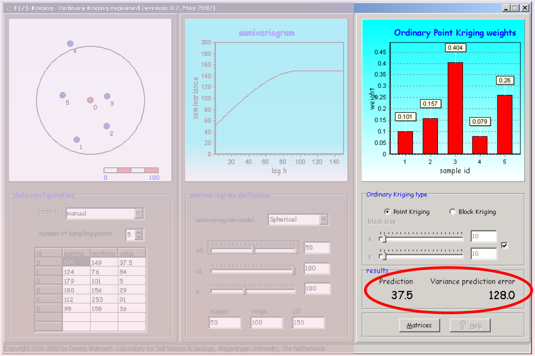
The block size can be set by means of the sliders.

Kriging Panel



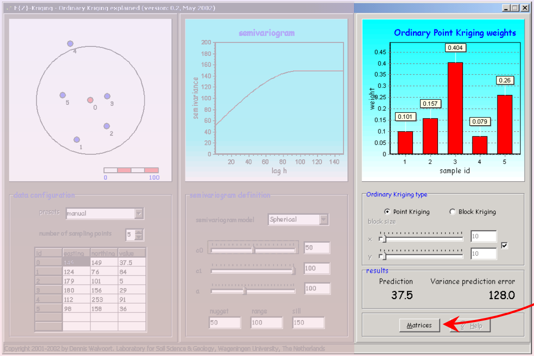
Check this checkbox to enforce *square* prediction blocks.

Kriging Panel



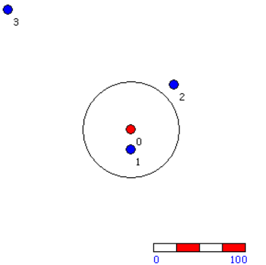
The ordinary kriging prediction and the associated variance of the prediction error are given here.

Kriging Panel



Press this button to get a glimpse of the underlying maths.

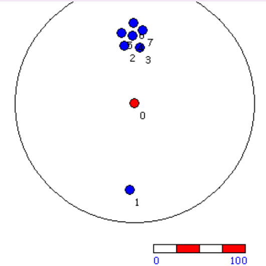
Interesting features to explore



Distance effect

Discover that points outside the range affect predictions differently than points within the range (cf. inverse squared distance interpolation).

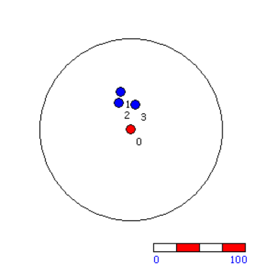
Interesting features to explore



Declustering effect

Discover how ordinary kriging reduces the influence of clustered sampling points (cf. inverse squared distance interpolation).

Interesting features to explore



Screening effect

Recall that ordinary kriging is a non-convex interpolator, *i.e.*, its predictions can be outside the data range. Explore data configurations and semivariogram settings that enhance this effect.

Interesting features to explore

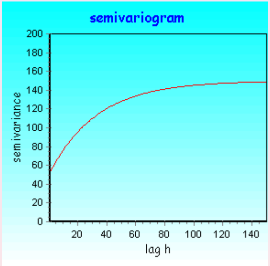
number of sampling points 5

id	easting	northing	value
0	149	149	24.3
1	133	62	22
2	209	114	88
3	230	208	4
4	158	193	2
5	86	161	14

Effect of data values

Discover how data values affect the weights, the prediction and the variance of the prediction error.

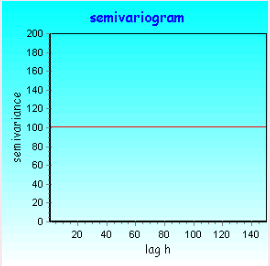
Interesting features to explore



Effect of semivariogram model

Study how model shape, nugget, sill and range affect the kriging results.

Interesting features to explore



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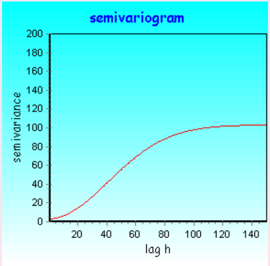

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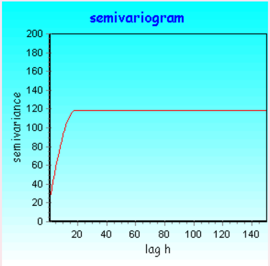

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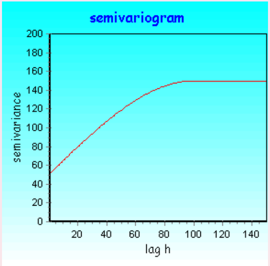

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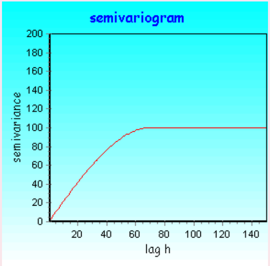
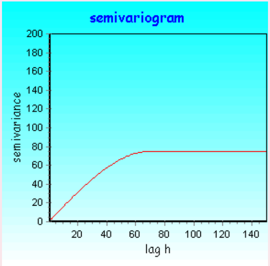


Effect of semivariogram scale

Explore how multiplying the semivariogram by a positive value affects the kriging weights, the kriging prediction, and the variance of the prediction error.

Interesting features to explore



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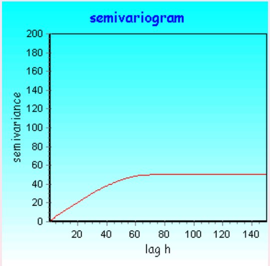

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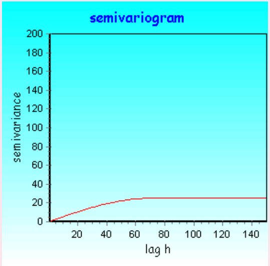

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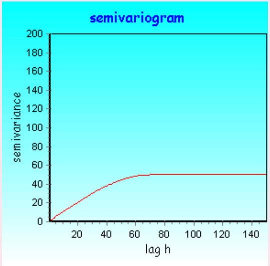

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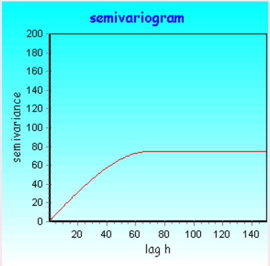

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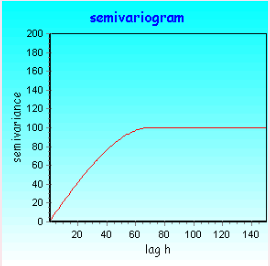

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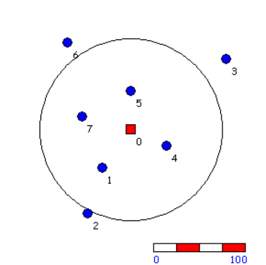

Effect of aggregation

Experiment with block size and see how it affects the kriging results.

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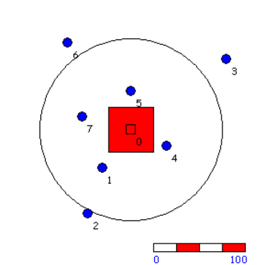

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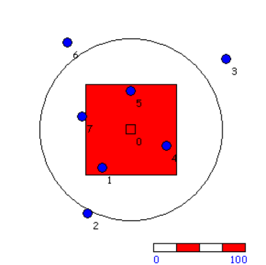

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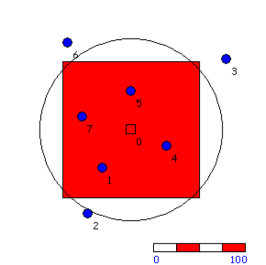

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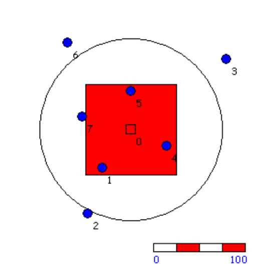

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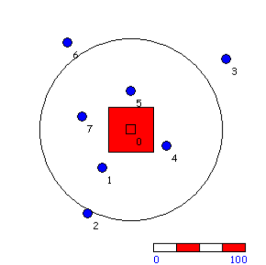

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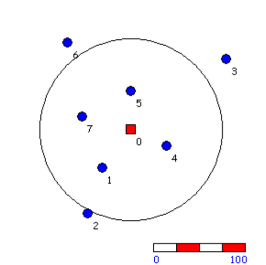

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Suggestions for further reading

- E.H. Isaaks and R.M. Srivastava.
  An Introduction to Applied Geostatistics.
  Oxford University Press, New York, 1989.
- P. Goovaerts.
  Geostatistics for Natural Resources Evaluation.
  Oxford University Press, New York, 1997.

Geostatistical software

- Vesper (www.usyd.edu.au/su/agric/acpa/vesper/vesper.html)
- GStat (www.gstat.org),
  GStat is also available as R-package (www.r-project.org)

License

$\mathrm{E}\{Z\}$-Kriging is freeware and provided *as is* without warranty of any kind, either express or implied.

Enjoy $\mathrm{E}\{Z\}$-Kriging!

Definitions

Spherical model

$$\gamma_s(h) = \begin{cases} \frac{3h}{2a} - \frac{1}{2}\left(\frac{h}{a}\right)^3 & \forall\ h < a \\ 1 & \forall\ h \geq a \end{cases}$$

$$\gamma(h) = c_0 + c_1\gamma_s(h)$$

where:

a :	range parameter
c_0 :	nugget variance
c_1 :	partial sill variance
h :	lag distance
γ_s	standardised semivariance
γ	semivariance

Return

Definitions

Exponential model

$$\gamma_s(h) = 1 - \exp\left(-\frac{h}{a}\right)$$

$$\gamma(h) = c_0 + c_1\gamma_s(h)$$

where:

a :	range parameter
c_0 :	nugget variance
c_1 :	partial sill variance
h :	lag distance
γ_s	standardised semivariance
γ	semivariance

Return

Definitions

Gaussian model

$$\gamma_s(h) = 1 - \exp\left(-\frac{h^2}{a^2}\right)$$

$$\gamma(h) = c_0 + c_1\gamma_s(h)$$

where:

a :	range parameter
c_0 :	nugget variance
c_1 :	partial sill variance
h :	lag distance
γ_s	standardised semivariance
γ	semivariance

Return

Definitions

Practical range

Lag h for which $\gamma(h) = 0.95\gamma(\infty)$,
i.e., that distance at which the semivariance is 95% of the sill.

Return