Experimental Semivariogram

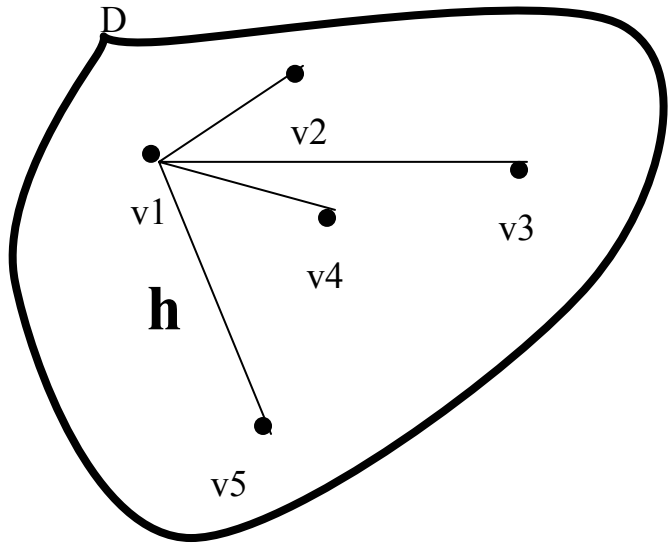
- It is a **graphical representation** that is used in applied geostatistics to **explore spatial variability** of a ReV.

- Some geostatisticians use the term **variogram** instead of semivariogram for simplicity purpose.

- Traditionally, estimating the variogram is preferable to estimating covariance function because the experimental variogram does not require a prior knowledge of the mean of population. Hence, it reduces the uncertainty of measuring spatial variability.

Experimental Semivariogram

- Theoretically, the variogram is defined as half of the expected squared difference between sample values separated by vector **h**.



$$\gamma(h) = \frac{1}{2} E\left[v(x_i) - v(x_i + h)\right]^2$$

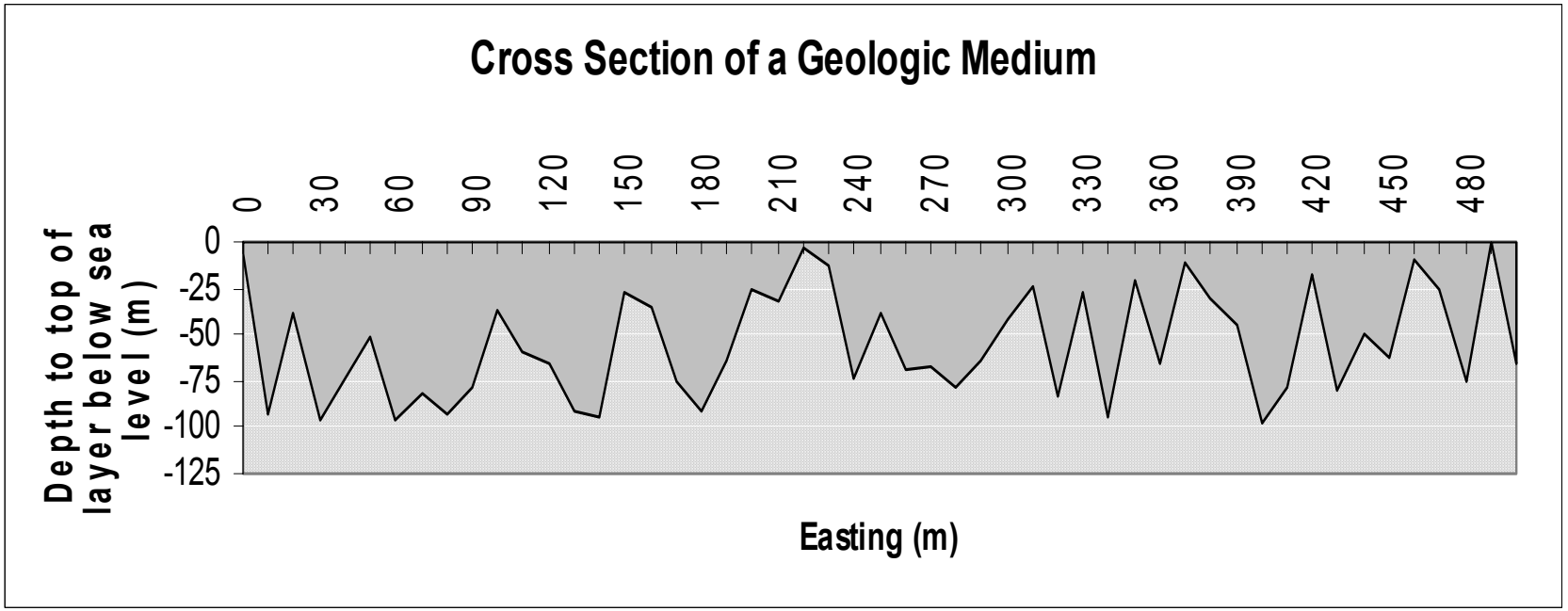
Experimental Semivariogram

- Mathematically, the variogram is expressed by the following formula:

$$\gamma(h) = \frac{1}{2} \sum_{i=1}^{n(h)} \frac{\left[v(x_i) - v(x_i + h) \right]^2}{n(h)}$$

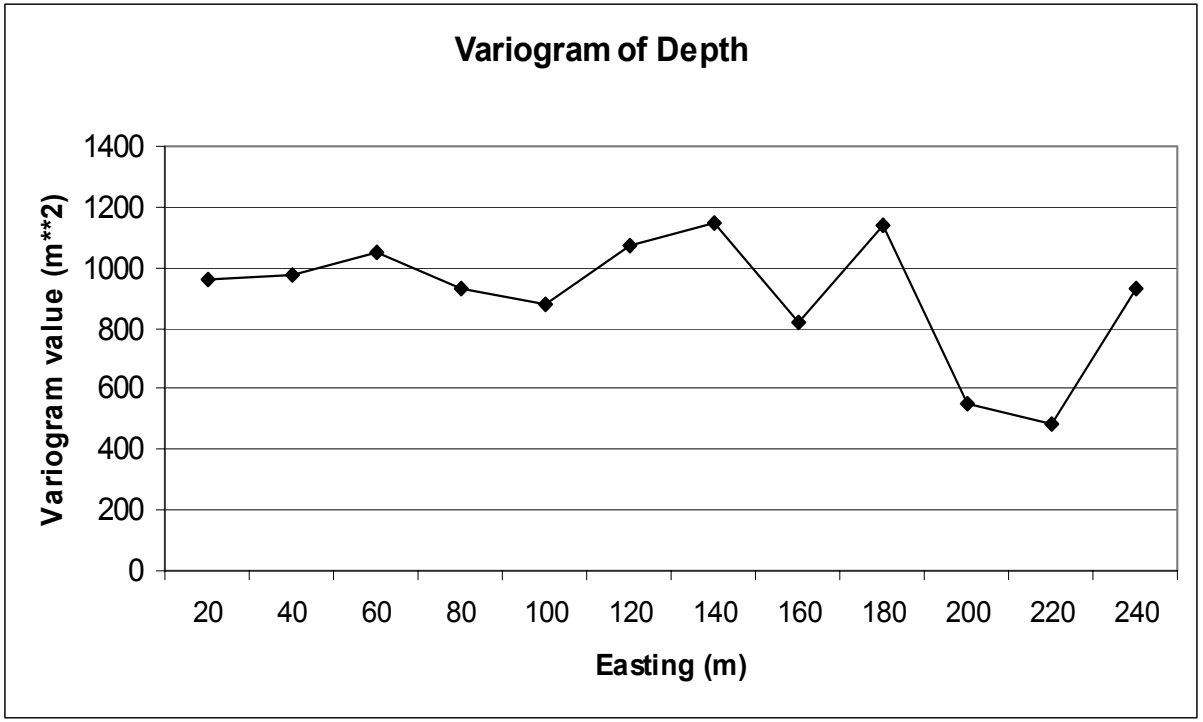
Experimental Semivariogram

Example: Depth to a heavily eroded surface of a sandstone layer that was deposited below a clay layer



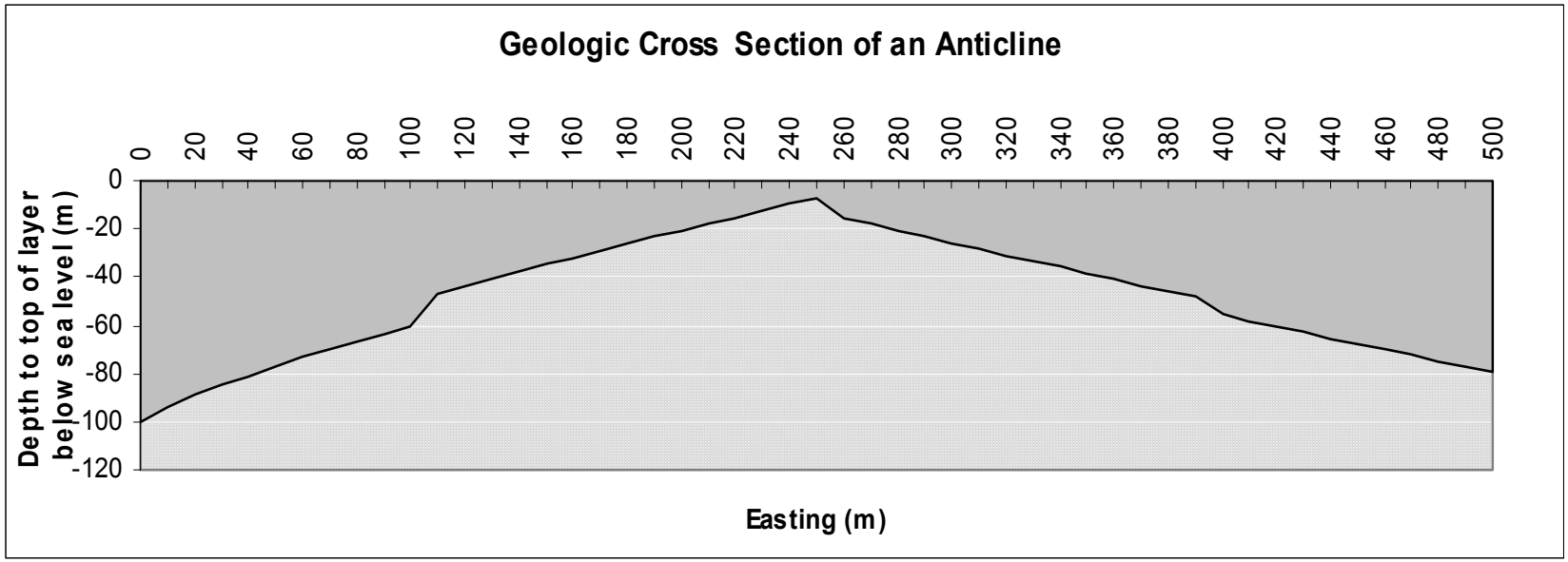
Experimental Semivariogram

Example: Depth to a heavily eroded surface of a sandstone layer that was deposited below a clay layer



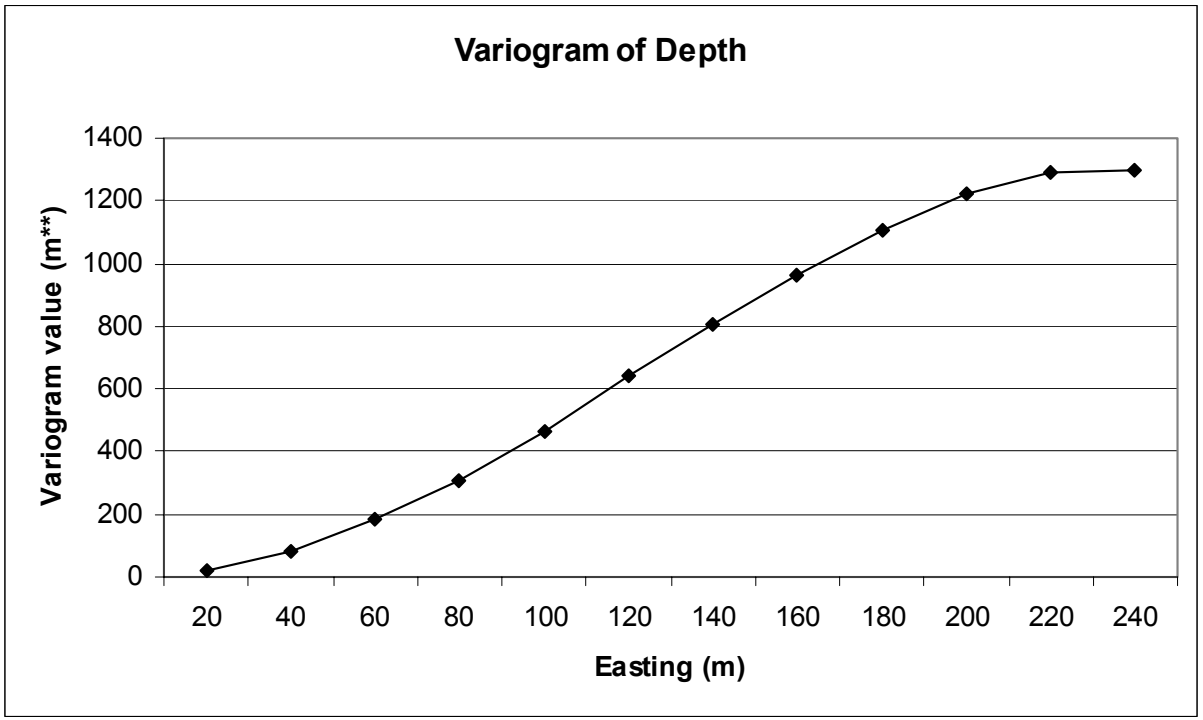
Experimental Semivariogram

Example: Depth to a structured anticline



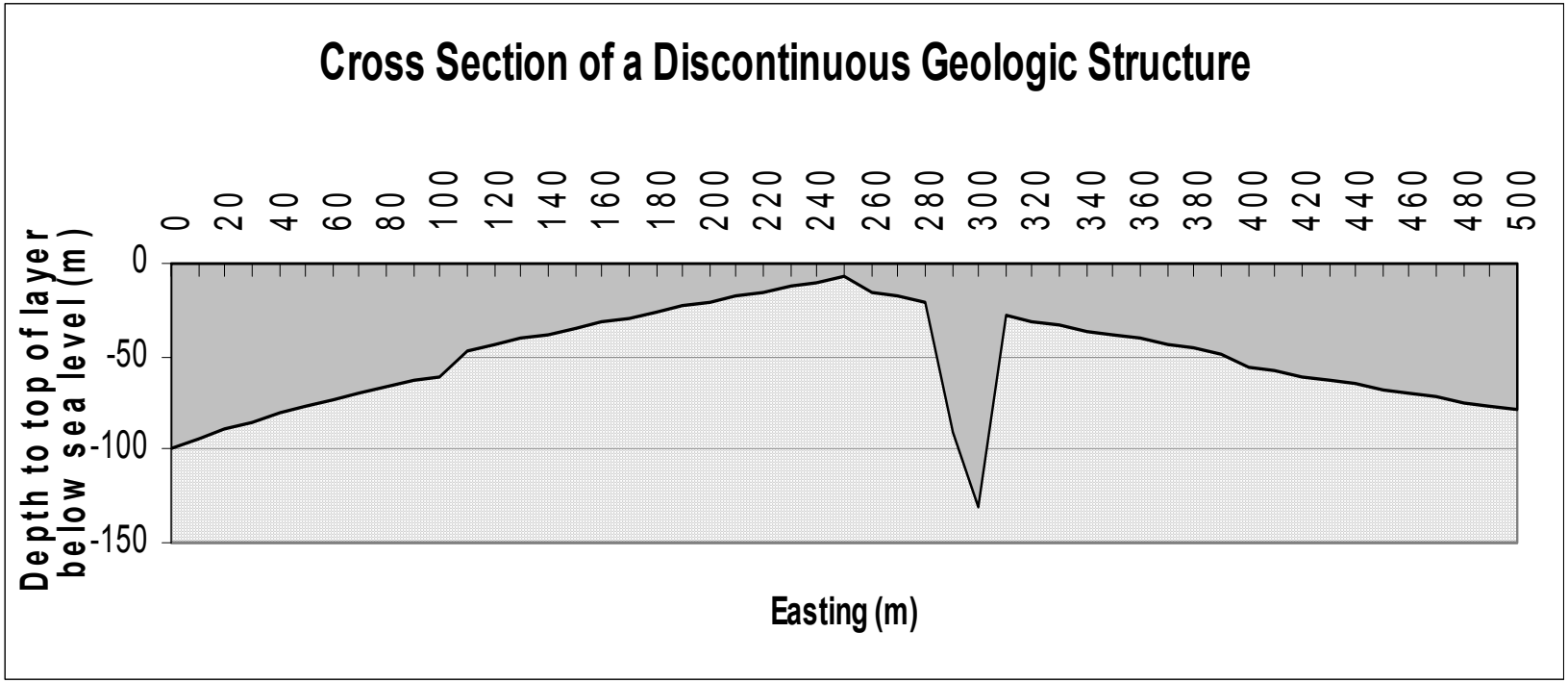
Experimental Semivariogram

Example: Depth to a structured anticline



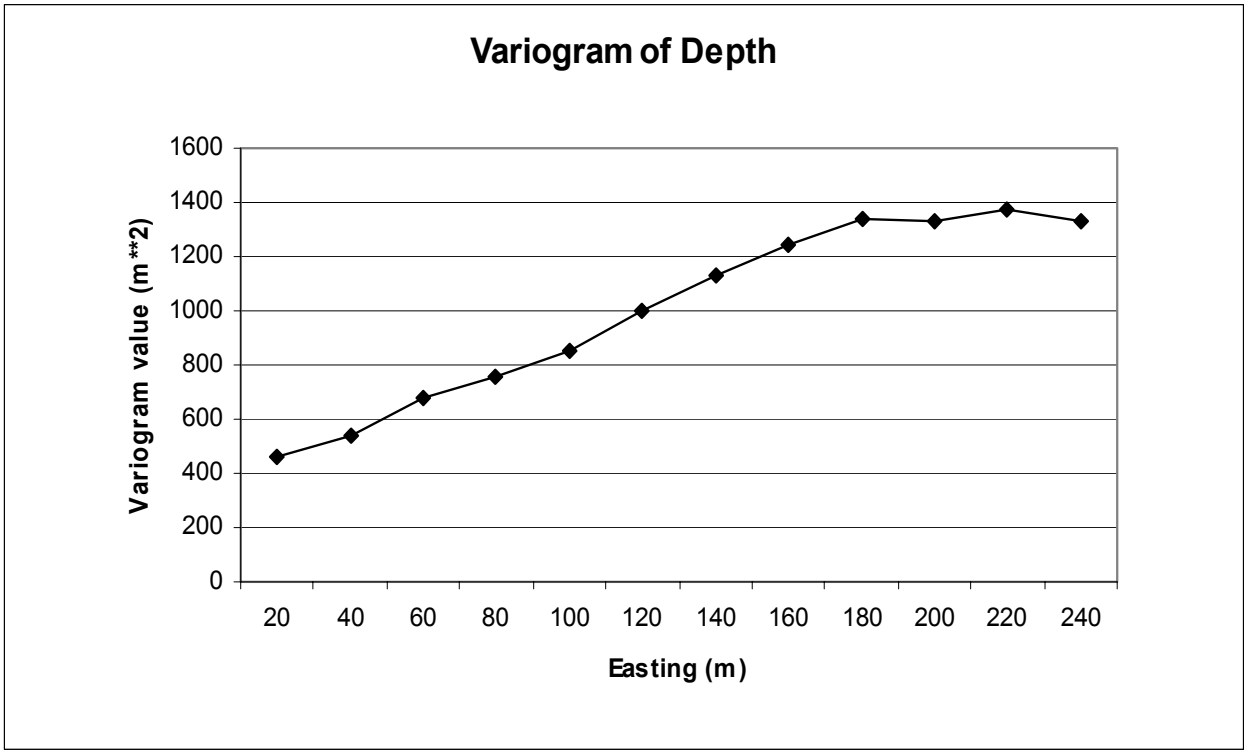
Experimental Semivariogram

Example: Depth to a discontinuous Structure



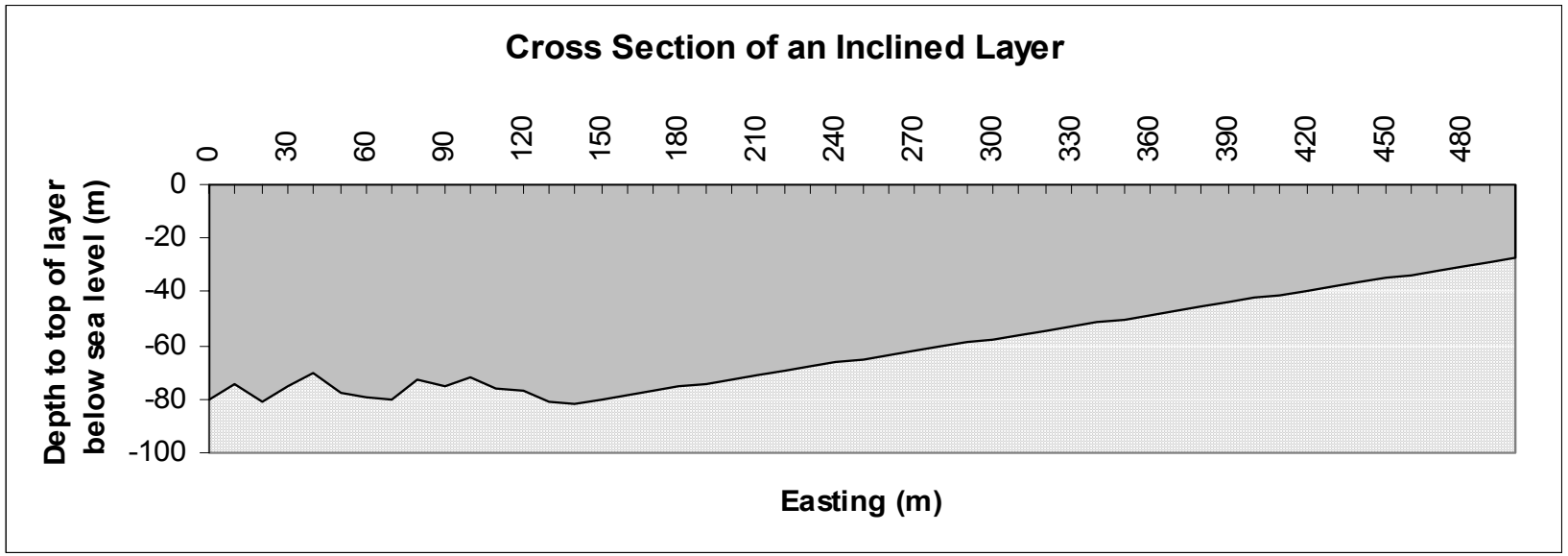
Experimental Semivariogram

Example: Depth to a discontinuous Structure



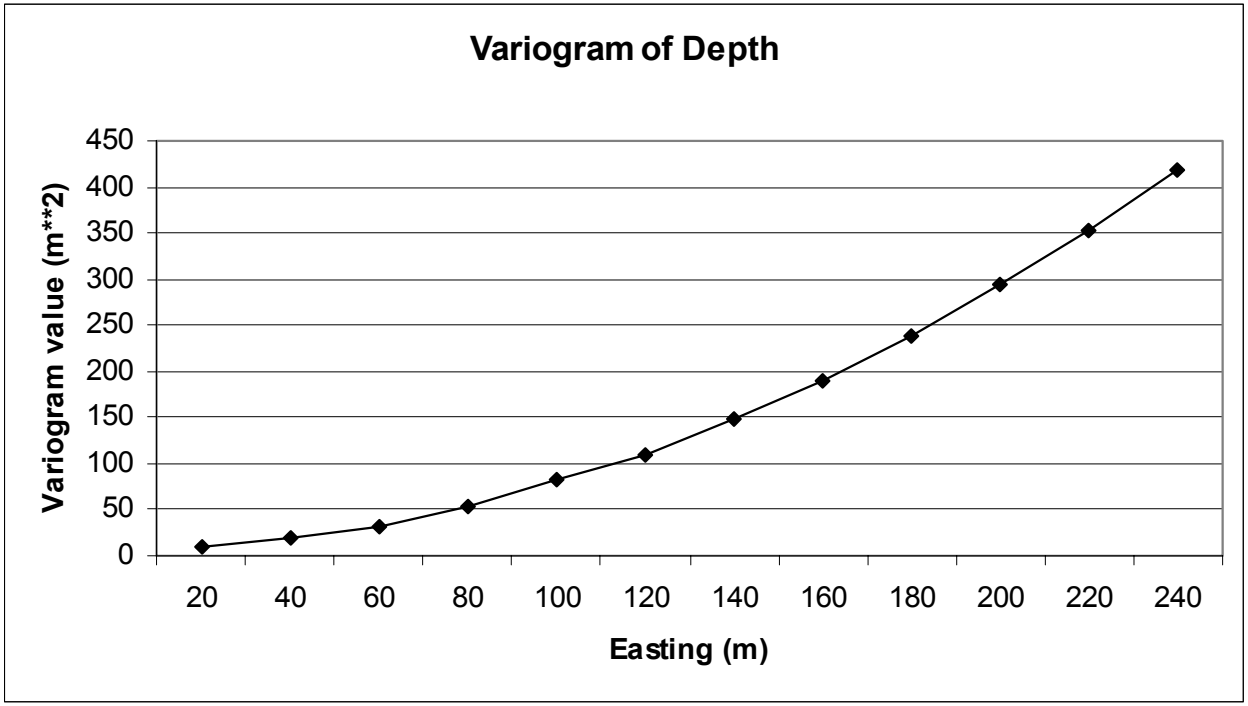
Experimental Semivariogram

Example: Depth to sandstone structure with a trend



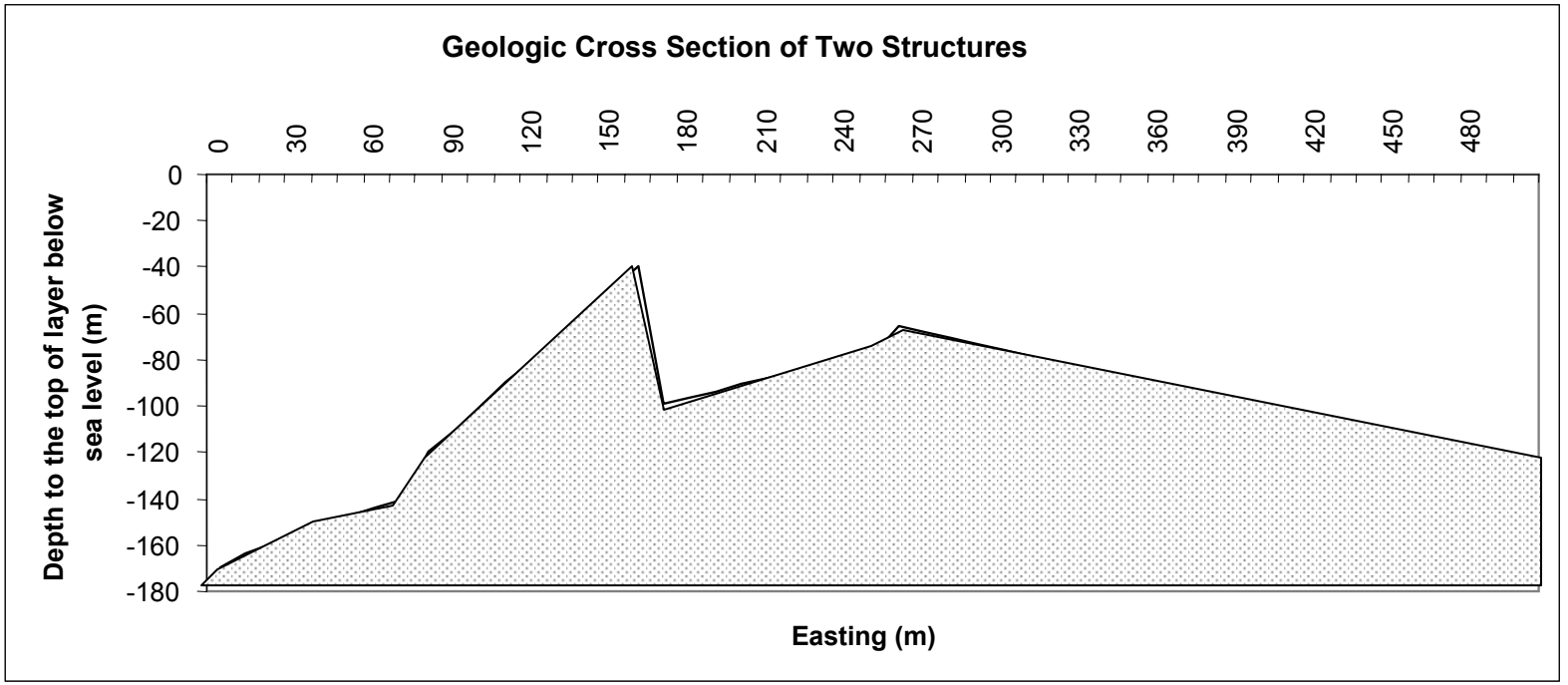
Experimental Semivariogram

Example: Depth to sandstone structure with a trend



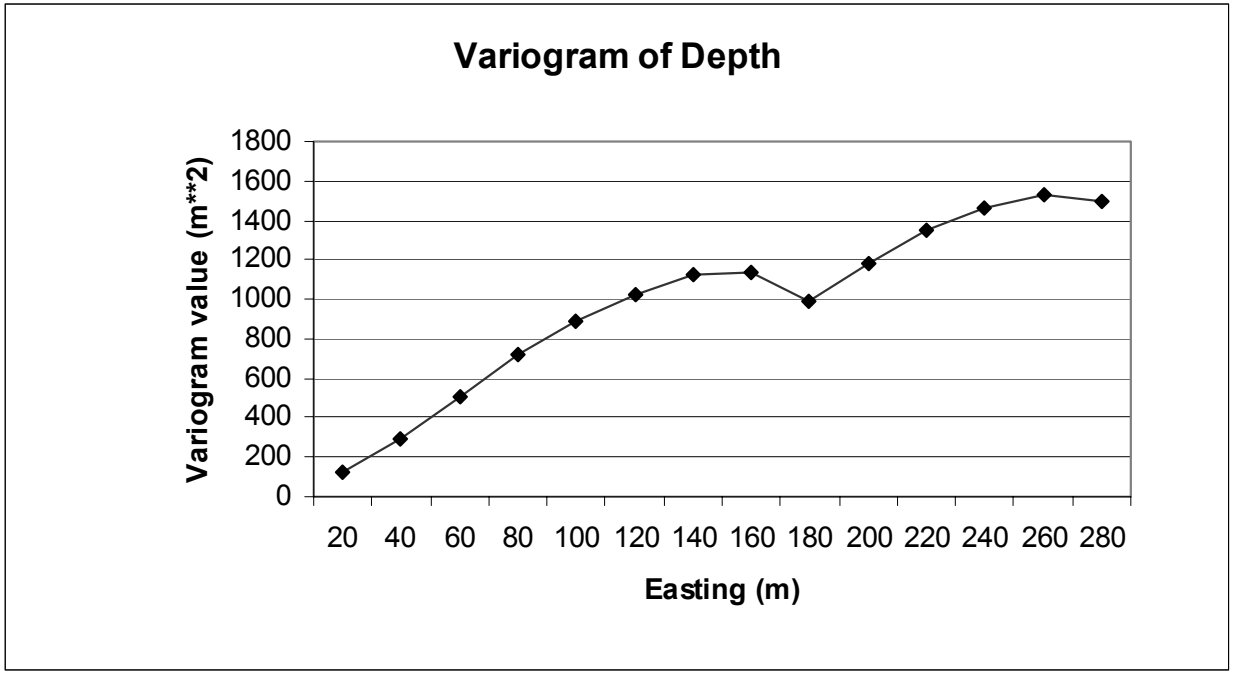
Experimental Semivariogram

Example: Depth to a complex sandstone structure



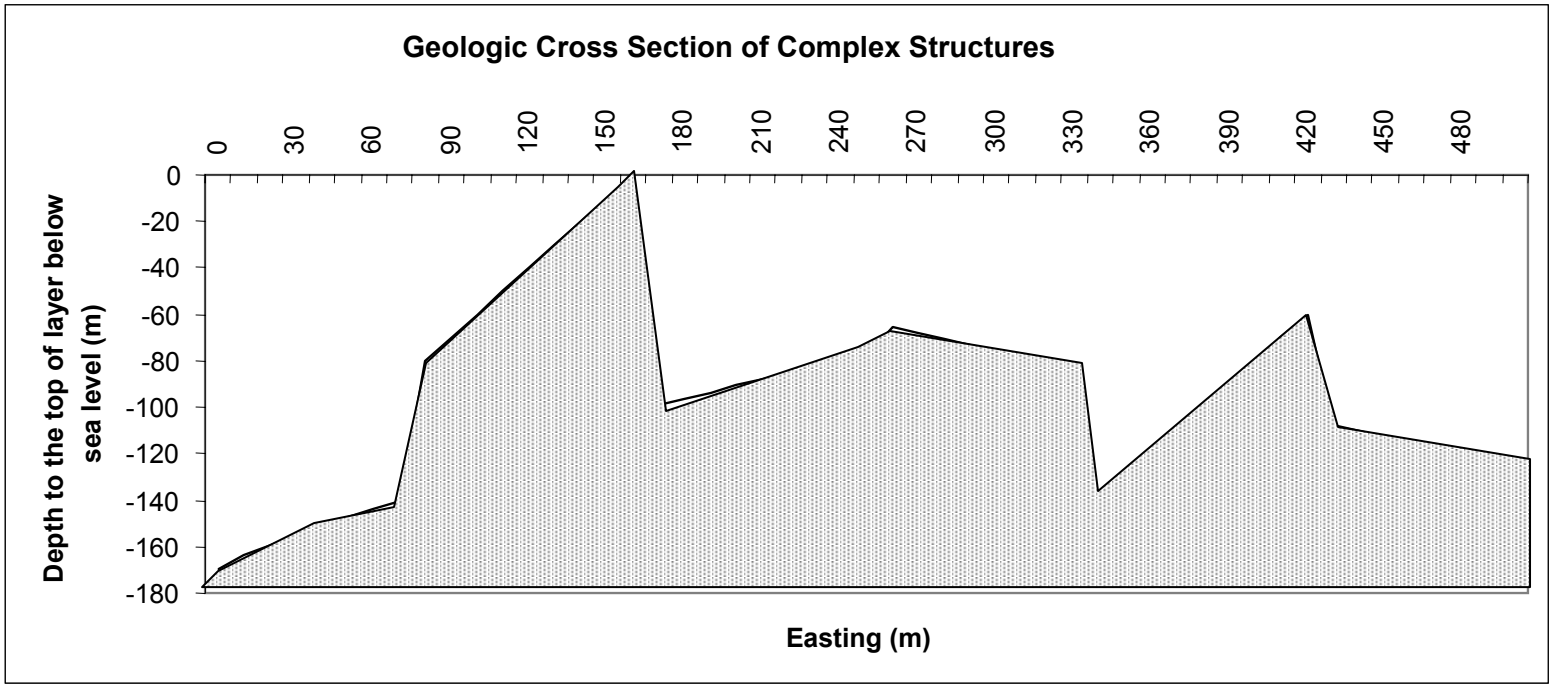
Experimental Semivariogram

Example: Depth to a complex sandstone structure



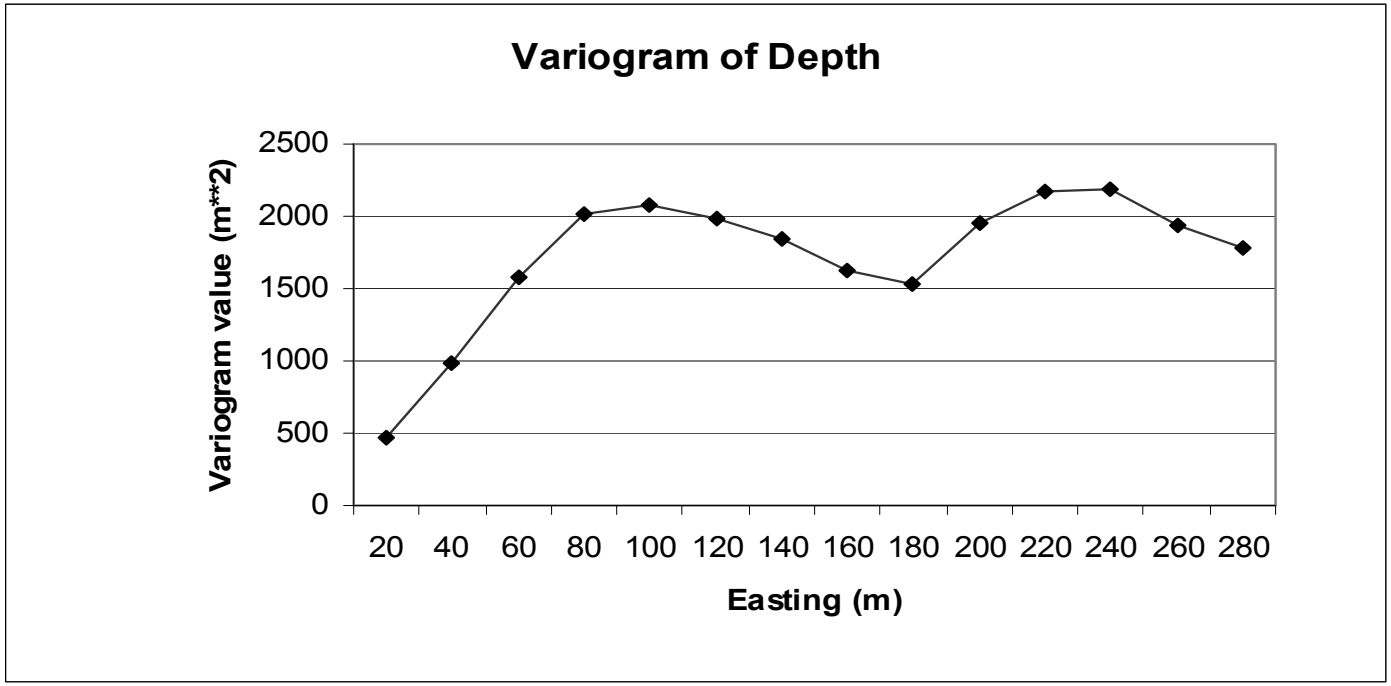
Experimental Semivariogram

Example: Depth to a more complex sandstone structure



Experimental Semivariogram

Example: Depth to a more complex sandstone structure



Experimental Semivariogram

- How to calculate variograms in:
  - 1D
  - 2D
  - 3D
- What is the difference between directional and isotropic variograms?