INTERPOLATION
• Impossible to visit all locations and collect data on elevation, precipitation, pollution, noise or any other phenomenon with a continuous distribution.

• The only alternative is to collect the data from sampling sites and estimate values for the rest of the surface.

• The interpolation is the process that allows to make this inference.
WALDO TOBLER'S 1ST LAW OF GEOGRAPHY

• The nearest points are more similar than those that are further away.

• Any value of a location should be estimated based on the values of the nearest points.
• Spatial interpolation aims to create a surface that estimates the behavior of a particular phenomenon based on a sample of values with a geographic location.

• Interpolation is the process of estimating unknown values that lie between known values.
• The distance of the cell with the unknown value in relation to the sampling points influences the final value of the estimation.
ASSUMPTIONS

• Spatial interpolation can be used to create a surface from a small set of sample points.

• However:

1. The higher the number of sampling points the more detailed the estimated surface.

2. These points should be homogeneously distributed throughout the study area.

3. The number of points should be more dense in areas of greater variation of the phenomenon.
SPATIAL AUTOCORRELATION

• Everything is related to everything but the things that are closer are more related than those that are further away.

• What measures the degree to which things, near and/or distant, are related is spatial autocorrelation.
Most interpolation methods apply spatial autocorrelation by assigning closer points to greater importance than to more distant points.
SAMPLE SIZE

• The methods allow you to control the number of points that will be used to estimate the values.

• It is possible to control by indicating the number, indicating a fixed radius or a variable radius.
Variable

Samples = 8
Radius = ?

Fix

Radius = 1000
Samples = ?
INTERPOLATION BARRIERS

- Physical terrain barriers represent a challenge when we attempt to model a surface through the use of interpolation.

- The values before and after any barrier represent a sudden interruption in the surface and are very different.
INTERPOLATION BARRIERS

• Most interpolators smooth these differences by incorporating the mean values on both sides of the barriers.

• Interpolators such as IDW (Inverse Distance Weighted) and Kriging allow the inclusion of barriers in the analysis. The barrier prevents the interpolator from using sampling points from the other side of the barrier.
INVERSE DISTANCE WEIGHTED (IDW)

- It literally implements the concept of spatial autocorrelation.
- Assume that the closer a point is from a cell that will be estimated, more similar the value of that cell will be.
- It works well for cases where we have a dense and regular samples.
- It does not consider certain patterns in the data.
- If there are abrupt variations in the data, this interpolator smooths these differences.
• The IDW does not make estimates above or below the values in the sample.

• On an elevation surface, it causes a flattening effect on the peaks and valleys. You cannot predict mountains, valleys, and rivers;

• Ideal for precipitation data, soil analysis, and agriculture.
PARAMETERS

• Allows you to adjust:
  • Power: how quickly the influence falls with the distance
  • Search Radius and Number of Points
  • Barriers

• Power Option: By defining a higher power value, more emphasis can be put on the nearest points. Thus, nearby data will have the most influence, and the surface will have more detail (be less smooth). As the power increases, the interpolated values begin to approach the value of the nearest sample point. Specifying a lower value for power will give more influence to surrounding points that are farther away, resulting in a smoother surface.
SPLINE

• This interpolator makes the surface fit over the known values.

• This effect is especially useful when estimating values that are above or below of the values of the sample points.
• The interpolated surface goes over all the points and can exceed the range of the sample values.

• However, when the points are very close and have a large difference in their values, the interpolator does not work well.
Types of spline

- Regularized
  - Extrapolate values
  - "Overlays" surface
  - Higher hills, lower valleys
  - Smooth surface
  - Higher weight: greater smoothing

- Tension
  - Maintains values
  - Forces the surface
  - Flatter valleys and hills
  - Surface less smooth
  - Higher weight: less smoothing
Spline

- It generates a flexible surface, as if it were a stretched elastic surface to pass through all the sample points.
- It estimates well maximum and minimum values (even if not included in the sampling) and therefore represents the discontinuities well.
- It uses the slope calculus to calculate the shape of the surface.
- It represents better phenomena that vary gradually (e.g., temperature)
- It does not represent well phenomena like faults and vertical cliffs.
- It does not allow the use of interpolation barriers (such as IDW).
TOPO TO RASTER

• Best option for interpolating land in general:
  • Creates "hydrologically correct" surfaces.
  • Avoid sinks
  • Drainage reinforcement

• Uses contour line and points as samples;

• Adjusts surfaces from drainage shapes, ponds and borders;

• Generates a connected drainage structure.
KRIGING

• Kriging is a technique that uses a weighted average.

• This interpolator measures the distances between all possible pairs of points in the sample and uses this information to model spatial autocorrelation for the surface to be interpolated.

• It is an iterative method.
• Due to the fact that the estimated values are average, the resulting surface does not pass in the points of the sample.

• There are two methods of Kriging:
  • Universal: used in cases where we know the data follow a certain behavior.
  • Ordinary: is more appropriate for cases where we do not know if the data has a tendency (it is the most used).

• Very used for mining
Natural Neighbors

• It is based on the Voronoi polygons, that is, on the areas of influence of the points sampled. An average of the distance for these points is calculated to infer the value of the cells within the areas of influence.

• Best for very dense samples (e.g., clouds of LIDAR points).