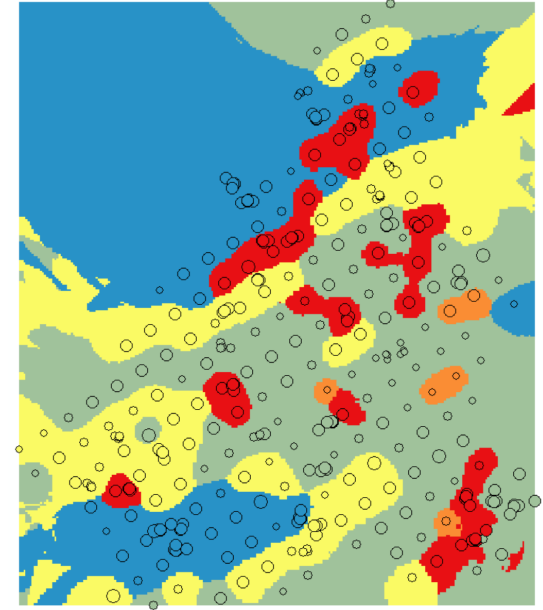
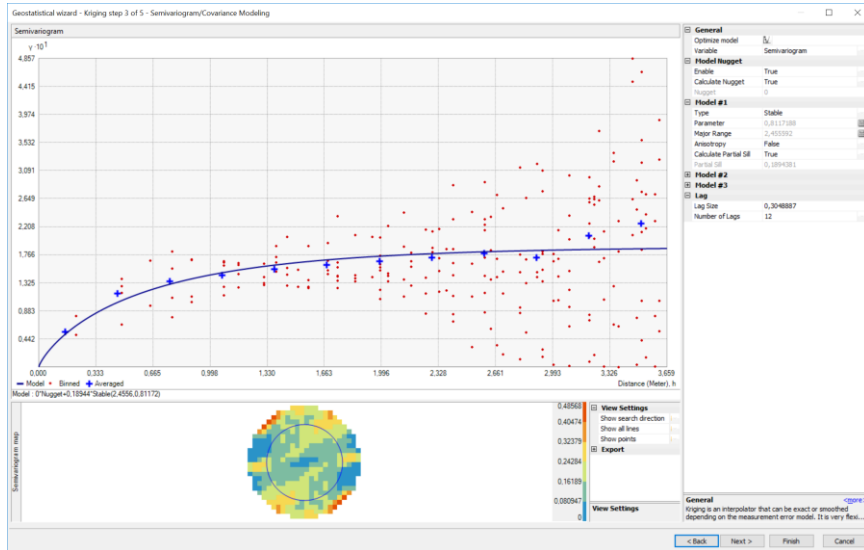


Übung Grundlagen GIS Geostatistik

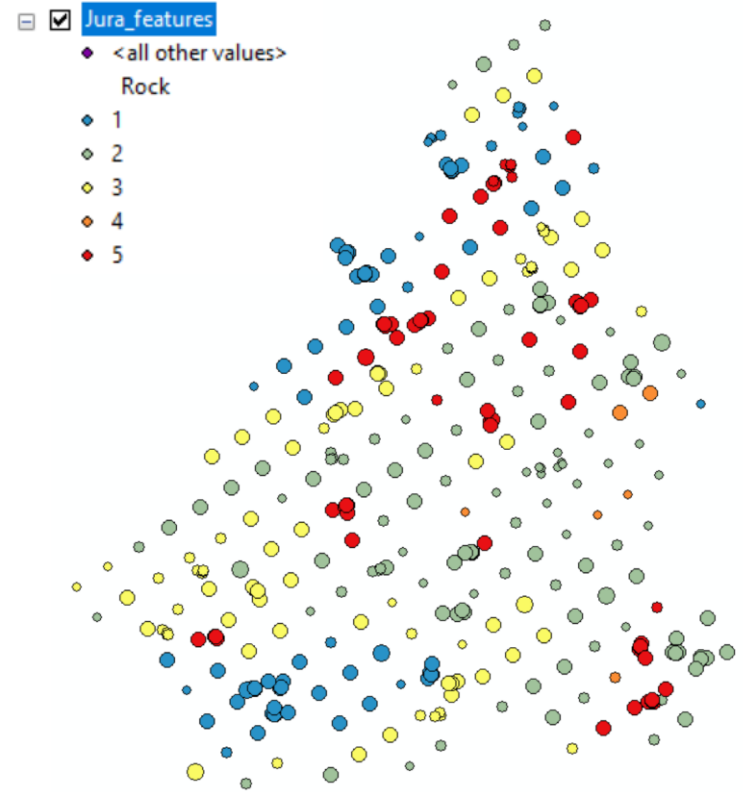


Geostatistik mit der ArcGIS *Geostatistical Analyst* Toolbar

- ArcGIS stellt erweiterte Geostatistik Funktionen inkl. eines umfassenden *Geostatistical Wizard* bereit
- Klassisches Kriging/Cokriging
- Indicator Kriging
- ...

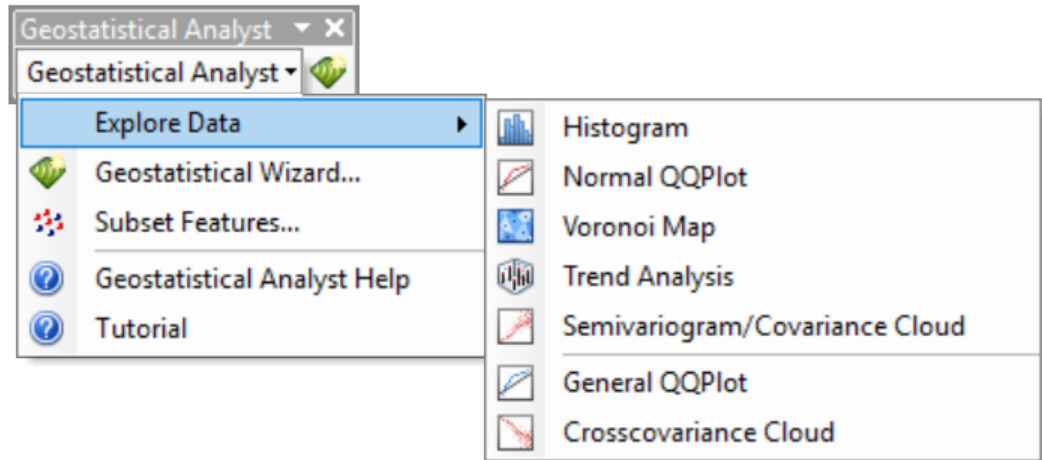
Vorarbeiten

- Laden Sie das Datenfile jura359.dat als Tabelle in eine neue *Geodatabase* und erstellen Sie neues ArcMap-Projekt. Exportieren Sie die Tabelle als Punkt-Feature in die *Geodatabase* (Data >> Export ...). Verwenden Sie als Spatial Reference die gegebene Projektion (Local_Carthesian_Coordinates.prj).
- Verschaffen Sie sich einen Überblick über die vorhandenen Felder.
- Stellen Sie die Datenpunkte farblich anhand des Feldes „Rock“, die Punktgröße soll auf dem Feld „Land“ basieren.



Geostatistical Analyst Toolbar

- *Customize > Toolbars > Geostatistical Analyst*
- *Datenanalyse mittels Explore Data*
- *Geostatistical Wizard ...*



Ordinary Kriging des Feldes “Zn”

Geostatistical Wizard: Kriging / CoKriging

Methods

- [-] **Deterministic methods**
 - Inverse Distance Weighting
 - Global Polynomial Interpolation
 - Radial Basis Functions
 - Local Polynomial Interpolation
- [-] **Geostatistical methods**
 - Kriging / CoKriging**
 - Areal Interpolation
 - Empirical Bayesian Kriging
- [-] **Interpolation with barriers**
 - Kernel Smoothing
 - Diffusion Kernel

Input Data

Dataset	
Source Dataset	Jura_features
Data Field	Zn
Dataset 2	
Source Dataset	<none>
Dataset 3	
Source Dataset	<none>
Dataset 4	
Source Dataset	<none>

Kriging / CoKriging

Kriging is an interpolator that can be exact or smoothed depending on the measurement error model. It is very flexible and allows you to investigate graphs of spatial auto- and cross-correlation. Kriging uses statistical models that allow a variety of output surfaces including predictions, prediction standard errors, probability and quantile. The flexibility of kriging can require a lot of decision-making. Kriging assumes the data come from a stationary stochastic process, and some methods assume normally-distributed data.

[About Kriging / CoKriging](#)

< Back
Next >
Finish
Cancel

Ordinary Kriging des Feldes “Zn”

Geostatistical wizard - Kriging step 2 of 5

Kriging Type

- Ordinary
- Simple
- Universal
- Indicator
- Probability
- Disjunctive

Output Surface Type

- Prediction
- Quantile
- Probability
- Prediction Standard Error

Dataset #1

Transformation type	None
Order of trend removal	None

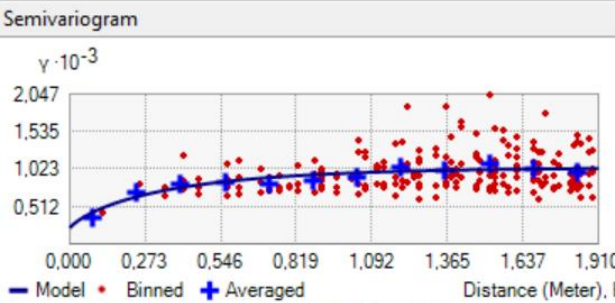
Dataset #1
Location: Z:\GIS\SS2019\9\Geostatistics.gdb
Name: Jura_features
Data field: Zn

< Back Next > Finish Cancel

Ordinary Kriging des Feldes "Zn"

Geostatistical wizard - Kriging step 3 of 5 - Semivariogram/Covariance Modeling

Semivariogram



Model : 217,49*Nugget+830,49*Stable(1,3658,0,82051)

View Settings

- Show search direction
- Show all lines
- Show points

Export

General

Optimize model

Variable Semivariogram

Model Nugget

Enable True

Calculate Nugget True

Nugget 217,4903

Measurement Error 100 %

Model #1

Type Stable

Parameter 0,8205078

Major Range 1,365807

Anisotropy False

Calculate Partial Sill True

Partial Sill 830,4921

Model #2

Model #3

Lag

Lag Size 0,1592002

Number of Lags 12

General [<more>](#)

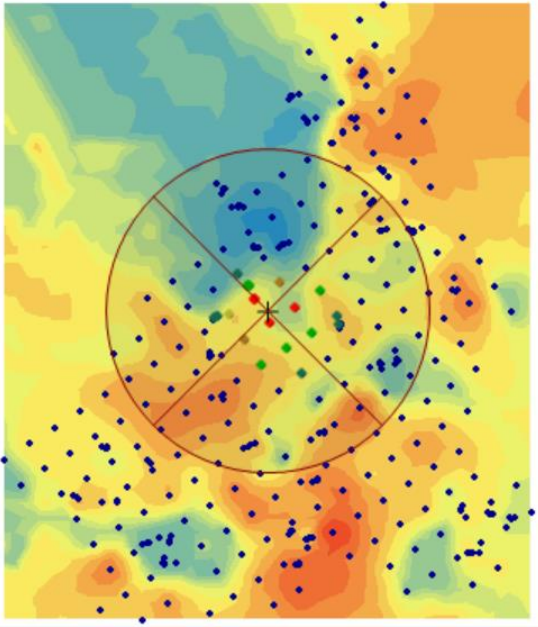
Kriging is an interpolator that can be exact or smoothed depending on the measurement error model. It is very flexi...

< Back Next > Finish Cancel

Parametrisierung
des
Variogrammodells

Ordinary Kriging des Feldes "Zn"

Geostatistical wizard - Kriging step 4 of 5 - Searching Neighborhood

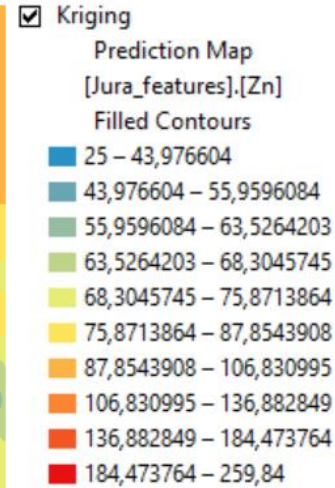
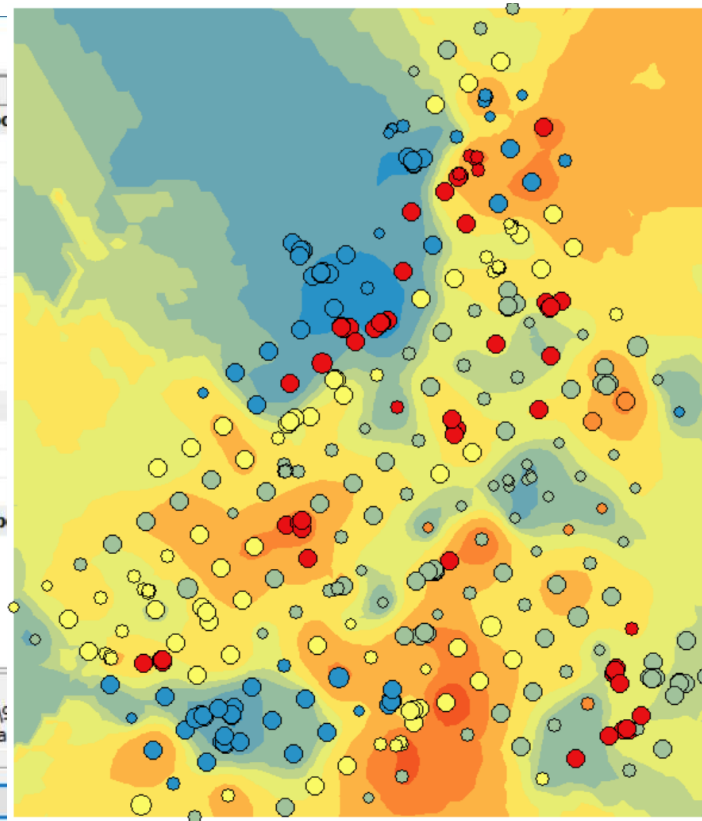
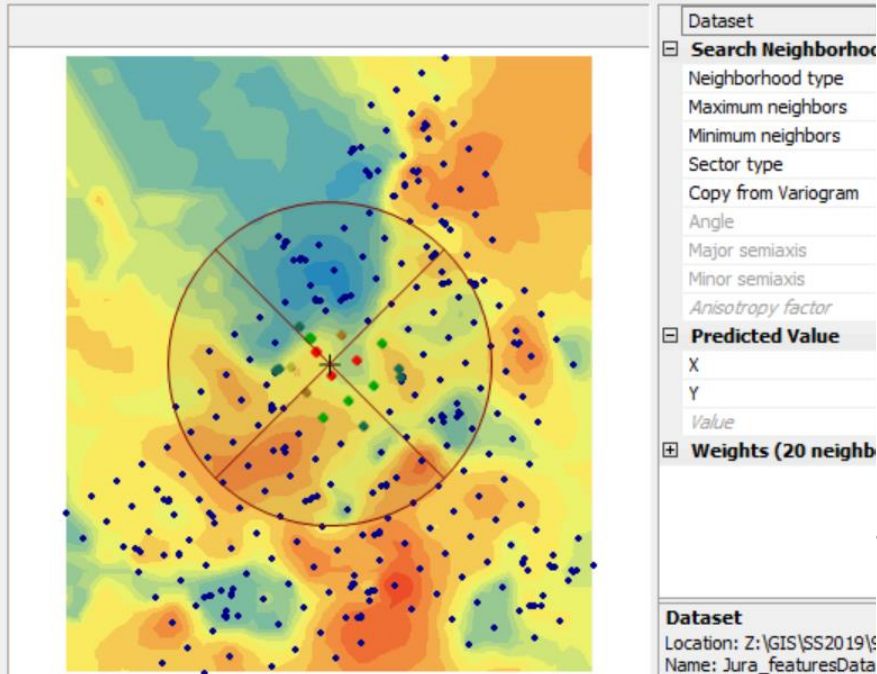


Dataset	#0 [Jura_features - Zn]
Search Neighborhood	
Neighborhood type	Standard
Maximum neighbors	5
Minimum neighbors	2
Sector type	4 Sectors with 45° offset
Copy from Variogram	True
Angle	0
Major semiaxis	1,365807
Minor semiaxis	1,365807
Anisotropy factor	1
Predicted Value	
X	2,705597
Y	3,107117
Value	68,57153
Weights (20 neighbors)	
Dataset	
Location: Z:\GIS\SS2019\9\Geostatistics.gdb	
Name: Jura_featuresData field: Zn	

< Back **Next >** Finish Cancel

Ordinary Kriging des Feldes "Zn"

Geostatistical wizard - Kriging step 4 of 5 - Searching Neighborhood



Ordinary Kriging des Feldes “Zn”

- Ergebnis ist ein temporärer Layer (*Geostatistical Layer*)
- Konversion zu einem *Rasterdataset* in der *Geodatabase* über Rechtsklick auf *Geostatistical Layer : Data >> Export to Raster ...*

Interpolation des Feldes “Rock”

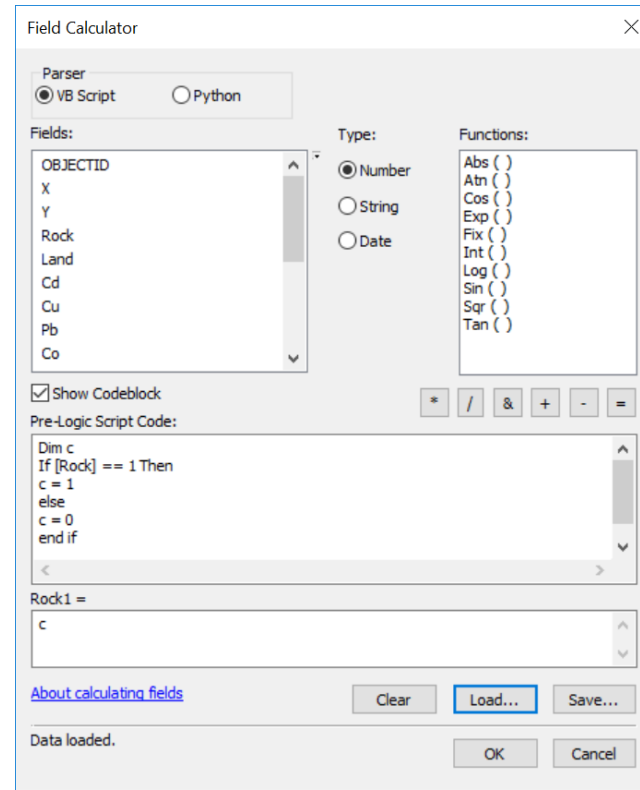
- Ziel: Interpolierte Karte der kartieren Gesteinstypen, **Feld „Rock“**
- Problem: „Rock“ ist kategorielle Variable. Ist da eine Interpolation möglich?

Interpolation des Feldes „Rock“

- Ziel: Interpolierte Karte der kartieren Gesteinstypen
- Problem: „Rock“ ist kategorielle Variable. Ist da eine Interpolation möglich?

Indikatorvariablen erstellen und interpolieren

1. Berechnen sie 5 neue Felder (short integer), in denen für jeden „Rock“-Typ (1-5) pro Punkt eine 1 (für trifft zu) oder 0 (für trifft nicht zu) gespeichert wird.



Field Calculator

Parser
 VB Script Python

Fields:
 OBJECTID
 X
 Y
 Rock
 Land
 Cd
 Cu
 Pb
 Co

Type:
 Number
 String
 Date

Functions:
 Abs ()
 Atn ()
 Cos ()
 Exp ()
 Fix ()
 Int ()
 Log ()
 Sin ()
 Sqr ()
 Tan ()

Show Codeblock

Pre-Logic Script Code:

```
Dim c
If [Rock] == 1 Then
c = 1
else
c = 0
end if
```

Rock1 =

c

[About calculating fields](#) Clear Load... Save...

Data loaded. OK Cancel

Interpolation des Feldes “Rock”

- Ziel: Interpolierte Karte der kartieren Gesteinstypen
- Problem: „Rock“ ist kategorielle Variable. Ist da eine Interpolation möglich?

Indikatorvariablen erstellen und interpolieren

2. Indicator-Kriging mit threshold = 0.5 für alle 5 Indikatorvariablen.
 - Einzeln interpolieren und als Raster speichern

Inte

- Ziel: Interpolierte
- Problem: „Rock“ i
eine Interpolation

- Indikatorvariablen er
2. Indicator-Kriging
Indikatorvariable
 - Einzeln inter

Geostatistical Wizard: Kriging / CoKriging

Methods	Input Data																		
<ul style="list-style-type: none"> <input type="checkbox"/> Deterministic methods <ul style="list-style-type: none"> Inverse Distance Weighting Global Polynomial Interpolation Radial Basis Functions Local Polynomial Interpolation <input type="checkbox"/> Geostatistical methods <ul style="list-style-type: none"> Kriging / CoKriging Areal Interpolation Empirical Bayesian Kriging <input type="checkbox"/> Interpolation with barriers <ul style="list-style-type: none"> Kernel Smoothing Diffusion Kernel 	<table border="1"> <thead> <tr> <th colspan="2">Dataset</th> </tr> </thead> <tbody> <tr> <td>Source Dataset</td> <td>Jura_features</td> </tr> <tr> <td>Data Field</td> <td>Rock1</td> </tr> <tr> <th colspan="2">Dataset 2</th> </tr> <tr> <td>Source Dataset</td> <td><none></td> </tr> <tr> <th colspan="2">Dataset 3</th> </tr> <tr> <td>Source Dataset</td> <td><none></td> </tr> <tr> <th colspan="2">Dataset 4</th> </tr> <tr> <td>Source Dataset</td> <td><none></td> </tr> </tbody> </table>	Dataset		Source Dataset	Jura_features	Data Field	Rock1	Dataset 2		Source Dataset	<none>	Dataset 3		Source Dataset	<none>	Dataset 4		Source Dataset	<none>
Dataset																			
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Dataset 4																			
Source Dataset	<none>																		

Kriging / CoKriging

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[About Kriging / CoKriging](#)

< Back **Next >** Finish Cancel

Indikatorvariablen 1 - 5

Inte

- Ziel: Interpolierte
- Problem: „Rock“ i
eine Interpolation

Indikatorvariablen er
2. Indicator-Kriging
Indikatorvariable

- Einzeln inter

Geostatistical wizard - Kriging step 2 of 5

Kriging Type	
Ordinary	
Simple	
Universal	
Indicator	
Probability	
Disjunctive	

Output Surface Type	
Probability	
Standard Error of Indicators	

Primary Threshold	
Threshold	Exceed
Threshold value	0,5
Cutoffs	
Number of Cutoffs	0

Threshold value [<more>](#)
Threshold value for the probability map creation.

< Back Next > Finish Cancel

Inte

- Ziel: Interpolierte
- Problem: „Rock“ i
eine Interpolation

- Indikatorvariablen er
- Indicator-Kriging
 - Indikatorvariable
 - Einzeln inter

Geostatistical wizard - Kriging step 3 of 5 - Semivariogram/Covariance Modeling

Semivariogram

Model : 0*Nugget+0,18944*Stable(2,4556,0,81172)

General

Optimize model

Variable Semivariogram

Model Nugget

Enable

Calculate Nugget

Nugget 0

Model #1

Type Stable

Parameter 0,8117188

Major Range 2,455592

Anisotropy False

Calculate Partial Sill

Partial Sill 0,1894381

Model #2

Model #3

Lag

Lag Size 0,3048887

Number of Lags 12

Semivariogram map

View Settings

Show search direction

Show all lines

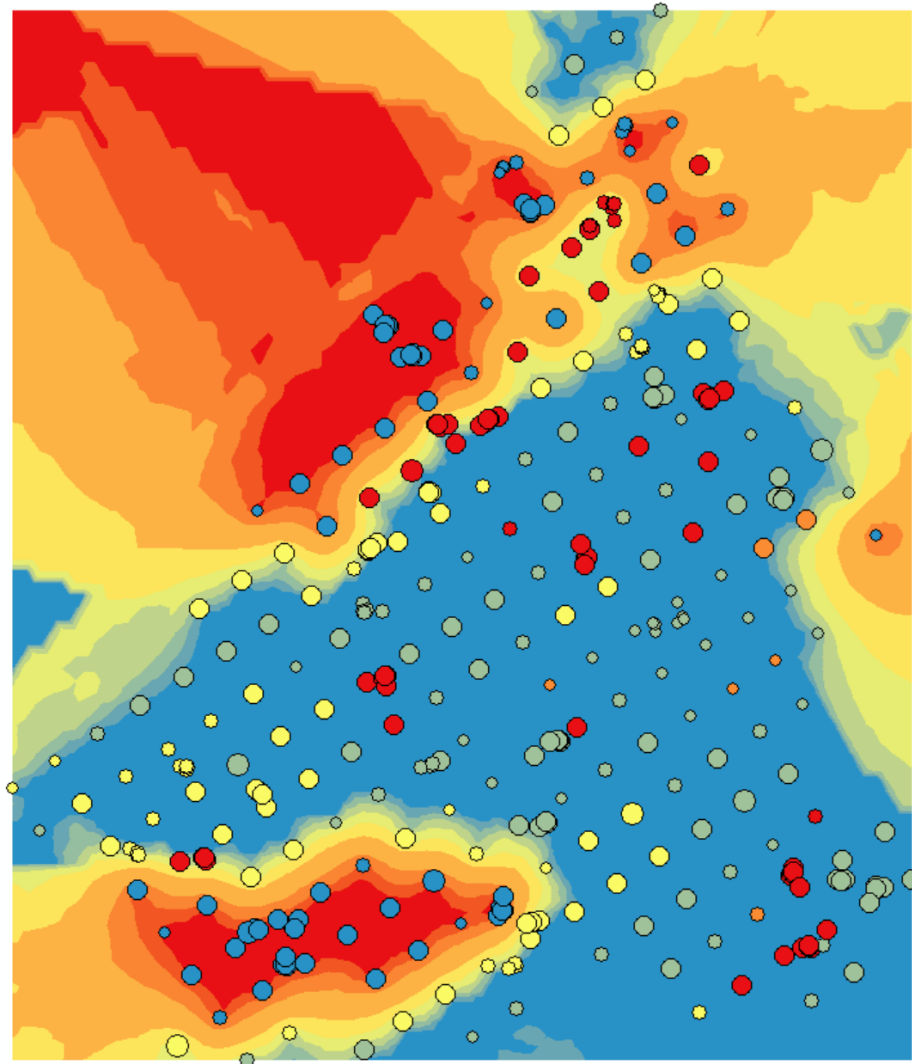
Show points

Export

General

Kriging is an interpolator that can be exact or smoothed depending on the measurement error model. It is very flexi...

< Back
Next >
Finish
Cancel



- Jura_features
 - ◆ <all other values>
 - Rock
 - ◆ 1
 - ◆ 2
 - ◆ 3
 - ◆ 4
 - ◆ 5

- Kriging_2
 - Probability Map
 - [Jura_features].[Rock1]
 - Filled Contours
 - 0 – 0,005296275
 - 0,005296275 – 0,01595708
 - 0,01595708 – 0,037416079
 - 0,037416079 – 0,080610623
 - 0,080610623 – 0,167556368
 - 0,167556368 – 0,342568349
 - 0,342568349 – 0,69484773
 - 0,69484773 – 0,869859711
 - 0,869859711 – 0,956805456
 - 0,956805456 – 1

_ □ ×

#0 [Jura_features - Rock1] ▾

Neighborhood

Neighborhood type: Standard

Number of neighbors: 5

Neighbors: 2

Type: ⊗ 4 Sectors with 45° offset

Use Variogram: True

0

miaxis: 2,455592

miaxis: 2,455592

ropy factor: 1

Estimated Value

2,705597

3,107117

0

Neighbors (20 neighbors)

:\GIS\SS2019\9\Geostatistics.gdb

_featuresData field: Rock1

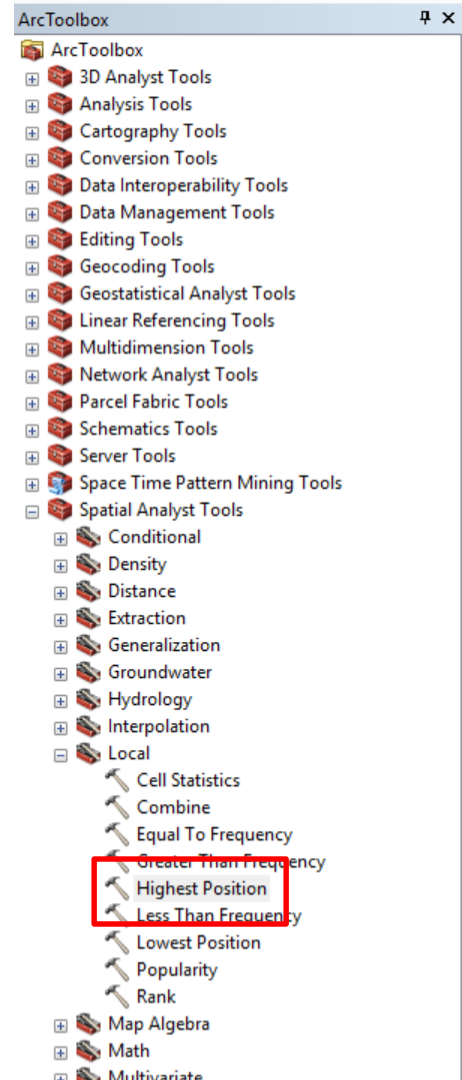
Next > Finish Cancel

Interpolation des Feldes „Rock“

- Ziel: Interpolierte Karte der kartieren Gesteinstypen
- Problem: „Rock“ ist kategorielle Variable. Ist da eine Interpolation möglich?

Raster mit den bevorzugten „Rock“-Werten pro Pixel

- Nummer des Wahrscheinlichkeits-Rasters mit max. Wahrscheinlichkeit
- Operation: *Highest Position*
- Eingabewerte: 5 Raster mit Wahrscheinlichkeiten





- Zi
- Pr
- ei

Neue
Pixel

Highest Position

Input rasters or constant values

- Z:\GIS\SS2019\9\Geostatistics.gdb\Rock1Prob
- Z:\GIS\SS2019\9\Geostatistics.gdb\Rock2Prob
- Z:\GIS\SS2019\9\Geostatistics.gdb\Rock3Prob
- Z:\GIS\SS2019\9\Geostatistics.gdb\Rock4Prob
- Z:\GIS\SS2019\9\Geostatistics.gdb\Rock5Prob

Output raster

Z:\GIS\SS2019\9\Geostatistics.gdb\mostLikelyRock

OK Cancel Environments... Show Help >>

ck”

ArcToolbox

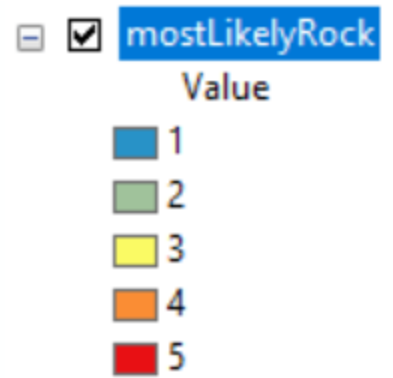
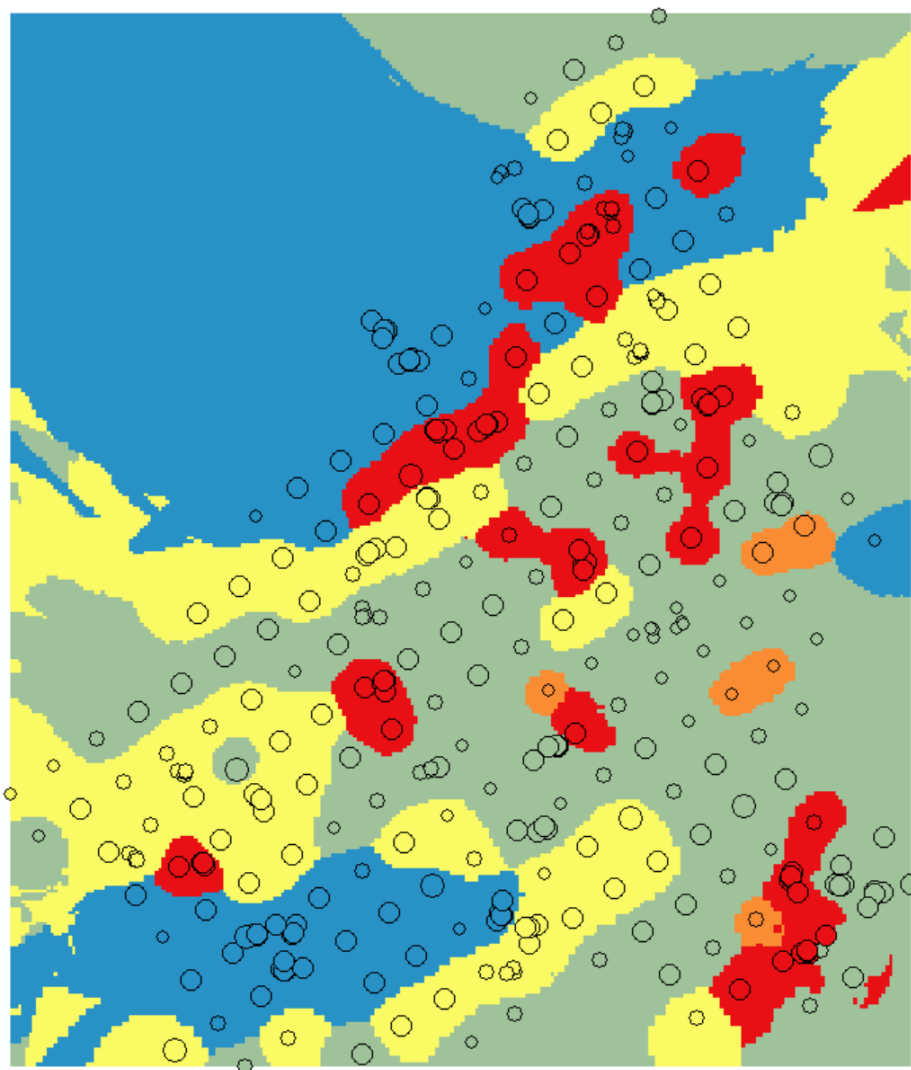
- 3D Analyst Tools
- Analysis Tools
- Cartography Tools
- Conversion Tools
- Data Interoperability Tools
- Data Management Tools
- Editing Tools
- Geocoding Tools
- Geostatistical Analyst Tools
- Linear Referencing Tools
- Multidimension Tools
- Network Analyst Tools
- Parcel Fabric Tools
- Schematics Tools
- Server Tools
- Space Time Pattern Mining Tools
- Spatial Analyst Tools
 - Conditional
 - Density
 - Distance
 - Extraction
 - Generalization
 - Groundwater
 - Hydrology
 - Interpolation
 - Local
 - Cell Statistics
 - Combine
 - Equal To Frequency
 - Highest Position**
 - Less Than Frequency
 - Lowest Position
 - Popularity
 - Rank
 - Map Algebra
 - Math
 - Multivariate

Int

- Ziel: Interpolier
- Problem: „Rock
eine Interplat

Neuen Raster mit
Pixel

- Nummer (
- max. Wah
- Operation
- Eingabew



Interpolation des Feldes “Rock”

- Problem: 5 unabhängige Kriging-Vorgänge, keine Beachtung der Covarianzen zwischen den Indikatorvariablen => Cokriging
 - Zusätzlich zur primären Variable können bis zu 3 weitere Variablen angegeben werden, um die Interpolation zu verbessern
 - Semivariogramme und Covariogramme werden gefittet

Interp

- Problem: 5 unabhängige
Covarianzen zwischen
Variablen ange
• Zusätzlich zur
• Semivariogram

Geostatistical Wizard: Kriging / CoKriging

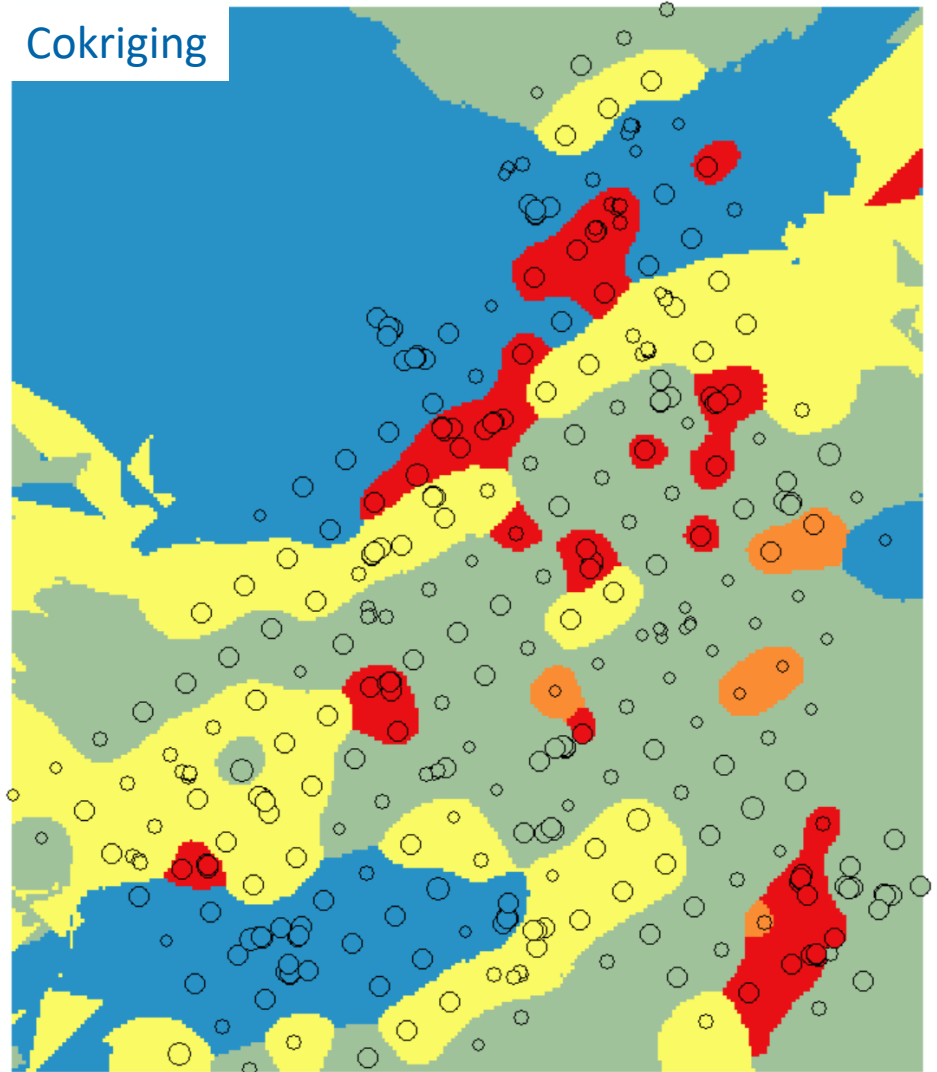
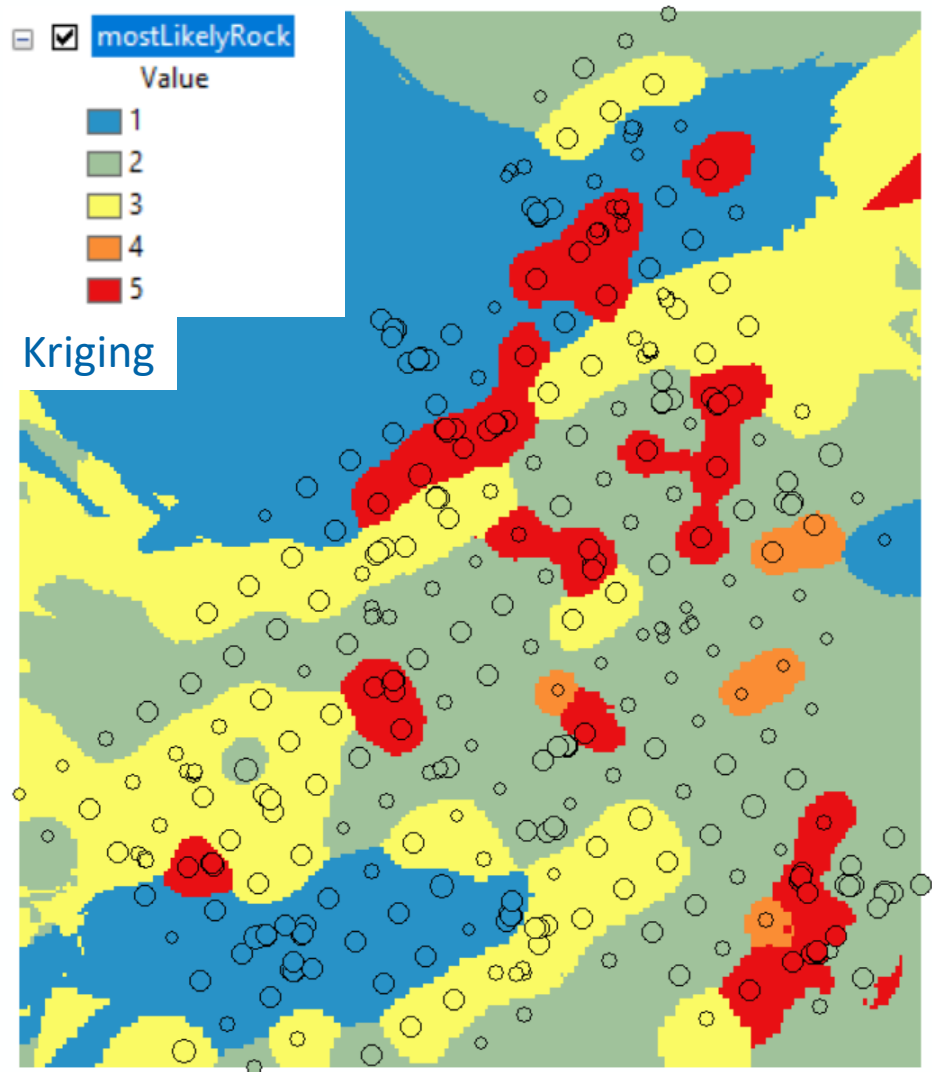
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[About Kriging / CoKriging](#)

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Hinweis

- Theoretische und praktische Aspekte von Kriging/Cokriging und allg. Geostatistik
- Veranstaltungen:
 - Multivariate und Geostatistik*** (Wintersemester, Prof. Gerhards)
Wahlpflichtkatalog BGIP / BGM
 - oder
 - Geomodellierung*** (Wintersemester, Prof. Benndorf)
Wahlpflichtkatalog BGIP / Ma