Technical Manual

HOW TO CREATE AN INTERPOLATION MAP IN ARCMAP USING KRIGING

A step-by-step guide to Geostatistical Analyst tool

Version 1.2

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How to create an interpolation map in ArcMap using Kriging

A step-by-step guide to Geostatistical Analyst tool

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<u>Aim</u>: Create an interpolation map in ArcMap (Geostatistical Analyst tool) using Kriging as interpolation method to estimate values over the selected area of interest.

Case study and data: soil data from the valley of Thessaloniki, Greece.

An introduction to the ArcGIS Geostatistical Analyst Tutorial can be found <u>here</u>.

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1. Input data

We will use as data the following: (a) Samples500.shx (soil data) and (b) Samples500_BorderC.shp (border of the region). Right click on "layers" and then select "Add data ..." (Figure 1). The result is shown in Figure 2.



Figure 1. Add data to ArcMap project.



Figure 2. ArcMap project after soil data (samples500) and border (samples500_BorderC) added.

2. Activate the Geostatistical Analyst tool

If the "Geostatistical Analyst" tool is not already available, then just right click on an empty space on the menu bar and then check/select it. Several options for analyzing spatial data are available after activating the Geostatistical Analyst tool (Figure 3).



Figure 3. Geostatistical Analyst tool: (a) activate the Geostatistical Analyst tool from the menu; (b) options after activating the Geostatistical Analyst tool.

3. Check the data that will be used for the interpolation

It is always good practice to check the data that will be used for the interpolation. For this reason, right click on the layer containing the data (soil data samples) and then select the option "Open Attribute Table" (Figure 4). A new window-table will be appeared with all the records of this layer (Figure 5).



Figure 4. Check the data that will be used; open the attribute table for the data by right click on the corresponding layer and then select "Open Attribute Table".

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	H-	2 Point ZM	1120004 112	SA	338900	4516671 1120493	1120004	2479 30-60	49,	3 22	28,7 8,2 3.8	0,36 0.21	0.63	3,3	0,35 209	24,2 11,79 Normal 38.9 7.94 Validation		
		3 Point ZM	1120006 112	SA	339310	4512611 1120405	1120006	2483 30-60	39	3 24	36,7 8,1 0.1	2,15 1,25	0,41	16,4	1,26 176	36,7 20,02 Normal	-1	
		4 Point ZM	1120007 112	SA	339566	4508252 1120337	1120007	2485 30-60	43,	3 28	30,7 6,6 0	4,45 2,59	0,71	22,6	2,6 433	28,6 24,88 Validation		
	- H-	5 Point ZM	1120008 112	SA	341604	4509549 1120400	1120008	2487 30-60	47.	3 22	30,7 7,5 0.2	1,69 0,98	0,6	5.9	0,95 209	27,3 16,48 Normal	_	
		7 Point ZM	1120010 112	SA	342312	4513298 1120412	1120010	2491 30-60	47	3 32	20.7 8.1 23	8 2.04 1.19	1.51	6.2	1.25 222	29.9 14.33 Normal		6
		8 Point ZM	1120011 112	SA	342514	4511176 1120411	1120011	2493 30-60	27,	3 24	48,7 7,9 1.8	1,32 0,77	0,84	3,5	0,84 341	35 24,16 Normal		
	H-	9 Point ZM	1120012 112	SA	342718	4515745 1120388	1120012	2495 30-60	37,	3 38	26,7 8 1.2	1,41 0.82	0,42	12.3	0.7 267	31,4 14,66 Normal		•
		10 Point ZM	1120013 112	SA	343652	4512697 1120388	1120013	2497 30-60	41,	3 26	32,7 7,7 0.7	2.11 1.23	0,57	5,9	1.2 230	29,8 16,16 Normal 29,5 20,14 Normal		
		12 Point ZM	1120015 112	SA	344457	4509707 1120410	1120015	2501 30-60	35,	3 34	30,7 7,8 0.8	2,22 1,29	0,98	2,5	1,3 152	22,2 18,43 Validation		
		13 Point ZM	1120016 112	SA	345133	4496659 1120327	1120016	2503 30-60	31,	3 36	32,7 7,5 0.8	1,66 0,97	0,89	18,5	0,99 146	26,3 17,51 Validation		
	- H-	14 Point ZM	1120017 112	SA	345200	4516782 1120389	1120017	2505 30-60	71	3 24	4,7 8,4 4.9	0,16 0,09	0,6	3.7	0.2 41	0,5 2,85 Normal	-	
		16 Point ZM	1120019 112	SA	345743	4512201 1120414	1120019	2509 30-60	45	3 24	30,7 8,3 12	2 1,16 0.67	0.63	3.9	0,74 156	25 14,95 Normal		
		17 Point ZM	1120020 112	SA	346086	4495558 1120344	1120020	2511 30-60	39,	3 38	22,7 8 6.8	1,32 0,77	0,51	8	0,88 119	18,4 13,05 Validation		
	- H-	18 Point ZM	1120021 112	SA RA	346150	4510295 1120409	1120021	2513 30-60	23,	3 24	52,7 8,2 1.2	1,7 0,99	0,66	4.5	1 277	37,8 26,9 Validation	•	
		20 Point ZM	1120023 112	SA	346599	4508437 1120407	1120022	2517 30-60	23	3 32	44.7 8.1 2.4	1.55 0.9	0.58	6.2	1.05 261	29.7 23.49 Normal	_	
		21 Point ZM	1120024 112	SA	347160	4513673 1120390	1120024	2519 30-60	49.	3 38	12,7 8,5 2	0,85 0,49	0,41	5,7	0,56 140	0,5 8,14 Normal	•	
	- H-	22 Point ZM	1120025 112	SA	347178	4512307 1120413	1120025	2521 30-60	41,	3 40	18,7 8,3 5,3	1,07 0,62	1,22	3,5	0.7 127	22 10,96 Normal		
		24 Point ZM	1120026 112	SA	347533	4494167 1120335	1120026	2525 30-60	49,	3 24	28.7 71 01	1.6 0.93	0.31	52.9	0.96 293	31.3 15.63 Normal	_	
		25 Point ZM	1120028 112	SA	347646	4510776 1120420	1120028	2527 30-60	51,	3 34	14,7 8,7 8	1,01 0,59	1,35	6,6	0,66 80	7,1 9,2 Normal		1
	H	26 Point ZM	1120029 112	SA	347843	4497294 1120325	1120029	2529 30-60	61,	3 26	12,7 8,1 15	0,72 0,42	0.83	2,1	0.55 64	19,1 7,39 Normal	-	
		28 Point ZM	1120030 112	SA	348306	4511124 1120422	1120030	2533 30-60	35, 67.	3 34	87 86 36	1.4 0.81	1	34.9	0.9 74	9.3 7.97 Normal		
		29 Point ZM	1120032 112	SA	348378	4495550 1120326	1120032	2535 30-60	31,	3 . 30	38,7 7,6 0.3	1,75 1,02	0,58	5,9	1 254	25 19,7 Normal	•	
	H-	30 Point ZM	1120033 112	SA	348401	4498244 1120345	1120033	2537 30-60	23,	3 38	40.7 8 2.6	1,31 0,76	0,74	5,1	0.8 224	23,8 21,29 Normal	_	
		31 Point ZM	1120034 112	SA	348590	4515212 1120415	1120034	2539 30-60	57.	3 28	10,7 8,4 7.3	0.85 0.49	0.39	51	0.51 140	20 8,76 Normal 7.5 8,26 Validation		1
		33 Point ZM	1120036 112	SA	349299	4499490 1120359	1120036	2543 30-60	23,	3 34	42,7 7,9 4.7	1,65 0,96	0,71	2,9	1,02 215	31 23,05 Validation		
		34 Point ZM	1120037 112	SA	349306	4493099 1120350	1120037	2545 30-60	37,	3 24	38,7 7,9 9	1,26 0,73	0,43	5,1	0,75 293	31,8 18,05 Normal		
	H	35 Point ZM 36 Point ZM	1120038 112	SA	349369	4490778 1120334	1120038	2547 30-60	21	3 20	58,7 7,6 9	1,02 0,59	0,1	3,3	0,62 400	37,8 27,14 Normal	-	
		37 Point ZM	1120040 112	SA	349750	4494731 1120347	1120040	2551 30-60	21.	3 30	48.7 8.2 0.6	1.04 0.6	0.34	3.7	0.66 287	31.8 23.5 Normal		
		38 Point ZM	1120041 112	SA	349805	4514653 1120418	1120041	2553 30-60	39,	3 46	14,7 8,5 6.1	1,03 0,6	0,47	3,5	0,63 94	1,3 9,62 Normal		
	H-	39 Point ZM	1120042 112	SA	350010	4509850 1120421	1120042	2555 30-60	81,	3 10	8,7 8,1 2.4	0,98 0,57	3,29	5,1	0,66 72	2 6,29 Normal	_	
	H-	4u Pont ZM	1120043 112	SA	350099	4430723 1120363	1120043	2557 30-60	57	3 22	20,1 8,2 9.8	1,5 0,87	0,51	0,4	0,00 111	13/0 12/41 Normal		

Figure 5. Attribute Table with all the data records from the layer Samples500 that will be used for the interpolation process.

4. Interpolation process

ArcMap provides a useful tool called "Geostatistical Wizard" to facilitate the process of selecting the parameters needed for the interpolation process. To open the Geostatistical Wizard, we only must left click on the Geostatistical Analyst and then select the option "Geostatistical Wizard" from the menu (Figure 6).



Figure 6. Open the Geostatistical Wizard to proceed with the interpolation process.

We must make sure that "Kriging/Cokriging" is selected as the interpolation method that will be used and that the correct layer of data (Samples500) is selected in the Source Dataset along with the correct data field (PH) that will be used for the interpolation (Figure 7).



Figure 7. Selecting the parameters for the interpolation with Kriging/Cokriging method; selecting the data (PH) that will be used for the "Kriging/Cokriging" interpolation method.

After clicking on next, we move on to the selection of the proper Kriging type for the interpolation (Figure 8).



Figure 8. Selection of the Kriging type that will be applied for the interpolation.

For more information on how Kriging works and on the different types available please check the following link:

https://pro.arcgis.com/en/pro-app/3.1/tool-reference/3d-analyst/how-kriging-works.htm

Click on next we move on to a new window that provides all the information about the interpolation (Figure 9). We can right click on Semivariogram plot and then select "copy" to copy and paste the graph in a text. In tab "General" at the right side of the window "Optimized model" is selected by default, so we do not have to make changes.



Figure 9. Semivariogram/Covariance Modeling with Kriging

Clicking on next we get a preview of the interpolation results. We can change the "Sector Type" to the left side of the window to "8 Sectors" instead of "4 sectors with 45° offset", which is the default option (**Figure 10**), to take into consideration more neighboring data values (**Figure 11**). To check the weights that are being calculated we can expand the "Weights (16 neighbors) to examine the weights that have been assigned to each of the neighboring data measurement.



Figure 10. Searching Neighborhood in Kriging; default option the "4 sectors with 450 offset (8 neighbors)"



Figure 11. Searching Neighborhood in Kriging; selecting 8 sectors (16 neighbors)

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We can also have the option to define the neighbor type of the search in searching neighbors in each neighborhood of the data that can be either "normal" or "smooth". We usually select "normal".



Figure 12. Selecting the type of neighbor type in searching neighbors: normal (default) or smooth.

Moving to the next step, we finally get a window with cross validation results (Figure 13) presenting the predicted values. Plots are available for (a) Predicted vs measured; (b) Error; (c) Standardized Error, and (d) Normal QQ-Plot for normality check.

The plots can be copied and pasted into a new document by right clicking on them and selecting "copy". At the down right side of the window the primary interpolation metrics are available and can be exported to file. These are the main statistical metrics that must be reported for each interpolation.

By clicking on "Finish" a small window appears presenting all the corresponding interpolation information and it can also be exported in a xml file.



Figure 13. Cross validation results for the interpolation and corresponding plots.

The final interpolation product is an interpolation map that provides estimates for the given parameter (pH) over the study area (Figure 14).



Figure 14. Interpolation map as the result of the interpolation process using Kriging and the Geostatistical Analyst tool of ArcMap.

In case we want to crop this final interpolation map to the extent of the border then we export the "Kriging" layer to raster and then we search for the tool "Extract by mask" (Figure 15).



Figure 15. Cropping the interpolation map to the extent of the border layer.



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