Exercise 5: Mapping the probability of ozone exceeding a critical threshold

ArcMap 10.4
|
Other versions

- 10.4
- 10.3

Available with Geostatistical Analyst license.

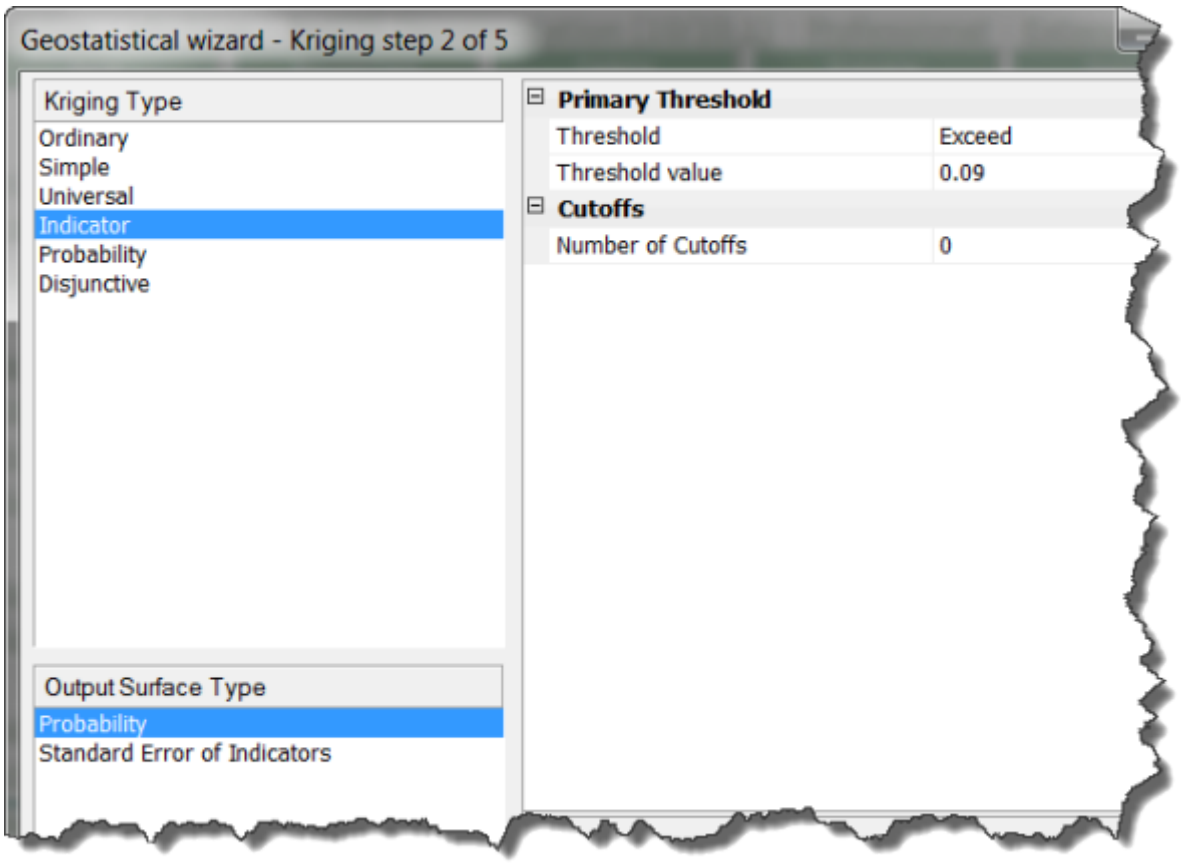
Complexity:
Beginner
Data Requirement:
ArcGIS Tutorial Data for Desktop
Data Path:
C:\ArcGIS\ArcTutor\Geostatistical Analyst
Goal:
Create a map of the probability that ozone concentration exceeded a specific threshold during the one-hour period when the samples were taken.

In exercises 1 and 3, you used ordinary kriging to map ozone concentration in California using different parameters.

In the decision-making process, care must be taken in using a map of predicted ozone for identifying unsafe areas because it is necessary to understand the uncertainty of the predictions. For example, suppose the critical threshold ozone value is 0.09 ppm for a one-hour period and you want to determine if any locations exceed this value. For a specific location, the predicted value may be 0.1 ppm, but due to the uncertainty associated with that prediction, the true ozone value may lie between 0.07 and 0.12 ppm. To aid the decision-making process, you can use Geostatistical Analyst to map the probability that ozone values exceed the threshold.

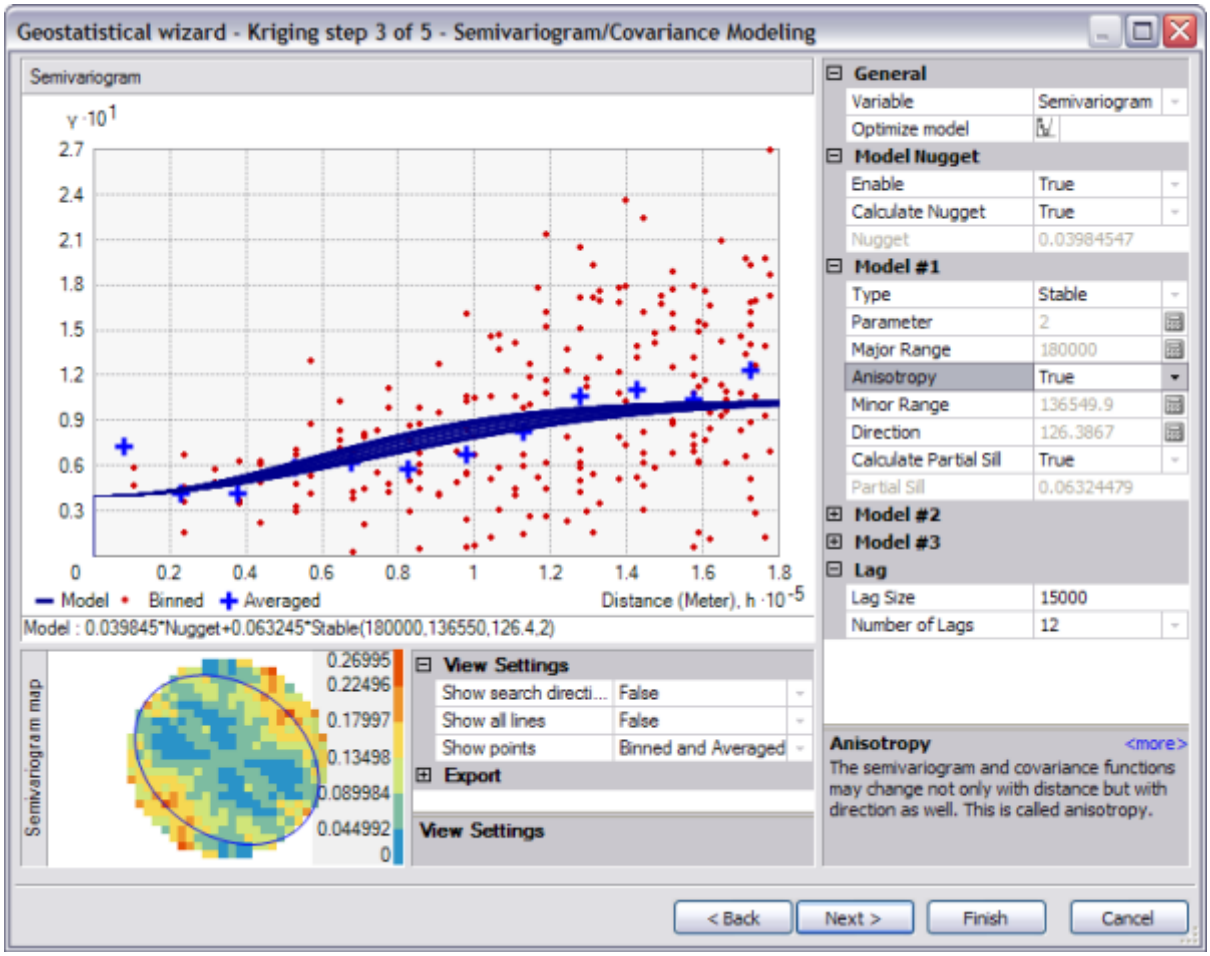
While Geostatistical Analyst provides a number of methods that can perform this task, for this exercise you will use the simplest available model, indicator kriging. This technique does not require the dataset to conform to a particular distribution. The data values are transformed to a series of 0s and 1s according to whether the values of the data are below or above a threshold. If a threshold of 0.09 ppm is used, any value below this threshold will be assigned a value of 0, whereas the values above the threshold will be assigned a value of 1. Indicator kriging then uses a semivariogram model that is calculated from the 0–1 dataset.

1. If you closed your previous ArcMap session, start the program again and open the Ozone Prediction Map.mxd.
2. On the Geostatistical Analyst toolbar, click Geostatistical Analyst > Geostatistical Wizard.
3. Click Kriging/Cokriging in the Methods list box.
4. Click the Input data drop-down arrow and click O3_Sep06_3pm.
5. Click the Attribute drop-down arrow and click the OZONE attribute.
6. Click Next.
7. Click Indicator Kriging; notice that Probability Map is selected as the output type.
8. Make sure that the Threshold is set to Exceed, then set the Primary Threshold Value to 0.09.



9. Click Next.
10. Change the Lag size to 15000.
11. Change Anisotropy to True to account for the directional nature of the data.

    The blue lines show the estimated semivariogram models in different directions.

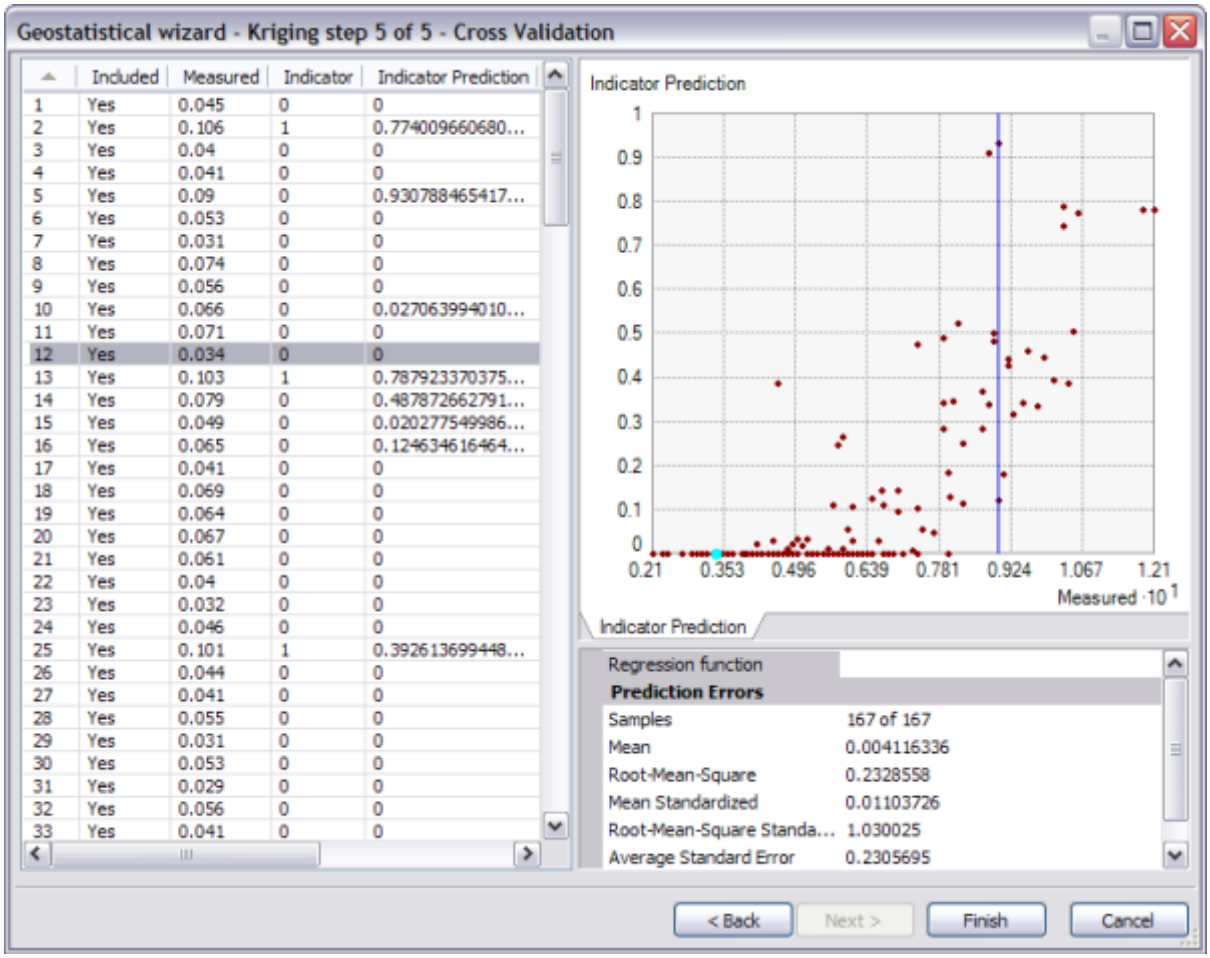


12. Click Next on the Semivariogram/Covariance Modeling dialog box.
13. Click Next on the Searching Neighborhood dialog box.

    The blue line represents the threshold value (0.09 ppm). Points to the left of the blue line have an indicator-transform value of 0, whereas points to the right have an indicator-transform value of 1.

14. Click to select a row in the table with an indicator value of 0. The selected point will be shown in green on the scatterplot, to the left of the blue threshold line.

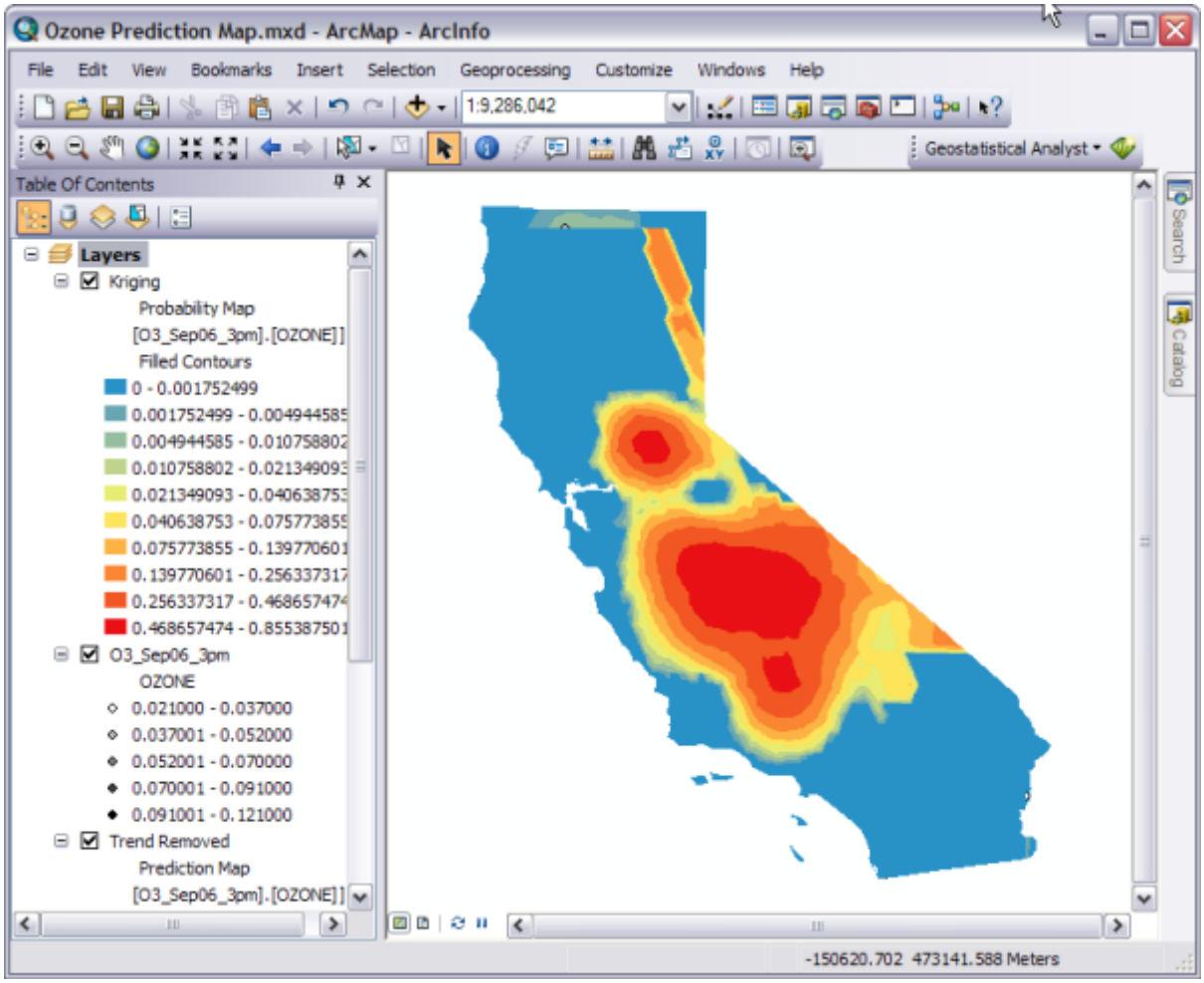
    In the case of the selected row in the figure below, the prediction is exactly the same as the indicator value.



The Measured and Indicator columns display the actual and transformed values for each sample location. The indicator prediction values can be interpreted as the probability of exceeding the threshold. The indicator prediction values are calculated using the semivariogram modeled from the binary (0,1) data, created based on indicator transformations of your original data. Cross-validation sequentially omits a point and calculates indicator prediction values for each. For example, the highest measured value is 0.121. If this location had not actually been measured, the indicator kriging model shows about a 78 percent chance that the ozone value at that location was above the 0.09 ppm threshold.

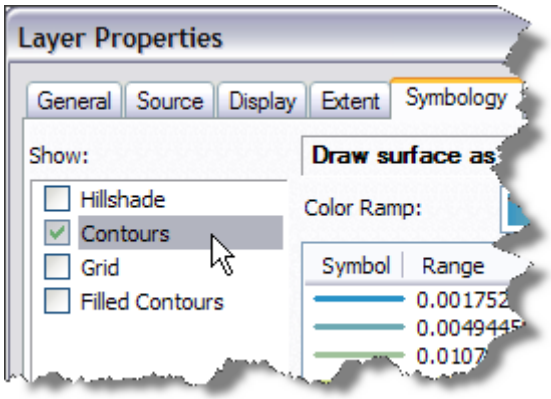
15. Click Finish on the Cross Validation dialog box.
16. Click OK on the Method Report dialog box.

The probability map will appear as the top layer in ArcMap. The map displays the indicator prediction values, interpreted as the probability that the threshold value of 0.09 ppm was exceeded between 3 and 4 p.m. on September 6, 2007.

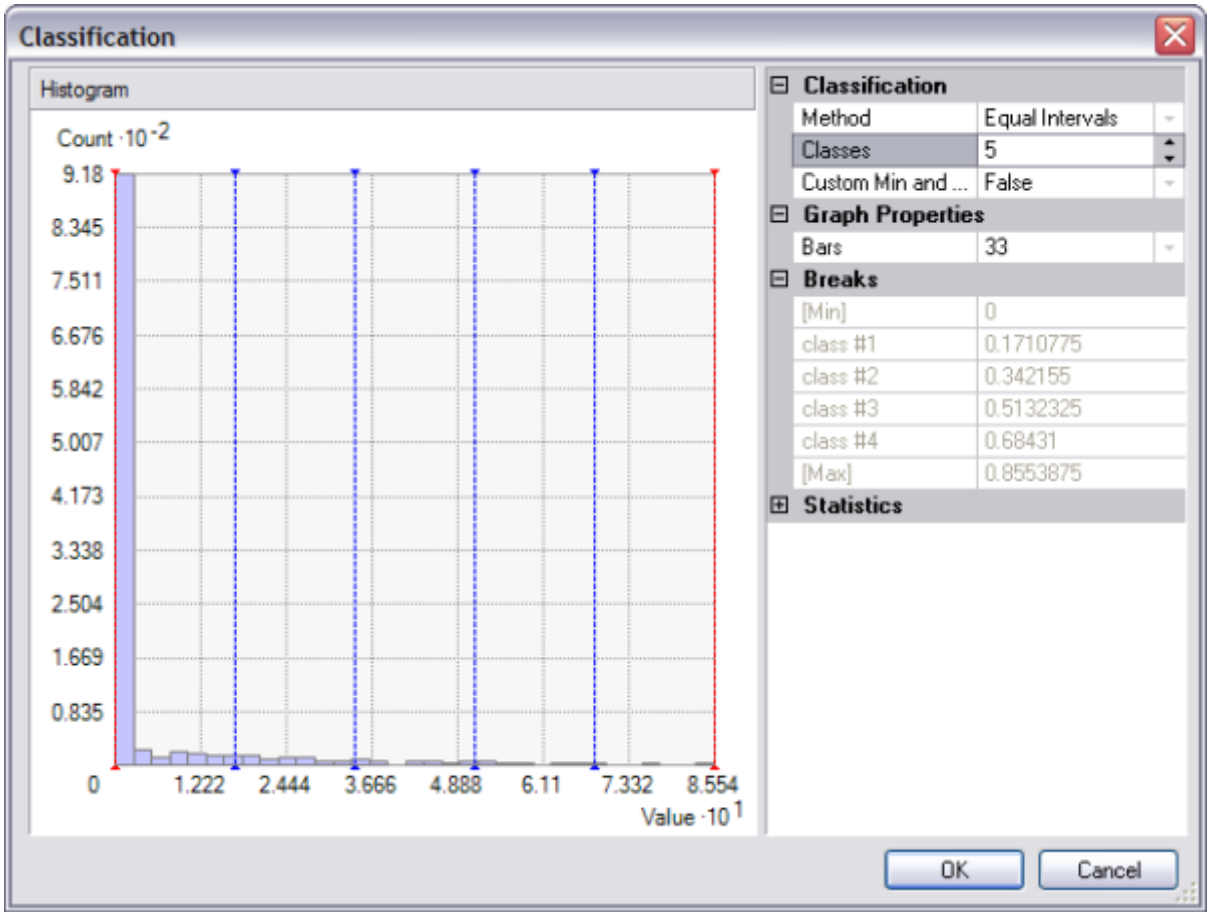


It is clear from the map that in central California, the probability that ozone concentrations exceed the threshold of 0.09 ppm is likely.

17. Change the layer's name to Indicator Kriging
18. Drag the Indicator Kriging layer to reposition it between the O3_Sep0_3pm and Trend Removed layers.
19. Right-click the Indicator Kriging layer and click Properties.
20. Click the Extent tab and set the extent to specify the rectangular extent of ca_outline.
21. Click Apply.
22. Click the Symbology tab.
23. Uncheck the Filled Contours option and check the Contours option.
24. Click Contours so that the symbology for contours (lines) appears. Choose a green to blue color ramp.

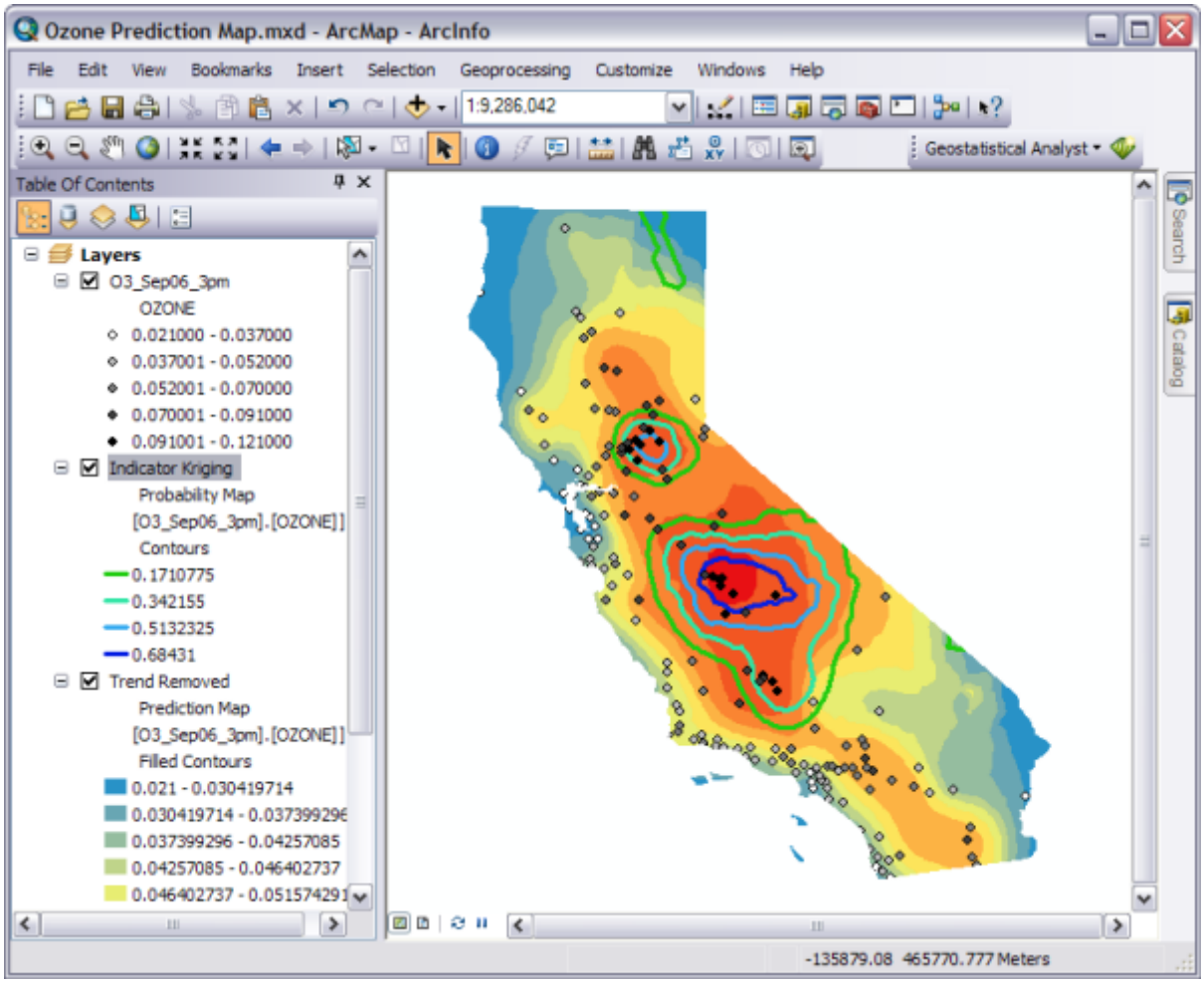


25. Click the Classify button. In the Classification dialog box, change Method to Equal Interval and Classes to 5.

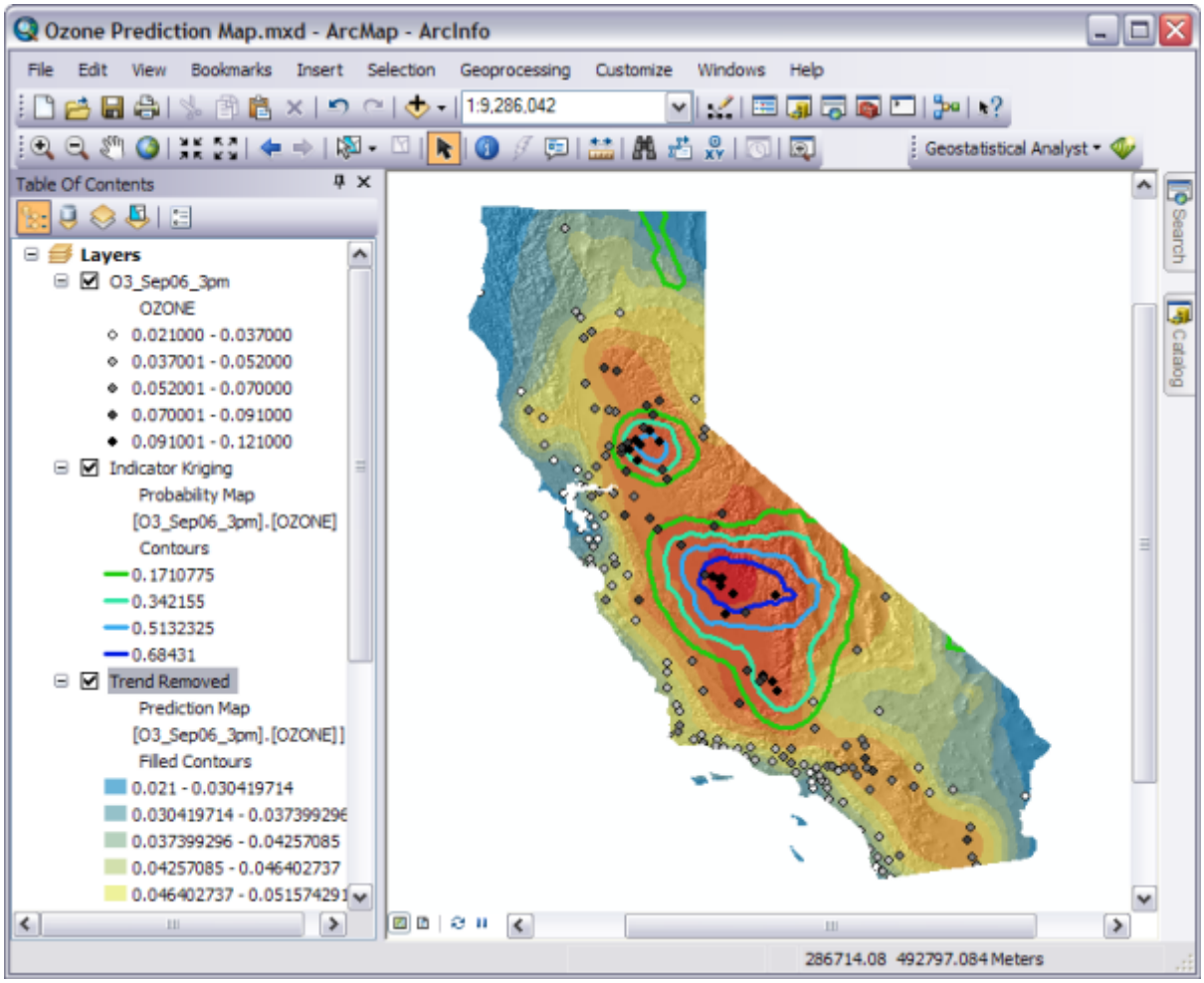


26. Click OK, then click OK again.

    You should now have green and blue contours on top of the ozone predictions. The map now shows areas of high and low predicted ozone values and areas of high probability that the ozone concentrations exceeded the California State Air Quality Standard for one-hour measurements.



27. As a final touch to the map, you can add the **ca_hillshade** dataset to the project (from C:\ArcGIS\ArcTutor\Geostatistical Analyst). It should be added to the bottom of the table of contents and depicted using a white to black color ramp.
28. Right-click the Trend Removed layer, click Properties, then click the Display tab.
29. Set the Transparency to 30% and click OK.



30. Click Save on the Standard toolbar to save your map.

In this tutorial, you have been introduced to the Geostatistical Wizard, data exploration using the ESDA tools, ordinary kriging (using default parameter values and more refined options) to predict ozone values across California, and indicator kriging to map the probability that ozone concentrations exceeded a critical threshold value. Many other interpolation methods are offered in the Geostatistical Wizard, and several are also offered in geoprocessing tools that can be used in ModelBuilder.

Related Topics

- Introduction to the ArcGIS Geostatistical Analyst Tutorial