**Spatial Interpolation and Error Analysis**

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**Project Overview**

This lab focused on using different interpolation techniques to estimate monthly rainfall across the western United States. Students compared Voronoi (Thiessen), Average Nearest Neighbor, Inverse Distance Weighting (IDW), and Kriging methods using a July precipitation dataset. A portion of the data (test points) was withheld to validate model accuracy through Root Mean Square Error (RMSE) calculations.

The lab emphasized the trade-offs between interpolation precision and plausibility. It explored the impact of neighborhood shapes and sizes on output, highlighted how some methods (e.g., Kriging) can produce values outside the original data range, and provided a critical comparison of models based on RMSE, range conformity, and spatial realism.

**Graphic 1: Near Neighbor Interpolation Under Voronoi Polygons**

**Description:**  
This map layers a Near Neighbor interpolation raster with a multi-color gradient underneath vector Voronoi (Thiessen) polygon outlines. The visualization highlights sharp transitions between interpolated values that do not align with natural rainfall gradients. This demonstrates the weakness of Voronoi polygons in modeling continuous environmental variables. While Voronoi is excellent for territory-based modeling (e.g., cellular coverage), it's a poor estimator for gradual climatic phenomena.

A screenshot of a computer screen

Description automatically generated

**Graphic 2: Error Locations in Interpolation Models**

**Description:**  
This map identifies geographic locations where the largest discrepancies (errors) occurred between estimated and actual rainfall values. It helps diagnose where interpolation models struggle, such as regions with sparse data or complex terrain. The inclusion of a legend and scale bar aids interpretation, making this a strong spatial diagnostic tool.

A screenshot of a map

Description automatically generated

**Table 1: Interpolation Results Comparison**

**Description:**  
This table compares four interpolation methods based on minimum and maximum raster values and RMSE. Kriging had the lowest RMSE but produced invalid (negative) rainfall estimates. IDW offered slightly higher errors but remained within realistic bounds, making it the preferred method for this dataset.

|  |  |  |  |
| --- | --- | --- | --- |
| Raster Method | Min Raster Value **(millimeters)** | Max Raster Value **(millimeters)** | Total RMSE Error **(millimeters)** |
| Voronoi | 0 | 241.5 | 50.95 |
| Average Nearest Neighbor | 0 | 203.10 | 39.22 |
| IDW | 0 | 199.91 | 37.88 |
| Kriging | -0.12 | 209.31 | 35.50 |