Stat 406 – Statistical Methods for Spatial Data

Spring 2008

Topics overview
Part I: Geostatistics

Precision agriculture

(data and images courtesy of M. Perez-Bidegain and P. Barbagelata)
Precision agriculture: Analysis of soil fertility

South Field—sampled locations

Multiple measurements for each sample:
- SOM (soil organic matter)
- soil Ph, P (Phosphorus)
- K (Potassium)
- CEC (Cation exchange capacity)
- Mg (Magnesium)
Precision agriculture

Histogram of mg.z

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Precision agriculture

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Precision agriculture

South field---Magnitude of MG

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Precision agriculture

South field: Contour Plot of MG

X coordinate (m)  Y coordinate (m)
Precision agriculture
Precision agriculture
Precision agriculture

South plot: Perspective Plot of MG

X coordinate (m)
Y coordinate (m)
MG

South plot: Perspective Plot of MG
Meteorology and Climatology

Data sets that encompass hundreds of location sites are common. (e.g. Historical Climate Network (HCN) developed and maintained by NOAA) now has several hundreds location sites:

The Precipitation Network: 5873 sites
Agriculture: Pollen Disspersal

–data collected by S. A. Goggi (ISU, Department of Agronomy) and her team, in 2003 and 2004
Agriculture: Pollen Dispersal

Y-coordinate (meters)
Part II: Areal (Lattice) data

Map of proficiency in Math for 8-th graders in Wisconsin, 2003

Data were collected from an $8 \times 8 \times 1$ inch piece of old field habitat, from which mites were extracted and recorded as from one of 64 quadrats defined by a two-dimensional $1 \times 1$ inch grid placed over the exposed surface of the sampled habitat.
The data are reproduced below, showing the spatial distribution of these small counts.

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Hairston, Hill and Ritte analyzed these data with varying quadrat sizes by pooling adjacent 1 \(\times\) 1 inch squares, and computing for each an index of aggregation. In a comment on that analysis, R.M. Cormack points out that patterns of aggregation are fundamentally a question of “the behavior of neighbors”.

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Part III: Point Patterns

Plant Pathology–Infection in Papaya:
(data and images courtesy of Paul Esker)

–due to phytoplasmas (phytoplasma are microorganisms that are not culturable (i.e., they cannot be grown on agar media), however, they can cause devastating effects in crops).
This data was collected by Anna Padovan and Karen Gibb from Charles Darwin University (Darwin, Northern Territories, Australia), in conjunction with Forrest W. Nutter, Jr., Department of Plant Pathology (Iowa State University) in the Northern Territories of Australia. Plants were examined monthly and those suspected of being infected had samples taken for further testing to verify if the plant was infected. The use of molecular tools was used and results indicated that two dominant phytoplasma types were found: TBB (tomato big bud) and SPLL-V4 (sweet potato little leaf V4). These two pathogens are genetically similar to the yellow crinkle disease and based on the genetic makeup are in the faba bean phyllody. At the end of the 3-year study period, there were a total of 230 infected papaya (this includes both TBB and SPLL-V4). Of that, 76 were TBB while 154 were V4. This is approximately 6.2% of the total plants in the plantation. From these 3 plots, it appears that there may be something interesting spatially, especially when examining all infected trees or the V4-infected trees.
Nest initiation or nest destruction: (data and images courtesy of Dale Tessin)

Waterfowl nesting data collected during the breeding season of 1997 in Saskatchewan, Canada. The one fourth section field of nesting habitat searched contained 154 total nests, or nests initiated during the season, and 50 nests destroyed by predators. After nests were found, they were followed until the young successfully fledged or the nest was depredated.
This is a habitat map for the field, where greens represent grassland nesting habitat and blues represent open water. Both the black and yellow dots represent nest locations (black: initiation, yellow: depredated).