Using Mathematics on the Web and Other Computer Technology to Facilitate Learning

ITL Conference
Tuesday, March 19, 1:45 - 3:15

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Themes:

- communication of mathematics
- computation
- modelling
- visualization
- deduction

Jordan:

- *Blackboard; The Geometer's Sketchpad;* Graphing Calculator

Tiedemann:

- Analysis of spatial data -- visualization, statistical techniques modelling, testing of hypotheses

Lewis:

- *TeX* and more

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Education of teachers of mathematics (from elementary school through university)

a. A few favorite web sites:

- The first place to look -- http://mathforum.org/ the Math Forum (Drexel University; formerly hosted by Swarthmore University; funded by NSF; cited by all math sites, including AMS, MAA)
- Federal agencies with statistical services: http://www.fedstats.gov/agencies/ . This is an annotated bibliography, including Centers for Disease Control and Prevention, Bureau of Labor Statistics, Bureau of the Census, NASA.
- Neil Sloane's *On-Line Encyclopedia of Integer Sequences*: http://www.research.att.com/~njas/sequences/ .
- Chicago Public Schools: http://www.cps.edu/ ; Illinois State Board of Education: http://www.isbe.net/ .
- Stupid math tricks: http://www.cecm.sfu.ca/pi/yapPing.html .

b. Experiences with *Blackboard:* http://courseinfo.edu/ .

- "Practicum: MthT 589" -- threaded discussion; more productive than weekly meetings
- Probability and Statistics -- forced the issue -- good for interim reports on projects
- STEAC -- an idea whose time may never come.

c. *Geometer's Sketchpad:*

- Getting Started -- circumscribed circle
- Perspective drawing: Professor James Heitsch, Lou Ann Tollefson
- Other programs: *Maple, Mathematica, Logo, Excel*

d. Graphing Calculator

- Reform calculus
- Rational function, piecewise linear equation
- parametic equation
- χ^2

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Using Monte Carlo Methods in the Analysis of Spatial Patterns

The formal statistical material--that which supports part II in the outline below--comes form Ebdon, 1985. *Statistics in Geography*. 2nd ed. Blackwell. Everything else, including all program code, is my own and is distributed to students for use on ICARUS.

I. Introduction
- A. Why do we do this? ...in an attempt to understand spatial processes.
- B. What are spatial processes?
  1. conscious and unconscious "decisions" or documentable sequences of events that give rise to arrangements of things on landscapes
  2. examples: arrangements of points: cities and towns, eagles' nests, partiular tree species, lunar craters; of zones: census-tract data, crime incidences by police district, voting tallies by precinct
  3. arrangements we see are "artifacts" of the processes that gave rise to them
- C. Are there conceptual models of spatial processes?
  1. geography: central place theory
  2. notions of bird-nesting behavior, seed distribution, etc.

II. A quick review of "standard" pattern analytic methods, which involves
- A. having students fabricate two sets of hypothetical datasets
  1. use random number generaters to create point and quadrat data
  2. objectives: get people up and running on ICARUS, thinking in terms of what "random" MIGHT mean, and able to do some editting
- B. develop a real world dataset
  1. use immediately available means to come up with point and quadrat data for an assigned study area
  2. objective: learn some of the methods (and drudgery?) of developing real world data and preparing it for analysis
- C. and process fabricated and real data using a variety of analyses
  1. fixed quadrat methods (with multiple variations for each)
     - a. quadrat counts, single-process models
     - b. mixed-process models
     - c. join count methods
  2. floating quadrat methods
  3. neareast neighbor methods
     - a first and higher order neighbors

c. effects and implications of "biases" and "disturbances"

4. contiguity analysis for (fixed) quadrats
   a. Moran's "I" statistic
   b. Geary's "C" statistic
5. contiguity analysis for points
6. objectives: assess test capabilities, assumptions, formulation of working and null hypotheses, interpretatons, and data requirements

III. Shooting for more than "one-number ouotcomes," as in...

A. tease more information out of nearest neighbor analysis
   1. "standardizing" nearest neighbor distances
   2. size-spacing analysis of central places

B. and out of Geary's "C" statistic.
   1. computations resemble those for Chi-square
   2. contributing terms may lend themselves to K-S testing
   3. develop criteria for contextual evaluations of quadrat values

C. objectives: learn to identify "anomalous" observations and patterns

III. Extentions to "nonstandard" applications, as in...

A. locate potentially viable market centers in rural areas
B. support archeological "prospecting"
C. recognize possible "dispersed cities"
D. devise "geographic taxonomies"
E. objectives: add to existing knowledge and/or guide future research

TeX and More

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