Applications of GIS in School Enrollment Forecasting

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School Enrollment Forecasting: Background

- Facilities planning and capital budgets
- Distribution of teachers for next year
- Operating fund allocations
- Attendance area boundary adjustments
- *The methods discussed in this presentation were utilized by the Population Research Center in several studies carried out for school districts in Oregon and Washington in 1998-2001*

Demographic Methods Used in Enrollment Forecasting

- Simple Trend models
  - Used for large and small areas. Based on trends in student enrollment data.
- Cohort Component
  - Used for large geographical areas such as entire school districts. Based on fertility, mortality, migration, and capture rates.
- Grade Progression
  - Used for large and small areas. Based on trends in student enrollment data.
- Housing based
  - Used for large and small areas. Based on changes in the numbers and types of housing and the persons residing therein.

Cohort – Component Model: Data

♦ The model uses:

Population by age at outset

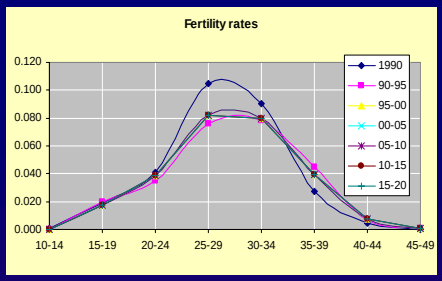
Age Specific rates for:

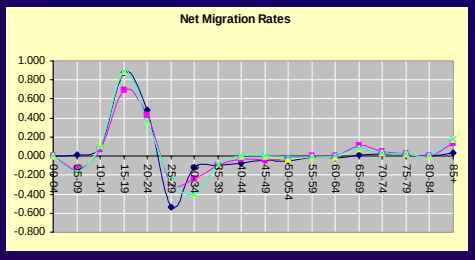
NM = Net migration

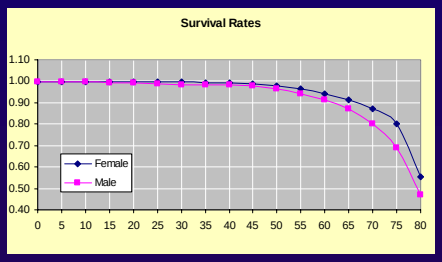
B = Fertility

D = Mortality

$Pop_{t2} = Pop_{t1} + B - D + NM$







Grade Progression Model

- The grade progression model is based on recent trends in student enrollments. It tracks the progression of cohorts.
- An example of such a cohort trend is the ratio of students in grade 6 this year compared to the number in grade 5 last year.

GRP: actual and forecasted enrollemnt														
	1989	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
01/K		1.036	1.023	1.038	1.098	1.087	1.059	1.081	1.047	1.029	1.082	1.069	1.013	1.016
02/01		1.025	1.018	1.018	1.010	0.985	0.976	1.023	0.976	0.993	1.002	1.065	1.050	1.038
03/02		1.018	1.009	1.015	1.008	0.971	0.963	0.975	0.956	0.959	0.959	0.992	1.023	1.026
04/03		1.014	0.954	0.985	0.981	0.957	1.000	1.021	0.986	0.987	0.972	1.013	1.004	1.010
05/04		1.018	1.013	0.988	1.011	0.938	0.970	0.973	0.956	1.000	0.989	1.048	0.976	0.984
06/05		0.993	1.010	0.968	1.047	0.960	0.974	1.069	1.016	0.987	1.000	1.045	0.993	0.996
07/06		1.005	0.976	0.997	1.000	0.971	0.992	1.011	0.995	1.005	0.968	1.068	1.071	1.047
08/07		0.989	1.012	1.004	1.010	1.007	1.003	1.011	0.982	0.977	0.961	1.087	1.013	1.016
09/08		1.051	0.995	1.015	1.042	1.007	0.986	1.031	1.060	1.068	1.084	1.127	0.978	1.002
10/09		0.988	0.973	0.996	0.985	0.975	0.992	1.041	0.978	1.012	1.020	1.005	0.954	0.962
11/10		0.964	0.994	0.954	1.005	0.922	1.015	0.985	0.950	0.956	0.940	0.975	1.120	1.084
12/11		0.953	1.012	0.994	1.029	0.961	0.984	1.018	1.045	1.040	1.036	1.055	0.998	1.000

Housing Units Method

- Method uses
  - Total population at outset
  - Number of residential building permits by housing type (BP)
  - Vacancy rates by housing type (V)

    BP * (1 - V) = Occupied housing units (HU_O)
  - Number of persons in households by housing type (PPH)

    HU_O * PPH = Persons added since the outset

    $Pop_{t2} = Pop_{t1} + BP * (1 - V) * PPH$

Geographical Scales Used

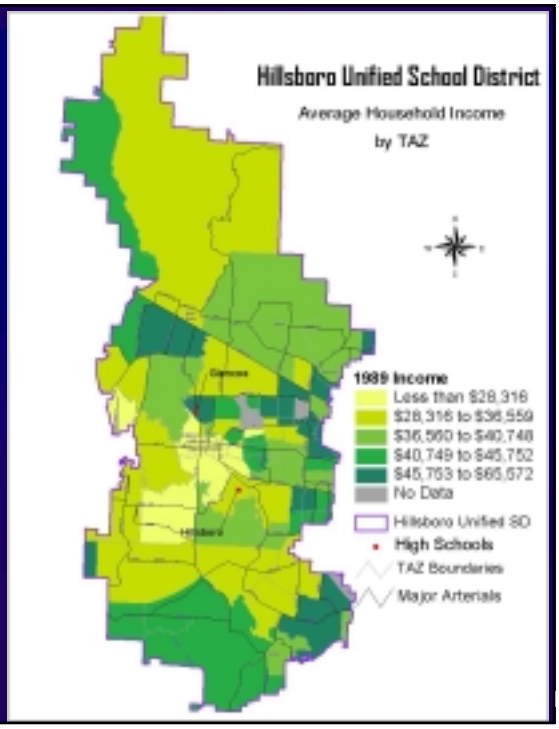
- Scale Types
  - District-wide
  - By attendance area
  - By Census tract
  - By TAZ
  - By planning areas
- Choice of the forecasting method depends on the scale and data available (e.g., cohort-component method vs. housing units method)
- Scale implications for accuracy of the forecasts

GIS Functions: Database Development

- Spatial database development
  - Importing, merging, re-projecting
- Geo processing:
  - Using overlay capabilities (e.g.., intersect/allocate)
  - Getting population and housing characteristics
- Geocoding:
  - Spatial distribution
    - Students by place of residence
    - Births by place of residence
  - Development of indicators of change
    - Housing constructions and demolitions (from building permits)
    - Net migration rates (from longitudinal student data)
    - Change in birth rates

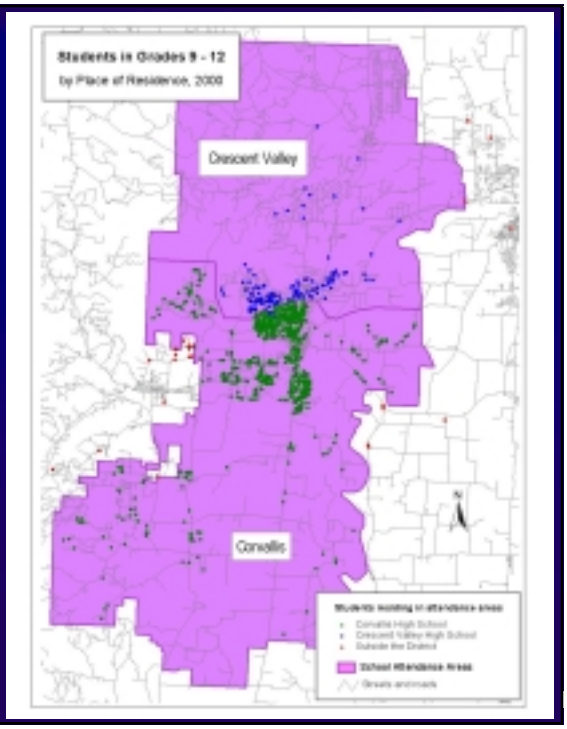
Overlay

- *1990 Census data on aggregate household income and number of households by block group was used to calculate average household income by TAZ (Transportation Analysis Zones)*



Geocoding

- *October 2000 student address file was geocoded to display the location (spatial distribution) of students by place of residence and school attending*



Geocoding (Indicators of Change)

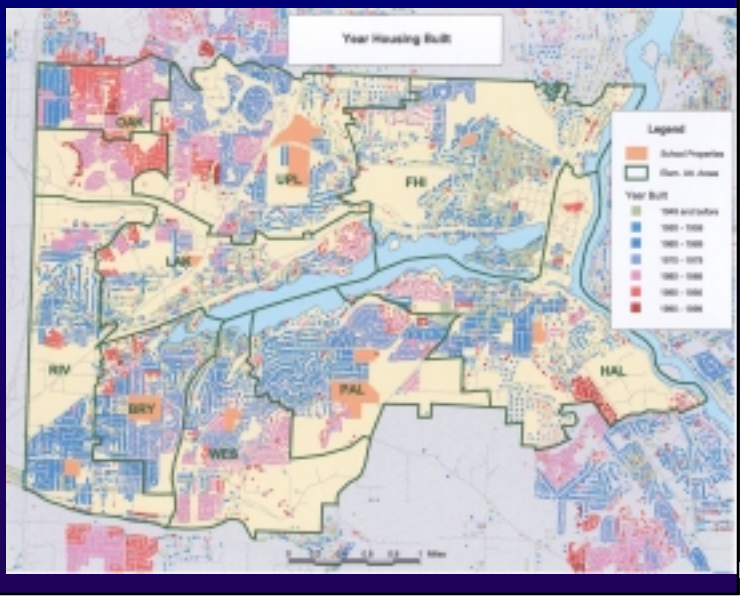
- *Students' residences in 1997 and 1998 were compared to identify in- and out-migrants to the District*

GIS Functions: Analysis

- Classification
- Grid analysis
  - Calculating density
  - Map algebra
- Redistricting
  - "Building blocks"?
- Unique Situations
  - "Transparent Boundaries"

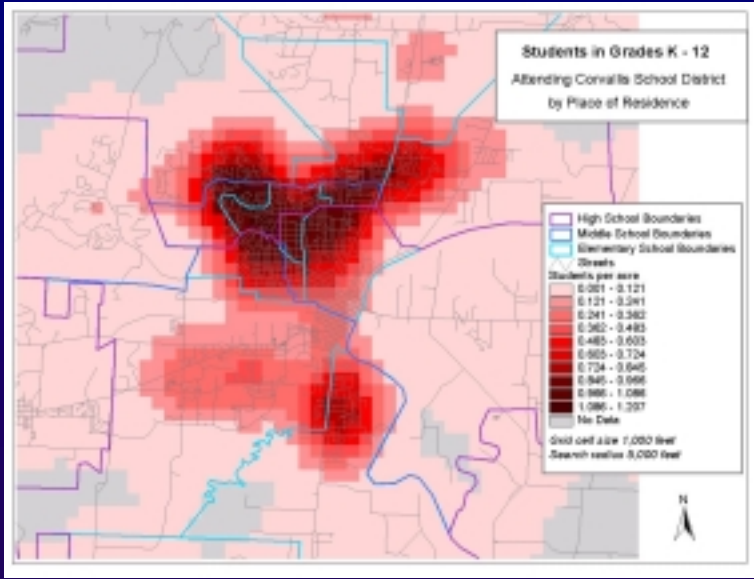
Classification

- *Individual properties (taxlots) classified by the year the house was built*
- *Polygon features transformed into point features*



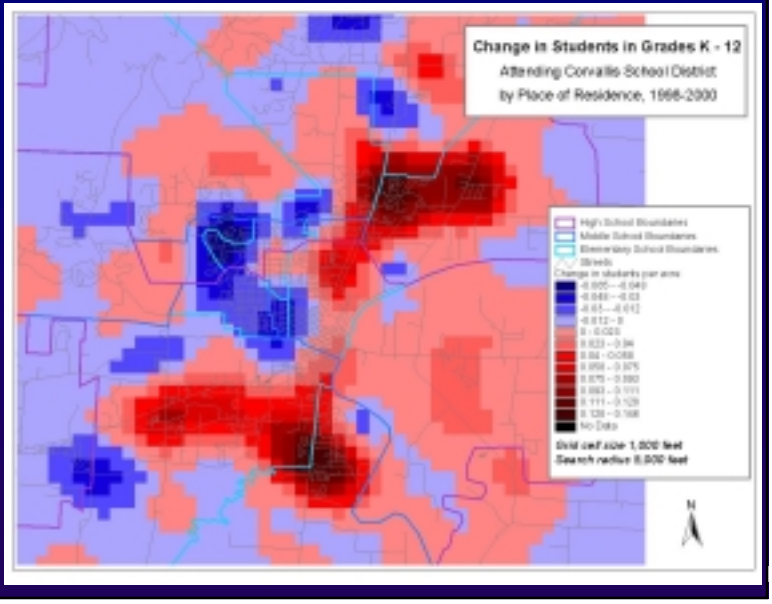
Density

- *Students' residences in 2000 were used to create a density grid*



Map algebra

- *Grids created from locations of students in 1998 and 2000 were used to calculate a change in student density*

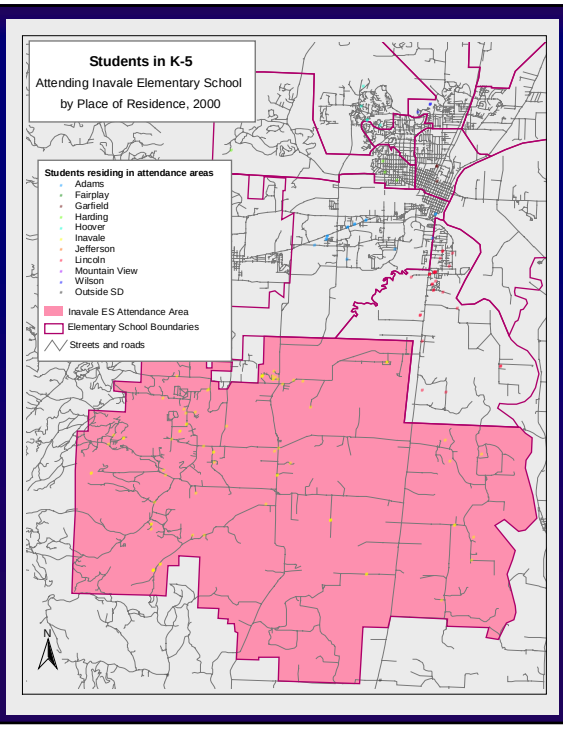


Redistricting

- *Planning areas range from TAZs and Census tracts to Census blocks, housing subdivisions, and households, or custom-designed areas*

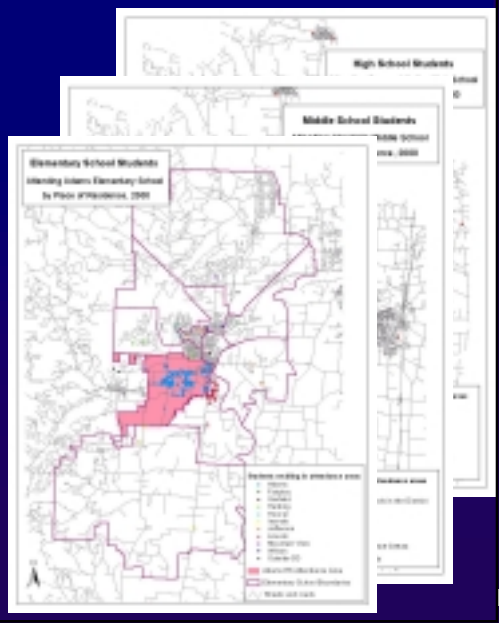
"Transparent boundaries"

- *Open enrollment policy creates unique problems when forecasting school attendance areas enrollments*
- *"Reside-attend" correspondence table is needed*



GIS Functions: Visualization

- Cartographic design
- Presentations in real time
  - Public participation
  - Redistricting scenarios



Conclusions: Applications of GIS in School Enrollment Forecasting

- The use of GIS in school enrollment forecasting is one of many niche areas in GIS. This area combines the use of GIS and demographic analysis.
- The range of GIS functions involved in this type of work is extensive but includes:
  - Spatial database development – bringing data together from diverse sources, importing, merging, and re-projecting.
  - Geo-coding – using multiple address reference sources and achieving high match rates and low error rates.
  - Tabular data – manipulating attribute data
  - Geo processing – point in polygon, point to point joins
  - Grid analysis – generalizing point data using grid methods
  - Cartographic design – communication counts for a lot