Holloway, S. R., Schumacher, J., and Redmond, R. L. 1997.

Dasymetric Mapping Using Arc/Info. Cartographic Design Using ArcView and ARC/INFO.

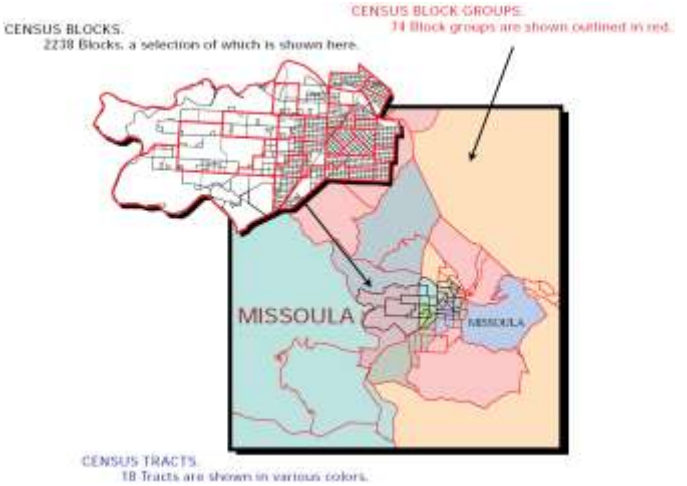
High Mountain Press, NM.

Data Enumeration Units & Mapping Units

- Aggregate data vs individual data
  - Census population / public use microdata sample (PUMS)
  - Traffic volume / speed
- Enumeration and mapping units
  - EU: the spatial extent in which the data were collected/recorded
  - MU: the spatial extent that shares the same map symbol

Aggregated Data

- Enumeration Units



Mapping Aggregated Data

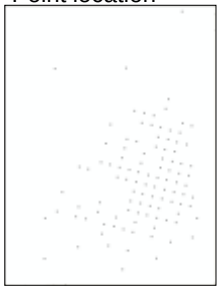
- Choropleth maps
  - Each spatial unit (polygon) is filled with a uniform color or pattern
  - Enumeration unit of data is the same as mapping unit
- Dasymetric maps
  - Each spatial unit (polygon or grid cell) is filled with a uniform color or pattern
  - Mapping unit is based on sharp changes in the statistical surface of data
  - A technique to spatially disaggregate aggregated data

Mapping Aggregated Data (cont.)

- Isopleth maps
  - No pre-defined mapping unit
  - Data are associated with point locations
  - Represented by lines of equal attribute value (e.g., contours)

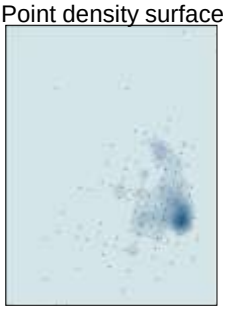
Example: Kernel Density Estimate (KDE)

Point location



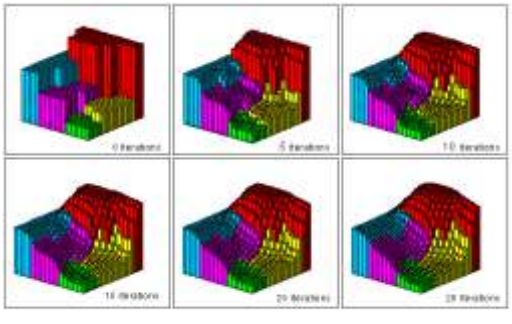
Point value

Point density surface



Mapping Aggregated Data (cont.)

- Pycnophylactic Smoothing Technique (Tobler 1979)
  - Pycnophylactic property: summing the variable values for all the mapping units within any enumeration unit produces the same variable figure as that originally assigned to that enumeration unit.



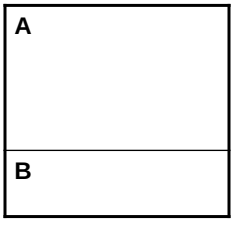
Pycnophylactic interpolation

Applications of Dasymetric Mapping

- Changing mapping unit (areal interpolation)
- Disaggregating aggregated information
  - Areal interpolation where mapping unit is a subset of enumeration unit
  - Areal interpolation where ancillary information is used (aka intelligent dasymetric mapping)

Area Interpolation

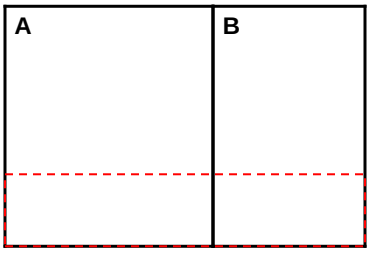
- Estimate the value of a mapping unit based on the values of associated enumeration units.



Example:
Total population: 100
Total area of enumeration unit: 10
Area of A: 7 (Proportion: 0.7)
Area of B: 3 (Proportion: 0.3)
What are the est. popu. In A and B?

Popu. A = Total Popu x Area Proportion of A
Popu. B = Total Popu x Area Proportion of B

Dasymetric Mapping (pro rata)



Enumeration Units:
A: Total popu: 300
B: Total popu: 100
Proportion of mapping unit in A: 0.3
Proportion of mapping unit in B: 0.3

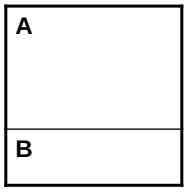
What's the popuation in the mapping unit?

300 x 0.3 + 100 x 0.3 = 120

Population and Population Density

- Popu. Density = Popu. / Area
- Popu. = Popu. Density x Area

Dasymetric Mapping with Ancillary Info

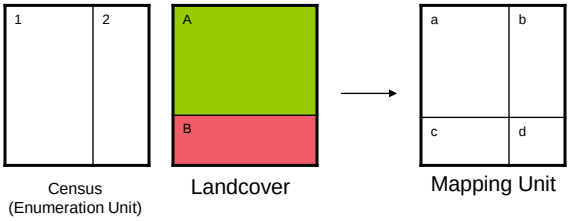


Example:
Total population N: 100
Total area of enumeration unit: 10 (unit^2)
Area of A A_A : 7 (unit^2)
Area of B A_B : 3 (unit^2)
B's population is twice as dense as A's (i.e., relative density A : B = 1 : 2)

Actual density of A and B: 1 x K, 2 x K (K is a constant)
Actual population of A and B: 1K x 7, 2K x 3
Total population 100 = 1K x 7 + 2K x 3
K = 100 / 13
Population of A = 1K x 7 = 100 / 13 x 7 = 53.85
Population of B = 2K x 3 = 2 x 100 /13 x 3 = 46.15

$K = N / (R_A x A_A + R_B x A_B)$
$P_A = R_A x A_A x K$, $P_B = R_B x A_B x K$
$P_{mu} = (R_A x A_A) x N / E$
$E = R_A x A_A + R_B x A_B$

Dasymetric Mapping (cont.)



Census (Enumeration Unit) | Landcover | Mapping Unit

$P_{mu} = (R_A x A_A) x N / E$

E_ID	Area	N
1	60	100
2	40	25

L_ID	Area	RD
A	70	0.1
B	30	0.9

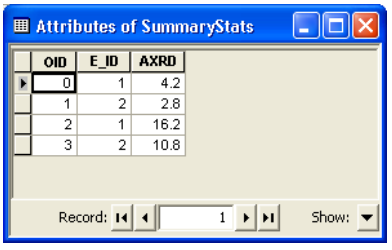
O_ID	Area	E_ID	L_ID	N	RD	A*RD	E	P=A*RD*N/E	P
a	42	1	A	100	0.1	4.2	20.4	4.2 x 100 / 20.4	20.59
b	28	2	A	25	0.1	2.8	13.6	2.8 x 25 / 13.6	5.15
c	18	1	B	100	0.9	16.2	20.4	16.2 x 100 / 20.4	79.41
d	12	2	B	25	0.9	10.8	13.6	10.8 x 25 / 13.6	19.85

E_ID	E=Sum(A*RD)
1	20.4
2	13.6

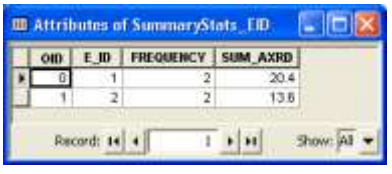
- ArcToolBox

  Analysis Tool toolset -> Statistics -> Summary Statistics

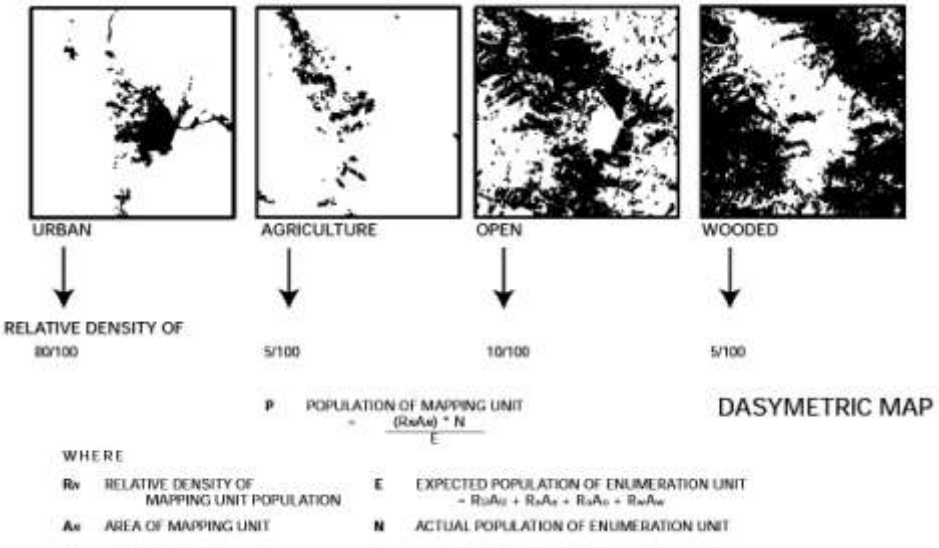
Input table



Output table



Dasymetric mapping



Choropleth vs Dasymetric Maps

A

B

Grid-based Dasymetric Mapping (Lab 4)

$$P_{mu} = (R_A \times P_A) \times N / E$$

$$P_{cell} = (R_A \times P_A/P_A) \times (N / A_T) / E$$
$$= (R_A \times N / A_T) / E$$

Where,

P_{cell} is the population of a cell,

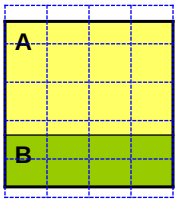
R_A is the relative density of a cell with land-cover type A,

P_A is the proportion of cells of land-cover type A in the enumeration unit.

N is the actual population of enumeration unit (i.e., census block group)

E is the expected population of enumeration unit calculated using the relative densities.

A_T is the total number of cells in the enumeration unit.



P_A / P_A cancels P_A out of the equation, i.e., not used in the cell-based method.