Quantifying Town Development

in Space and Time using Land Use Data

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JOANNEUM RESEARCH – POLICIES

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🟨 **uncontrolled spreading out of built-up areas**

> "A gallon of gas can be used up just driving to get a gallon of milk."
> - Al Gore (1999)

Main components of Urban Sprawl:

🟨 Low density zoning

🟨 Single family homes on large plots

🟨 Congestion due to increased car use

www.lsgraves.com

Measuring Urban Sprawl

"We know that sprawl is significant,
but we are not sure
what it is exactly or how to measure it."
- Frenkel and Ashkenazi (2008)

(1) Density Measures

- ◾ Population density of the whole area:

$$D_1 = \frac{population}{whole\ area}$$

- ◾ Population density of the built-up area:

$$D_2 = \frac{population}{built-up\ area}$$
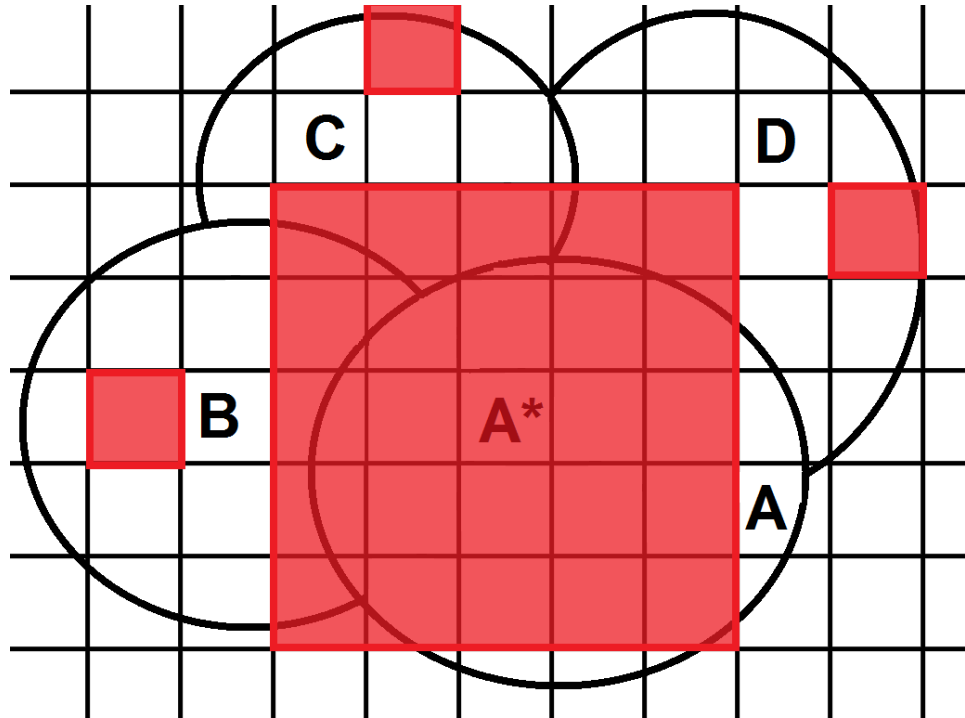
Population doesn't spread evenly across all land use types (e.g. nationalparks, water, industry area, …)

Decreasing population density ⇌ increasing urban sprawl!
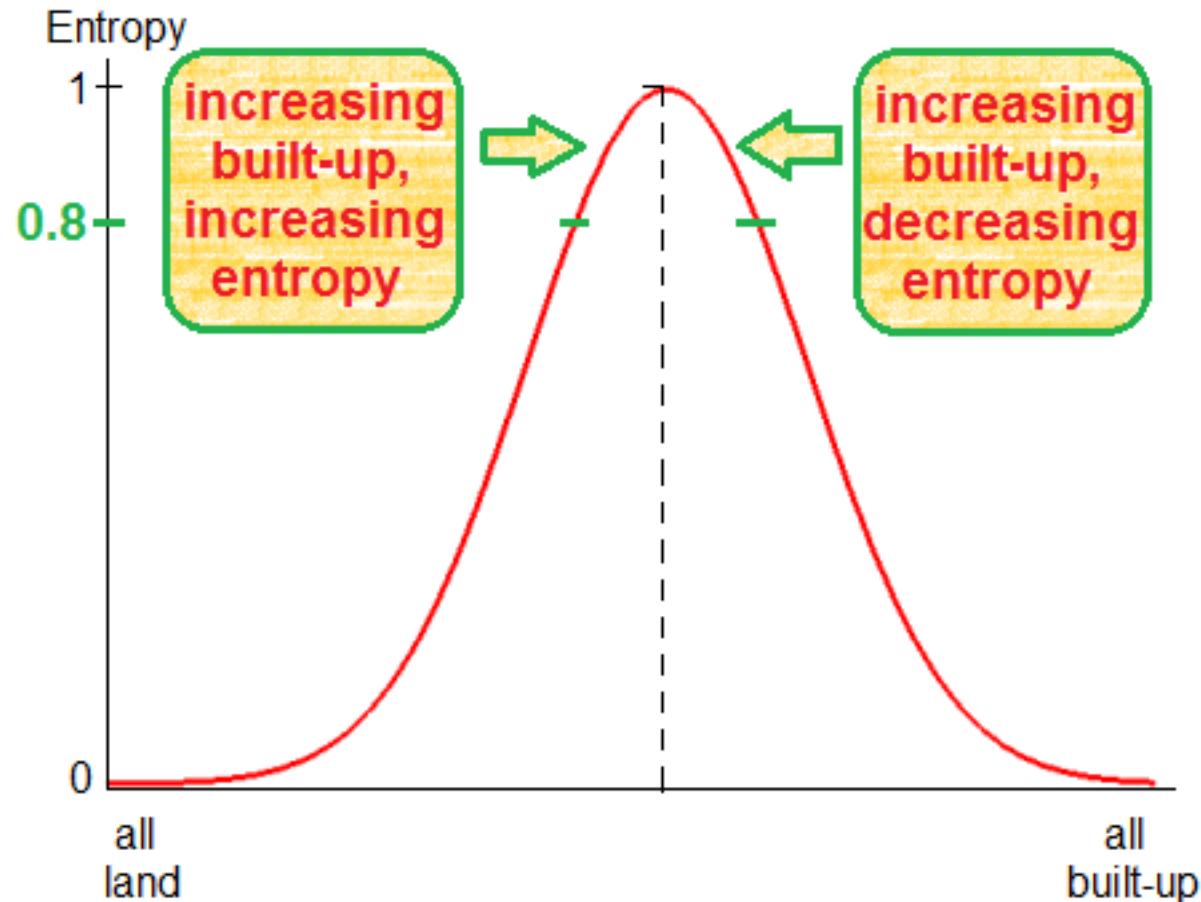
That's not always true!

(2) Shape based Measures

🟨 Often **political** boundary does not coincide with its **functional** boundary (no population data available)

Entropy Measures

- Ranges from 0 to 1

  - 0: no sprawl, very compact; 1: high sprawl, very dispersed
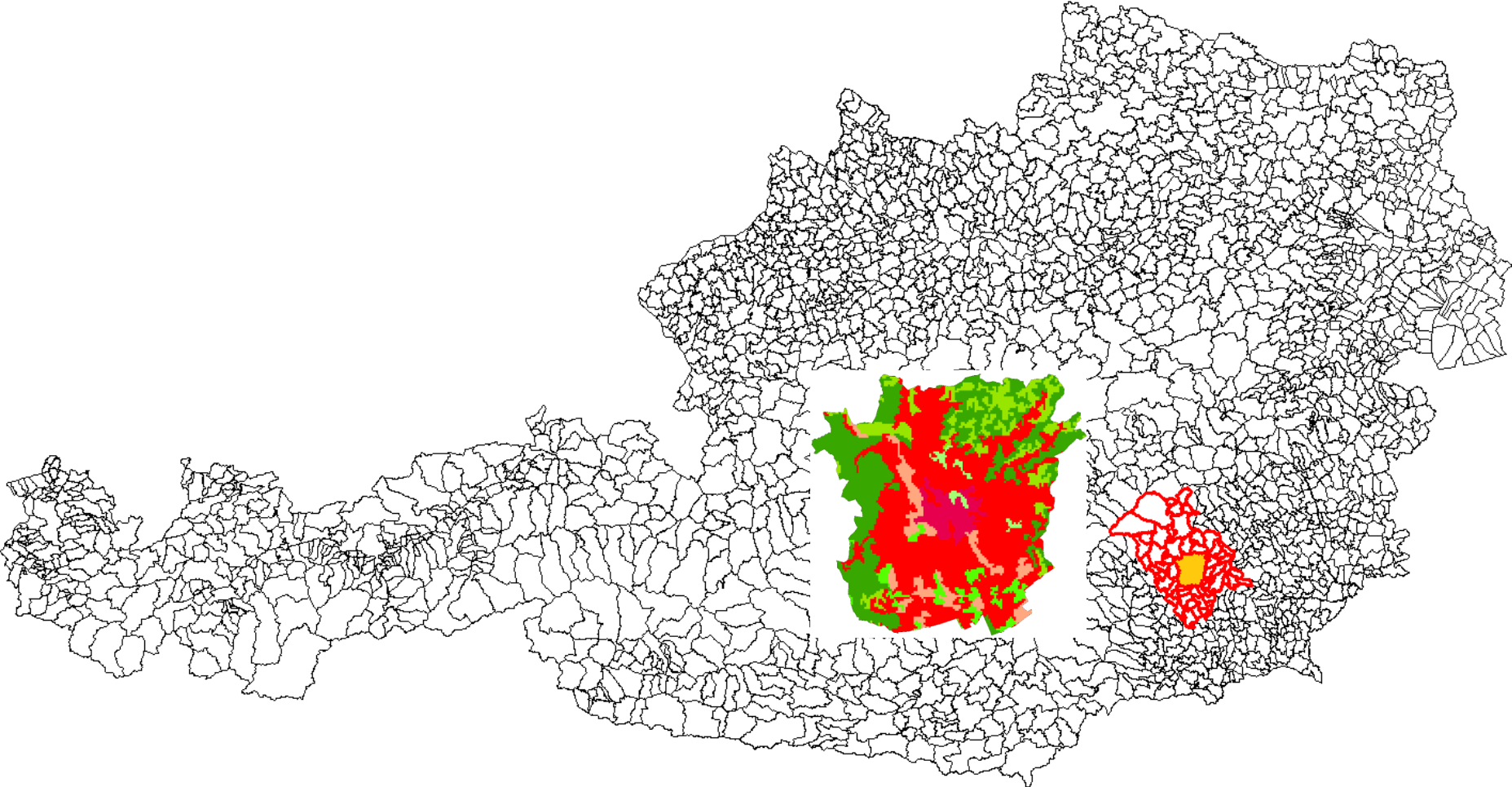
$$E = -\sum_i p_i \cdot \log(p_i)$$

$$p_i = \frac{x_i}{\sum_i x_i}$$

- Entropy Measure E_1 with population density D_1
- Entropy Measure E_2 with population density D_2
- Entropy Measure E_3 with density of built-up area

increasing entropy ⇨ increasing urban sprawl

Results

decreasing increasing urban sprawl

Sprawl Measures	Density D_1		Density D_2		Entropy E_1		Entropy E_2		Entropy E_3	
	2000	2006	2000	2006	2000	2006	2000	2006	2000	2006
Graz	1.781	1.944	3.140	3.635	0.901	0.928	0.952	0.937	0.978	0.990
Surrounding communities	108	123	323	297	0.914	0.914	0.924	0.931	0.981	0.979
Graz including surrounding area	281	311	614	642	0.913	0.915	0.927	0.932	0.981	0.981

Urban Sprawl has many faces, we need different techniques!

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