City shape, scale, and heterogeneity

Christa Brelsford
Is there an ideal city form?

Brelsford, Martin, Hand & Bettencourt, SFI working paper
Die Fürstliche Haupt-Statte Königsberg
in Preußen
(a) Königsberg in 1736

(b) Euler's graphical representation
\[ \chi = 1 - b \]
\[ \chi = v - e = 1 - b \]
New York City
Midtown Manhattan

Nicholas de Monchaux, UC Berkeley
Cape Town, South Africa

This map shows a block in Khayelitsha, a township in Capetown, South Africa. These parcels were identified from March 2009 aerial photography, in conjunction with a data collection exercise by SDI South African Alliance and the Santa Fe Institute. In this map, black lines show new roads and paths, orange outlines parcels with no direct access to roads or paths. Parcels with street access are outlined in grey.

639m of paths
22,513m² of parcels
2.13% of area needed for paths
184 isolated parcels

Step Selector
A. Epworth: minimally connected
A. Epworth: minimally connected

B. Khayelitsha: minimally connected
A. Epworth: minimally connected

B. Khayelitsha: minimally connected

C. Khayelitsha: Four Bisecting Paths
By Nosmot Gbadamosi, for CNN

Updated 5:37 AM ET, Wed July 6, 2016

Photos:
\[ Y_j(N) = Y_0 N_j^\beta e^{\epsilon_j}, \]
Self Identified Development Priorities
$X_i = X_i^{housing} \times X_i^{water} \times X_i^{sanitation} \times X_i^{electricity}$
Measures of Heterogeneity

- Standard deviation

\[ \sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2} \]
Measures of Heterogeneity

- Standard deviation
  \[ \sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2} \]
- Gini Coefficient
Measures of Heterogeneity

- Standard deviation
- Gini Coefficient
- Moran’s I

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2}$$
$\sigma = 0.306; \text{ Gini} = 0.083; \text{ Moran's } I = 0.045$
\[ \sigma = 0.306; \quad \text{Gini} = 0.083; \quad \text{Moran’s I} = -0.030 \]
\( \sigma = 0.505; \) \( \text{Gini} = 0.168; \) \( \text{Moran’s I} = 0.247 \)
\( \sigma = 0.505; \) Gini = 0.168; Moran’s I = -0.090
\[ \sigma_i = b_i \sqrt{X_i(1 - X_i)}, \]
thanks!