



ITU Kaleidoscope 2013
Building Sustainable Communities

Intra-City Digital Divide Measurements Through Clustering Algorithms

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Motivation of the research...

There are no studies, neither in the literature nor in practice to understand the gap and its nature between ICT users in a city.

Goal: quantification of digital gap within social, economic and physical dimensions by neighborhood level in Istanbul through clustering algorithms.

Actual questionnaire data, collected from 1140 distinct respondents from different neighborhoods in Istanbul is standardized and clustered. 6 clustering techniques:

- pure k-means (C1),
- z-score k-means (C2),
- USTD k-means (C3),
- Hierarchical clustering (C4),
- controlled k-means (C5)
- fuzzy c-means (C6)

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ICT SERVICE TYPES THAT ARE ASKED TO RESPONDENTS.

Internet	Fixed Line	Mobile Phone
3G	Home Line (PSTN)	3G
Wi-Fi hot spots	Mobile: 2G	2G
xDSL	Mobile: 3G	WiFi hot spots
Fiber	Mobile: VoIP application	
WiMAX		

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Main categories and answers for each of the households	
Geographic structure:	
-	Gender,
-	Age,
-	Place of birth,
-	Mother tongue,
-	Literacy.
Economic Structure:	
-	Occupation status,
-	Monthly income.
ICT ownership and use:	
-	Number of mobile phones,
-	Network type,
-	Invoice type,
-	Computer usage and frequency (hour/day)
-	Internet usage and frequency (hour/day)
-	Place of internet accessibility
-	Mobile phone usage,
-	Mobile services,
-	Reasons of computer use,
-	Reasons of internet use,
-	Mobile phone applications.
ICT Education:	
-	Date of learning computer skills,
-	Date of learning internet skills,
-	Place of learning computer skills,
-	Place of learning internet skills.
Expenditure for ICT services:	
-	Monthly expenditure for cellular phone.

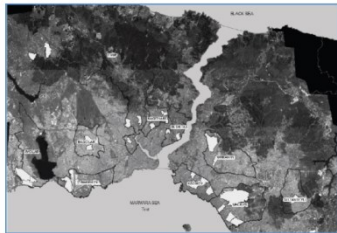


Figure 1: 31 Selected Neighborhoods, labeled white

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TABLE 2. COMPARISON OF CLUSTERING METHODS

	C1	C2	C3	C4	C5	C6
C1	1	0	0	0	0	0
C2	0.58	1	0	0	0	0
C3	0.58	1.00	1	0	0	0
C4	0.84	0.56	0.56	1	0	0
C5	0.99	0.57	0.57	0.84	1	0
C6	0.85	0.59	0.59	0.78	0.84	1

ANALYSIS AND RESULTS

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TABLE 1. ASSIGNED CLUSTERS AND THEIR SIZES

	Digital Literates (%)	Digital Immigrants (%)	Digital Illiterates (%)
C1	23	35	42
C2	51	26	23
C3	51	26	23
C4	31	35	34
C5	23	35	42
C6	32	24	44

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TABLE 3. CLUSTERS' VALIDATIONS

	Validation Ratio	V ⁻¹	Acceptance
C1	0.58	0.0428	0.02500
C2	0.76	0.6950	0.53041
C3	0.76	0.6950	0.53040
C4	0.66	1.3285	0.87285
C5	0.58	0.0428	0.02490
C6	0.56	1.2625	0.71099

