



SCORUS 2018

Data and Methods for Territorial

Modelling: LUISA case study

Presented by Ricardo Barranco ricardo.barranco@ec.europa.eu

Territorial Development Unit (JRC.B3)

Warsaw, 8th June 2018

Joint Research Centre the European Commission's in-house science service

Contents

- 1. LUISA Territorial Modelling Platform
- 2. Conventional Data Sources: Buildings & Dwellings stock
- 3. Unconventional Data Sources: Big Data (TripAdvisor & Booking.com)
- 4. Applications and Projects: (Tourism analysis)
- 5. Applications and Projects: (ENACT project)
- 6. Innovative Methods: Machine Learning





European Commission – Joint Research Centre (JRC)



As the European Commission's science and knowledge service, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

> Science and Research for Policy Support



1000	

- A **platform** of inter-linked data, processes, models and indicators;
- Conceived to contribute to Territorial Impact Assessment of EU policies;
- Linked to several upstream models to capture multi-sector trends and multi-policy scenarios;
- Designed to make scenario-based projections in a multi-scale framework;
- New approach towards activity-based modelling;
- Producing 50+ indicators which cover most policy-relevant domains
- Coverage/Resolution: EU-28 (+ Balkans), 100x100m, 2015->2050, 1- or 5-years step
- Thematic detail: 17 simulated land functions and land cover classes





1. LUISA Territorial Modelling Platform





LUISA Approach: Spatial Allocation Module



00000

Conventional data sources: official statistics (Buildings & Dwellings stock)





Objective

To identify spatial patterns, at the municipal scale or within single cities, of **energy consumption** levels of residential buildings, for the whole of the EU28.

To investigate quality of life at sub-municipal level, as impacted by local factors amongst which: quality of the built environment, availability and quality of public spaces, local environmental characteristics, and behavioural patterns.

Data overview (National Statistical Offices & Agencies):

- Buildings & occupants characteristics
- Construction sector statistics
- Volume of transactions
- Property values (residential, industry, and commerce & services)
- Topographical DBs and high resolution data for cities
- DB for spatial planning instruments
- Reference DBs for local weather data

Llevel	II level	III level	1	V level	AT	BE	BG CY	CZ	DE	DK EE	ES I	FI FI	RGR	HR H	IU IE	IT	LT LL	JLV	MT N	IL PL	. PT	RO S	E SI	SK L	ЈК Т	OTAL
			residential		1	✓.			× .	< <	× -	 Image: A second s		1		× .	~	1		\checkmark	× .			\checkmark		14
			tertiary		1	× .				× .		× -						1								5
			industial		1	✓				 Image: A set of the set of the		 Image: A second s						1								5
			transport/communication		1	×	× .			 Image: A set of the set of the		 Image: A set of the set of the						1								6
		Building use	services (+ hostels)		1	✓	× .			11	× -	 Image: A second s					1	1			1					10
			vacant					×		1								1		1						4
			second house/ summer house				× .			 Image: A set of the set of the								1		T	1		C			5
			other		1	✓				 Image: A set of the set of the				1												4
			social housing																		× .					1
			house				< <	<	× 1	< <		1			1		1	1	-	1			1	×		13
				attached								×			1		~	·	~	1						4
				detached								 Image: A set of the set of the	1		1		1	1					1			6
			block of flats				< <	1	1	11		< <	r -		1		1	1	~	1				×		13
		Pullding type	mixed (over 60% living space)				< <													\top						2
		building type	duplex				1						1							T						2
			row house /terraced				1		× .	< <								1								5
			country house/ back yard house /fa	rm house			< <			< <			1				1	1		\top			1			8
			primitive				× .					1	r -		1						1					4
			mobile				× .										1	·								2
			water supply		1			×			×													✓		4
				individual	1															\top				✓		2
				public	1															T				✓		2
				other	1															\top				✓		2
			sewage disposal		1			×			×													✓		4
				individual	1																			×		2
				public	1			✓.																✓		3
				cesspool	1																			✓		2
				septic tank																				✓		1
		Building characteristic		other	1																			✓		2
			gas supply																					✓		1
			elevator available		✓.						× .	1				× .					× .					5
			cellar								1			1												2
			number of floor		✓.	✓.		<			1			1		1								× -		7
			garage								1															1
	Characteristics		accessible/disable friendly								× .										× .					2
	characteristics		volume			$\checkmark ~$																				1
			surface area /floor area			$\checkmark ~$				 Image: A set of the set of the										\checkmark						3
				habitable I groos floor area		$\checkmark \cdot$						 Image: A second s														2
			central heating in whole building		\checkmark			×	1	 Image: A second s																4
			central heating in dwelling		\checkmark																					1
			individual stove		\checkmark				1	 Image: A set of the set of the																3
		Kind of beating of buildings	district heating		\checkmark				× 1	 Image: A set of the set of the																3
		Kind of heating of buildings	built-in electric heater		1					× .																2
			block heating		\checkmark				1																	2
			no central heating		1				1																	2

number	6 4 1 5 5 4 4 22 7
floor space floor space i	4 1 5 5 4 4 22 7
breaking permits (and new bwennig) volume volume<	1 5 5 4 4 22 7
use one or more usual residents i <t< td=""><td>1 5 5 4 4 22 7</td></t<>	1 5 5 4 4 22 7
one or more usual residents Image: sident siden	5 5 4 4 22 7
Dwelling occupancy no usual residents Image: Additional content of the second content of	5 4 4 22 7
Dweiling occupancy	4 4 22 7
permanently \checkmark	4 22 7
not permanentely and the second s	22
owner occupied v	7
occupied	
relatives of house owners	2
Dwelling tenure* rented/tenancy/reserved vv	22
subtenancy	1
freehold V V V V V V V V V V V V V V V V V V V	10
official dwelling(as income in kind)	1
	2
on sale	2
empty 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	14
others V V	3
public V V V V V V V V V V V V V V V V V V V	11
	3
	2
private $\sqrt{2}$	12
by the court by the court	1
Dwelling eviction	1
Energy consumption of households	2
water (number)	1
water (percapita)	1
ags (number)	1
ags(percapita)	1
Number of household I	20
Number of household/floor level	1
Number of persons in household \checkmark	14
family V V V V V V V V V V V V V V V V V V V	11
Household type Image: Mail of the second secon	8
institutional V V V V V V V V V V V V V V V V V V V	4
SEX SEX	11
age 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	11
	18
single father 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	9
Single mother Image: Single mother Image: Single mother	9
single with children	11
cohabiting couple/other type of cohabitation	12
family status children V V V V V V V V V V V V V V V V V	10
	17

Cοι	ज्ञ Typology/file name 🚽	Typology LUISA Reclass	 Geographical detail 	Temporal coverage	Source 🗸	Note 👻	Link
A	T Characteristics of building	Building characteristic	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Buildings completed	Building completed	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Subsequent construction measures	Building intervention	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Owner of building	Building ownership	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Building permits	Building permits	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Use of building	Building use	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2010 2011	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Construction period	Construction period (B)	NUTS2/LAU2 above 10000	1919-2001 or later	Census		http://statcube.at/statistik.at/ext/statcu
A	T Housing costs	Dwelling cost	NUTS2/LAU2 above 10000	1974-1985 / 1986-1993 / 1994-2003 / 2004	Other		http://statcube.at/statistik.at/ext/statcu
A	T Equipment standard of dwelling	Dwelling facilities	NUTS2/LAU2 above 10000	yearly, from 1971 to 2015	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Roooms/Floor space	Dwelling size 1	NUTS3	1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Roooms/Floor space	Dwelling size 2	NUTS2/LAU2 above 10000	1974-1985 / 1986-1993 / 1994-2003 / 2004	Other		http://statcube.at/statistik.at/ext/statcu
A	T Floor level	Dwelling size 3	LAU1/LAU2 above 10000	1991, 2001	Census		http://statcube.at/statistik.at/ext/statcu
A	T Legal basis of dwelling	Dwelling tenure	NUTS2/LAU2 above 10000	1974-1985 / 1986-1993 / 1994-2003 / 2004, 1991, 2001, 2011	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Use of dwelling	Dwelling use	NUTS2/LAU2 above 10000	1974-1985 / 1986-1993 / 1994-2003 / 2004	Other		http://statcube.at/statistik.at/ext/statcu
A	T Running costs declared	Dwellings with running costs	NUTS2/LAU2 above 10000	1974-1985 / 1986-1993 / 1994-2003 / 2004	Other		http://statcube.at/statistik.at/ext/statcu
A	T Energy consumption of households	Energy consumption of households	NUTS2	2003-2004 / 2009-2010 / 2011-2012 / 2013-2014	Other		http://statcube.at/statistik.at/ext/statcu
A	T Heating of buildings	Heating of buildings	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Heating of dwellings	Heating of dwellings	NUTS2/LAU2 above 10000	yearly, from 1971 to 2015	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Age, sex, income of household representative	Household characteristics /family status	NUTS2	yearly, from 2004 to 2016	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Household type	Household type	NUTS2/LAU2 above 10000	yearly, from 1960 to 2015	Other, Census	LAU2 above 10000	http://statcube.at/statistik.at/ext/statcu
A	T heating predominant system	Kind of heating of building	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Heating predominant system	Kind of heating of dwelling	NUTS2/LAU2 above 10000	yearly, from 1971 to 2015	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Newlly built of whole buildings	New Buildings	NUTS2/LAU2 above 10000	1970-1979 / 1980-2002, 1971, 1981, 1991, 2001	Other, Census		http://statcube.at/statistik.at/ext/statcu
A	T Number of Buildings	Number of buildings	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Buildings with dwelling	Number of buildings with dwelling	NUTS2	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Number of dwellings	Number of dwellings	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Kind of building	Number of dwellings in building	NUTS2/LAU2 above 10000	1971, 1981, 1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
A	T Dwellers	Number of households	NUTS3	1991, 2001, 2011	Census		http://statcube.at/statistik.at/ext/statcu
В	E Number of floors	Building characteristic	LAU2	1995-2015	Other		http://statbel.fgov.be/fr/statistiques/ch
В	E Surface area	Building characteristic	LAU2	1995-2015	Other		http://statbel.fgov.be/fr/statistiques/ch
В	E Volume	Building characteristic	NUTS1	yearly, from 1980 to 2015	Other		https://stat.nbb.be/Index.aspx?DataSet
В	E Type of intervention (newly built of entire building	n Building intervention	LAU2		Other		http://statbel.fgov.be/fr/modules/public
В	E Building ownership	Building ownership	LAU2	before 1919, 1919-1945, 1946-1960, 1961-1970, 1971-1980, 1	S Census		http://census2011.fgov.be/download/do
В	E Building permit	Building permits 1	NUTS1	yearly, from 1980 to 2015	Other		https://stat.nbb.be/Index.aspx?DataSet

AT Language Metadata [EN] [D] Relevant definitions

Building

A building is defined as any independent structure containing one or more conventional dwellings or other units, covered by a roof and enclosed within external freestanding walls or, in the case of a closed structure, by a firewall from roof to cellar, and that is used for residential and/or other commercial purposes. If such structures are subdivided by means of their own access systems (own entrance and staircase) and supply and disposal systems, each part represents a building (e.g. apartment blocks, semi-detached and terrace houses). There are many different types of buildings, e.g. residential buildings, buildings for communities, hotels and other buildings for short-term accommodation, office, wholesale and retail buildings, transport and communications buildings, industrial and storage buildings, buildings for cultural and recreational purposes, educational and healthcare buildings as well as churches and other religious buildings.

Dwelling (conventional dwelling)

Conventional dwellings are structurally separate units with their own entrance from the street, or a stairwell in permanent buildings, that are suitable for residential purposes. Dwellings consist of one room or multiple rooms with ancillary rooms. It makes no difference whether a kitchen or kitchenette is present.

Year of construction (decade period)

The year of construction is the year in which the building was completed for habitation. In the case of entirely destroyed and reconstructed buildings, the year of construction is the year of reconstruction.

Kind of building

The distinction between residential building and non-residential building is based on the answers to the questions concerning 'predominant use', 'agricultural holding', 'local unit of employment' as well as the share of residential space. Residential buildings must contain dwellings as well as a sufficiently large floor space:

Plus seat of an agr.holding: 1-2 non-holiday dwellings (at least 1 'main residence'): at least 25 per cent

1-2 dwellings and no local unit of employment: at least 25 per cent

1-2 dwelling and local unit of employment: at least 50 per cent

More than 3 dwellings: at least 50 per cent

With additional usage: 25 to under 50 per cent

Private households

All persons living in a dwelling as their main residence form a private household (householddwelling-concept). Institutional households: Establishments that are used for the accommodation and care of a group of persons – normally over the longer term. Primary homeless persons: Persons with a residence confirmation which enables them to prove residency.

Providers

Austrian Central Statistical Office

Overall Statistics:

- Total number of indicators: 334
- Indicators divided by country: 759

\mathbf{O}

Unconventional data sources: Big Data (Web scraping TripAdvisor & Booking)







Data collected:

- Lat/Lon
- Туре
- Reviews/Season
- Rating
- Date 1st Review
- Keywords
- Num Rooms
- Min-Max Price



TripAdvisor Dataset: EU28 - 2017





Data collected:

- Lat/Lon
- Туре
- Reviews/Season
- Rating
- Date 1st Review
- Keywords
- Num Rooms
- Min-Max Price



Valletta



Spring

Summary Statistics

Total Points: | 104

Total Reviews: 353 055 **Avg Reviews: 3**20 Std: 577.59 Max: 5 990 **Avg Rating:** 3.6

Malta island: Stable all year tourism, mainly in Valletta, Sliema and Rabat cities.

Gozo & Comino islands:

10 km

Strong seasonal tourism. Possible indication of less structured economy (lack off-season attractiveness).



SPRING

29577

21154



Summary Statistics

Total Points: 4 077 **Total Reviews:** 736 865

Attractions Points: 705 Attractions Reviews: 272 636

Hotels Points: 679 Hotels Reviews: 219 073

Restaurants Points: 2 640 Restaurants Reviews: 245 140

Madrid:

Motorways seem to have a strong geographical relation with the points of interest.



Tourist Accommodation Establishments: EU28 - 2017



Applications and projects (Tourism analysis)





ricardo.barranco@ec.europa.eu



Objective

To map tourism density at the highest possible temporal and spatial resolutions, for the whole of the EU28.

Tourism density was defined as the number of tourists present in a given location at a given time.

Main challenge: Available statistics from Eurostat are limited in terms of the spatial and temporal resolutions:

 Table 1. Data and sources used.

Ref.	Variable / dataset description	Spatial resolution	Temporal resolution	Reference year	Source(s)
а	Nights-spent at tourist accommodation establishments	NUTS-2	Annual	2016	Eurostat
b	Number of bed-places	NUTS-3	Annual	2011	Eurostat
с	Nights-spent or arrivals at tourist accommodation establishments	NUTS-2/3	Quarterly or monthly	2011	National Statistical Offices
d	Location and capacity (no. of rooms) of tourism accommodation facilities	Lat. and long. coordinates	Not applicable	2017	Online booking services









00



Methodology

- 1. Downscale total nights-spent from NUTS-2 to NUTS-3 proportionally to the number of bed-places available at NUTS-3;
- 2. Breakdown the nights-spent at NUTS-3 by months using the share of nights-spent (or arrivals) per month, derived from



- 3. Transform the resulting monthly nights-spent at NUTS-3 to 'average daily number of overnight tourists' (e.g. each 31 nights-spent in the month of January correspond to an average of 1 tourist on a daily basis).
- 4. Disaggregate the average daily number of overnight tourists per month and per NUTS-3 to grid level proportionally to the tourism accommodation capacity (i.e. room density grid).







Monthly tourism density in Northeast Italy





Tourism intensity, seasonality and vulnerability.



Applications and projects (Enhacing ACTivity and population mapping: ENACT)





What is (was) missing in population distribution?

- Current knowledge of population distribution is limited to residential or night-time population, based on place of residence statistics.
- No official records of where people are **during the day**, nor in **different seasons** of the year...

Main objectives

- To produce multi-temporal population grids for Europe that take into account both daily and seasonal variations.
 - Spatial coverage: EU-28
 - Temporal resolution: 12 months, night and day
 - Spatial resolution: 100 m (working resolution) 1 km (for dissemination)



Methodology

Creation of population grids by disaggregating regional population stocks to grid level, using location of activities as spatial proxies.













Night-time population density

Day-time population density



Validation

Difference between Day- and night-time

(derived from Proximus mobile network data)



LUISA



russe

Charlero

Lièae

5.00 4.50 4.00 3.50



Belgium (ENACT vs Mobile data)

R-squared: 0.696

Allocation accuracy: 77.0%

Italy (ENACT vs Census 2011)



R-squared: 0.973

Allocation accuracy: **84.6%**



Innovative Methods: Machine Learning









Set of 9 demographic indicators 289 metropolies

METRO_CAPITAL	AGE	FOREIGNERBORN	MIGRATED	POP	OVER65	PD	PWD	POPCHANGE	URBPROP
***AT001M	62.819328	24.201520	1.766176	2676812	17.817245	304	8911	8.704668	85.20
AT002M	63.365023	12.548340	1.078051	619388	17.995581	179	2667	7.122139	68.83
AT003M	61.849896	13.796246	0.836528	737220	17.385046	167	2419	4.039385	66.79
AT004M	61.931580	17.773107	1.342767	353780	17.917575	203	2793	3. 7 98269	79.25
AT005M	63.364139	17.084127	1.422241	302537	17.435565	145	3918	7.168504	86.71

Similarities at high and low dimensions



Dimensionality Reduction: 3 to 2 dimensions



Set of 9 demographic indicators 289 metropolies

METRO_CAPITAL	AGE	FOREIGNERBORN	MIGRATED	POP	OVER65	PD	PWD	POPCHANGE	URBPROP
***AT001M	62.819328	24.201520	1.766176	2676812	17.817245	304	8911	8.704668	85.20
AT002M	63.365023	12.548340	1.078051	619388	17.995581	179	2667	7.122139	68.83
AT003M	61.849896	13.796246	0.836528	737220	17.385046	167	2419	4.039385	66.79
AT004M	61.931580	17.773107	1.342767	353780	17.917575	203	2793	3. 7 98269	79.25
AT005M	63.364139	17.084127	1.422241	302537	17.435565	145	3918	7.168504	86.71



• Each city is represented by a dot





Set of 9 demographic indicators 289 metropolies

METRO_CAPITAL	AGE	FOREIGNERBORN	MIGRATED	POP	OVER65	PD	PWD	POPCHANGE	URBPROP
***AT001M	62.819328	24.201520	1.766176	2676812	17.817245	304	8911	8.704668	85.20
AT002M	63.365023	12.548340	1.078051	619388	17.995581	179	2667	7.122139	68.83
AT003M	61.849896	13.796246	0.836528	737220	17.385046	167	2419	4.039385	66.79
AT004M	61.931580	17.773107	1.342767	353780	17.917575	203	2793	3.798269	79.25
AT005M	63.364139	17.084127	1.422241	302537	17.435565	145	3918	7.168504	86.71



- Each city is represented by a dot
- Colours represent cities clusters





Set of 9 demographic indicators 289 metropolies

METRO_CAPITAL	AGE	FOREIGNERBORN	MIGRATED	POP	OVER65	PD	PWD	POPCHANGE	URBPROP
***AT001M	62.819328	24.201520	1.766176	2676812	17.817245	304	8911	8.704668	85.20
AT002M	63.365023	12.548340	1.078051	619388	17.995581	179	2667	7.122139	68.83
AT003M	61.849896	13.796246	0.836528	737220	17.385046	167	2419	4.039385	66.79
AT004M	61.931580	17.773107	1.342767	353780	17.917575	203	2793	3.798269	79.25
AT005M	63.364139	17.084127	1.422241	302537	17.435565	145	3918	7.168504	86.71

Dimensionality Reduction: 9 to 2 dimensions

- Each city is represented by a dot
- Colours represent cities clusters
- Size population
- Label capitals
- Red Cluster (13 of 28 capitals)





Clusters Analysis



Cluster 0:

- High urbanisation;
- High share of foreigners;
- Young population.

Cluster 4:

- Low urbanisation;
- Very low share of foreigners;
- High population age.



Map clusters

- Most clusters have regional spatial distribution
- Cluster 0 has the widest geographical distribution
- Capitals tend to be demographically different from their countries but similar between them.





Map clusters

- Most clusters have regional spatial distribution
- Cluster 0 has the widest geographical distribution
- Capitals tend to be demographically different from their countries but similar between them.





Clustering urban spatial densities:

- LUISA Population grid (1km²)





- LUISA Population grid (1km²) for 266 Metro regions:

			X	×		1	*		1				and the second s		*	ñ.		*	1	**
AT001M	AT002M	AT003M	AT004M	AT005M	BE001M	BE002M	BE003M	BE004M	BE005M	BG001M	BG002M	BG003M	CY001M	CZ001M	CZ002M	CZ003M	CZ004M	DE001M	DE002M	DE003M
		<i>)</i>		₩¢	×.	A.	*	X	1	\$.		<u></u>		8 10	×.	*	19 C		*	***
DE004M	DE005M	DE007M	DE008M	DE009M	DE011M	DE012M	DE013M	DE014M	DE017M	DE018M	DE019M	DE020M	DE021M	DE025M	DE027M	DE028M	DE031M	DE032M	DE033M	DE034M
	۲		tiyr	1. Alton			1		4	*		A.	M	ģ.		*		÷	Â.	
DE035M	DE036M	DE037M	DE038M	DE039M	DE040M	DE042M	DE043M	DE044M	DE045M	DE052M	DE053M	DE054M	DE057M	DE059M	DE061M	DE063M	DE064M	DE069M	DE073M	DE074M
			A.	**	*	a construction of the second s	sa la constante da la constant	%	*	1		and the second s		S.	14	and the second s			and the second	Č.
DE077M	DE079M	DE083M	DE084M	DE504M	DE507M	DE510M	DE513M	DE517M	DE520M	DE522M	DE523M	DE524M	DE527M	DE529M	DE532M	DE533M	DE534M	DE537M	DE540M	DE542M
	1	4	1	۲	6 C .	- ANT	1 1	and the second s	-	and the	X	*	1×.				19 A. S.		97 % ~-	Ť.
DE544M	DE546M	DK001M	DK002M	DK003M	DK004M	EE001M	EL001M	EL002M	ES001M	ES002M	ES003M	ES004M	ES005M	ES006M	ES007M	ES009M	ES010M	ES012M	ES013M	ES014M
- The			1	10th	1 Alexandre	${\rm Tr}^{p^2}$	1. Star	R.	- And And	\$	3			A.	×	A				1
ES015M	ES019M	ES020M	ES021M	ES022M	ES026M	ES501M	ES510M	ES522M	FI001M	FI002M	FI003M	FR001M	FR003M	FR004M	FR006M	FR007M	FR008M	FR009M	FR010M	FR011M
		1		ðs:	Ř					4	*	♠.	1			1	۲			~? X
FR013M	FR014M	FR015M	FR016M	FR018M	FR019M	FR020M	FR021M	FR022M	FR023M	FR024M	FR025M	FR026M	FR032M	FR035M	FR036M	FR037M	FR038M	FR039M	FR040M	FR043M
		- CROODMA	FROM								-		TTOO I M			ITOOAAA				
FR044IVI	FK045IVI	PR203IVI	FR205IVI	HKUUIM		HUUUIM	HUUUZIVI	HUUU4IM	HUUUSIVI		IEUUIM		TIUUIIM	11002101	11003101	11004101		/	11007101	11008101
HOOM	ITO10M	HOIIM	HOLDA		HOUTA	JT038M		HOROM		JITE0204	ITEO2M					MT001M	MI OO IM			
11009101		TIULIW	TIUIZIM	11022101	1102/101	11020101	11029101	11050101	IT JULIN	11502101	11 JUSIM	LIUUIW	LTUUZIVI		LVUUIM			NLUUZIVI	NLOUSIVI	NL004IVI
NLOOSM	NU006M					NI 012M	MI 502M	PLOOIM	PL002M	PLOOR	PLOOAM	PLOOSM	PL006M	PLOOTM	PL008M	PI 009M	PLO10M	PLOTIM	PL012M	PL015M
142003141			- ALCOONT		A s	14E012141	ALC: NO	275	- LOOZIVI	1 EUOSIVI	- COOTIN	12005141	LOODIN	- 007 M	1 EUGONI		127.4	North	2012101	1 LOIDIN
PL016M	PL024M	PL025M	DI 506M	DI 514M	PT001M	PT002M	DT005M	ROOOIM	PO002M	ROOORM	ROOMM	RO501M	RO502M	ROSORM	ROSOMM	SE001M	SE002M	SEOOSM	SEODEM	SIDOT M
FLOIDIN	FL024IVI	FLOZDIVI	PEDODVI	PLJ14IVI			F 1005101	/	NO002IWI	KOOOSIWI	KO004IVI		105021vl		M+0CON	SLOOTIVI	31002101	52005141	32000141	300111
51002M	SK001M	SK002M	UK001 M	- Сорона Икоо2М	25		- Щ UK005M	МК006М		WK008M	<u></u> UK009М	1 000000000000000000000000000000000000	UK011M	UK012M	UK013M	UK014M		UK017M	UK018M	UK025M
		A	1		1	۰	and the	-	Miles -		<u>ka</u>)							

- If each metro image is plotted on the corresponding point, similar spatial patterns are groupped together.



- Dispersed and sprawled metro are on the left





- More compact and dense on the right





- Cities with streched horizontal pattern on the bottom





ricardo.barranco@ec.europa.eu

- If each metro image is plotted on the corresponding point, similar spatial patterns are groupped together.



Stretch		1			-		2	-	X				8	*
vertical	and a		*						14 AN					
T	-		1ª			۶.		X	k	%				
	- A	Ser.	1	×		*	*	<u>Z</u>			-			٨
		N.	*		*		X	A	*		*		1	
	1	1 and a second			Ŵ	No.		*			1	*		*
		S.	N. S.	<i>.</i>		à.	A .			*	*			
				M			*	*	Ŵ		\$			
	AUT.								A	*		*	*	2
Round					1.0			%	×	Vige	*	1		X
		A STATE	1. Second	*			The second secon	-	\$		1	*	A	**
	· Antonio	and the second	*	**	ñ.	2	-	a a a a a a a a a a a a a a a a a a a	<u>ka</u>	The second secon				
	- Contraction	Raf			ACT.				1	*		<u>here</u>		
		and the second	99 % ~		₹ 7 €.			*	*					***
		43.			and the	⇒∳₿					**	*	N	
	and the second second	*		-	-37	*	×		*	*				
	学考虑		1996	A.	18 M	*	8 40	N	۹.				-	*
•	1	M			-			***	**			***	*	
Stretch	AND A	10. A.							MARK .			-		**
Horizontal														

Dispersed

Compact

Modelling Commercial Activities

- Ensembeled regression model trained on LUISA layers to predict consumption layer of 521 FUA.

Data used

- Consumption Density Layer

LUISA Layers (1km² grid):

- Accessibility (Ai, Avd, MaxDistance)
- GVA
- Population
- FUA centre distance
- Closest city distance
- Bus stop density
- Bus stop distance
- Local road density
- Local road distance
- Airport distance





Modelling Commercial Activities

- Ensembeled regression model trained on LUISA layers to predict consumption layer of 521 FUA.

Data used

- Consumption Density Layer

LUISA Layers (1km² grid):

- Accessibility (Ai, Avd, MaxDistance)
- GVA
- Population
- FUA centre distance
- Closest city distance
- Bus stop density
- Bus stop distance
- Local road density
- Local road distance
- Airport distance





Modelling Commercial Activities

- Ensembeled regression model trained on LUISA layers to predict consumption layer of 521 FUA.

Data used

- Consumption Density Layer (TomTom)

LUISA Layers (1km² grid):

- Accessibility (Ai, Avd, MaxDistance)
- GVA
- Population
- FUA centre distance
- Closest city distance
- Bus stop density
- Bus stop distance
- Local road density
- Local road distance
- Airport distance





Partial Dependence

Dependence between the target function and a set of features, marginalizing over the values of all the others.
 Combined partial dependence



Modelling Housing Costs



Numerical Features (Total 34): lat - Latitude lon - Longitude keys - ID price - Selling Price (€) totalRooms - Total Rooms bedrooms - Bed Rooms bathrooms - Bathr totalsqm - Total Square Meters (m2) lotsize - Lot Size (m2) year - Construction Year builtArea - Building Area (m2) parkingspaces - Number of parking spaces floors - Number of floors floorlevel - Floor of the house toiletRooms - Number of toilets

energyClass - Energy class ***
energyEff - Energy Efficiency (kWh/m2 per year)

Binary Features (Total 17 - yes or no):

garage - Garage (yes/no) pool - Swimming Pool (yes/no) renovated - Renovated (yes/no) fireplace - Fireplace (yes/no) terrace - Terrace (yes/no) balcony - Balcony (yes/no) garden - Garden (yes/no) liftelev - Lift or Elevator (yes/no) parking - Parking places (yes/no) heating - Heating System (yes/no) solar - Solar panels (yes/no) oil - Oil heating (yes/no) ac - Air Conditioner (yes/no) sewer - Connected to sewer (yes/no) pool - Swimming Pool(yes/no) security - Alarm or security system (yes/no) kitchen - Kitchen (yes/no)



Modelling Housing Costs (predict std. house €/m²)

Standard House



Thank you !! Dziękuję !! ... and don't forget to vote for best presentation !!

ricardo.barranco@ec.europa.eu

LUISA Web platforms:

LUISA Territorial Modelling Platform http://urban.jrc.ec.europa.eu/ http://urban.jrc.ec.europa.eu/t-board http://urban.jrc.ec.europa.eu/strat-board http://urban.jrc.ec.europa.eu/t-pedia



