



Leibniz Institute of Agricultural Development
in Transition Economies

Economics of Climate Change: Application of Spatial Econometric Techniques with R

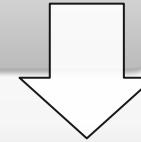
2nd session

Presenter: Tinoush Jamali Jaghdani, PhD

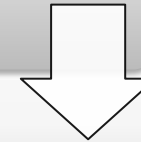
Organizer: Prof. Dr. Mohammad Reza Farzanegan

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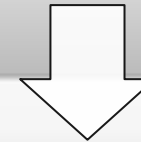
Part 1: Presentation of
exercises



Part 2: Summary of 1st session

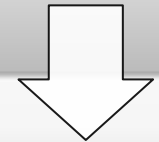


Part 3: Case studies and new
issues in spatial econometrics



Part 4: Spatial econometrics with R

- Spatial regressions, mapping and plotting



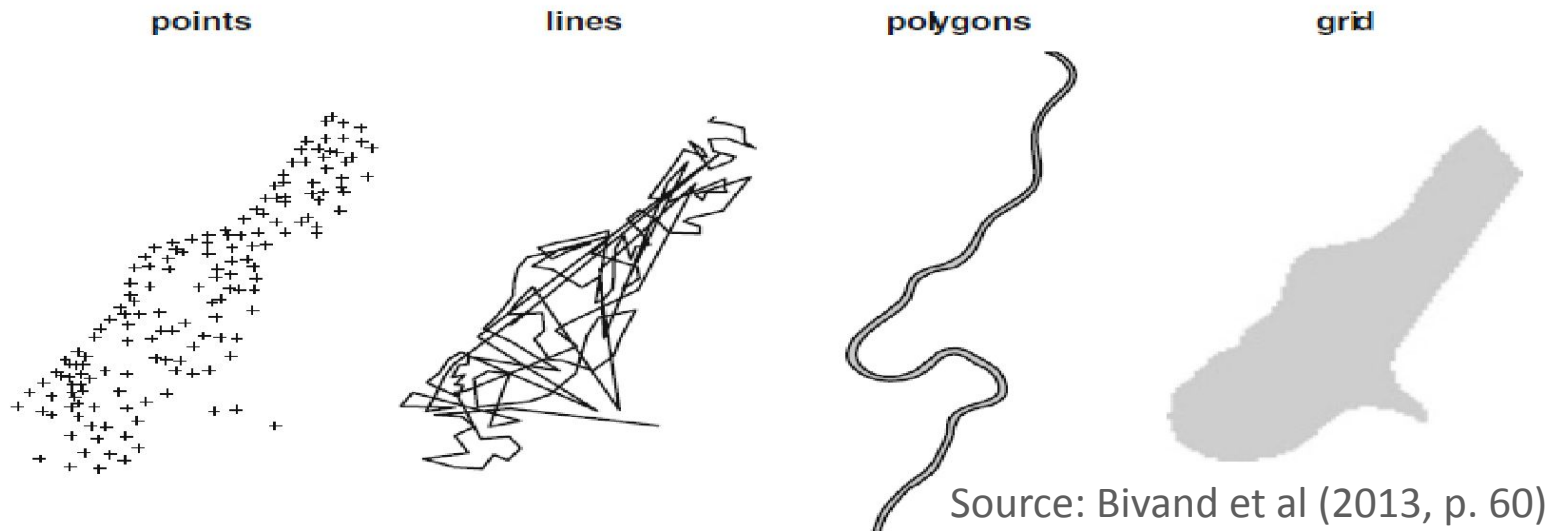
Final words

1. Beef production in NRW, North Saxony, Hamburg and Bremen
2. Milk production in Bayern and Baden Württemberg

- Introduction to spatial data analysis
- Spatial weight matrix
- Moran I test
- Spatial regressions (emphasis on SEM, SAR)
- SAR
 - $y = \rho W y + X\beta + \mu$, $|\rho| < 1$
 - $\mu \sim N(0, \sigma^2)$, iid
- SEM
 - $y = X\beta + \mu$
 - $\mu = \lambda W \mu + \varepsilon$, $|\lambda| < 1$
 - $\varepsilon \sim N(0, \sigma^2)$, iid

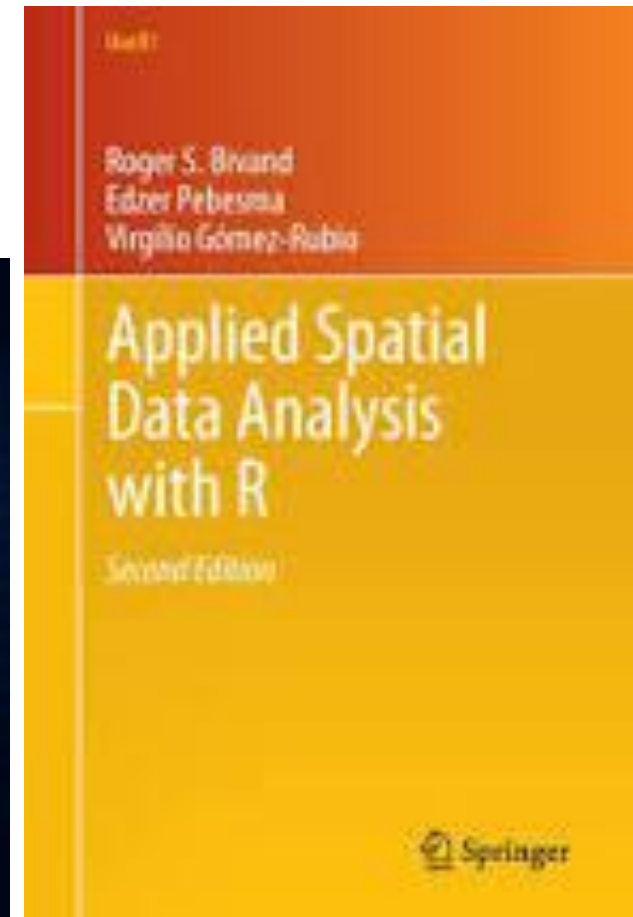
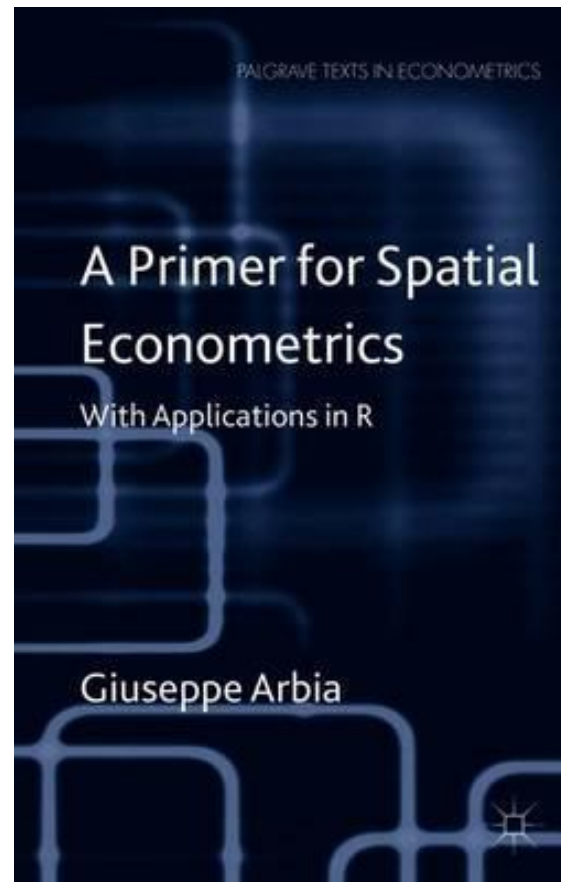
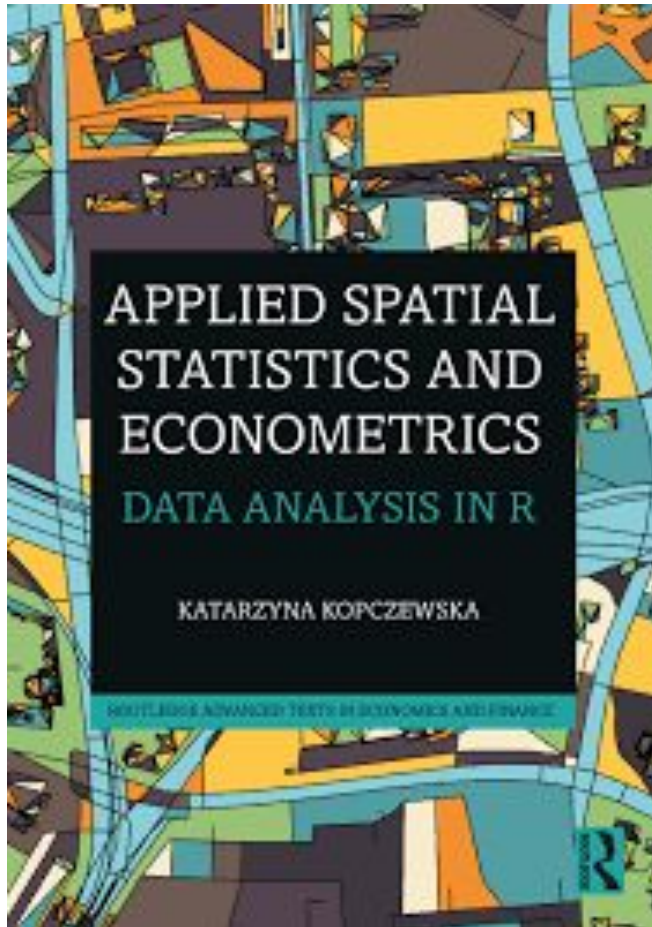
Summary of 1st session, continue

- Coordinates and UTM
- Basics of R
- Spatial objects, mapping and weight matrix R



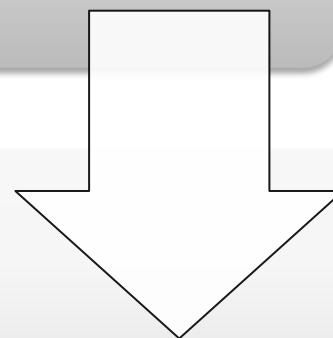
- Spatial regressions in R
- Exercise distribution between two groups

Some references on spatial econometrics with R



Case studies:

- 2008, hedonic pricing of irrigation water
- 2020, agricultural productivity
- 2020, Water conservation policies



New issues:

- Spatial econometrics and big data
- Spatiotemporal approach toward data
- Spatial econometrics for resilience and climate and environmental shock studies
- Spatial microeconometrics



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SPATIAL HEDONIC PRICING MODELS FOR THE VALUATION OF IRRIGATION WATER

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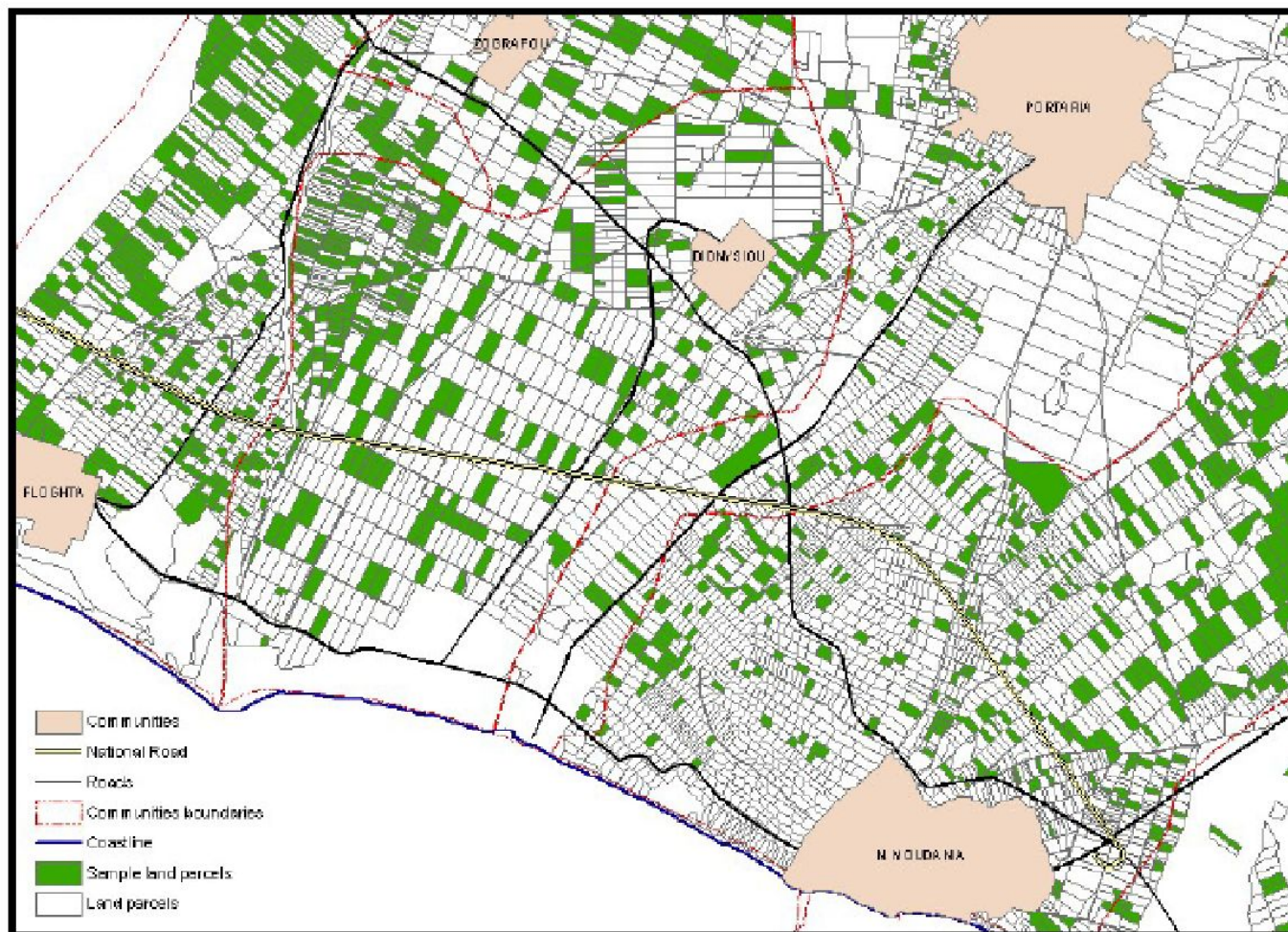
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Spatial hedonic pricing models for the valuation of irrigation water

Greater area of the Municipality of Moudania in Chalkidiki, Greece



Spatial hedonic pricing models for the valuation of irrigation water

- The goal was assessing the economic value of irrigation water, as one of the individual attributes of the value of agricultural land parcels.
- Data consists of 1,517 land parcels
- More geographical variables than socio-economics
- Conventional/ Spatial lag (SAR) and spatial error (SEM) both applied.
- Spatial models produced better results but SEM performed

AGRICULTURAL PRODUCTIVITY IN SPACE: AN ECONOMETRIC ASSESSMENT BASED ON FARM-LEVEL DATA

EDOARDO BALDONI AND ROBERTO ESPOSTI

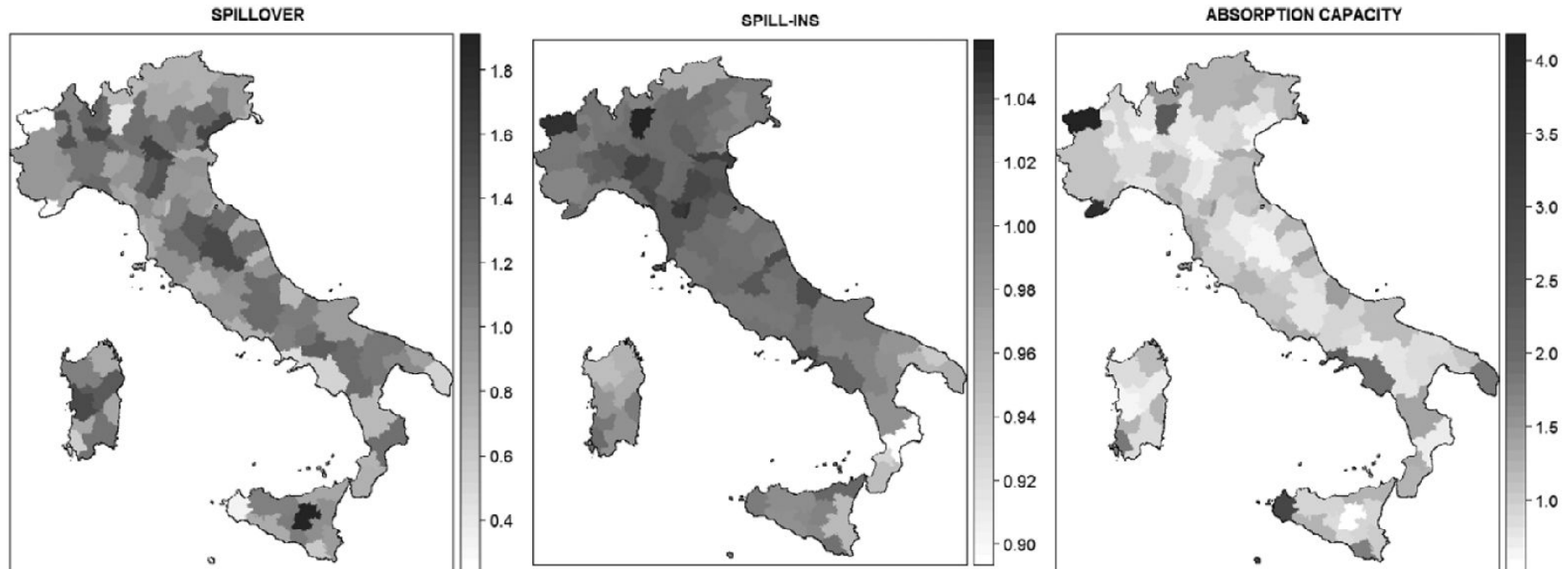
Amer. J. Agr. Econ. 103(4): 1525–1544; doi:10.1111/ajae.12155

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- scale, scope and nature of spatial dependence of agricultural total factor productivity (TFP) by using farm-level survey data investigated.
- Italian FADN farm-level data over the period 2008–2015 used and then the results are aggregated at the NUTS3 level.
- SEM applied

Agricultural Productivity in Space: an Econometric Assessment Based



- Bayesian model selection procedure is used to inspect the spatial properties of TFP
- Results suggest that agricultural productivity spillovers significantly occur though over a limited spatial range.

中華水土保持學報, 51(3):109-116(2020)

Journal of Chinese Soil and Water Conservation, 51 (3): 109-116(2020)

DOI: 10.29417/JCSWC.202009_51(3).0003

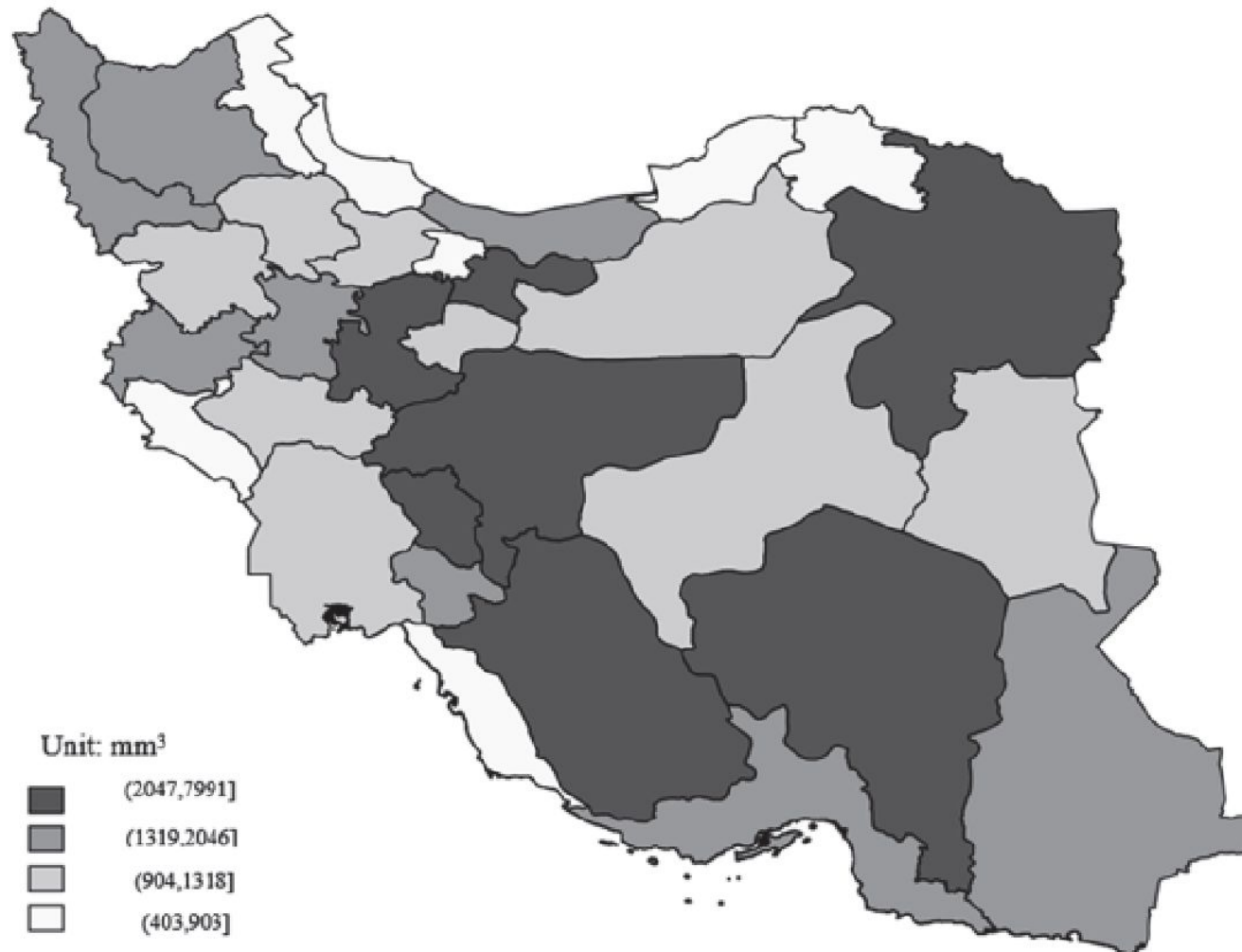
Effect of Water Conservation Policies on Groundwater Depletion in Iran

Mohammad Mehdi Farsi Aliabadi^[1] Mahmoud Daneshvar Kakhky^{[1]*}

Mahmoud Sabohi Sabouni^[1] Arash Dourandish^[1] Hamid Amadeh^[2]

- Goal: investigates the effect of conservation policy on Iran's groundwater depletion.

Effect of water conservation policies on groundwater depletion in Iran



Effect of water conservation policies on groundwater depletion in Iran

- Dependant variable: depletion of groundwater, difference between the yearly water extraction and the water recharge (MCM per year)
- Panel data set is constructed based on all the available data in 31 provinces from 2010 to 2016.
- Conservation policy is price increase!
- Moran I test implemented on conventional model
- SAR, SEM and SAC (kelijan-Perucha)

Table 2 The result of Moran's I, Geary's GC and, Getis and Ord's GO tests

Statistical significant test	Statistic value	P-value
Moran's I	0.06	0.08
Geary's GC	0.85	0.03
Getis and Ord's GO	-0.28	0.08

Effect of water conservation policies on groundwater depletion in Iran

Table 3 Results of Spatial Panel Model Estimation

Variables	SAR Coefficients	SEM Coefficients	SAC Coefficients
Number of Shallow Well	-0.009**	-0.01**	-0.01***
Number of Deep Well	0.129**	0.14**	0.13***
Number of qanats	0.23**	0.25**	0.24***
Agricultural Cultivated Area	0.001**	0.0001**	0.001***
Area under modern Irrigation	0.015**	0.014**	0.015***
Precipitation	0.4 ^{Ns}	0.18 ^{Ns}	0.51 ^{Ns}
Temperature	-0.18 ^{Ns}	-0.16 ^{Ns}	-0.17 ^{Ns}
Population	0.02 ^{Ns}	-0.002 ^{Ns}	0.02 ^{Ns}
Drought Index	0.34*	35.6 ^{Ns}	40.5**
Agricultural Price Index	13.6 ^{Ns}	14 ^{Ns}	16.72**
Cost of Electricity	-0.156 ^{Ns}	-0.16 ^{Ns}	-0.18**
Constant	-3398 ^{Ns}	-3004 ^{Ns}	-3941.3**
ρ	0.021*	-	0.03**
λ	-	0.012 ^{Ns}	0.017*
LM	17.59***	1.15 ^{Ns}	6742.6***
LM Robust	6741.4***	6725***	-
F-test	73.79***	79.65***	82.7***
R Square	0.85	0.85	0.86
Adjusted R Square	0.79	0.8	0.81
Log of Likelihood Function	-1229.7	-1230.9	-1227.8
Akaike Information Criterion	613316.4	574473	556260
Schwarz Criterion	776270.4	727106.6	704055.6

*, **, and *** present the level of significance in 5, 1 and 0.1 Percent and Ns shows the non-significant coefficients.

Effect of water conservation policies on groundwater depletion in Iran

- Conclusion:
- Finally, it was found that there is a spatial correlation in the groundwater depletion in different provinces.
- The results indicated that the gradual removal of energy subsidies for agricultural activities is an effective policy to mitigate water depletion.
- In Iran where water depletion is a serious challenge, a small increase in energy price through the removal of energy subsidies would not lead to a significant reverse in the water depletion.

- **Do you agree with this conclusions?**
- **Are there any critics there?**
- **What could be the replacing research**

609 Plains



Source: <http://basin.ir/1395/02/06/Regional%20Water%20Authority>

New issues in spatial econometrics: application and methods

iamo


Leibniz Institute of Agricultural Development
in Transition Economies

SPRINGER BRIEFS IN REGIONAL SCIENCE

Rita De Siano
Valerio Leone Sciabolazza
Alessandro Sapio

Regional Resilience to Climate and Environmental Shocks A Spatial Econometric Perspective

MOREMEDIA 

 Springer

SPATIAL ECONOMETRICS AND SPATIAL STATISTICS

SPATIAL ANALYSIS USING BIG DATA

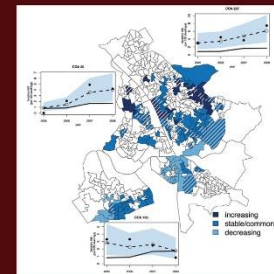
METHODS AND URBAN APPLICATIONS

Edited by Yoshiki Yamagata and Hajime Seya



Chapman & Hall/CRC
Statistics in the Social and Behavioral Sciences Series

Modelling Spatial and Spatial-Temporal Data A Bayesian Approach



Robert Haining
Guangquan Li

 CRC Press
Taylor & Francis Group
A CHAPMAN & HALL BOOK

ROUTLEDGE ADVANCED
TEXTS IN ECONOMICS
AND FINANCE



Spatial Microeconometrics

Giuseppe Arbia, Giuseppe Espa
and Diego Giuliani



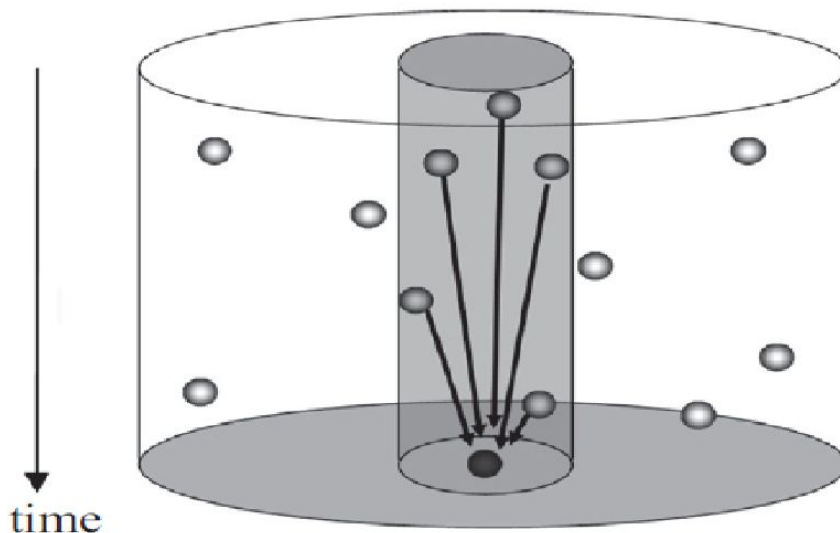
- The disruptive climate and environmental changes have the spatial propagation process
- It can affect capital stocks, physical infrastructure labour productivity, ...
- Understanding those process can help to improve the resilience of economic systems
- Climate policies in view on stronger mitigation and adaptation can be designed.

- Digital revolution has created tremendous data to be available through technologies such as internet of things (IoT), ...
- Spatial big data also become available through technological developments
- Demand for smart cities, environmental management, climate issues make increase the demand for spatial econometrics with big data

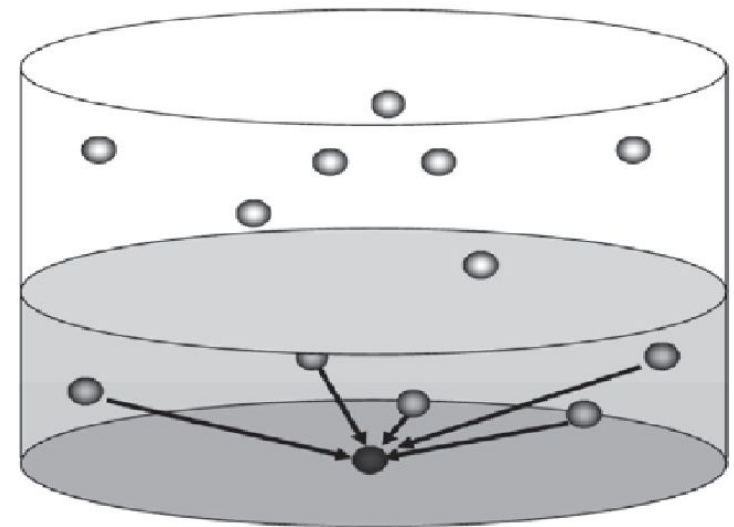
Spatial panel econometrics and spatiotemporal approach toward data

- Fixed observation point through time can be analysed by panel econometrics.
- But if part of observations move through the time, we need to use spatiotemporal autoregressive models (STAR) to analyse those observations.

S: Spatial relations



T: Temporal relations

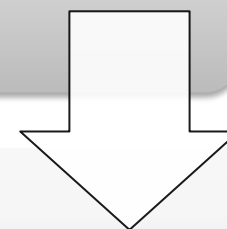


Source: Seya et al. (2020)

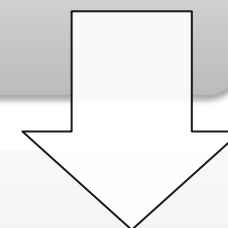
- Analysis of points in economic space (micro data) has arisen concerns on the methods to deal with spatial micro data
- Therefore, methods are divided to three groups
 - Modelling the spatial behaviour of economic agents in a given set of locations
 - Modelling the spatial locational choices of economic agents
 - Modelling both the spatial location choices and the spatial behaviour of economic agents (locational choice of economic agents and their joint locations with respect to other agents.)

Any question before
practical part?

Examples of spatial
regressions



Mapping and weight
matrix



Plotting

- Important do following:
 1. “spatial object” go to
 2. “neighbour list (nb)” go to
 3. “spatial weights (listw)”
- In spdep:
 - neighbourhood
 - cell2nb
 - grid2nb
 - Knn2nb
 - poly2nb
 - Weight
 - nb2listw

1. Huge help on R: <https://rseek.org/>

2. ExamplesNecessaryPackages

3. ExampleThree2GermanyMap

1. Coordinates to UTM

2. Ggplot2

3. Shapefiles of Germany in ggplot2

4. ExampleFourSPDEP (0)

1. Neighbours and weight matrix

5. ExampleFourSPDEP (1)

1. Regression



Go to example in R



Go to example in R



Go to example in R

- Examples used from the following websites:
- http://www.econ.uiuc.edu/~lab/workshop/Spatial_in_R.html
- <https://rpubs.com/quarcs-lab/tutorial-spatial-regression>
- <https://rdr.io/rforge/spdep/man/bptest.sarlm.html>
 - More play with weight matrix with Iran/Germany coordinates

- I hope you have enjoyed.
- I hope you can apply this concept in your research.
- Many thanks to Prof. Farzanegan for his initiatives and this opportunity.
- Thanks for support of NaDiMa team and University of Marburg.

End of session 2

THANK YOU

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