SAN DIEGO STATE UNIVERSITY

Geography 780, Spring 2014
Spatial Analysis, Modeling, and Simulation
Class meet on Monday, 4:00 pm ~ 6:40 pm, at Storm Hall 325 (SAL every other week for 70 minutes; see the course schedule below)
Email: lan@mail.sdsu.edu

Dr. Li An (Instructor)
Office: Storm Hall 308B
Office hours: Wednesday, 3:30~5:30 pm or by appointment.
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Course objectives	This graduate-level course aims to expose to you various approaches of GIS, spatial analysis and modeling, and simulation to students. We focus on understanding, describing, and predicting spatial patterns. During the course we will read articles about different spatial analysis and modeling approaches, discuss their applications, and work on three (out of six) lab assignments. Completing the course, students will be able to evaluate the trade-offs associated with use of a particular approach under a given situation, and to implement and interpret several of the approaches discussed.
Prerequisites	Basic GIS and statistics.
Readings	No text for this seminar; all the required readings are collected from the literature.
Computer assignments	During the semester, six lab assignments will be available in SAL and CESAR. You are required to work on **THREE** of them only: Labs 1 is required, and you choose your second and third labs from Labs 2a and 2b and from Labs 3a, 3b, and 3c, respectively. We will meet in SAL only every OTHER Monday (see the course schedule) to go over the assignment and provide you some time to work on it. Turn in your lab assignments at the designated dates below.
Journal article report	Each student is required to select **Two** articles to review and lead class discussion. The report should take the form of a written (2 page max.; email it to me at least three days before) and oral summary and critique of the article (if you choose to use PowerPoint, we have an LCD projector available).
Project or comprehensive paper	Option 1: Use your own data or the data of any of the six labs, choose a topic (e.g., part of your thesis or dissertation) and at least one of the models included in this class. The topic(s) should be approved by the instructor. Option 2: Write a spatial analysis/modeling literature review based on the class content. Talk about the strengths and weaknesses of these approaches, and the conditions under which they can be used.
Grading	Your grade will be determined based on your article review/discussion (25%), performance in class discussion (15%), lab assignments (40%), and project or paper (20%).

Course schedule (Spring 2014)

	Day	Time	Topic(s)	Required readings	Labs
Block 1 IDRISI + Habitat modeling	Jan. 27	4:00-5:20	Class introduction; Spatial analysis, modeling, and simulation preliminaries (An)	NRC 2013 (Ch 1)	
		5:30-6:40	Habitat modeling (An) Review/discussion 1: Habitat modeling	Guisan and Thuiller 2005	
	Feb. 3	4:00-5:20	Idrisi introduction	Eastman 2001	
		5:30-6:40	Lab 1 on Idrisi (in CESAR)		Terrain analysis
Block 2 Land Changes	Feb. 10	4:00-5:20	Empirical land change modeling (An)		
		5:30-6:40	Review/discussion 2: logistic regression	Wear and Bolstad 1998	
	Feb. 17	4:00-5:20	Article review/discussion 3: Survival analysis (Event history analysis)	An & Brown 2008; Wang et al. 2013	
		5:30 -6:40	Lab 2A (Idrisi)		Logistic regression
Block 3 Multilevel models & latent trajectory models	Feb. 24	4:00-5:20	Introduction (An)		Lab 1 due
		5:30-6:40	Article review/discussion 4: Multilevel models (MLM)	Subramanian 2010	
	Mar. 03	4:00 -5:20	Article review/discussion 5: latent trajectory models (LTM)	Guo and Hipp 2004	
		5:30- 6:40	Lab 2B (using web search data in SAS)		MLM
Block 4 Model comparison	Mar. 10	4:00-5:20	Proposal Presentation (Option 1) Progress report (Option 2) Verification and validation	Oreskes et al. 1994	
		5:30 -:40	Article review/discussion 6: Multiple resolution map comparison	Pontius 2011	
	Mar. 17	4:00-5:20	Article review/discussion 7: Fuzziness map comparison	Hagen 2003	
		5:30-6:40	Lab 3A		Map comparisons

Block 5 Multivariate regression on data with spatial dependence	Mar. 24	4:00-5:20	Guest lecture by Dr. A. Getis	Getis 1995	Lab 2 due
		5:30-6:40	Article review/discussion 8: Getis spatial filtering technique	Getis 2010	
		Mar. 31: No class (Holiday)			
	Apr. 7	4:00-5:20	Article review/discussion 9: Spatial autoregressive models	Anselin and Bera 1998	
		5:30-6:40	Lab 3B (based on web search data on climate change across USA--county-level)		Spatial filtering regression
Block 6 Spatial agent-based modeling and Cellular Automata	Apr. 14	4:00-5:20	Agent-based models and cellular automata overview (An); Article review/discussion 10: ABM	Parker et al. 2003	
		5:30-6:40	Article review/discussion 11: ABM application Article review/discussion 12: ABM and spatial model validation	An et al. 2005; An et al. in press Brown et al. 2005	
	Apr. 21	4:00-5:20	Article review/discussion 13: CA application	Batty 1997; Clark et al. 1997	
		5:30-6:40	Lab 3C (Human-environment ABM)		ABM
	Apr. 28		Project time (Lab 3 due)		
	May 5	4:00-6:40	Project or paper presentation (20 minutes/person)		

*The class is comprised of six learning blocks, approximately two weeks to cover one topic. Each block begins with the instructor's overview of the corresponding topic (followed by students' article reviews/discussions) and ends up with a lab that gets your hands wet. **All readings are available on SDSU blackboard. ***All the yellow (shaded if you print in black and white) areas are reserved for labs that mark the end of each learning block.

Reading list:

An, L., Linderman, Marc. A., Shortridge, Ashton, Qi, Jiaguo, Liu, Jianguo. 2005. Exploring complexity in a human-environment system: an agent-based spatial model for multidisciplinary and multi-scale integration. Annals of Association of American Geographers 95 (1), 54-79.

An, L., and D.G. Brown. 2008. Survival analysis in land-change science: integrating with GIScience to address temporal complexities. Annals of Association of American Geographers 98(2): 323-344.

An, L., A. Zvoleff, J. Liu, and W. Axinn (in press). Agent based modeling in coupled human and natural systems (CHANS): Lessons from a comparative analysis. Annals of Association of American Geographers.

Anselin, L., A. K. Bera. 1998. Spatial dependence in linear regression models with an introduction to spatial econometrics. In A. Ullah, D.E.A. Giles (eds.): Handbook of Applied Economic Statistics, p. 237-289, Marcel Dekker: New York.

Batty, M. 1997. Cellular automata and urban form: A primer. Journal of the American Planning Association 63(2): 266-275.

Brown, D., S. Page, R. Riolo, M. Zellner, W. Rand. 2005. Path dependence and the validation of agent-based spatial models of land use, International Journal of Geographical Information Science, 19, 2, p.153-174.

Clarke, K.C., S. Hoppen, and L. Gaydos. 1997. A self-modifying cellular automaton model of historical urbanization in the San Francisco Bay area. Environment and Planning B-Planning & Design 24(2): 247-261—optional reading.

Eastman, J. R. 2001. The Evolution of Modeling Tools in GIS. Directions Magazine.

Fischer M.M., and A. Getis (eds). 2010. Handbook of Applied Spatial Analysis: Software Tools, Methods, and Applications. Springer: New York (Read Introduction, Section A1 Spatial Statistics in ArcGIS).

Getis, A. 1995. Spatial filtering in a regression framework: Experiments on regional inequality, government expenditures, and urban crime. In L. Anselin and R.J.G.M Florax (eds.): New Directions Spatial Econometrics, p. 172-188, Springer: Berline.

Getis, A. 2010. Spatial autocorrelation. In Fischer M.M. and A. Getis (eds.), Handbook of Applied Spatial Analysis: Software Tools, Methods, and Applications, pp. 255-278 (B.3). Springer: New York.

Guisan, A., and W. Thuiller. 2005. Predicting species distribution: Offering more than simple habitat models. Ecology Letters 8: 993-1009.

Guo, G., and J. Hipp. 2004. Longitudinal analysis for continuous outcomes: Random effects models and latent trajectory models. In M. Hardy and A. Bryman (eds.): The Handbook of Data Analysis, pp. 347-368. SAGE Publications: Los Angeles.

Hagen, A.E. 2003. Fuzzy set approach to assessing similarity of categorical maps. International Journal of Geographical Information Science 17(3): 235-250.

National Research Council (NRC). 2013. Advancing Land Change Modeling: Opportunities and Research Requirements. National Academies Press: Washington, D.C.

Oreskes, N., K. Shrader-Frechette, and K. Belitz. 1994. Verification, validation, and confirmation of numerical models in the earth sciences. /Science/ 263 (5147, Feb. 4, 1994): 641-646.

Parker, D.C., S.M. Manson, et al. 2003. Multi-agent systems for the simulation of land-use and land-cover change: A review. Annals of the Association of American Geographers 93(2): 314-337.

Pontius Jr, RG, S Peethambaram, and J-C Castella. 2011. Comparison of three maps at multiple resolutions: a case study of land change simulation in Cho Don District, Vietnam. Annals of the Association of American Geographers 101(1): 45-62.

Subramanian, S.V. 2010. Multilevel modeling. In Fischer M.M. and A. Getis (eds.), Handbook of Applied Spatial Analysis: Software Tools, Methods, and Applications, pp.507-525 (C.7). Springer: New York.

Wang, N., D.G. Brown, L. An, S. Yang, and A. Ligmann-Zielinska (in press). Comparative performance of logistic regression and survival analysis for detecting spatial predictors of land-use change. International Journal of Geographic Information Science.

Wear, D.N. and P. Bolstad. 1998. Land-use changes in Southern Appalachian landscapes: Spatial analysis and forecast evaluation. Ecosystems 1(6): 575-594.

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