

# **Seminar: Topics in spatial and spatio-temporal analyses**

GEOG607 Fall 2018

Instructor: Dr. Henry Hui Luan

Course meetings: Thursdays, 9-11:50am, 207 Condon Hall

Office hours: TBD

Spatial analysis is a technique that explores spatial data, which contains both locational and attribute information. Its goal is to analyze the locational information to reveal the underlying processes that generate the observed attribute values. Spatio-temporal analysis arises when spatial data is collected across time. For robust statistical inferences, this type of analysis not only accounts for the well-known spatial autocorrelation, but also the temporal autocorrelation as well as spatio-temporal interactions. The emerging new technologies such as social media, mobile sensors, High Performance Computing, and Artificial Intelligence have drastically changed the way we collect, process, analyze, and visualize spatial and spatio-temporal datasets.

This seminar aims to discuss selected topics in spatial and spatio-temporal analyses, including persistent and newly proposed fundamental issues such as the Modifiable Areal/Temporal Unit Problem and the Uncertain Geographic Context Problem. Opportunities and challenges that spatial and spatio-temporal analyses face in the big data era are also covered, for example, the ethical and geoprivacy issues. For each topic, there will be readings from journal articles and/or book chapters. Students will lead presentations of readings and participate in discussions. Depending on the enrollment size of the class, each student will be a discussion leader at least once during the term. Students will also conduct independent research on a topic covered in the course that they are interested in and/or relevant to their own research. An oral presentation and a 15-page report of student research are required. This report could take the form of an article, a dissertation chapter, or a term paper.

## **Evaluation criteria:**

- (1) Presentation of readings & discussion lead (30%)
- (2) Discussion participation (20%)
- (3) Student research presentation (15%)
- (4) Student research report (35%)

### **Class 1: Introduction**

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- Readings
1. Goodchild, M. F., & Haining, R. P. (2003). GIS and spatial data analysis: Converging perspectives. *Papers in Regional Science*, 83(1), 363–385.
  2. Miller, H. J. (2004). Tobler's First Law and Spatial Analysis. *Annals of the Association of American Geographers*, 94(2), 284–289.
  3. Griffith, D. A., Chun, Y., O'Kelly, M. E., Berry, B. J. L., Haining, R. P., & Kwan, M.-P. (2013). Geographical Analysis: Its First 40 Years. *Geographical Analysis*, 45(1), 1–27.

### **Class 2: Fundamental issues I**

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- Readings
1. Fotheringham, A. S., & Wong, D. W. S. (1991). The Modifiable Areal Unit Problem in Multivariate Statistical Analysis. *Environment and Planning A*, 23(7), 1025–1044.
  2. Wong, D. W. S. (2009). The Modifiable Areal Unit Problem (MAUP). In *The SAGE Handbook of Spatial Analysis* (pp. 105–123). London: Sage.
  3. Fortin, M.-J., & Dale, M. R. T. (2009). Spatial autocorrelation. In *The SAGE Handbook of Spatial Analysis* (pp. 89–104).

### **Class 3: Bringing time in: from spatial to spatio-temporal analysis**

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- Readings
1. Bernardinelli, L., Clayton, D., Pascutto, C., Montomoli, C., Ghislandi, M., & Songini, M. (1995). Bayesian analysis of space-time variation in disease risk. *Statistics in Medicine*, 14(21–22), 2433–2443.
  2. Kwan, M. (1998). Space-Time and Integral Measures of Individual Accessibility: A Comparative Analysis Using a Point-based Framework. *Geographical Analysis*, 30(3), 191–216.
  3. Dodge, S., Weibel, R., Ahearn, S. C., Buchin, M., & Miller, J. A. (2016). Analysis of movement data. *International Journal of Geographical Information Science*, 30(5), 825–834.

### **Class 4: Spatial and spatio-temporal analyses in the big data era**

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- Readings
1. Miller, H. J., & Goodchild, M. F. (2015). Data-driven geography. *GeoJournal*, 80(4), 449–461. <http://doi.org/10.1007/s10708-014-9602-6>
  2. Li, S., Dragicevic, S., Castro, F. A., Sester, M., Winter, S., Coltekin, A., ... Cheng, T. (2015). Geospatial big data handling theory and methods: A review and research challenges. *ISPRS Journal of Photogrammetry and Remote Sensing*, 115(2016), 119–133.
  3. Kwan, M. P. (2016). Algorithmic geographies: Big data, algorithmic uncertainty, and the production of geographic knowledge. *Annals of the American Association of Geographers*, 106(2), 274–282.
  4. Miller, H. J., & Tolle, K. (2016). Big Data for Healthy Cities: Using Location-Aware Technologies, Open Data and 3D Urban Models to

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Design Healthier Built Environments. *Built Environment*, 42(3), 441–456.

### **Class 5: Fundamental issues II**

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| Readings | <ol style="list-style-type: none"><li>1. Kwan, M.-P. (2012). The Uncertain Geographic Context Problem. <i>Annals of the Association of American Geographers</i>, 102(5), 958–968.</li><li>2. Cheng, T., &amp; Adepeju, M. (2014). Modifiable temporal unit problem (MTUP) and its effect on space-time cluster detection. <i>PLoS ONE</i>, 9(6), 1–10.</li><li>3. Robertson, C., &amp; Feick, R. (2018). Inference and analysis across spatial supports in the big data era: Uncertain point observations and geographic contexts. <i>Transactions in GIS</i>, (January), 1–22.</li></ol> |
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### **Class 6: Emerging spatial data sources**

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| Readings | <ol style="list-style-type: none"><li>1. Goodchild, M. F. (2007). Citizens as sensors: The world of volunteered geography. <i>GeoJournal</i>, 69(4), 211–221.</li><li>2. Haklay, M. (2010). How good is volunteered geographical information? A comparative study of OpenStreetMap and ordnance survey datasets. <i>Environment and Planning B: Planning and Design</i>, 37(4), 682–703.</li><li>3. Goodchild, M. F. (2013). The quality of big (geo)data. <i>Dialogues in Human Geography</i>, 3(3), 280–284.</li><li>4. Arribas-Bel, D. (2014). Accidental, open and everywhere: Emerging data sources for the understanding of cities. <i>Applied Geography</i>, 49, 45–53.</li></ol> |
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### **Class 7: Ethical and geoprivacy issues**

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| Readings | <ol style="list-style-type: none"><li>1. Elwood, S., &amp; Leszczynski, A. (2011). Privacy, reconsidered: New representations, data practices, and the geoweb. <i>Geoforum</i>, 42(1), 6–15.</li><li>2. Kounadi, O., &amp; Leitner, M. (2014). Why does geoprivacy matter? The scientific publication of confidential data presented on maps. <i>Journal of Empirical Research on Human Research Ethics</i>, 9(4), 34–45.</li><li>3. Ricker, B., Schuurman, N., &amp; Kessler, F. (2015). Implications of smartphone usage on privacy and spatial cognition: academic literature and public perceptions. <i>GeoJournal</i>, 80(5), 637–652.</li><li>4. Keßler, C., &amp; McKenzie, G. (2018). A geoprivacy manifesto. <i>Transactions in GIS</i>, 22(1), 3–19.</li></ol> |
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### **Class 8: Geovisual analytics**

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| Readings | <ol style="list-style-type: none"><li>1. Andrienko, G., Andrienko, N., Jankowski, P., Keim, D., Kraak, M. J., MacEachren, A., &amp; Wrobel, S. (2007). Geovisual analytics for spatial decision support: Setting the research agenda. <i>International</i></li></ol> |
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- Journal of Geographical Information Science*, 21(8), 839–857.
2. Andrienko, G., Andrienko, N., Demsar, U., Dransch, D., Dykes, J., Fabrikant, S. I., ... Tominski, C. (2010). Space, time and visual analytics. *International Journal of Geographical Information Science*, 24(10), 1577–1600.
  3. Cheshire, J., & Batty, M. (2012). Visualisation tools for understanding big data. *Environment and Planning B: Planning and Design*, 39(3), 413–415.
  4. Robinson, A. C., Peuquet, D. J., Pezanowski, S., Hardisty, F. A., & Swedberg, B. (2017). Design and evaluation of a geovisual analytics system for uncovering patterns in spatio-temporal event data. *Cartography and Geographic Information Science*, 44(3), 216–228.

### **Class 9: From proprietary to open-source**

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- Readings
1. Rey, S. J. (2009). Show me the code: spatial analysis and open source. *Journal of Geographical Systems*, 11(2), 191–207.
  2. Anselin, L. (2012). From SpaceStat to CyberGIS: Twenty Years of Spatial Data Analysis Software. *International Regional Science Review*, 35(2), 131–157.
  3. Anselin, L., & Rey, S. J. (2012). Spatial econometrics in an age of CyberGIScience. *International Journal of Geographical Information Science*, 26(12), 2211–2226.

### **Class 10: Student research presentation**

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Readings                      No readings for this week