

Predictive Analytics: Reading List

Here are the core texts and references used for this part of the course. I wouldn't recommend reading everything; instead read the papers from the parts that you find the most interesting, and use these core texts to find others. The list is quite heavily annotated so it should give you an idea of the most relevant readings.

General Texts

Although this part of the course does not follow a single text book, there are some good general textbooks that are extremely useful.

Batty, M., 2013. *The New Science of Cities*. MIT Press.

Brunsdon C and Singleton S. 2015. *Geocomputation: a practical primer*, p392 pages, SAGE.
Edmonds, B., Meyer, R., 2013. *Simulating social complexity : a handbook*. Springer-Verlag, Heidelberg.

Gilbert, G.N., Troitzsch, K.G., 2005. *Simulation for the social scientist*. Open University Press, Maidenhead, England; New York, NY.

Gilbert, G.N., Troitzsch, K.G., 2005. *Simulation for the social scientist*. Open University Press, Maidenhead, England; New York, NY.

Heppenstall, A.J., Crooks, A.T., See, L.M., Batty, M. (2012) *Agent-based models of geographical systems*. Springer.

O'Sullivan, D., Perry, G.L., 2013. *Spatial simulation : exploring pattern and process*. John Wiley & Sons Inc, Chichester, West Sussex, UK.

O'Sullivan, D., Perry, G.L., 2013. *Spatial simulation exploring pattern and process*. John Wiley & Sons Inc, Chichester, West Sussex, UK.

Paul A. Longley, Sue M. Brooks, Rachael McDonnell, Bill MacMillan (1998). *Geocomputation: A Primer*, Wiley, 290 pages

Railsback, S.F., 2012. *Agent-based and individual-based modeling : a practical introduction*. Princeton University Press, New Jersey.

For academic papers, the most relevant journal is the *The journal of artificial societies and social simulation*. (JASSS). It is an open access journal and all content is available from the website: <http://jasss.soc.surrey.ac.uk/JASSS.html>. JASSS is the best place to start looking for agent-based modelling and other simulation papers.

Also the [On-Line Guide for Newcomers to Agent-Based Modeling in the Social Sciences](#) (published by Robert Axelrod and Leigh Tesfatsion) has links to relevant papers for various topics that are relevant to this course.

Social Simulation and ABM

The following papers provide excellent introductions to agent-based modelling and are easily accessible.

Macal, C. M., & North, M. J. (2010). Tutorial on agent-based modelling and simulation.

Journal of simulation, 4(3), 151–162. doi:10.1057/jos.2010.3

Bonabeau, E. (2002). Agent-based modeling: Methods and techniques for simulating human systems. *Proceedings of the National Academy of Sciences of the United States of*

America. (PNAS), 99(90003), 7280–7287. doi:10.1073/pnas.082080899

Castle, C. J. E. and Crooks, A. T. (2006). Principles and concepts of agent-based modelling for developing geospatial simulations . *UCL Working Papers Series, Paper 110* , Centre For

Advanced Spatial Analysis, University College London. Available online at:

<http://eprints.ucl.ac.uk/3342/1/3342.pdf>

This paper is somewhat less optimistic about ABM, providing a more balanced view of the methodology. When reading around the subject you might look for other papers who have referenced O’Sullivan and Haklay.

O’Sullivan & Haklay (2000), Agent-based models and individualism: is the world agent-

based? , *Environment and planning. A : environment and planning*. (32), 1409-25 There is also a very long list of papers on the MASS blog:

<http://mass.leeds.ac.uk/2013/02/13/an-excellent-abm-paper/>

Mike Batty's has some excellent arguments as to why agent-based modelling (and similar techniques) are ideal for modelling cities

Batty, M., 2013. *The new science of cities*. MIT Press.

Complexity and Emergence

The following two textbooks both have chapters that are extremely relevant and are both great reads in their own right. Flake (1998) is possibly my favourite academic book! They are both large books, but choosing one or two choice chapters from each will provide some excellent background information into the worlds of emergence and complexity.

Flake, G. (1998) *The computational beauty of nature : computer explorations of fractals, chaos, complex systems, and adaptation*. MIT Press.

Wolfram, S. (2002). *A new kind of science*. Wolfram Media.

The following book also has a chapter on Emergence, with worked NetLogo examples that you can run yourself:

Railsback, S.F., 2012. *Agent-based and individual-based modeling : a practical introduction*.

Princeton University Press, New Jersey.

We don't really discuss *chaos*, but it is a concept that is closely tied to complexity. This book gives a great lay introduction:

Gleick, J. (1987) *Chaos: Making a New Science*. <http://www.around.com/chaos.html>

The [On-Line Guide for Newcomers to Agent-Based Modeling in the Social Sciences](#) has a section on [Complexity and ABM](#) that includes a number of relevant papers. Also the following are relevant:

Brakman, S., Garretsen, J.H., Marrewijk, J.G.M. van, and Berg, M. van den (1999) The return of Zipf: towards a further understanding of the rank-size distribution. *Journal of Regional Science*. 183-213.

Heppenstall, A.J., Evans, A.J. and Birkin, M.H., (2006) Using Hybrid Agent-Based Systems to Model Spatially-Influenced Retail Markets . *JASSS* . vol 9(3).
<http://jasss.soc.surrey.ac.uk/9/3/2.html>

Nair, A.S., Jyh-Charn Liu, Rilett, L., and Gupta, S. (2001) Non-linear analysis of traffic flow. Intelligent Transportation Systems, 2001. Proceedings. 2001 IEEE. 681-685 [[online](#)] *IEEE conference proceedings*

Scheffer, M., Bascompte, J., Brock, W.A., Brovkin, V., Carpenter, S.R., Dakos, V., Held, H., van Nes, E.H., Rietkerk, M. and Sugihara, G. (2009) Early-warning signals for critical transitions. *Nature*. 461, 53-59 [[online](#)]

Weaver, W. (1948) Science and Complexity. *American scientist*.. 36, 536-544. [[online](#)]

Interaction and Behaviour

Interactions aren't covered explicitly, but lots of the general texts (and papers) here will discuss interactions.

For KISS and KIDS principles these two papers present contrasting views:

Axelrod, R. (1997). Advancing the art of simulation in the social sciences. In Conte, R., Hegselmann, R., and Terna, P. (eds) *Simulating social phenomena*, pages 21–40. Springer-Verlag, Berlin. (Note: this book is available in the library, the author has also made a draft of the chapter available online: <http://www-personal.umich.edu/~axe/research/AdvancingArtSim2005.pdf>).

Edmonds, B. and Moss, S. (2005). From KISS to KIDS: an 'anti-simplistic' modelling approach. In Davidsson, P., Logan, B., and Takadama, K., editors, *Multi-agent and multi-agent-based simulation : joint workshop MABS 2004, Lecture notes in artificial intelligence.* , pages 130–144. Springer. Available online: <http://cfpm.org/cpmrep132.html> (also [here](#)).

This chapter is extremely relevant for modelling behaviour:

Kennedy, W.G., 2012. Modelling Human Behaviour in Agent-Based Models, in: Heppenstall, A.J., Crooks, A.T., See, L.M., Batty, M. (Eds.), *Agent-based models of geographical systems.* Springer Netherlands, pp. 167–179.

Beliefs-desires-intention (BDI) , PECS and BBAI

Nick Malleon has produced a short summary of PECS, BDI and BBAI in his thesis. The relevant papers are online:

http://www.geog.leeds.ac.uk/courses/level3/geog3150/lectures/lecture5/behaviour_sample-from_NM_Thesis.pdf. The full thesis reference is:

Malleon, N. (2010). *Agent-based modelling of burglary.* PhD Thesis, School of Geography, University of Leeds.

BDI

Wooldridge, M (2000) *Reasoning about rational agents [electronic resource]* MIT Press, Cambridge. (There is also a review of the book in the [JASSS](#)).

PECS

Schmidt, B. (2000) *The modelling of human behaviour : artificial intelligence, artificial life, psychology, social sciences.* SCS Publications, Erlangen. (There is also a review of the book in [JASSS](#))

Bratman, M. E., Israel, D. J., and Pollack, M. E. (1988). *Plans and resource-bounded practical reasoning* . *Computational intelligence.*, 4(3):349–355. ___

Balzer, W. (2000). SMASS: A sequential multi-agent system for social simulation. In Suleiman, R., Troitzsch, K. G., and Gilbert, N., editors, *Tools and techniques for social science simulation*, chapter 5, pages 65–82. Physica-Verlag.

BBAI

A paper about the move from normal AI to behaviour-based AI in robotics (also a good overview of BBAI in itself)

Brooks, R. (1996) From Earwigs to Humans. *Robotics and Autonomous Systems* 20: 291--304

A chapter illustrating the use of BBAI to simulate crime:

Birks, D. J., Donkin, S., and Wellsmith, M. (2008). Synthesis over analysis: Towards an

ontology for volume crime simulation. In Liu, L. and Eck, J., editors, *Artificial crime analysis systems : using computer simulations and geographic information systems*, pages 160–192, Hershey, PA. Information Science Reference.

The Model Building Process

Chapter 7 (Model Uncertainty and Evaluation) in the following book covers many of the topics discussed in the lecture:

O'Sullivan, D. (2013) *Spatial simulation : exploring pattern and process* Chichester: John

Wiley & Son. <http://lib.leeds.ac.uk/record=b3432142>

Chapter 6 ('Checking Simulations') and Chapter 8 ('Validating simulations') in the following are also relevant:

Edmonds, B. and R. Meyer (Eds) (2013) *Simulating social complexity : a handbook*. Springer. <http://lib.leeds.ac.uk/record=b3432143>

This working paper provides a good, broad overview of many of the concepts: Castle, C. and A. Crooks (2006) Principles and Concepts of Agent-Based Modelling for Developing Geospatial Simulations. CASA Working Paper 110. Available online: <http://www.energy-epidemiology.info/bartlett/casa/publications/working-paper-110>

Balci's principles of Validation, Verification and Testing:

Balci, O. (1997) Principles of Simulation Model Validation, Verification, and Testing.

Transactions of the Society for Computer Simulation International Simulation conference proceedings 14(1): 3-12. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=478717&tag=1

For the designing models, and the ODD protocol, have a look at:

Chapter 3 in: Railsback, S.F., 2012. *Agent-based and individual-based modeling : a practical introduction*. Princeton University Press, New Jersey.

Grimm, V., U. Berger, D. L. DeAngelis, J. G. Polhill, J. Giske, S. Railsback (2010) The ODD protocol: A review and first update. *Ecological modelling*. 221 (23-24): 2760-2768 <http://dx.doi.org/10.1016/j.ecolmodel.2010.08.019>.

Or the original ODD paper:

Volker Grimm, Uta Berger, Finn Bastiansen, Sigrunn Eliassen, Vincent Ginot, Jarl Giske, John Goss-Custard, Tamara Grand, Simone K. Heinz, Geir Huse, Andreas Huth, Jane U. Jepsen, Christian Jørgensen, Wolf M. Mooij, Birgit Müller, Guy Pe'er, Cyril Piou, Steven F. Railsback, Andrew M. Robbins, Martha M. Robbins, Eva Rossmanith, Nadja Rürger, Espen Strand, Sami Souissi, Richard A. Stillman, Rune Vabø, Ute Visser, Donald L. DeAngelis. (2006) A standard protocol for describing individual-based and agent-based models. *Ecological modelling*. 198 (1-2): 115-126 (<http://www.sciencedirect.com/science/article/pii/S0304380006002043>)

There are also loads of academic papers on the topics of model building generally and evaluation specifically. Here are a few published in *JASSS* and others to get started with: Windrum, P., G. Fagiolo and A. Moneta (2007) Empirical Validation of Agent-Based Models:

Alternatives and Prospects *The journal of artificial societies and social simulation*.. 10(2) <http://jasss.soc.surrey.ac.uk/10/2/8.html>

Axtell, R., Axelrod, R., Epstein, J. M., and Cohen, M. D. (1996). Aligning simulation models: A case study and results. *Computational and mathematical organizational theory*, 1(2):123–141.

Moss, S. (2008) Alternative Approaches to the Empirical Validation of Agent-Based Models. *The journal of artificial societies and social simulation*. 11(1)
<http://jasss.soc.surrey.ac.uk/11/1/5.html>

Ngo, T. A. and L. See (2012) Calibration and Validation of Agent-Based Models of Land Cover Change. in: Heppenstall, A.J., Crooks, A.T., See, L.M., Batty, M. (Eds.), *Agent-based models of geographical systems*. Springer Netherlands, pp. 181-197.

Boero, R. and F. Squazzoni (2005) Does Empirical Embeddedness Matter? Methodological Issues on Agent-Based Models for Analytical Social Science. *The journal of artificial societies and social simulation*. 8(4) <http://jasss.soc.surrey.ac.uk/8/4/6.html>

Agent-Based Modelling and Geography

This interesting chapter discusses whether or not a realistic virtual environment ('spatial backcloth') is necessary for crime models:

Elffers, H. and van Baal, P. (2008). Realistic spatial backcloth is not that important in agent

based simulation: An illustration from simulating perceptual deterrence. In Liu, L. and Eck, J., editors, *Artificial Crime Analysis Systems: Using Computer Simulations and Geographic Information Systems*, chapter 2, pages 19-34. IGI Global.

The above book ([Artificial Crime Analysis Systems](#)) also has loads of examples of crime simulations.

The following is a beautiful example of an abstract agent-based model used to explore theory:

Birks, Daniel, Michael Townsley, and Anna Stewart. Generative Explanations of Crime: Using Simulation to Test Criminological Theory. *Criminology*. 50, no. 1 (2012): 221-254.

And finally, here are two good references if you are interested in Time Geography: Miller, H. J. (2005) A measurement theory for time geography. *Geographical Analysis*.

37(11): 17-45.

Hägerstrand, T. (1970) What about people in regional science? *Papers of the Regional Science Association*. 24(1): 6-21.

Simulation for Policy Modelling

Alexander, D.,E. (2002) *Principles of emergency planning and management*. Terra Publishing; Harpenden.

Batty, M. (2003), Agent-Based Pedestrian Modelling, Centre for Advanced Spatial Analysis (University College London): Working Paper 61, London, UK (pdf). Available online at: <http://www.bartlett.ucl.ac.uk/casa/pdf/paper61.pdf>

Castle, C. (2007) *Guidelines for Assessing Pedestrian Evacuation Software Applications* Centre for Advanced Spatial Analysis (University College London): Working Paper 115, London, UK. Available online at: <http://www.bartlett.ucl.ac.uk/casa/publications/working-paper-115>

Cova, T. (2005) GIS in Emergency Management, in Longley, P.A., Maguire, D.J., Goodchild, M.F. and Rhind, D. (eds.), *Geographical information systems : principles, techniques, management, and applications* pp. 845-858. New York: John Wiley and Sons Available as an Online Course Reading in the VLE

Helbing, D. (1996), Gas-Kinetic Derivation of Navier-Stokes-like Traffic Equations, *Physical review. E: Statistical physics, plasmas, fluids, and related interdisciplinary topics*. 53(3): 2366-2381.

Helbing, D. and Molnár, P. (1995) Social Force Model for Pedestrian Dynamics, *Physical review. E: Statistical physics, plasmas, fluids, and related interdisciplinary topics*. 51(5): 4282-4286.

Horni, A., Scott, D., Balmer, M. and Axhausen, K. (2009) Location Choice Modeling for Shopping and Leisure Activities with MATSim Combining Microsimulation and Time Geography. *Transportation research record. : Journal of the Transportation Research Board* 2135 87–95.

Lansing, Stephen J. (2006) *Perfect order [electronic resource] : recognizing complexity in Bali* Princeton University Press.

Okazaki, S. and Matsushita, S. (1993) A Study of Simulation Model for Pedestrian Movement with Evacuation and Queuing, in Smith, R.A. and Dickie, J.F. (eds.), *Engineering for Crowd Safety: Proceedings of the International Conference on Engineering for Crowd Safety*, London, UK, pp. 271-280. [Available on the VLE: [pdf](#)]

Pluchino, A., C. Garofalo, G. Inturri, A. Rapisarda and M. Ignaccolo (2014) Agent-Based Simulation of Pedestrian Behaviour in Closed Spaces: A Museum Case Study *The journal of artificial societies and social simulation*. 17 (1) 16 <http://jasss.soc.surrey.ac.uk/17/1/16.html>

Patel, A. and A. Hudson-Smith (2012) Agent tools, techniques and methods for macro and microscopic simulation. In A.J. Heppenstall, A.T. Crooks, L.M. See & M. Batty (Eds.), *Agent-based models of geographical systems*. Berlin: Springer, chapter 18.

Understanding Models through their Patterns

The main reading for this final lecture is:

Evans, A., A. Heppenstall and M. Birkin (2013) Understanding Simulation Results. In B.

Edmonds and R. Meyer (eds) *Simulating social complexity : a handbook*. Springer. [Available on the VLE:
[https://vlebb.leeds.ac.uk/bbcswebdav/institution/ENV/GEOG/GEOG3150/Readings/E vans-Understanding_Simulation_Results.pdf](https://vlebb.leeds.ac.uk/bbcswebdav/institution/ENV/GEOG/GEOG3150/Readings/E%20vans-Understanding_Simulation_Results.pdf)]