

## 2.g. Using EVOLUTIONARY ALGORITHMS to develop an agent-based model

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### The problem

Management strategies for farmers depend on many different factors – subsidies, the type of land, which they are farming, economic conditions, climate etc. A model is needed to explain the decisions which farmers make and to predict the emergent properties of the overall agricultural system in the UK. There are observations of how agricultural practices are developing around the country, but it is difficult to transform this information into rule sets. Some limited rules are available from interviewing farmers, although it is very often difficult to know what questions one should be asking.

### Data available

Interviews with farmers about farming strategy; vegetation & soil maps; agricultural census information; subsidy and policy directives.

### Why use evolutionary algorithms and not another method?

In this case, the development of a working agent-based model is practically impossible due to the complexity of the system.

### Simple description of how it was done

Instead of trying to build a model to fit the observations, a set of rules (IF condition A AND condition B THEN do C) is created randomly and evolved by mutating the conditions or operators, by adding or subtracting rules and by comparing the resulting models with observations and with what is already known from baseline data. This process is similar to that used in simulated annealing, but instead of mutating parameter values the rules themselves are altered. Fitness of the rule set is measured in terms of both how well the model fits the data, and how complex the model is. A simple model, which gives the same results as a complex one is preferable. The end result of the process is a set of rules which describe how the agents (farmers) interact with their physical and economic environment, and which can be used to predict how agriculture in the UK will appear under different climatic and socioeconomic environments.

### Software used and alternative generic packages that could be used

Object-oriented programming languages

### Reference

Gotts, N.M., Polhill, J.G., Law, A.N.R., Izquierdo, I.R., 2003. Dynamics of Imitation in a Land Use Simulation. Proceedings of the AISB '03 Second International Symposium on Imitation in Animals and Artifacts, 7-11 April 2003, University of Wales, Aberystwyth, pp.39-46.

### Further reading

Robert Axelrod. The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration. Princeton University Press, 1997.