

A brief history of AZTool

The zone design approach implemented in AZTool is based on the automated zoning procedure (AZP), first developed by Openshaw (1977a; 1997b) and then enhanced by Openshaw and Rao (1995).

AZP was developed into the AZM (Automated Zone Matching) software (archived version available on the [Download](#) tab) by [Martin \(2003\)](#). AZM will either design a set of new zones (tracts) from scratch by aggregating a set of building blocks based on user-defined criteria, or optimise the match between two existing zonal systems. AZM's functionality was extended by [Cockings and Martin \(2005\)](#).

Over a series of projects, AZM evolved into the more general purpose software program AZTool. AZTool takes a set of building blocks and aggregates them into fewer larger zones, optimised according to user-specified criteria. In the run up to the 2011 Census in England and Wales, a number of algorithmic improvements were made to improve the flexibility and performance of AZTool, including options for varying how the initial random aggregation and optimisation are achieved, and enhanced reporting and de-bugging facilities. For the first time, AZTool was employed to update (or 'maintain') a set of existing zones because the underlying characteristics of the phenomena being mapped had changed ([Cockings et al, 2011](#)), and also to modify an existing set of zones to create a new set of zones for a new purpose ([Martin et al, 2013](#)).

Previous versions of AZTool have been based on an adjacency matrix, whereby zones can only be merged with neighbouring zones with which they share a common boundary. The current version of AZTool incorporates a substantial extension to this functionality and has two modes: (i) adjacency, (ii) connectivity. Users can select whether mergers should be based on zones which are adjacent or connected. Connectedness may be measured and represented in various ways but usually implies that it is possible to travel from one zone to another e.g. via a transport network. In this respect, zones which are not adjacent to one another, but which are connected e.g. via a bypass, may be merged in the formation of tracts. This extension to AZTool's functionality permits the exploration of many new types of zone design problems, and has recently been implemented for planning and managing workloads of field staff collecting data for the 2021 Census and the 2021 Census Coverage Survey in England and Wales.

The latest version of AZTool is the result of a long series of developments, which have included support from the Economic and Social Research Council (award RES-348-25-0019), Office for National Statistics and University of Southampton. The algorithm has subsequently been used by a wide range of organisations and researchers for different applications throughout the world. You can read more about these on the [Use Cases](#) tab.

References

Openshaw S (1977a) A geographical solution to scale and aggregation problems in region-building, partitioning and spatial modeling, *Transactions of the Institute of British Geographers New Series*, 2, 459 - 472

Openshaw S (1977b) Algorithm 3: a procedure to generate pseudo-random aggregations of N zones into M zones, where M is less than N, *Environment and Planning A*, 9, 1423 - 1428

Openshaw S, Rao L (1995) Algorithms for re-engineering 1991 Census geography, *Environment and Planning A*, 27, 425 – 446

Martin D (2003) Extending the automated zoning procedure to reconcile incompatible zoning systems, *International Journal of Geographical Information Science*, 17, 181-196
<https://doi.org/10.1080/713811750>

Cockings S, Martin D (2005) Zone design for environment and health studies using pre-aggregated data, *Social Science & Medicine*, 60, 2729 – 2742 <https://doi.org/10.1016/j.socscimed.2004.11.005>

Cockings S, Harfoot A, Martin D, Hornby D (2011) Maintaining existing zoning systems using automated zone design techniques: methods for creating the 2011 Census output geographies for England and Wales, *Environment and Planning A*, 43(10), 2399-2418 <https://doi.org/10.1068/a43601>

Martin D, Cockings S, Harfoot A (2013) Development of a geographical framework for census workplace data, *Journal of the Royal Statistical Society Series A – Statistics in Society*, 176, 585-602
<https://doi.org/10.1111/j.1467-985X.2012.01054.x>