

Scottish Index of Multiple Deprivation (SIMD) 2006 – Geographic and Telecommunications domain

Methodology

The drive times to the nearest service were calculated from the population weighted grid reference of each Census output area. Drive time calculations are based on average travel speeds. Each of the road classes (e.g. A roads or B roads) in the road network have an assigned speed, this speed is the average for that class. The average travel speeds on the different classes of roads are based on figures provided by the Department of Environment, Transport and the Regions. There is currently no way of modelling for a reduced or lower than average speed at morning and evening peak periods.

Data zone level indicators were created by averaging (population weighted) the drive times (or walk times where faster) from each Census output area within a data zone to a particular service. For islands which do not have a particular service, drive times included ferry times and appropriate waiting times for ferry services.

Indicators

- Drive time to a GP
- Drive time to a Petrol Station
- Drive time to a Post Office
- Drive time to a Primary School
- Drive time to a Secondary School
- Drive time to a Retail Centre

Sources of Data

- Road network – Ordnance Survey's OSCAR Route Manager dataset 2005 (1:10,000). This network includes motorways, trunk roads, A roads, B roads and the majority of minor and unclassified roads'.
- Ferry route data – Ordnance Survey Strategy 2005 and Scottish Executive 2005
- Service locations: GP, primary school, shops and post offices - PointX Data 2006. Retail centres – CACI 2006 and petrol station – Catalist 2006,
- Census output area population weighted grid references – General Register Office for Scotland 2001
- Census output areas population figures - General Register Office for Scotland 2001
- Number of students per census output area for Primary and Secondary school – Scottish Executive 2005.

Creation of road and ferry network

To calculate the drive and walk times the ESRI ArcGIS software extension ProTERRITORY was used. This software requires the creation of a road grid. A road grid is typically a road network that includes motorways, 'A' roads, 'B' roads and unclassified roads. Depending on the resolution of the road grid and the speed profile used, a 30 minute drive time accurately reflects the area that can be reached from a source within 30 minutes. The following section describes the methodology used to create this road grid.

Road grid input files:

- OSCAR Route Manager dataset 2005 (1:10,000) - road network for Scotland from Ordnance Survey
- Major roads and motorway in North England from Ordnance Survey Strategy 2005 (1:50,000)
- Ferry routes derived from Ordnance Survey Strategy 2005 and Scottish Executive 2005
- Settlements 2004 from General Registers Office for Scotland

The system caters for as many or as few road classifications depending on your specific requirements; it can adjust travel speeds for different road types as well as specifying different speeds for rural and urban roads. Different speed profiles for different modes of transport including: cars or walking can also be defined. Model multi-modal transport, for example, ferry routes can be included in your road grid to model journey times to islands.

To create a 20 metre square pixel road grid for SIMD 2006 the roads from OSCAR covering Scotland, the roads covering North England and the Ferry routes were merged and the Settlement 2004 dataset was used to define urban areas (represent areas that would have a maximum speed of 30 mph).

While the roads datasets only required reclassification (see table below). The building of the ferry routes required more work: reclassification, editing and speed calculation. A total of 101 ferry routes were created, ranging from 225 metres (Noss Sound – Gungstie) to 355 km. (Aberdeen – Lerwick).

For SIMD 2006¹ ferry and waiting times were incorporated into the road network used to calculate drive times. Initially each ferry route was assigned a minimum estimated travel time. This information came from either Ordnance Survey Strategy 2005 or the individual ferry service internet sites. The next stage was to add ferry waiting times. A 30 minutes waiting time was selected after comparing the values for estimated waiting time for several different ferry routes. The ferry routes compared ranged from 10 minutes to 3 hours in estimated travel time but all had a 30 minutes waiting time.

From the travel time (including waiting time) and calculated length for each ferry route, the speed was calculated. Speeds ranged from between 2 and 22 miles/hour, where the slowest speeds in general correspond to the shorter ferry routes due to the relative long waiting time. The ferry routes were then classified into 10 speed classes.

The final class given to each ferry route and associated speed can be found in table 1. The roads were reclassified into similar road types resulting in the following classes and speeds for urban and rural areas. Walk times were derived from information provided by ESRI.

¹ For SIMD 2004 ferry times were calculated using the following method. The drive times to the island's harbour were calculated from the population weighted grid reference of each data zone on the island. The ferry times from the harbour to the mainland were taken from ferry route data supplied by Ordnance Survey. Then the drive time from this harbour to the data zone the service is located in was calculated. These figures were added to arrive at the total drive time from a data zone to the nearest service. It was not possible to include ferry waiting times.

Table 1. Road/ferry class and speed

ROAD TYPE	SIMD 2006 RURAL [m/hr]	SIMD 2006 URBAN [m/hr]	SIMD 2004 RURAL [m/hr]	SIMD 2004 URBAN [m/hr]²	Walk Times RURAL [m/hr]	Walk Times URBAN [m/hr]
Motorway	65	44	65	34 - 52	0	0
A road	40	19	40	12 - 24	0	0
B road	34	16	34	9 - 21	3	3
Minor and other road	25	14	25	9 - 18	3	3
Non-network road	25	14	25	9 - 18	3	3
Pedestrian road	25	14	25	9 - 18	3	3
Private road - acc. to public	25	14	25	9 - 18	3	3
Private road	25	14	25	9 - 18	3	3
Ferry - 22	22	22	-	-	22	22
Ferry - 20	20	20	-	-	20	20
Ferry - 18	18	18	-	-	18	18
Ferry - 16	16	16	-	-	16	16
Ferry - 14	14	14	-	-	14	14
Ferry - 12	12	12	-	-	12	12
Ferry - 10	10	10	-	-	10	10
Ferry - 8	8	8	-	-	8	8
Ferry - 6	6	6	-	-	6	6
Ferry - 4	4	4	-	-	4	4
Ferry - 2	2	2	-	-	2	2
Unknown	6	4	-	-	1	1

Services

This section describes the methodology used to generate the drive and walk time datasets for the SIMD. The following service datasets were used:

Service	Source	SIMD 2006 Number of points	SIMD 2004 Number of points
Doctors ³	PointX (June 2006)	1046	1241
Retail	PointX and CACI	11211	-
Post offices ³	PointX (June 2006)	1718	2169

² The drive time software (MapInfo Drivetime) used in SIMD 2004 had four classes of Urban roads (small, large, inner, conurbation). Speeds used for this analysis were averages of these. Speeds originally came from DETR. Road network was a generalised version of OSCAR (1:50,000) and did not include cul-de-sacs less than 200 metres in length, pedestrianised streets, private roads or ferry routes.

³ Services within a 1,000 Km² area adjacent to Scotland were included in the Point X dataset and used during analysis.

Primary Schools ³	PointX (June 2006)	2172	2246
Petrol Stations ⁴	Catalist	965	593
Secondary Schools ³	PointX (June 2006)		

Drive and walk times were created from each service, then times to Census output area population weighted centroids were calculated. The data zone level indicators were created by averaging (based on population) the drive times from each Census output area within a data zone to a particular service.

Walk times were calculated, though limited to a maximum of 30 minutes. Originally walk times were to replace drive times if they were faster, however this situation never occurred; for every road type walk speeds were always lower than corresponding drive speeds. To ensure walk routes did not follow motorways and A roads, these road types were given a walk speed of 0. Some (around 450) census output area centroids fall on a motorway or A road and no walk time could be calculated for them.

The population weighted drive times were calculated as follows: each Census output area had its drive time multiplied by its population (or number of primary / secondary school pupils) to give the total drive time. For each data zone the total drive times from each Census output area within it were added together and then divided by the data zone population. The population datasets used were:

- Census output areas population figures - General Register Office for Scotland 2001
- Number of students per census output area for Primary and Secondary school – Scottish Executive 2005.

The Primary and Secondary school student population data did not have a figure for every output area so some data zones could not be averaged using this method. The population weighted results using census population figures were also provided for schools.

⁴ One petrol station fell outside coastline, this was moved inland so drive and walk times could be accurately calculated.