

# Housing conditions and household characteristics: what (and where) really matters?

Insights into the Manchester and Salford contexts

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# Housing deprivation

- The concept of housing deprivation is used in the literature to refer to a number of unsatisfactory housing situations (Hick et al., 2022).
- *Dependent variable problem*: issues about conceptualisation and measurement of housing deprivation
- Four domains have been explored in housing deprivation (Eurofound, 2016) :
  - ① basic facilities availability
  - ② structural problem
  - ③ overcrowding
  - ④ neighbourhood deprivation
- The concentrations of low-income households in certain neighbourhoods characterized by bad housing conditions could be the result of entry barriers to the labor market, insufficient income and the lack of choice in the housing market (Murie, 2002) and could lead to the some form of **residential segregation**.

- Our aim is twofold:
  - 1 Investigate the determinants of housing deprivation in a local/small area context.
  - 2 Assess the variation of housing deprivation across neighbourhood of the two english cities of Manchester and Salford.
- We test the hypothesis of a **neighbourhood effect** on housing deprivation condition and one of their sub-component, overcrowding.

## How do we measure *housing deprivation*?

Following the UK Census 2021 definition, a household is classified deprived if the accommodation is either:

- \* Overcrowded
- \* In a shared dwelling
- \* without central heating

Our observation units are the inhabitants of the districts of Manchester and Salford.

## Research questions

- How housing deprivation is distributed across the neighbourhoods in Manchester and Salford?
- Are there neighbourhood's differences in the probability of being in housing deprivation?
- Which factors increase the risk of housing deprivation, considering for neighbourhoods differences?
  - \* Socio-demographic characteristics of individuals and households
  - \* Characteristics of the neighbourhoods
- What is the relationship between housing deprivation and health status?

# Data

- 1 *UK Census microdata sample* (2021) containing 40143 individuals for the Local Distrinct of Manchester and Salford. The Census sample provides:
  - Information on individual and household sociodemographic characteristics (e.g. household composition, tenure type, socio-economic status)
  - Disaggregated information on types of deprivation (health, housing, education, and employment)

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  - Information on individual and household sociodemographic characteristics (e.g. household composition, tenure type, socio-economic status)
  - Disaggregated information on types of deprivation (health, housing, education, and employment)
- 2 *Census areal data* (2021) containing 456 Lower layer Super Output Areas (LSOAs) for the Local District of Manchester (295 LSOAs) and Salford (161 LSOAs). The areal Census provides:
  - Information on neighbourhoods characteristics (e.g. count of households with children and without children, count of owners or tenants, ect)
  - Aggregated information about the number of deprivation (count of households deprived in one, two, three, and four dimensions for each area, without specifying the type of deprivation)
  - Possibility to merge with *Index of Multiple Deprivation* data (IMD, 2019) providing detailed information on various dimensions of poverty for LSOAs.

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- 2 *Census areal data* (2021) containing 456 Lower layer Super Output Areas (LSOAs) for the Local District of Manchester (295 LSOAs) and Salford (161 LSOAs).
- 3 A “new” **spatial microdata** is obtained by merging the previous datasets through a procedure called *spatial microsimulation*. The new data contains jointly all the information from the individual and aggregated data, for a total of 318816 individuals.

## Spatial microdataset construction

- *Spatial microsimulation* is a “population synthesis” tool that combines individual and geographical aggregates dataset.
- The result is a spatial microdataset - containing a single row per individual and extra additional variables related to the neighborhood. This procedure allows the “new” clustered data to be analysed considering also the neighbourhood levels.

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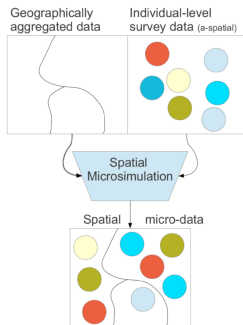


Figure: Schematic diagram of population synthesis. Source: Lovelace & Dumont (2016).

## *Steps to build the spatial microdata:*

- 1 Choose common variables that allow linking the individual and areal data.
  - These variables must be related to the *target variable* (housing deprivation).
  - The more detailed (more levels), the more accurate the procedure.

## *Steps to build the spatial microdata:*

- 1 Choose common variables that allow linking the individual and areal data.
  - These variables must be related to the *target variable* (housing deprivation).
  - The more detailed (more levels), the more accurate the procedure.
- 2 Assigns a weight to each individual in relation to every area, leveraging aggregated constraints. The **weight matrix** reflect how well individual's characteristics align with a specific neighbourhood.
- 3 Generate the weight matrix via a *deterministic method* known as **Iterative proportional fitting** (IPF).
  - IPF is used to estimate internal cells based on known marginals.
  - IPF is an *entropy maximisation* method.

- 4 Convert these fractional weights into integers, corresponding to the number of repetitions needed for each individual in the synthetic spatial microdataset. This process is known as *integerisation*.
- 5 This results in a *spatial microdataset* with a total of 318816 individuals - this number is equal to the total number of counts for each area of the aggregated dataset - with the corresponding geographical location.

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It is worth noting that the results of the spatial microsimulation are not real, but a **best estimate of the population in a given area**, given the following assumptions:

- The individual level microdata are representative of the study area.
- The target variable is dependent on the constraint variables.
- The relationships between the constraint variables are not spatially dependent.

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Our target variable is *housing deprivation* while the variables that we used as constraints are **tenure status**, **accommodation type** and **household composition**.

## Exploratory analysis

**Table:** Distribution of individuals in housing deprivation and sub-component in Manchester, Salford, and the UK. *Source:* Spatial microdata

<b>Housing deprv</b>	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>Yes</b>	37270	<b>17.8</b>	13348	12.3	342914	11.6
<b>No</b>	172697	82.2	95501	87.7	2622407	88.4
<b>Total</b>	209967	100.0	108849	100.0	2965321	100.0

<b>Overcrowded</b>	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>Yes</b>	27904	<b>13.3</b>	9214	8.5	246838	8.3
<b>No</b>	182063	86.7	99635	91.5	2718483	91.7
<b>Total</b>	209967	100.0	108849	100.0	2965321	100.0

<b>No central heating</b>	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>Yes</b>	4776	2.3	2036	1.9	36760	1.2
<b>No</b>	205191	97.7	106813	98.1	2928561	98.8
<b>Total</b>	209967	100.0	108849	100.0	2965321	100.0

**Table:** Distribution of household composition in Manchester, Salford, and UK. *Source:* Spatial microdata

Household Composition	Manchester		Salford		UK	
	n	%	n	%	n	%
One person househ old	18354	8.7	12657	11.6	166651	5.6
One person househ young	51372	<b>24.4</b>	25992	<b>23.8</b>	213487	7.20
Household with children	81319	<b>38.7</b>	38971	<b>35.8</b>	1235800	<b>41.68</b>
Household without children	58922	28.1	31229	28.6	1349383	<b>45.51</b>
Total	209967	100	108849	100	2965321	100

**Table:** Distribution of tenure status in Manchester, Salford, and UK. *Source:* Spatial microdata

Tenure	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>Owens outright</b>	43757	20.8	27742	25.5	803556	27.1
<b>Owens with a mortgage</b>	51817	24.7	29684	<b>27.3</b>	1034550	<b>34.9</b>
<b>Social rented</b>	51876	<b>24.7</b>	25388	<b>23.3</b>	489008	16.5
<b>Private rented</b>	59789	<b>28.5</b>	24685	22.7	609267	20.5
<b>Other (shared and free)</b>	2728	1.3	1350	1.2	28940	1.0
<b>Total</b>	209967	100	108849	100	2965321	100

**Table:** Distribution of socio-economic status in Manchester, Salford, and UK. *Source:* Spatial microdata

Tenure	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>Higher occupation</b>	5874	<b>21.2</b>	3367	<b>25.2</b>	795799	<b>26.8</b>
<b>Intermediate occupation</b>	3607	13.5	2095	15.7	531154	17.9
<b>Routine and manual occ.</b>	5580	20.8	3120	23.4	692157	23.3
<b>Never worked or student</b>	5820	<b>21.7</b>	2007	15.	361674	12.2
<b>NA</b>	5922	22.1	2751	20.6	584537	19.7
<b>Total</b>	209967	100	108849	100	2965321	100

**Table:** Distribution of country of birth in Manchester, Salford, and UK. *Source:* Spatial microdata

Country of birth	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>UK</b>	18145	<b>67.7</b>	10757	<b>80.6</b>	2438500	<b>82.2</b>
<b>European countries</b>	2418	9	1043	7.8	204680	6.9
<b>Africa</b>	1883	7	539	4	77889	2.63
<b>Middle East and Asia</b>	3650	13.6	738	5.5	162207	5.5
<b>Others</b>	498	1.9	167	1.3	47906	1.6
<b>NA</b>	209	0.8	96	0.7	34139	1.1
<b>Total</b>	209967	100	108849	100	2965321	100

**Table:** Distribution of health status in Manchester, Salford, and UK. *Source:* Spatial microdata

<b>Health</b>	Manchester		Salford		UK	
	n	%	n	%	n	%
<b>Good health</b>	21949	81.9	10855	81.4	2411777	81.3
<b>Fair health</b>	3023	11.3	1594	11.9	368759	12.4
<b>Bad health</b>	1241	4.6	598	4.5	116761	3.9
<b>Very bad health</b>	381	1.4	197	1.5	33885	1.1
<b>NA</b>	209	0.8	96	0.72	34139	1.2
<b>Total</b>	209967	100	108849	100	2965321	100

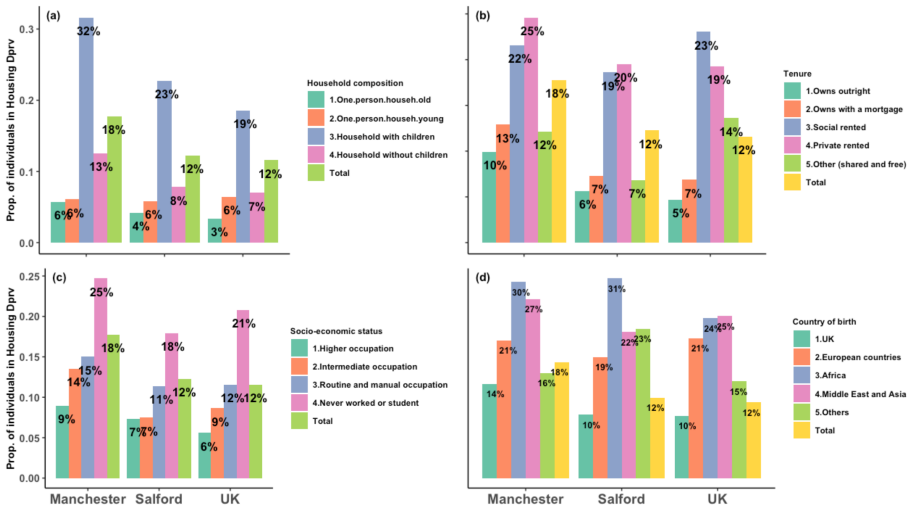


Figure: Proportions of individuals in housing deprivation by socio-demographic characteristics for each area.

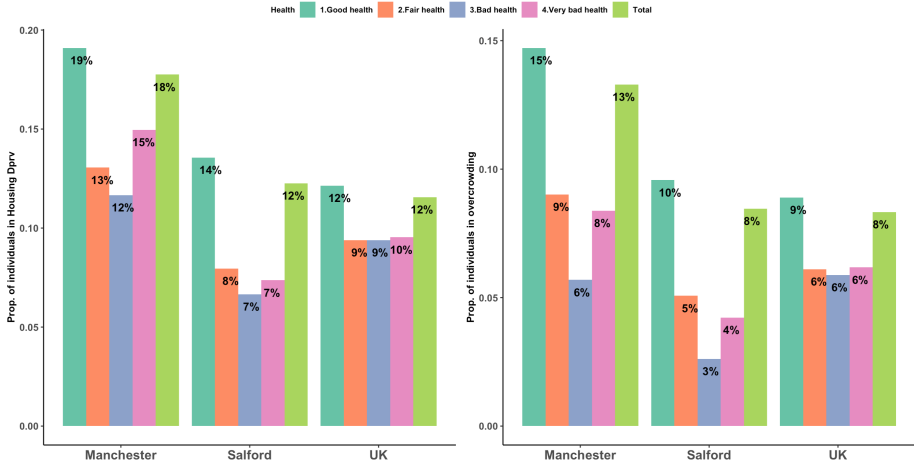


Figure: Proportions of individuals in housing deprivation (left) and overcrowding (right) by health status for each area.

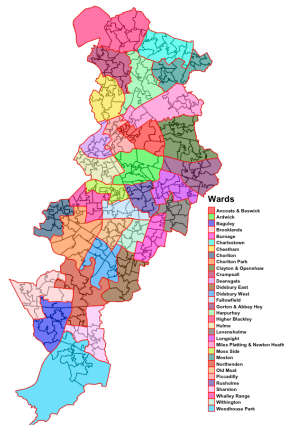
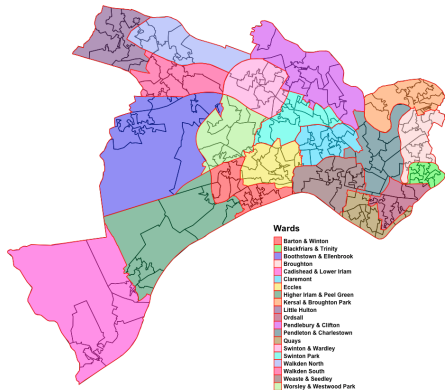
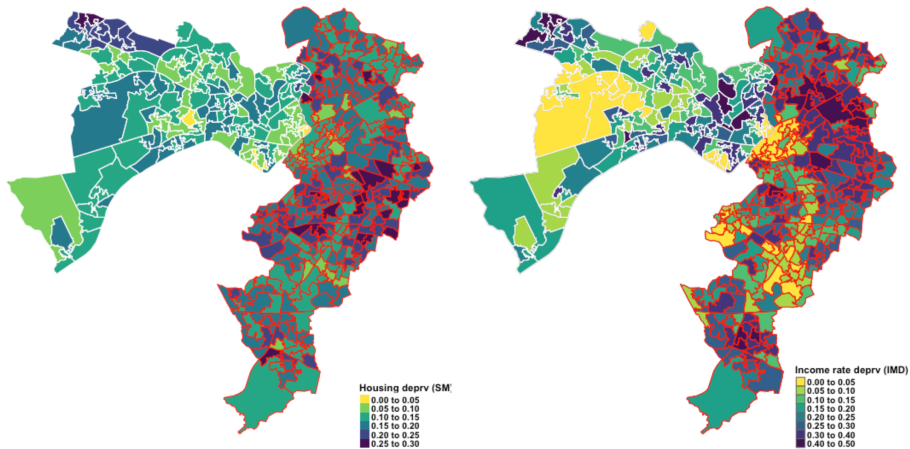


Figure: Maps of of LSOAs (2021) and Wards (2021) at Salford (left) and Manchester (right). LSOAs are 161 at Salford and 295 at Manchester.



**Figure:** Proportions of people in housing deprivation (left) and income deprivation (right) for each LSOA. The boundaries of the Salford LSOAs are in white, those of the Manchester LSOAs in red.

## Multilevel model

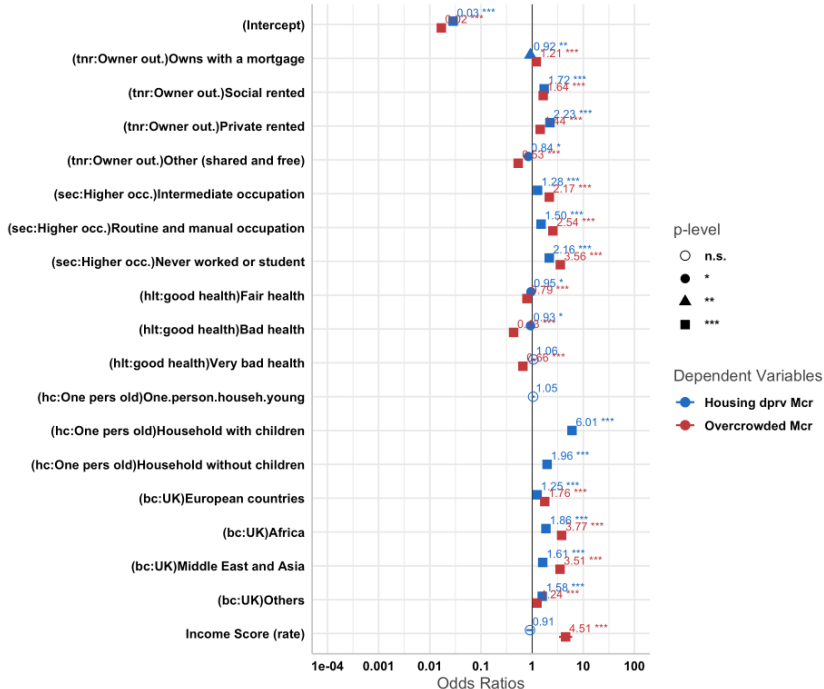
- Our study populations have a two-level structure with individuals that live in Manchester and Salford at level 1 and neighbourhoods (LSOAs) at level 2.
- It may ask if people who live in the same neighbourhood are more likely to experience housing deprivation than those who live in other neighbourhoods. In other words, we want to investigate whether there is a *neighbourhood effect* on housing deprivation, even after considering individual characteristics.
- **Multilevel modelling** enables us to investigate the between-neighbourhoods variability, and the effects of group-level characteristics on individual outcomes.

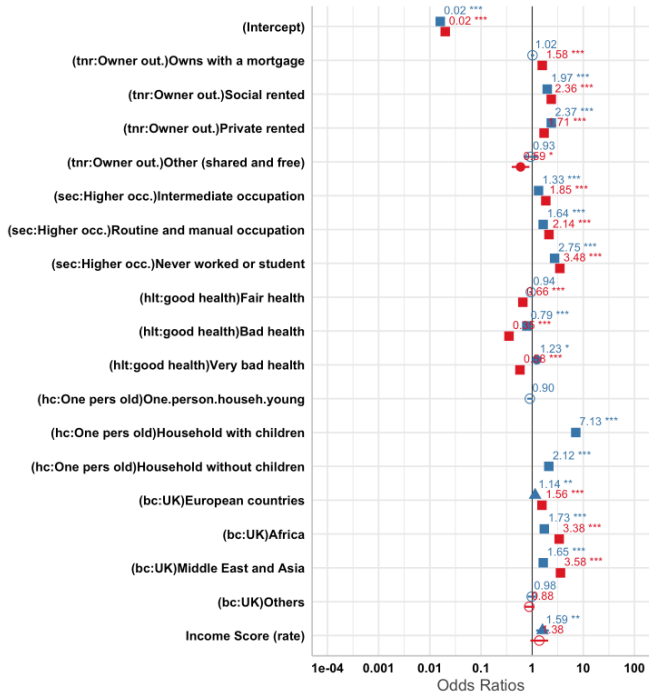
$$\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 \text{Tenure}_{ij} + \beta_2 \text{HouseComp}_{ij} + \beta_3 \text{NS-sec}_{ij} + \beta_4 \text{Birth.Country}_{ij} + \beta_5 \text{Health.Status}_{ij} + \beta_6 \overline{\text{Income.dprv.rate}_j} + u_{0j}$$

- $\beta_0$  is the log-odds that  $y = 1$  when  $x = 0$  and  $u = 0$  and is referred to as the *overall intercept*.
- $\beta_* x_{ij}$  are level-1 covariates. They measure the effect of  $x$  on the log-odds that  $y = 1$  for individuals within the same neighbourhood so  $\beta$  is usually referred to as a *cluster-specific effect* or the *within-group effect*.
- $\beta_6 \bar{x}_j$  is a level-2 covariate and is a measure of the *contextual effect* of  $x$ , which is the effect of the neighbourhood mean of  $x$  on an individual.
- $u_{0j} \sim \mathcal{N}(0, \sigma_{u0}^2)$  neighbourhood-level random effect (level-2 residual) shared by individual in the same neighbourhood.
- $\beta_{0j} = \beta_0 + u_{0j}$  random intercept captures differences in housing deprivation across neighbourhoods.

Figure: Null model with random intercept results: Manchester sample (left) and Salford sample (right).

<i>Predictors</i>	<b>house dprv 1</b>			<b>house dprv 1</b>		
	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	0.20	0.19 – 0.21	<b>&lt;0.001</b>	0.14	0.13 – 0.15	<b>&lt;0.001</b>
<b>Random Effects</b>						
$\sigma^2$	3.29			3.29		
$\tau_{00}$	0.12	LSOA21CD		0.18	LSOA21CD	
ICC	0.04			0.05		
N	295	LSOA21CD		161	LSOA21CD	
Observations	209942			108874		
Marginal $R^2$ / Conditional $R^2$	0.000 / 0.035			0.000 / 0.053		





Dependent Variables

● Housing dprv Sif

● Overcrowded Sif

p-level

○ n.s.

● \*

▲ \*\*

■ \*\*\*

Figure: Full model with random intercept for Manchester sample (left) and Salford sample (right).

<i>Predictors</i>	<b>house dprv 1</b>			<b>house dprv 1</b>		
	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>	<i>Odds Ratios</i>	<i>CI</i>	<i>p</i>
(Intercept)	0.03	0.03 – 0.03	<b>&lt;0.001</b>	0.02	0.01 – 0.02	<b>&lt;0.001</b>
<b>Random Effects</b>						
$\sigma^2$	3.29			3.29		
$\tau_{00}$	0.01	LSOA21CD		0.02	LSOA21CD	
ICC	0.00			0.01		
N	295	LSOA21CD		161	LSOA21CD	
Observations	172048			89645		
Marginal $R^2$ / Conditional $R^2$	0.222 / 0.224			0.268 / 0.273		

- The determinants of housing deprivation and its sub-component of overcrowding are rather stable for the two cities.
- The contribution of the variation between areas is significantly reduced when considering covariates, but remains statistically significant (likelihood ratio test).
- The relationship between housing deprivation and health status seems to be a bit tricky and need to be investigated more. According to our results *the better the health status, the higher the probability of being in housing deprivation, with the exception of people in poor health.*
  - For Manchester residents, there seems to be no difference, in terms of being in housing deprivation, between those with very good and very bad health.
  - For Salford residents, those in very poor health face greater probability of being in housing deprivation than those in very good health.
  - In both cases, those with average health status are less likely to be in housing deprivation than those with very good health status.

## Limits & Further developments

- The “dependent variable problem” has been neglected in this part of the analysis.
- The addition of other two-level variables and the interaction between the first and second variable could provide more information on the urban dynamics of housing deprivation, but is computationally expensive.
- A comparison between cities in different parts of the UK and Europe with similar data is possible.

**Thanks for the attention!**

# Household definition

A household is defined as:

- one person living alone
- a group of people (not necessarily related) living at the same address who share cooking facilities and share a living room or sitting room, or dining area

This includes:

- all sheltered accommodation units in an establishment (irrespective of whether there are other communal facilities),
- all people living in caravans on any type of site that is their usual residence; this will include anyone who has no other usual residence elsewhere in the UK

A household must contain at least one person whose place of usual residence is at the address. A group of short-term residents living together is not classified as a household, and neither is a group of people at an address where only visitors are staying.

# Occupancy rating

Whether household's accommodation is overcrowded, ideally occupied or under-occupied, is calculated by comparing the number of bedrooms the household requires to the number of available bedrooms. The number of bedrooms the household requires is calculated according to the *Bedroom Standard*.

An occupancy rating of:

- negative 1 or less implies that a household's accommodation has fewer bedrooms than required (overcrowded)
- positive 1 or more implies that a household's accommodation has more bedrooms than required (under-occupied)
- 0 suggests that a household's accommodation has an ideal number of bedrooms

The *Income Deprivation Domain* measures the proportion of the population experiencing deprivation relating to low income. The definition of low income used includes both those people that are out-of-work, and those that are in work but who have low earnings. The indicators included in the Income deprivation Domain are the follow:

- Adults and children in Income Support families
- Adults and children in income-based Jobseeker's Allowance families
- Adults and children in income-based Employment and Support Allowance families
- Adults and children in Pension Credit (Guarantee) families
- Adults and children in Working Tax Credit and Child Tax Credit families not already counted, and whose equivalised income (excluding housing benefit) is below 60 per cent of the median before housing costs
- Asylum seekers in England in receipt of subsistence support, accommodation support, or both
- Adults and children in Universal Credit families where no adult is classed within the 'Working - no requirements' conditionality regime