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VALIDATION AND WEIGHTING OF CENSUS BASED DEPRIVATION INDICES

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Introduction

The construction of Census based deprivation indices is one of the most economically important uses of social statistics since they form a key element in the allocation of both local government and health resources. However, none of the questions in the 1991 Census was specifically designed to measure either poverty or deprivation. Therefore, any Census based index must be comprised of variables that are, at best, proxy indicators of deprivation rather than direct measures. It is, therefore, unsurprising that a bewildering array of indices has been proposed, using different combinations of variables and different statistical methods.

The key question that most researchers want answered is 'which index is the best?' This question can be divided into two parts: firstly, what does the index measure (if anything) and, secondly, 'which index provides the most accurate and precise measurement?' Answering these questions is often far from a simple matter. Advocates of new Census based deprivation indices rarely make detailed comparisons between their index and others. Similarly, theoretical discussions on the nature and measurement of deprivation are often dealt with in a cursory manner or are entirely lacking from many papers. Indeed, many deprivation indices seem to be composed from combinations of variables that the authors think measure something 'bad'. Although, what this 'bad' thing is is often unclear. Various statistical procedures and transformations are often performed on the indices components, usually in order to ensure equal weighting, ie so that each variable provides an equal contribution to the final index. However, the justification for such statistical procedures is often absent. The terms 'deprivation' and 'multiple deprivation' are generally used loosely, with little reference to the specific technical meanings of these terms.

Under these circumstances, it is unsurprising that the non-specialist (and often the specialist) has difficulty in selecting which deprivation index to use. Despite these problems, it is relatively easy to describe the broad pattern of the distribution of poverty within a region. Figure 1 shows the estimated percentage of poor households in the 366 local authority districts of England

(Gordon and Forrest, 1995). The districts have been divided into approximate quartiles (the poorest 25% of authorities, the next 25% and so forth) and a clear pattern is evident on the map. There are high numbers of poor households living in inner London, Tyneside, Merseyside, Greater Manchester and into Yorkshire. Poor households are also found in the major cities and in rural districts of Cornwall, East Anglia, Kent, Cumbria and Northumberland.

This same pattern is evident from maps produced using the Social Deprivation (SOCDEP) index of Forrest and Gordon (1993), the 'Townsend Index' Z-score[1] (the most widely used deprivation index) and the Department of Environment's Index of Local Conditions[2] (the current 'official' deprivation index). Since these indices use different combinations of variables and different statistical methods, these striking similarities are remarkable and indicate that poverty had, by 1991, become so widespread in England and its manifestations were so varied, that the same broad patterns can be discerned almost irrespective of the methods used to measure it. To put it bluntly, when there is a lot of poverty, it becomes relatively easy to measure (Gordon and Forrest, 1995).

However, although there are broad similarities between the results obtained from these different indices, there are considerable differences in the specific rankings. This is important if these indices are to be used to allocate resources. These differences become even more marked when smaller and more homogeneous geographic areas (such as electoral wards) are compared.

The Theory of Poverty and Deprivation

In order to measure deprivation/poverty more accurately, it is necessary to be precise about the meaning of these terms. There are two basic concepts of in social science the 'absolute' and 'relative' theories. The 'absolute' concept of poverty; is dominated by the individual's requirements for physiological efficiency. However, this is a very limited conception of human needs, especially when considering the roles that men and women play in society. People are not just physical beings, they are social beings. They have obligations as workers, parents, neighbours, friends and citizens that they are expected to meet and which they themselves want to meet. Studies of people's behaviour after they have experienced a drastic cut in resources show that they sometimes act to fulfil their social obligations before they act to satisfy their physical wants. They require income to fulfil their various roles and participate in the social customs and associations to which they have become habituated and not only to satisfy their physical wants (Townsend and Gordon, 1989).

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[1] Townsend, Phillimore and Beattie (1986)
[2] Department of Environment (1994)

Poverty can be defined as where resources are so seriously below those commanded by the average individual or family that the poor are, in effect, excluded from ordinary living patterns, customs and activities. As resources for any individual or family are diminished, there is a point at which there occurs a sudden withdrawal from participation in the customs and activities sanctioned by the culture. The point at which withdrawal escalates disproportionately to falling resources can be defined as the poverty line or threshold (Townsend, 1979, 1993)

This 'relative' concept of poverty is now widely accepted (Piachaud, 1987), however it is not easy to measure poverty directly (Atkinson, 1985a, 1985b, Lewis and Ulph, 1988) but it is possible to obtain measures of 'deprivation'. These two concepts are tightly linked and there is general agreement that the concept of deprivation covers the various conditions, independent of income, experienced by people who are poor, while the concept of poverty refers to the lack of income and other resources which makes those conditions inescapable or at least highly likely (Townsend, 1987).

The Measurement of Poverty and Deprivation

From these definitions, it is clear that, in order to measure poverty/deprivation accurately, surveys or censuses must be used that both establish the 'normal' or 'average' standard of living of the majority in a society/culture as well as any 'enforced' reductions in this standard due to lack of resources.

Social scientists have been using deprivation surveys to study poverty in Britain for over a hundred years. All these surveys have shown that certain groups are more likely to suffer from multiple deprivation than others (ie lone parents and the unemployed are not equally likely to be living in poverty and indices that consider them to be are probably wrong.) Therefore, Census based deprivation indices that give equal weight to their component variables are likely to yield inaccurate results.

Since all Census based deprivation indices are generally composed of surrogate or proxy measures of deprivation rather than direct measures, there are two basic requirements they should fulfil to ensure accuracy:

1 The components of the index should be weighted to reflect the different probability that each group has of suffering from deprivation; and

2 the components of the index must be additive, eg if an index is composed of two variables, unemployment and lone parenthood, then researchers must be confident that unemployed lone parents are likely to be poorer than either lone parents in employment or unemployed people who are not lone parents.

Weighted indices also have the advantage that their results are often much easier to understand, eg saying that, in Brent, 25% of households are living in poverty has a much greater intuitive meaning than saying that Brent has a Townsend Z-score of 7.86 or a Department of Environment Index of Local Conditions signed Chi-squared score of 22.46.

Obtaining Weightings for Census Based Deprivation Indices

The easiest method of obtaining weightings for component variables in Census based deprivation indices is to use a survey (conducted at or around the same time as the Census) that was specifically designed to measure poverty and deprivation. The weightings used to estimate the percentage of poor households, shown in Figure 1, were derived from the Breadline Britain in the 1990's Survey (Frayman, 1991; Gosschalk and Frayman, 1992; Gordon and Pantazis, 1994). This was a nationally representative survey,[3] designed specifically to measure the extent and nature of poverty in Britain at the end of 1990 (eg a few months before the Census). The previous Breadline Britain Survey, in 1983, had pioneered the 'consensual' or 'perceived deprivation' approach to measuring poverty, which is defined from the viewpoint of the public's perception of minimum need:

"This study tackles the questions 'how poor is too poor?' by identifying the minimum acceptable way of life for Britain in the 1980's. Those who have no choice but to fall below this minimum level can be said to be 'in poverty'. This concept is developed in terms of those who have an enforced lack of ***socially perceived*** *necessities. This means that the 'necessities' of life are identified by public opinion and not by, on the other hand, the views of experts or, on the other hand, the norms of behaviour per se."* (Mack and Lansley, 1985).

The 1990 Survey asked respondents about a list of 44 items designed to cover the range of possessions and activities that people might consider important. Respondents (and their households) were assigned a deprivation index score each time they answered that they 'don't have and can't afford' an item that was considered to be a necessity by more than 50% of respondents.[4] The resulting 32-item deprivation index has been shown to be highly reliable (Cronbach's Alpha 0.8754) and effectively identical results would have been obtained if different sets of questions on deprivation had been asked (Gordon and Pantazis, 1994).

The 'poverty line' was identified at a deprivation index score of 3 (ie those people/households lacking 3 or more socially perceived necessities) using

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[3] For the Breadline Britain in the 1990's Survey, MORI interviewed a quota sample of 1319 adults aged 16+, face-to-face in their homes, between 14 and 25 July 1990. Additional fieldwork among households living in particularly deprived areas was carried out between 26 November and 9 December 1990, with 512 quota interviews conducted face-to-face in home. Quotas were based on sex, age and working status. Aggregated data was weighted by age, household type, tenure and ACORN housing type to be representative of the population of Great Britain (Frayman, 1991).

[4] 32 out of the 44 items were considered to be necessities by more than 50% of respondents after the sample had been weighted to represent the population.

the discriminant analysis methodology of Townsend and Gordon (1989)[5]. Weightings were obtained using logistic regression for the best subset of deprivation indicator variables that were measured in both the 1991 Census and the Breadline Britain Survey

Eleven variables, which have been used in one or more Census based indices, were examined:

1 Unemployment
2 Lone Parents
3 Limiting Long Term Illness/Disability
4 Unskilled/Low Social Class
5 No Access to a Car
6 Living in Rented Accommodation (not Owner Occupied)
7 Single Pensioners
8 Divorced People
9 Widows
10 Lacking or Sharing Basic Amenities (Indoor Toilet, Bath/Shower)
11 Not Self Contained Accommodation

There was a considerable degree of overlap between single pensioners and widows and both variables were excluded because they were not good predictors of poverty. Divorced people were excluded because of their high overlap with single parenthood, which was a better predictor of poverty. 'Lacking basic amenities' and 'not self contained accommodation' were dropped because they were found not to be additive[6], eg households which contained someone with a limiting long term illness and also lacked basic amenities were not likely to be poorer than a household with an ill person but with basic amenities. The reason for this is that many poor disabled people live in local authority accommodation which invariably have indoor toilets and bathrooms.

The relative weightings and the odds ratios from the logistic regression results are shown in Table 1.

Table 1: Logistic Regression Results

	Relative Weights	**Odds Ratio**	**95% Confidence Interval of Odds Ratio**
Unemployment	0.094	1.7	2.5 - 1.1
Long Term Illness	0.108	1.9	2.5 - 1.1
Social Class IV & V	0.159	2.5	3.4 - 1.9
No Car	0.217	3.6	4.8 - 2.7
Not Owner Occupied	0.203	3.3	4.3 - 2.4
Lone Parents	0.160	2.5	4.6 - 1.4

[5] See also Gordon and Townsend (1990) and Gordon and Pantazis (1994)

[6] Standard statistical techniques were used to establish additivity. First order interaction plots were produced using the Minitab v10.2 package and fully saturated ANOVA and GLM models were used to examine higher order interactions.

Note: Relative Weights have been calculated from the beta coefficient

The regression equation classifies 82% of the cases correctly, which means that, even using the best weighted subset of variables available from the Census, there is still a one in five error rate. Basically, the Census is not designed to measure poverty and therefore does not do it particularly well. However, an estimate of the number of poor households in an area can be calculated as: 21.7% of the number of households with no access to a car + 20.3% of the number of households not in owner-occupied accommodation + 16% of the number of lone parent households + 15.9% of the number of workers in Social Classes IV and V + 10.8% of the number of households containing a person with a limiting long-term illness + 9.4% of unemployed workers.

Poverty, Low Income and State Benefits

Recently, Davis *et al* (1995) have used the Family Expenditure Survey (FES) and General Household Survey (GHS) to produce a set of weightings that can be used with Census variables to predict the number of low income households (the bottom quintile): and Noble *et al* (1995) have suggested weightings to predict households in receipt of state benefits (Income Support/Housing Benefit). Although there is a considerable overlap between poor households, low income households and households on benefit, these groups are not identical. Specifically, pensioners, lone parents and the self employed often have low incomes (as measured in the FES and GHS) but have a reasonable standard of living due to previously accumulated wealth. Similarly, people who have only recently got a job after a period of unemployment, may have reasonable incomes but a low standard of living. These factors mean that there is only a 55-75% overlap between low income households and poor households (Callaghan *et al*, 1993; Gordon and Pantazis, 1995).

The correspondence between low income households and households in receipt of state benefits is of a similar magnitude. The Households Below Average Income Statistics (DSS, 1994) show that, in 1991/92, only 59% of households in the bottom decile of income received any state benefits (including pensions). Similarly, the last set of Low Income Statistics, produced for 1987 (Johnson and Webb, 1990), showed that, of the 11,570,000 people in families with incomes at or below the Income Support level, only 56% were receiving Supplementary or Housing Benefit. The Breadline Britain in the 1990's Survey found that only 63% of non-pensioner households, in receipt of any state benefit, were also living in poverty.

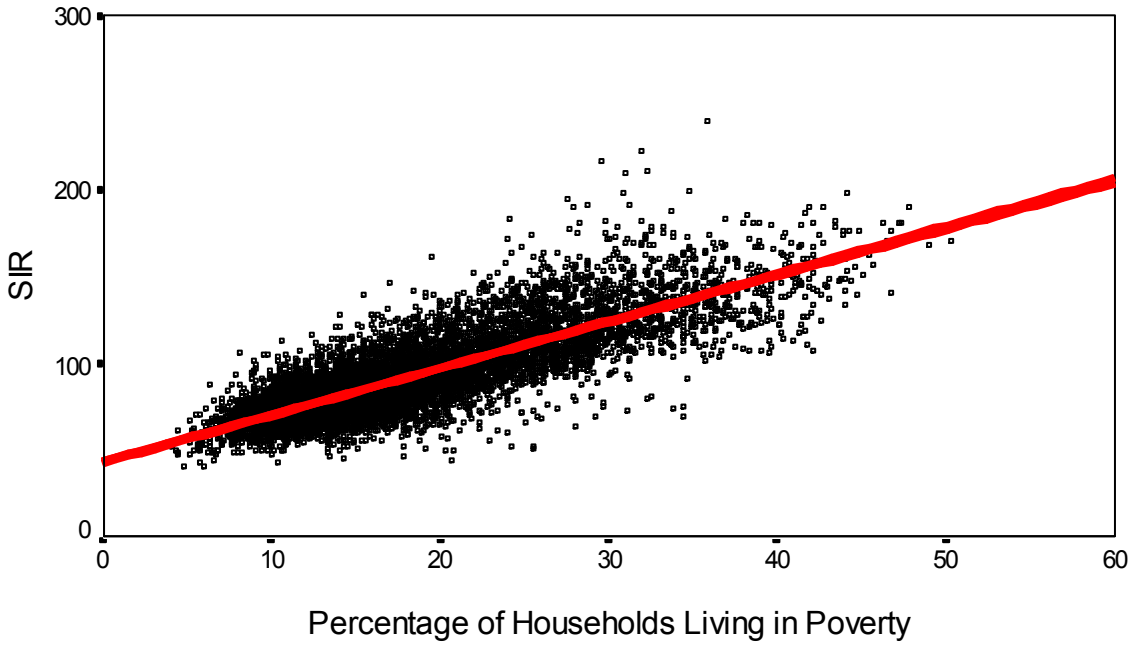
Validation of Census Based Deprivation Indices

In order to test the accuracy of a Census based deprivation index, it is advisable to use one or more validation procedures. Since the publication of

The Black Report (Townsend and Davidson, 1988), literally hundreds of studies have been published demonstrating that, after age and gender, poverty is one of the major determinants of ill health. Similarly, all things being equal, poor households are likely to have less income than non-poor households. Therefore, ill health and income can be used as validation criteria for deprivation indices.

Figure 2 shows a scatter plot of the estimated percentage of poor households against the Standardised Illness Ratio[7] (SIR) for the 8,519 electoral wards of England. The regression line with a 95% Confidence Interval is also shown. There appears to be very good agreement between these two variables (Pearson's Product Moment Correlation 0.82).

Figure 2: Poor Households Vs Standardised Illness Ratio (SIR)



Although the 1991 Census collected no information on income, detailed information on occupation is available. Table 99 of the Local Base Statistics list occupation grouped into 77 categories by gender. It is possible to estimate the average income from earnings for an area by multiplying the number of men and women in each occupational group by the average weekly full time earnings of that occupation as recorded in the 1991 New Earnings Survey. Adjustments are then made for the numbers in part time work, those on government schemes and the unemployed. Finally this total figure is divided by the economically active population to give an average estimated income from earnings.

This methodology does not give accurate absolute figures for income since no estimate is made of unearned income (eg dividends from stocks and shares, etc). However, since people of working age with the highest earned income

[7] Standardised Illness Ratio calculated using the method of Forrest and Gordon (1993).

tend to also have higher unearned income (Banks, Dilnot and Law 1994), the variations in average income between areas can be considered to be minimum estimates.

Figure 3: Poor Households Vs Estimated Average Weekly Earnings

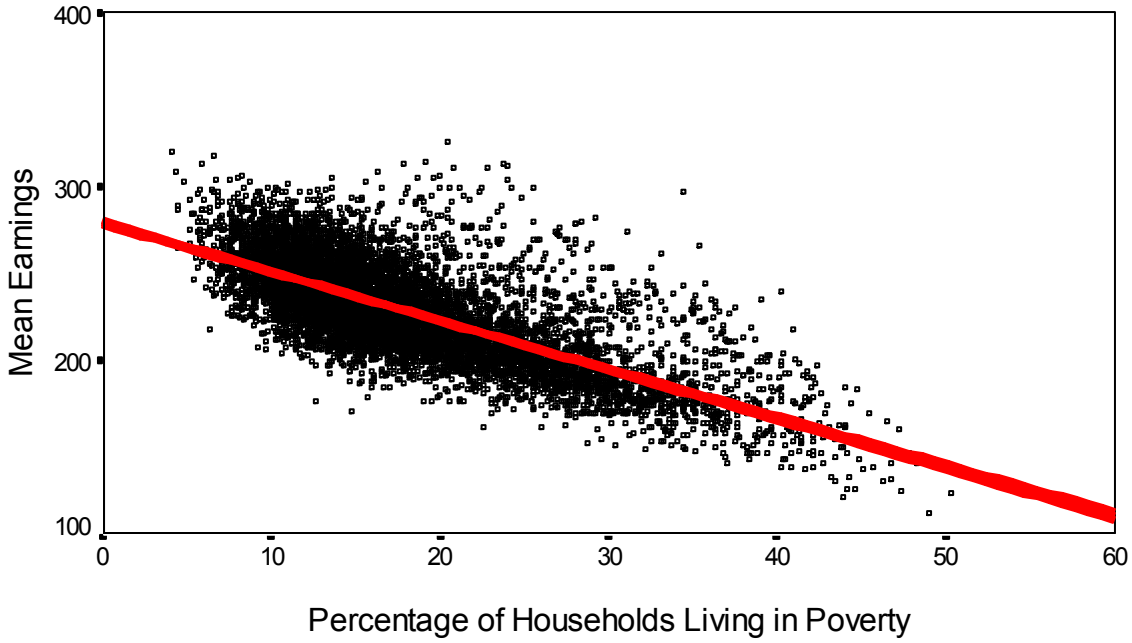


Figure 3 shows a scatterplot of the estimated percentage of poor households against estimated average earnings for the 8,519 electoral wards of England. The regression line with a 95% Confidence Interval is also shown. There appears to be good agreement between these two variables (Pearson's Product Moment Correlation -0.73).

Conclusion

In order to obtain accurate estimates of deprivation from the UK Census it is necessary to use a weighted index. Allowance must be made for the fact that different groups have different probabilities of suffering from deprivation and poverty.

Validation is a crucial step in establishing the likely accuracy and precision of any Census based deprivation index. Validation criteria are available both internally to the 1991 Census (eg Standardised Illness Ratios (SIR's) and estimated income) and also externally (eg Standardised Mortality Ratios (SMR's) and Benefit statistics).

The method of estimating the number of poor households in an area suggested by Gordon and Forrest (1995) has been shown to yield valid and reasonably accurate results for the 8,519 electoral wards of England.

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