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Methods for Comparing 1991 and 2001 Population and Deprivation Distributions

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understanding population trends and processes
ESRC RES-163-25-0012 for 2005-07

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

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Welcome to your new job …

… research officer for Welwyn-Hatfield council

Day 1: A councillor walks through the door and asks a very simple question …

"How has the population size and geographical distribution of different ethnic groups at ward level changed between 1991 and 2001?"

You say, **"No problem, I'll get back to you"**

– Right, I'll get some data & boundary files … I'll have this done by tea break …

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Data by ethnic group … via CASWEB … No problem … Hmm, a bit of problem …

1991 Ethnic groups

TOTAL PERSONS	Ethnic group									
	White	Black Caribbean	Black African	Black other	Indian	Pakistani	Bangladeshi	Chinese	Other groups	
									Asian	Other

2001 Ethnic groups

All people	People in ethnic groups																
	White			Mixed				Asian or Asian British				Black or Black British			Chinese or other ethnic group	
	White British	White Irish	Other White	White and Black Caribbean	White and Black African	White and Asian	Other Mixed	Indian	Pakistani	Bangladeshi	Other Asian	Caribbean	African	Other Black	Chinese	Other ethnic group
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

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Data by ethnic group … a solution? …

1991 Census	2001 Census	Compatible
White	White – British	White
	White – Irish	
	White Other – White	
Black – Caribbean	Black or Black British – Black Caribbean	Black Caribbean
Black – African	Black or Black British – Black African	Black African
Indian	Asian or Asian British – Indian	Indian
Pakistani	Asian or Asian British – Pakistani	Pakistani
Bangladeshi	Asian or Asian British – Bangladeshi	Bangladeshi
Chinese	Chinese or Other Ethnic Group – Chinese	Chinese
Black – Other	Mixed – White and Black Caribbean	Other
Other – Asian	Mixed – White and Black African	
Other – Other	Mixed – White and Asian	
	Mixed – Other Mixed	
	Black or Black British – Other Black	
	Asian or Asian British – Other Asian	
	Chinese or Other Ethnic Group – Other Ethnic Group	

Less than ideal, perhaps

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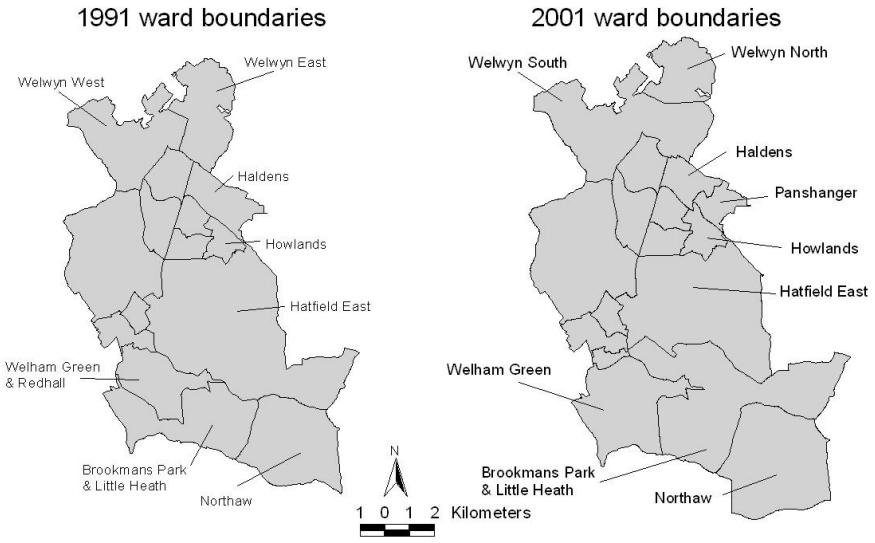
GIS boundaries … via UKBORDERS … Hmm, a bit of problem …



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Administrative & Census boundary change over time

- Administrative boundary change: due to
  - Need for good governance (re-organise subnational structure of administrative geography) &
  - Differential population change by small areas and need for equity in electoral representation
- Census boundary change: due to
  - Many census geographies aligned with administrative geographies (as above) &
  - Need for a local geography which protects confidentiality yet delivers usable statistics, & thus may be time point specific
- Lead to boundaries being re-drawn
  - But this severely hampers comparison of cross-sections
  - Census & other applications may need consistent geographical areas over time for analysis of change

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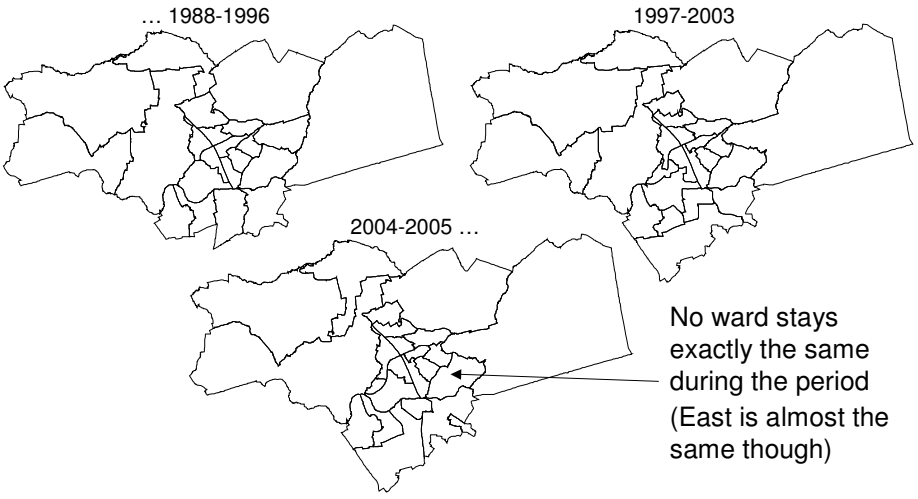
Boundary change is not unusual …

- Peterborough: 1988 - 2005



No ward stays exactly the same during the period (East is almost the same though)

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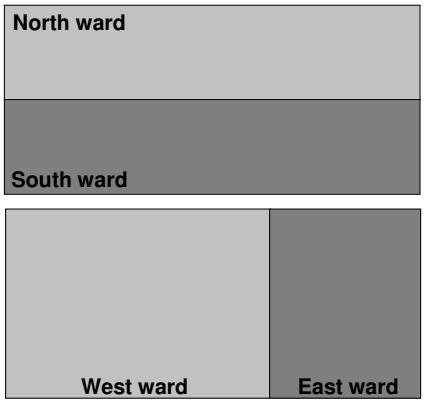
Converting data between geographies



'Source' geography
- North = 9,000 people
- South = 6,000 people

'Target' geography
- West = ?
- East = ?

Apportionment of counts by area overlap inappropriate as people not distributed evenly across space

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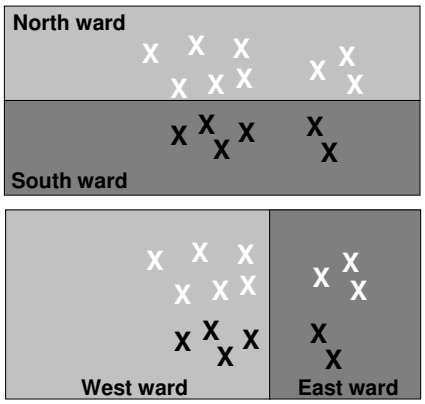
Converting data between geographies

Postcode distribution a proxy for population distribution



'Source' geography
- North = 9,000 people
- South = 6,000 people

'Target' geography
- West = ?
- East = ?

Count postcodes in source-target intersections
North/West = 6; North/East = 3; South/West = 3; South/East = 2

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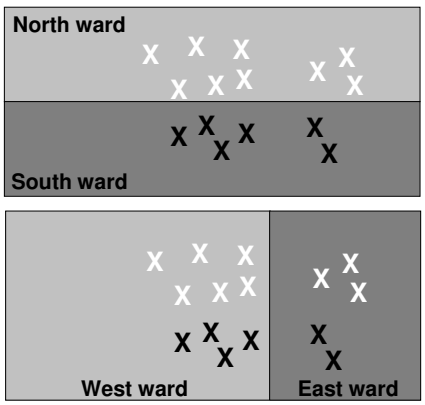
Converting data between geographies

Apportion the populations by the source-target intersection postcode counts



'Source' geography
- North = 9,000 people
- South = 6,000 people

'Target' geography
- West 10,000 =
  (9,000 x 6 / 9) + (6,000 x 4 / 6)
- East 5,000 =
  (9,000 x 3 / 9) + (6,000 x 2 / 6)

Since there are urban-rural gradients in the number of people living per postcode, postcode counts can be enhanced by address or household counts

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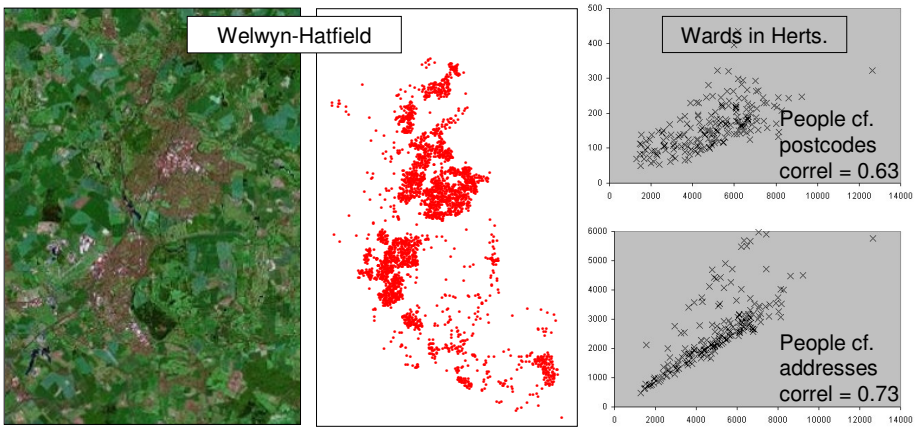
Converting data between geographies

- Postcode distribution a proxy for population distribution: indicator must relate to the data



Postcode distribution enhanced by address counts

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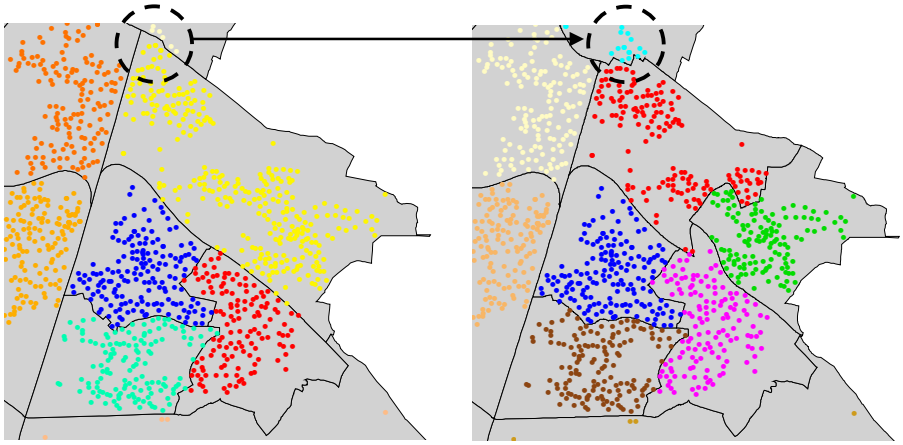
Converting data between geographies

- Postcodes used to link geographies



Postcode directories available from UKBORDERS

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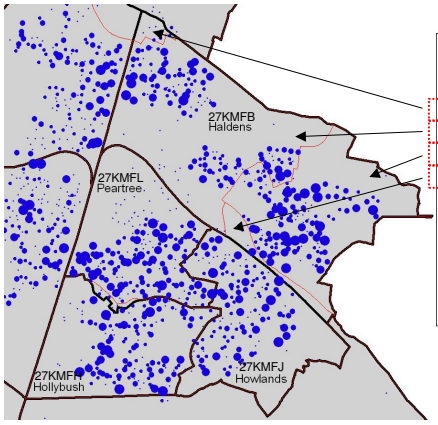
Converting data between geographies

- Postcode-address counts aggregated across intersections & used for calculating source-target intersection weights



Ward 1991	Ward 2001	Addresses in Intersection	Ward 1991 total addreses	Conversion weight
...	...	...	...	...
27KMFB	26ULHB	64	5734	0.0112
27KMFB	26ULGK	2651	5734	0.4623
27KMFB	26ULGW	2941	5734	0.5129
27KMFB	26ULGT	78	5734	0.0136
...	...	...	...	...
27KMFH	26ULGS	2642	2642	1.0000
27KMFJ	26ULGT	2423	2423	1.0000
27KMFL	26ULGS	57	3160	0.0180
27KMFL	26ULGX	3103	3160	0.9820
...	...	...	...	...

Conversion weight =
Addresses in Intersection / Total addresses in ward

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So, about that councillor's question …

- Size & distribution of ethnic groups 1991 & 2001

2001 wards: ethnicity	Total-91	Total-01	White-91	White-01	Indian-91	Indian-01
Brookmans Park & Little Heath	5577	5936	5452	5665	31	71
Haldens	6033	6076	5805	5748	94	66
Handside	6033	6414	5935	6085	19	69
Hatfield Central	5612	6270	5382	5724	47	98
Hatfield East	6116	5997	5907	5548	44	93
Hatfield North	5714	5851	5530	5483	43	64
Hatfield South	3787	4381	3667	3967	31	85
Hatfield West	5757	7296	5437	6254	70	266
Hollybush	5517	5505	5360	5222	44	59
Howlands	5670	6099	5472	5675	48	110
Northaw	5112	5190	5014	4985	49	73
Panshanger	6566	6433	6319	6017	102	130
Peartree	6263	6985	6067	6580	56	49
Sherrards	5492	5799	5408	5567	28	41
Welham Green	3697	3637	3595	3493	27	43
Welwyn North	4042	4227	3963	4027	18	55
Welwyn South	5205	5454	5101	5324	31	33
Total	**92193**	**97550**	**89414**	**91364**	**782**	**1405**

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That's all fine then …

- Oh, no! Spoke too soon!!

Dear Research Assistant

The council's economic development unit want to know whether the regeneration scheme implemented in the 1990s was successful.

Cheers, Your friendly Councillor

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Are areas becoming more or less deprived over time?

Use of area characteristics measures

Cross-sectional research

- Allocation of funding
- Business marketing
- Deprivation relationship with health

Time-series: deprivation measures

- Are areas becoming more or less deprived over time?
- Has health improved in areas now less deprived?

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Classification of areas

Considerations when comparing areas at two or more time points

Input variables
- Availability, definition and categorisation
- Applicability over time

Geography
- Boundary change

Method of classification
- Applicability over time

Need to compare like with like & need consistency of information, geography & method
- Official IMDs are time-point & country specific

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Calculating comparable deprivation

Townsend Index: comparable across UK & time

Input variables for: c.10,400 small areas in both 1991 & 2001, deprivation relative to National 1991 & 2001 average

National rates	Unemployment	No car	Non-home owners	Overcrowding
1991	8.73	28.41	31.25	2.04
2001	3.13	22.97	28.90	1.53
Avg.	**5.93**	**25.69**	**30.08**	**1.78**

Example area unemployment

$$zscore - 0.26 = \frac{(5\% - 5.93)}{3.58} \qquad zscore - 0.54 = \frac{(4\% - 5.93)}{3.58}$$

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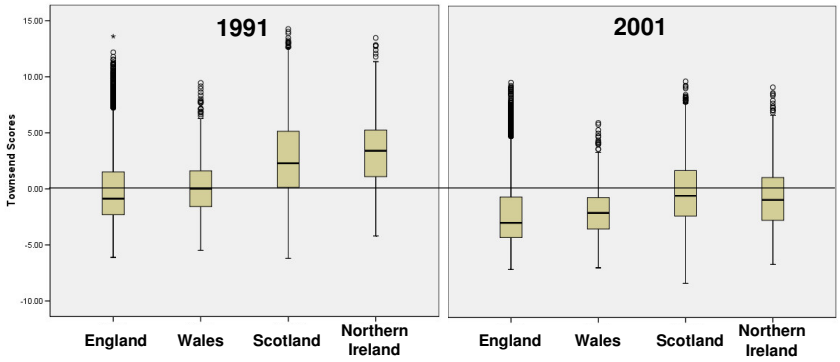
Deprivation change

Townsend scores: easing overall



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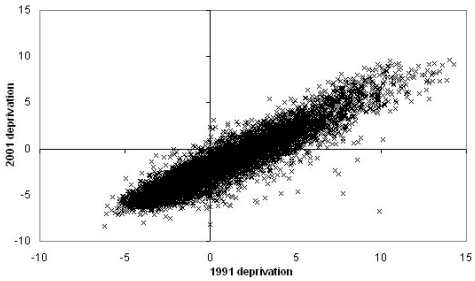
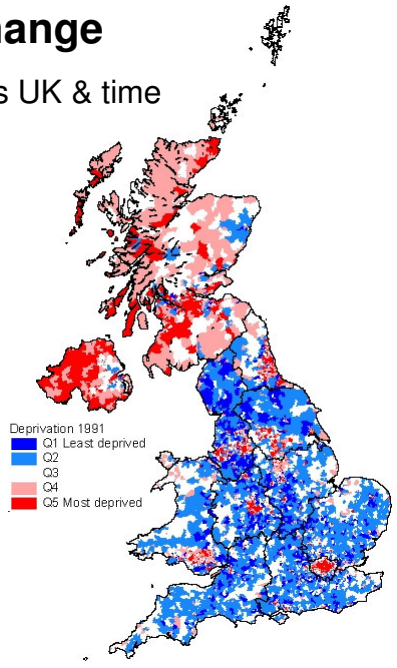
Deprivation change

Townsend Index: comparable across UK & time



		2001 Q1	Q2	Q3	Q4	Q5	Total
1991	Q1	1066	11	2	0	0	1079
	Q2	2334	285	9	0	0	2628
	Q3	841	1356	255	9	1	2462
	Q4	76	545	1212	291	4	2128
	Q5	9	39	288	1013	759	2108
	Total	4326	2236	1766	1313	764	10405



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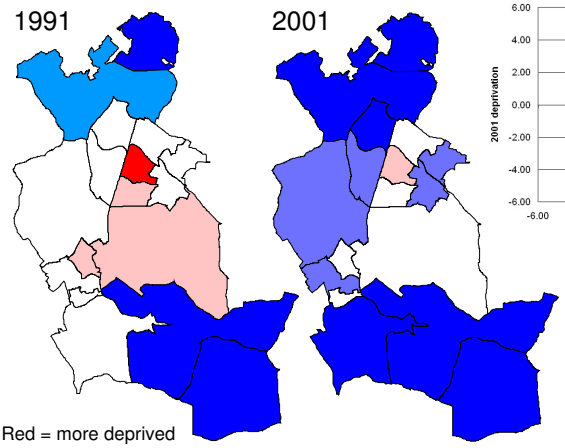
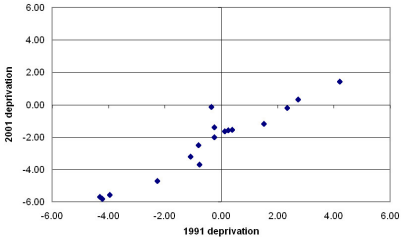
So, Mr Councillor … deprivation in Welwyn-Hatfield …

1991

2001



Red = more deprived
White = National average
Blue = Less deprived



Overall deprivation eased

-0.40 to -2.30

(cf. national c. 0.00)

Biggest improvements in Peartree & Hollybush wards

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Methods for Comparing 1991 and 2001 Population and Deprivation Distributions

Background: research questions

Between subnational areas & two or more time points …

Population & deprivation change

- Is the size of the population increasing or decreasing?
- Are fertility rates falling?
- Is the ethnic diversity changing?
- Has health improved?
- Have the area characteristics changed?
- Has a regeneration scheme worked?

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Potential problems

If you want to analyse change for subnational areas between two or more time points …

Check for consistency of:

- Population base
- Geography
- Variable detail
- Data availability

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What is your study population?

Population definition

From one census to the next may vary

- Usual residents, persons present, visitors
- Students at term-time address or parental domicile

Study population

To look at change check populations are consistent

- Even when used as denominators can make a difference
- Total persons (or households) varies between census tables in the same year
- Household & communal establishment residents

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What geography are you using?

You need to compare like with like over time

Regional analysis:

- Registrar General's Standard Regions ≠ Government Office Regions

District level analysis:

- Previous local government districts ≠ current districts

Small area analysis:

- Wards: Carpet rarely nailed down
- New geographies for statistical reporting e.g. Super Output Areas (& Data Zones in Scotland)
- EDs ≠ OAs (in Scotland OAs 1991 ≠ OAs 2001)

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Methods for Comparing 1991 and 2001 Population and Deprivation Distributions

Between two or more time points

Checklist …

- Are the datasets available for all time points?
- Is the study population the same definition?
- Are the answers to questions the same categories?
- Can the variable detail be made consistent?
- Has the geography changed?

NB …

- The smaller your areas, the greater your data preparation challenges & chance of inconsistency!

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Resources: examples

Census change over time & data issues:

- Champion A G (1995) Analysis of change through time. In *Census Users' Handbook* (ed. Openshaw S). GeoInformation International: Cambridge: 307-336
- Dale A (1993) The content of the 1991 Census: change and continuity. In *The 1991 Census User's Guide* (eds. Dale A and Marsh C). HMSO: London: 16-51
- Martin D, Dorling D & Mitchell R (2002) Linking censuses through time: problems and solutions. *Area*, 34: 82-91
- Rees P, Parsons J & Norman P (2005) Making an estimate of the number of people and households for Output Areas in the 2001 Census. *Population Trends* Winter 2005, 122: 27-34

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Resources: examples

Converting between geographies

- Simpson L (2002) Geography conversion tables: a framework for conversion of data between geographical units. *International Journal of Population Geography* 8: 69-82
- Norman P, Rees P & Boyle P (2003) Achieving data compatibility over space and time: creating consistent geographical zones. *International Journal of Population Geography*. Vol 9, Issue 5, September-October 2003: 365-386

Geography & variable detail consistent over time: issues & usage

- Norman P (2004) Constructing a sociodemographic data time-series: computational issues and solutions. ESRC Research Methods Programme. Online: www.ccsr.ac.uk/methods/publications/
- Rees P, Brown D, Norman P & Dorling D (2003) Are socioeconomic inequalities in mortality decreasing or increasing within some British regions? An observational study, 1990-98. *Journal of Public Health Medicine.* 25(3): 208-214

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Resources: examples

Estimating time-series of small area populations

- Rees P, Norman P & Brown D (2004) A framework for progressively improving small area population estimates. *Journal of the Royal Statistical Society A*. Vol. 167 Part 1: 5-36
- Norman P, Simpson L & Sabater A (forthcoming) 'Estimating with Confidence' and hindsight: new UK small area population estimates for 1991. *Population, Space and Place*

Consistent ethnic groupings

- Platt L, Akinwale B, Simpson L (2005) Stability and change in ethnic group in England and Wales. *Population Trends* 121. 35-45
- Simpson L. Ethnic group: identity and change 1991-2001. www.ccsr.ac.uk/research/egiac.htm