Appendix 1
Supporting documentation

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Appendix 1.1: Project resources and output

Software

The main software used in the production of this atlas were:

HealthWIZ –data analysis and mapping
Harvard Graphics –charting
Microsoft Excel for Windows –correlation analysis
Microsoft Word for Windows –word processing

Hardware

A variety of IBM compatible microcomputers were used in the production of the atlas. A HP Laser Jet 5000 Series printer was used for printing drafts of the text and maps.

Printing

The atlas was printed by Openbook Publishers, Adelaide. They were supplied with word processing documents containing the text, tables, graphs and the maps (the maps were pasted into frames in the document). The atlas was then electronically transferred to plates for offset printing, without the need for film or bromides.

Project output

Data in electronic and printed form

Separate atlases are available for each State and Territory and for Australia. For each atlas there is a companion volume comprising the data on which the maps are based: for Australia, it is Volume 1.1. Both of these can be purchased from Government Info Shops in the capital cities.

The text and maps can also be downloaded for reading and printing from the Public Health Information Development Unit World Wide Web site at www.publichealth.gov.au

In addition, the text, maps and data can be accessed electronically from a CD-ROM (for Windows). On the CD-ROM, the text is in documents in Microsoft Word format. The data are in spreadsheet files in Microsoft Excel format and include all of the data mapped in the atlas, in table format as presented in Volume 1.1. Some data are also available in the HealthWIZ database.

Additional analyses will be posted to the Public Health Information Development Unit web site from time to time.

HealthWIZ software

HealthWIZ is a comprehensive health statistics database product, with a small area focus, produced by the Commonwealth Department of Health and Aged Care. It is comprised of detailed, content-rich data collections from Australia's hospital systems, cause of death registries, Medicare and social security payment systems and population censuses, together with data from administrative systems such as aged care and child care.

The data are contained on a CD-ROM and are accompanied by high performance table-building software. The menu-driven interface allows for a range of statistical calculations (age-standardised rates, confidence intervals, indices, time series data) to be undertaken to choose the most appropriate for the dataset and the needs of the user. These calculations are built into the software. The HealthWIZ software is also accessible via the World Wide Web at www.prometheus.com.au

HealthWIZ Version 4.0 comes with an integrated high performance mapping module. All the datasets and variables in the database can be mapped without the need for specialist knowledge of mapping software. All necessary digitised boundaries are included for users to be able to copy the maps to their own documents for publication.

Selected data from the atlas will be available in HealthWIZ. This includes all of the deaths and income support payments data, as well most of the hospital data, although its inclusion is subject to approval from the States and Territories. Its inclusion in HealthWIZ will allow greater flexibility in mapping the variables in the atlas, as well as many more variables from the same and other topics. The Census data, as well as the remaining health status data (the disability and handicap predictions, Total Fertility Rate), cannot be incorporated at this stage because of restrictions imposed on its use by the Australian Bureau of Statistics.

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Appendix 1.2: Geographic areas mapped

Introduction

The following notes are intended to amplify and explain points raised in Chapter 2, *Methods* as to the areas mapped in this atlas.

Areas

Background

The data variables in each chapter are mapped separately for the capital cities and other major urban centres and for Australia as a whole. The basic geographic area mapped for the capital cities and other major urban centres and for Australia as a whole is the Statistical Subdivision (SSD): SSDs are described in Chapter 2. Maps have been produced in the HealthWIZ software using an approximation to Lambert's Conformal Conic Projection.

SSDs mapped

The SSDs mapped for the capital cities and other major urban centres and Australia are shown in **Maps A1, A2**, **A3** and **A4** and listed in the accompanying tables. Copies of the boundaries to use as overlays with the maps in this volume are in a pocket inside the back cover.

Boundary changes

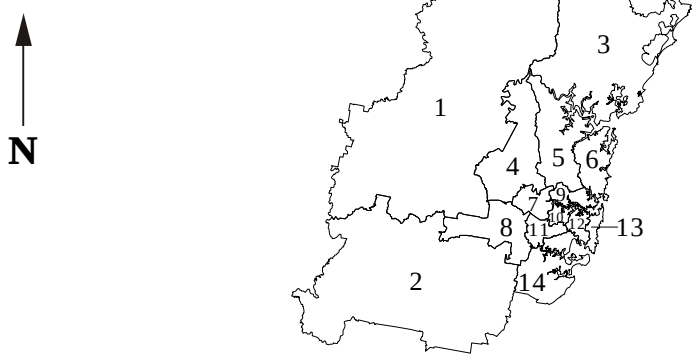
The boundaries of some SSDs have changed over the periods for which the data has been collected (varying from one year to four years). In a small number of cases this meant that comparisons between the datasets based on different boundaries could not be made. In some cases, simply combining two SSDs was sufficient to enable comparisons to be made.

In others, however, the boundary changes were such that combining areas was not a satisfactory option. This occurred either because combining areas produced maps that were not immediately recognisable as representing the particular area; or where the combinations were so extensive as to reduce the value of the correlation analysis, or of other comparisons of the data.

For example, changes to the outer boundary of Hobart Statistical Division over the period from 1992 to 1995 (for which deaths data is coded) required that the map of Hobart for deaths include a number of adjoining SSDs (those containing the SLAs from which land and population was incorporated into the Hobart Statistical Division). This made the map unrecognisable, doubling its size in relation to the actual area of Hobart. Similar problems occurred in a number of areas in Victoria. To avoid mapping data to areas that would not be recognisable, the Australian Institute of Health and Welfare assisted by providing deaths data for these areas on boundaries comparable with the 1996 Census areas.

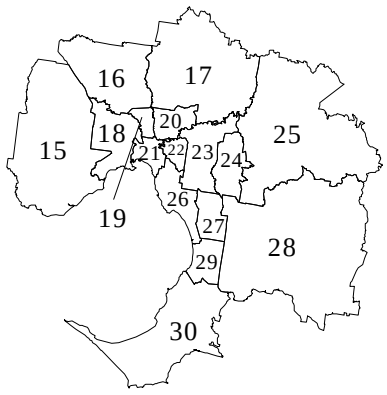
Map A1
Key to areas mapped for the capital cities, 1996
(also included as clear film overlay inside back cover flap)

Sydney

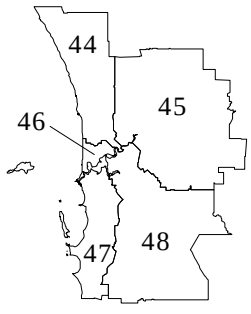


Adelaide

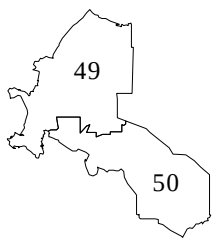
Melbourne



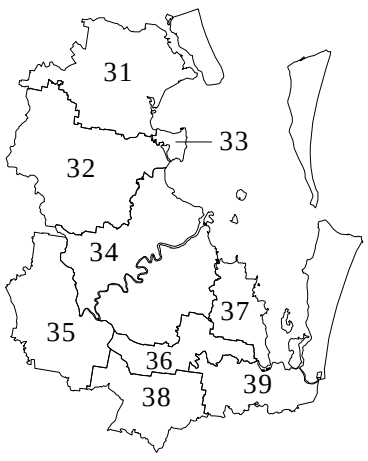
Perth



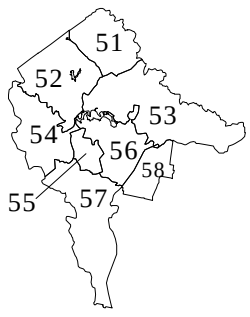
Darwin



Brisbane



Canberra



Details of map boundaries are in Appendix 1.2

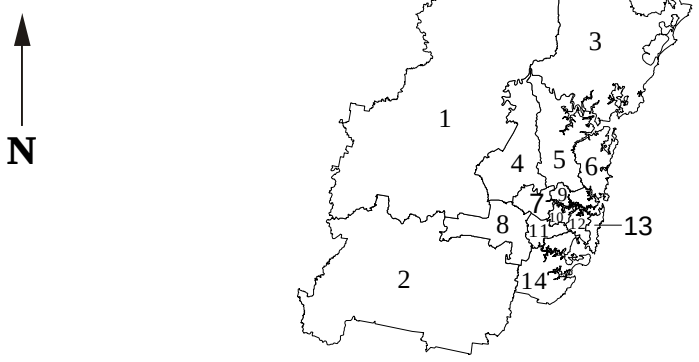
Table A1: Key to Statistical Subdivisions in the capital cities, 1996

Statistical Subdivision name	Area number	Statistical Subdivision name	Area number
Sydney		**Brisbane... *cont***	
Inner Sydney	12	Caboolture Shire Part A	31
Eastern Suburbs	13	Ipswich City	35
St George-Sutherland	14	Logan City	36
Canterbury-Bankstown	11	Pine Rivers Shire	32
Fairfield-Liverpool	8	Redcliffe City	33
Outer South Western Sydney	2	Redland Shire	37
Inner Western Sydney	10		
Central Western Sydney	7	**Adelaide**	
Outer Western Sydney	1	Northern	40
Blacktown-Baulkham Hills	4	Western	41
Lower Northern Sydney	9	Eastern	42
Hornsby-Ku-ring-gai	5	Southern	43
Northern Beaches	6		
Gosford-Wyong	3	**Perth**	
		Central Metropolitan	46
Melbourne		East Metropolitan	45
Inner Melbourne	21	North Metropolitan	44
Western Melbourne	18	South West Metropolitan	47
Melton-Wyndham	15	South East Metropolitan	48
Moreland City	19		
Northern Middle Melbourne	20	**Darwin**	
Hume City	16	Darwin City	49
Northern Outer Melbourne	17	Palmerston-East Arm	50
Boroondara City	22		
Eastern Middle Melbourne	23	**Canberra**	
Eastern Outer Melbourne	24	Gungahlin-Hall	51
Yarra Ranges Shire Part A	25	Belconnen	52
Southern Melbourne	26	North Canberra	53
Greater Dandenong City	27	Western Creek-Stromlo	54
South Eastern Outer Melbourne	28	Woden Valley	55
Frankston City	29	South Canberra	56
Mornington Peninsula Shire	30	Tuggeranong	57
		Queanbeyan	58
Brisbane			
Brisbane City	34		
Gold Coast City Part A	39		
Beaudesert Shire Part A	38		

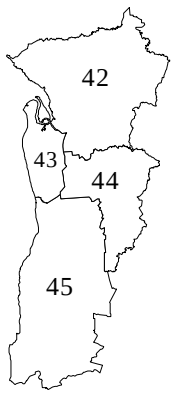
Note: Hobart is not shown as there are no Statistical Subdivisions
Source: Compiled from project sources

Map A2
Key to areas mapped for the capital cities, 1994
(also included as a clear film overlay inside back cover flap)

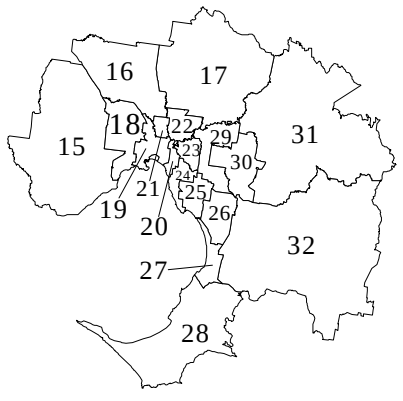
Sydney



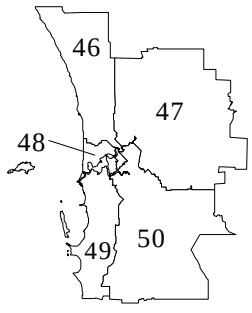
Adelaide



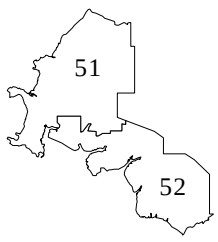
Melbourne



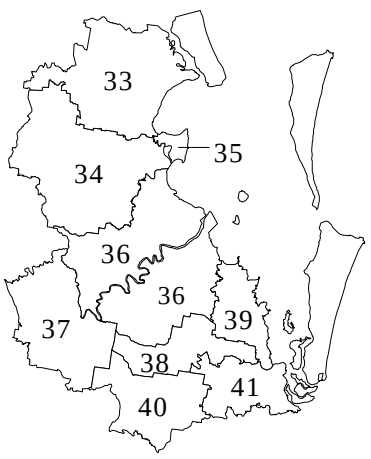
Perth



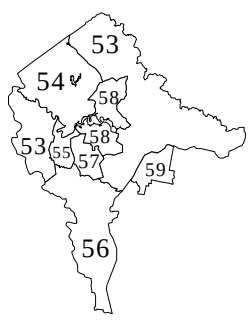
Darwin



Brisbane



Canberra



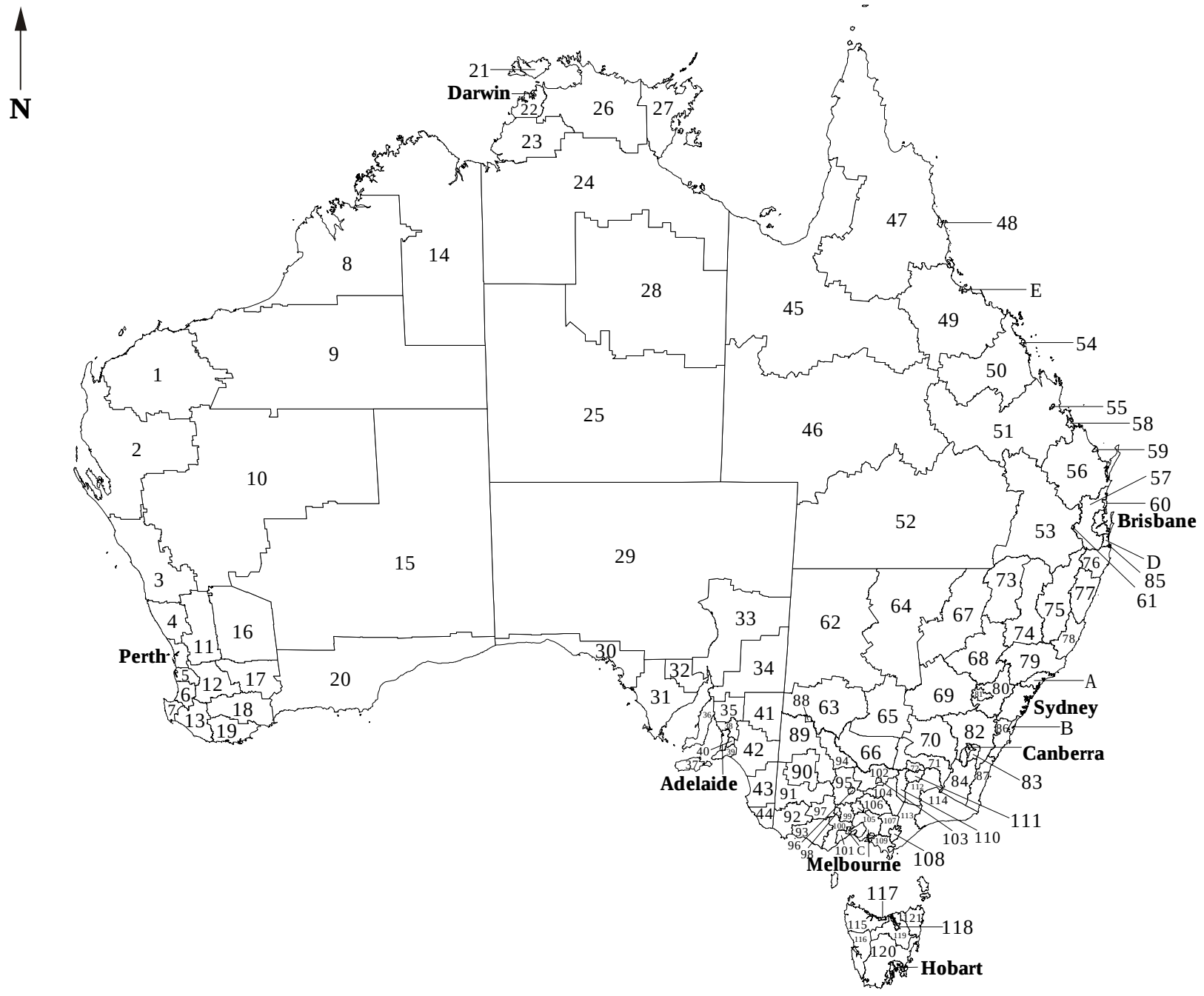
Details of map boundaries are in Appendix 1.2

Table A2: Key to Statistical Subdivisions in the capital cities, 1994

Statistical Subdivision name	Area number	Statistical Subdivision name	Area number
Sydney		**Brisbane**	
Inner Sydney	12	Brisbane City	36
Eastern Suburbs	13	Gold Coast City Part A	41
St George-Sutherland	14	Beaudesert Shire Part A	40
Canterbury-Bankstown	11	Caboolture Shire Part A	33
Fairfield-Liverpool	8	Ipswich City	37
Outer South Western Sydney	2	Logan City	38
Inner Western Sydney	10	Pine Rivers Shire	34
Central Western Sydney	7	Redcliffe City	35
Outer Western Sydney	1	Redland Shire	39
Blacktown-Baulkham Hills	4		
Lower Northern Sydney	9	**Adelaide**	
Hornsby-Ku-ring-gai	5	Northern	42
Northern Beaches	6	Western	43
Gosford-Wyong	3	Eastern	44
		Southern	45
Melbourne			
Central Melbourne	20	**Perth**	
Western Inner Melbourne	19	Central Metropolitan	48
Western Outer Melbourne	18	East Metropolitan	47
Western Fringe Melbourne	15	North Metropolitan	46
Northern Inner Melbourne	21	South West Metropolitan	49
Northern Middle Melbourne	22	South East Metropolitan	50
Northern Fringe Melbourne	16		
Northern Outer Melbourne	17	**Darwin**	
Eastern Inner Melbourne	23	Darwin City	51
Eastern Middle Melbourne	29	Palmerston-East Arm	52
Eastern Outer Melbourne	30		
Eastern Fringe Melbourne	31	**Canberra**	
Southern Inner Melbourne	24	Central Canberra	58
Southern Outer Melbourne	25	Belconnen	54
South Eastern Inner Melbourne	26	Woden Valley	57
South Eastern Outer Melbourne	32	Weston Creek	55
Mornington Peninsula Inner	27	Tuggeranong	56
Mornington Peninsula Outer	28	Outer Canberra	53
		Queanbeyan	59

Note: Hobart is not shown as there are no Statistical Subdivisions
Source: Compiled from project sources

Map A3
Key to areas mapped for Australia, 1996
(also included as clear film overlay inside back cover flap)



Details of map boundaries are in Appendix 1.2

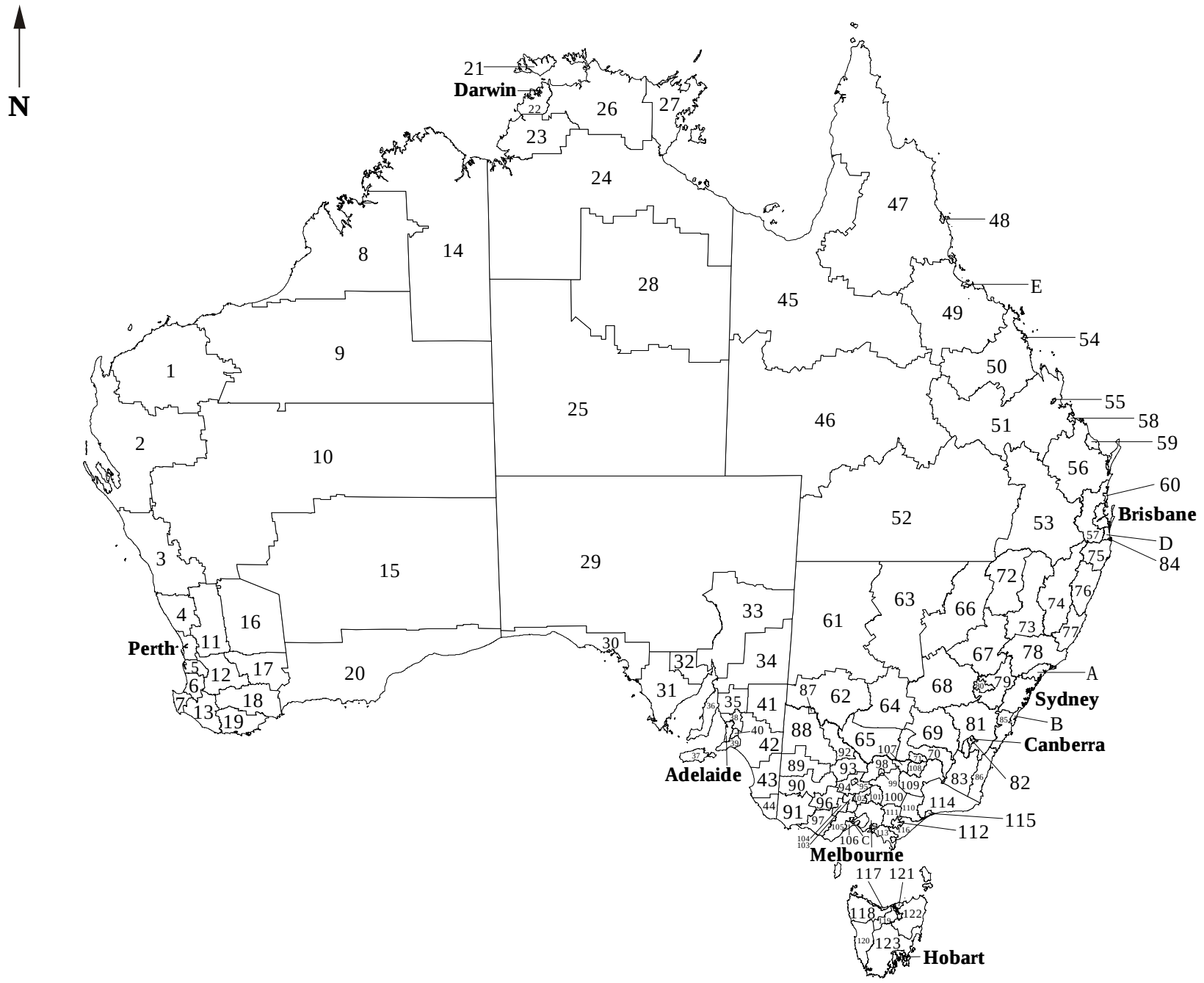
Table A3: Key to Statistical Subdivisions in the non–metropolitan areas of Australia: 1996

Statistical Subdivision name	Area no.
New South Wales	
Hunter SD Balance	79
Illawarra SD Balance	86
Tweed Heads	85
Richmond-Tweed SD Balance	76
Clarence	77
Hastings	78
Northern Slopes	74
Northern Tablelands	75
North Central Plain	73
Central Macquarie	68
Macquarie-Barwon	67
Upper Darling	64
Bathurst-Orange	81
Central Tablelands	80
Lachlan	69
Queanbeyan	83
Southern Tablelands	82
Lower South Coast	87
Snowy	84
Central Murrumbidgee	70
Lower Murrumbidgee	65
Albury	72
Upper Murray	71
Central Murray	66
Murray-Darling	63
Far West	62
Victoria	
East Barwon	101
West Barwon	100
Hopkins	93
Glenelg	92
Ballarat City	98
East Central Highlands	99
West Central Highlands	97
South Wimmera	91
North Wimmera	90
Mildura Rural City Part A	88
West Mallee	89
East Mallee	94
Greater Bendigo City Part A	96
North Loddon	95
South Loddon	105
Greater Shepparton City Part A	103
North Goulburn	102
South Goulburn	104
South West Goulburn	106
Wodonga	111
Victoria *... cont*	
West Ovens-Murray	110
East Ovens-Murray	112
East Gippsland Shire	114
Wellington Shire	113
La Trobe Valley	108
West Gippsland	107
South Gippsland	109
Queensland	
Sunshine Coast	60
Moreton SD Balance	57
Bundaberg	59
Wide Bay-Burnett SD Balance	56
Toowoomba City	61
Darling Downs SD Balance	53
South West	52
Rockhampton	55
Gladstone	58
Fitzroy SD Balance	51
Central West	46
Mackay City Part A	54
Mackay SD Balance	50
Northern SD Balance	49
Cairns City Part A	48
Far North SD Balance	47
North West	45
South Australia	
Barossa	38
Kangaroo Island	37
Onkaparinga	40
Fleurieu	39
Yorke	36
Lower North	35
Riverland	41
Murray Mallee	42
Upper South East	43
Lower South East	44
Lincoln	31
West Coast	30
Whyalla	32
Pirie	34
Flinders Ranges	33
Far North	29
Western Australia	
Dale	5
Preston	6
Western Australia *... cont*	
Vasse	7
Blackwood	13
Pallinup	18
King	19
Hotham	12
Lakes	17
Moore	4
Avon	11
Campion	16
Lefroy	15
Johnston	20
Gascoyne	2
Carnegie	10
Greenough River	3
De Grey	9
Fortescue	1
Ord	14
Fitzroy	8
Tasmania	
Southern	120
Greater Launceston	118
Central North	119
North Eastern	121
Burnie-Devonport	117
North Western Rural	115
Lyell	116
Northern Territory	
Darwin Rural Areas	22
Bathurst-Melville	21
Alligator	26
Daly	23
East Arnhem	27
Lower Top End NT	24
Barkly	28
Central NT	25
Australian Capital Territory	
Balance of ACT[1]	..
Other major urban centres	
Newcastle	A
Wollongong	B
Geelong	C
Gold Coast	D
Townsville-Thuringowa	E

[1]Area not mapped

Source: Compiled from project sources

Map A4
Key to areas mapped for Australia, 1994
(also included as clear film overlay inside back cover flap)



Details of map boundaries are in Appendix 1.2

Table A4: Key to Statistical Subdivisions in the non–metropolitan areas of Australia: 1994

Statistical Subdivision name	Area no.	Statistical Subdivision name	Area no.	Statistical Subdivision name	Area no.
New South Wales		**Victoria ... *cont***		**Western Australia ... *cont***	
Hunter SD Balance	78	North Ovens-Murray	107	Vasse	7
Illawarra SD Balance	85	South Ovens-Murray	109	Blackwood	13
Tweed Heads	84	Gippsland Lakes	115	Pallinup	18
Richmond-Tweed SD Balance	75	Mitchell-Snowy	114	King	19
Clarence	76	Macalister-Avon	110	Hotham	12
Hastings	77	Latrobe Valley	112	Lakes	17
Northern Slopes	73	West Gippsland	111	Moore	4
Northern Tablelands	74	Strzlecki	116	Avon	11
North Central Plain	72	South Gippsland	113	Campion	16
Central Macquarie	67			Lefroy	15
Macquarie-Barwon	66	**Queensland**		Johnston	20
Upper Darling	63	Sunshine Coast	60	Gascoyne	2
Bathurst-Orange	80	Moreton SD Balance	57	Carnegie	10
Central Tablelands	79	Bundaberg	59	Greenough River	3
Lachlan	68	Wide Bay-Burnett SD Balance	56	De Grey	9
Queanbeyan[1]	82	Darling Downs	53	Fortescue	1
Southern Tablelands	81	South West	52	Ord	14
Lower South Coast	86	Rockhampton	55	Fitzroy	8
Snowy	83	Gladstone	58		
Central Murrumbidgee	69	Fitzroy SD Balance	51	**Tasmania**	
Lower Murrumbidgee	64	Central West	46	Southern	123
Albury	71	Mackay City Part A	54	Greater Launceston	119
Upper Murray	70	Mackay SD Balance	50	Central North	121
Central Murray	65	Northern SD Balance	49	North Eastern	122
Murray-Darling	62	Cairns City Part A	48	Burnie-Devonport	117
Far West	61	Far North SD Balance	47	North Western Rural	118
		North West	45	Lyell	120
Victoria					
East Barwon	106	**South Australia**		**Northern Territory**	
West Barwon	105	Barossa	38	Darwin Rural Areas	22
Hopkins	97	Kangaroo Island	37	Bathurst-Melville	21
Glenelg	91	Onkaparinga	40	Alligator	26
Ballarat City	104	Fleurieu	39	Daly	23
East Central Highlands	103	Yorke	36	East Arnhem	27
West Central Highlands	96	Lower North	35	Lower Top End NT	24
South Wimmera	90	Riverland	41	Barkly	28
North Wimmera	89	Murray Mallee	42	Central NT	25
Mildura	87	Upper South East	43		
West Mallee	88	Lower South East	44	**Australian Capital Territory**	
East Mallee	92	Lincoln	31	Balance of ACT[2]	..
Greater Bendigo City Part A	95	West Coast	30		
Northern Loddon-Campaspe	93	Whyalla	32	**Other major urban centres**	
Central Loddon-Campaspe	94	Pirie	34	Newcastle	A
South Loddon-Campaspe	102	Flinders Ranges	33	Wollongong	B
Shepparton-Mooroopna	99	Far North	29	Geelong	C
North Goulburn	98			Gold Coast	D
South Goulburn	100	**Western Australia**		Townsville-Thuringowa	E
South West Goulburn	101	Dale	5		
Wodonga	108	Preston	6		

[1]This area is not visible on the map: see text in this volume or tables in Volume 1.1 for data
[2]Area not mapped
Source: Compiled from project sources

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Appendix 1.3: Analysis and presentation of data

Data ranges settings

The selection of data ranges for the maps in this atlas took into account a variety of factors. These factors were:

- the data ranges used for other maps, particularly closely related maps;
- the number of areas in each range; and
- the 'balance' of the visual impact of the map.

Indirect standardisation

In comparing populations, for example the mortality of two populations, crude rates (eg. the number of deaths per 1,000 people) may be misleading. Mortality, for example, depends strongly on age and sex. If the two areas have different age structures this variation alone may explain a difference in crude rates. The technique of standardisation is used to prevent variations in population structure from distorting differentials in events.

Indirect standardisation, used in this analysis, calculates the number of events (eg. services by GPs) which would theoretically occur if the rates for each age/sex group in a given population (the standard – in this case the population of Australia) were applied to the population of interest. The result is termed the 'expected' number of events. If the actual number of events is then divided by this expected number and expressed as a percentage, we obtain the standardised ratio, a figure which is independent of population age and sex structure.

Thus the standardised ratio for a particular area will show the percentage by which it differs from the experience found in the whole population. Taking an example, the Standardised Death Ratio for deaths of males in the Statistical Subdivision of ***Inner Sydney*** was 199 that is, there were almost twice the number of deaths of male residents of ***Inner Sydney*** aged from 15 to 64 years (99 per cent more) than would have been the case had the Australian rates applied in this area. In other words, the ratio was substantially above the Australian average.

The data for persons (ie. the total of females and males) has been standardised for both age and sex. That is, standardised ratios have been produced using separate details of the number of males and females in each age group. This eliminates distortion of the data which may occur where the illness or death experience of males and females is different (eg. as in the case for circulatory system disease among the population under 65 years of age). The ages used for all but the deaths data were generally each five year age group from 0 to 4 years to 80 to 84 years, and 85 years and over. For the deaths data, the ages were the five year age groups for the population aged from 15 to 64 years for all but accidents, poisonings and violence (where a separate analysis was undertaken for 15 to 24 year olds) and infant deaths. In the case of infant deaths (deaths of children under 12 months of age), the Infant Death Rate was calculated; the Infant Death Rate is the number infant deaths per 1,000 live births. Standardised ratios (SRs) were not calculated for areas where fewer than five events (deaths, admissions, etc.) were expected from the Australian rates, because of the doubtful reliability of such small numbers. All cases were, however, retained in the analysis for the calculation of capital city and State/Territory totals and ratios.

In some areas, however, high ratios are due to the relatively high proportion of Aboriginal and/or Torres Strait Islander people. This occurs because, in the methodology used, a standard population with a fixed age structure is introduced. The mortality or morbidity, etc., for a particular population (eg. people in an SLA) is then adjusted to allow for discrepancies in age structure between the standard and the particular population. When the particular population includes a sub group with a substantially different age structure and health experience (for example, mortality experience) the process is distorted. Indigenous people represent such a population. They have a substantially lower life expectancy than the total population, are a much younger population, have higher age-specific death rates at all ages and their average age at death is lower. However, since data relating to the Indigenous population is not adequately identified in, for example, death or hospital statistics, they cannot be analysed as a discrete group.

The high SRs for some data for areas with a relatively large proportion of Indigenous people therefore reflect, in part, that the data has not been effectively standardised. This does not invalidate the data for these areas – on the contrary, it highlights the inequity evident in the health of Indigenous people, and the urgent need to address this inequity, as well as the need to identify Indigenous people more accurately in the statistics.

It should be noted that SRs derived for each area by this indirect method are comparable only by relation to the standard population (the Australian population) and not directly with each other.

For variables presented as SRs the text and tables include details of whether the ratios were statistically significant ie. that they differed significantly from the standard. Whether an SR for an area differs significantly from the standard depends not only on the size of the ratio but also on the population size of the area and the overall rate for the particular event (eg. a cause of death, use of a general medical practitioner), both of which contribute to the 'expected' number of cases in an area. The same SR value in two areas which differ greatly in population size may be significantly different from the standard in the area with the larger population, but not so in the area with the smaller population.

Data sources

Table A5 shows data sources in addition to those noted in the footnotes to the tables in the earlier chapters. Further details of the HealthWIZ software (referenced in the table) are on page 373.

Table A5: Data sources

Chapter	Data sources
Chapter 4	
Tables	
4.2 to 4.11	Data for **1989** from *A Social Health Atlas of Australia 1992*. Data for **1996** is at 30 June and was compiled in HealthWIZ from data supplied by the DFACS (for all variables), DVA (Service Pension (Age) and Service Pension (Permanently Incapacitated)) and ATSIC (Community Development Employment Program data, at 30 June 1998).
Maps	As for Tables, above
Chapter 5	
Tables	
5.3 to 5.6	Compiled in HealthWIZ from data supplied by the ABS.
5.7 to 5.8	Data for **1988** from *A Social Health Atlas of Australia 1992*. Data for **1993** was compiled in HealthWIZ from data supplied by the ABS.
5.10 to 5.32	Data for **1985** to **1989** from *A Social Health Atlas of Australia 1992*. Data for **1992** to **1995** was compiled in HealthWIZ from data supplied by the Registrars of Deaths.
5.33 and 5.34	Compiled in HealthWIZ from data supplied by the ABS.
Figures	
5.3 to 5.7, 5.10	See note for Tables, above
Maps	As for Tables, above
Chapter 6	
Tables	
6.3, 6.5	With the exception of data for Queensland, data was compiled in HealthWIZ from data supplied by the AIHW from the National Hospital Morbidity Database: this database comprises data supplied to the AIHW by the State and Territory health authorities. Data for SLAs in Queensland were not available from the AIHW database and were obtained directly from the Queensland Health Department. The data was supplemented with details of the postcode or SLA of patients admitted to hospital in a State/Territory other than the State/Territory of their usual residence: these details were obtained from the individual State/Territory health authorities.
6.4	Data for **1989** (1989/90 for New South Wales) is from *A Social Health Atlas of Australia 1992*. With the exception of the data for same day patients which was from *NSW Inpatient Statistics Data Book 1989-90* for NSW and for South Australia was supplied by the Department of Human Services. Data for **1995/96**: see notes re Table 6.3, above, other than for data for same day patients which was supplied by the NSW Health Department and the South Australian Department of Human Services.
6.6, 6.7, 6.12 to 6.15, 6.18 to 6.25, 6.30 to 6.41	Data for **1989** is from *A Social Health Atlas of Australia 1992*. Data for **1995/96**: see notes re Table 6.3, above.
6.8 to 6.11, 6.16 and 6.17, 6.26 to 6.29, 6.44 to 6.61	Data for **1995/96**: see notes re Table 6.3, above.
6.63 to 6.66	Data for **1989** from *A Social Health Atlas of Australia 1992*. Data for **1996** was compiled in HealthWIZ from Medicare statistics supplied by DHAC.
6.67 and 6.68	Data was compiled in HealthWIZ from immunisation rates supplied from the Australian Childhood Immunisation Register by the National Centre for Immunisation Research and Surveillance of Vaccine at the New Children's Hospital, Westmead, New South Wales.
Figures	
6.1 to 6.09	See note for Table 6.3, above
Maps	As for Tables, above
Chapter 7	
Tables	
7.3 and 7.4	Data for **1990/91** from *A Social Health Atlas of Australia 1992*. Data for **1996/97** was compiled in HealthWIZ from Medicare statistics supplied by DHAC.
7.5 to 7.8	Data for **1989** from *A Social Health Atlas of Australia 1992*. Data for **1995/96** (public acute hospitals) and **1997** (private hospitals) was compiled in HealthWIZ from data supplied by DHAC.
7.2 and 7.9 to 7.12	Data for **1992** from *A Social Health Atlas of Australia 1992*. Data for **1997** was compiled in HealthWIZ from data supplied by DHAC.
Maps	As for Tables, above

Note: Details of abbreviations used in the table are ABS, Australian Bureau of Statistics; ATSIC, Aboriginal and Torres Strait Islander Commission; DFACS, Department of Family and Community Services; DHAC, Department of Health and Aged Care; DVA, Department of Veterans' Affairs.

Appendix 1.4: Classification of deaths, admissions and procedures

Codes used

Causes of death are classified by the Australian Bureau of Statistics to the Ninth (1975) Revision of the World Health Organisation's International Classification of Diseases (ICD-9) which was adopted for world-wide use from 1979. The codes used for the variables mapped in Chapter 5 are listed in **Table A6**.

Diagnoses and procedures mapped in Chapter 6 are classified according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM October 1988 Revision). External causes are classified according to ICD-9-CM Supplementary Classification of External Causes of Injury and Poisoning ('E' codes) classification codes. The codes used for the variables mapped in Chapter 6 are listed in **Table A7** and **A8**.

Table A6: ICD–9 Codes for causes of death mapped in Chapter 5

Cause of death	ICD code
All cancers [malignant neoplasms]	140-208
Lung cancer	162
Circulatory system diseases	390-459
Respiratory system diseases	460-519
Accidents, poisonings and violence	E800-E999

Table A7: ICD–9 Codes for diagnoses/external causes mapped in Chapter 6

Diagnoses /External cause	ICD code
Infectious and parasitic diseases	001-139
Cancers [malignant neoplasms]	140-208
Lung	162
Female breast	174
Psychiatric conditions	290-319
Psychoses	290-299
Neurotic, personality and other disorders	300-316
Circulatory system diseases	390-459
Ischaemic heart disease	410-414
Respiratory system diseases	460-519
Bronchitis, emphysema, asthma	490-493
Accidents, poisonings and violence	E800-E999

Table A8: ICPM Codes for surgical procedures mapped in Chapter 6

Principal procedures	Codes
All procedures	010-169; 180-695; 704-789; 792-793; 795-796; 798-869
Tonsillectomy and/or adenoidectomy	28.2, 28.3
Myringotomy [limited to 0-9 year olds]	20.01
Hysterectomy [limited females aged 30 years and over]	68.3-68.7
Caesarean section [limited to females aged 15 to 44 years]	74.0, 74.1, 74.2, 74.4; 74.99
Hip replacement	81.51, 81.53
Lens insertion	13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7
Endoscopies	42.23, 42.24, 44.13, 44.14, 45.13, 45.14, 45.16, 45.23-45.25

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Appendix 1.5: Synthetic estimates for small areas

Staff of the Adelaide office of the Australian Bureau of Statistics (ABS) produced the synthetic predictions discussed and mapped in Chapter 5 as a consultancy for the Public Health Information Development Unit. The following paper prepared by the ABS describes the techniques used in production of the estimates.

Introduction

Statistics for small geographic regions are generally available only through administrative sources or the population census. Although household surveys contain much data of value, they provide estimates at a broad geographic level, usually the State or Territory level or, for some of the more populous States, for large regions. Estimates are rarely available for small areas such as the Statistical Local Area (SLA) mapped in this atlas.

Estimates produced from sample surveys are subject to two types of error: non-sampling errors which arise from errors in collecting, recording and processing the data; and sampling errors which arise because a sample, rather than the entire population, is surveyed. The sampling error tends to increase as the sample size decreases. Thus estimates produced from small samples can be subject to such high sample errors as to make them too unreliable for most practical purposes. Since household surveys typically have a small sample from large regions, it is not possible to provide direct survey estimates of suitable reliability for small regions.

Through the use of synthetic estimation techniques it is possible to produce reliable region level statistics (Marker 1999). The method of synthetic estimation was applied in predicting, at the SLA level, two characteristics from the 1995 National Health Survey (NHS):

- the number of people who had a self-assessed poor or fair health status; and
- the Physical Component Summary score from the SF-36 component of the NHS (see page 111 for details).

Predictions are also provided in this atlas of the number of people with a handicap; these estimates were produced by the ABS using a similar technique as part of another project. This technical note concentrates on the prediction of the former characteristics.

Background

Synthetic estimation predicts a value for a small geographic region based on modelled survey data and known characteristics of the region. A synthetic prediction can be interpreted as the expected value, for the variable of interest, for a 'typical' area with those characteristics. The SLA was the regional level of interest for this project (in the Australian Capital Territory and, in some cases in Queensland and the Northern Territory, SLAs were grouped; details of these groupings are contained in the relevant State and Territory atlases).

The model used for predicting small region data is determined by analysing data at a higher geographic level, in this case Australia. The relationship observed at the higher level between the characteristic of interest and predictor variables is assumed to also hold at the lower level. The predictions are made by applying the model to the small region counts of the predictors.

This modelling technique can be considered as a sophisticated pro-rating of Australian level characteristic of interest across the regions in accordance with the joint distributions across the regions of the predictors.

The process of producing the predictions consists of four parts:

- preparation of data;
- model fitting;
- synthetic prediction; and
- assessing the prediction.

Data

As noted above, the two characteristics predicted were self-assessed health status and the Physical Component Summary score, both from the 1995 NHS. Self-assessed health status is provided by respondents to the survey indicating their assessment of the health status, on a scale of 'Excellent', 'Very Good', 'Good', 'Fair' or 'Poor'. The variables of interest here were those of people reporting their health as being 'Fair' or 'Poor'. The Physical Component Summary score is calculated from responses to the SF-36 component of the NHS. It is derived from a subset of items that ask respondents to the NHS aged 18 years and over, about their general physical health and wellbeing. A higher score indicates a better state of physical health and wellbeing.

Predictor data must satisfy the following criteria. It must be

- well related to the characteristic of interest;
- available from the NHS;
- available for similar time periods, both date and length of period; and be
- available at a similar geographic level, both Australia and SLA.

Sources of predictor data utilised were:

- the 1995 NHS;
- the 1996 Census of Population and Housing;
- administrative data from the Department of Family and Community Services;
- hospital separations data; and
- unreferred attendances with general medical practitioners (GPs).

One of the most important data related tasks was to identify predictors from these potential sources which satisfy the above criteria. Data considered included variables such as:

- age;
- sex;
- employment status;
- currently a student;
- income;
- receiving a Disability Support Pension;
- receiving Sickness Allowance;
- receiving the Age Pension;

- Socio-Economic Indexes for Areas derived from the Census;
- whether an inpatient at a hospital; and
- whether consulted with a GP in the two weeks prior to interview.

Many of the available variables common with the NHS differed by definition, collection methodology, reference period and geography. In such instances, appropriate adjustments were made using information obtained by comparing counts, proportions and distributions of the common variables. For example, the income variable was available to the nearest dollar from the NHS, but was available from the Census by income range only. This required the NHS income data to be classified to similar ranges. A comparison of the counts and distributions of persons across the income ranges indicated that income data from the NHS and Census were closely aligned and for the purposes of prediction could be considered well aligned. Several variables also required conversion of their geography from postcode to SLA using the 1994 Australian Standard Geographical Classification (ABS 1994).

There was, however, a fair degree of commonality in the datasets, with the NHS taken over the 1995 year, the hospital inpatient data being for 1995-96, pensioner and beneficiary data being at 30 June 1996 and the Population Census at 4 August 1996.

Model fitting

Once data preparation was completed the relationship between the characteristic of interest and the predictor variables was modelled using data from the NHS at the Australian level. The self-assessed health status and Physical Component Summary score were modelled independently.

The model applied took the linear form:

$$Y = p_o + p_1X_1 + p_2X_2 + p_3X_3 + ... + p_jX_j$$

where
Y is the characteristic of interest

X_i are the predictor variables

p_i are the coefficients which are produced from the modelling process.

In the case of the variable for self-assessed health status, the Y takes the value 1 if the individual's status was fair or poor and 0 otherwise. For the Physical Component Summary score, Y ranges in value from around 45 to 55.

The X_i predictors take the value 1 if the individual has the predictor characteristic (eg. has visited a GP in last two weeks) or 0 otherwise.

The coefficients, p_i, were estimated using the linear regression technique. An original subset of data items from the NHS were compiled that satisfied the specified criteria. The NHS data file, with the subset of data items, was randomly split into two halves with a regression model fitted to both data sets. Data items that were not important in predicting the variable of interest in either, or both, of the two models were removed. This process continued until a final linear model was obtained whereby all variables were significant ($p < 0.05$) in the estimation of the response variable (characteristic of interest). Fitting the model to the split data produces a more robust final model as it reduces the probability of including a variable with high variability.

The final form of the model was then fitted to the full data set to produce regression coefficients and diagnostics which were examined using Cook's D statistic (Cook 1979) to identify any individual respondent who had undue influence on the final parameter estimates. Any 'outliers' identified were removed from the data and the model refitted.

Below is a list of variables that were included in the final models.

Self-assessed health status:
- State/Territory of usual residence;
- age (in 10 year age groups);
- sex;
- employed;
- employed (aged 18 to 24 years);
- employed (aged 25 to 34 years);
- admitted to hospital for at least one night in the last two weeks;
- consulted a general medical practitioner in the last two weeks;
- receives Disability Support Pension;
- receives Disability Support Pension (aged 18 to 24 years);
- receives Sickness Allowance;
- receives Age Pension;
- SEIFA Index of Relative Socio-Economic Disadvantage.

Physical Component Summary score:
- State/Territory of usual residence;
- age (in 10 year age groups);
- income (gross personal annual income);
- studying (currently studying full or part-time at college, university, etc.);
- employed;
- admitted to hospital for at least one night in the last two weeks;
- consulted a general medical practitioner in the last two weeks;
- receives Disability Support Pension;
- receives Disability Support Pension (aged 18 to 24 years);
- receives Sickness Allowance;
- receives Age Pension;
- SEIFA Index of Relative Socio-Economic Disadvantage.

Synthetic prediction

The prediction for an SLA was derived from the linear combination, specified by the regression coefficients, of the counts of individuals within the SLA with the predictor characteristics.

Note that for the Physical Component Summary score the predicted value for the SLA was scaled to a person level score by dividing the prediction by the number of people aged 18 years and over. The final prediction can therefore be considered as a mean score for people living in the SLA.

The predictions of poor or fair health status give an indication of the number of persons aged 18 years and over who would assess their health as poor or fair.

The predictions were age-sex standardised to remove variations between SLAs solely related to variations in age and sex.

Assessing the predictions

The models were assessed in terms of how well they predicted for individuals, SLA and larger regions (Statistical Divisions and Sub-Divisions). This involved comparing predicted values against values determined directly from the NHS. For individuals, this was the reported value, while for SLA and larger regions it was the direct survey estimate. The comparisons were made by examining plots of the predictions against the NHS reported values and estimates. The plots were checked to ensure that there was a reasonable relationship between the predictions and NHS results.

The 95% confidence intervals were calculated for the direct survey estimates and compared to the predictions. If the majority of predictions fall within the confidence intervals then there is a high level of confidence that the predictions are reliable.

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