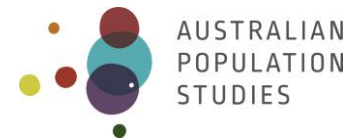


# Elsewhere in Australia: a snapshot of temporary mobility on the night of the 2016 Census



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## Abstract

### Background

Temporary population mobility, moves of more than one night's duration that do not entail a change in usual residence, are an important feature of the Australian population surface. The ABS Census of Population and Housing (Census) provides a snapshot of temporary movements one night every five years.

### Aims

This paper examines the intensity, age and spatial patterns of temporary movements captured at the 2016 Census, and creates a classification of regions based on the age profile of movers on Census nights.

### Data and methods

2016 Census data were extracted using ABS TableBuilder Pro. Summary metrics were calculated to measure the intensity and age profile of movements. Origin–destination flows were derived from a cross-classification of data on Place of Usual Residence and Place of Enumeration. A classification of regions (SA4s) was constructed from the age profile of movers at origins and at destinations.

### Results

1,142,005 individuals (about 5 per cent of the Australian population) were enumerated away from home on Census night 2016. Mobility peaked in younger (20–30) and older (65–70) age groups. Most movements were between capital city regions; however, resource regions and coastal areas were also implicated. The mobility surface was segmented by age: younger people dominated visits to cities and older movers comprise the majority of visitors to coastal areas, while remote areas had a significant proportion of visitors in the peak working ages.

### Conclusions

Temporary population mobility is selective by age and sex and geographically segmented by these characteristics. Improved understanding of the attribute of visitors to regions can assist to formulate and validate estimates of temporary populations from emerging data sets.

### Key words

Temporary population mobility; non-residents; spatiotemporal populations; service populations; migration; Census; Australia.

## 1. Introduction

Temporary population mobility drives significant short-term changes in national population distributions. Population scholars, particularly in the developed world, have tended to ignore these movements in favour of permanent migration. This is changing. There is widespread recognition of the implications of short-term changes in population numbers for service provision (Charles-Edwards and Bell 2013), emergency response and preparedness (Canterford 2011; Wilson et al. 2016) and disease transmission (Bharti et al. 2011). Data sets derived from social media (Tenkanen et al. 2017), mobile telephones (Silm and Ahas 2010; Deville et al. 2014) and other sources are providing new opportunities to monitor dynamics shifts in population numbers but are not a panacea. They are often partial, suffer from bias and lack detail on the underlying population flows and the characteristics of movers. It is against this backdrop that censuses and surveys have continued value for understanding temporary populations.

This short paper explores the intensity and spatial pattern of temporary population mobility, along with the age and sex of movers, as captured by the Australian Bureau of Statistics (ABS) 2016 Census of Population and Housing (Census). It provides a short discussion of past studies of temporary population mobility in Australia in section 2, then in section 3 briefly describes how temporary mobility is captured by the Census and the limitation inherent in these data. Section 4 reports the intensity of movements and age profile of movers as captured in 2016, and compares this to data collected at the 1996 Census. In section 5, the spatial patterns of temporary flows are examined. In section 6, the sex and age characteristics of movers at origins and destinations are explored. Brief conclusions are presented in section 7.

## 2. Background

Temporary population mobility can be defined as moves more than one night in duration that do not entail a change in usual residence (Bell and Ward 2000). This separates temporary mobility from diurnal movements, such as daily commuting, and from permanent migration. There are some problems with this definition. Many individuals do not have a single place of usual residence, for example, Fly-in Fly-out (FIFO)/Drive-In Drive-out (DIDO) miners and children in joint custody arrangements. The distinction between temporary and permanent mobility may also be unclear, with some 'temporary' movements stretching over years. Notwithstanding, this definition has the advantage of being operationalised using common Census definitions for Place of Usual Residence and Place of Enumeration.

Temporary population movements are undertaken for a range of reasons. A simple distinction is between moves undertaken for work or production-related reasons (e.g. FIFO/DIDO mining, seasonal agricultural labour and business travel) and moves undertaken for consumption-related reasons (e.g. tourism, second home travel, visits to friends and relatives). Different types of mobility have distinct spatiotemporal signatures, with diverse destinations, durations, seasonal patterns and periodicities. For example, FIFO mobility is spatially concentrated in resource regions and follows a common roster, such as two weeks on site followed by one week at home (McKenzie 2011). By contrast, coastal tourism can range from a few days to a few weeks in duration, is highly seasonal and concentrated in the summer months (Charles-Edwards and Bell 2015).

In addition to having distinct spatiotemporal signatures, temporary movers can be segmented according to age. In a schema proposed by McHugh, Hogan and Happel (1995), mobility in childhood and adolescence is tied to the family and may include both touristic mobility and mobility associated

with family dissolution. In adulthood, mobility becomes increasingly tied to work, which can necessitate strategies such as long-distance commuting. With the transition to middle age, more financial resources enable some individuals to purchase second homes, initiating another form of temporary mobility. Older age may be associated with a relaxation of work-related constraints on mobility, providing opportunities for new forms of recreational mobility and extended stays with children and grandchildren, but also additional constraints due to ill health.

There have been a number of studies of temporary population mobility in Australia drawing on Census data (Bell and Brown 2006), data from the National Visitor Survey (Charles-Edwards, Bell and Brown 2008) and purposive surveys (Mings 1997; Hanson and Bell 2007). Bell and Ward (1998) undertook the first systematic study of temporary population mobility in Australia, utilising data from the 1991 Census. They found that the incidence of temporary mobility remained relatively stable between the 1976 and 1991 censuses, with around 5 per cent of Australians enumerated away from home on Census night. The study found that temporary moves tended to cover longer distances than permanent moves, and revealed a regional pattern of net gains with inner cities, tourist regions and resource regions all attracting temporary visitors.

Follow up studies comparing temporary and permanent migration (Bell and Ward 2000) and the characteristics of temporary movers (Bell and Brown 2006) revealed the age profile of temporary movers, with movements selective of both younger (20–30 years) and older (65–70 years) adults. Charles-Edwards, Bell and Brown (2008) and Charles-Edwards and Bell (2015), using data from the National Visitor Survey, confirmed the regionalisation of temporary movements but also the significant seasonal variation in spatial patterns tied to institutional and climatic factors.

The current study provides an updated account of temporary population mobility in Australia drawing on data from the 2016 Census. It seeks also to extend our understanding of temporary moves by examining patterns of origin–destination flows and regional variations in the sex ratio and age profile of movers. The latter is of particular relevance to agencies interested in providing services to temporary populations. Data on the age and sex of movers are also critical for the validation of emerging sources of data on temporary mobility.

### **3. Data and methods**

Data were sourced from the 2016 Census. The Census was conducted on a de facto residence basis, meaning that people were enumerated where they happened to be on Census night, 9 August 2016. By combining data on Place of Usual Residence and Place of Enumeration it is possible to generate a snapshot of people away from home (referred to as ‘visitors’ through the text) on one night every five years. The count of the number of people in Australia enumerated away from their Place of Usual Residence is coded in the Usual Address Indicator (UAICP). UAICP data were extracted from the ABS Counting Persons, Place of Usual Residence Census database within TableBuilder Pro by age and sex to estimate the intensity of temporary population mobility on Census night, along with the age profile of movers.

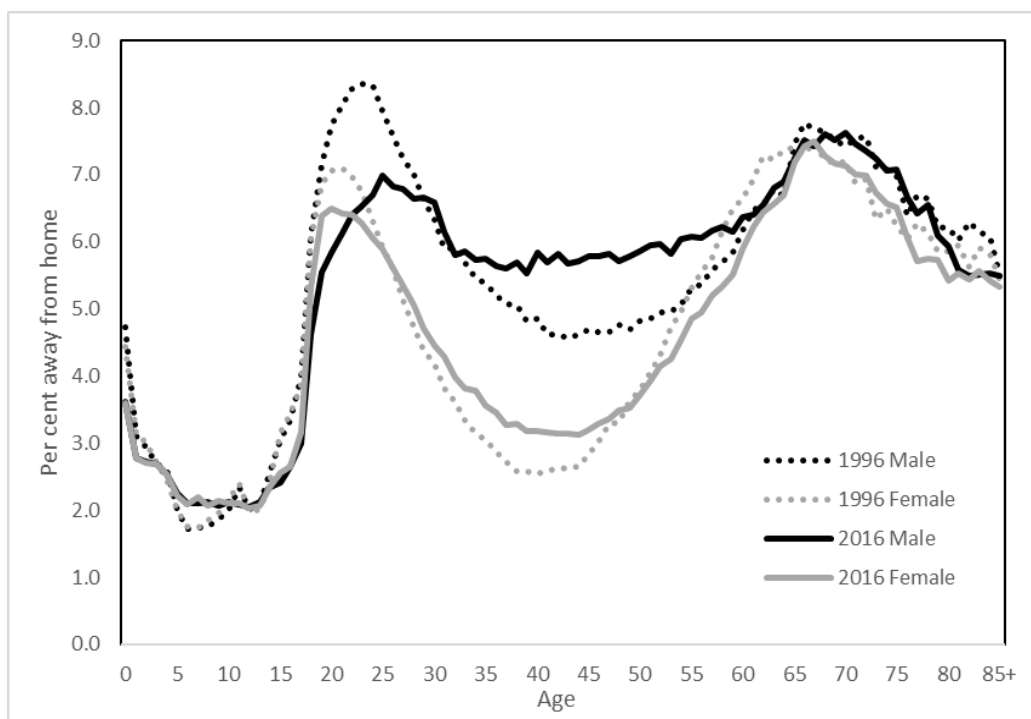
While UAICP provides an estimate of the stock of people enumerated away from home on Census night, it does not provide information on origin–destination flows. To explore the spatial distribution of movements, origin–destination matrices were constructed based on individuals’ Place of Usual Residence (i.e. PUR, the origin) and Place of Enumeration (i.e. POE, the destination) for Statistical

Areas Level 4 (SA4s). In TableBuilder Pro, PUR data and POE data are only available for cross-tabulation in the Counting Employed Persons, Place of Work database, which is restricted to individuals aged 15 years and older. All analyses were done in R (version 3.4.3, R Core Team 2018) with the *circlize* package used to draw the flow diagram (Gu et al. 2014). Maps were prepared using QuantumGIS software (QGIS Development Team 2018).

#### 4. How much movement?

Of 23,401,891 people enumerated on Census night 2016, 1,142,005 (4.9%) were captured away from their usual residence. In relative terms, this figure has been remarkably stable over the past two decades, with 4.7 per cent of the population away from home at the 1996 Census (Bell and Ward 2000). When we limit this to adults (aged 15 and over), 5.5 per cent of the population were away from home. While most moves were over short distances, almost a third of moves were between different states and territories. In addition to the 4.7 per cent of Australians away from home on Census night, the Census enumerated 315,530 overseas visitors, equivalent to 1.3 per cent of the 2016 Census count.

Like permanent migration, temporary mobility is highly selective by age and sex. The age schedule of temporary mobility is bimodal (Figure 1). The highest levels of mobility are among older adults (65–70 years) and younger adults (20–30 years). The peak in mobility at both older and younger ages reflects fewer work and family related constraints on these populations on a school night in mid-winter. The lowest level of mobility is observed among school-aged children, with only 2 per cent enumerated away from home on Census night. There are marked sex differentials in the mobility age schedules. Mobility among young women peaks at a younger age and at a lower level than for men. It then drops to well below the male propensities during key labour force ages before it rises again to match male levels in retirement.



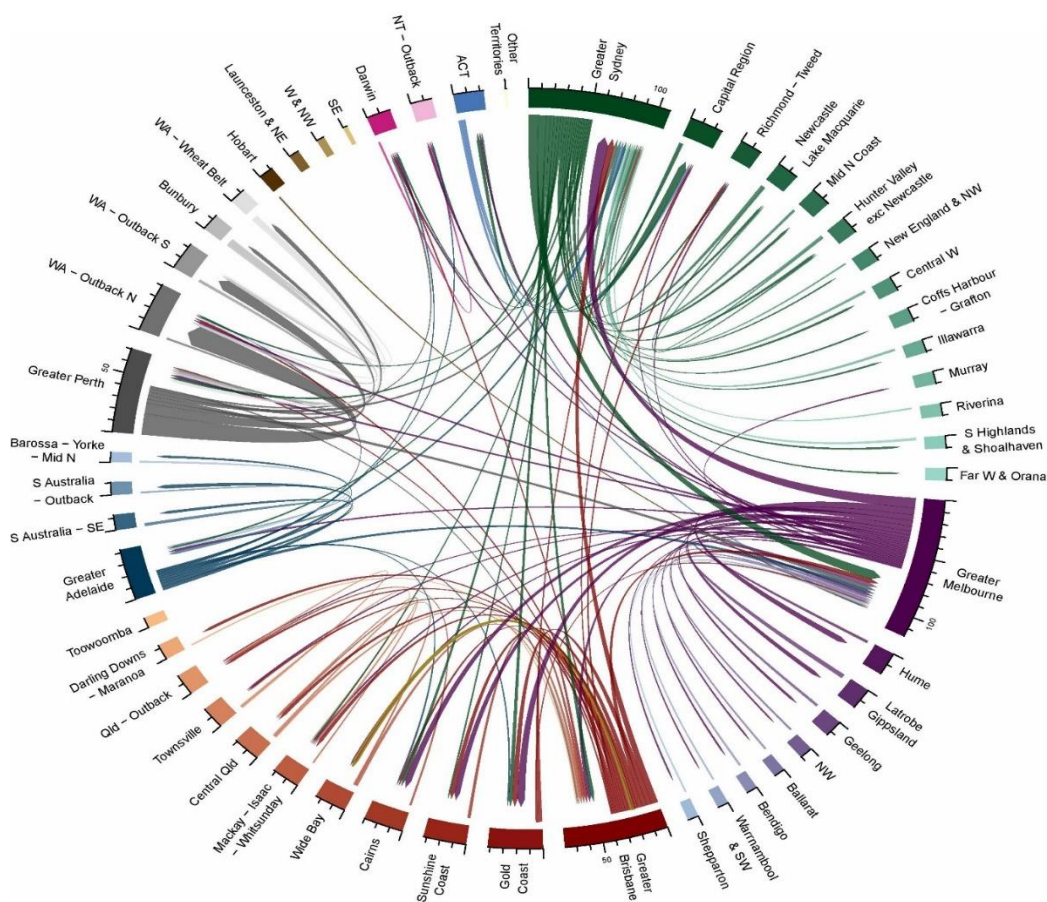
**Figure 1:** Per cent of individuals away from home on Census night by age and sex, 1996 and 2016 Censuses

Source: ABS 1996 and 2016 censuses.

How might we explain these differences? The early peak in mobility among females is likely tied to age differentials in partnering and the absences associated with non-residential relationships. In key labour force ages, the lower mobility of women might reflect occupational structure, with women less likely to be employed in roles and industries associated with large amounts of travel (Bell and Brown 2006). Women are also more likely than men to be constrained by childcaring roles limiting work-related mobility (ABS 2016). Sex differentials in movement at older ages may again reflect age differentials in partnering, with a persistent three to four year lag in mobility rates.

There has been an ageing in the profile of movers since the 1996 Census. Mobility has decreased among younger men, with the percentage away at age 20 declining by more than 25 per cent. This decline has been offset by a substantial increase in the rate of movement across key labour force ages (25–65). For women, there has also been a drop in mobility in early adulthood. This is accompanied by a slight increase in rates between ages 25–45, but also a decline between ages 45–65. Mobility in the retirement ages (65 and over) remained largely unchanged between 1996–2016, while movement intensity in infancy dropped for both males and females. Based on the schema set out by McHugh, Hogan and Happel (1995), these changes suggest a shift away from consumption-related moves, particularly at younger ages, towards production-related motivations for temporary movements on Census night.

## 5. Where do people move?

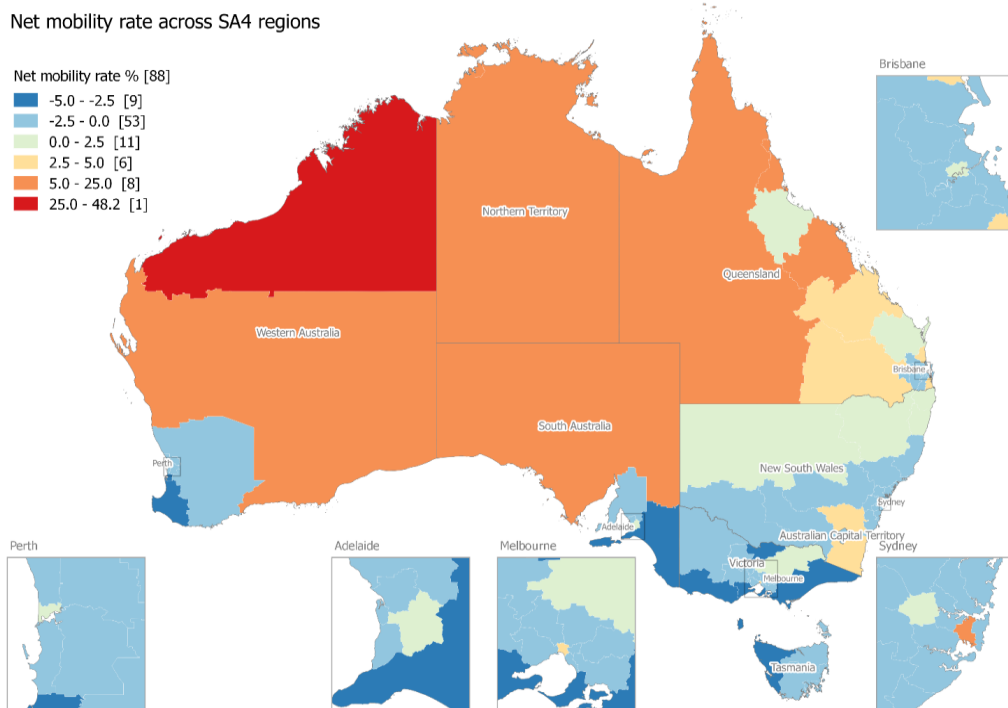


**Figure 2:** Circular plot showing origin–destination flows between Greater Capital City Statistical Areas and SA4s (for the rest of Australia), 2016 Census

Figure 2 (above) shows the temporary flows recorded on Census night between Greater Capital City Statistical Areas (GCCSA) and SA4s (for the rest of Australia). The circular plot represents all inter-SA4 flows, but only shows chords for flows greater or equal to 1,000 people. Colour hues are used to define Australian states and territories. The direction of the flow is defined by the colour of the origin and the presence of an arrow at the end of the chord. The width represents the number of movers.

From Figure 2 we learn a number of things. At the national level, we see that the most populous states of New South Wales, Victoria and Queensland dominate the mobility system in terms of gross flows (i.e. both ins and outs). The largest flows originate and terminate in metropolitan areas, with the largest reciprocal flows between Greater Sydney and Greater Melbourne. Greater Brisbane is an important source of flows to Greater Sydney and Greater Melbourne, but is less attractive as a destination. Another striking feature is the containment of larger flows within the states and territories, particularly in the resource states of Western Australia and Queensland. Of all states and territories, flows from Victoria are the most widely dispersed across Australia, with movers from Victoria recorded in coastal tourism areas including the Gold Coast, Sunshine Coast and Cairns (all in Queensland).

Figure 3 shows the pattern of net mobility rate (NMR), which captures gains and losses for SA4s. NMR was calculated by subtracting the number of residents temporarily absent (i.e. out-movers) from the number of visitors (i.e. in-movers) divided by the usual resident population for each SA4. The pattern follows a north–south gradient with the greatest gains in northern Australia, including outback areas of Western Australia, Queensland and the Northern Territory, and the largest losses in the southern states. Modest gains were also recorded in coastal destinations in southeast Queensland and northern New South Wales, as well as SA4s encompassing the alpine resort areas of New South Wales and Victoria. This is consistent with climatic factors dictating the timing and destination of some forms of temporary mobility (see Charles-Edwards and Bell 2015).



**Figure 3: Net mobility rate (%) across SA4s, 2016 Census**

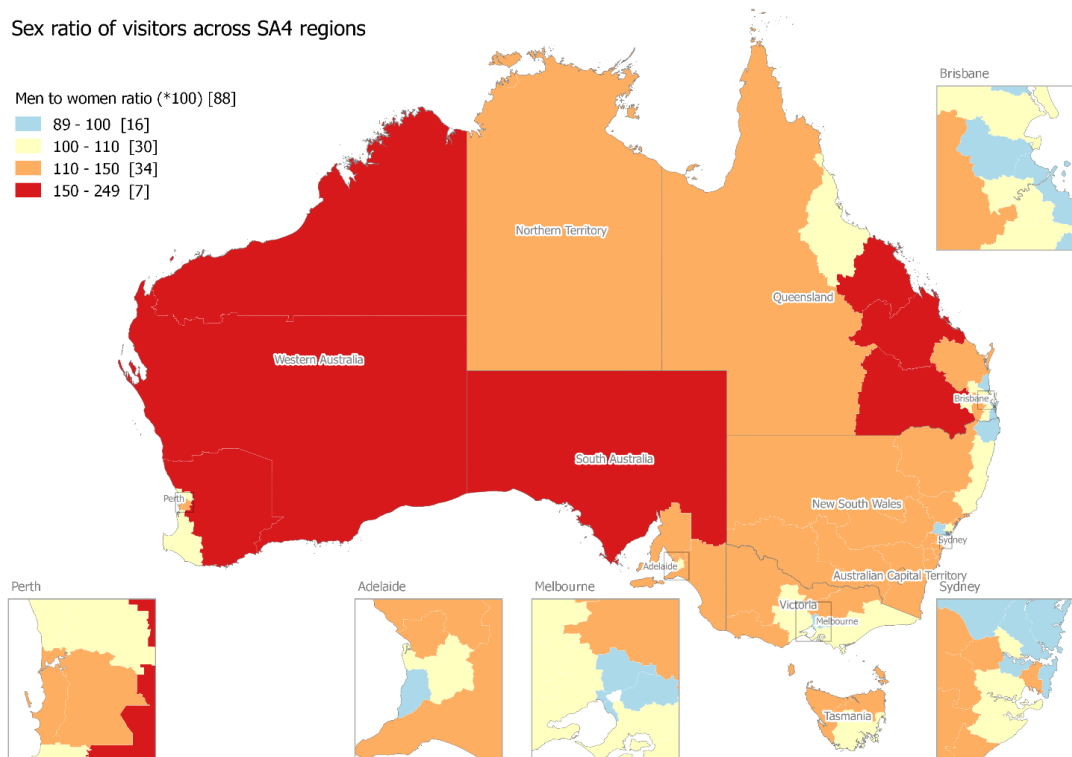
Note: Number in brackets indicates number of regions in category.

There is also a functional dimension to the mosaic of gains and losses. Capital cities experienced net population losses except in their urban core, which experienced modest (e.g. Greater Brisbane) to large (e.g. Greater Sydney) gains. These gains are probably tied to business flows. Gains in northwest Western Australia and central and southwest Queensland are likely underpinned by mining and oil and gas extraction-related (FIFO) mobility.

## 6. Who moves where?

The characteristics of movers are of interest to agencies involved in the planning and provision of services, as well as to researchers needing denominators for a range of social statistics. Age and sex are the most critical attributes to be captured.

Figure 4 shows the sex ratio of visitors to SA4s across Australia. The mobility surface is strongly differentiated by sex. Males dominate temporary moves to resource regions including northwest Western Australia and central and southern Queensland. The sex ratio is particularly skewed in northwest Western Australia with more than two male visitors for every female. Sex ratios are also skewed in favour of males in the closely settled irrigated agricultural zone of southern New South Wales and Victoria. Females dominate visitation to the suburbs and periphery of most urban areas (except Greater Perth), but not the central business districts. The sex ratio imbalance is in favour of females in southeast coastal districts of Queensland.



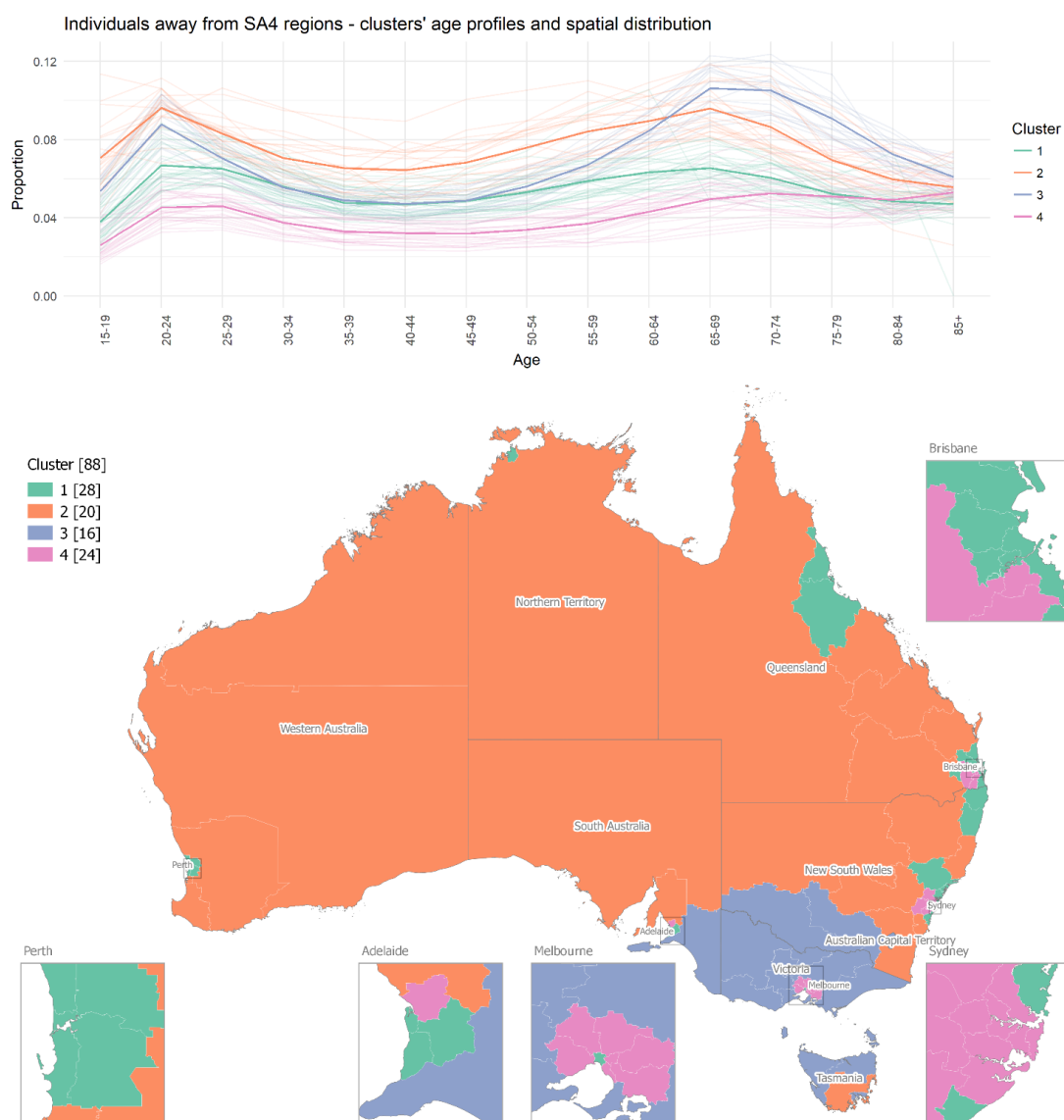
**Figure 4: Sex ratio of visitors to SA4s, 2016 Census**

*Note:* The number in brackets indicates the number of regions in each category.

We know that propensity to move varies across the life course. How does this manifest across space? To explore variations in the age structure of movers in both sending and receiving regions we grouped SA4s according to the age profiles of individuals temporarily absent from home (represented as an out-movement rate) and by the age profile of visitors to SA4s (measured as a proportion of all

visitors to that SA4). Clusters were selected using a k-means clustering algorithm implemented in the R package *stats* that determines the optimum partitioning of the dataset for a specified number of clusters. We derived four groups for residents away from home and four groups for visitors to SA4s.

Figure 5 shows the average age profile of absent residents for each of the four clusters and their spatial distribution. There are clear differences in both the level and age profile of mobility across sending regions. Cluster 1 contains the most SA4s (n=28) and comprises the coastal regions of Queensland and New South Wales, as well as SA4s in Greater Adelaide, Greater Perth, Greater Darwin and Other Territories (not shown). Outflows from this cluster are of average intensity and follow a bimodal pattern similar to the national distribution. Sparsely populated outback areas comprise the majority of SA4s in cluster 2 (n=20). The out-movement rates are the highest (on average) for younger and middle-aged individuals, and the second highest for individuals aged 65 and over.



**Figure 5:** Classification of SA4s based on age of absent residents, 2016 Census

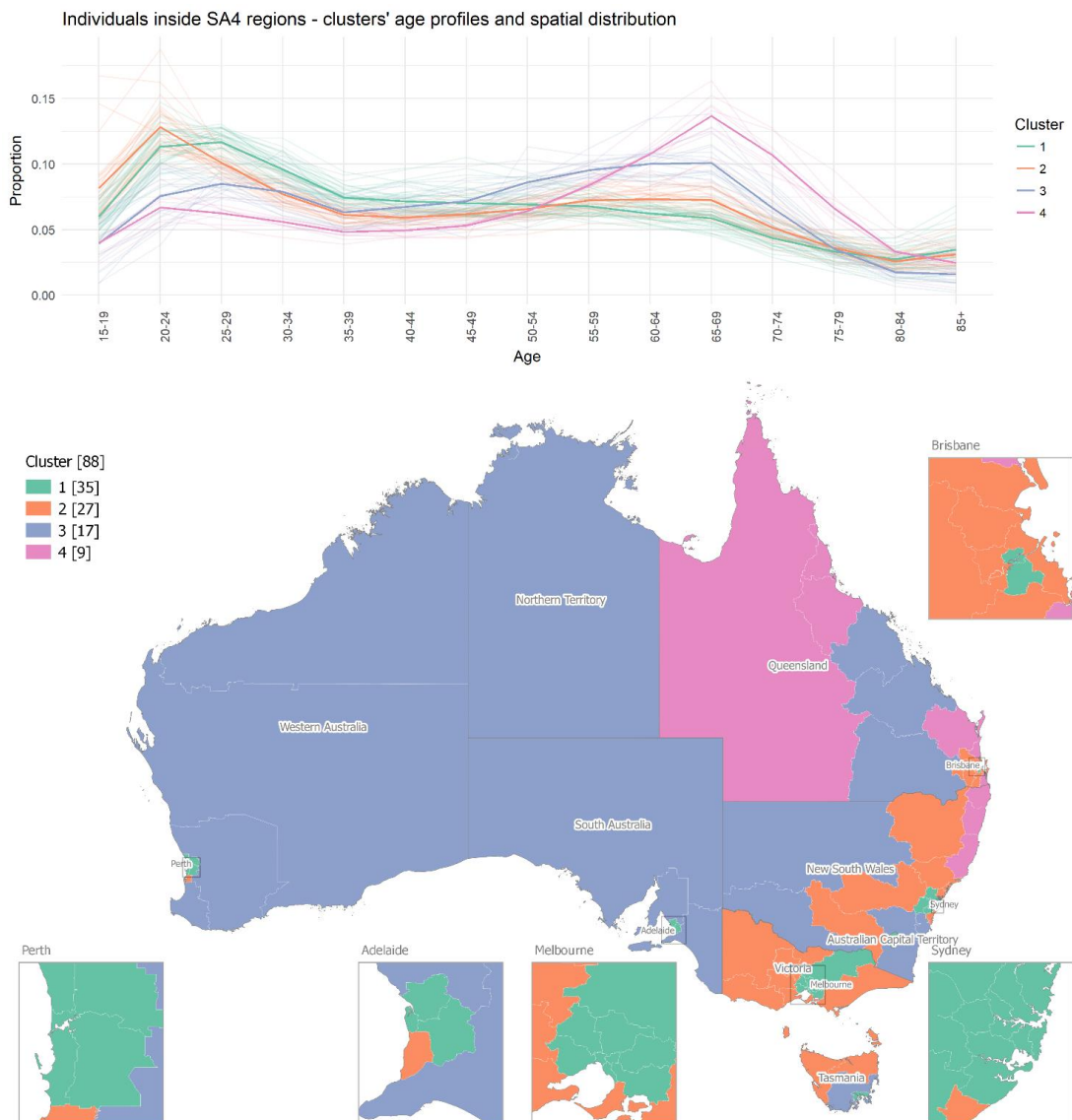
Note: The number in brackets indicates the number of regions in each category.

We can surmise that the high level of mobility in part reflects trips to access goods and services located at considerable distances from home. SA4s in cluster 3 (n=16) have (on average) the highest



proportion of individuals aged 65 and over away from home, and second largest proportion of people aged 20–29 away from home. SA4s belonging to this cluster are concentrated in the southeast corner of Australia, which suggests a climatic motivation for absences on Census night. Cluster 4 is the second largest (n=24) and is characterised by low mobility at all ages. These SA4s are concentrated in Greater Sydney, Greater Melbourne and Greater Brisbane.

The age profiles of movers are more varied at destinations than at origins. Four clusters are shown in Figure 6. Note that the clusters are based on the proportion of visitors by age, and thus do not reflect the level of visitation. The biggest between-cluster differences are at younger ages (below age 35) and older ages (above age 60). SA4s in cluster 1 (n=35) and cluster 2 (n=27) have younger than average visitors. Visitors to SA4s in cluster 3 and cluster 4 are older on average.



**Figure 6:** Classification of SA4s based on age of visitors, 2016 Census

Note: Number in brackets indicates the number of regions in each cluster.

Cluster 1 is comprised of SA4s located in state and territory capital cities. Visitors to these areas are more likely to be younger or in key labour force ages, suggesting employment as a key driver. Cluster 2 has a similar age profile, but has a higher peak at younger ages and a lower proportion of visitors in

key labour force ages. SA4s in this cluster are located on the peri-urban fringe of capital cities as well as southern coastal districts. The cluster includes the southern alpine ski resorts. Cluster 3 (n=18) has a relatively high proportion of older visitors as well as visitors in key labour force ages. SA4s in this cluster include the mining resource regions of Western Australia and Queensland, as well as large swathes of northern Australia which are climatically most attractive during the winter months. This suggests that a combination of production and consumption motivations are driving visits to these regions. Visitors to regions in the smallest cluster, cluster 4 (n=9), are older than average with relatively few individuals below age 50. SA4s belonging to this cluster are located in the coastal areas of northern New South Wales and southeast Queensland, and in northern Queensland.

## 7. Discussion and conclusion

Understanding the way in which populations shift over the course of a day, week and month due to temporary movements is important for planning and service provision, but also for the estimation of better dominators for a range of health and social statistics. This paper explored the intensity, age profile and patterns of temporary movements captured at the 2016 Census. It also generated a classification of regions based on the age profile of residents absent on Census night, and a separate classification of the age profile of visitors to Australian regions.

The results reveal that the intensity of temporary mobility in Australia has remained stable over the past two decades, with a rate of around one in twenty. There have, however, been shifts in the age/sex profile, with movement increasingly dominated by males in key labour force ages. The impact of temporary population mobility on Census night varies across Australia. Origin–destination flows connect metropolitan regions, particularly on the eastern seaboard. They distribute people from capital cities to regions in the resource rich states, and move Victorians to high amenity parts of Queensland.

With respect to impact, the suburbs of major cities and regions in southern Australia experience net losses. Gains occur in remote and northern Australia, selected high-amenity coastal districts and the core of major metro regions. When age is taken into account, a more differentiated mobility surface is revealed. At sending regions there is a close association between accessibility and the level of out-movement: the more remote an area, the higher the rate of out-movement. At destinations, there is a bifurcation between regions dominated by younger visitors and those more attractive to older Australians. The former includes the capital cities and regions in the southeast corner of Australia, while the latter incorporates the resource regions of central and northern Australia and selected high-amenity coastal districts.

Census data provides a partial insight into temporary movements in Australia, one night every five years. It provides no measure of seasonality, duration, frequency or periodicity, nor the complex circuits and motivations that underpin temporary moves. The spatial patterns observed will not be replicated at other times of the year: for example, during the January holiday period. The utility of Census data for the estimation of temporary populations is therefore limited. It does, however, have the singular advantage of complete enumeration of temporary populations coupled with detailed information on the characteristics of movers.

The emergence of new data sets, including those collected via social media and communication technologies, presents further opportunities for the generation of temporary population estimates.

However, these data are often partial, biased and confounded by individual behaviour and may not reliably represent the population present. Baseline data that accurately capture temporary populations and their characteristics, even if just for a single night, are essential for the production of robust estimates of non-resident populations. The integration of Census data with emerging data sets forms a key aspect of an ongoing program of work (the TEMPO project: Techniques for Estimating Mobile POpulations) aimed at developing techniques for estimating temporary populations in Australia.

### Key messages

- One in twenty Australians were enumerated away from their Place of Usual Residence on Census night 2016. This rate has been stable since 1996; however, the age and sex of movers has changed with males in key labour force age groups now much more likely to make temporary moves.
- On Census night temporary flows connect the capital cities in eastern Australia; cities to resource regions in Western Australia and Queensland; and Victoria to high amenity parts of Queensland and northern and outback Australia.
- Inner cities and select coastal areas gain temporary movers, while the suburbs and southern regions lose residents. This is a winter pattern: the pattern of gains and losses is expected to look different in summer months.
- The age of visitors varies across regions. Understanding these patterns is important for local service provision, housing and planning.
- The complete enumeration of temporary mobility by the Census, even for a single night, provides an opportunity to validate estimates of temporary populations derived from new data sources, such as social media and mobile phone data.

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