ETC5512: Wild Caught Data

Week 7

Census and Election Data

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6th May 2020

What is wild-caught data?

- data can be freely used
- data can be modified
- data can be shared by anyone for any purpose
- data source is traceable
- data collection is transparent
- data are updated as new measurements arrive
- if any data processing, the process is clearly described and reproducible

Observational data

Population is the whole set of units (such as people, animal, place etc) to which the question or experiment pertains to.

Sample is a subset of population that (hopefully) represents the population.

Sample or population?

Vò is a small town in northern Italy with 3,300 inhabitants. All inhabitants of the town were tested and retested for COVID-19. On 6th March, there were 89 infected in Vò. There are 4,636 known cases of infection out of about 60 million people in Italy on 6th March. As of 31st March, there are no longer new cases of infection in Vò and 101,739 known cases in all of Italy.

- Depends on the question of interest!
- We have the population data for Vò but for the whole of Italy, the number of known infection cases would be a sample.

Source: https://www.worldometers.info/ and https://www.abc.net.au/news/2020-03-21/one-italian-town-is-bucking-the-countrys-coronavirus-curve/12

Aim

This week we are interested in extracting and studying the **personal income data** from the 2016 Australian census and the **election data** from the 2019 Australian federal election.

You'll learn about tidy data.

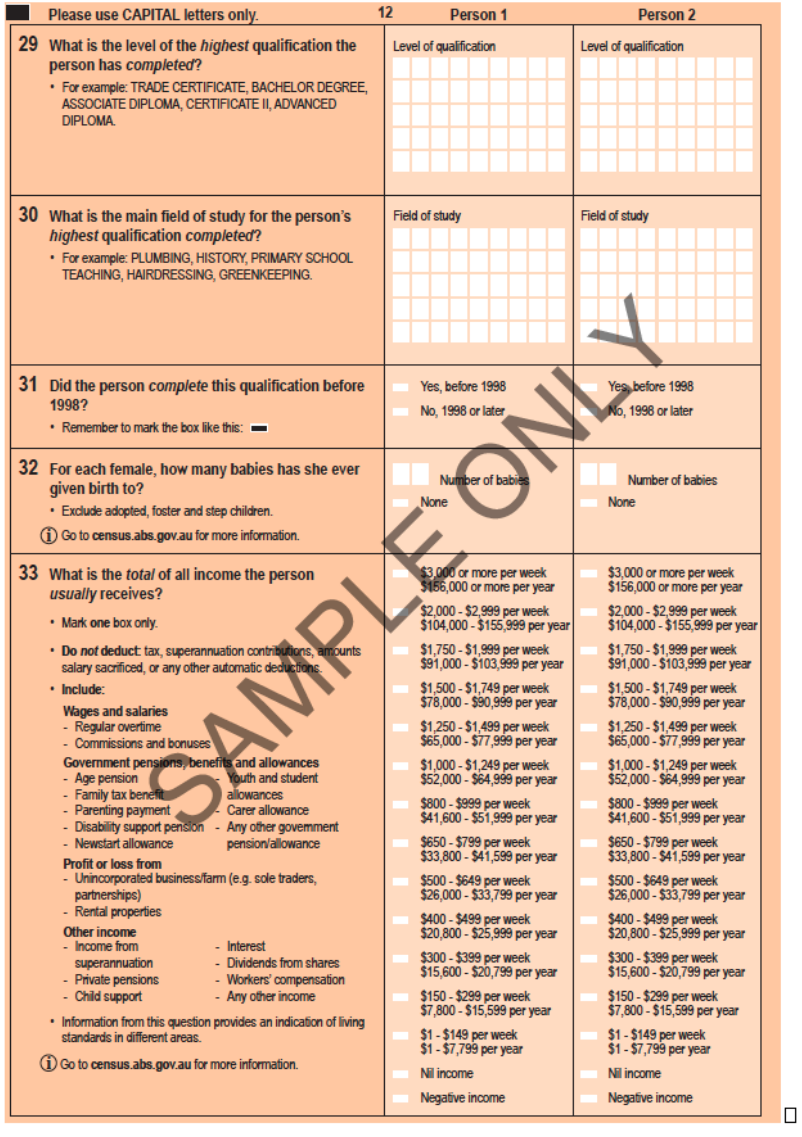
Australian Bureau of Statistics Census Data 2016

Australian Bureau of Statistics (ABS)

- ABS is the independent statistical agency of the Government of Australia.
- If you are from outside Australia, find the statistical government agency in your country 🔧, e.g. in Japan, this is the Statistics Bureau of Japan.
- ABS provides key statistics on a wide range of economic, population, environmental and social issues, to assist and encourage informed decision making, research and discussion within governments and the community.

ABS Census Data

- The first Australian census was held in 1911.
- Since 1961, the census occurs every 5 years in Australia.
- The last census was in 2016 at a *cost of $440 million*.
- The next census will be held in 2021.
- The ABS is legislated to collect and disseminate census data under the ABS Act 1975 and Census and Statistics Act 1905.
- Similar legislation are in place in many countries.



Please use CAPITAL letters only. 12

	Person 1	Person 2
29 What is the level of the *highest* qualification the person has *completed*? • For example: TRADE CERTIFICATE, BACHELOR DEGREE, ASSOCIATE DIPLOMA, CERTIFICATE II, ADVANCED DIPLOMA.	Level of qualification	Level of qualification
30 What is the main field of study for the person's *highest* qualification *completed*? • For example: PLUMBING, HISTORY, PRIMARY SCHOOL TEACHING, HAIRDRESSING, GREENKEEPING.	Field of study	Field of study
31 Did the person *complete* this qualification before 1998? • Remember to mark the box like this: ▬	Yes, before 1998 No, 1998 or later	Yes, before 1998 No, 1998 or later
32 For each female, how many babies has she ever given birth to? • Exclude adopted, foster and step children. ⓘ Go to **census.abs.gov.au** for more information.	Number of babies None	Number of babies None
33 What is the *total* of all income the person *usually* receives? • Mark **one** box only. • **Do *not* deduct:** tax, superannuation contributions, amounts salary sacrificed, or any other automatic deductions. • **Include:** **Wages and salaries** - Regular overtime - Commissions and bonuses **Government pensions, benefits and allowances** - Age pension - Family tax benefit - Parenting payment - Disability support pension - Newstart allowance - Youth and student allowances - Carer allowance - Any other government pension/allowance **Profit or loss from** - Unincorporated business/farm (e.g. sole traders, partnerships) - Rental properties **Other income** - Income from superannuation - Private pensions - Child support - Interest - Dividends from shares - Workers' compensation - Any other income • Information from this question provides an indication of living standards in different areas. ⓘ Go to **census.abs.gov.au** for more information.	$3,000 or more per week $156,000 or more per year $2,000 - $2,999 per week $104,000 - $155,999 per year $1,750 - $1,999 per week $91,000 - $103,999 per year $1,500 - $1,749 per week $78,000 - $90,999 per year $1,250 - $1,499 per week $65,000 - $77,999 per year $1,000 - $1,249 per week $52,000 - $64,999 per year $800 - $999 per week $41,600 - $51,999 per year $650 - $799 per week $33,800 - $41,599 per year $500 - $649 per week $26,000 - $33,799 per year $400 - $499 per week $20,800 - $25,999 per year $300 - $399 per week $15,600 - $20,799 per year $150 - $299 per week $7,800 - $15,599 per year $1 - $149 per week $1 - $7,799 per year Nil income Negative income	$3,000 or more per week $156,000 or more per year $2,000 - $2,999 per week $104,000 - $155,999 per year $1,750 - $1,999 per week $91,000 - $103,999 per year $1,500 - $1,749 per week $78,000 - $90,999 per year $1,250 - $1,499 per week $65,000 - $77,999 per year $1,000 - $1,249 per week $52,000 - $64,999 per year $800 - $999 per week $41,600 - $51,999 per year $650 - $799 per week $33,800 - $41,599 per year $500 - $649 per week $26,000 - $33,799 per year $400 - $499 per week $20,800 - $25,999 per year $300 - $399 per week $15,600 - $20,799 per year $150 - $299 per week $7,800 - $15,599 per year $1 - $149 per week $1 - $7,799 per year Nil income Negative income

SAMPLE ONLY

Get the ABS 2016 Census Data

https://datapacks.censusdata.abs.gov.au/datapacks/

> 2016 Census Datapacks
> General Community Profile
> All geographies
> Vic

Census DataPacks

Step 1: Select Census year

2016 Census Datapacks

Step 2: Select DataPacks type

General Community Profile

Step 3: Select Geography

All geographies

Need help with DataPacks? Download the help file : Zip File

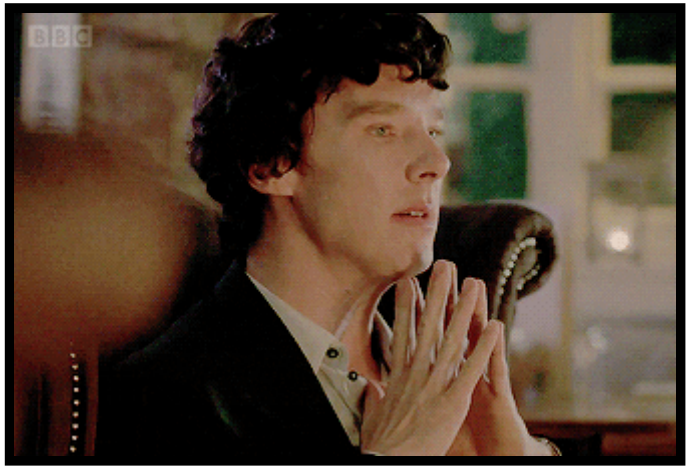
Geographies	Aust	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	OT	Geography boundary: ESRI Shapefile	Geography boundary: Map Interchange
All geographies												

Wild Data

And if you thought koala was cuddly and cute...

Navigating ABS Census data

- First, pray hard that there is some description!



- Without some description or understanding of the variables, it will be near impossible to extract meaningful information from the data.

Navigating ABS Census data

```
2016_GCP_ALL_for_Vic_short-header
 ├─── 2016 Census GCP All Geographies for VIC
 ├─── Metadata
 └─── Readme
```

- Readme is a good place to start here (phew!)

> *"About DataPacks_readme.md - "Read Me" documentation containing helpful information for users about the data and how it is structured (.md)"*

- *But there is no `DataPacks_readme.md`??*

Navigating ABS Census data

```
2016_GCP_ALL_for_Vic_short-header/Readme
 ├──── 2016POA_readme.txt
 ├──── AboutDatapacks_readme.txt
 ├──── CreativeCommons_Licensing_readme.txt
 ├──── Formats_readme.txt
 ├──── Summary_of_Changes.txt
 ├──── esri_arcmap_readme.txt
 └──── mapinfo_readme.txt
```

- There is no `DataPacks_readme.md` but there is `AboutDatapacks_readme.txt`.
- But it's not helpful in locating the income data...

Navigating ABS Census data

We could also try going through the meta-data.

```
2016_GCP_ALL_for_Vic_short-header/Metadata
├── 2016Census_geog_desc_1st_2nd_3rd_release.xl
├── 2016_GCP_Sequential_Template.xlsx
└── Metadata_2016_GCP_DataPack.xlsx
```

Metadata_2016_GCP_DataPack.xlsx

Table number	Table name	Table population
G17	Total Personal Income (Weekly) by Age by Sex	Persons aged 15 years and over
[illegible]	Total Family Income (Weekly) by Family	Families in family

Navigating ABS Census data

Where is Table G17?

```
2016_GCP_ALL_for_Vic_short-header/2016 Census GCP All Geographies for VIC/
├── CED
├── GCCSA
├── LGA
├── POA
├── RA
├── SA1
├── SA2
├── SA3
├── SA4
├── SED
├── SOS
├── SOSR
├── SSC
├── STE
├── SUA
└── UCL
```

Navigating ABS Census data

Back to metadata

```
2016_GCP_ALL_for_Vic_short-header/Metadata
├── 2016Census_geog_desc_1st_2nd_3rd_release.xl
├── 2016_GCP_Sequential_Template.xlsx
└── Metadata_2016_GCP_DataPack.xlsx
```

Let's open

`2016Census_geog_desc_1st_2nd_3rd_release.xlsx`

... and there are the region names of each geographical code.

Let's go with the easy one: STE Victoria.

Navigating ABS Census data

```
STE/VIC/
 ├──── ...
 ├──── 2016Census_G17A_VIC_STE.csv
 ├──── 2016Census_G17B_VIC_STE.csv
 ├──── 2016Census_G17C_VIC_STE.csv
 ├──── 2016Census_G18_VIC_STE.csv
 ├──── ...
```

- G17A, G17B, G17C?

Why is the table organised like this?

- Examine the files `2016Census_G17A_VIC_STE.csv`, `2016Census_G17B_VIC_STE.csv` and

Tables G17A-G17C

2016Census_G17A_VIC_STE.csv

STE_CODE_2016	M_Neg_Nil_income_15_19_yrs	M_Neg_Nil_income_20_24_yrs
2	88338	31685

2016Census_G17B_VIC_STE.csv

STE_CODE_2016	F_400_499_15_19_yrs	F_400_499_20_24_yrs	F_400_499_25_3
2	4020	17474	

2016Census_G17C_VIC_STE.csv

STE_CODE_2016	P_1000_1249_15_19_yrs	P_1000_1249_20_24_yrs	P_1000_12
2	1061	25642	

Table G17

There are few things to note:

- There are 201 columns in G17A and G17B and 81 columns in G17C.
- Perhaps there is an export limitation for a data that contains more than 200 columns, thus it is broken up into different csv files.
- Which means that you have to join the tables G17A, G17B and G17C as one (you'll do this in the tutorial 🔧).

But what does the data show?

What is Tidy Data?

Tidy Data Principles

1. Each variable must have its own column
2. Each observation must have its own row
3. Each value must have its own cell

So what about the ABS 2016 Census Data?

- The table header in fact contains information!
- E.g. `F_400_499_15_19_yrs` is female aged 15-19 years old who earn $400-499 per week (in Victoria).
- The number in the cells are the **counts**.
- Is the data tidy?

Wickham (2014) Tidy Data. *Journal of Statistical Software* **59**

Tidying the ABS 2016 Census Data

- Ideally we want the data to look like:

age_min	age_max	gender	income_min	income_max	count
15	19	female	400	499	4020

- You can include other information, e.g. geography code (useful if combining with other geographical area) or average age/income.
- Note that some don't have upper bounds, e.g. `M_3000_more_85ov`. In R, `-Inf` and `Inf` are used to represent $-\infty$ and ∞, respectively.
- You'll wrangle the data into the tidy form in tutorial 🔧

Raw Data vs. Aggregated Data

- Although the data collected was from individual households surveying each person in the household (see sample form here), the downloaded data are aggregated.
- Aggregated data presents summary statistics from the *raw data*. When the only summay statistics are counts then it is generally called *frequency data*.
- The raw data collected would be similar to the form

household_id	person	gender	age	maritial_status	income_per_week
1	John Smith	F	40	Married	400-499
1	Jane Smith	M	39	Married	300-399
1	David Smith	M	10	Never married	Nil
1	Mary Smith	F	8	Never married	Nil
2	John Citizen	M	32	Never married	400-499

What you lose in aggregate data

- For aggregate data, there are less scope for you to draw insights conditioned on other variables.
- E.g. based on frequency data alone, you cannot answer questions like: how many middle income families with 2 children?
- Raw data are desirable if you can get hold of it!

Trust and skepticism

- By the way, did you notice anything odd about the dummy data presented in the last slide?
- John Smith was recorded as female and Jane Smith as male. Data may have been incorrectly recorded.
- How much do you trust the aggregate data?
- Have some healthy dose of skepticism in your data.

Data Confidentiality

- The data is not just aggregated, but it is also anonymised
- E.g. in `2016_GCP_Sequential_Template.xlsx`, Sheet "G 17a", footnote says "*Please note that there are **small random adjustments** made to all cell values to protect the confidentiality of data. These adjustments may cause the sum of rows or columns to differ by small amounts from table totals.*"
- Why is confidentiality of data important?
- 2013 New York City taxi data 🚖:
  - ~20GB of data on over 170 million taxi trips
  - anonymised taxi license numbers were easily decoded
  - the taxi trips were matched with celebrities that have photos taken with the taxi license plate number and reveals how they tip

Australian Federal Election 2019

Get the distribution of preferences by candidate by division for the 2019 Australian Federal Election

https://results.aec.gov.au/

```
> 2019 federal election
> Downloads
> Distribution of preferences by candidate by div
```

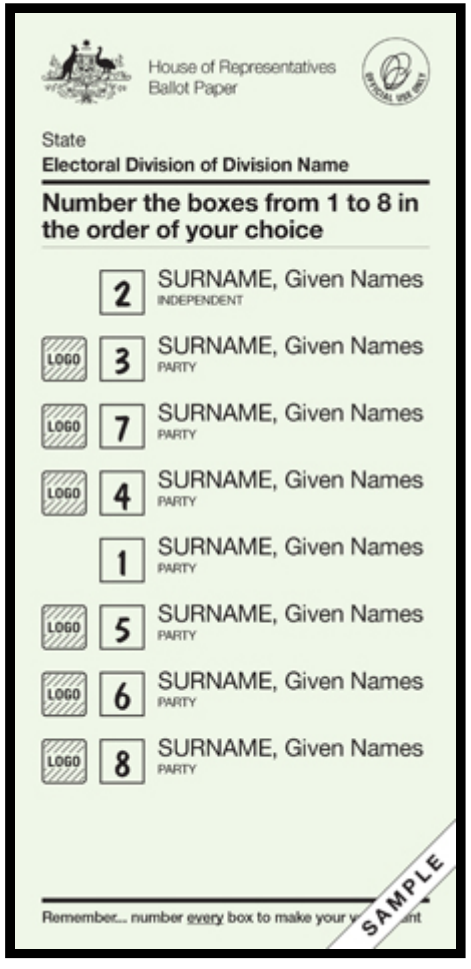
2019 Australian Federal Election

- Parliament of Australia comprsises two houses:
  - Senate (upper house) comprising 76 senators
  - House of Representatives (lower house) comprising 151 members
- Government is formed by the party or coalition with majority of the seats in the lower house
- The 2019 Australian Federal Election was held on Sat 18th May 2019
- Voting is compulsory if you are an Australian citizen

- Major parties in Australia:
  - Coalition:
    - Liberal
    - National
  - Labor
- Some minor parties in Australia:
  - The Greens
  - One Nation

Ballots

- House of Representatives uses the instant-runoff voting system
- Senate uses the single tranferable voting system


House of Representatives
Ballot Paper

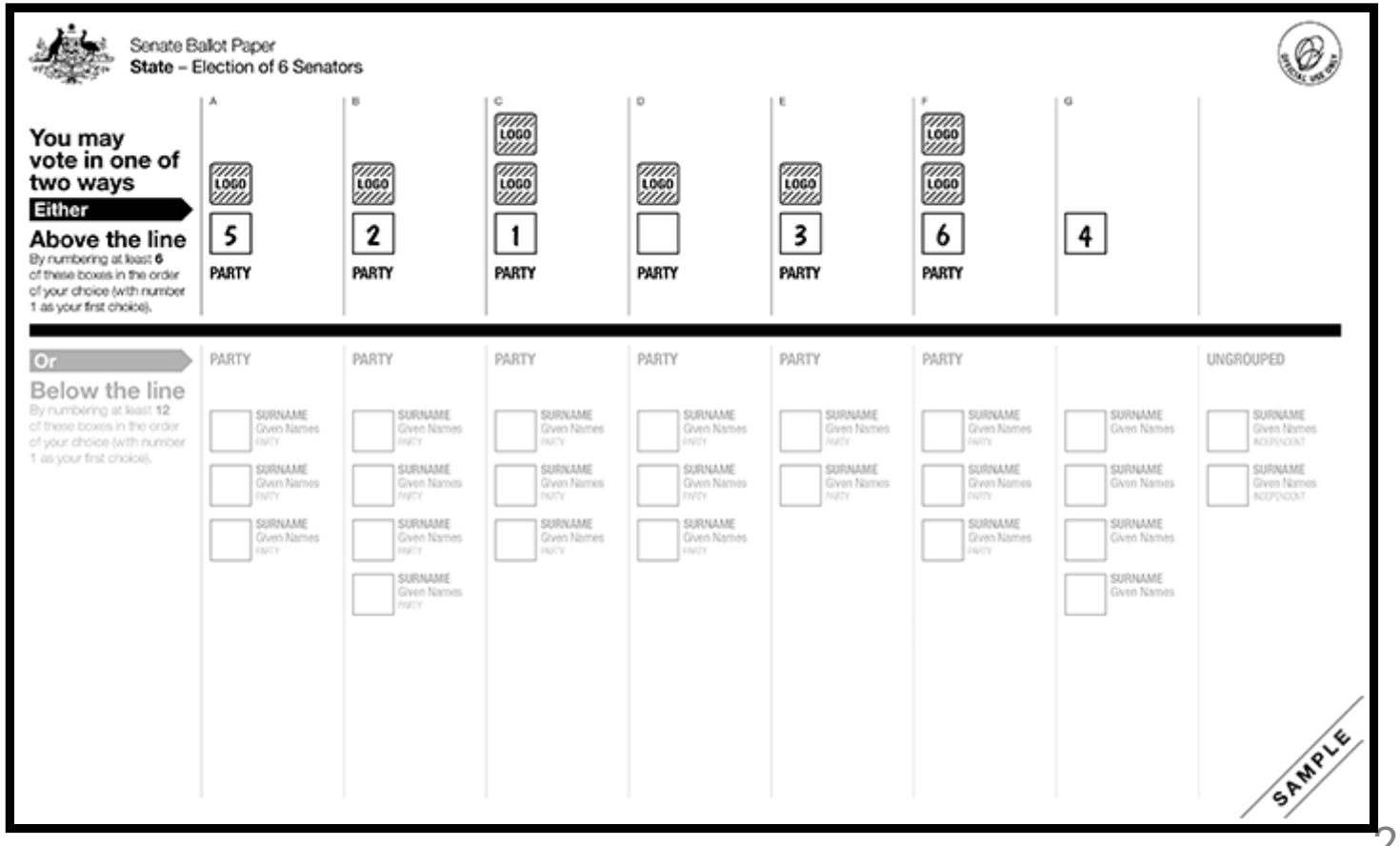
State
Electoral Division of Division Name

Number the boxes from 1 to 8 in the order of your choice

2 SURNAME, Given Names INDEPENDENT
LOGO 3 SURNAME, Given Names PARTY
LOGO 7 SURNAME, Given Names PARTY
LOGO 4 SURNAME, Given Names PARTY
1 SURNAME, Given Names PARTY
LOGO 5 SURNAME, Given Names PARTY
LOGO 6 SURNAME, Given Names PARTY
LOGO 8 SURNAME, Given Names PARTY

Remember... number every box to make your v... int

SAMPLE


Senate Ballot Paper
State – Election of 6 Senators

You may vote in one of two ways

Either
Above the line
By numbering at least 6 of these boxes in the order of your choice (with number 1 as your first choice).

A	B	C	D	E	F	G
LOGO 5 PARTY	LOGO 2 PARTY	LOGO LOGO 1 PARTY	LOGO PARTY	LOGO 3 PARTY	LOGO LOGO 6 PARTY	4

Or
Below the line
By numbering at least 12 of these boxes in the order of your choice (with number 1 as your first choice).

PARTY | PARTY | PARTY | PARTY | PARTY | PARTY | | UNGROUPED

SAMPLE

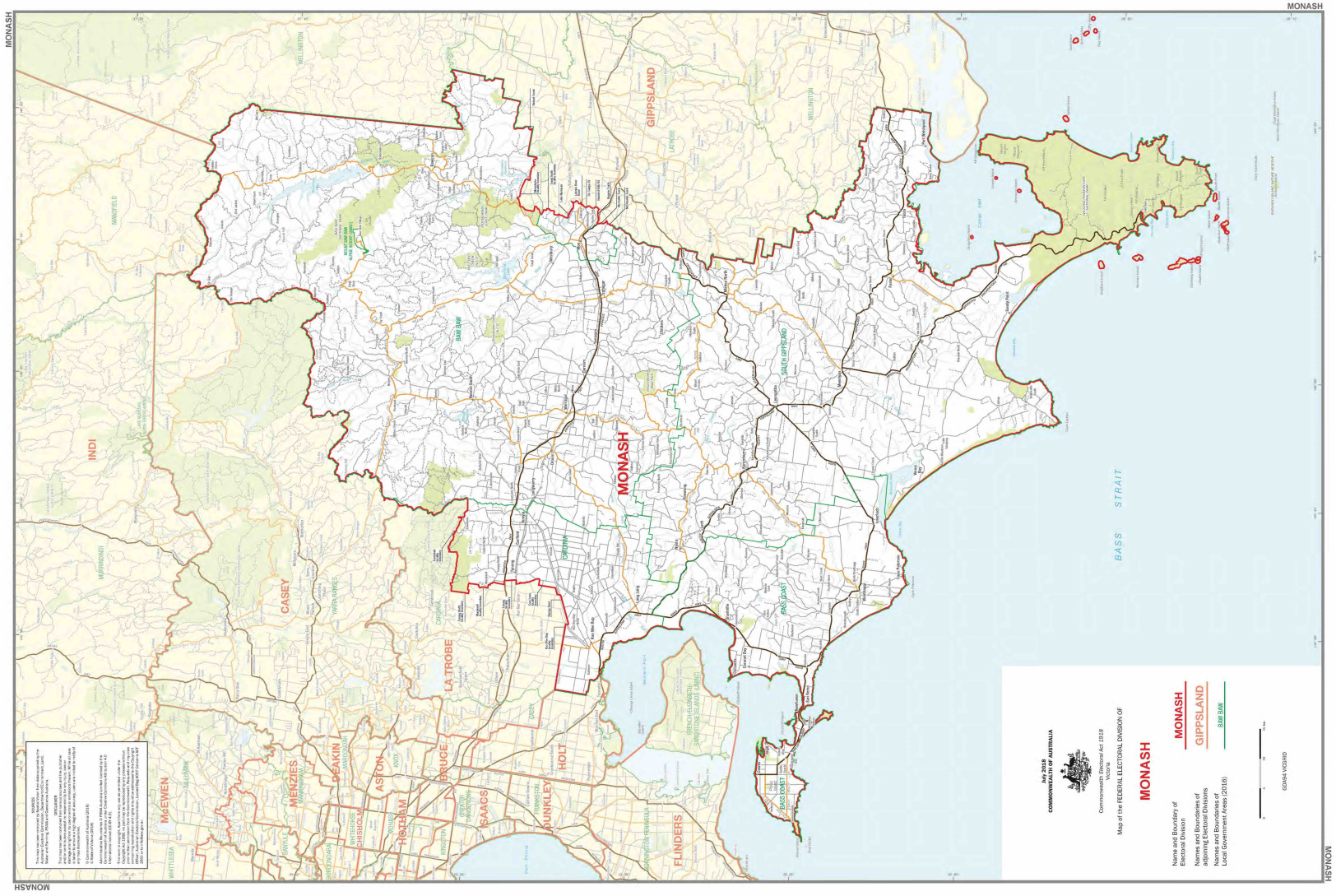
House of Representative Voting Data

```
library(tidyverse)
library(gganimate)
dat <- read_csv("https://results.aec.gov.au/24310/Website/Downloads/HouseD
glimpse(dat)
```

```
## Rows: 26,632
## Columns: 14
## $ StateAb          <chr> "ACT", "ACT", "ACT", "ACT", "ACT", "ACT", "ACT",
## $ DivisionID       <dbl> 318, 318, 318, 318, 318, 318, 318, 318, 318, 318
## $ DivisionNm       <chr> "Bean", "Bean", "Bean", "Bean", "Bean", "Bean",
## $ CountNumber      <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
## $ BallotPosition   <dbl> 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4,
## $ CandidateID      <dbl> 33426, 33426, 33426, 33426, 32130, 32130, 32130,
## $ Surname          <chr> "FAULKNER", "FAULKNER", "FAULKNER", "FAULKNER",
## $ GivenNm          <chr> "Therese", "Therese", "Therese", "Therese", "Jan
## $ PartyAb          <chr> "AUP", "AUP", "AUP", "AUP", "IND", "IND", "IND",
## $ PartyNm          <chr> "Australian Progressives", "Australian Progressi
## $ Elected          <chr> "N", "N", "N", "N", "N", "N", "N", "N", "N", "N
## $ HistoricElected  <chr> "N", "N", "N", "N", "N", "N", "N", "N", "N", "N
```

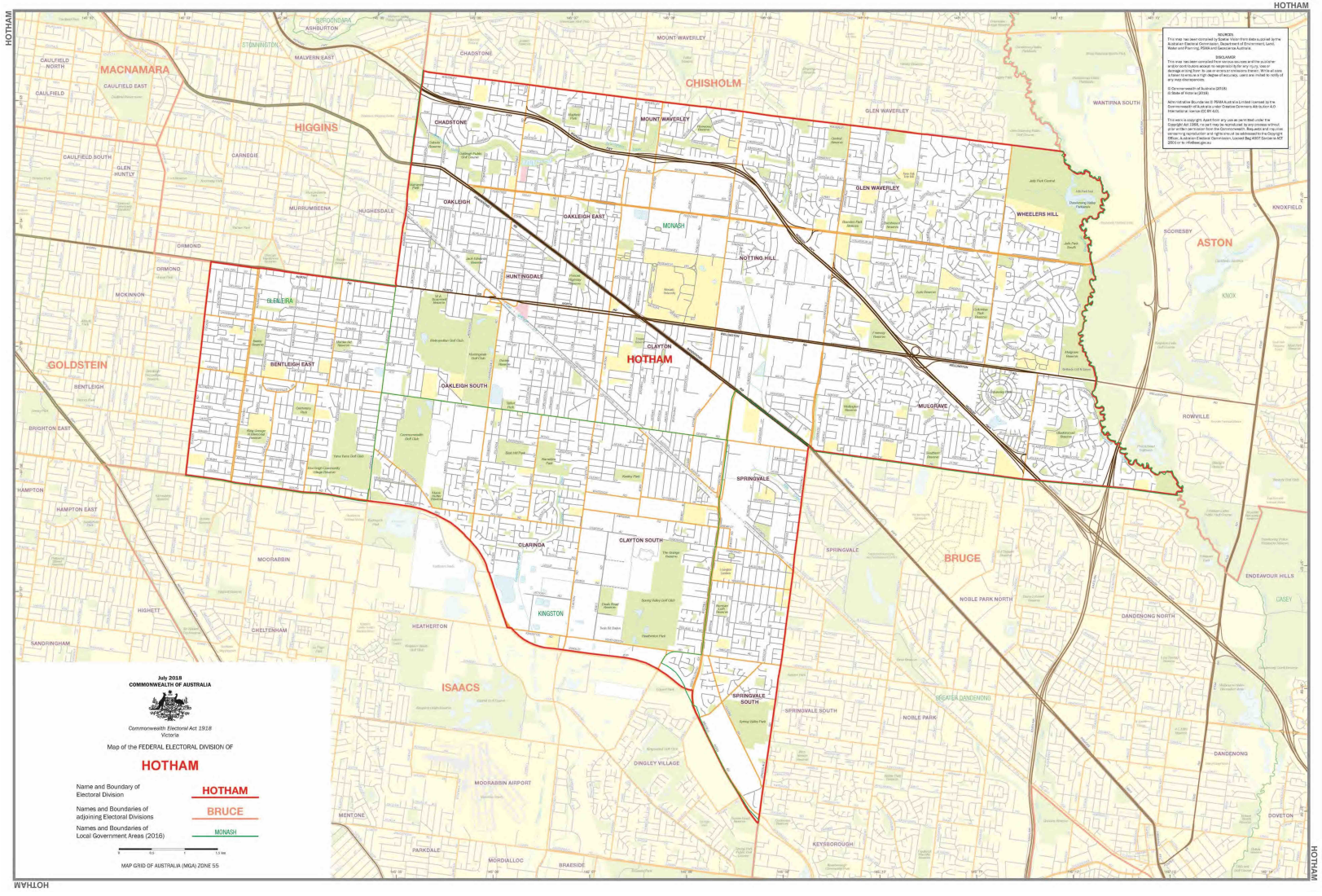
Electoral district of Monash

- ...*doesn't* include Monash Clayton campus



Electoral district of Hotham

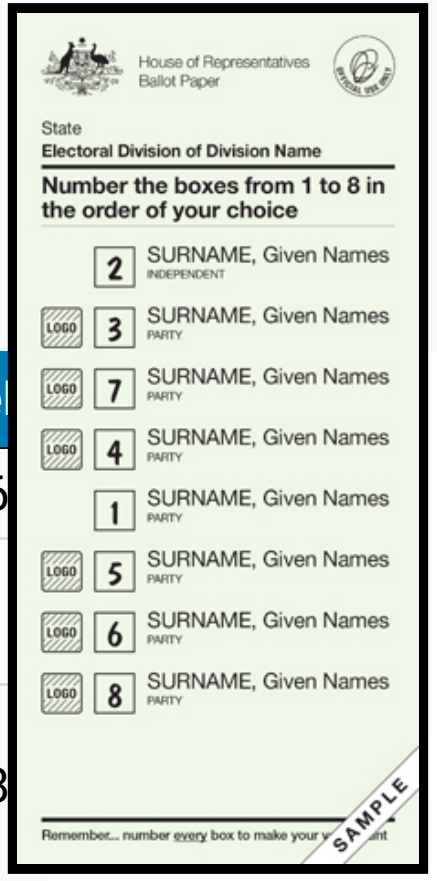
- *Does* include Monash Clayton campus



District: Monash

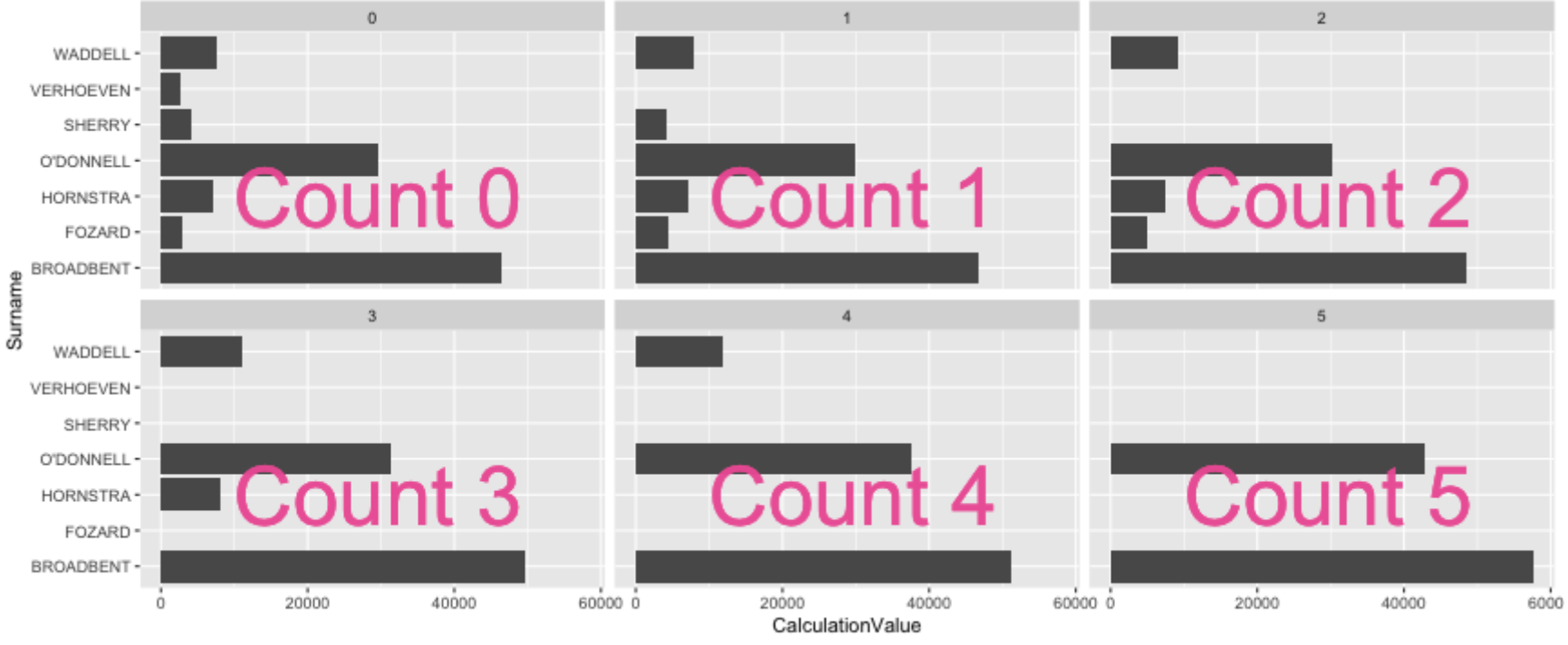
```
dat_monash <- dat %>%
  # get the preference count only
  filter(CalculationType == "Preference Count") %>%
  # get the Monash division
  filter(DivisionNm == "Monash")
```

	StateAb	DivisionID	DivisionNm	CountNumber	BallotPosition	Candidate
1	VIC	323	Monash	0	1	326
2	VIC	323	Monash	0	2	321
3	VIC	323	Monash	0	3	328
4	VIC	323	Monash	0	4	3229



Visualising the counts

```
dat_monash %>%
  ggplot() +
  geom_col(aes(x = CalculationValue, y = Surname)) +
  geom_text(aes(label = paste("Count", CountNumber)),
            x = 10000, y = 3, size = 16, color = "#ee64a4", alpha = 0.4, h
  facet_wrap(~CountNumber)
```

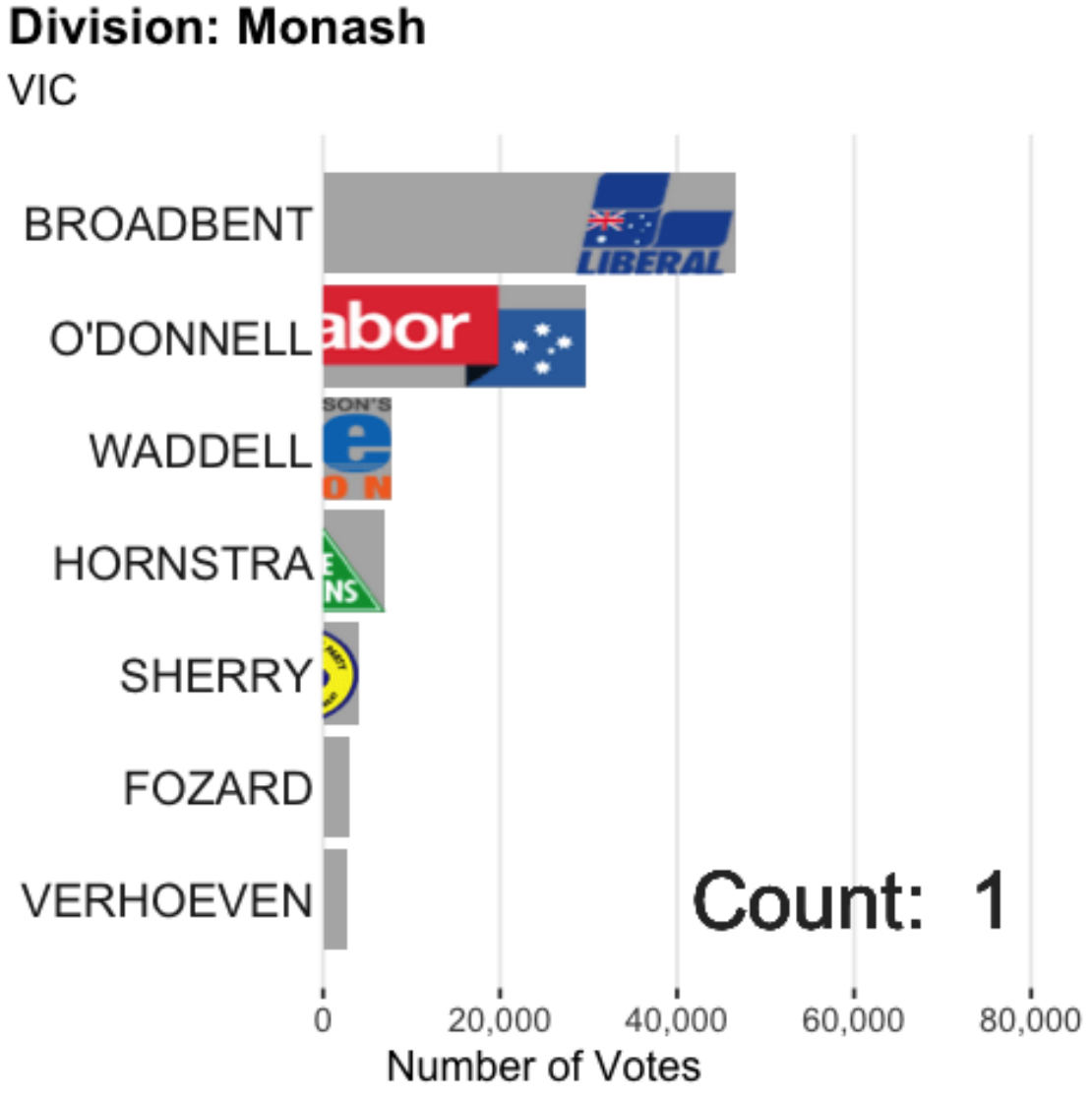


… but better to order candidates by counts

```
dat_monash %>%
  mutate(Surname = fct_reorder(Surname, CalculationValue)) %>%
  ggplot() +
  geom_col(aes(x = CalculationValue, y = Surname)) +
  geom_text(aes(label = paste("Count", CountNumber + 1)),
            x = 10000, y = 3, size = 16, color = "#ee64a4", alpha = 0.4, h
  facet_wrap(~CountNumber)
```

Winner:
Russel
Broadbent

House of Representative Voting Animation

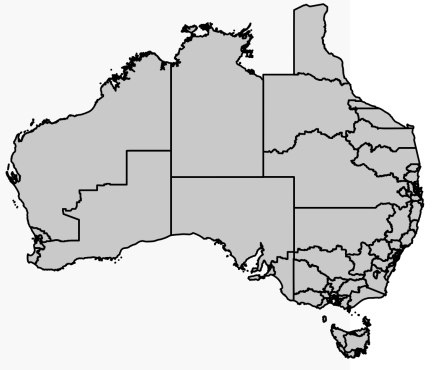


Combining Australian Election and Census Data

eechidna

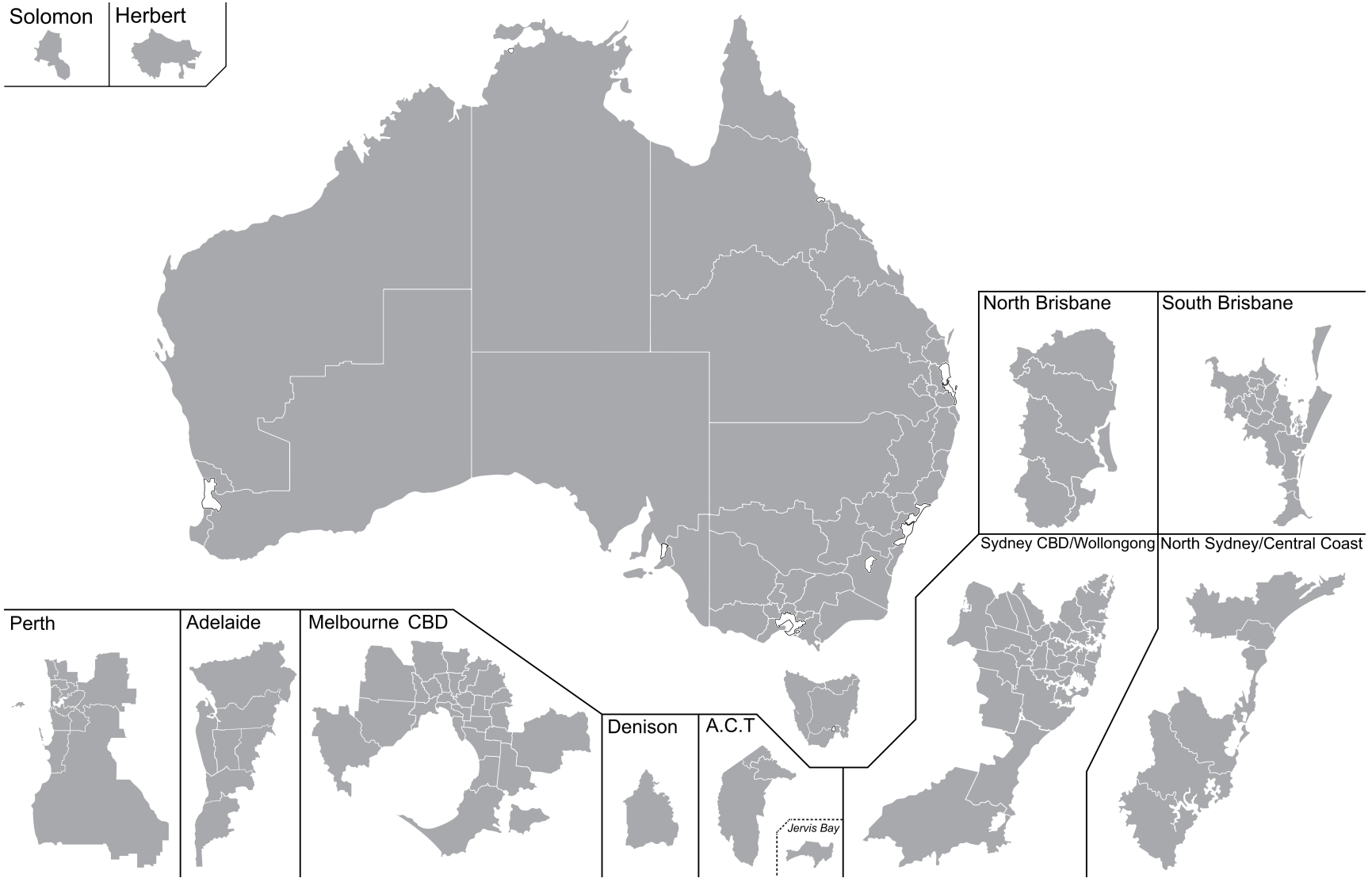
- eechidna (**E**xploring **E**lection and **C**ensus **H**ighly **I**nformative **D**ata **N**ationally for **A**ustralia) provides data from the Australian Federal elections from 2001-2019 and census information from 2001-2016.
- It also includes the map data! Read more about getting the shape files here.

```
library(eechidna)
nat_map19 <- nat_map_download(2019)
ggplot(data=nat_map19) +
  geom_polygon(aes(x = long, y = lat, group = group),
               color = "black") +
  theme_void() +
  coord_equal() +
  theme(legend.position="bottom")
```



Australian Electorates Divsions

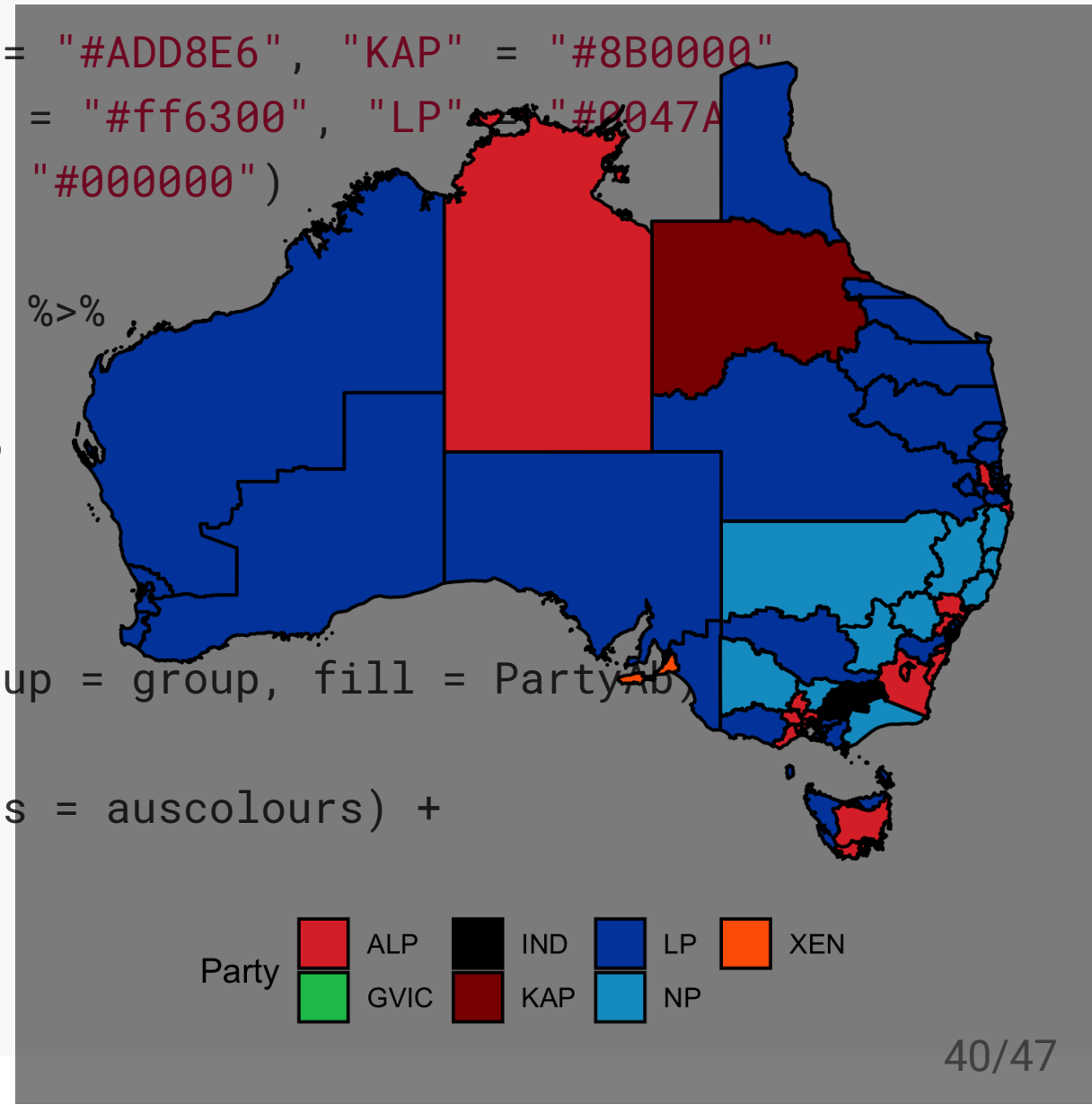
There are 151 electorates in 2019.



Drawing Choropleth Map with R

```
auscolours <- c("ALP" = "#DE3533", "LNP" = "#ADD8E6", "KAP" = "#8B0000"
                "GVIC" = "#10C25B", "XEN" = "#ff6300", "LP" = "#0047A
                "NP" = "#0a9cca", "IND" = "#000000")
map_winners <- fp19 %>%
  mutate(elect_div = toupper(DivisionNm)) %>%
  filter(Elected == "Y") %>%
  select(elect_div, PartyAb, PartyNm) %>%
  left_join(nat_map19, by = "elect_div")

ggplot(data = map_winners) +
  geom_polygon(aes(x = long, y = lat, group = group, fill = PartyAb),
               color = "black") +
  scale_fill_manual(name = "Party", values = auscolours) +
  theme_void() +
  coord_equal() +
  theme(legend.position="bottom")
```

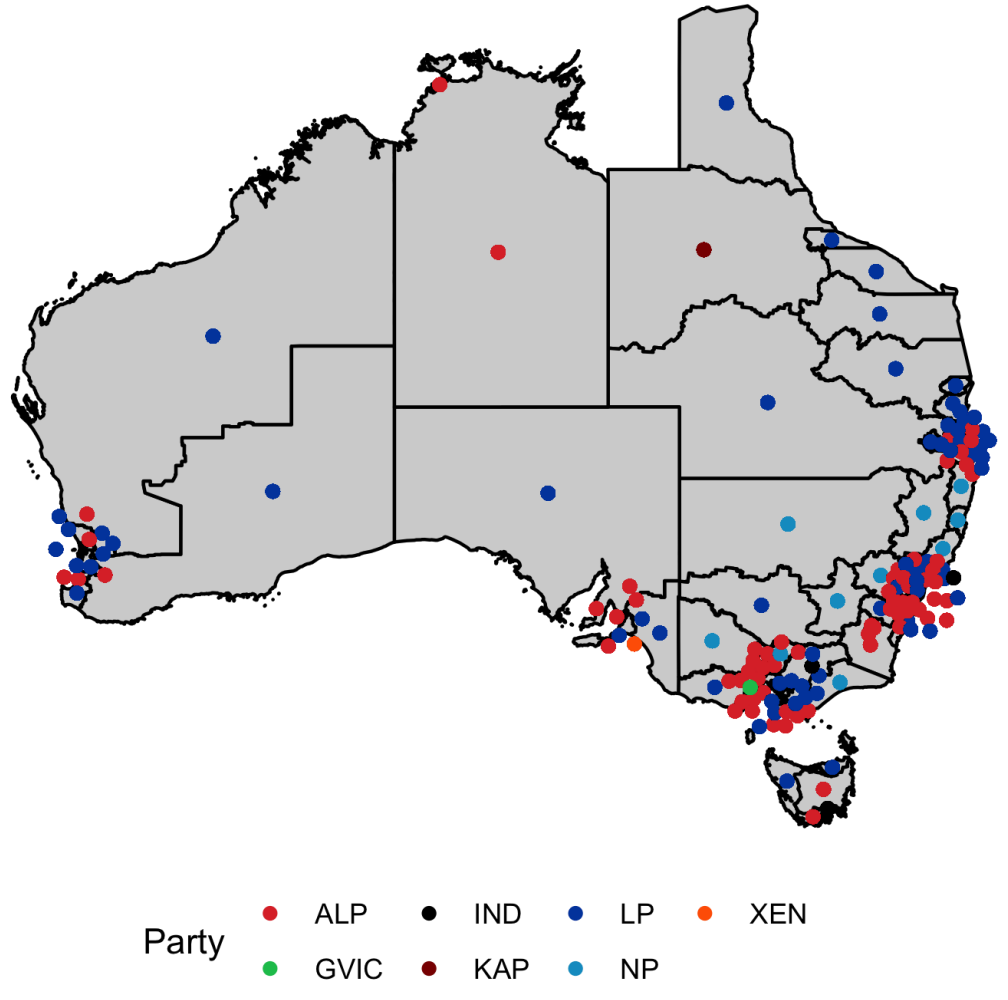


Choropleth Map

Which party won from looking at this map and by how much?

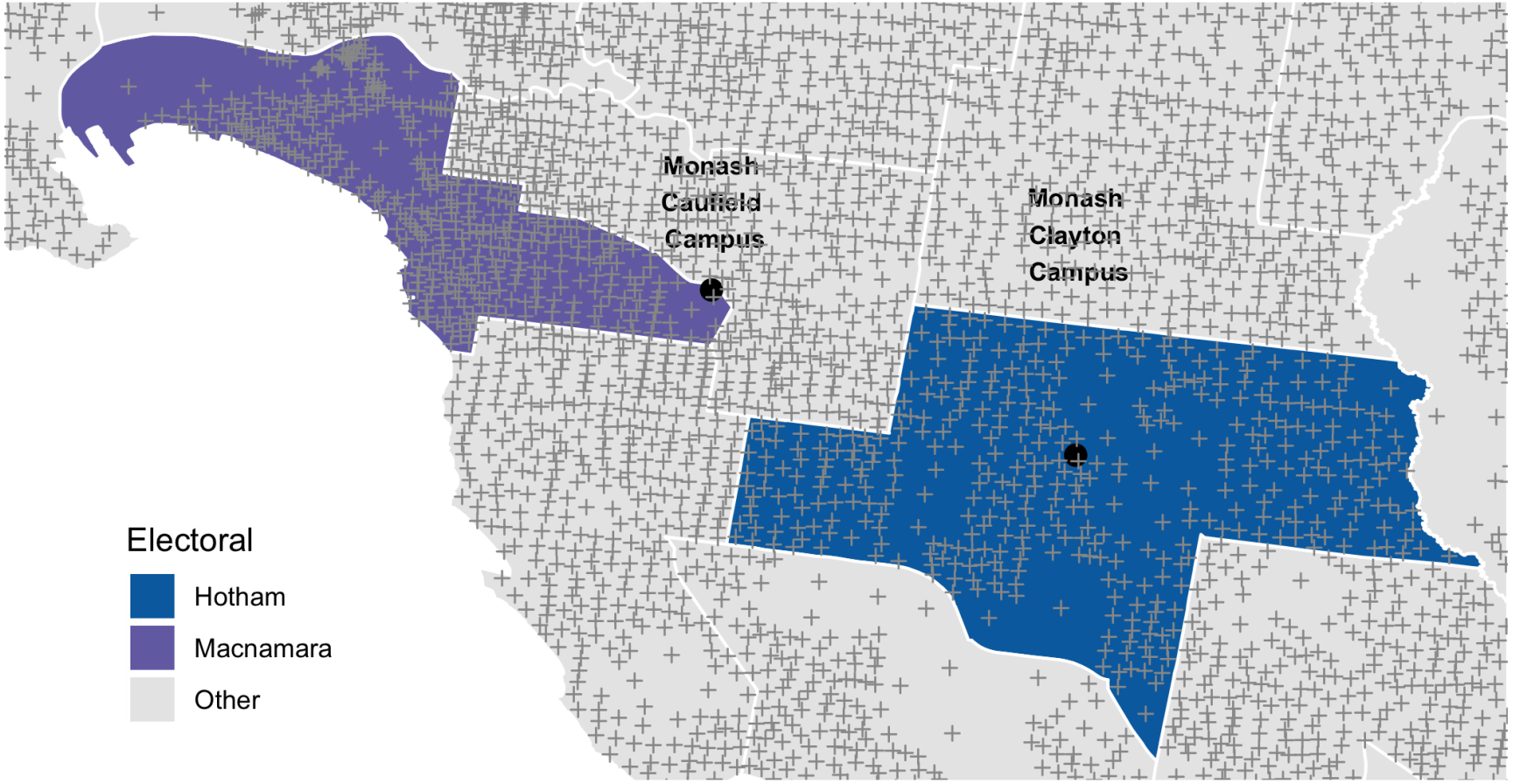
Liberal/National Coalition: **77**
Labor: **68**
Greens: **1**
Katter's Australian: **1**
Centre Alliance: **1**
Independents: **3**

Non-Contiguous, Dorling Cartogram

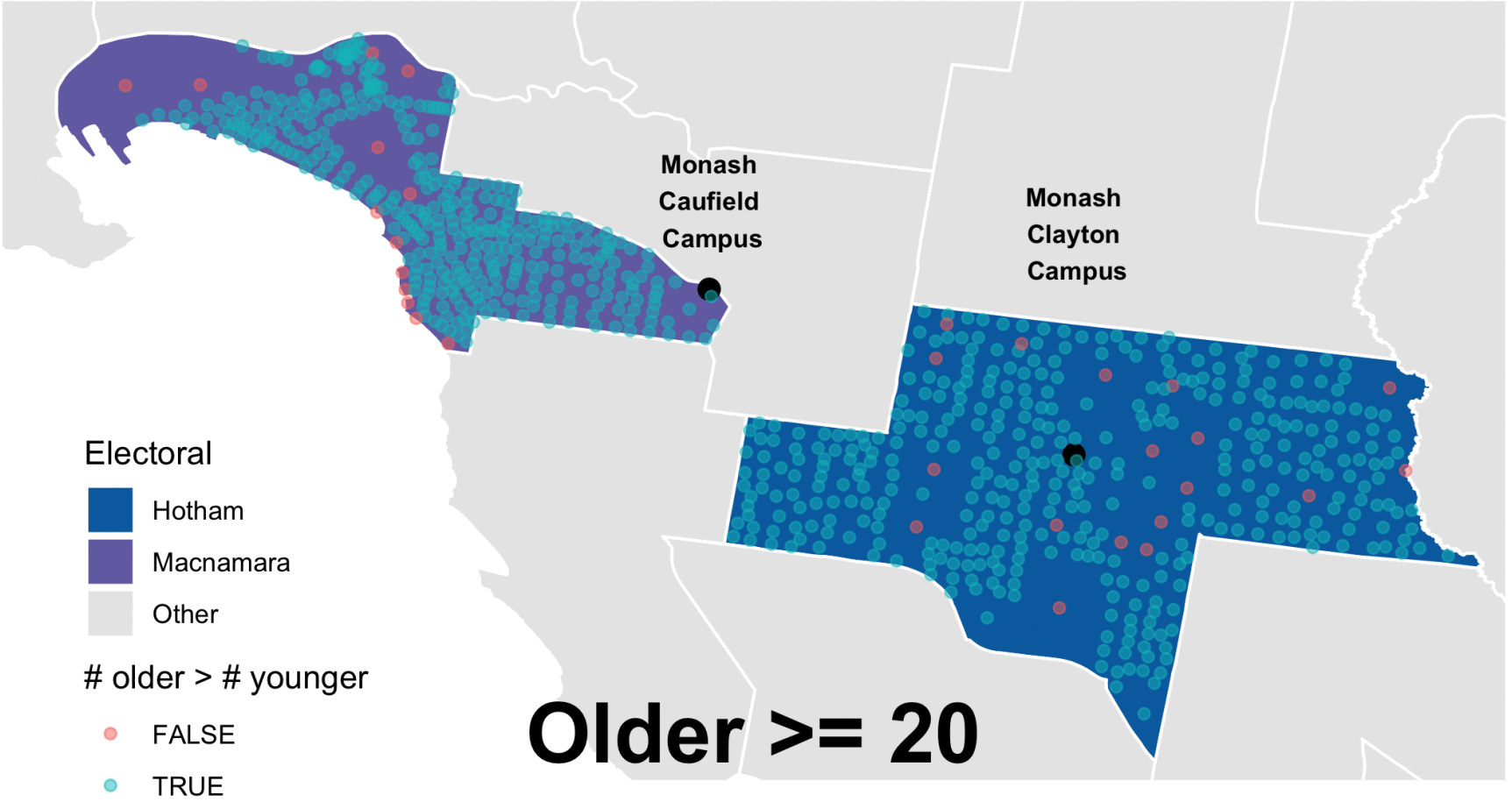


Electorate Map

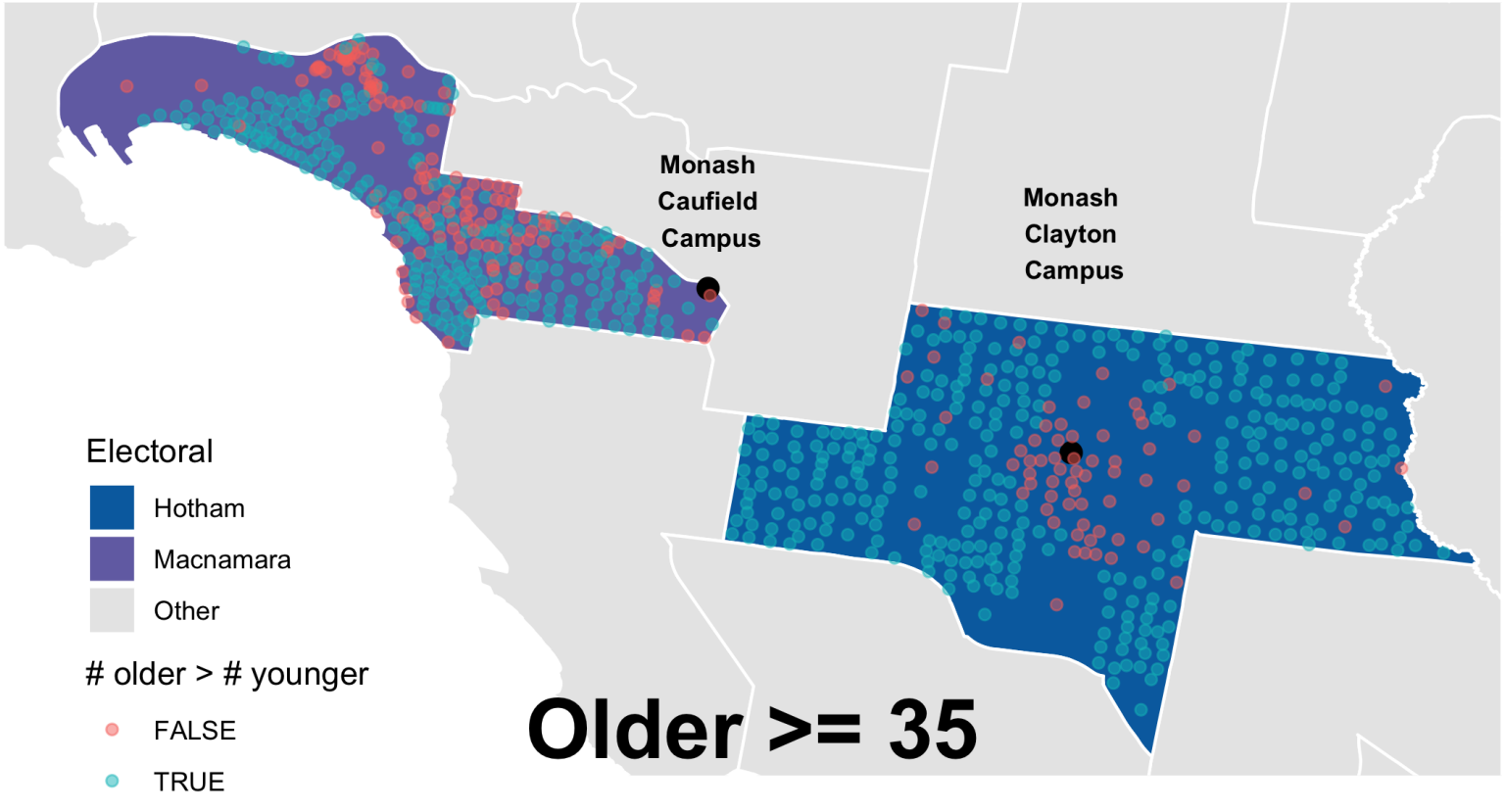
Now superimposed with the centroids of the Statistical Area 1 (SA1) from 2016 Census



Spatial distribution of age group



Spatial distribution of age group



There is a clear cluster of younger people (< 35 years old) centered around Monash clayton campus.

References

- To install `eechinda` R-packages use

```
devtools::install_github("emitanaka/eechidna")
```

Normally you should replace `emitanaka` with `ropenscilabs`, but current forked repo `@emitanaka` contains some (untested) bug fixes.

- Check out the vignettes for `eechidna` for more details.
- Also check out the paper by Forbes, Cook & Hyndman (2020) Spatial modelling of the two-party preferred vote in Australian federal elections: 2001–2016. *Australian & New Zealand Journal of Statisitcs* (to appear). .
- The RStudio Cloud Project containing the code for the maps and animations can be found here.

That's it!

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