ETC5512: Wild Caught Data

Combining Australian census and election data

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Week 6

Today you will:

- look at the ABS geographical boundaries for the 2016 census
- integrate data from different sources (census and election) to make exploratory inferences

Recall 2019 Federal Election Data

```
library(tidyverse)
library(sf)
aec_map <- read_sf(here::here("data/vic-july-2018-esri/E_AUGFN3_region.shp"))
votes <- read_csv("https://results.aec.gov.au/24310/Website/Downloads/HouseDopByDivisionDownload-24310.csv", skip = 1)

winners_fix <- votes %>%
  mutate(DivisionNm = ifelse(DivisionNm=="McEwen", "Mcewen", DivisionNm)) %>%
  filter(Elected=="Y" & CountNumber==0 & CalculationType=="Preference Count") %>% # get the winner
  right_join(aec_map, by = c("DivisionNm" = "Elect_div")) # join the data

auscolours <- c("ALP" = "#DE3533", "LNP" = "#ADD8E6", "KAP" = "#8B0000", "GVIC" = "#10C25B", "XEN" = "#ff6300",
                "LP" = "#0047AB", "NP" = "#0a9cca", "IND" = "#000000")

ggplot(winners_fix) +
  geom_sf(aes(fill = PartyAb, geometry = geometry)) +
  scale_fill_manual(values = auscolours)
```

There are two sources of data:

1. Electoral boundary
2. The votes for candidates in each electorate

Recall 2016 ABS Census Data

- DataPacks https://datapacks.censusdata.abs.gov.au/datapacks/
- GeoPackages https://datapacks.censusdata.abs.gov.au/geopackages/

ABS Census 2016 GeoPackages

GeoPackage

> *A **GeoPackage** (GPKG) is an open, non-proprietary, platform-independent and standards-based data format for geographic information system implemented as a SQLite database container. Defined by the **Open Geospatial Consortium** (OGC) with the backing of the US military and published in 2014, GeoPackage has seen widespread support from various government, commercial, and open source organizations.*
>
> — *Wikipedia*

Recall: OGC also defines the WKT

ABS GeoPackage

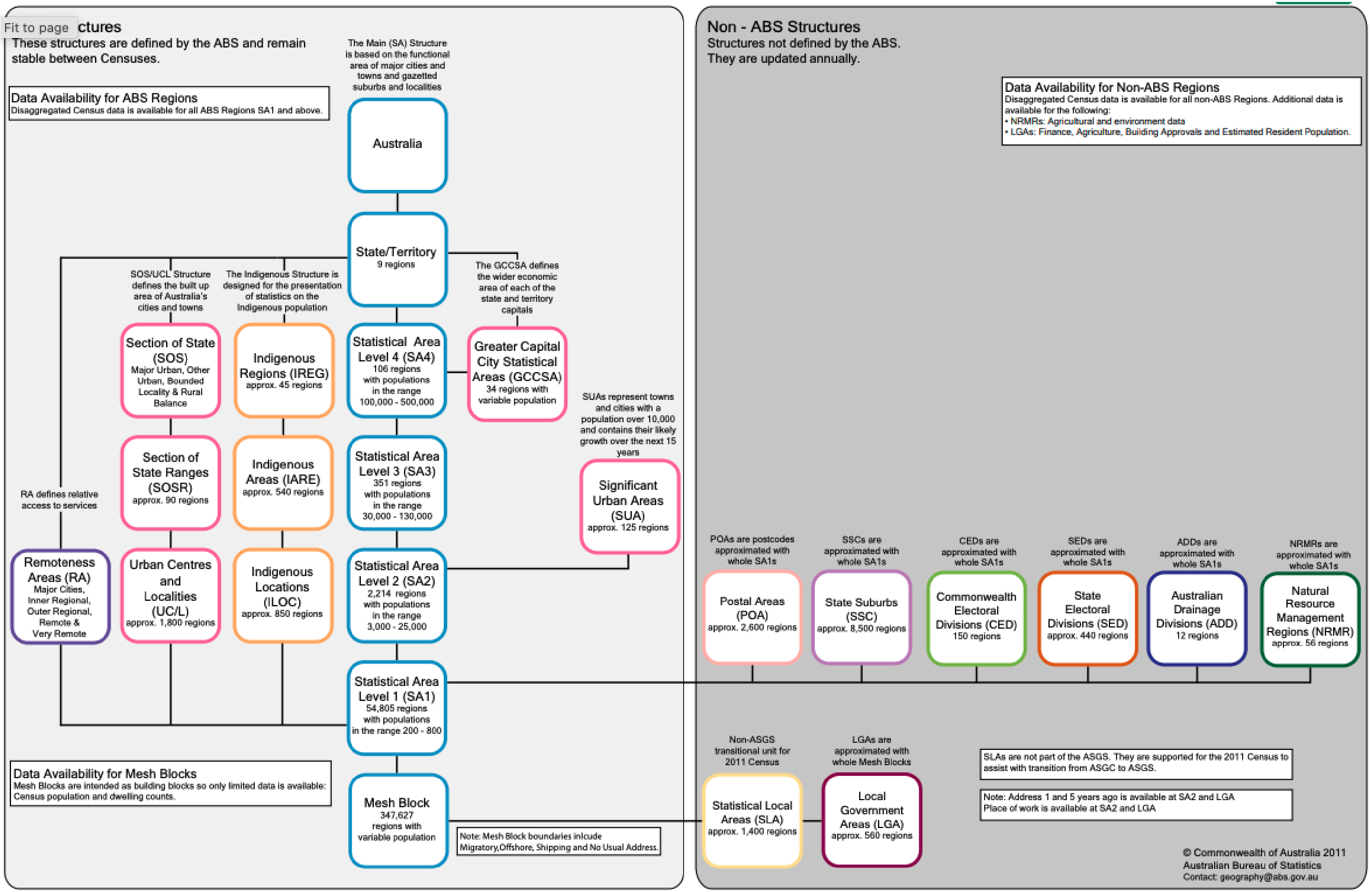
https://datapacks.censusdata.abs.gov.au/geopackages/

1. Victoria
2. Employment, Income and Unpaid Work (EIUW)
3. EIUW GeoPackage A

- **Or use the `strayr` package!** We'll use the one from the ABS website instead.

```
geopath <- here::here("data/Geopackage_2016_EIUWA_for_VIC/census2016_eiuwa_vic_short.gpkg")
st_layers(geopath)

## Driver: GPKG
## Available layers:
##                         layer_name geometry_type features fields
## 1     census2016_eiuwa_vic_ced_short                     39    489
## 2   census2016_eiuwa_vic_gccsa_short                      4    489
```

The Australian Statistical Geography Standard (ASGS)



The number of regions for each layer

```
st_layers(geopath) %>%
  # make it into a data.frame first
  tibble(!!!.) %>%
  # then you can the dplyr operations
  dplyr::arrange(features)
```

```
## # A tibble: 16 × 5
##    name                             geomtype  driver features fields
##    <chr>                            <list>    <chr>     <dbl>  <dbl>
##  1 census2016_eiuwa_vic_ste_short   <chr [1]> GPKG          1    489
##  2 census2016_eiuwa_vic_gccsa_short <chr [1]> GPKG          4    489
##  3 census2016_eiuwa_vic_ra_short    <chr [1]> GPKG          6    489
##  4 census2016_eiuwa_vic_sos_short   <chr [1]> GPKG          6    489
##  5 census2016_eiuwa_vic_sosr_short  <chr [1]> GPKG         12    489
##  6 census2016_eiuwa_vic_sa4_short   <chr [1]> GPKG         19    489
##  7 census2016_eiuwa_vic_sua_short   <chr [1]> GPKG         22    489
##  8 census2016_eiuwa_vic_ced_short   <chr [1]> GPKG         39    489
##  9 census2016_eiuwa_vic_sa3_short   <chr [1]> GPKG         68    489
## 10 census2016_eiuwa_vic_lga_short   <chr [1]> GPKG         82    489
## 11 census2016_eiuwa_vic_sed_short   <chr [1]> GPKG         90    489
## 12 census2016_eiuwa_vic_ucl_short   <chr [1]> GPKG        353    489
## 13 census2016_eiuwa_vic_sa2_short   <chr [1]> GPKG        464    489
## 14 census2016_eiuwa_vic_poa_short   <chr [1]> GPKG        698    489
## 15 census2016_eiuwa_vic_ssc_short   <chr [1]> GPKG       2931    489
## 16 census2016_eiuwa_vic_sa1_short   <chr [1]> GPKG      14073    489
```

Data in the layer

```r
vicmap_ste <- read_sf(geopath, layer = "census2016_eiuwa_vic_sa1_short")
vicmap_ste$geom
```

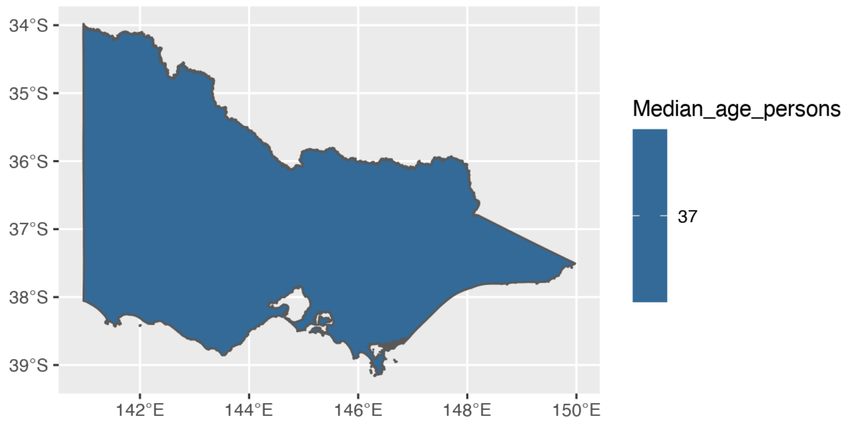
```
## Geometry set for 14073 features  (with 4 geometries empty)
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: 140.9617 ymin: -39.15919 xmax: 149.9763 ymax: -33.98043
## Geodetic CRS:  GDA94
## First 5 geometries:
```

```r
str(vicmap_ste)
```

```
## sf [14,073 × 490] (S3: sf/tbl_df/tbl/data.frame)
##  $ sa1_7digitcode_2016          : chr [1:14073] "2145523" "2111727" "2104305" "2128614" ...
##  $ Median_age_persons           : num [1:14073] 35 26 45 39 43 43 38 48 35 54 ...
##  $ Median_mortgage_repay_monthly: num [1:14073] 1419 2134 2167 1517 2600 ...
##  $ Median_tot_prsnl_inc_weekly  : num [1:14073] 659 403 672 671 763 477 595 586 521 445 ...
##  $ Median_rent_weekly           : num [1:14073] 350 462 340 250 400 312 418 215 280 150 ...
##  $ Median_tot_fam_inc_weekly    : num [1:14073] 1640 1624 1906 1542 2437 ...
##  $ Average_num_psns_per_bedroom : num [1:14073] 0.8 1 0.8 0.8 0.8 0.8 0.8 0.7 0.8 0.8 ...
##  $ Median_tot_hhd_inc_weekly    : num [1:14073] 1525 1031 1805 1279 1906 ...
##  $ Average_household_size       : num [1:14073] 2.7 2.1 2.8 2.5 2.7 3 2.7 2.1 2.4 1.8 ...
##  $ M_Neg_Nil_income_15_19_yrs   : num [1:14073] 9 7 8 6 6 0 3 0 3 3 ...
##  $ M_Neg_Nil_income_20_24_yrs   : num [1:14073] 0 6 0 0 0 0 4 0 4 0 ...
##  $ M_Neg_Nil_income_25_34_yrs   : num [1:14073] 0 5 0 0 0 0 0 0 3 0
```

State or Territory (STE)

```r
vicmap_ste <- read_sf(geopath, layer = "census2016_eiuwa_vic_ste_short")
ggplot(vicmap_ste) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

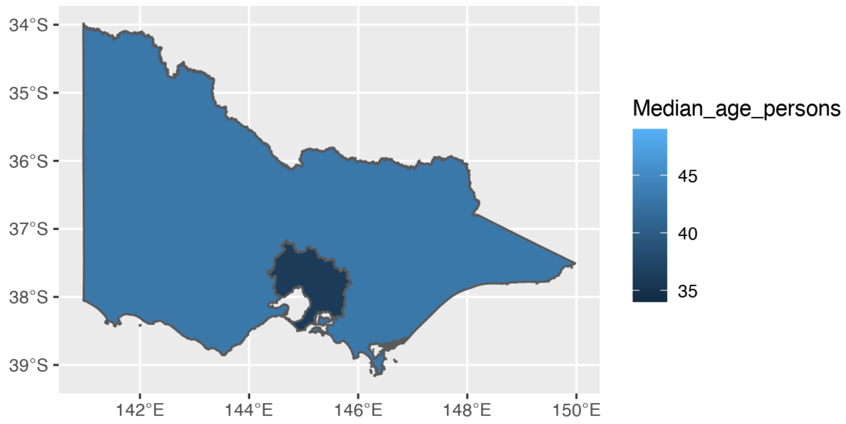



```r
nrow(vicmap_ste)

## [1] 1
```

Greater Capital City Statistical Areas (GCCSA)

- Each region with variable population

```
vicmap_gccsa <- read_sf(geopath, layer = "census2016_eiuwa_vic_gccsa_short")
ggplot(vicmap_gccsa) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

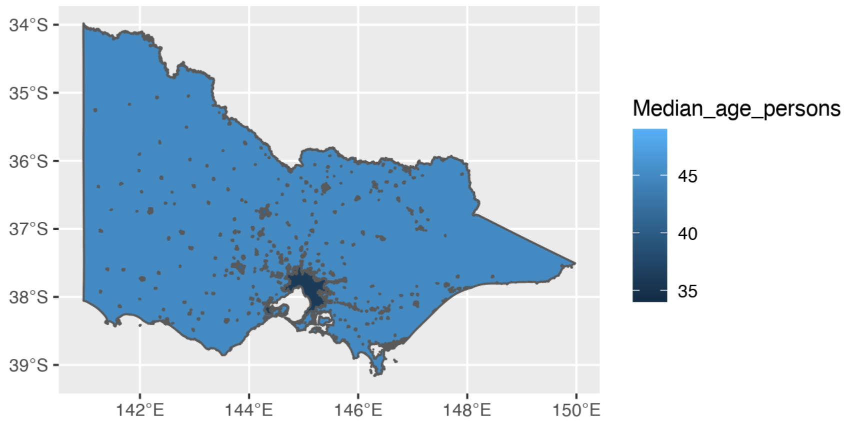



```
nrow(vicmap_gccsa)

## [1] 4
```

Section of State (SOS)

- Major urban, other urban, bounded locally & rural balance

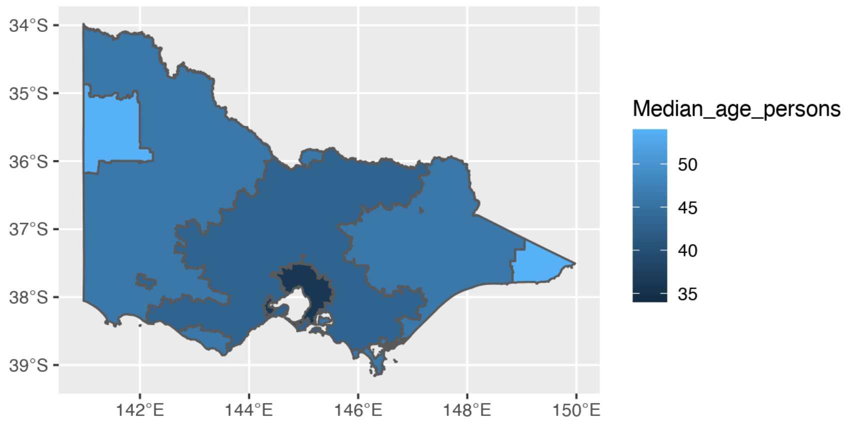
```
vicmap_sos <- read_sf(geopath, layer = "census2016_eiuwa_vic_sos_short")
ggplot(vicmap_sos) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```
nrow(vicmap_sos)

## [1] 6
```

Remoteness Areas (RA)

```r
vicmap_ra <- read_sf(geopath, layer = "census2016_eiuwa_vic_ra_short")
ggplot(vicmap_ra) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

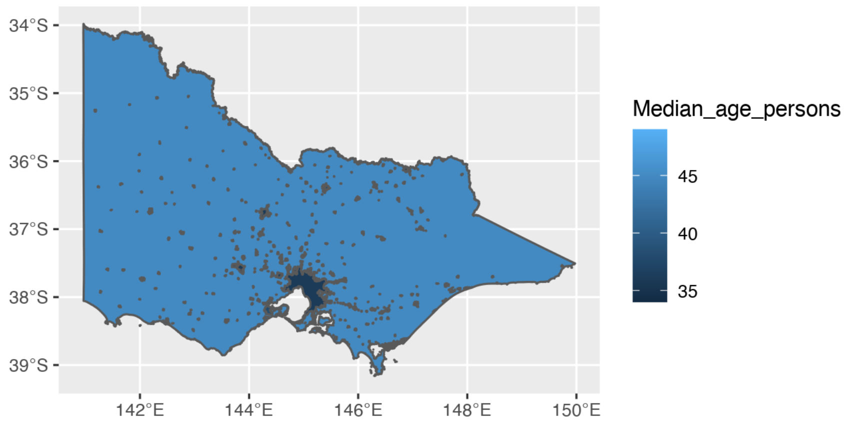



```r
nrow(vicmap_ra)
```

```
## [1] 6
```

Section of State Ranges (SOSR)

```
vicmap_sosr <- read_sf(geopath, layer = "census2016_eiuwa_vic_sosr_short")
ggplot(vicmap_sosr) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

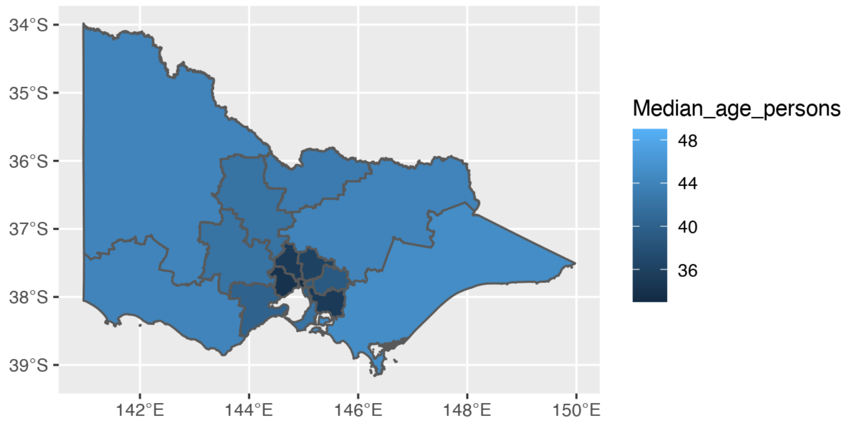



```
nrow(vicmap_sosr)

## [1] 12
```

Statistical Area Level 4 (SA4)

- Each region with population of 100,000 - 500,000

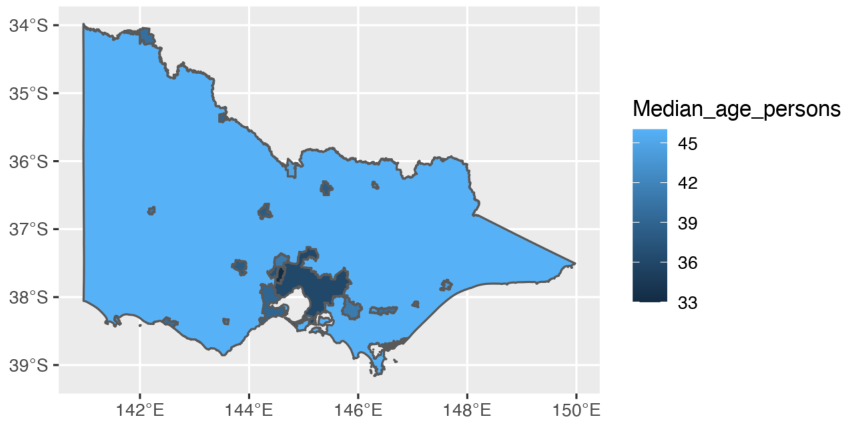
```
vicmap_sa4 <- read_sf(geopath, layer = "census2016_eiuwa_vic_sa4_short")
ggplot(vicmap_sa4) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```
nrow(vicmap_sa4)

## [1] 19
```

Significant Urban Areas (SUA)

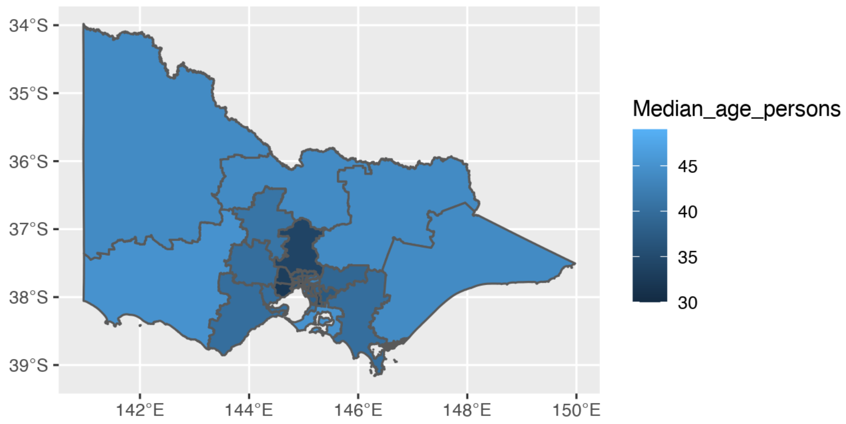
```
vicmap_sua <- read_sf(geopath, layer = "census2016_eiuwa_vic_sua_short")
ggplot(vicmap_sua) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```
nrow(vicmap_sua)

## [1] 22
```

Commonwealth Electoral Division (CED)

```
vicmap_ced <- read_sf(geopath, layer = "census2016_eiuwa_vic_ced_short")
ggplot(vicmap_ced) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

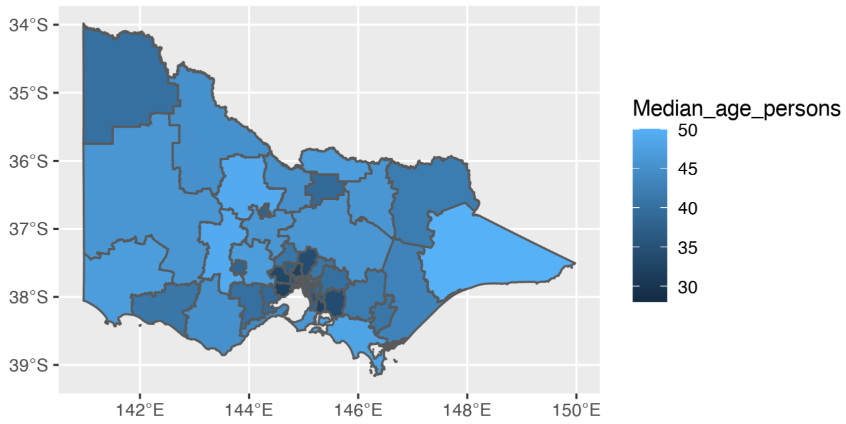



```
nrow(vicmap_ced)

## [1] 39
```

Statistical Area Level 3 (SA3)

- Each region with population of 30,000 - 130,000

```r
vicmap_sa3 <- read_sf(geopath, layer = "census2016_eiuwa_vic_sa3_short")
ggplot(vicmap_sa3) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

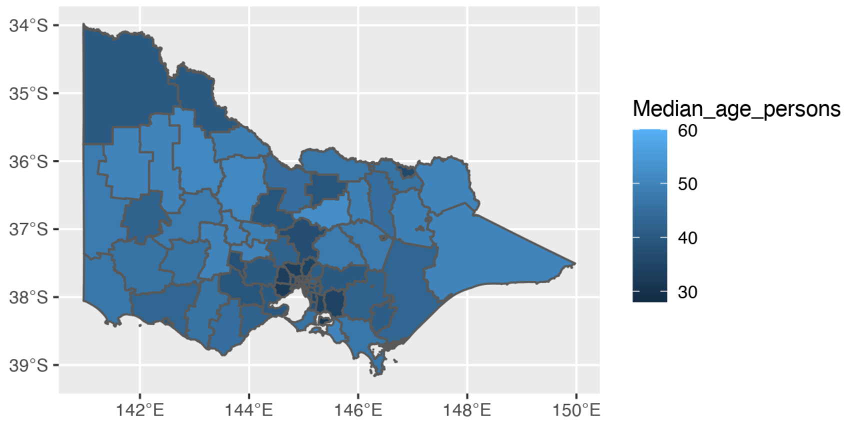



```r
nrow(vicmap_sa3)
```

```
## [1] 68
```

Local Government Area (LGA)

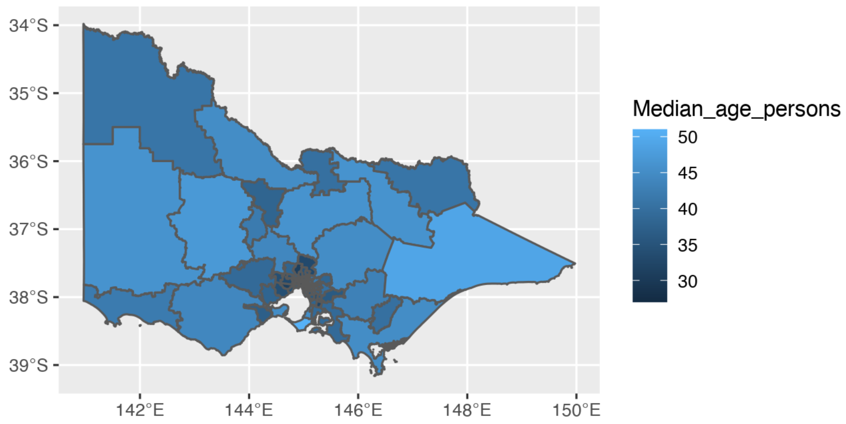
```r
vicmap_lga <- read_sf(geopath, layer = "census2016_eiuwa_vic_lga_short")
ggplot(vicmap_lga) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```r
nrow(vicmap_lga)

## [1] 82
```

State Electoral Division (SED)

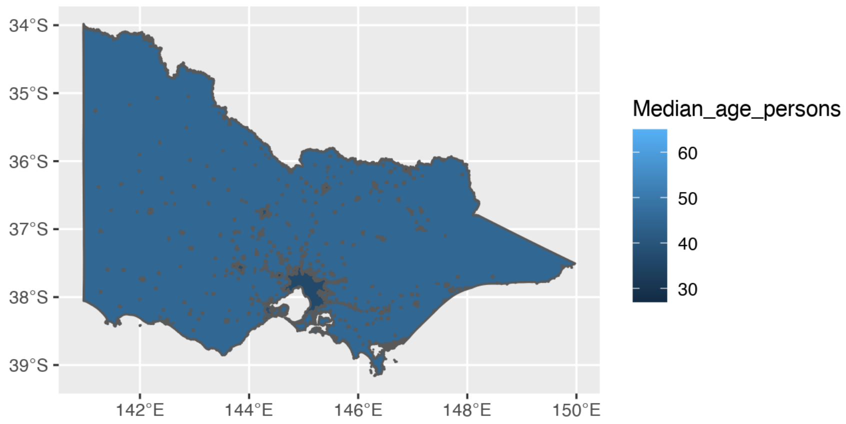
```
vicmap_sed <- read_sf(geopath, layer = "census2016_eiuwa_vic_sed_short")
ggplot(vicmap_sed) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```
nrow(vicmap_sed)

## [1] 90
```

Urban Centres and Localities (UCL)

```
vicmap_ucl <- read_sf(geopath, layer = "census2016_eiuwa_vic_ucl_short")
ggplot(vicmap_ucl) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

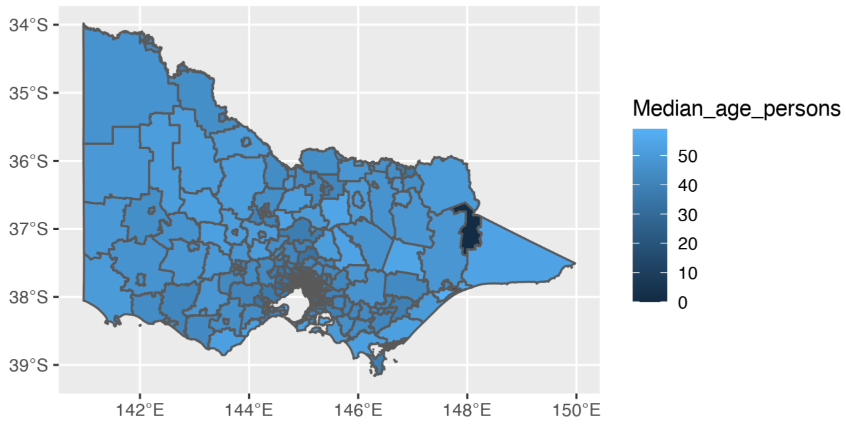



```
nrow(vicmap_ucl)

## [1] 353
```

Statistical Area Level 2 (SA2)

- Each region with populations in the range of 3,000-25,000

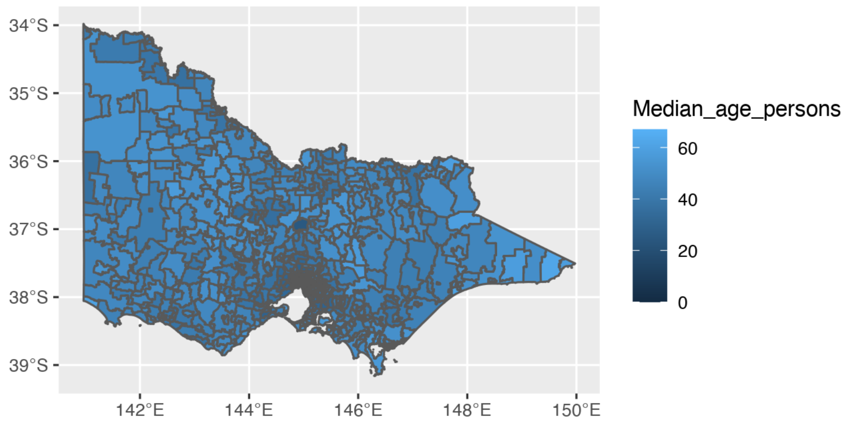
```
vicmap_sa2 <- read_sf(geopath, layer = "census2016_eiuwa_vic_sa2_short")
ggplot(vicmap_sa2) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```
nrow(vicmap_sa2)

## [1] 464
```

Postal Areas (POA)

```r
vicmap_poa <- read_sf(geopath, layer = "census2016_eiuwa_vic_poa_short")
ggplot(vicmap_poa) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```

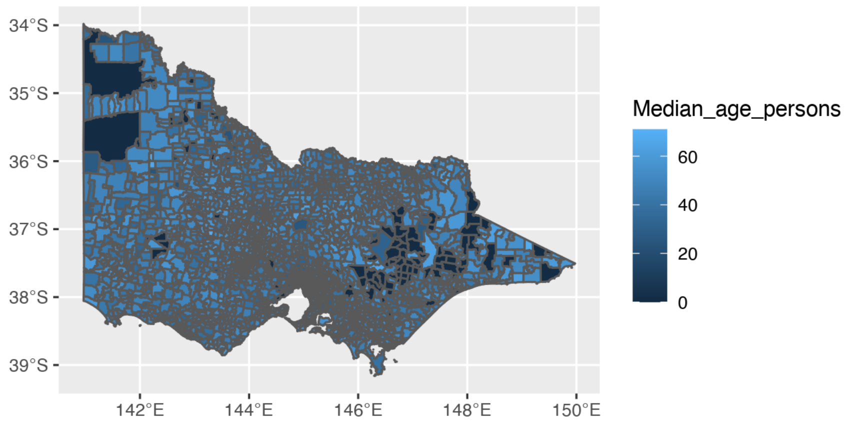



```r
nrow(vicmap_poa)
```

```
## [1] 698
```

State Suburbs (SSC)

```r
vicmap_ssc <- read_sf(geopath, layer = "census2016_eiuwa_vic_ssc_short")
ggplot(vicmap_ssc) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```



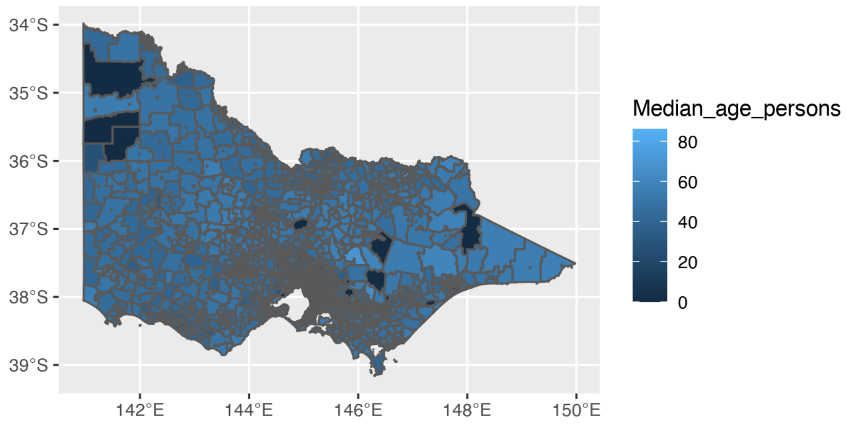

```r
nrow(vicmap_ssc)
```

```
## [1] 2931
```

Statistical Area Level 1 (SA1)

- Each region with a population of range 200-800

```
vicmap_sa1 <- read_sf(geopath, layer = "census2016_eiuwa_vic_sa1_short")
ggplot(vicmap_sa1) +
  geom_sf(aes(geometry = geom, fill = Median_age_persons))
```




```
nrow(vicmap_sa1)

## [1] 14073
```

Electorate boundary

vs

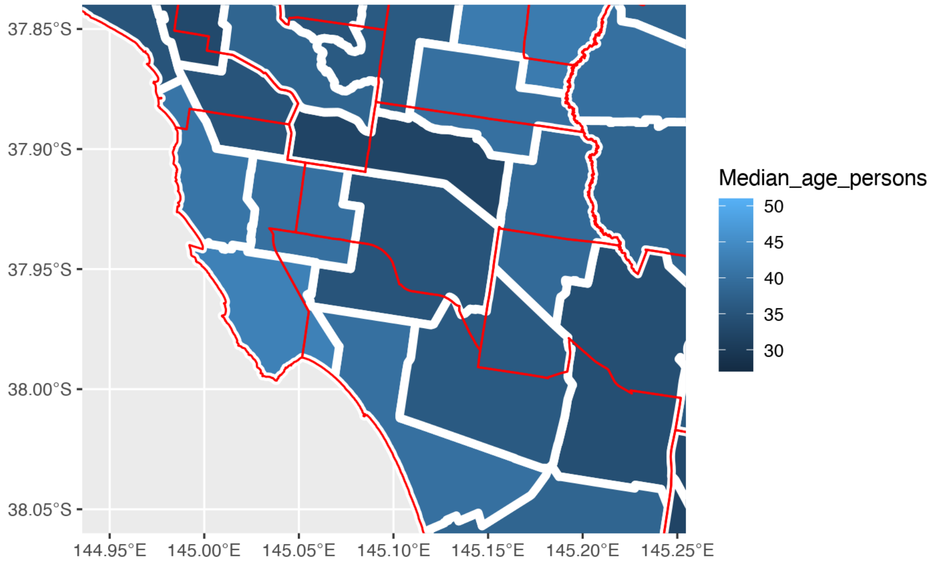
Census boundary

🎯 Estimate a median age for an electorate

Comparing SED 2016 and electorates divisions 2019

See here for `winners_fix` data was.

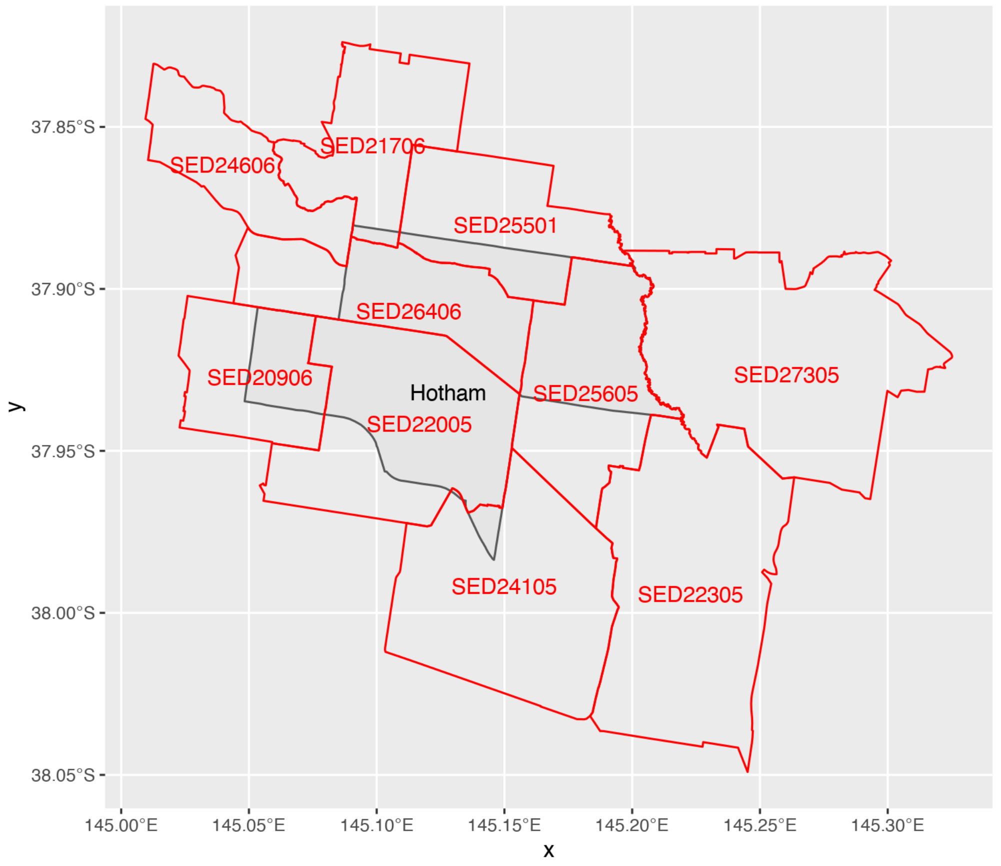
```
ggplot(winners_fix) +
  geom_sf(data = vicmap_sed, aes(geometry = geom, fill = Median_age_persons),
          alpha = 1, color = "white", size = 2) +
  geom_sf(aes(geometry = geometry),
          fill = "transparent", color = "red") +
  coord_sf(xlim = c(144.95, 145.24), ylim = c(-38.05, -37.85))
```



Closer look 🔬 Hotham electorate ❶

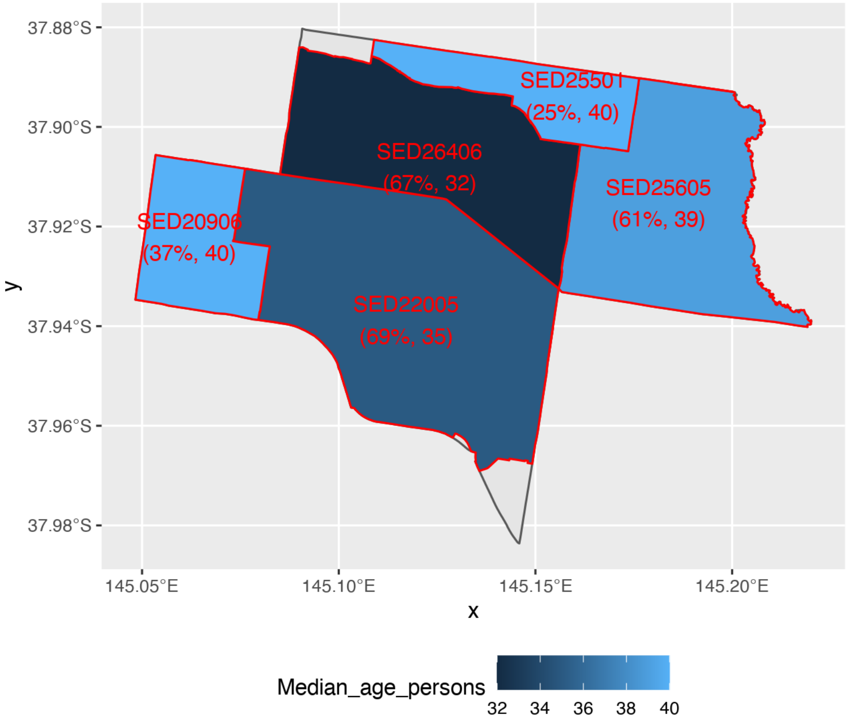
```r
electorate <- winners_fix %>%
  filter(DivisionNm=="Hotham")

sed_intersect <- vicmap_sed %>%
            filter(st_intersects(geom,
                                 electorate$geometry,
                                 sparse = FALSE)[,1])


ggplot(electorate, aes(geometry = geometry)) +
  geom_sf() +
  geom_sf_text(aes(label = DivisionNm)) +
  geom_sf(data = sed_intersect,
          aes(geometry = geom),
          color = "red", fill = "transparent") +
  geom_sf_text(data = sed_intersect,
            aes(label = sed_code_2016,
                geometry = geom),
            color = "red")
```

- There are 10 SED regions that intersect with Hotham electorate.



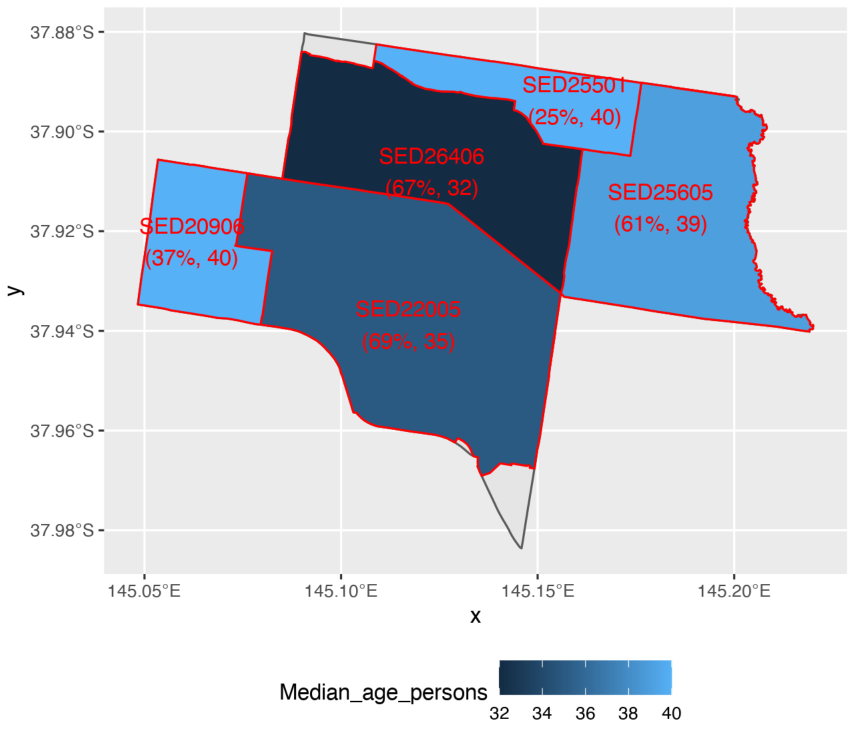
Closer look 🔬 Hotham electorate ❷

```r
sed_intersect2 <- sed_intersect %>%
  mutate(geometry = st_intersection(geom, electorate$geometry),
         perc_area = 100 * st_area(geometry) / st_area(geom),
         perc_area = as.numeric(perc_area))  %>%
  filter(perc_area > 5)

ggplot(sed_intersect2, aes(geometry = geometry)) +
  geom_sf(data = electorate) +
  geom_sf_text(data = electorate,
               aes(label = DivisionNm)) +
  geom_sf(color = "red", aes(fill = Median_age_persons)) +
  geom_sf_text(aes(
    label = glue::glue("{sed_code_2016}
                        ({scales::comma(perc_area, 1)}%, {Median_age_per
    color = "red") +
  theme(legend.position = "bottom")
```



- There are 5 SED areas with at least 5% intersection with the electoral area.
- **How would you characterise the median age for Hotham?**

Closer look 🔬 Hotham electorate ❸



Strategy 1

```
sort(sed_intersect2$Median_age_persons)

## [1] 32 35 39 40 40
```

Strategy 2

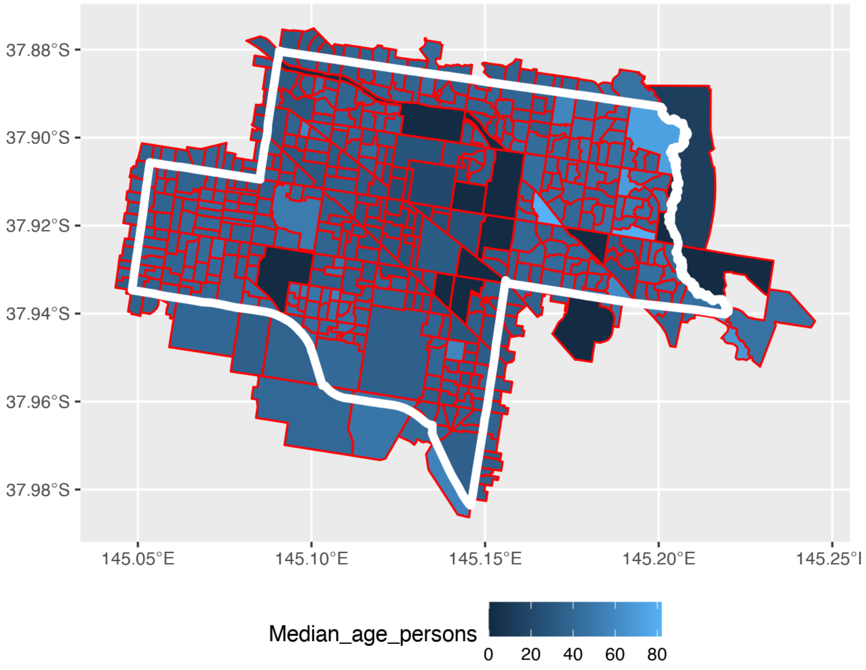
```
mean(sed_intersect2$Median_age_persons)

## [1] 37.2
```

Strategy 3

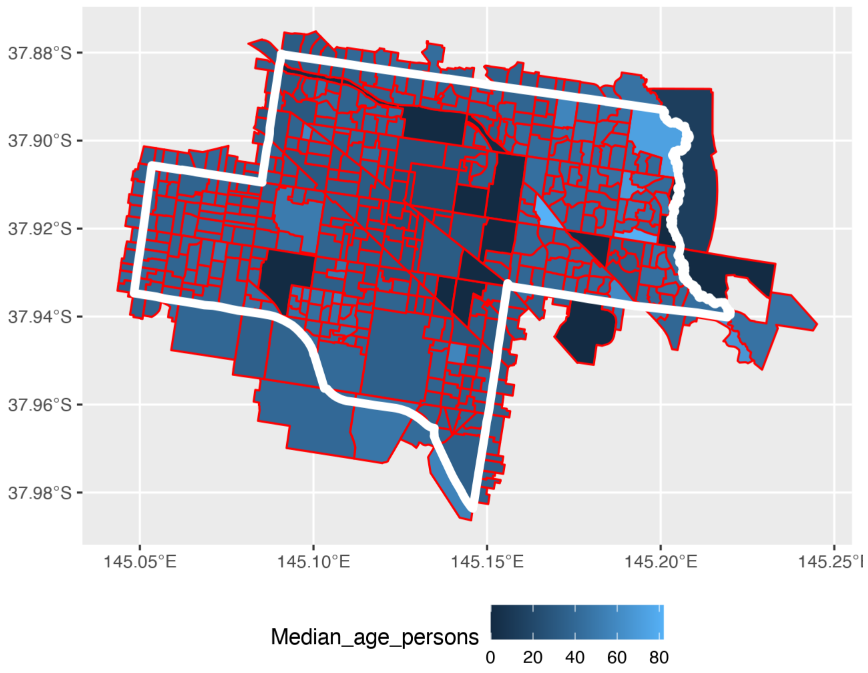
```
weighted.mean(sed_intersect2$Median_age_persons,
              sed_intersect2$perc_area)

## [1] 36.35205
```

Closer look 🔬 Hotham electorate ❹

```r
sa1_intersect <- vicmap_sa1 %>%
            filter(st_intersects(geom,
                                 electorate$geometry,
                                 sparse = FALSE)[,1])
sa1_intersect2 <- sa1_intersect %>%
  mutate(geometry = st_intersection(geom, electorate$geometr
         perc_area = 100 * st_area(geometry) / st_area(geom)
         perc_area = as.numeric(perc_area))  %>%
  filter(perc_area > 5)

ggplot(sa1_intersect) +
  geom_sf(color = "red",
          aes(fill = Median_age_persons,
              geometry = geom)) +
  geom_sf(data = electorate, color = "white", size = 2,
          fill = "transparent",
          aes(geometry = geometry)) +
  theme(legend.position = "bottom")
```



Closer look 🔬 Hotham electorate 5



Strategy 1

```
fivenum(sa1_intersect2$Median_age_persons)

## [1]  0 34 38 42 82
```

Strategy 2

```
mean(sa1_intersect2$Median_age_persons)

## [1] 37.38235
```

Strategy 3

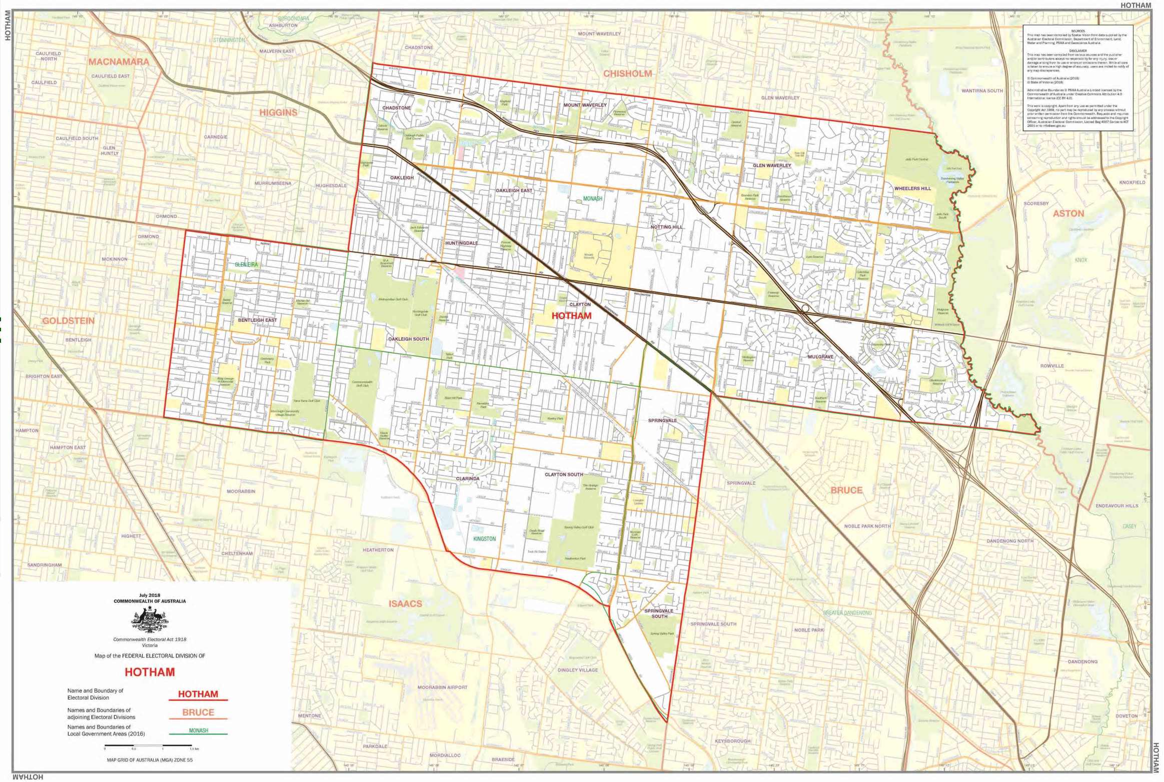
```
weighted.mean(sa1_intersect2$Median_age_persons, sa1_intersect2$perc_are

## [1] 37.35034
```

Strategy 4

```
ggplot(sa1_intersect2, aes(x = Median_age_persons)) +
  geom_histogram(binwidth = 1)
```

Closer look 🕵️ Zero median age

```
sa1_intersect2 %>%
  filter(Median_age_persons==0) %>%
  ggplot() +
  geom_sf() +
  geom_sf(data = electorate, color = "re
          fill = "transparent",
          aes(geometry = geometry))
```



Closer look 🔬 Hotham electorate 6

Before

Strategy 1

```
fivenum(sa1_intersect2$Median_age_persons)

## [1]  0 34 38 42 82
```

Strategy 2

```
mean(sa1_intersect2$Median_age_persons)

## [1] 37.38235
```

Strategy 3

```
weighted.mean(sa1_intersect2$Median_age_persons,

## [1] 37.35034
```

After

```
sa1_intersect3 <- sa1_intersect2 %>%
  filter(Median_age_persons != 0)
```

Strategy 1

```
fivenum(sa1_intersect3$Median_age_persons)

## [1] 20 34 38 42 82
```

Strategy 2

```
mean(sa1_intersect3$Median_age_persons)

## [1] 38.61266
```

Strategy 3

```
weighted.mean(sa1_intersect3$Median_age_persons, sa1_intersect3$perc_a

## [1] 38.58491
```

Dorling Cartogram

```
sa1_intersect4 <- sa1_intersect %>%
  mutate(centroid = st_centroid(geom))
ggplot(sa1_intersect4) +
  geom_sf(data = electorate,
          aes(geometry = geometry), size = 2, fill = "grey60") +
  geom_sf(aes(geometry = centroid, color = Median_age_persons),
          size = 0.5, shape = 3) +
  scale_color_viridis_c(name = "Median age", option = "magma")
```

Closer look 🔬 Hotham electorate 7

```r
sa1_intersect5 <- sa1_intersect4 %>%
  filter(st_intersects(centroid,
                       electorate$geometry,
                       sparse = FALSE)[,1],
         Median_age_persons!=0)
```

Strategy 1

```r
fivenum(sa1_intersect5$Median_age_persons)

## [1] 20 34 38 42 82
```

Strategy 2

```r
mean(sa1_intersect5$Median_age_persons)

## [1] 38.58015
```

Strategy 4

```r
ggplot(sa1_intersect5, aes(x = Median_age_persons)) +
  geom_histogram(binwidth = 1)
```

- There are many ways to characterise an electorate.
- Estimates of median age of an electorate is more consistent using SA1 map data than SED map data.

Summary

- We looked at mapping the 2016 census boundaries and projected a summary of the census variable (i.e. median age) onto a 2019 electoral district

Read Forbes, Cook & Hyndman (2020) Spatial modelling of the two-party preferred vote in Australian federal elections: 2001–2016. *Australian & New Zealand Journal of Statisitcs*. for a more sophisticated approach to studying the census variables and election results together.

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Week 6