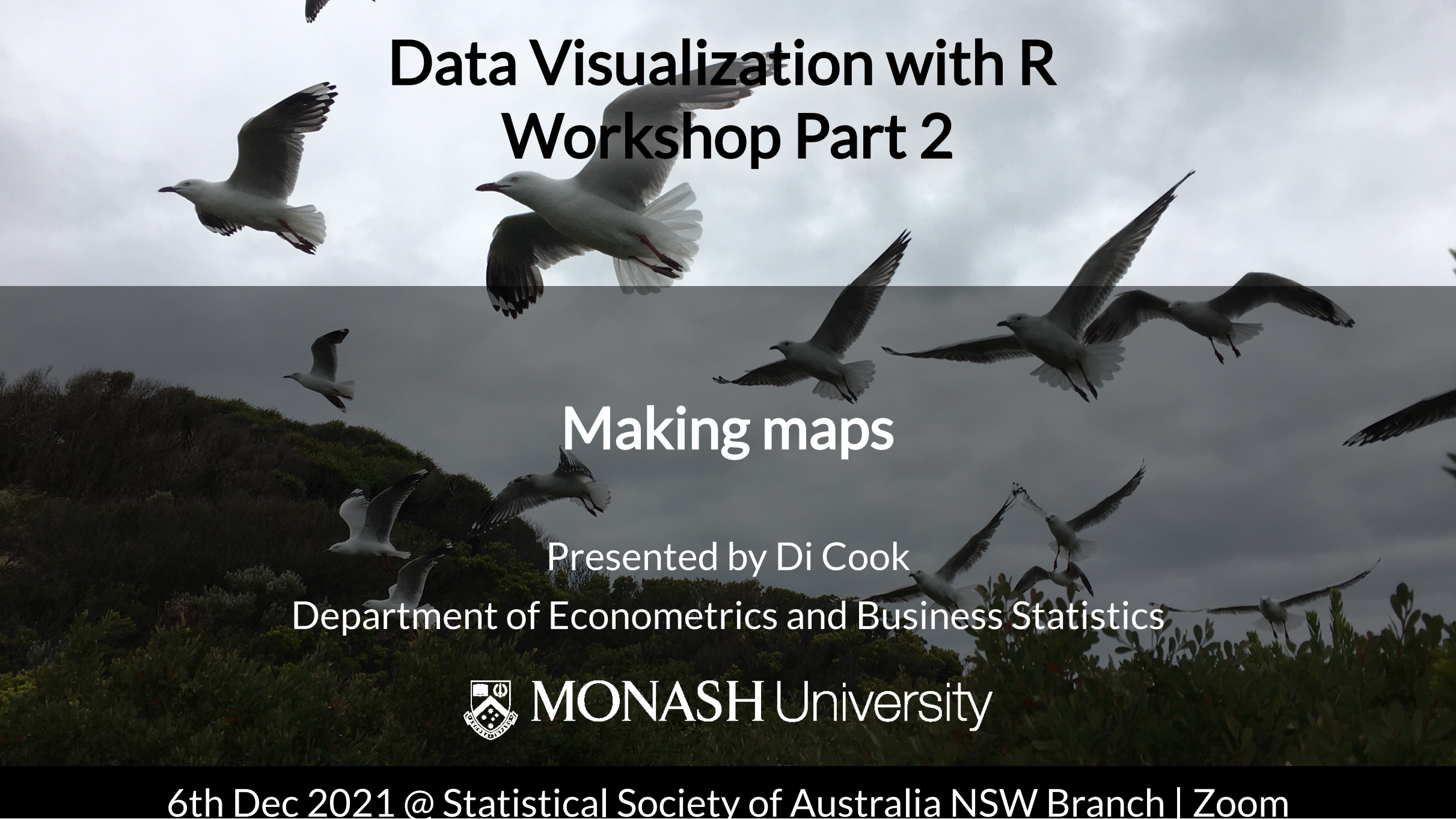


Data Visualization with R Workshop Part 2

Making maps

Presented by Di Cook

Department of Econometrics and Business Statistics

MONASH University

6th Dec 2021 @ Statistical Society of Australia NSW Branch | Zoom

Tuberculosis incidence

The TB data is from the WHO.

```
## # A tibble: 40,800 × 5
##    country      year age_group sex   count
##    <chr>       <dbl> <fct>     <chr> <dbl>
##  1 Afghanistan  1997 15-24     m        10
##  2 Afghanistan  1997 25-34     m         6
##  3 Afghanistan  1997 35-44     m         3
##  4 Afghanistan  1997 45-54     m         5
##  5 Afghanistan  1997 55-64     m         2
##  6 Afghanistan  1997 65-       m         0
##  7 Afghanistan  1997 15-24     f        38
##  8 Afghanistan  1997 25-34     f        36
##  9 Afghanistan  1997 35-44     f        14
## 10 Afghanistan  1997 45-54     f         8
## # … with 40,790 more rows
```

What is a choropleth map?
Why use a choropleth map?

How do we get a map?

A polygon map of the world can be extracted from the `maps` package.

```
world_map <- map_data("world")
world_map %>%
  filter(region == "Australia") %>%
      DT::datatable(width=1150, height=100)
```

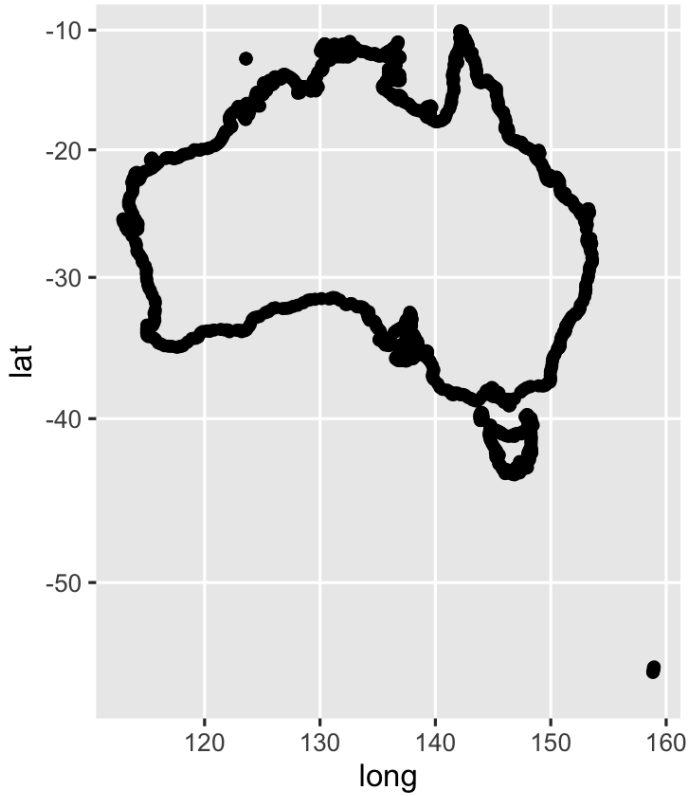
Show 10 entries Search:

	long	lat	group	order	region	subregion
1	123.594528198242	-12.4256830215454	133	7115	Australia	Ashmore and Cartier Islands
2	123.595207214355	-12.4359369277954	133	7116	Australia	Ashmore and Cartier Islands
3	123.573150634766	-12.4341802597046	133	7117	Australia	Ashmore and Cartier Islands
4	123.572463989258	-12.4239253997803	133	7118	Australia	Ashmore and Cartier Islands
5	123.594528198242	-12.4256830215454	133	7119	Australia	Ashmore and Cartier Islands
6	158.878799438477	-54.7097625732422	139	7267	Australia	Macquarie Island
7	158.84521484375	-54.7492179870605	139	7268	Australia	Macquarie Island

Maps are basically groups of connected dots

These are the points, defining the country boundary for Australia

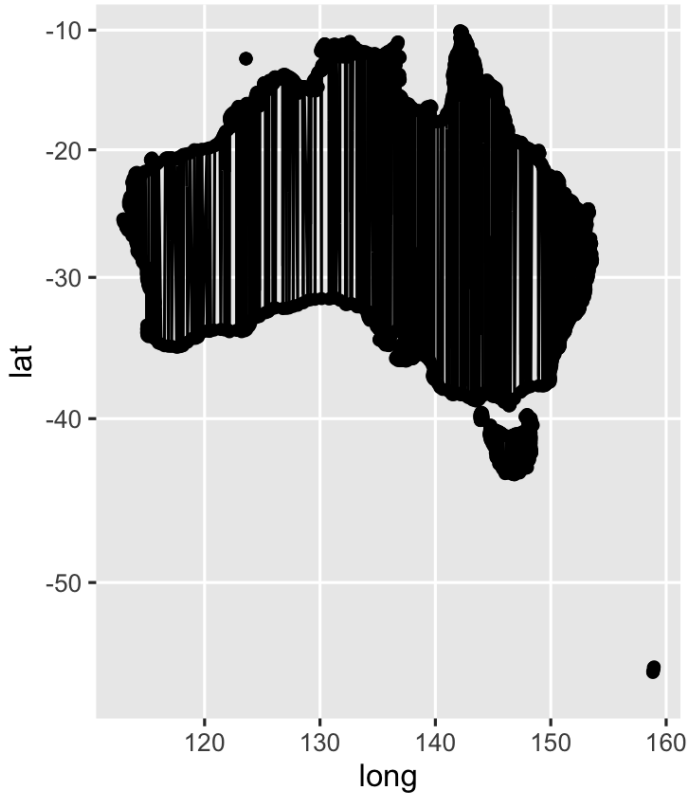
```
oz <- world_map %>%
  filter(region == "Australia")
ggplot(oz, aes(x = long, y = lat)) +
  geom_point() +
  coord_map()
```



Maps are basically groups of connected dots

Connect the dots

```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_point() +
  geom_line() +
  coord_map()
```

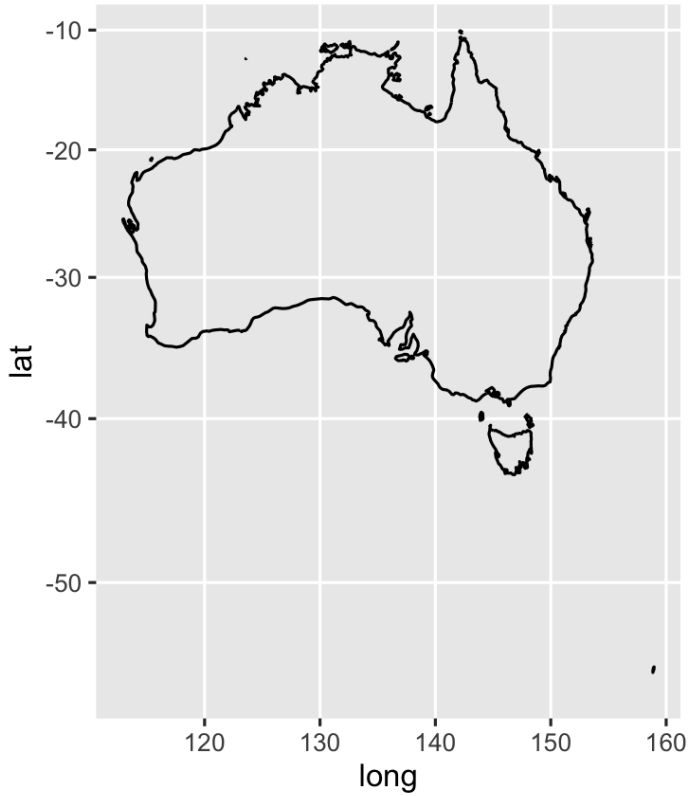


What happened?

Maps are basically groups of connected dots

Connect the dots

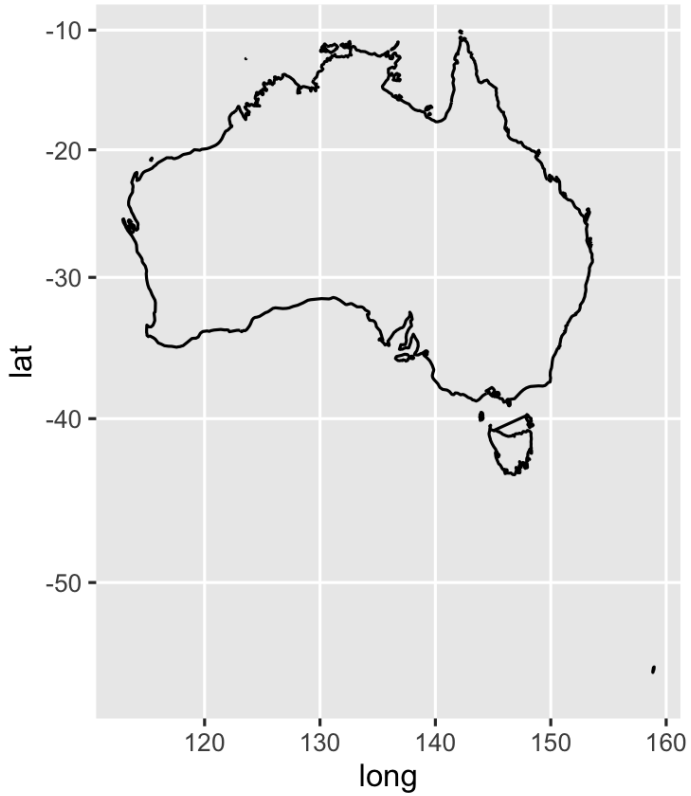
```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  #geom_point() +
  geom_path() +
  coord_map()
```



Maps are basically groups of connected dots

This map doesn't have states and territory connections, and also sub-regions is not uniquely defining islands.

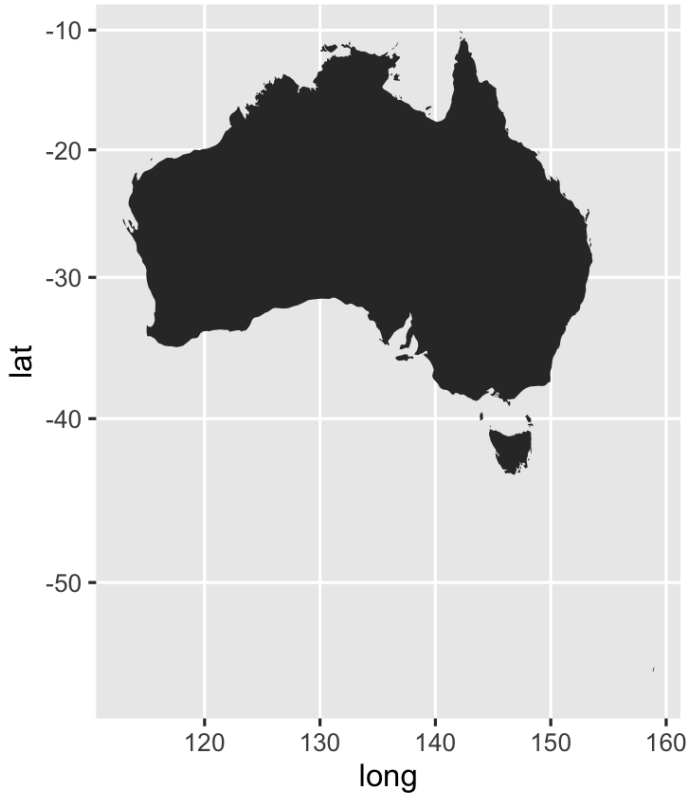
```
ggplot(oz, aes(x = long, y = lat,
               group = subregion)) +
  geom_path() +
  coord_map()
```



Maps are basically groups of connected dots

We can also plot the map using `geom_polygon`, and fill with colour.

```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_polygon() +
  coord_map()
```



Maps are basically groups of connected dots

Using a map theme makes the result look more map-like

```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_polygon() +
  coord_map() +
  theme_map()
```

Tips for mapping

For data analysis, maps are a set of points, connected correctly to generate polygons.

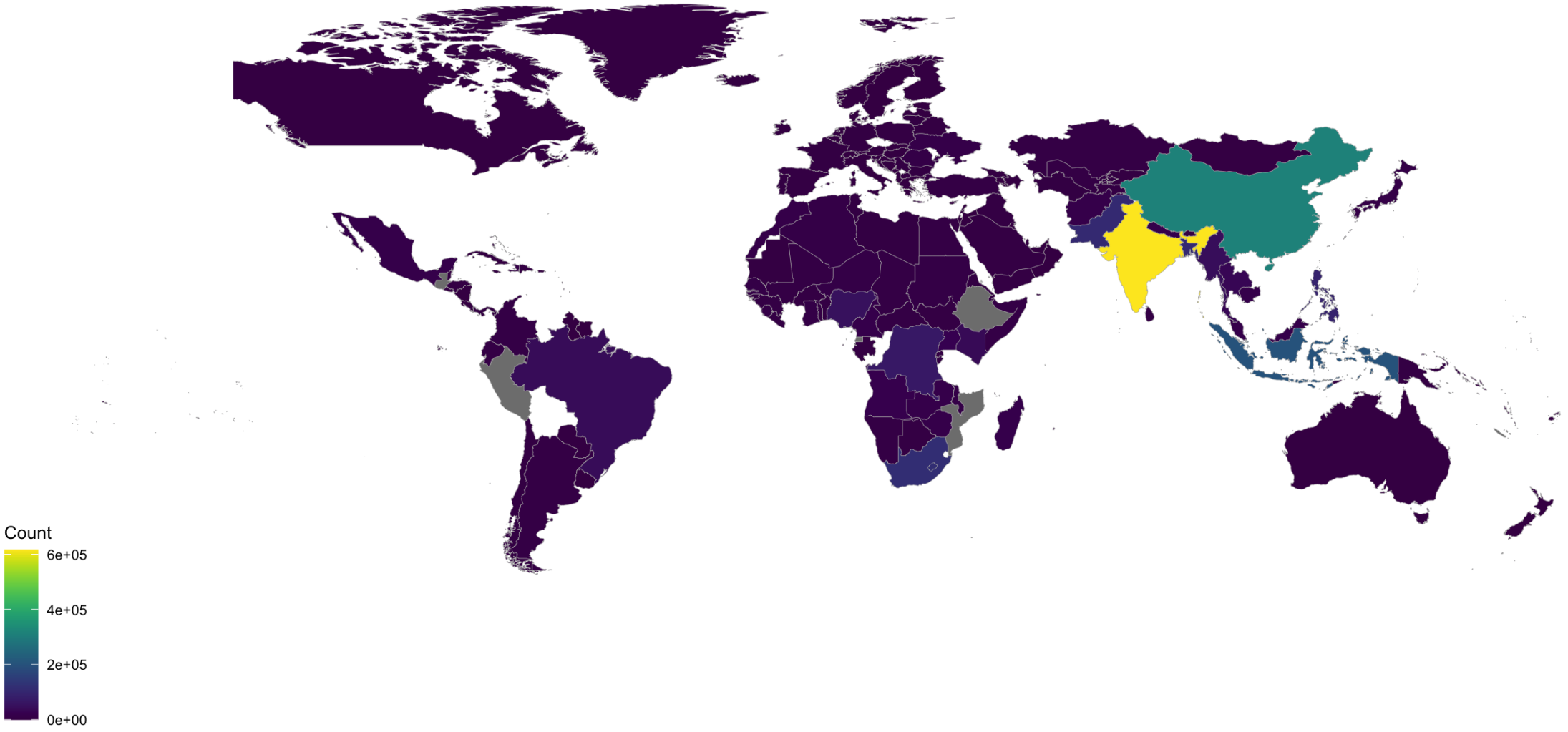
Note: It is important when converting spatial objects from a mapping software to a data analysis project is "thinning" the map to make it smaller and efficient to work with. See the `rmapshapr` package to help with this.

Let's make a choropleth map of tuberculosis

Pre-process the data

Aggregate counts across sex and age group for 2012

```
tb_2012 <- tb %>%
  filter(year == 2012) %>%
  rename(region = country) %>%
  group_by(region) %>%
  summarise(count = sum(count))
ggplot(tb_2012, aes(map_id = region)) +
    geom_map(aes(fill = count), map = world_map,
             color="grey70", size = 0.1, na.rm = TRUE) +
    expand_limits(x = world_map$long, y = world_map$lat) +
    scale_fill_viridis("Count") +
    theme_map()
```



What happened to the USA? UK?

Check the name matching

```
wm_names <- world_map %>%
  select(region) %>%
  distinct()
tb_names <- tb %>%
  filter(year == 2012) %>%
  select(country) %>%
  distinct()
tb_miss_from_wm <- anti_join(tb_names, wm_names,
                             by=c("country" = "region"))
wm_miss_from_tb <- anti_join(wm_names, tb_names,
                             by=c("region" = "country"))
```

```
DT::datatable(tb_miss_from_wm, width = 1150, height = 100)
```

Show 10 entries Search:

	country
1	Antigua and Barbuda
2	Bolivia (Plurinational State of)
3	British Virgin Islands
4	Brunei Darussalam
5	Cabo Verde
6	China, Hong Kong SAR
7	China, Macao SAR
8	Congo
9	Côte d'Ivoire
10	Curaçao

Showing 1 to 10 of 33 entries Previous 1 2 3 4 Next

```
DT::datatable(wm_miss_from_tb, width = 1150, height = 100)
```

Show 10 entries Search:

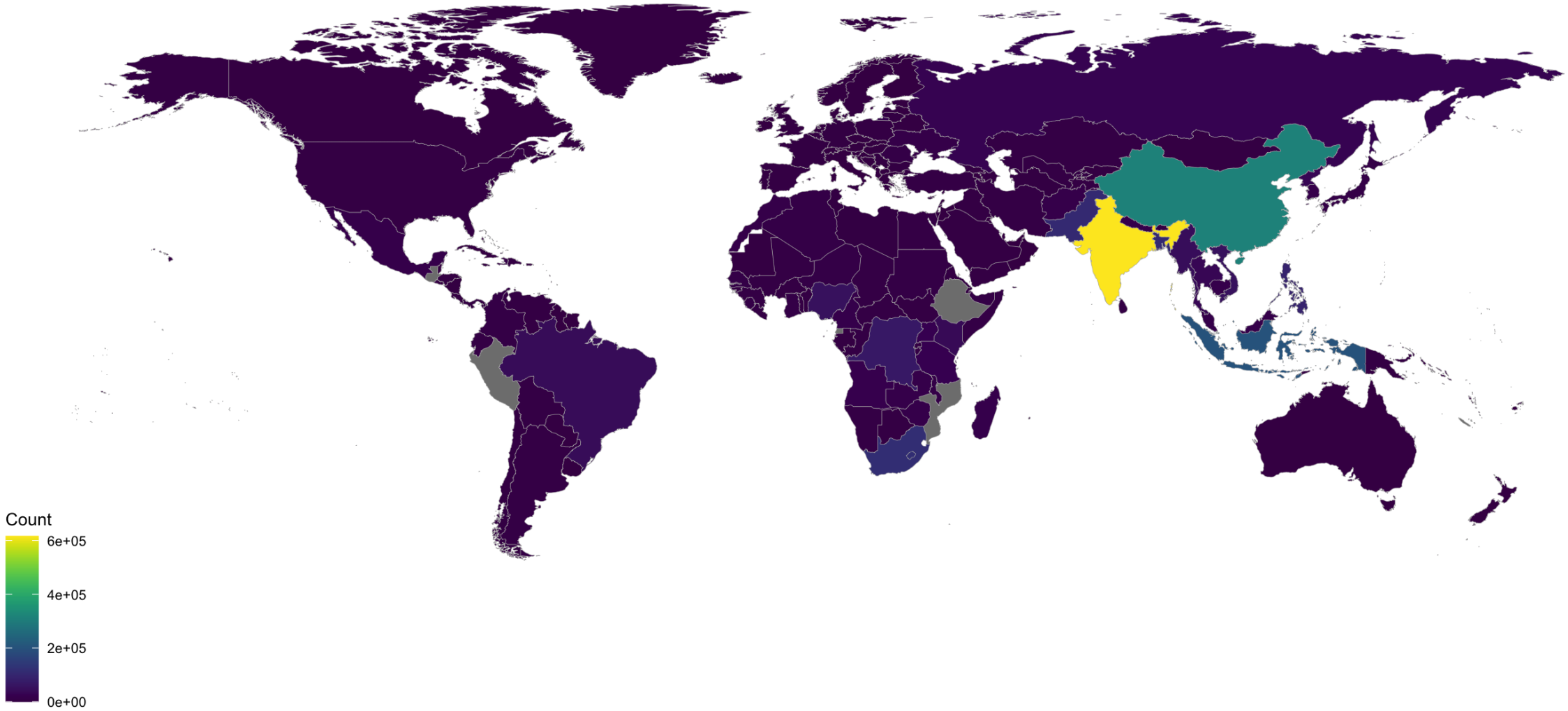
	region
1	Antarctica
2	French Southern and Antarctic Lands
3	Antigua
4	Barbuda
5	Saint Barthelemy
6	Bolivia
7	Brunei
8	Ivory Coast
9	Republic of Congo
10	Cape Verde

Showing 1 to 10 of 70 entries Previous 1 2 3 4 5 6 7 Next

```r
tb_fixed <- tb %>%
  mutate(region=recode(country,
                       "United States of America" = "USA",
                       "United Kingdom of Great Britain and Northern Ireland" =
                       "Russian Federation" = "Russia",
                       "Viet Nam" = "Vietnam",
                       "Venezuela (Bolivarian Republic of)" = "Venezuela",
                       "Bolivia (Plurinational State of)" = "Bolivia",
                       "Czechia" = "Czech Republic",
                       "Iran (Islamic Republic of)" = "Iran",
                       "Iran (Islamic Republic of)" = "Laos",
                       "Democratic People's Republic of Korea" = "North Korea",
                       "Republic of Korea" = "South Korea",
                       "United Republic of Tanzania" = "Tanzania",
                       "Congo" = "Republic of Congo"))
```

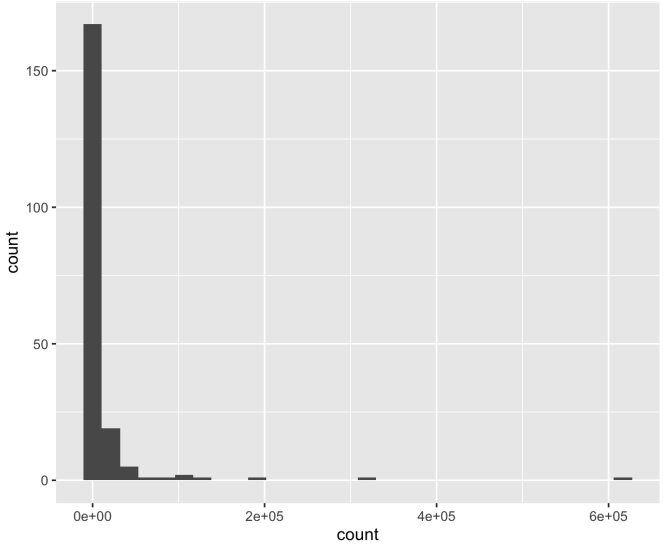
😄 Try again!

```
tb_2012 <- tb_fixed %>%
  filter(year == 2012) %>%
  group_by(region) %>%
  summarise(count = sum(count))
ggplot(tb_2012, aes(map_id = region)) +
    geom_map(aes(fill = count), map = world_map,
             color = "grey70", size = 0.1, na.rm = TRUE) +
    expand_limits(x = world_map$long, y = world_map$lat) +
    scale_fill_viridis("Count") +
    theme_map()
```


Count
6e+05
4e+05
2e+05
0e+00

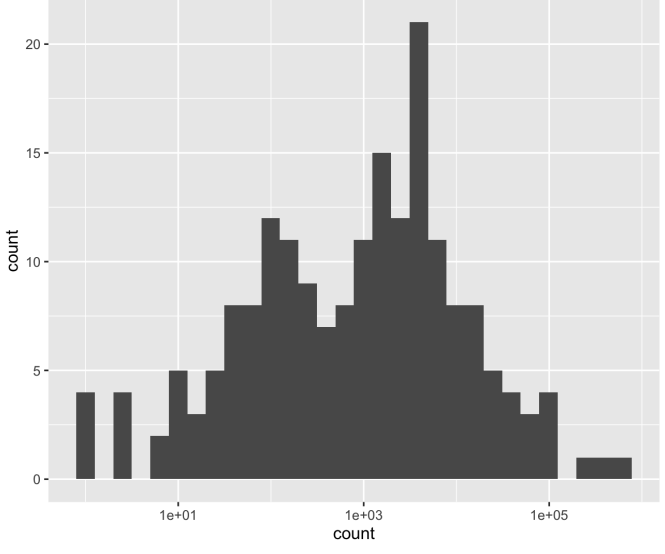
Counts are typically skewed

```
ggplot(tb_2012, aes(x = count)) +
  geom_histogram()
```



Symmetrising count, helps visual perception of a choropleth map.

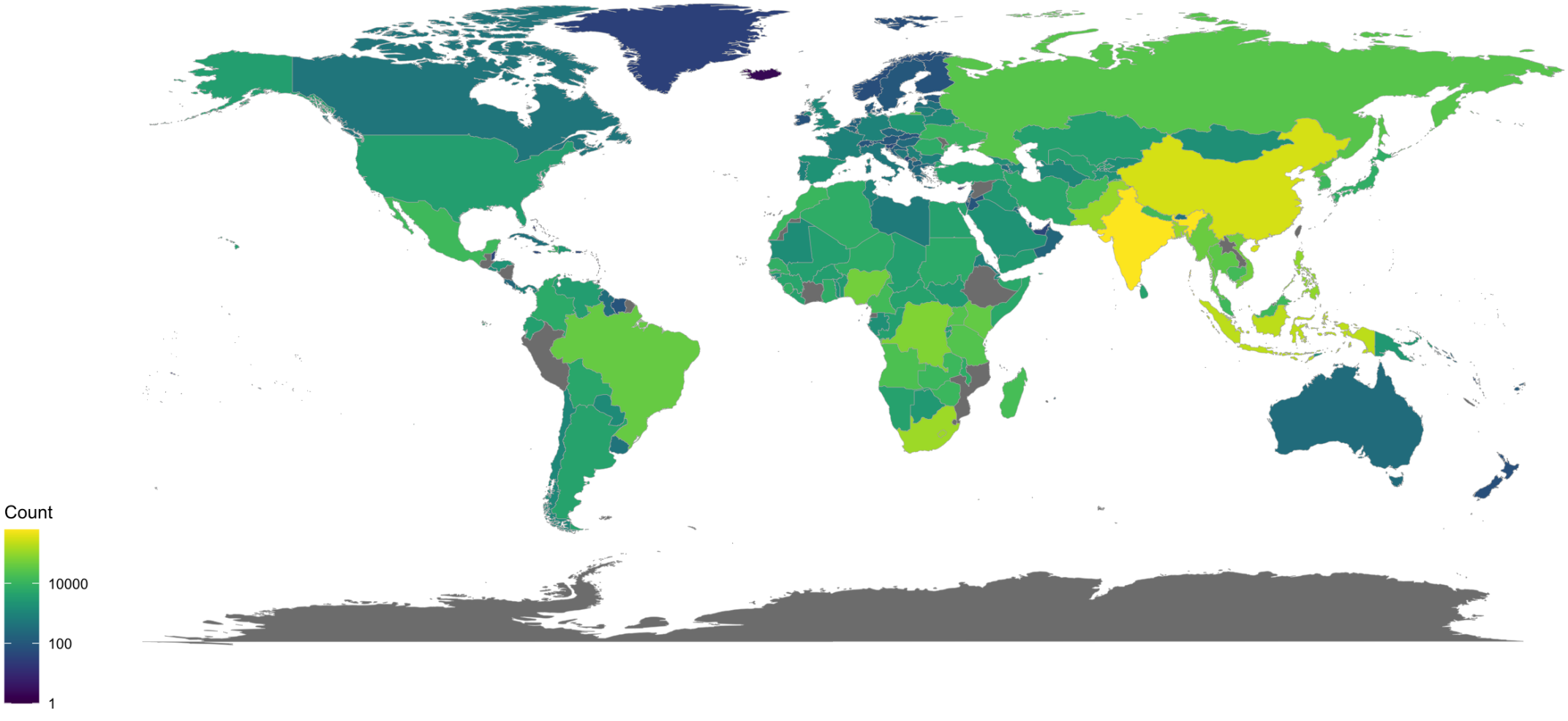
```
ggplot(tb_2012, aes(x = count)) +
  geom_histogram() +
  scale_x_log10()
```



Choropleth on log scale

```
tb_2012_map <- world_map %>% left_join(tb_2012)
ggplot(tb_2012_map, aes(x = long, y = lat, group=group)) +
    geom_polygon(aes(fill = count),
              color="grey70", size = 0.1, na.rm = TRUE) +
    expand_limits(x = world_map$long*1.1, y = world_map$lat*1.1) +
    scale_fill_viridis("Count", trans = "log10") +
    theme_map()
```

Note: `geom_polygon` can be used instead of `geom_map`.


Count
10000
100
1

COMPLEX EXAMPLE: COVID incidence in Victoria

choropleth vs cartogram

Get the data

This is extracted from https://www.covid19data.com.au/victoria

data R

Show 10 entries Search:

	Date	NAME	cases
1	2020-07-01	Alpine	1
2	2020-07-01	Ararat	5
3	2020-07-01	Ballarat	11
4	2020-07-01	Banyule	98
5	2020-07-01	Bass Coast	4
6	2020-07-01	Baw Baw	5
7	2020-07-01	Bayside	35
8	2020-07-01	Benalla	3
9	2020-07-01	Boroondara	76
10	2020-07-01	Brimbank	131

Fix LGA names

data R

- Read the LGA data from `ozmaps` package.
- This has LGAs for all of Australia.
- Need to filter out Victoria LGAs, avoiding LGAs from other states with same name, and make the names match covid data names. This is done using a regex expression removing () state and LGA type text strings

Join and colour the map

plot R

Get population data

data R

- Incorporate population data to make cartogram
- Population from https://www.planning.vic.gov.au/land-use-and-population-research/victoria-in-future/tab-pages/victoria-in-future-data-tables
- Polygons are transformed so that area matches, as best possible, to the population

Show 10 entries Search:

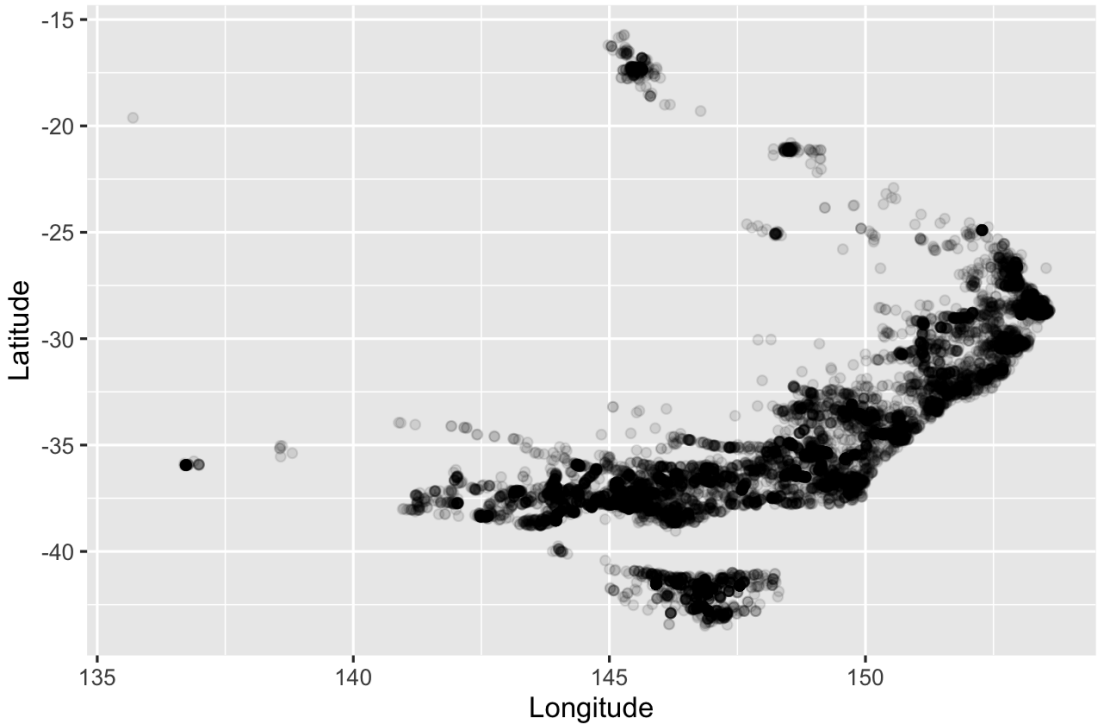
	NAME	pop
1	Alpine	12578
2	Ararat	11746
3	Ballarat	103500
4	Banyule	127447
5	Bass Coast	33465
6	Baw Baw	49296
7	Bayside	102912
8	Benalla	13981

Make a cartogram

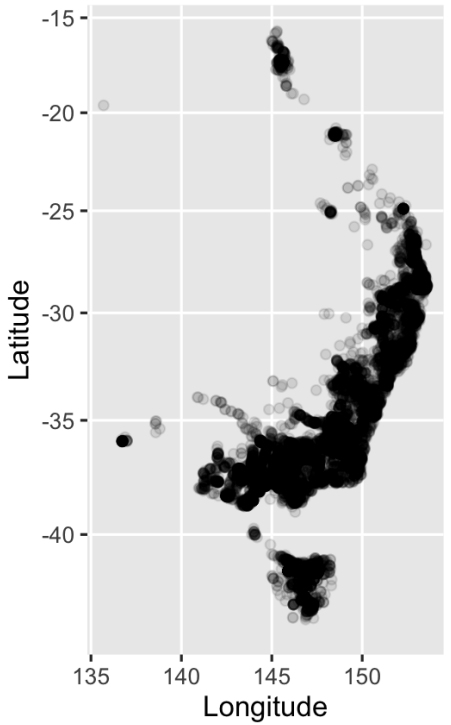
plot R

Raster map with data overlaid

```
load(here::here("data/platypus.rda"))
p <- ggplot(platypus) +
  geom_point(aes(x = Longitude,
                 y = Latitude),
             alpha = 0.1)
p
```




```
p + coord_map()
```



Extract Open Street Map using `ggmap`

Download and save the map, so that you don't need to do multiple downloads.

```
oz_bbox <- c(112.9, # min long
             -45, # min lat
             159, # max long
             -10) # max lat
oz_map <- get_map(location = oz_bbox, source = "osm")
save(oz_map, file=here::here("data/oz_map.rda"))
```

Platypus occurrences across Australia

```
load(here::here("data/oz_map.rda"))
ggmap(oz_map) +
  geom_point(data = platypus,
             aes(x = Longitude,
                 y = Latitude),
             alpha = 0.1,
             colour = "orange") +
  theme_map()
```

</> Open `part2-exercise-02.Rmd`

15:00

Resources

These are sites with lots of useful information about making maps in R:

- `ozmaps` package: https://github.com/mdsumner/ozmaps, https://mdsumner.github.io/ozmaps/
- `strayr` package: https://runapp-aus.github.io/strayr/
- https://www.littlemissdata.com/blog/maps
- https://www.r-spatial.org/r/2018/10/25/ggplot2-sf.html
- https://www.paulamoraga.com/book-geospatial/sec-spatialdataandCRS.html
- https://rspatialdata.github.io

Session Information

```
devtools::session_info()
```

```
## ─ Session info  🤳🏻  🧔🏾  👷  ──────────────────────────────────────────────
##  hash: person raising hand: light skin tone, man: medium-dark skin tone, bald, construc
##
##  setting  value
##  version  R version 4.1.2 (2021-11-01)
##  os       macOS Big Sur 10.16
##  system   x86_64, darwin17.0
##  ui       X11
##  language (EN)
##  collate  en_AU.UTF-8
##  ctype    en_AU.UTF-8
##  tz       Australia/Melbourne
##  date     2021-11-30
##  pandoc   2.11.4 @ /Applications/RStudio.app/Contents/MacOS/pandoc/ (via rmarkdown)
```