Mappe e GIS

Paolo Bosetti (per TSM)

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0.1 GGPlot

```
knitr::opts_chunk$set(fig.align="center", fig.dim=c(6, 4), out.width="4in")
library(ggplot2)
library(lubridate)
```

```
##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(xts)
```

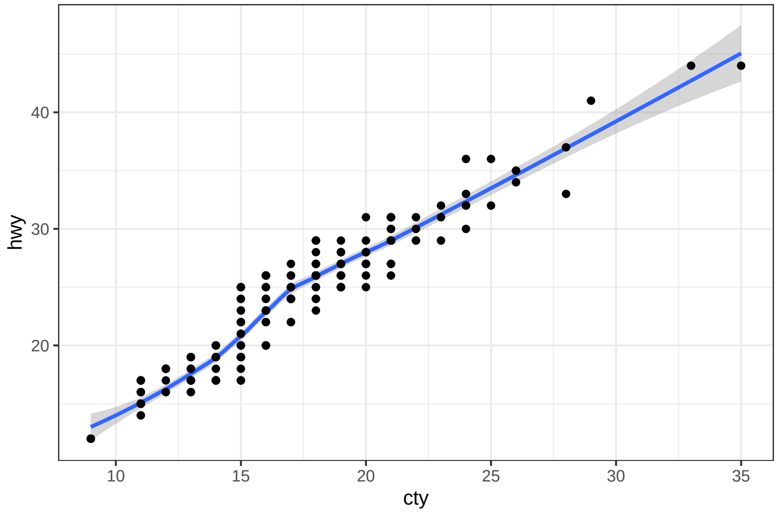
```
## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
theme_set(theme_bw())
```

0.2 Standard

```
a <- ggplot(mpg, aes(cty, hwy))
a + geom_smooth(formula = y~x) +
  geom_point()
```

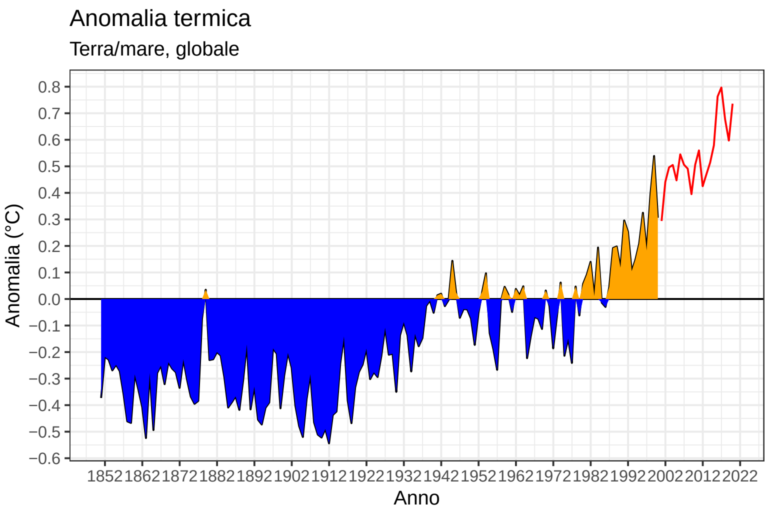
```
## `geom_smooth()` using method = 'loess'
```



0.3 Serie temporali

```
datafile <- "temperature-anomaly.csv"
data <- read.csv(datafile)
data <- data[data$Entity=="Global",]
t.global <- xts(data$Median.temp,
                order.by=as.Date(as.character(data$Year), format="%Y"),
                frequency = 1)
```

```
x1 <- t.global["/1999-12-31"]
p1 <- autoplot(x1) +
  geom_hline(yintercept = 0) +
  geom_area(aes(x=index(x1), y=ifelse(x1<0, x1, 0)), fill="blue") +
  geom_area(aes(x=index(x1), y=ifelse(x1>0, x1, 0)), fill="orange") +
  labs(title="Anomalia termica", subtitle = "Terra/mare, globale") +
  xlab("Anno") +
  ylab("Anomalia (°C)")

x2 <- t.global["2000-1-1/"]
p1 + geom_line(data=x2, aes(Index, x2), color="red") +
  #scale_x_continuous(breaks=seq(start(x1), end(x2), by="20 years")) +
  scale_x_date(breaks="10 years", date_labels="%Y") +
  scale_y_continuous(breaks=seq(round(min(t.global), 0.1), round(max(t.global), 0.1), by=0.1))
```



1 Mapping

```
library(tmap)
library(sf)
```

```
## Linking to GEOS 3.8.1, GDAL 3.2.1, PROJ 7.2.1
```

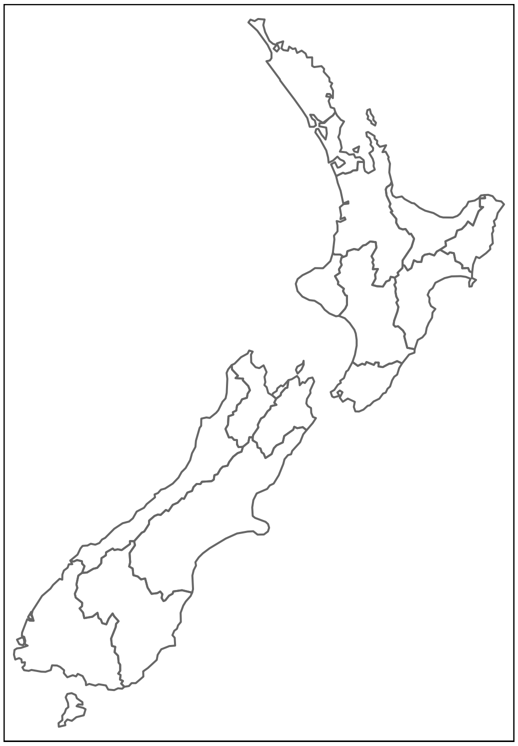
```
library(spData)
library(spDataLarge)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:xts':
##
##     first, last

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(purrr)
library(stringr)
```

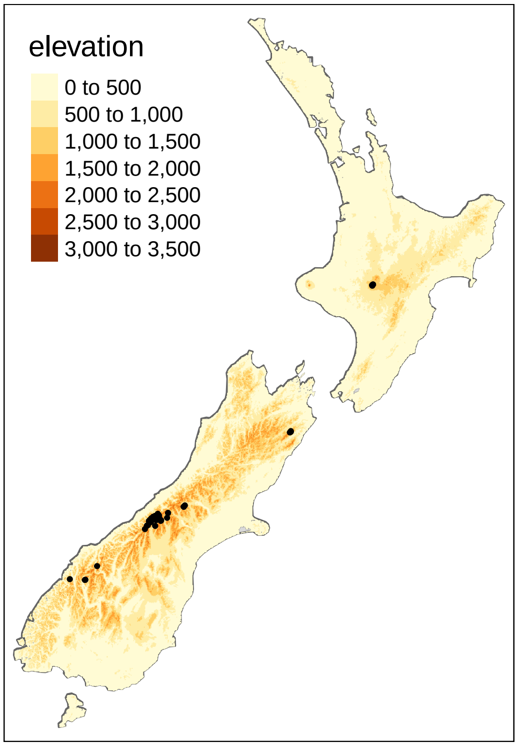
```
tm_shape(nz) + tm_fill()
```

```
tm_shape(nz) + tm_borders()
```



```
qtm(nz) + qtm(nz_elev) + qtm(nz_height)
```

```
## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)
```

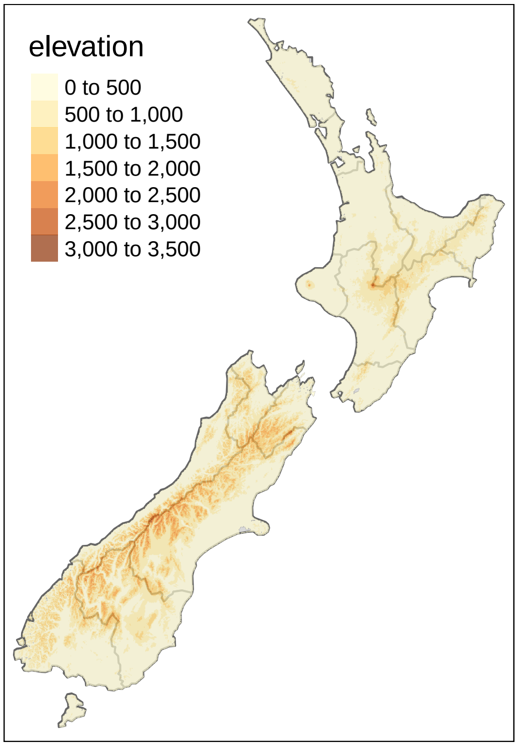


```r
map_nz = tm_shape(nz) + tm_polygons()
class(map_nz)
```

```
## [1] "tmap"
```

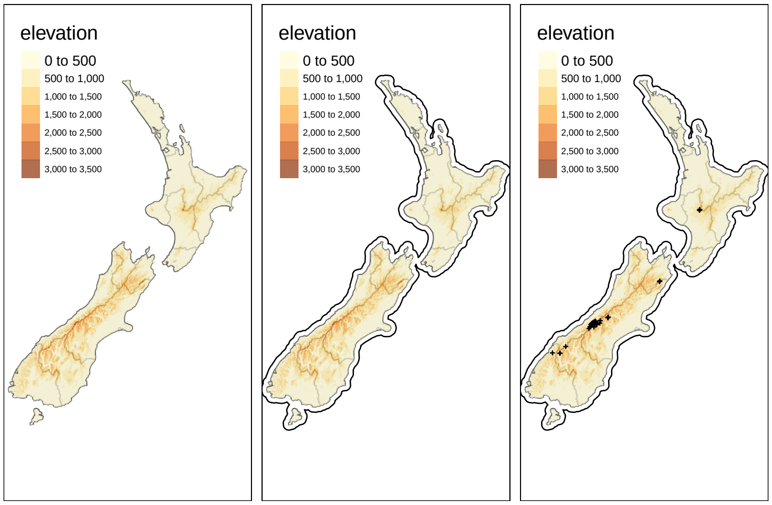
```r
map_nz1 = map_nz +
  tm_shape(nz_elev) + tm_raster(alpha = 0.7)
print(map_nz1)
```

```
## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)
```



```
nz_water = st_union(nz) %>% st_buffer(22200) %>%
  st_cast(to = "LINESTRING")
map_nz2 = map_nz1 +
  tm_shape(nz_water) + tm_lines()

map_nz3 = map_nz2 +
  tm_shape(nz_height) + tm_dots(shape = 3)

tmap_arrange(map_nz1, map_nz2, map_nz3)
```

```
## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)
## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)
## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)
## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)

## Some legend labels were too wide. These labels have been resized to 0.50, 0.43, 0.43, 0.43, 0.43, 0.4

## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)

## Some legend labels were too wide. These labels have been resized to 0.50, 0.43, 0.43, 0.43, 0.43, 0.4

## stars object downsampled to 877 by 1140 cells. See tm_shape manual (argument raster.downsample)

## Some legend labels were too wide. These labels have been resized to 0.50, 0.43, 0.43, 0.43, 0.43, 0.4
```



```
#leaflet() %>% addTiles()
```

2 Trentino

- Limiti amministrativi scaricati da (WebGIS)[https://webgis.provincia.tn.it/wgt/], in formato ESRI (.shp)
- Dati COVID-19 scaricati da (FBK)[https://covid19trentino.fbk.eu/data/stato_comuni_td.csv]

```
amm <- read_sf(dsn="ammcom/ammcom.shp")
cva <- read_sf(dsn="ammcva/ammcva.shp")
cva$nome <- cva$nome %>% str_to_title()
covid <- read.csv("https://covid19trentino.fbk.eu/data/stato_comuni_td.csv")
```

Ispezioniamo i due oggetti con `str()`:

```
str(amm)
```

```
## sf [166 x 19] (S3: sf/tbl_df/tbl/data.frame)
##  $ objectid  : num [1:166] 2209 2210 2211 2212 2213 ...
##  $ classid   : chr [1:166] "AMB003_1" "AMB003_26" "AMB003_60" "AMB003_237" ...
##  $ codice    : num [1:166] 1 26 60 237 203 51 136 155 47 188 ...
##  $ istat     : chr [1:166] "22001" "22026" "22060" "22237" ...
##  $ istatcat  : chr [1:166] "A116" "B158" "C727" "M351" ...
##  $ nome      : chr [1:166] "ALA" "BRESIMO" "CIS" "AMBLAR-DON" ...
##  $ supcom    : num [1:166] 120 41 5.5 19.9 50.2 ...
##  $ altcom    : num [1:166] 180 1036 732 971 525 ...
##  $ fkcomcva  : chr [1:166] "AMB002_10" "AMB002_6" "AMB002_6" "AMB002_6" ...
##  $ fkammprv  : chr [1:166] "AMB001_1" "AMB001_1" "AMB001_1" "AMB001_1" ...
##  $ struttura : chr [1:166] "S133" "S133" "S133" "S133" ...
##  $ struttura_: chr [1:166] "Servizio Catasto" "Servizio Catasto" "Servizio Catasto" "Servizio Catast
##  $ fkfonte   : chr [1:166] "05" "05" "05" "05" ...
##  $ fktfonte_d: chr [1:166] "altre fonti" "altre fonti" "altre fonti" "altre fonti" ...
##  $ fktipoelab: chr [1:166] "01" "01" "01" "01" ...
##  $ fktipoel_d: chr [1:166] "manuale" "manuale" "manuale" "manuale" ...
##  $ fkscala   : chr [1:166] "03" "03" "03" "03" ...
##  $ fkscala_d : chr [1:166] "10000" "10000" "10000" "10000" ...
##  $ geometry  :sfc_MULTIPOLYGON of length 166; first list element: List of 1
##   ..$ :List of 1
##   .. ..$ : num [1:1420, 1:2] 663379 663430 663474 663535 663602 ...
##   ..- attr(*, "class")= chr [1:3] "XY" "MULTIPOLYGON" "sfg"
##  - attr(*, "sf_column")= chr "geometry"
##  - attr(*, "agr")= Factor w/ 3 levels "constant","aggregate",..: NA NA NA NA NA NA NA NA NA NA ...
##   ..- attr(*, "names")= chr [1:18] "objectid" "classid" "codice" "istat" ...
```

```
str(covid)
```

```
## 'data.frame':    166 obs. of  9 variables:
##  $ codice       : int  1 26 60 237 203 51 136 155 47 188 ...
##  $ nome         : chr  "ALA" "BRESIMO" "CIS" "AMBLAR-DON" ...
##  $ contagi      : int  862 20 16 40 120 80 128 112 340 267 ...
##  $ guariti      : int  725 20 16 38 107 74 120 105 327 235 ...
##  $ decessi      : int  8 0 0 1 3 3 5 3 8 2 ...
##  $ dimessi      : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ lat          : num  45.7 46.4 46.4 46.4 45.8 ...
##  $ lon          : num  11 10.9 11 11.2 11.1 ...
##  $ aggiornamento: chr  "21/12/2021" "21/12/2021" "21/12/2021" "21/12/2021" ...
```

Dunque `amm` è un oggetto `sf`, la cui classe è `sf, tbl_df, tbl, data.frame`, mentre `covid` è ovviamente un `data.frame`. Siccome `amm` eredita da `data.frame`, possiamo aggiungere e modificare le sue colonne mediante l'operatore `$`, oppure possiamo usare la più avanzata libreria `dyplr` per unire le due tabelle condividendo le stesse colonne `nome` e `codice`:

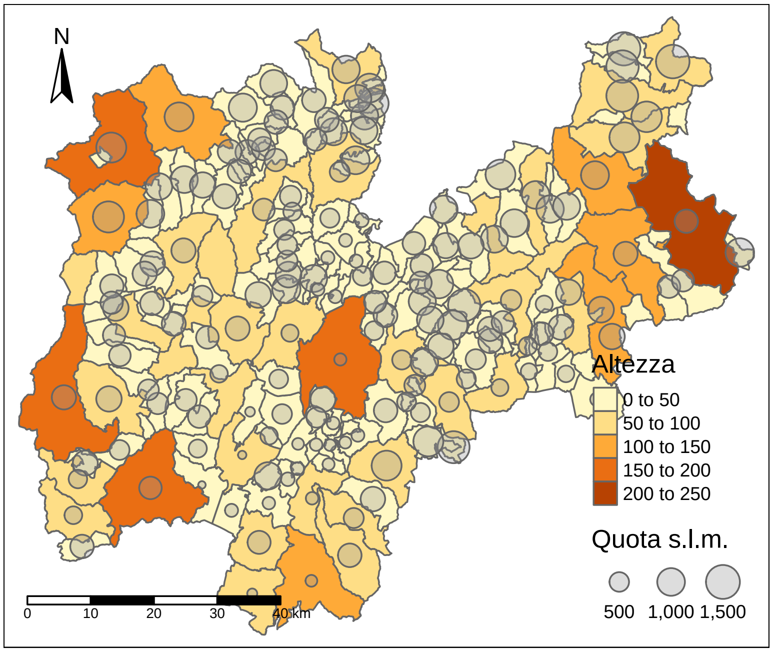
```
comuni <- amm %>% full_join(covid, by=c("codice", "nome"))
str(comuni)
```

```
## sf [166 x 26] (S3: sf/tbl_df/tbl/data.frame)
##  $ objectid     : num [1:166] 2209 2210 2211 2212 2213 ...
##  $ classid      : chr [1:166] "AMB003_1" "AMB003_26" "AMB003_60" "AMB003_237" ...
##  $ codice       : num [1:166] 1 26 60 237 203 51 136 155 47 188 ...
##  $ istat        : chr [1:166] "22001" "22026" "22060" "22237" ...
##  $ istatcat     : chr [1:166] "A116" "B158" "C727" "M351" ...
##  $ nome         : chr [1:166] "ALA" "BRESIMO" "CIS" "AMBLAR-DON" ...
##  $ supcom       : num [1:166] 120 41 5.5 19.9 50.2 ...
##  $ altcom       : num [1:166] 180 1036 732 971 525 ...
##  $ fkcomcva     : chr [1:166] "AMB002_10" "AMB002_6" "AMB002_6" "AMB002_6" ...
##  $ fkammprv     : chr [1:166] "AMB001_1" "AMB001_1" "AMB001_1" "AMB001_1" ...
##  $ struttura    : chr [1:166] "S133" "S133" "S133" "S133" ...
##  $ struttura_   : chr [1:166] "Servizio Catasto" "Servizio Catasto" "Servizio Catasto" "Servizio Cata
##  $ fkfonte      : chr [1:166] "05" "05" "05" "05" ...
##  $ fktfonte_d   : chr [1:166] "altre fonti" "altre fonti" "altre fonti" "altre fonti" ...
##  $ fktipoelab   : chr [1:166] "01" "01" "01" "01" ...
##  $ fktipoel_d   : chr [1:166] "manuale" "manuale" "manuale" "manuale" ...
##  $ fkscala      : chr [1:166] "03" "03" "03" "03" ...
##  $ fkscala_d    : chr [1:166] "10000" "10000" "10000" "10000" ...
##  $ geometry     :sfc_MULTIPOLYGON of length 166; first list element: List of 1
##   ..$ :List of 1
##   .. ..$ : num [1:1420, 1:2] 663379 663430 663474 663535 663602 ...
##   ..- attr(*, "class")= chr [1:3] "XY" "MULTIPOLYGON" "sfg"
##  $ contagi      : int [1:166] 862 20 16 40 120 80 128 112 340 267 ...
##  $ guariti      : int [1:166] 725 20 16 38 107 74 120 105 327 235 ...
##  $ decessi      : int [1:166] 8 0 0 1 3 3 5 3 8 2 ...
##  $ dimessi      : int [1:166] 0 0 0 0 0 0 0 0 0 0 ...
##  $ lat          : num [1:166] 45.7 46.4 46.4 46.4 45.8 ...
##  $ lon          : num [1:166] 11 10.9 11 11.2 11.1 ...
##  $ aggiornamento: chr [1:166] "21/12/2021" "21/12/2021" "21/12/2021" "21/12/2021" ...
##  - attr(*, "sf_column")= chr "geometry"
##  - attr(*, "agr")= Factor w/ 3 levels "constant","aggregate",..: NA NA NA NA NA NA NA NA NA NA ...
##   ..- attr(*, "names")= chr [1:25] "objectid" "classid" "codice" "istat" ...
```

Come si vede, ora `comuni` contiene anche i dati COVID-19.

Possiamo creare mappe attribuite mediante la libreria `tmap`, che ha una sintassi analoga a `ggplot2`: si crea una mappa con `tm_shape()` a cui si commano poi altri layer `tm_*()`:

```r
tm_shape(amm) +
  tm_borders() +
  tm_fill(col="supcom", title="Altezza") +
  tm_bubbles(size="altcom", title.size="Quota s.l.m.", alpha=1/3) +
  #tm_text(text="nome", size="supcom") +
  tm_compass(type = "arrow", position = c("left", "top")) +
  tm_scale_bar(position=c("left", "bottom"), bg.alpha=0.5)
```



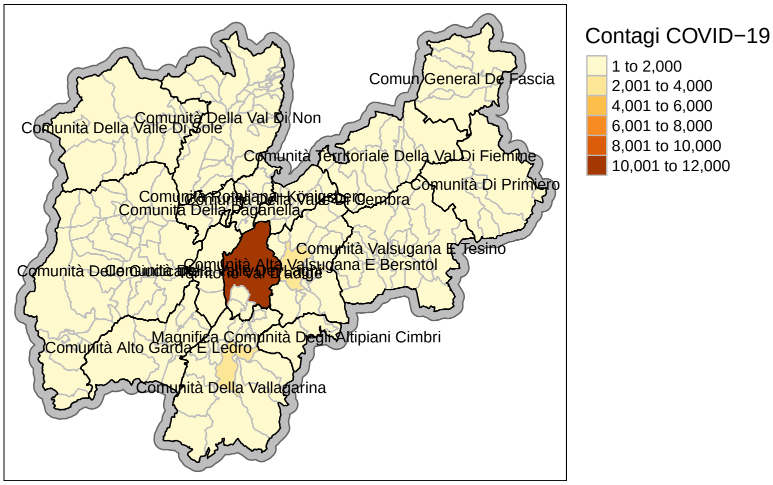
```r
tmap_mode("view") # Per usare tm_basemap
```

```
## tmap mode set to interactive viewing
```

```r
tmap_mode("plot")
```

```
## tmap mode set to plotting
```

```r
tnplus <- st_union(comuni) %>% st_buffer(dist=2000) %>% st_cast(to="POLYGON")
tn <- tm_shape(comuni) +
  tm_borders(col="gray") +
  tm_fill(col="contagi", title="Contagi COVID-19") +
  tm_layout(legend.outside = TRUE, legend.outside.position = "right")
tm_shape(tnplus) + tm_polygons(col="gray") +
  tn +
  tm_shape(cva) +
  tm_borders(col="black") +
  tm_text("nome", size=2/3) +
  tm_basemap(server="OpenStreetMap")
```


Comun General De Fascia
Comunità Della Val Di Non
Comunità Della Valle Di Sole
Comunità Territoriale Della Val Di Fiemme
Comunità Di Primiero
Comunità Rotaliana-Königsberg
Comunità Della Valle Di Cembra
Comunità Della Paganella
Comunità Valsugana E Tesino
Comunità Alta Valsugana E Bersntol
Comunità Delle Giudicarie
Comunità Della Valle Dei Laghi
Territorio Val D'adige
Magnifica Comunità Degli Altipiani Cimbri
Comunità Alto Garda E Ledro
Comunità Della Vallagarina
Contagi COVID−19
1 to 2,000
2,001 to 4,000
4,001 to 6,000
6,001 to 8,000
8,001 to 10,000
10,001 to 12,000