# GIS 3 Lab 2

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```
#This is a quick tutorial on how to join non-spatial data with spatial data,
#as well as how to view this data on a map.
```

```
#These are the essential libraries needed.
library(sf)
```

```
## Linking to GEOS 3.6.1, GDAL 2.2.3, PROJ 4.9.3
```

```
library(raster)
```

```
## Warning: package 'raster' was built under R version 3.5.3
```

```
## Loading required package: sp
```

```
## Warning: package 'sp' was built under R version 3.5.3
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 3.5.3
```

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

```
## The following objects are masked from 'package:raster':
##
##     intersect, select, union
```

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

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

```
library(stringr)
library(tidyr)
```

```
## Warning: package 'tidyr' was built under R version 3.5.3
```

```
##
## Attaching package: 'tidyr'
```

```
## The following object is masked from 'package:raster':
##
##     extract
```

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.5.3
```

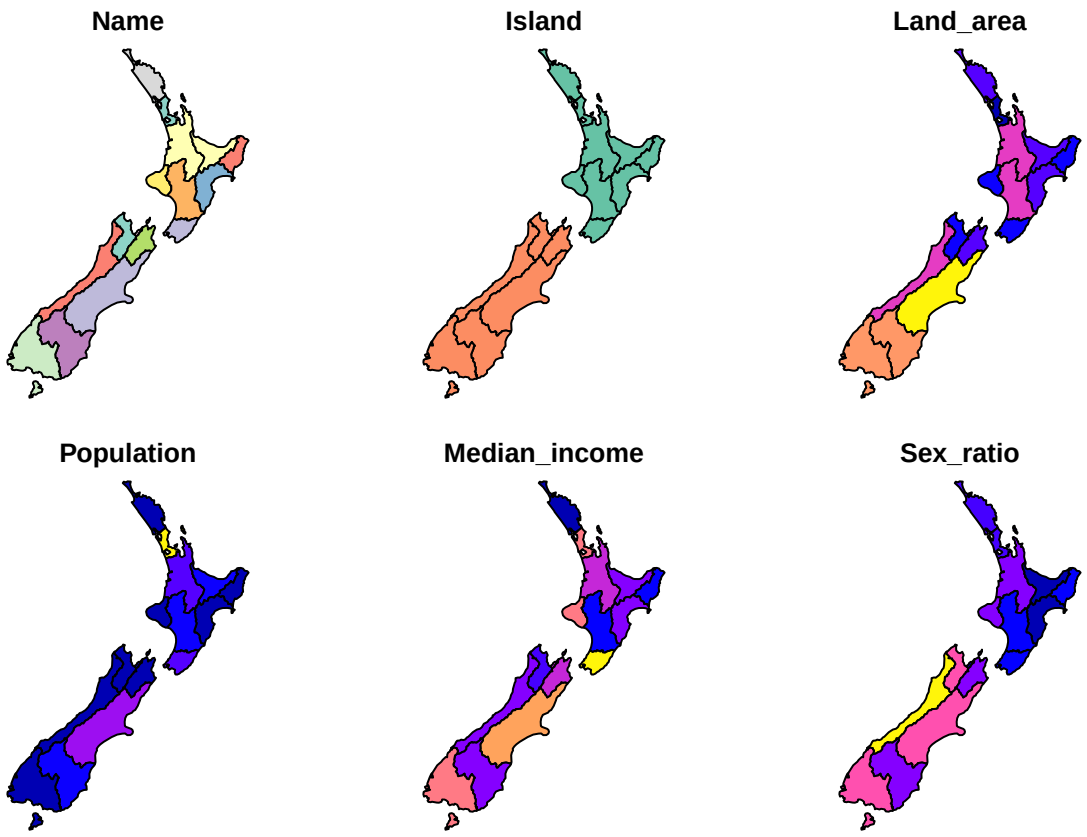
```
library(spData)
```

```
## Warning: package 'spData' was built under R version 3.5.3
```

```
#First, we need to visualize the entire New Zealand dataset in the spData package.
nz
```

```
## Simple feature collection with 16 features and 6 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:           xmin: 1090144 ymin: 4748537 xmax: 2089533 ymax: 6191874
## CRS:            EPSG:2193
## First 10 features:
##                 Name Island Land_area Population Median_income Sex_ratio
## 1          Northland  North 12500.561     175500         23400 0.9424532
## 2           Auckland  North  4941.573    1657200         29600 0.9442858
## 3            Waikato  North 23900.036     460100         27900 0.9520500
## 4      Bay of Plenty  North 12071.145     299900         26200 0.9280391
## 5           Gisborne  North  8385.827      48500         24400 0.9349734
## 6        Hawke's Bay  North 14137.524     164000         26100 0.9238375
## 7           Taranaki  North  7254.480     118000         29100 0.9569363
## 8  Manawatu-Wanganui  North 22220.608     234500         25000 0.9387734
## 9         Wellington  North  8048.553     513900         32700 0.9335524
## 10        West Coast  South 23245.456      32400         26900 1.0139072
##                             geom
## 1  MULTIPOLYGON (((1745493 600...
## 2  MULTIPOLYGON (((1803822 590...
## 3  MULTIPOLYGON (((1860345 585...
## 4  MULTIPOLYGON (((2049387 583...
## 5  MULTIPOLYGON (((2024489 567...
## 6  MULTIPOLYGON (((2024489 567...
## 7  MULTIPOLYGON (((1740438 571...
## 8  MULTIPOLYGON (((1866732 566...
## 9  MULTIPOLYGON (((1881590 548...
## 10 MULTIPOLYGON (((1557042 531...
```

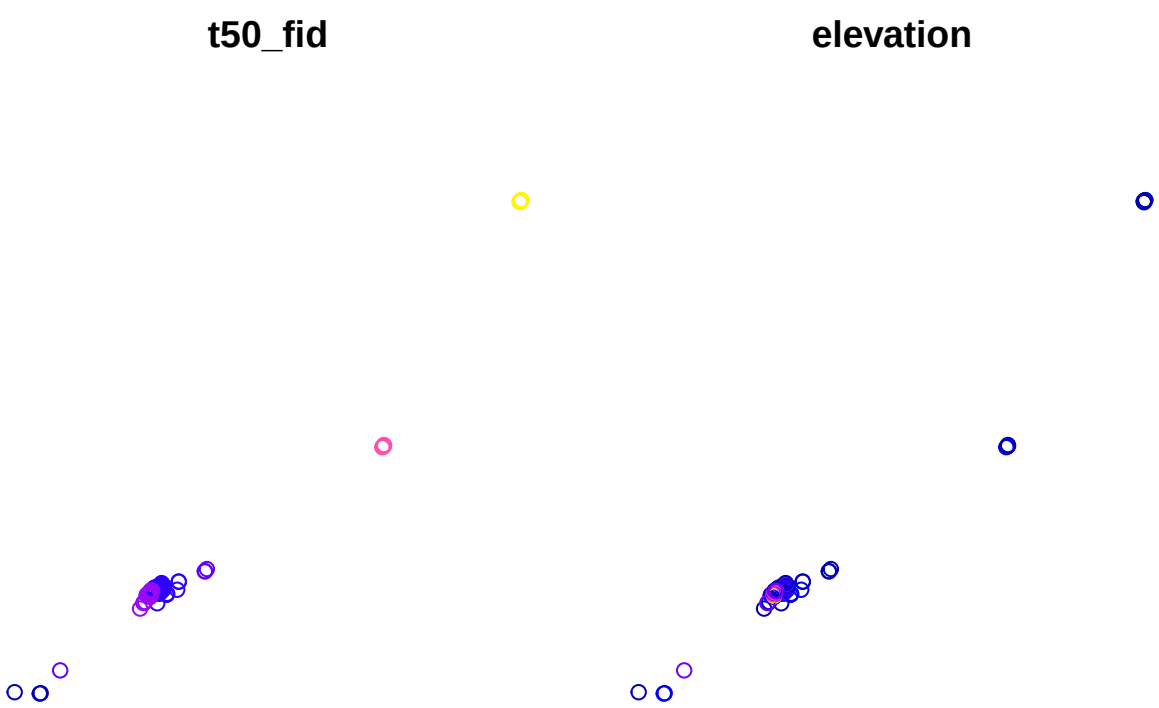
```
plot(nz)
```




```
#We find that the nz dataset has a variety of different variables that we can look at.
#Let's take a look at the elevation data.
nz_height
```

```
## Simple feature collection with 101 features and 2 fields
## geometry type:  POINT
## dimension:      XY
## bbox:           xmin: 1204143 ymin: 5048309 xmax: 1822492 ymax: 5650492
## CRS:            EPSG:2193
## First 10 features:
##    t50_fid elevation                geometry
## 1  2353944      2723 POINT (1204143 5049971)
## 2  2354404      2820 POINT (1234725 5048309)
## 3  2354405      2830 POINT (1235915 5048745)
## 4  2369113      3033 POINT (1259702 5076570)
## 5  2362630      2749 POINT (1378170 5158491)
## 6  2362814      2822 POINT (1389460 5168749)
## 7  2362817      2778 POINT (1390166 5169466)
## 8  2363991      3004 POINT (1372357 5172729)
## 9  2363993      3114 POINT (1372062 5173236)
## 10 2363994      2882 POINT (1372810 5173419)
```

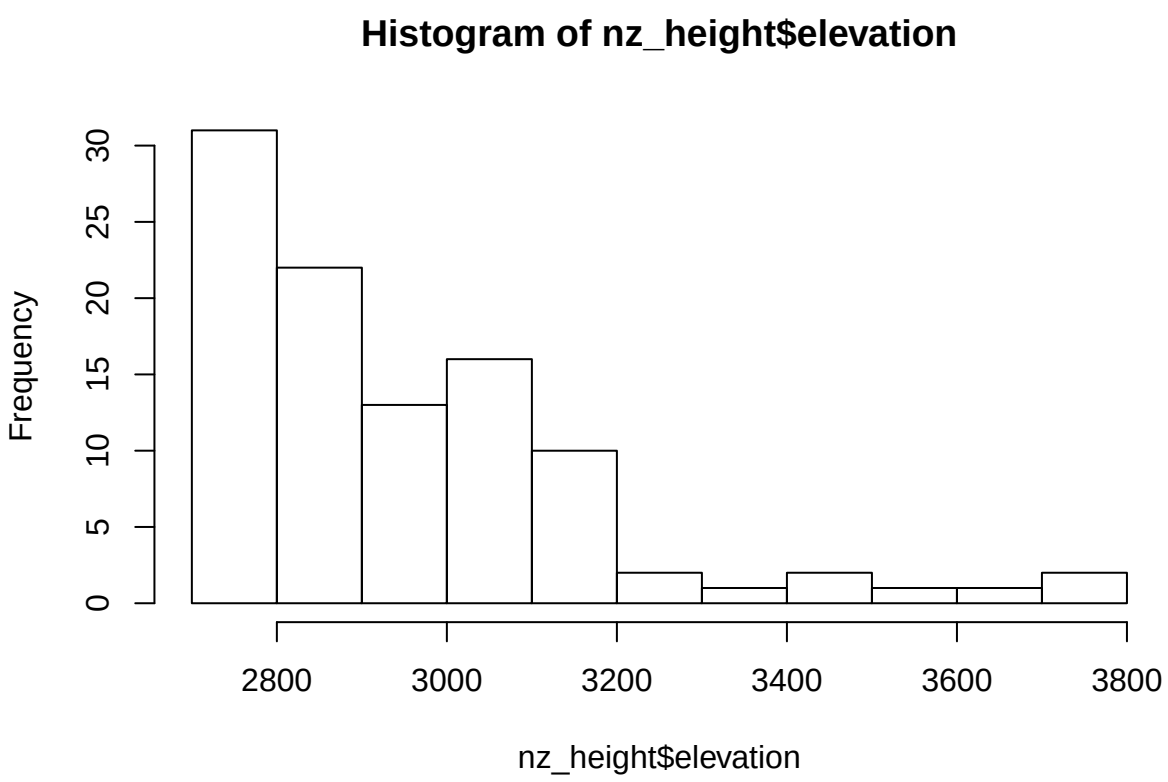
```
plot(nz_height)
```




```
#While we can see above that the data itself is inherently spatial point data,
#we can run non-spatial functions on the variable data.
#Let's see the summary statistics and a histogram of the values in the elevation column.
summary(nz_height$elevation)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    2706    2782    2885    2951    3054    3724
```

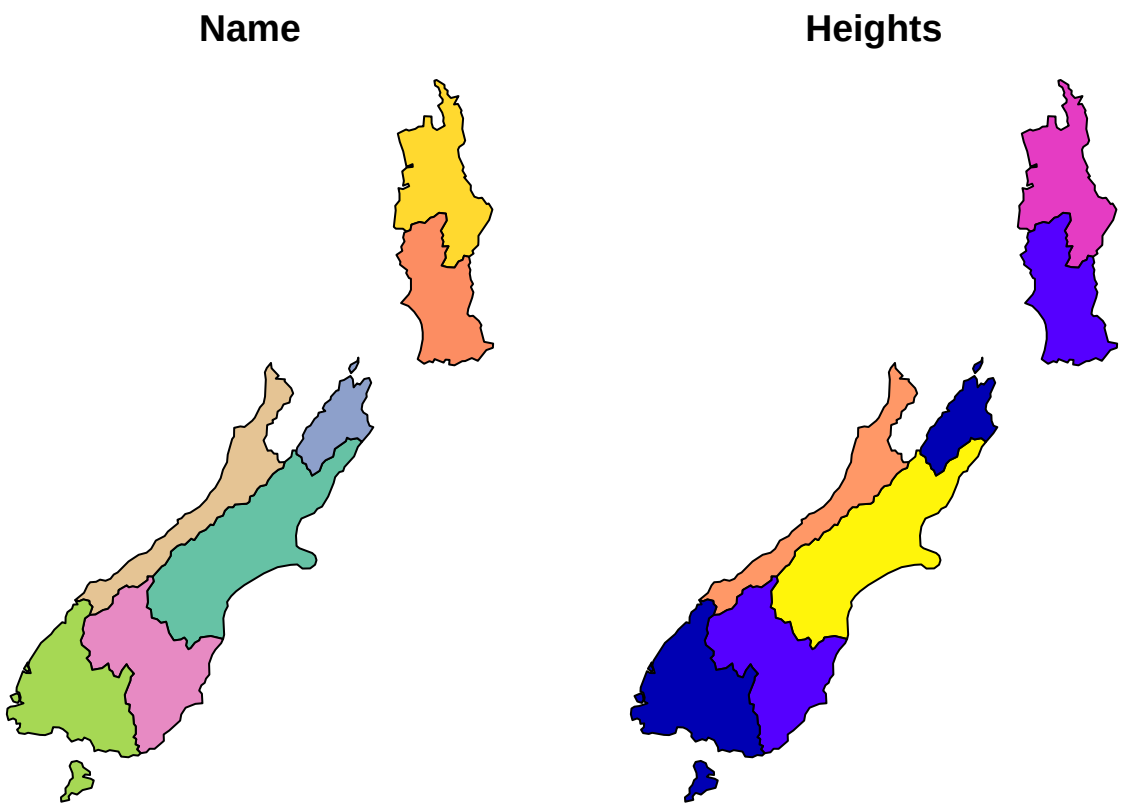
```
hist(nz_height$elevation)
```



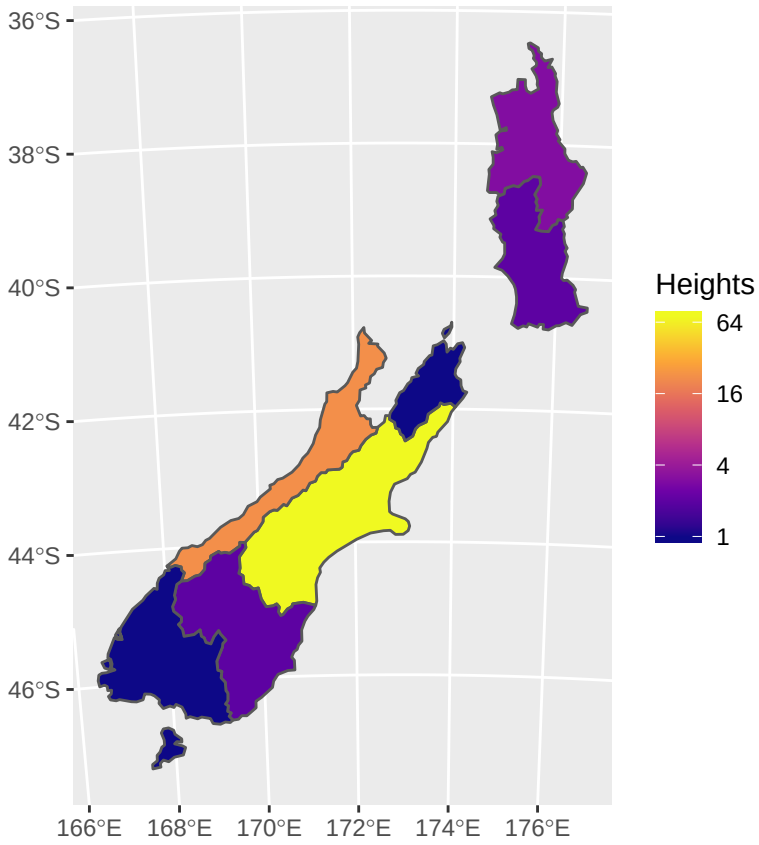

```
#Now let's join the point data we saw before with the polygon data of all the regions in New Zealand.
#We will be able to also see how many points are in each region polygon.
nz_highs = st_join(nz, nz_height, left=FALSE) %>% group_by(Name) %>% summarize(Heights = n()) %>%
  arrange(desc(Heights))
nz_highs
```

```
## Simple feature collection with 7 features and 2 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:           xmin: 1090144 ymin: 4748537 xmax: 1907315 ymax: 5961468
## CRS:            EPSG:2193
## # A tibble: 7 x 3
##   Name         Heights                                                 geom
##   <chr>          <int>                                    <MULTIPOLYGON [m]>
## 1 Canterbury        70 (((1686902 5353233, 1679996 5344809, 1673699 532882~
## 2 West Coast        22 (((1557042 5319333, 1554239 5309440, 1546356 530656~
## 3 Waikato            3 (((1860345 5859665, 1857808 5853929, 1850511 584904~
## 4 Manawatu-Wa~       2 (((1866732 5664323, 1868949 5654440, 1865829 564993~
## 5 Otago              2 (((1335205 5126878, 1336956 5118634, 1325903 510272~
## 6 Marlborough        1 (((1686902 5353233, 1679241 5359478, 1667754 535734~
## 7 Southland          1 (((1229078 5062352, 1221427 5056736, 1217551 503852~
```

```
plot(nz_highs)
```




```
#The maps we saw above had two variables plotted and neither of them were plotted well.
#We want to look only at the elevation data and we want a legend that actually tells us what we are loo
ggplot(data = nz_highs) +
  geom_sf(aes(fill = Heights)) +
  scale_fill_viridis_c(option = "plasma", trans = "log2")
```


36°S
38°S
40°S
42°S
44°S
46°S
166°E
168°E
170°E
172°E
174°E
176°E
Heights
64
16
4
1