February 3, 2023

The results below are generated from an R script.

```
# Introduction to R, for Economists
library(tidyverse)

# Don’t stress about coding along  with me here,
#   there are a lot of packages to download. Do ask questions and make suggestions

## There’s a package for everything---------------------------------------------

# XKCD Data
# Package for downloading XKCD comics
library(XKCDdata)

print_xkcd(comic = 2048)
print_xkcd(comic = 2327)

## Flextable--------------------------------------------------------------------

# Lets look at how we might create publication quality tables using the flextable
# package and the mtcars dataset (part of the tidyverse)

library(flextable)

mtcars

##                      mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4           21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag       21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710          22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive      21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
## Valiant             18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
## Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## Merc 240D           24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
## Merc 230            22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
## Merc 280            19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
## Merc 280C           17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
## Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
## Merc 450SL          17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
## Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
## Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
## Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
## Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
## Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
## Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
## AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
## Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
## Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
## Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
## Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
## Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
## Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
## Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
## Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
## Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
```

```
# First lets turn the row names into columns called make and model. Note that currently
# they are formatted as rownames rather than as a column which are treated differently

mtcars %>%
  rownames_to_column(var = "Model") %>%
  separate(Model, c("make", "model"))
```

```
## Warning:  Expected 2 pieces.  Additional pieces discarded in 5 rows [2, 4, 26, 27, 29].
## Warning:  Expected 2 pieces.  Missing pieces filled with ‘NA‘ in 1 rows [6].
```

```
##        make       model  mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## 1     Mazda         RX4 21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
## 2     Mazda         RX4 21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
## 3    Datsun         710 22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## 4    Hornet           4 21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## 5    Hornet  Sportabout 18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
## 6   Valiant        <NA> 18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
## 7    Duster         360 14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## 8      Merc        240D 24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
## 9      Merc         230 22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
## 10     Merc         280 19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
## 11     Merc        280C 17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
## 12     Merc       450SE 16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
## 13     Merc       450SL 17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
## 14     Merc      450SLC 15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## 15 Cadillac   Fleetwood 10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
## 16  Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
## 17 Chrysler    Imperial 14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## 18     Fiat         128 32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
## 19    Honda       Civic 30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
## 20   Toyota     Corolla 33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
## 21   Toyota      Corona 21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## 22    Dodge  Challenger 15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
## 23      AMC     Javelin 15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
## 24   Camaro         Z28 13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
## 25  Pontiac    Firebird 19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
## 26     Fiat          X1 27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
## 27  Porsche         914 26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
## 28    Lotus      Europa 30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
## 29     Ford     Pantera 15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
## 30  Ferrari        Dino 19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
## 31 Maserati        Bora 15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
## 32    Volvo        142E 21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2

# Now lets only select those columns relating to engine specifications and other
#  specifications
mtcars %>%
  select(cyl, hp, disp, mpg, wt, gear)

##                     cyl  hp  disp  mpg    wt gear
## Mazda RX4             6 110 160.0 21.0 2.620    4
## Mazda RX4 Wag         6 110 160.0 21.0 2.875    4
## Datsun 710            4  93 108.0 22.8 2.320    4
## Hornet 4 Drive        6 110 258.0 21.4 3.215    3
## Hornet Sportabout     8 175 360.0 18.7 3.440    3
## Valiant               6 105 225.0 18.1 3.460    3
## Duster 360            8 245 360.0 14.3 3.570    3
## Merc 240D             4  62 146.7 24.4 3.190    4
## Merc 230              4  95 140.8 22.8 3.150    4
## Merc 280              6 123 167.6 19.2 3.440    4
## Merc 280C             6 123 167.6 17.8 3.440    4
## Merc 450SE            8 180 275.8 16.4 4.070    3
## Merc 450SL            8 180 275.8 17.3 3.730    3
## Merc 450SLC           8 180 275.8 15.2 3.780    3
## Cadillac Fleetwood    8 205 472.0 10.4 5.250    3
## Lincoln Continental   8 215 460.0 10.4 5.424    3
## Chrysler Imperial     8 230 440.0 14.7 5.345    3
## Fiat 128              4  66  78.7 32.4 2.200    4
## Honda Civic           4  52  75.7 30.4 1.615    4
## Toyota Corolla        4  65  71.1 33.9 1.835    4
## Toyota Corona         4  97 120.1 21.5 2.465    3
## Dodge Challenger      8 150 318.0 15.5 3.520    3
## AMC Javelin           8 150 304.0 15.2 3.435    3
## Camaro Z28            8 245 350.0 13.3 3.840    3
## Pontiac Firebird      8 175 400.0 19.2 3.845    3
## Fiat X1-9             4  66  79.0 27.3 1.935    4
## Porsche 914-2         4  91 120.3 26.0 2.140    5
## Lotus Europa          4 113  95.1 30.4 1.513    5
## Ford Pantera L        8 264 351.0 15.8 3.170    5
## Ferrari Dino          6 175 145.0 19.7 2.770    5
## Maserati Bora         8 335 301.0 15.0 3.570    5
## Volvo 142E            4 109 121.0 21.4 2.780    4

# Combine both steps and send to flextable
# mtcars %>%
#   rownames_to_column(var = "Model") %>%
#   select(Model, cyl, hp, disp, mpg, wt, gear) %>%
#   separate(Model, c("make", "model")) %>%
#   flextable()

# This is ok, but we can add headers and footers to make this better

# mtcars %>%
#   rownames_to_column(var = "Model") %>%
#   select(Model, cyl, hp, disp, mpg, wt, gear) %>%
```

```r
#   separate(Model, c("make", "model")) %>%
#   flextable() %>%
#   add_header_row(values = c("Car","Engine specifications", "Other physical specifications"),
#                  colwidths = c(2,3,3)) %>%
#   add_footer_lines("mtcars data set showing headers and footers in flextable")

# We can even add themes to further improve
# mtcars %>%
# rownames_to_column(var = "Model") %>%
#   select(Model, cyl, hp, disp, mpg, wt, gear) %>%
#   separate(Model, c("make", "model")) %>%
#   flextable() %>%
#   add_header_row(values = c("Car","Engine specifications", "Other physical specifications"),
#                  colwidths = c(2,3,3)) %>%
#   add_footer_lines("mtcars data set showing headers and footers in flextable") %>%
#   theme_zebra()

# https://ardata-fr.github.io/flextable-book/design.html
# Show some of the very pretty table sin the documentation


# modeltime---------------------------------------------------------------------
# https://cran.r-project.org/web/packages/modeltime/index.html

# Modeltime combines both machine learning and time series modelling in one
# handy package.

# https://www.rdocumentation.org/packages/modeltime/versions/1.2.4
# this shows the different modelling (ARIMA/ETS/Random Forest/)

# https://cran.r-project.org/web/packages/modeltime/vignettes/getting-started-with-modeltime.html

# Modeltime forecasting---------------------------------------------------------

#install.packages("modeltime")
#install.packages("tidymodels")
#install.packages("lubridate")
library(modeltime)
library(tidymodels)
library(tidyverse)
library(timetk)
library(parsnip)
library(lubridate)

?bike_sharing_daily
bike_sharing_daily

## # A tibble: 731 x 16
##    instant dteday     season    yr  mnth holiday weekday worki~1 weath~2  temp atemp   hum
##      <dbl> <date>      <dbl> <dbl> <dbl>   <dbl>   <dbl>   <dbl>   <dbl> <dbl> <dbl> <dbl>
##  1       1 2011-01-01      1     0     1       0       6       0       2 0.344 0.364 0.806
##  2       2 2011-01-02      1     0     1       0       0       0       2 0.363 0.354 0.696
##  3       3 2011-01-03      1     0     1       0       1       1       1 0.196 0.189 0.437
##  4       4 2011-01-04      1     0     1       0       2       1       1 0.2   0.212 0.590
##  5       5 2011-01-05      1     0     1       0       3       1       1 0.227 0.229 0.437
##  6       6 2011-01-06      1     0     1       0       4       1       1 0.204 0.233 0.518
##  7       7 2011-01-07      1     0     1       0       5       1       2 0.197 0.209 0.499
##  8       8 2011-01-08      1     0     1       0       6       0       2 0.165 0.162 0.536
##  9       9 2011-01-09      1     0     1       0       0       0       1 0.138 0.116 0.434
## 10      10 2011-01-10      1     0     1       0       1       1       1 0.151 0.151 0.483
## # ... with 721 more rows, 4 more variables: windspeed <dbl>, casual <dbl>,
## #   registered <dbl>, cnt <dbl>, and abbreviated variable names 1: workingday,
## #   2: weathersit
```

```
# Modeltime workflow:
#   1) Split data ito training and test
#   2) Create and fit models
#   3) Create model table
#   4) Calibrate models
#   5) Perform testing set evaluation
#   6) Refit models to full dataset and forecast


# 1) Selecting the timeseries date variable and the one we want to visualise
bike_data <- bike_sharing_daily %>%
  select(dteday, cnt)

interactive <- TRUE

bike_data %>% plot_time_series(.date_var = dteday, .value = cnt, .interactive = interactive)
```

```
## Error in loadNamespace(name):  there is no package called 'webshot'
```

```
# this is a plotly (opposed to ggplot visualisation) which means we can interact
# with it. But we can turn it off with the interactive arg which calls the
# interactive object


splits <- time_series_split(
  data = bike_data, # specifying data
  date_var = dteday, # specifying the date variable
  assess = "3 months", # specifying the assessment sample
  cumulative = TRUE) # allowing resampling to change the size of the training set

# 2) Create and fit models

## First lets fit an ARIMA
model_arima <- arima_reg() %>%
  set_engine(engine = "auto_arima") %>%
  fit(cnt ~ dteday, data = training(splits))
```

```
## frequency = 7 observations per 1 week
```

```
model_arima
```

```
## parsnip model object
##
## Series: outcome
## ARIMA(0,1,3) with drift
##
```

```
## Coefficients:
##           ma1      ma2      ma3   drift
##       -0.6106  -0.1868  -0.0673  9.3169
## s.e.   0.0396   0.0466   0.0398  4.6225
##
## sigma^2 = 730568:  log likelihood = -5227.22
## AIC=10464.44   AICc=10464.53   BIC=10486.74

## Second lets fit a Boosted ARIMA
model_boosted_arima <- arima_boost(
  min_n = 2, #min. data points for for node to split
  learn_rate = 0.015 #rate boosting algorithm adapts each iteration
) %>%
  set_engine(engine = "auto_arima_xgboost") %>%
  fit(cnt ~ dteday + as.numeric(dteday),
    data = training(splits))

## frequency = 7 observations per 1 week

## Third lets fit an Error-Trend Season (ETS) model
model_ets <- exp_smoothing() %>%
  set_engine(engine = "ets") %>%
  fit(cnt ~ dteday, data = training(splits))

## frequency = 7 observations per 1 week

## Fourth lets fit a Prophet model
model_prophet <- prophet_reg() %>%
  set_engine(engine = "prophet") %>%
  fit(cnt ~ dteday, data = training(splits))

## Disabling yearly seasonality.  Run prophet with yearly.seasonality=TRUE to override this.
## Disabling daily seasonality.  Run prophet with daily.seasonality=TRUE to override this.

## Fifth lets fit a Linear Regression

model_linear_regression <- linear_reg() %>%
  set_engine(engine = "lm") %>%
  fit(cnt ~ as.numeric(dteday) + factor(month(dteday, label = T),
                                        ordered = F),
      data = training(splits))

# 3) Creating the modeltime table
tbl_models <- modeltime_table(
  model_arima,
  model_boosted_arima,
  model_ets,
  model_prophet,
  model_linear_regression)


tbl_models

## # Modeltime Table
## # A tibble: 5 x 3
##   .model_id .model   .model_desc
##       <int> <list>   <chr>
## 1         1 <fit[+]> ARIMA(0,1,3) WITH DRIFT
## 2         2 <fit[+]> ARIMA(1,1,1)(1,0,2)[7] WITH DRIFT W/ XGBOOST ERRORS
## 3         3 <fit[+]> ETS(M,A,N)
## 4         4 <fit[+]> PROPHET
## 5         5 <fit[+]> LM
```

```
# 4) Calibrate to testing sets

tbl_calibration <- tbl_models %>%
  modeltime_calibrate(new_data = testing(splits))

# 5) Testing set evaluation
tbl_calibration %>%
  modeltime_forecast(
    new_data = testing(splits),
    actual_data = bike_data) %>%
  plot_modeltime_forecast(
    .interactive = interactive
  )
```

```
## Error in loadNamespace(name):  there is no package called 'webshot'
```

```
modeltime_accuracy(tbl_calibration)
```

```
## # A tibble: 5 x 9
##   .model_id .model_desc                          .type   mae  mape  mase smape  rmse   rsq
##       <int> <chr>                                <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1         1 ARIMA(0,1,3) WITH DRIFT              Test  2540.  475.  2.74  46.0 3188. 0.390
## 2         2 ARIMA(1,1,1)(1,0,2)[7] WITH DRIFT W~ Test  2408.  460.  2.60  44.5 3043. 0.324
## 3         3 ETS(M,A,N)                           Test  2802.  490.  3.03  48.7 3496. 0.416
## 4         4 PROPHET                              Test  3063.  515.  3.31  51.6 3718. 0.292
## 5         5 LM                                   Test  1310.  378.  1.42  30.0 1854. 0.214
```

```
# 6) Refit to full data set and forecast forward
tbl_refit <- tbl_calibration %>%
  modeltime_refit(data = bike_data)
```

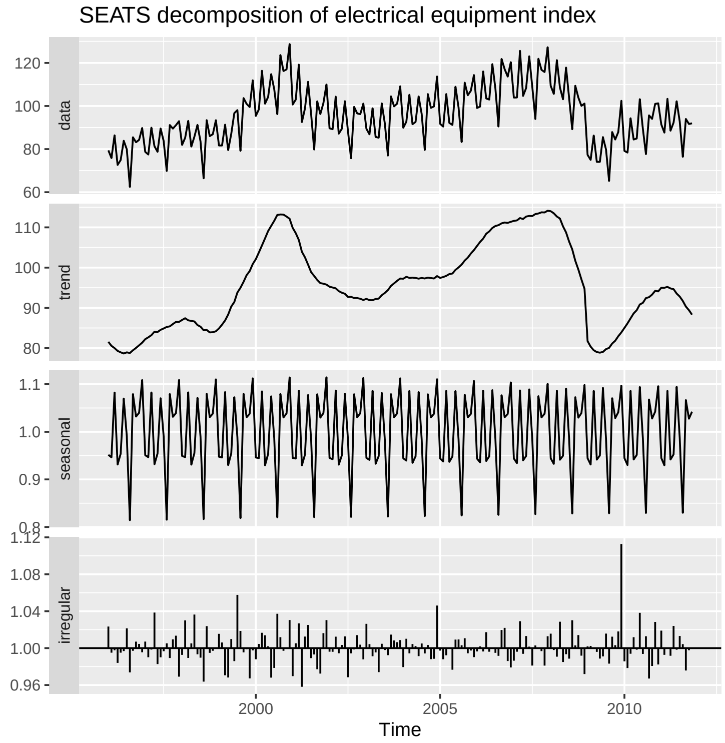
```
## frequency = 7 observations per 1 week
## frequency = 7 observations per 1 week
## frequency = 7 observations per 1 week
## Disabling daily seasonality.  Run prophet with daily.seasonality=TRUE to override this.
```

```
tbl_refit %>%
  modeltime_forecast(h = "3 weeks", actual_data = bike_data) %>%
  plot_modeltime_forecast(
    .legend_max_width = 25
  )
```

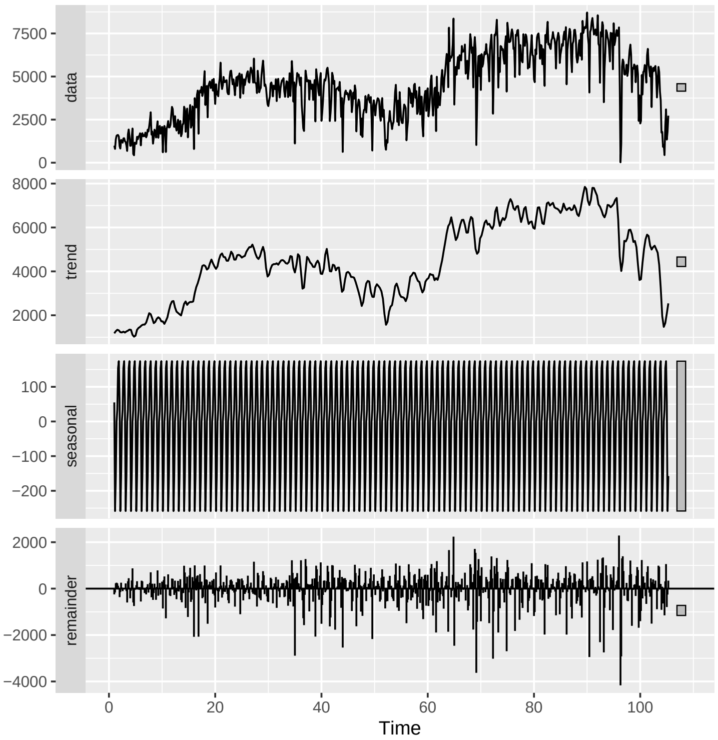
```
## Error in loadNamespace(name):  there is no package called 'webshot'
```

```
# Now the models are refitted to the actual data. This is just a taste of what
# time series modelling can be like. There are numerous other models we can
# employ too but for times sake I have shown 5 and the modeltime workflow.

# Decomposition-----------------------------------------------------------------
```

```r
library(tidyverse) #needed for ggtitle
library(seasonal) #needed for seas()
library(fpp)  #need for the elecequip data set

elecequip %>% seas() %>%
  autoplot() +
  ggtitle("SEATS decomposition of electrical equipment index")
```



```r
## using sthe previous bikes dataset
ts_bike <- ts(bike_sharing_daily$cnt, frequency = 7)

ts_bike %>%
  stl(s.window="periodic") %>%
  autoplot()
```



```
## Leaflet---------------------------------------------------------------------
library(leaflet)
# https://rstudio.github.io/leaflet/
# https://cran.r-project.org/web/packages/leaflet.minicharts/vignettes/introduction.html

# Leadflet creates interactive maps

## Leaflet workflow
#   1) Create a map widget by calling leaflet()
#   2) Add layers/features to map with layer functions
#   3) Repeat step 2 as desired
#   4) Print the map widget to display it

# Map of Auckland University (birthplace of R)
Auckland_University <- leaflet() %>%
  addTiles() %>%  # Add default OpenStreetMap map tiles
  addMarkers(lng=174.768, lat=-36.852, popup="The birthplace of R")
Auckland_University

## Error in loadNamespace(name):  there is no package called 'webshot'

## Extension - adding several points to an interactive map

NZUs <- tibble(Universities = c("UoA", "AUT", "Waikato", "Massey", "Vic", "Canterbury", "Lincoln", "Otag
               lat = c(-36.85224823346041, -36.853412307817784, -37.78890569065363, -40.355225055311955,
               lng = c(174.77252663829262, 174.76643757919567, 175.3164528404978, 175.60943830584307,174
  select(Universities, lng, lat)

NZUs %>% leaflet() %>%
  addTiles() %>%
  addMarkers(lng = ~lng, lat = ~lat, label = ~Universities, popup = "Universities of New Zealand")
```

```
## Error in loadNamespace(name):  there is no package called 'webshot'
```

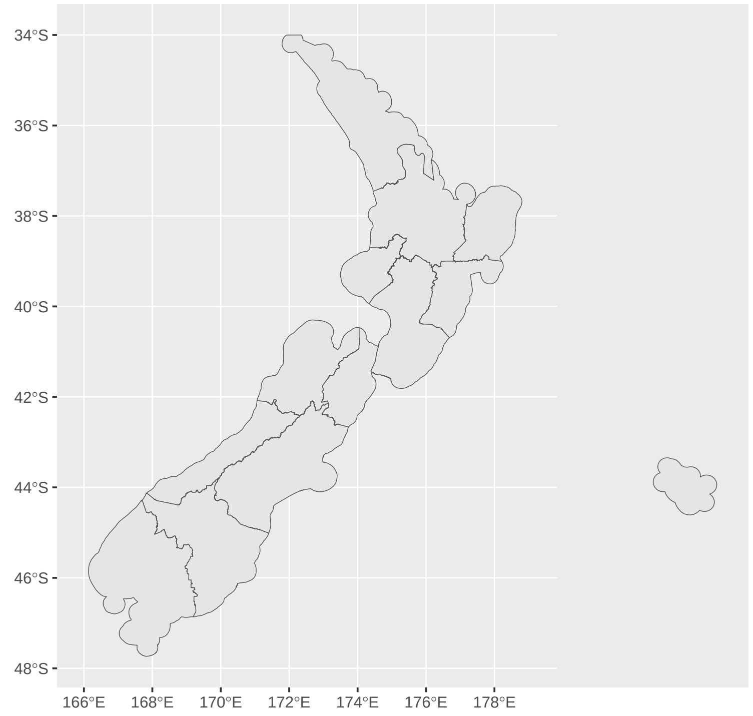
```
## Can assign the map and call it if I don't always want it built

## sf --------------------------------------------------------------------------
library(sf)
library(ggthemes)
library(ggrepel)
library(tidyverse)

nz_regions_sf <- st_read("_AARES/linz_download/nz-land-districts.shp")
```

```
## Reading layer 'nz-land-districts' from data source
##   'C:\Users\MarmontB\OneDrive - DairyNZ Limited\Documents\R\AARES-R-Workshop\_AARES\linz_download\nz-
##   using driver 'ESRI Shapefile'
## Simple feature collection with 12 features and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: 166.1345 ymin: -47.73475 xmax: 184.5 ymax: -33.99975
## Geodetic CRS:  NZGD2000
```

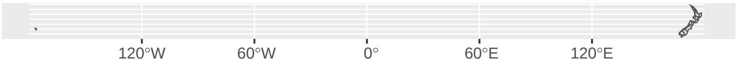
```
nz_outline_sf <- st_read("_AARES/linz_outline/nz-coastlines-and-islands-polygons-topo-150k.shp")
```

```
## Reading layer 'nz-coastlines-and-islands-polygons-topo-150k' from data source
##   'C:\Users\MarmontB\OneDrive - DairyNZ Limited\Documents\R\AARES-R-Workshop\_AARES\linz_outline\nz-c
##   using driver 'ESRI Shapefile'
## Simple feature collection with 9131 features and 7 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: 165.869 ymin: -52.62088 xmax: 183.8457 ymax: -29.23134
## Geodetic CRS:  NZGD2000
```

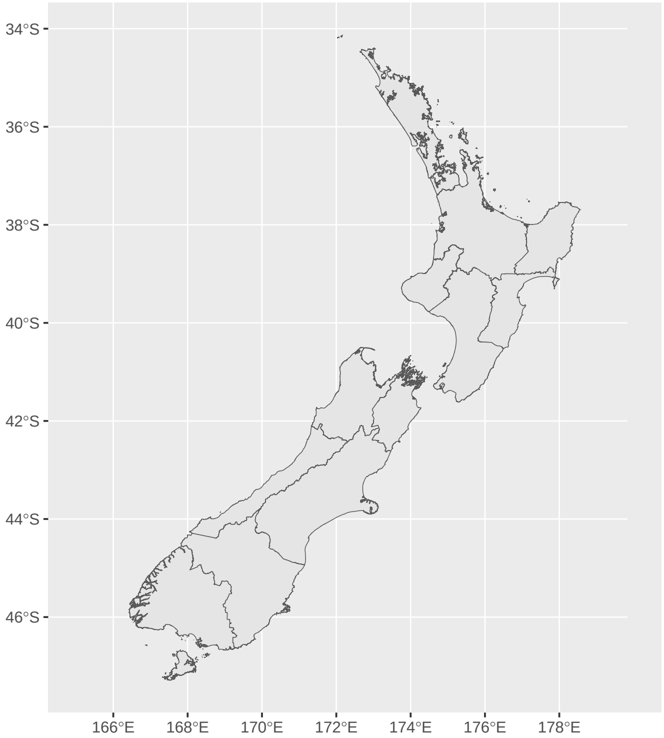
```
# Showing the regions outlines (extend into ocean)
ggplot() +
  geom_sf(data = nz_regions_sf)
```



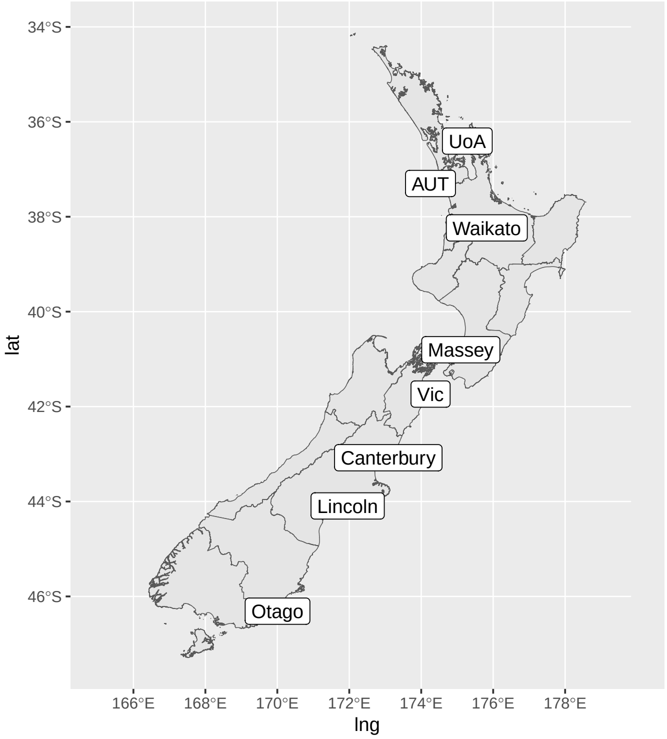
```
# Trimming to the intersection of the coastlines layer
trimmed <- st_intersection(nz_outline_sf, nz_regions_sf)

## Warning:  attribute variables are assumed to be spatially constant throughout all geometries

ggplot()+
  geom_sf(data = trimmed)
```



```r
# Plotting the trimmed outline and cropping to appropriate coords
ggplot() +
  geom_sf(data = trimmed) +
  coord_sf(xlim = c(165, 180))
```



```
# Adding NZUs
ggplot() +
  geom_sf(data = trimmed) +
  coord_sf(xlim = c(165, 180)) +
  geom_label_repel(data = NZUs, aes(x = lng, y = lat, label = Universities))
```



```
# Can be better again, theme, title, caption, axis labels

# Add the NZUs dataset from before
NZUS_sf <- ggplot() +
  geom_sf(data = trimmed) +
  coord_sf(xlim = c(165, 180)) +
  geom_label_repel(data = NZUs, aes(x = lng, y = lat, label = Universities)) +
  theme_economist() +
  labs (title = "Universities of New Zealand",
       caption = "Coordinates of Universities sourced from GoogleMaps") +
  xlab("Longitude") +
  ylab("Latitude")
```

The R session information (including the OS info, R version and all packages used):

```
sessionInfo()

## R version 4.2.1 (2022-06-23 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19045)
##
## Matrix products: default
##
```

```
## locale:
## [1] LC_COLLATE=English_New Zealand.utf8  LC_CTYPE=English_New Zealand.utf8
## [3] LC_MONETARY=English_New Zealand.utf8 LC_NUMERIC=C
## [5] LC_TIME=English_New Zealand.utf8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] ggrepel_0.9.2      ggthemes_4.2.4     sf_1.0-9           leaflet_2.1.1
##  [5] fpp_0.5            tseries_0.10-53    lmtest_0.9-40      zoo_1.8-11
##  [9] expsmooth_2.3      fma_2.4            forecast_8.20      seasonal_1.9.0
## [13] lubridate_1.9.1    timetk_2.8.2       yardstick_1.1.0    workflowsets_1.0.0
## [17] workflows_1.1.2    tune_1.0.1         rsample_1.1.1      recipes_1.0.4
## [21] parsnip_1.0.3      modeldata_1.1.0    infer_1.0.4        dials_1.1.0
## [25] scales_1.2.1       broom_1.0.3        tidymodels_1.0.0   modeltime_1.2.4
## [29] flextable_0.8.5    XKCDdata_0.1.0     forcats_1.0.0      stringr_1.5.0
## [33] dplyr_1.1.0        purrr_1.0.1        readr_2.1.3        tidyr_1.3.0
## [37] tibble_3.1.8       ggplot2_3.4.0      tidyverse_1.3.2    knitr_1.42
##
## loaded via a namespace (and not attached):
##   [1] utf8_1.2.3           tidyselect_1.2.0     htmlwidgets_1.6.1    grid_4.2.1
##   [5] munsell_0.5.0        units_0.8-1          codetools_0.2-18     xgboost_1.7.3.1
##   [9] future_1.31.0        withr_2.5.0          colorspace_2.1-0     highr_0.10
##  [13] uuid_1.1-0           rstudioapi_0.14      stats4_4.2.1         wk_0.7.1
##  [17] officer_0.5.2        TTR_0.24.3           listenv_0.9.0        labeling_0.4.2
##  [21] rstan_2.21.8         DiceDesign_1.9       farver_2.1.1         parallelly_1.34.0
##  [25] vctrs_0.5.2          generics_0.1.3       ipred_0.9-13         xfun_0.37
##  [29] timechange_0.2.0     R6_2.5.1             lhs_1.1.6            cachem_1.0.6
##  [33] assertthat_0.2.1     promises_1.2.0.1     nnet_7.3-17          googlesheets4_1.0.1
##  [37] gtable_0.3.1         globals_0.16.2       processx_3.8.0       timeDate_4022.108
##  [41] rlang_1.0.6          systemfonts_1.0.4    splines_4.2.1        lazyeval_0.2.2
##  [45] gargle_1.3.0         inline_0.3.19        s2_1.1.2             yaml_2.3.7
##  [49] modelr_0.1.10        crosstalk_1.2.0      backports_1.4.1      httpuv_1.6.8
##  [53] quantmod_0.4.20      tools_4.2.1          lava_1.7.1           ellipsis_0.3.2
##  [57] proxy_0.4-27         Rcpp_1.0.10          base64enc_0.1-3      classInt_0.4-8
##  [61] ps_1.7.2             prettyunits_1.1.1    rpart_4.1.16         openssl_2.0.5
##  [65] fracdiff_1.5-2       haven_2.5.1          fs_1.6.0             tinytex_0.44
##  [69] furrr_0.3.1          crul_1.3             magrittr_2.0.3       data.table_1.14.6
##  [73] reprex_2.0.2         GPfit_1.0-8          googledrive_2.0.0    x13binary_1.1.57-3
##  [77] matrixStats_0.63.0   hms_1.1.2            mime_0.12            evaluate_0.20
##  [81] xtable_1.8-4         readxl_1.4.1         gridExtra_2.3        compiler_4.2.1
##  [85] KernSmooth_2.23-20   crayon_1.5.2         StanHeaders_2.21.0-7 htmltools_0.5.4
##  [89] later_1.3.0          tzdb_0.3.0           RcppParallel_5.1.6   DBI_1.1.3
##  [93] dbplyr_2.3.0         MASS_7.3-57          Matrix_1.5-3         cli_3.6.0
##  [97] quadprog_1.5-8       parallel_4.2.1       gower_1.0.1          pkgconfig_2.0.3
## [101] plotly_4.10.1        xml2_1.3.3           foreach_1.5.2        hardhat_1.2.0
## [105] prodlim_2019.11.13   rvest_1.0.3          snakecase_0.11.0     callr_3.7.3
## [109] digest_0.6.31        janitor_2.2.0        httpcode_0.3.0       rmarkdown_2.20
## [113] cellranger_1.1.0     gdtools_0.3.0        curl_5.0.0           shiny_1.7.4
## [117] urca_1.3-3           lifecycle_1.0.3      nlme_3.1-157         jsonlite_1.8.4
## [121] viridisLite_0.4.1    askpass_1.1          fansi_1.0.4          pillar_1.8.1
## [125] lattice_0.20-45      loo_2.5.1            fastmap_1.1.0        httr_1.4.4
## [129] pkgbuild_1.4.0       survival_3.3-1       glue_1.6.2           xts_0.12.2
## [133] zip_2.2.2            iterators_1.0.14     class_7.3-20         stringi_1.7.12
## [137] prophet_1.0          gfonts_0.2.0         memoise_2.0.1        e1071_1.7-13
## [141] future.apply_1.10.0
```

```r
Sys.time()
```

```
## [1] "2023-02-03 13:38:49 NZDT"
```