Part III: Visualizations in R

TMA4268 Statistical Learning V2019. Module 1: INTRODUCTION TO STATISTICAL LEARNING

Martina Hall, Michail Spitieris, Stefanie Muff, Department of Mathematical Sciences, NTNU

January 06, 2020

Contents

Introduction

For each of the plots (scatter plot, histogram, boxplot, area chart, heat map, correlogram) *explain what you see (including what is on the x- and y-axis) and try to transform what you see into insight about the data.* All except the correlogram use `ggplot2` for plotting. If you want to read more about the idea behind `ggplot2` (grammar of graphics) Chapter 3 of R for Data Science is a good read. Other resources are:

http://t-redactyl.io/blog/2016/03/creating-plots-in-r-using-ggplot2-part-9-function-plots.html, https://ggplot2.tidyverse.org/reference/

Packages needed

```
install.packages("car")
install.packages("faraway")
install.packages("ggplot2")
install.packages("GGally")
install.packages("reshape")
install.packages("corrplot")
install.packages("corrgram")
```

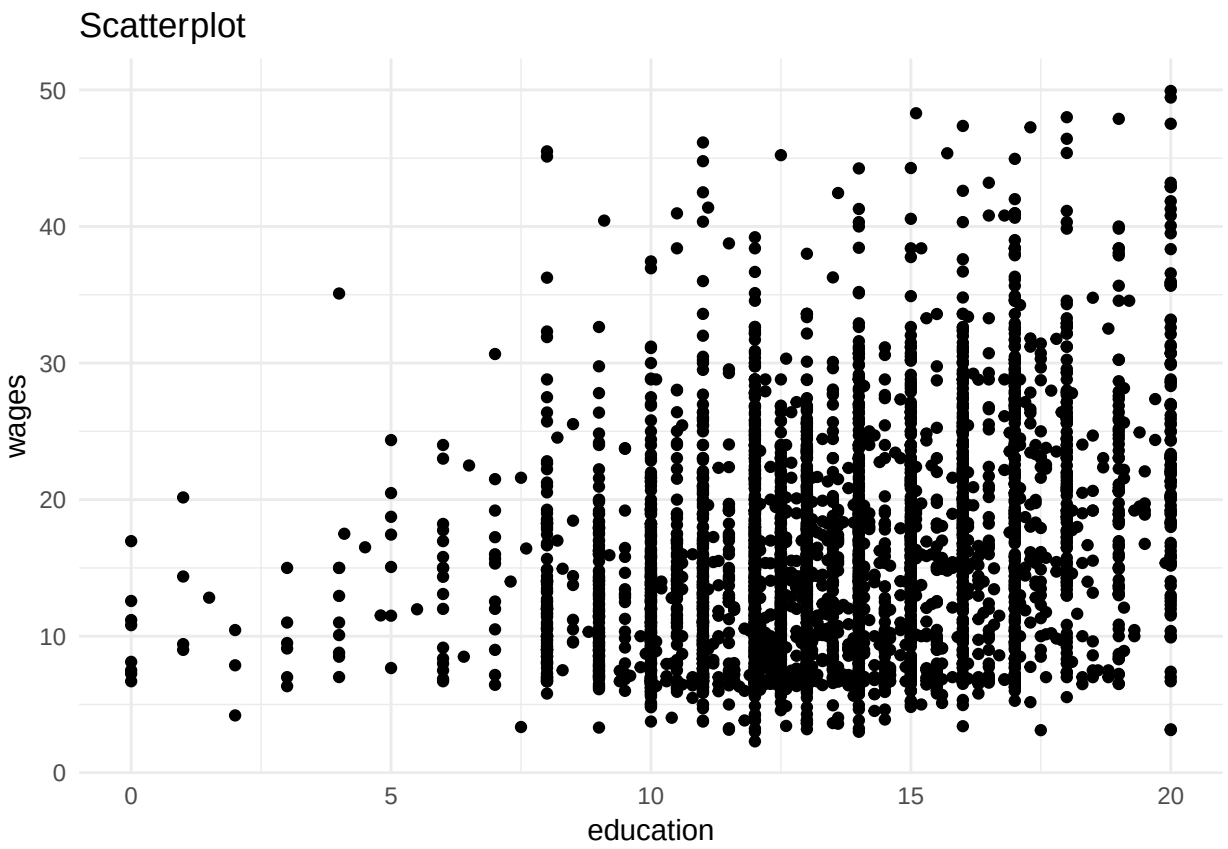
Data sets

Three different data sets are used - read descriptions in R:

- SLID: ?car::SLID
- mtcars: ?datasets::mtcars
- ozone: ?faraway::ozone

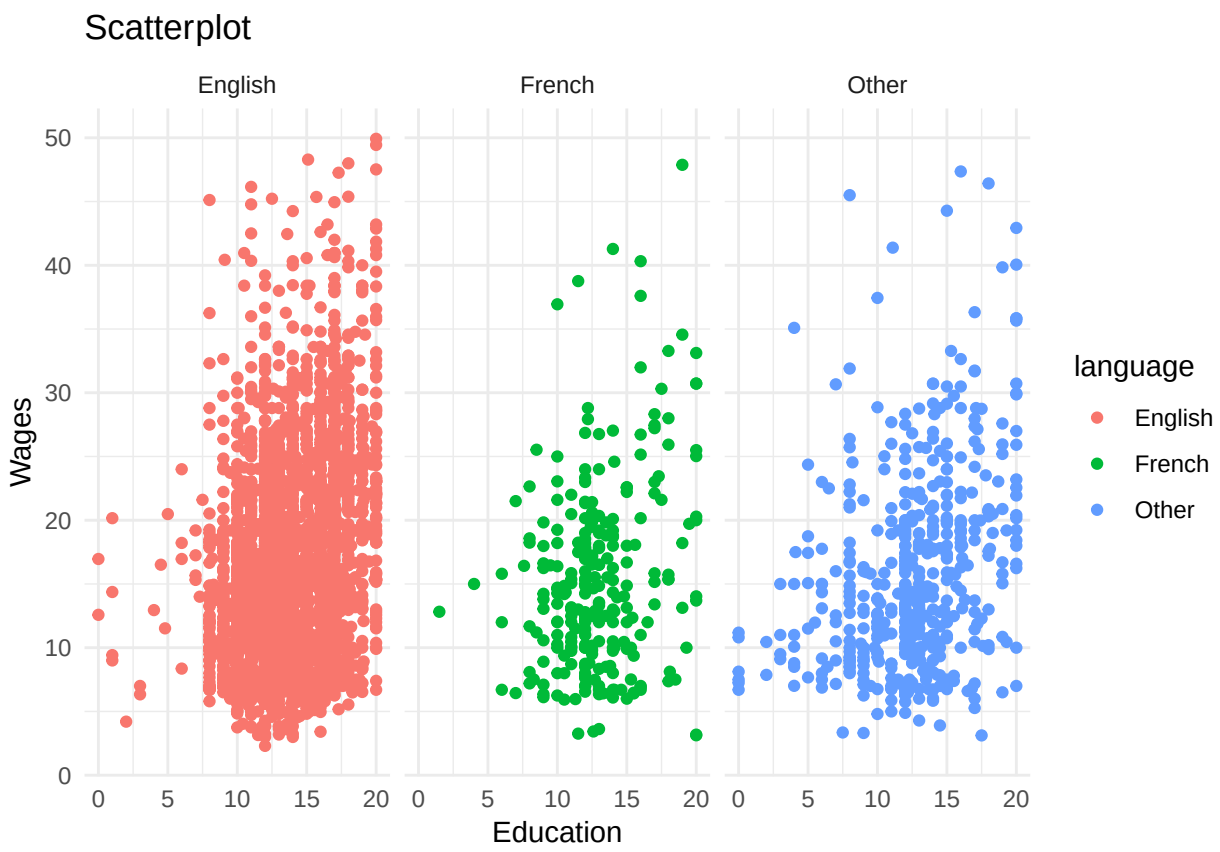
Scatter Plot

```
library(car)
library(ggplot2)
SLID = na.omit(SLID)
ggplot(SLID, aes(education, wages))+geom_point()+labs(title="Scatterplot")+theme_minimal()
```



Solution: The scatterplot shows that the people with the largest wages often are the people with the longest education. The plot also indicates that the variance increases as a function of education, i.e the expected wage vary less for a random person with 0-5 years of education compared to a person with 20 years of education.

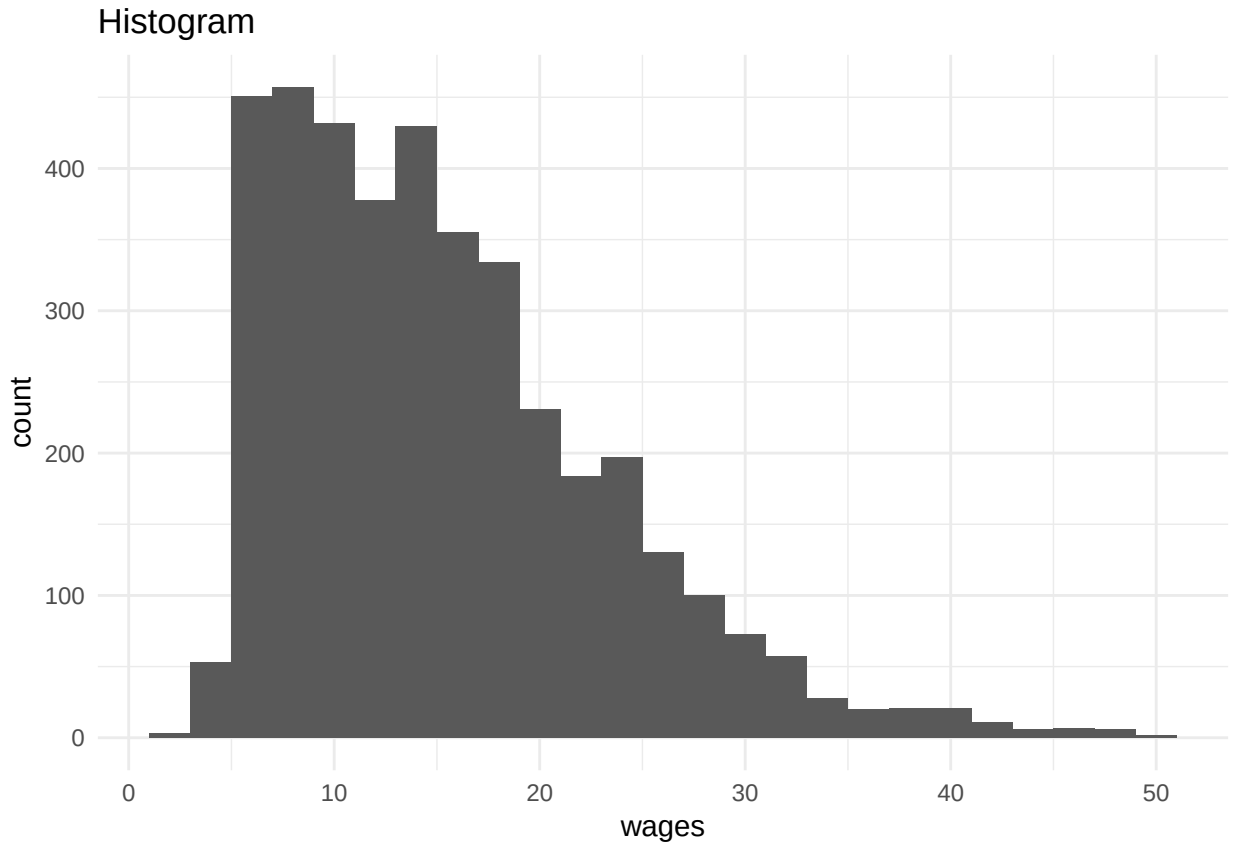
```
ggplot(SLID, aes(education, wages)) + geom_point(aes(color = language)) +
  scale_x_continuous("Education")+
  scale_y_continuous("Wages")+
  theme_bw() + labs(title="Scatterplot") + facet_wrap( ~ language)+theme_minimal()
```



Solution: From this plot we see that there are more english speaking people in the dataset. In general, the english speaking people have large education (relatively few people with education < 8 years). Among the people who speak other langauges than french and english, there is a larger amount of people with low education.

Histogram

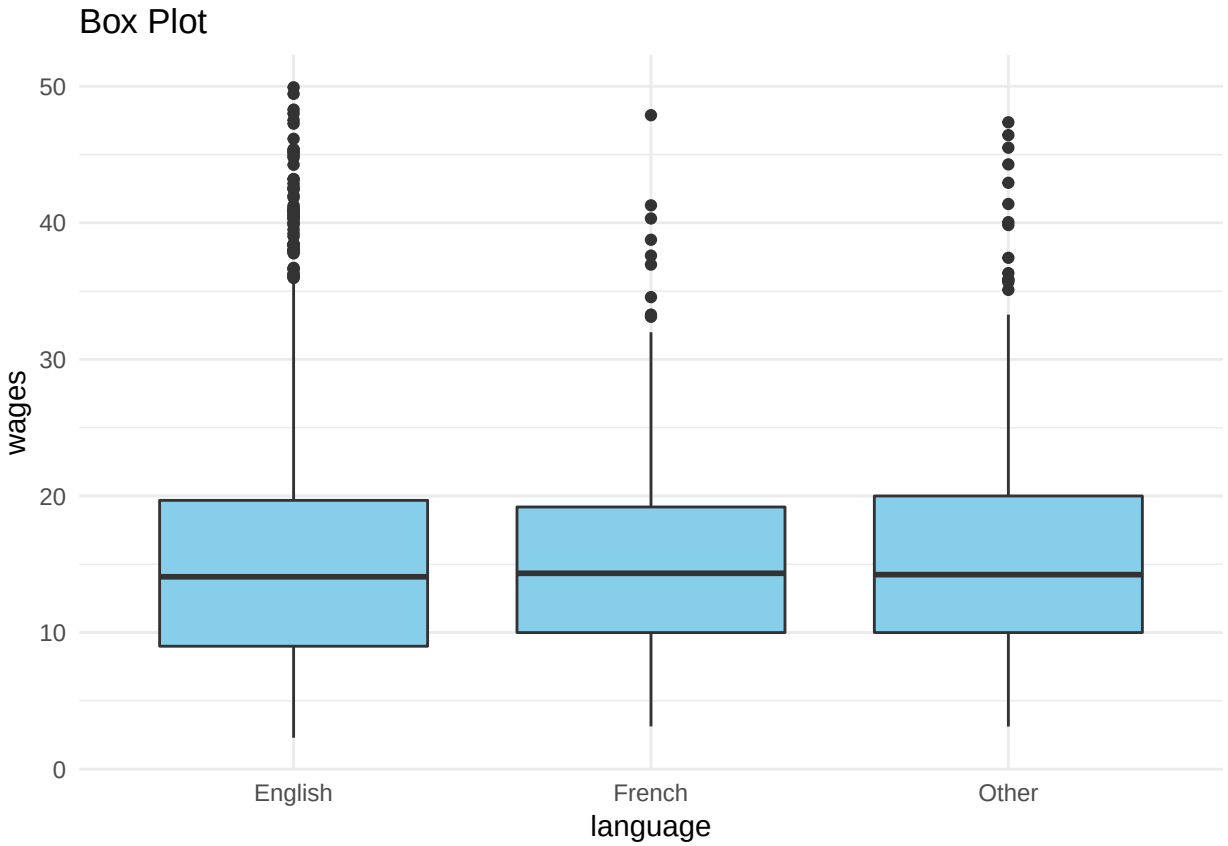
```
ggplot(SLID, aes(wages))+geom_histogram(binwidth=2)+labs(title="Histogram")+theme_minimal()
```



Solution: Shows the distributon of wages in the dataset.

Box-plot

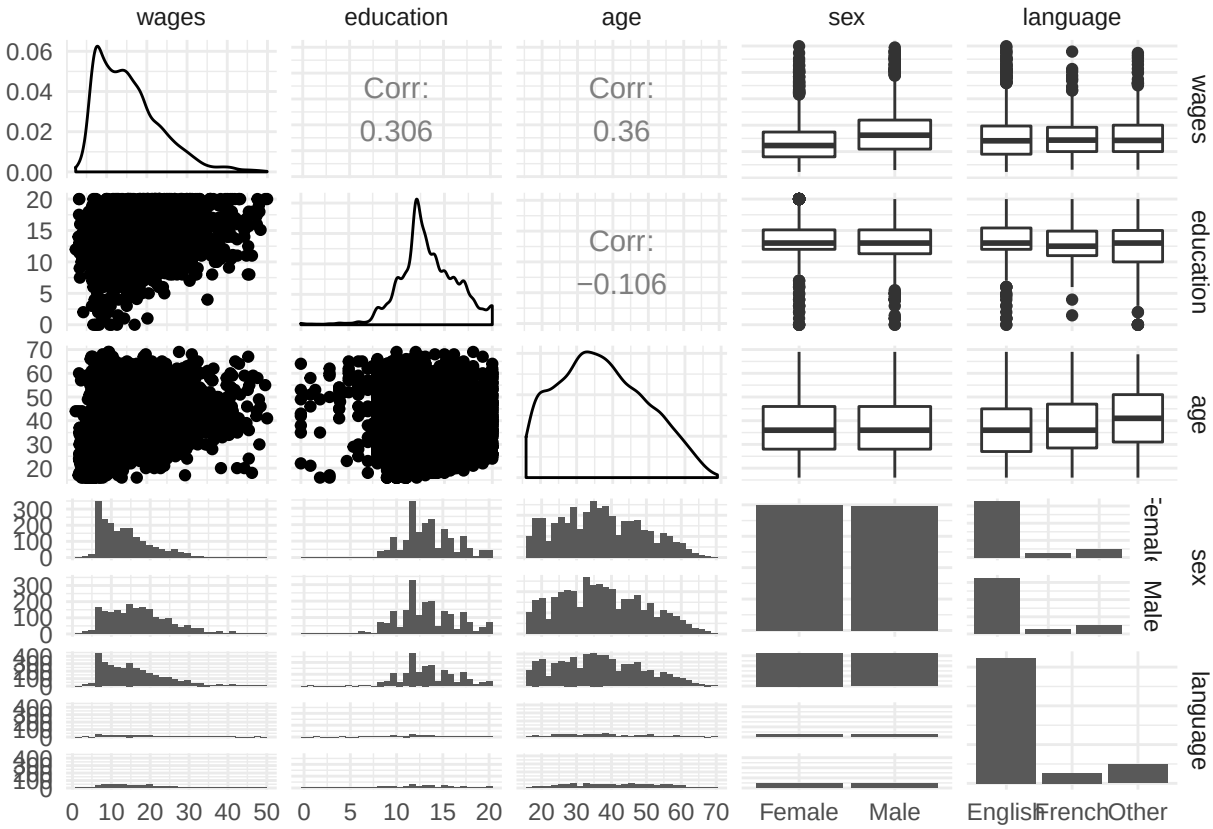
```
ggplot(SLID, aes(language,wages ))+geom_boxplot(fill="skyblue")+labs(title="Box Plot")+theme_minimal()
```



Solution: The median wage is similar for people speaking english, french and other languages. The 25 and $75 $ percentiles are also similar for the three boxplots. However, there are more outliers among the english speaking people: There are many people with wages that are larger than the upper $95 $ percentile.

All pairs and different plots

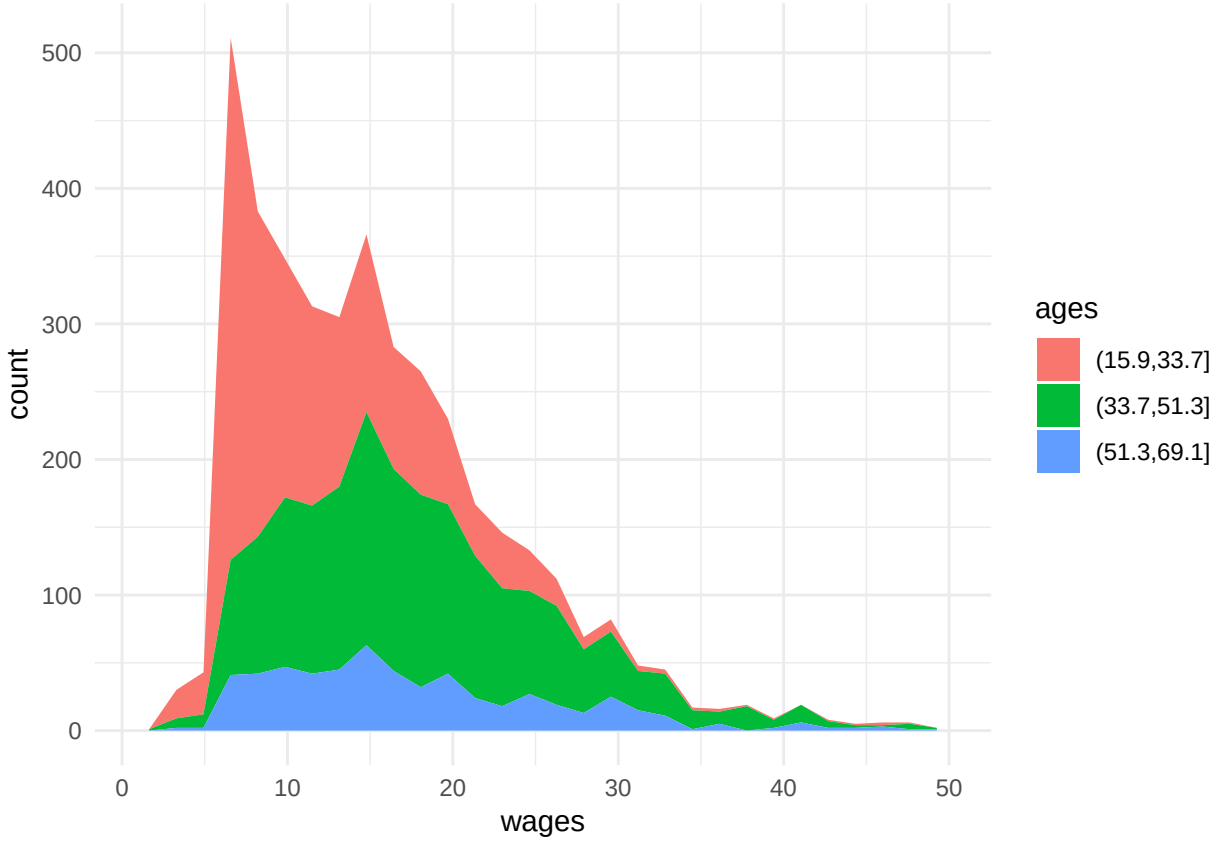
```
library(GGally)
ggpairs(SLID)+theme_minimal()
```



Solution: This plot gives us an overview of the dataset: * Correlation between different variables, e.g cor(age,wage)=0.36. * Distribution of wages in the dataset (upper left), education (row 1, column 2) and age (row 3, column 3). * Boxplots for different pairs of variables, e.g boxplots for wage as a function of gender (row 1, column 4). We see that males have a median wage that is larger than for the females in the dataset. * Histograms showing the distribution of the different covariates, i.e row 4, column 4 shows that there are approximately equally many males and females in the dataset. * Scatterplots indicating correlation between variables, e.g scatterplot between wages and education in row 2, column 1.

Area chart

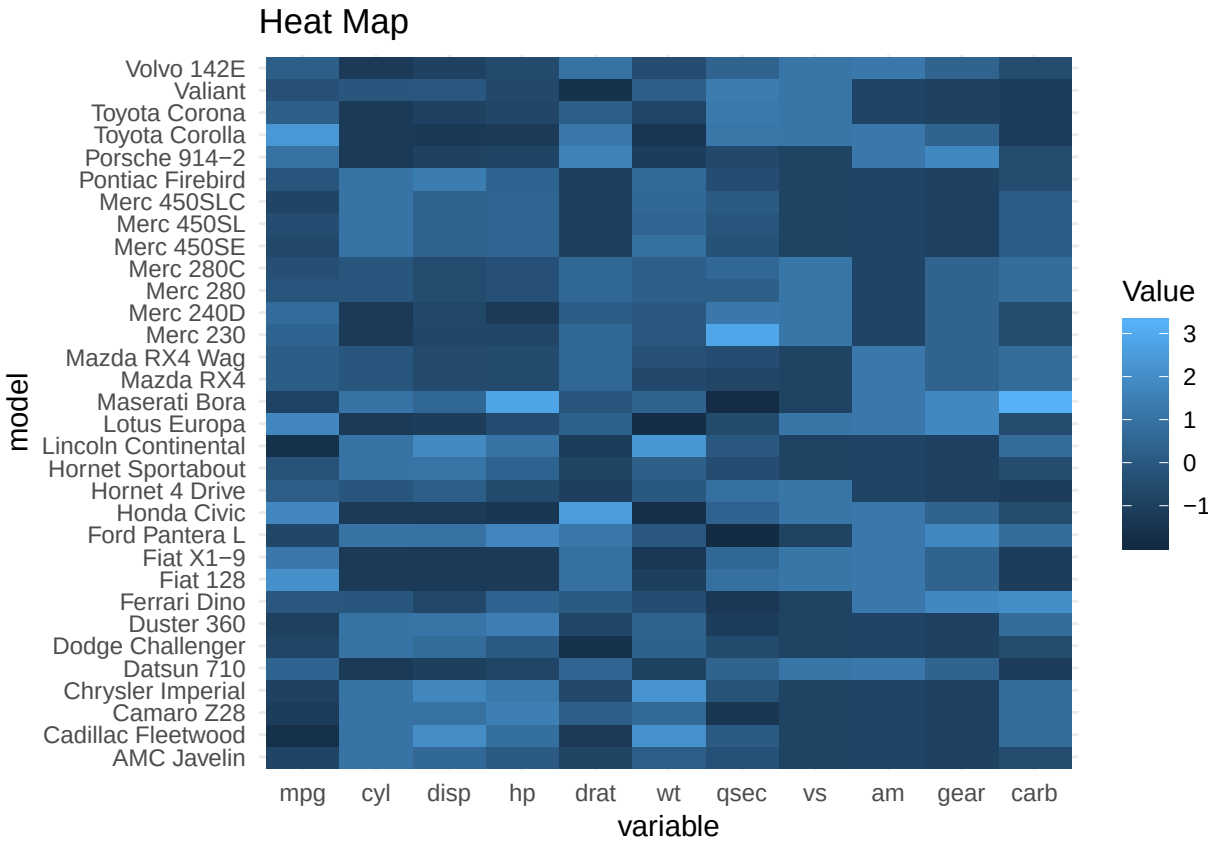
```
ages = cut(SLID$age, breaks=3)
SLID2 = cbind(SLID, ages)
ggplot(SLID, aes(x=wages, fill=ages))+geom_area(stat="bin")+theme_minimal()
```



Solution: Compares the distribution of wages for different age groups. Young people (red) tend to have lower wages than older people between 31.7 and 51.3 years (green).

Heat map

```
library(reshape)
head(mtcars)
carsdf = data.frame(scale(mtcars))
carsdf$model = rownames(mtcars)
cars_melt = melt(carsdf, id.vars="model")
ggplot(cars_melt, aes(x =variable, y = model)) +
  geom_raster(aes(fill=value)) +
  labs(title="Heat Map") +
  scale_fill_continuous(name="Value") +
  theme_minimal()
```




```
##                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

Solution: Visualization of the data. Shows the values of the different covariates (-1 to 3) for the different car models.

Acknowledgements

We thank Mette Langaas and her PhD students from 2018 and 2019 for building up the original version of this sheet.