Customer dropout membership[*]

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Abstract

Abstract of the article. Here we can place more info.

Introduction

Research idea:

-

Context: An organization membership located in Portugal. The organization offers an annual membership for the members, the service subscription has several payment options:

- Men with a annual fee of 10€
- Women annual fee of 6€

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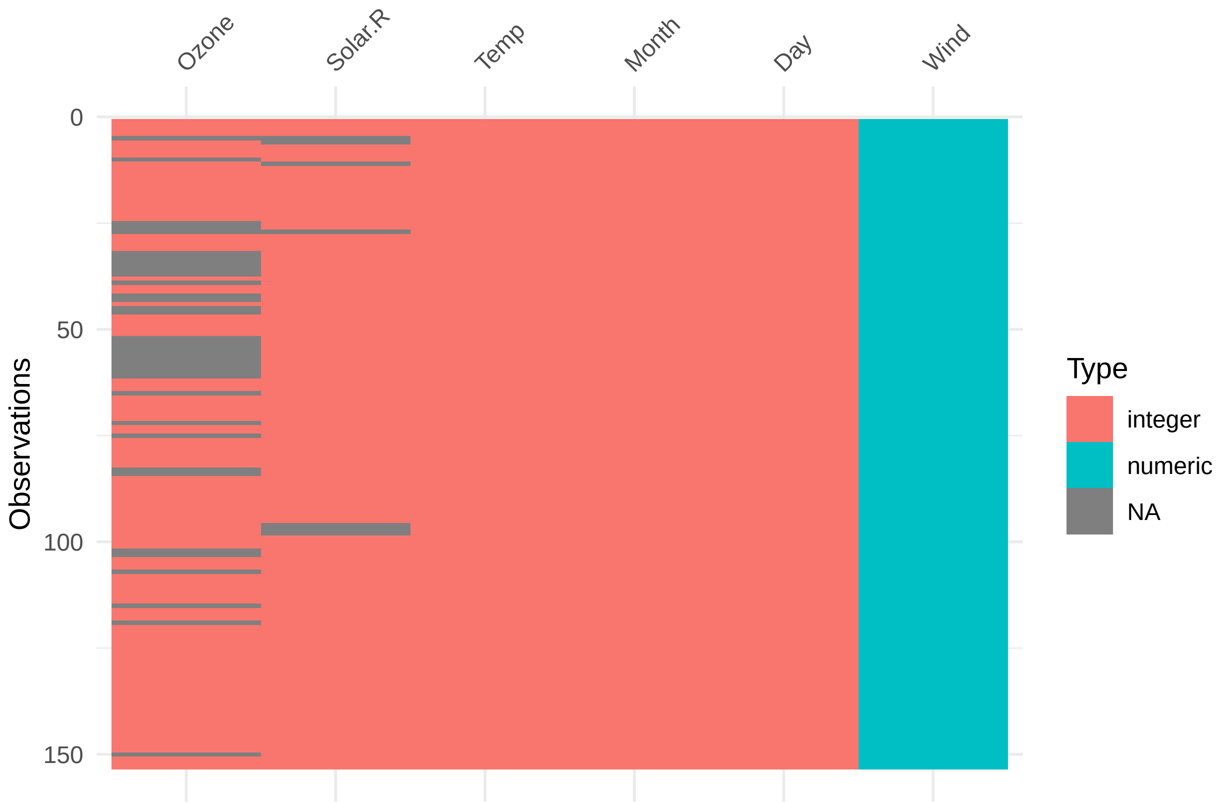
- Correspondent fee 6€
- Retired fee 5€
- Student fee 2.5€
- under-14 fee 1€

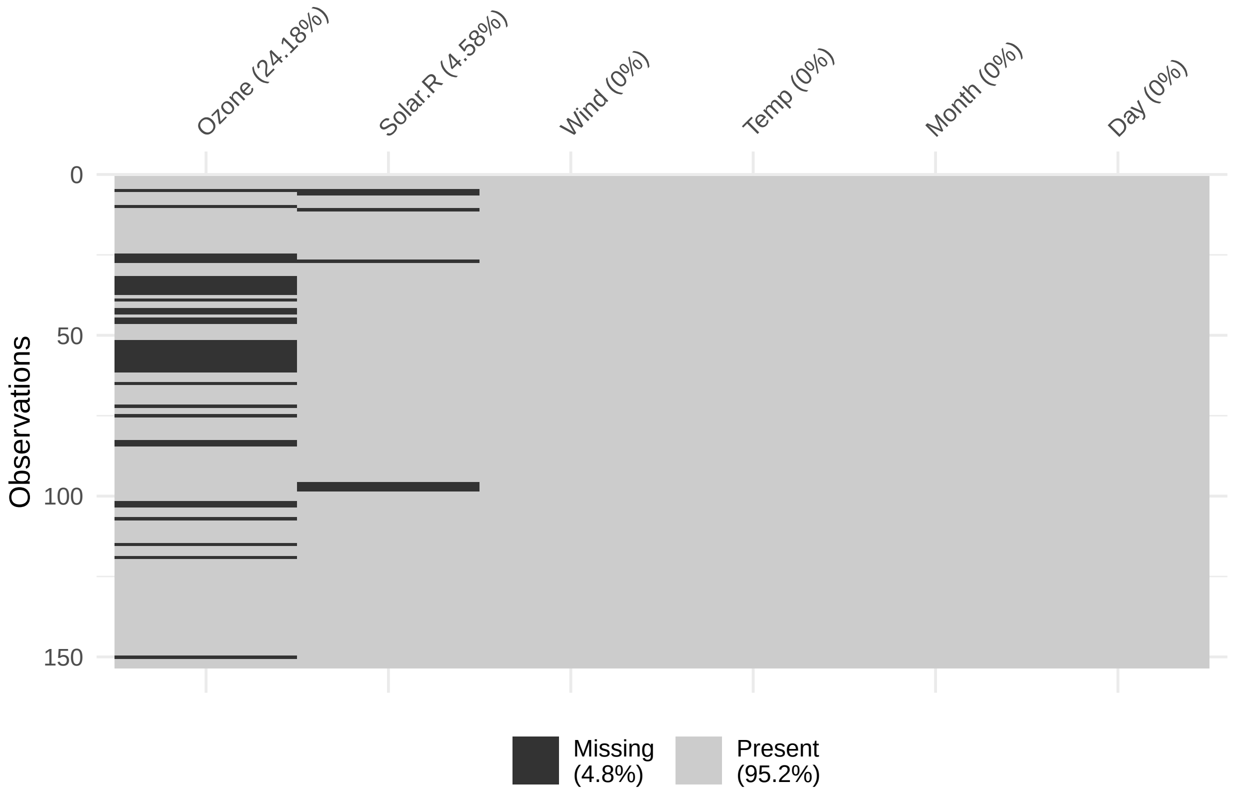
```r
library(dplyr)
library(dlookr)
library(ggplot2)

#eda_report(nlswork,output_dir  =
#   "C:/Users/mangelo.EEG/Documents/GitHub/prjs/reports/",
#   output_file = "eda_report.pdf")

## The data

names(airquality)
```

```
## [1] "Ozone"   "Solar.R" "Wind"    "Temp"    "Month"   "Day"
```

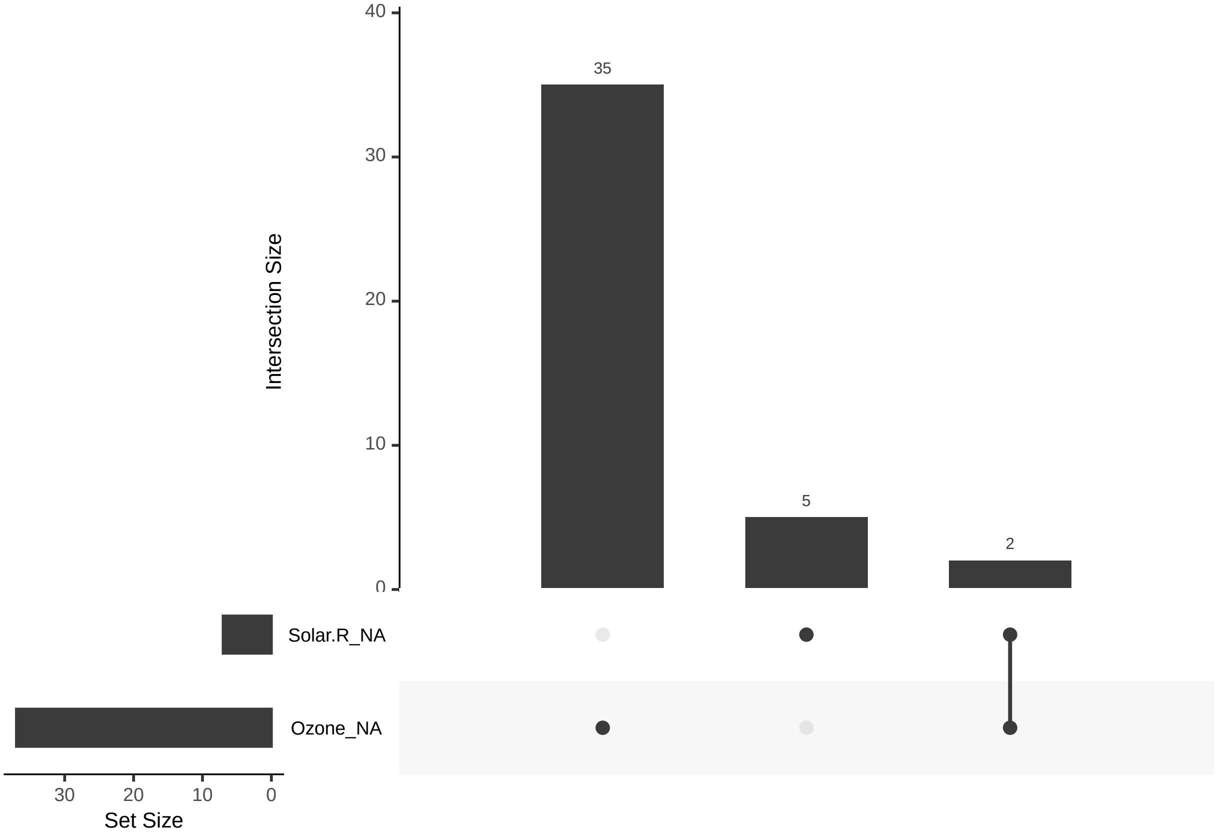
```r
#summary(nlswork)

## Missing values
library(visdat)
vis_dat(airquality)
```



```
library(naniar)
vis_miss(airquality)
```



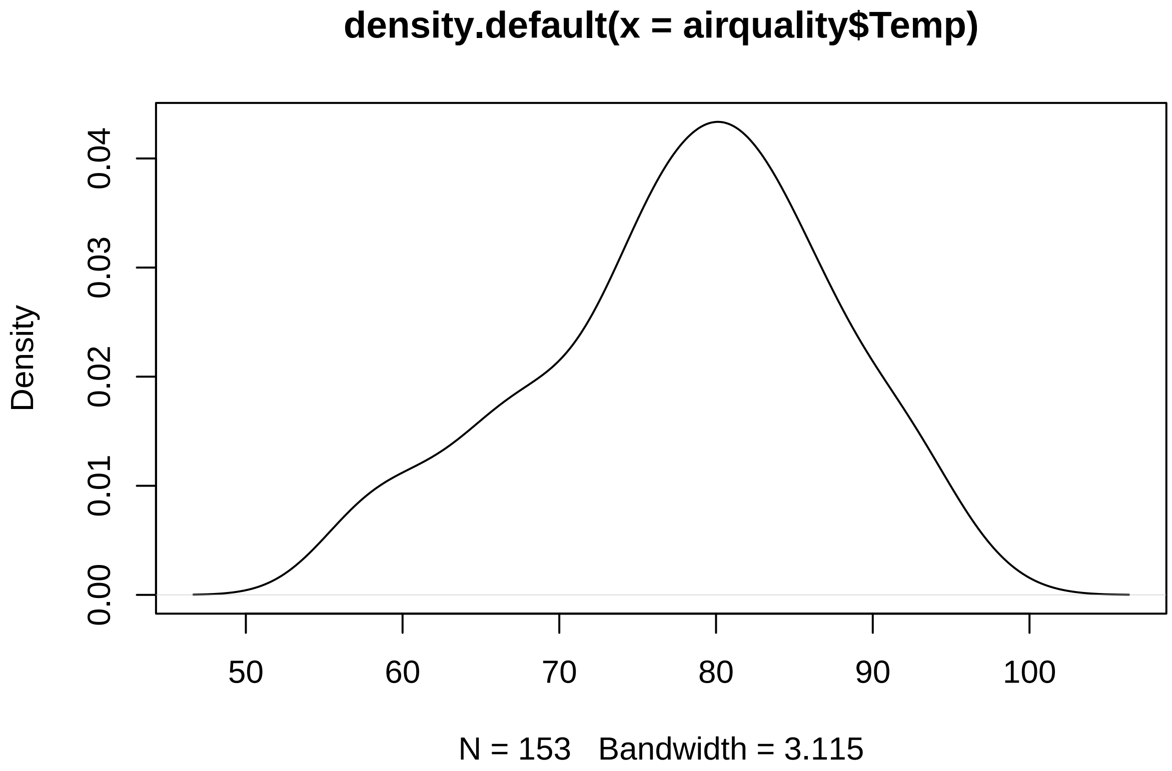
```
gg_miss_upset(airquality)
```



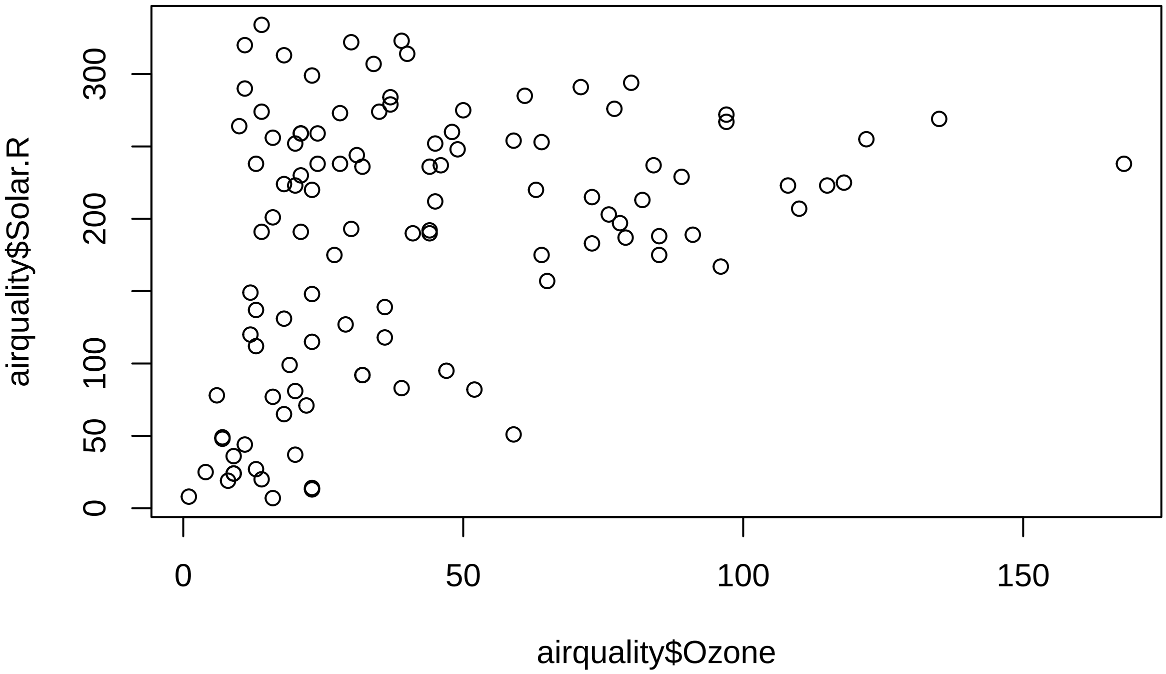
```
## GRAPHS
dplyr::glimpse(cars$Ozone)
```

```
##  NULL
```

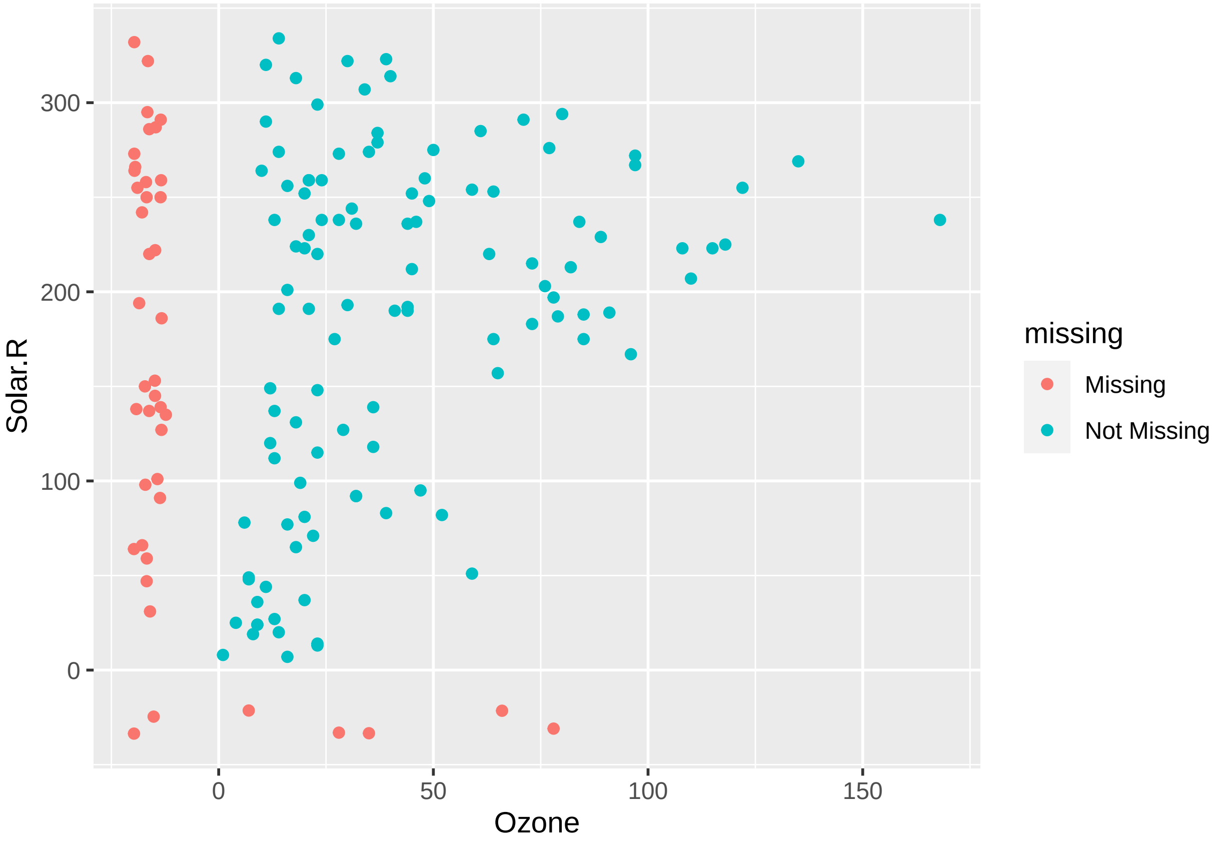
```
d <- density(airquality$Temp)
plot(d)
```



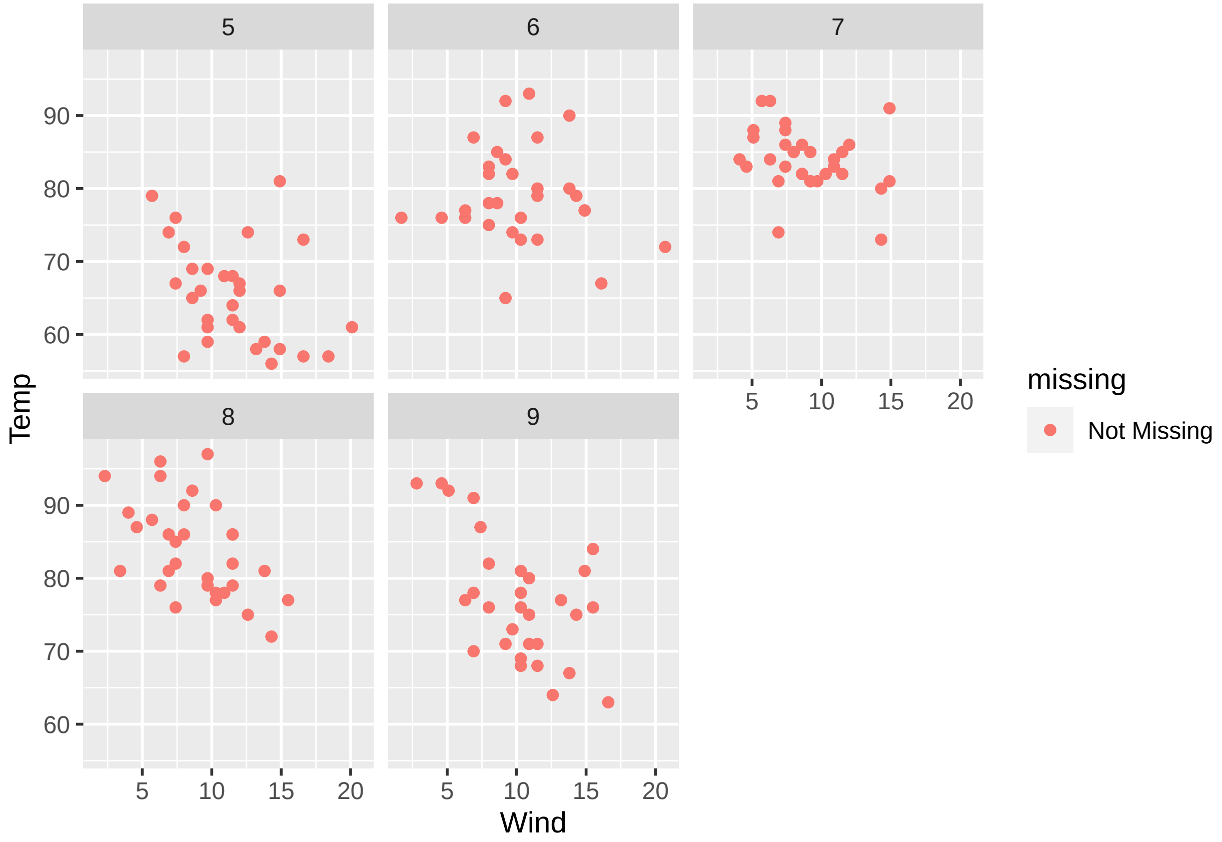
```
plot(airquality$Ozone, airquality$Solar.R)
```



```
ggplot(airquality, aes(x = Ozone, y = Solar.R)) +
geom_miss_point()
```



```
ggplot(airquality, aes(x = Wind, y = Temp)) +
geom_miss_point() +
facet_wrap(vars(Month))
```



```
stats <- summary(airquality$Temp)
stats
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   56.00   72.00   79.00   77.88   85.00   97.00 
```

```
describe(airquality)
```

```
## # A tibble: 6 x 26
##   variable     n    na  mean     sd se_mean   IQR skewness kurtosis   p00   p01   p05
##   <chr>    <int> <int>  <dbl> <dbl>   <dbl> <dbl>    <dbl>    <dbl> <dbl> <dbl> <dbl>
## 1 Ozone      116    37  42.1  33.0    3.06   45.2  1.24       1.29    1    4.3   7.75
## 2 Solar.R    146     7 186.   90.1    7.45  143   -0.428     -0.968   7   10.2  24.2
## 3 Wind       153     0   9.96  3.52   0.285   4.1  0.348      0.111   1.7  2.56  4.6
## 4 Temp       153     0  77.9   9.47   0.765  13   -0.378     -0.404  56   57    60.2
## 5 Month      153     0   6.99  1.42   0.115   2   -0.00239   -1.30    5    5     5
## 6 Day        153     0  15.8   8.86   0.717  15    0.00265   -1.20    1    1     2
## # ... with 14 more variables: p10 <dbl>, p20 <dbl>, p25 <dbl>, p30 <dbl>, p40 <dbl>,
## #   p50 <dbl>, p60 <dbl>, p70 <dbl>, p75 <dbl>, p80 <dbl>, p90 <dbl>, p95 <dbl>,
## #   p99 <dbl>, p100 <dbl>
```

Experimental Results

Data description

```
##  [1] "Sócio"               "dataAdesao"          "ano"
##  [4] "dataNascimento"      "idade"               "sexo"
##  [7] "estadoCivil"         "categoria"           "quotaMensal"
## [10] "profissao"           "codPostal"           "ultimaQuota"
## [13] "ultimoPagamento"     "valorTotal"          "totalJogos"
## [16] "jogosEpoca"          "diasUltimoPagamento" "mesesUP"
## [19] "abandonou"           "anosSocio"           "idaEstadio"
## [22] "escaloesTotalJogos"  "mes"
```

```
##  [1] "num_socio"                 "dt_inscription"
##  [3] "year"                      "birth_date"
##  [5] "age"                       "sex"
##  [7] "marital_status"            "category"
##  [9] "monthly_fee"               "occupation"
## [11] "zip_code"                  "dt_last_invoice"
## [13] "dt_last_payment"           "total_amount"
## [15] "total_matches"             "season_matches"
## [17] "days_since_last_payment"   "months_since_last_payment"
## [19] "dropout"                   "years_membership"
## [21] "stadium_access"            "quart_stadium_entries"
## [23] "inscription_month"
```

```
## tibble [25,316 x 14] (S3: tbl_df/tbl/data.frame)
##  $ year                     : num [1:25316] 1944 1944 1945 1945 1945 ...
##  $ age                      : num [1:25316] 83 88 73 97 97 91 88 95 88 78 ...
##  $ sex                      : chr [1:25316] "M" "M" "M" "M" ...
##  $ marital_status           : chr [1:25316] "casado" "solteiro" "nao definido" "casad
##  $ monthly_fee              : num [1:25316] 10 10 10 5 10 5 5 5 10 10 ...
##  $ total_amount             : num [1:25316] 1906 1906 1553 790 1466 ...
##  $ total_matches            : num [1:25316] 0 0 0 0 0 20 74 0 154 0 ...
##  $ season_matches           : num [1:25316] 0 0 0 0 0 0 0 0 6 0 ...
##  $ months_since_last_payment: num [1:25316] 3 3 36 8 35 4 41 40 4 2 ...
##  $ dropout                  : num [1:25316] 0 0 1 0 1 0 1 1 0 0 ...
##  $ years_membership         : num [1:25316] 74 74 73 73 73 73 73 73 73 72 ...
##  $ stadium_access           : num [1:25316] 0 0 0 0 0 1 1 0 1 0 ...
##  $ quart_stadium_entries    : chr [1:25316] "ate 1" "ate 1" "ate 1" "ate 1" ...
##  $ inscription_month        : num [1:25316] 10 10 8 9 9 12 1 1 2 4 ...
```

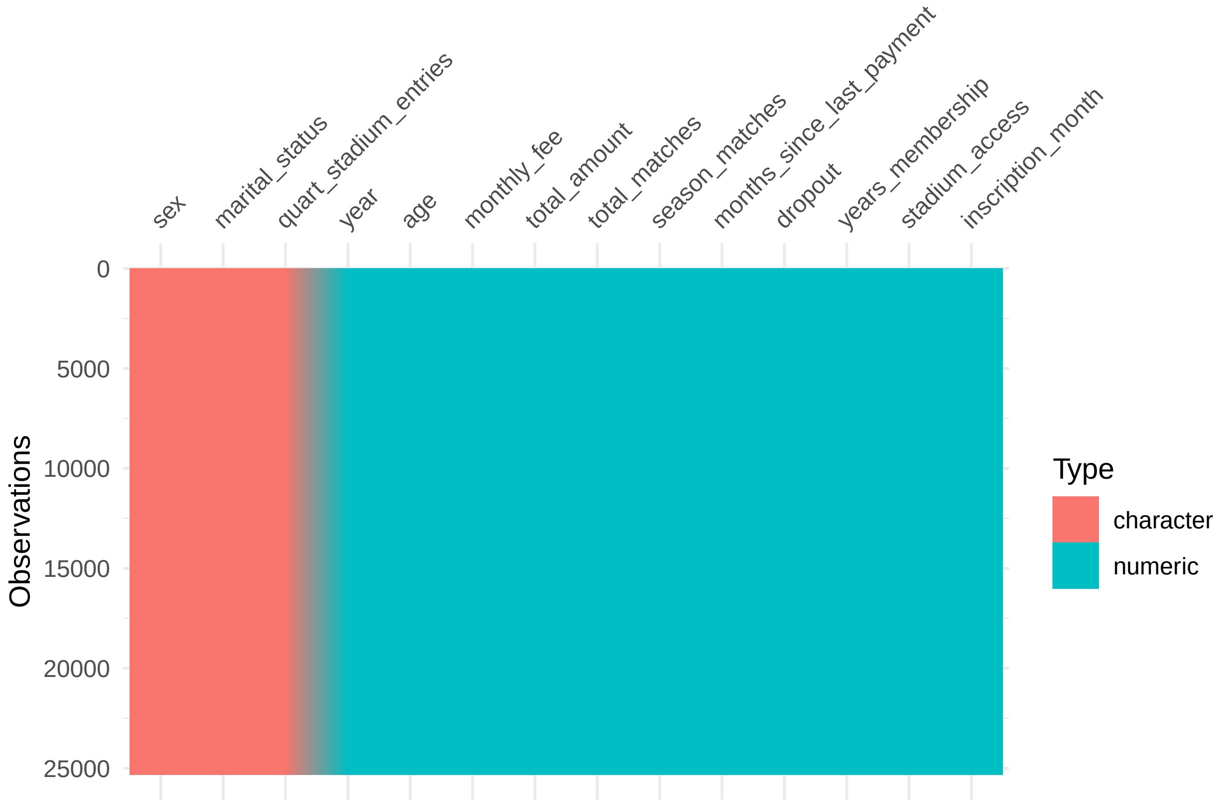


Table @ref(tab:tab1cars) shows data's summary statistics.[1] `stargazer()` is and excellent solution to export outputs.

Teste @ref(tab:summarytable)

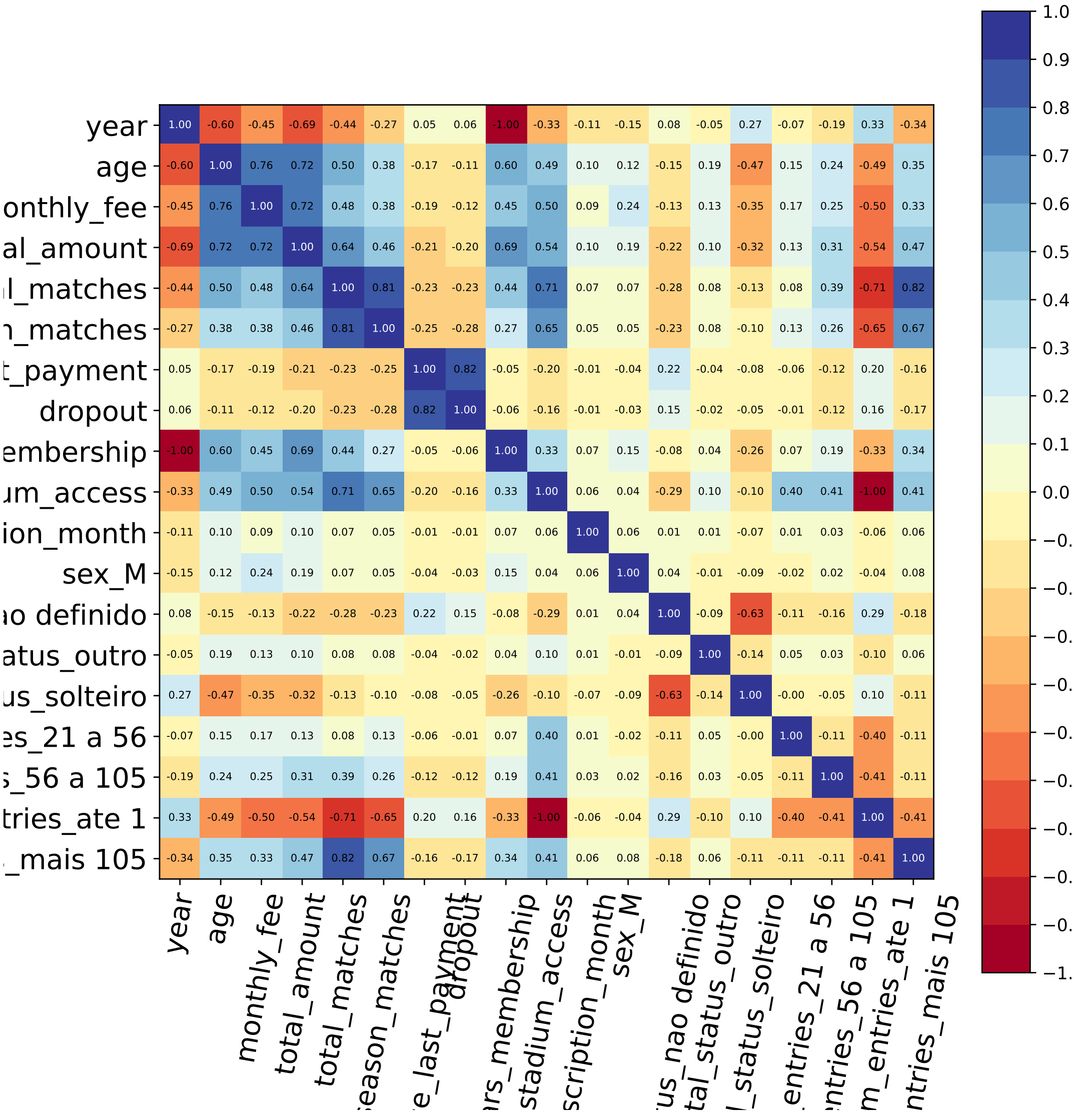
```
from pysurvival.utils.display import correlation_matrix
import pandas as pd
import numpy as np

col = ['sex','marital_status','quart_stadium_entries']

df_members = r.df_members #copy r dataframe to python

df_members = pd.get_dummies(df_members, columns=col,drop_first=True)

# Creating the time and event columns
time_column = 'years_membership'
event_column = 'dropout'
```

[1] You can reference the table as @ref(tab1cars).

Table 1: Summary statistics of features used

Characteristic	N = 25,316
Inscription year, Mean (SD)	2,007 (11)
Age in years, Mean (SD)	27 (20)
Male or female, %	
F	32%
M	68%
Single, married and other., %	
casado	20%
nao definido	30%
outro	2.0%
solteiro	48%
monthly_fee, %	
0	<0.1%
1	32%
2.5	28%
5	3.4%
6	12%
10	24%
total_amount, Mean (SD)	316 (494)
total_matches, Mean (SD)	27 (46)
season_matches, Mean (SD)	2.2 (4.1)
months_since_last_payment, Mean (SD)	19 (32)
dropout, %	22%
years_membership, Mean (SD)	11 (11)
stadium_access, %	40%
quart_stadium_entries, %	
1 a 21	10%
21 a 56	9.8%
56 a 105	10.0%
ate 1	60%
mais 105	10.0%
inscription_month, Mean (SD)	6.9 (3.4)

```
# Extracting the features
features = np.setdiff1d(df_members.columns, [time_column, event_column] ).tolist()


correlation_matrix(df_members, figure_size=(10,10), text_fontsize=6)
```



```
r.df_members = df_members
```

The average age is 27.3 ± 20.1.

total_amount total_matches season_matches12% 24% 316 (494) 27 (46) 2.2 (4.1) months_since_last_payment 19 (32) dropout 22% years_membership 11 (11)

```
str(df_members)
```

```
## 'data.frame':    25316 obs. of  19 variables:
##  $ year                          : num  1944 1944 1945 1945 1945 ...
##  $ age                           : num  83 88 73 97 97 91 88 95 88 78 ...
##  $ monthly_fee                   : num  10 10 10 5 10 5 5 5 10 10 ...
##  $ total_amount                  : num  1906 1906 1553 790 1466 ...
##  $ total_matches                 : num  0 0 0 0 0 20 74 0 154 0 ...
##  $ season_matches                : num  0 0 0 0 0 0 0 0 6 0 ...
##  $ months_since_last_payment     : num  3 3 36 8 35 4 41 40 4 2 ...
##  $ dropout                       : num  0 0 1 0 1 0 1 1 0 0 ...
##  $ years_membership              : num  74 74 73 73 73 73 73 73 73 72 ...
##  $ stadium_access                : num  0 0 0 0 0 1 1 0 1 0 ...
##  $ inscription_month             : num  10 10 8 9 9 12 1 1 2 4 ...
##  $ sex_M                         : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ marital_status_nao definido   : int  0 0 1 0 0 0 0 0 0 1 ...
##  $ marital_status_outro          : int  0 0 0 0 1 0 0 1 0 0 ...
##  $ marital_status_solteiro       : int  0 1 0 0 0 0 0 0 0 0 ...
##  $ quart_stadium_entries_21 a 56 : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ quart_stadium_entries_56 a 105: int  0 0 0 0 0 0 1 0 0 0 ...
##  $ quart_stadium_entries_ate 1   : int  1 1 1 1 1 0 0 1 0 1 ...
##  $ quart_stadium_entries_mais 105: int  0 0 0 0 0 0 0 0 1 0 ...
##  - attr(*, "pandas.index")=RangeIndex(start=0, stop=25316, step=1)
```

Tables

R Markdown PDF is now able to produce good tables with our output. For `stargazer` the label is contained in the function, while for `kable` it's contained in the chunk name.

stargazer(): Summary and regression tables

Table @ref(tab2) reports regression outputs. Name the models as you can refer to their names in the text (M1, M2, M3).

```
library(stargazer)
model1 <- lm(speed ~ dist, data = cars)
model2 <- lm(speed ~ dist, data = cars)
model3 <- lm(dist ~ speed, data = cars)
stargazer(model1, model2, model3,
          title = "Regression table with stargazer",
          label = "tab2",
          table.placement = "h",
          column.labels = c("M1", "M2", "M3"),
          model.numbers = FALSE,
          header = FALSE)
```

Table 2: Regression table with stargazer

	Dependent variable:		
	speed		dist
	M1	M2	M3
dist	0.166***	0.166***	
	(0.017)	(0.017)	
speed			3.932***
			(0.416)
Constant	8.284***	8.284***	$-$17.579**
	(0.874)	(0.874)	(6.758)
Observations	50	50	50
R^2	0.651	0.651	0.651
Adjusted R^2	0.644	0.644	0.644
Residual Std. Error (df = 48)	3.156	3.156	15.380
F Statistic (df = 1; 48)	89.567***	89.567***	89.567***
Note:	*p<0.1; **p<0.05; ***p<0.01		

Figures

Graphs with R

You can insert figures like this. One would like to produce and insert them on the fly in the `.rmd` file. Figure @ref(fig:fig-1) is such an example.

```
plot(cars$speed, cars$dist)
```

However, in some cases it does not work.

Example: ggplot2 graphs

See the `ggplot2` output reported in Figure @ref(fig:fig-2).

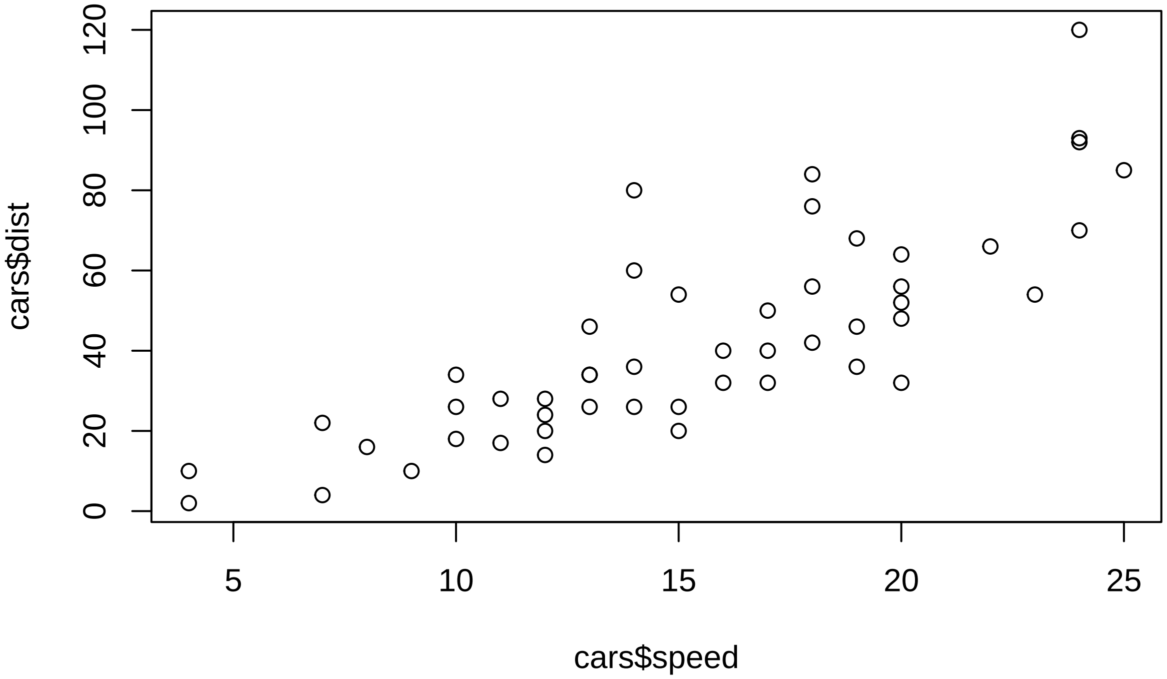


Figure 1: Scatterplot of Speed and Distance

```
mtcars$cyl <- as.factor(mtcars$cyl) # Convert cyl to factor
library(ggplot2)
ggplot(mtcars, aes(x = wt, y = mpg, shape = cyl)) + geom_point() +
  labs(x = "Weight (lb/1000)", y = "Miles/(US) gallon",
       shape = "Number of \n Cylinders") + theme_classic()
```

Another example using Plotly

With `Plotly` we can produce interactive graphs which play well, for example, once can embedded in html webpages (drop by here for an example). One can insert this type of graphs in R Markdown PDF using `Orca` (it generates static images from Plotly graphs). Go here to check how to install it. See Figure @ref(fig:fig-3) for an example.

```
library(plotly)
p <- plot_ly(cars, type = "scatter", mode = "markers",
        x = ~speed,
        y = ~dist)
```

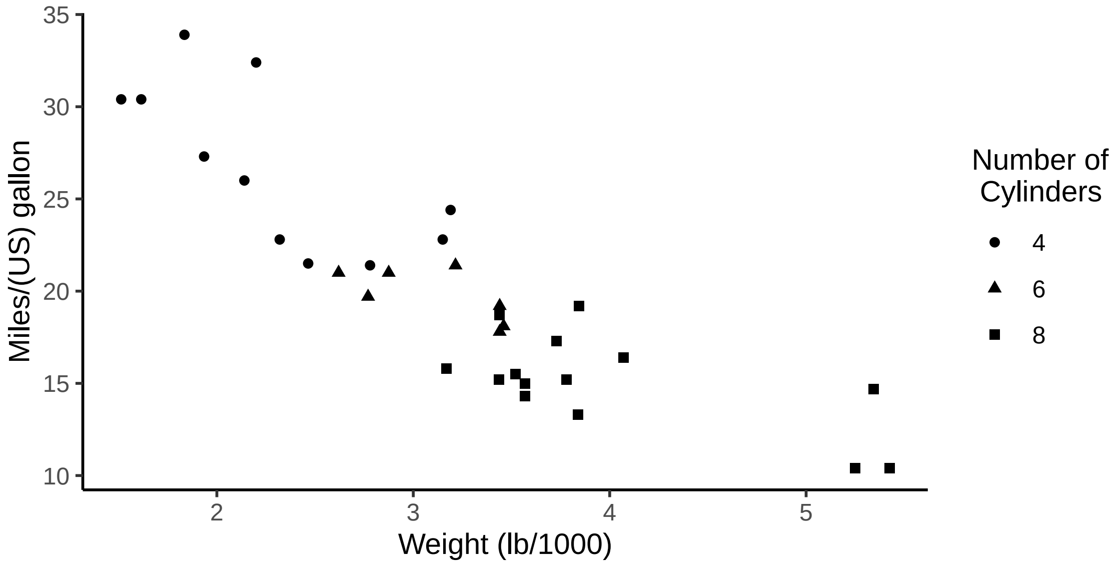


Figure 2: Miles per gallon according to the weight

```
#Sys.setenv('MAPBOX_TOKEN' = '12/23/23') # set arbitrary token
# Lets create a value for example


media <- mean(cars$speed)
```

The criminal rate is 15.4%o.

Miguel's tests

R

Example of an equation

$$\int_0^{2\pi} \sin x \ dx$$

Example of a matrix

$$\mathbf{X} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

or

$$f\left(k\right)=\binom{n}{k}p^{k}\left(1-p\right)^{n-k} \tag{1}$$

See Equation @ref(eq:binom).

$$y_{ijt}=\beta x_{ijt}+\eta_i+\gamma_j+\lambda_t+\varepsilon_{ijt} \tag{2}$$

```r
library(stargazer)
stargazer(cars,
          title = "Summary 24",
          label = "tab24",
          table.placement = "ht",
          header = FALSE)
```

Table 3: Summary 24

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
speed	50	15.400	5.288	4	12	19	25
dist	50	42.980	25.769	2	26	56	120

Final remarks

Check the replication package for Bonhomme, Lamadon and Manresa (2019): https://github.com/tlamadon/blm-replicate

References

Appendix: Chunk options

Software versioning

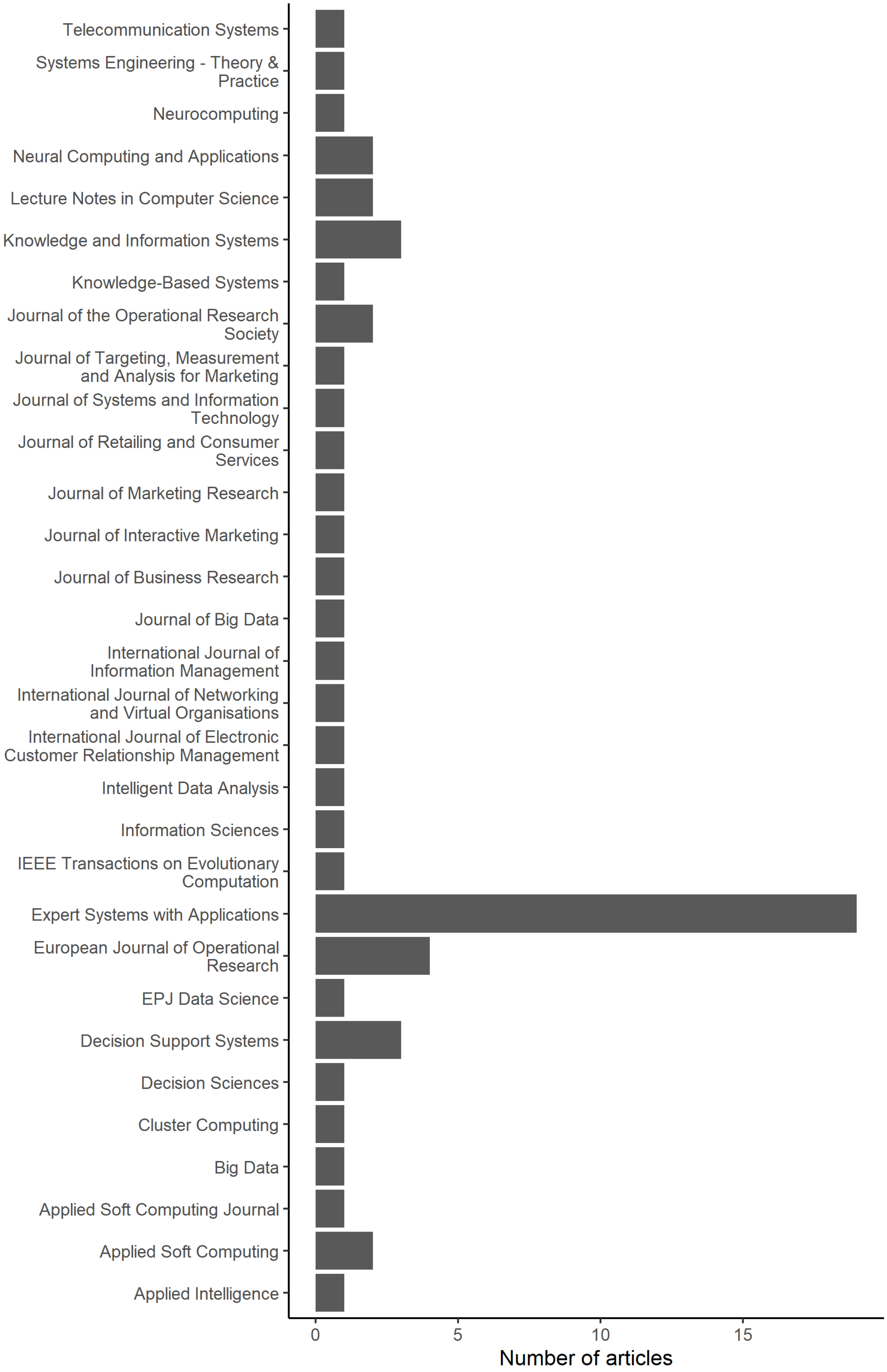
R

```
cat(paste("#", capture.output(sessionInfo()), "\n", collapse  = ""))
```

```
## # R version 4.1.0 (2021-05-18)
## # Platform: x86_64-pc-linux-gnu (64-bit)
## # Running under: Ubuntu 20.04.2 LTS
## #
## # Matrix products: default
## # BLAS:   /usr/lib/x86_64-linux-gnu/openblas-pthread/libblas.so.3
## # LAPACK: /home/sobreiro/miniconda3/envs/survival/lib/libmkl_intel_lp64.so
## #
## # locale:
## # [1] en_US.UTF8
## #
## # attached base packages:
## # [1] stats     graphics  grDevices utils     datasets  methods   base
## #
## # other attached packages:
## #  [1] labelled_2.8.0   plotly_4.9.4.1   kableExtra_1.3.4 gtsummary_1.4.2
## #  [5] readxl_1.3.1     stargazer_5.2.2  naniar_0.6.1     visdat_0.5.3
## #  [9] ggplot2_3.3.5    dlookr_0.4.5     dplyr_1.0.7      reticulate_1.20
## # [13] rmarkdown_2.9    nvimcom_0.9-115
## #
## # loaded via a namespace (and not attached):
## #   [1] colorspace_2.0-2    ellipsis_0.3.2      class_7.3-19        rio_0.5.27
## #   [5] htmlTable_2.2.1     base64enc_0.1-3     rstudioapi_0.13     proxy_0.4-26
## #   [9] farver_2.1.0        fansi_0.5.0         mvtnorm_1.1-2       xml2_1.3.2
## #  [13] splines_4.1.0       extrafont_0.17      libcoin_1.0-8       knitr_1.33
## #  [17] Formula_1.2-4       jsonlite_1.7.2      gt_0.3.0            Rttf2pt1_1.3.8
## #  [21] cluster_2.1.2       png_0.1-7           compiler_4.1.0      httr_1.4.2
## #  [25] backports_1.2.1     assertthat_0.2.1    Matrix_1.3-4        lazyeval_0.2.2
## #  [29] cli_3.0.1           hrbrthemes_0.8.0    htmltools_0.5.1.1   tools_4.1.0
## #  [33] partykit_1.2-13     gtable_0.3.0        glue_1.4.2          rappdirs_0.3.3
## #  [37] tinytex_0.32        Rcpp_1.0.7          carData_3.0-4       cellranger_1.1.0
## #  [41] vctrs_0.3.8         svglite_2.0.0       extrafontdb_1.0     crosstalk_1.1.1
## #  [45] broom.helpers_1.3.0 inum_1.0-4          xfun_0.24           stringr_1.4.0
## #  [49] openxlsx_4.2.4      rvest_1.0.0         lifecycle_1.0.0     RcmdrMisc_2.7-1
## #  [53] MASS_7.3-54         zoo_1.8-9           scales_1.1.1        hms_1.1.0
## #  [57] sandwich_3.0-1      RColorBrewer_1.1-2  yaml_2.2.1          curl_4.3.2
## #  [61] gridExtra_2.3       UpSetR_1.4.0        sass_0.4.0          gdtools_0.2.3
## #  [65] rpart_4.1-15        latticeExtra_0.6-29 stringi_1.7.3       highr_0.9
## #  [69] corrplot_0.90       nortest_1.0-4       e1071_1.7-7         checkmate_2.0.0
## #  [73] zip_2.2.0           commonmark_1.7      rlang_0.4.11        pkgconfig_2.0.3
## #  [77] systemfonts_1.0.2   evaluate_0.14       lattice_0.20-44     purrr_0.3.4
## #  [81] htmlwidgets_1.5.3   labeling_0.4.2      tidyselect_1.1.1    plyr_1.8.6
## #  [85] magrittr_2.0.1      R6_2.5.0            generics_0.1.0      Hmisc_4.5-0
## #  [89] DBI_1.1.1           pillar_1.6.1        haven_2.4.1         foreign_0.8-81
## #  [93] withr_2.4.2         prettydoc_0.4.1     survival_3.2-11     abind_1.4-5
## #  [97] nnet_7.3-16         tibble_3.1.3        crayon_1.4.1        car_3.0-11
## # [101] utf8_1.2.1          jpeg_0.1-8.1        grid_4.1.0          data.table_1.14.0
## # [105] forcats_0.5.1       digest_0.6.27       webshot_0.5.2       tidyr_1.1.3
## # [109] munsell_0.5.0       viridisLite_0.4.0
```

```
# or use message() instead of cat()
```

Figure 3: Example: export a Plotly figure using ‘orca‘


Telecommunication Systems
Systems Engineering - Theory & Practice
Neurocomputing
Neural Computing and Applications
Lecture Notes in Computer Science
Knowledge and Information Systems
Knowledge-Based Systems
Journal of the Operational Research Society
Journal of Targeting, Measurement and Analysis for Marketing
Journal of Systems and Information Technology
Journal of Retailing and Consumer Services
Journal of Marketing Research
Journal of Interactive Marketing
Journal of Business Research
Journal of Big Data
International Journal of Information Management
International Journal of Networking and Virtual Organisations
International Journal of Electronic Customer Relationship Management
Intelligent Data Analysis
Information Sciences
IEEE Transactions on Evolutionary Computation
Expert Systems with Applications
European Journal of Operational Research
EPJ Data Science
Decision Support Systems
Decision Sciences
Cluster Computing
Big Data
Applied Soft Computing Journal
Applied Soft Computing
Applied Intelligence
Number of articles