Literate programming with Python, R, Julia and Stata**

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16 December, 2019

Abstract

In this presentation I will discuss how we can enhance the workflow by using literate programming to combine key features of different statistical packages, namely Stata, R, Julia and Python, on the one hand, and Latex as the typesetting system on the other. The goal is to demonstrate and share a template aiming at producing a highly automated report, or research paper, within the same framework. The tasks will run from exploratory data analysis to regression analysis, where the output, from summary to regression tables and figures, is seamlessly included in the final document. Furthermore, important elements of Latex editing, such as automatic referencing, will be highlighted. We aim at freeing the researcher form repetitive tasks to focus on critical and creative writing. Efficiency and replicability will be at the core of the discussion. RStudio will be used to edit and compile R Markdown. The focus will be on producing PDF outputs. In the presentation I will make use of packages such as bookdown, knitr, stargazer, dlookr, ggplot2, plotly, Statamarkdown, reticulate, JuliaCall, pandas, numpy, matplotlib or FixedEffectModels. The current code is an adaptation of the Rmd by Paul C. Bauer, Mannheim Centre for European Social Research, mail@paulcbauer.eu..

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1 Exploratory data analysis

I start by exploring the data **NLSWORK** (National Longitudinal Survey. Young Women 14-26 years of age in 1968).

```
## ExPanDaR: Explore Panel Data Interactively

  library(ExPanDaR)

    ## type ExPanD() in the Console

setwd("/Users/miguelportela/Dropbox/1.miguel/bdp/4.code_ados/dados_descricao/data_descri

library(haven)

nlswork <- read_dta("/Users/miguelportela/Dropbox/1.miguel/bdp/4.code_ados/dados_descric

nls<-data.frame(nlswork)

attach(nlswork)

head(nlswork)
```

2 A tibble: 6 x 21

idcode year birth_yr age race msp nev_mar grade collgrad not_smsa <dbl+l> 1 1 70 51 18 2 [bla~ 0 1 12 0 0 2 1 71 51 19 2 [bla~ 1 0 12 0 0 3 1 72 51 20 2 [bla~ 1 0 12 0 0 4 1 73 51 21 2 [bla~ 1 0 12 0 0 5 1 75 51 23 2 [bla~ 1 0 12 0 0 6 1 77 51 25 2 [bla~ 0 0 12 0 0 # … with 11 more variables: c_city , south , ind_code , # occ_code , union , wks_ue , ttl_exp , tenure , # hours , wks_work , ln_wage

```
library(stargazer)
stargazer(nls,
          title = "Summary statistics",
          label="tab:tab1nls",
          table.placement = "ht",
          header=FALSE)
```

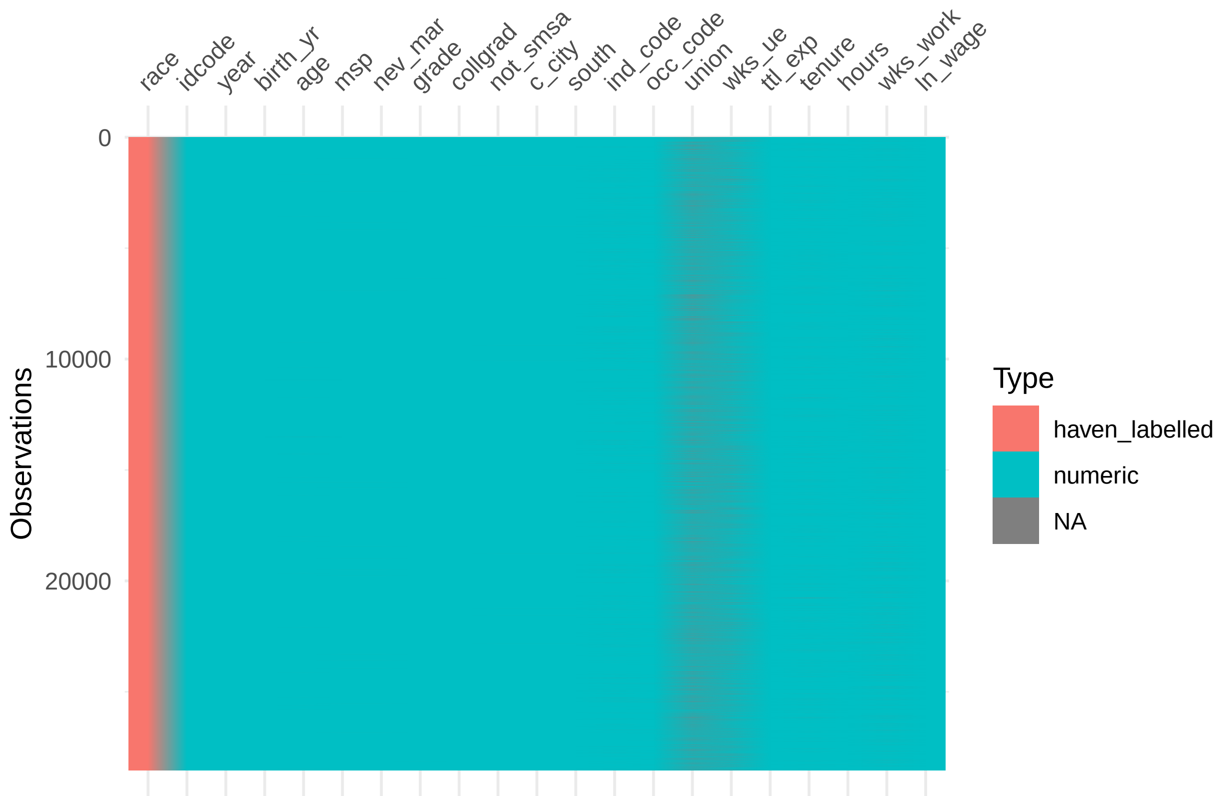
Table 1: Summary statistics

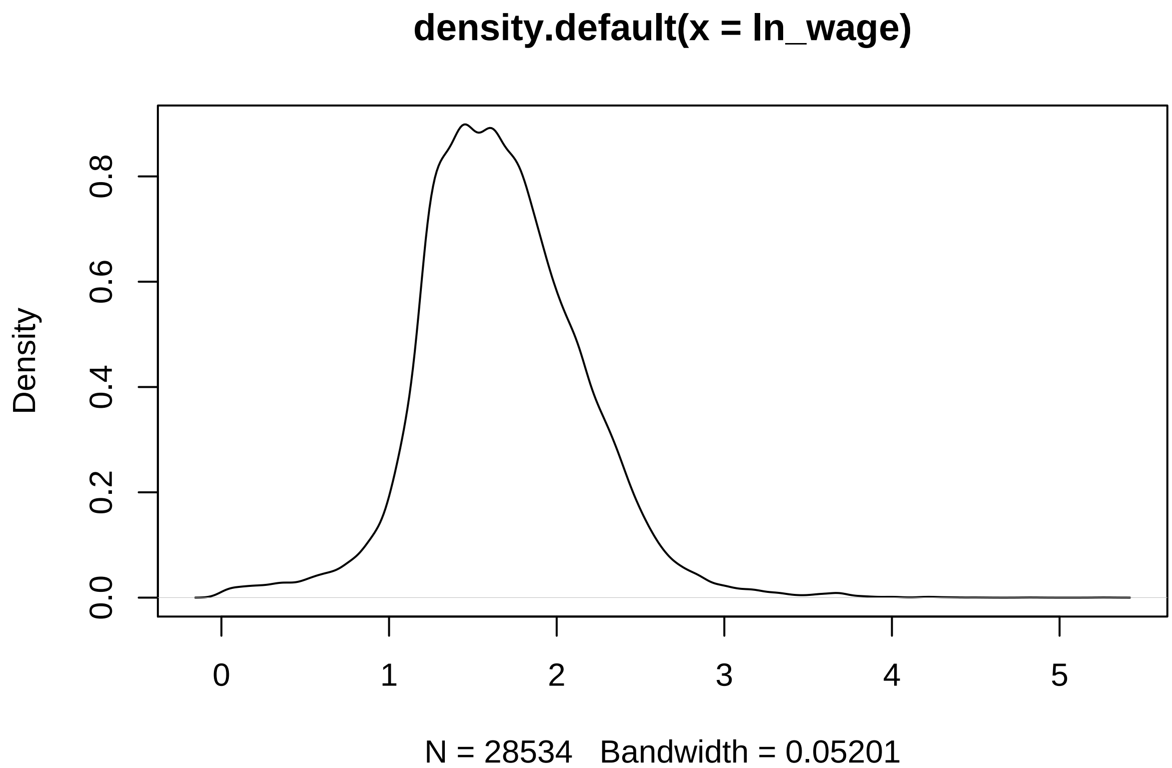
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
idcode	28,534	2,601.284	1,487.359	1	1,327	3,881	5,159
year	28,534	77.959	6.384	68	72	83	88
birth_yr	28,534	48.085	3.013	41	46	51	54
age	28,510	29.045	6.701	14.000	23.000	34.000	46.000
race	28,534	1.303	0.482	1	1	2	3
msp	28,518	0.603	0.489	0.000	0.000	1.000	1.000
nev_mar	28,518	0.230	0.421	0.000	0.000	0.000	1.000
grade	28,532	12.533	2.324	0.000	12.000	14.000	18.000
collgrad	28,534	0.168	0.374	0	0	0	1
not_smsa	28,526	0.282	0.450	0.000	0.000	1.000	1.000
c_city	28,526	0.357	0.479	0.000	0.000	1.000	1.000
south	28,526	0.410	0.492	0.000	0.000	1.000	1.000
ind_code	28,193	7.693	2.994	1.000	5.000	11.000	12.000
occ_code	28,413	4.778	3.065	1.000	3.000	6.000	13.000
union	19,238	0.234	0.424	0.000	0.000	0.000	1.000
wks_ue	22,830	2.548	7.294	0.000	0.000	0.000	76.000
ttl_exp	28,534	6.215	4.652	0.000	2.462	9.128	28.885
tenure	28,101	3.124	3.751	0.000	0.500	4.167	25.917
hours	28,467	36.560	9.870	1.000	35.000	40.000	168.000
wks_work	27,831	53.989	29.032	0.000	36.000	72.000	104.000
ln_wage	28,534	1.675	0.478	0.000	1.361	1.964	5.264

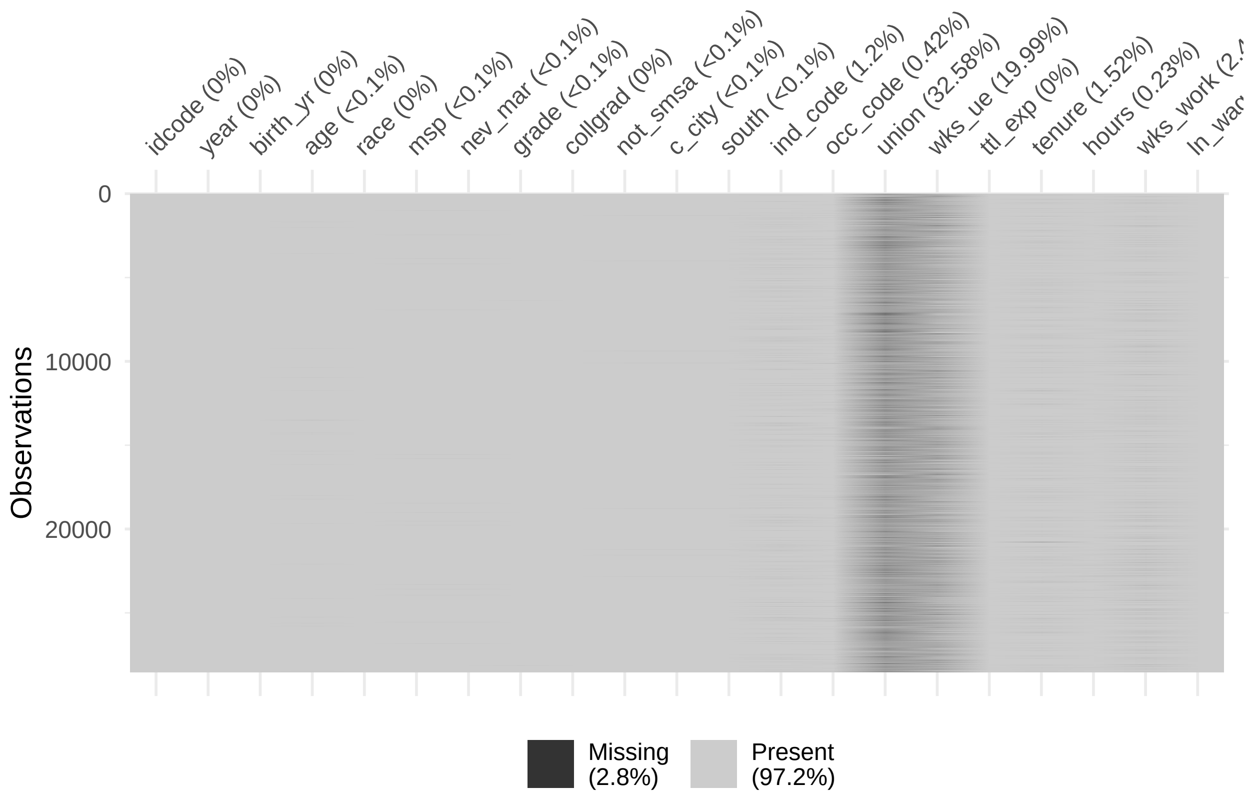
```r
library(stargazer)
stargazer(cars,
          title = "Summary table with stargazer",
          label="tab1",
          table.placement = "H",
          header=FALSE)
```

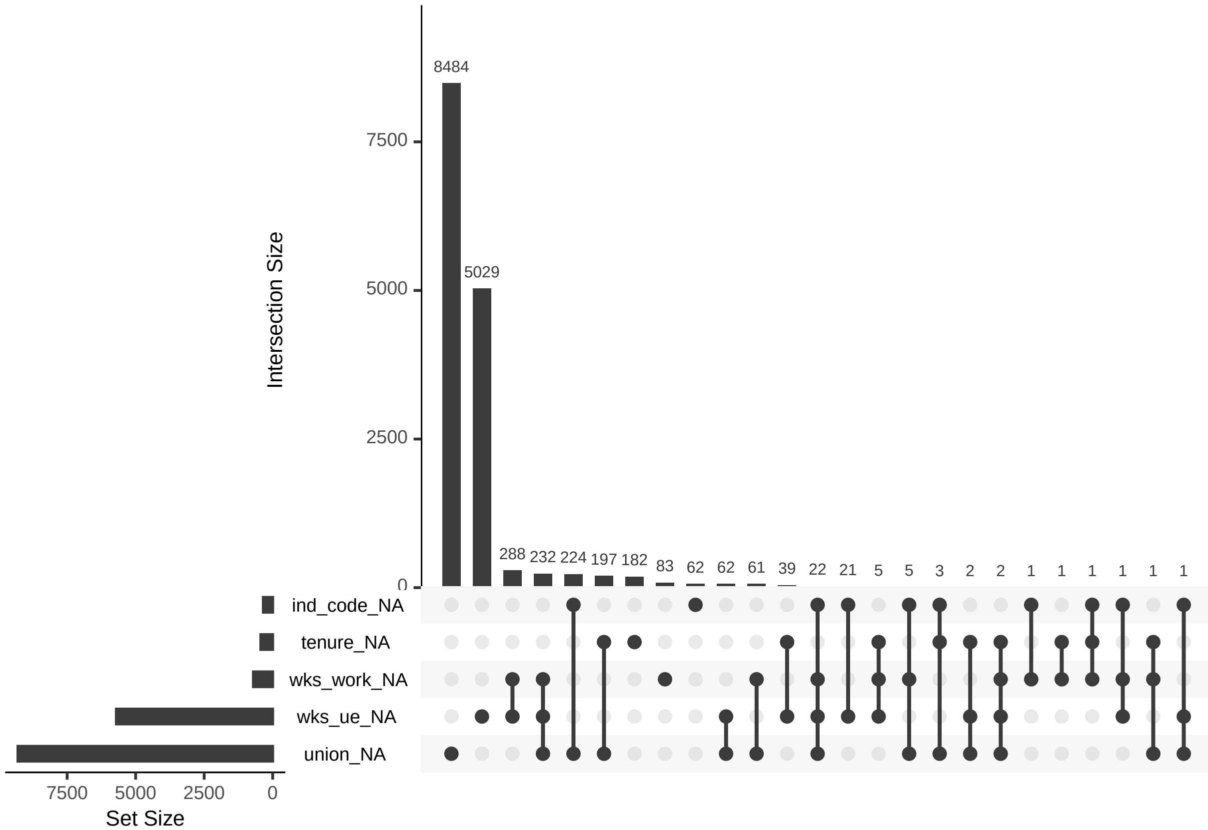
Table 2: Summary table with stargazer

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


race
idcode
year
birth_yr
age
msp
nev_mar
grade
collgrad
not_smsa
c_city
south
ind_code
occ_code
union
wks_ue
ttl_exp
tenure
hours
wks_work
ln_wage
0
10000
20000
Observations
Type
haven_labelled
numeric
NA


density.default(x = ln_wage)
Density
0.0
0.2
0.4
0.6
0.8
0
1
2
3
4
5
N = 28534   Bandwidth = 0.05201


idcode (0%)
year (0%)
birth_yr (0%)
age (<0.1%)
race (0%)
msp (<0.1%)
nev_mar (<0.1%)
grade (<0.1%)
collgrad (0%)
not_smsa (<0.1%)
c_city (<0.1%)
south (<0.1%)
ind_code (1.2%)
occ_code (0.42%)
union (32.58%)
wks_ue (19.99%)
ttl_exp (0%)
tenure (1.52%)
hours (0.23%)
Observations
0
10000
20000
Missing
(2.8%)
Present
(97.2%)




```
num [1:28534] 1.45 1.03 1.59 1.78 1.78 ...
- attr(*, "label")= chr "ln(wage/GNP deflator)"
- attr(*, "format.stata")= chr "%9.0g"
```

3 Tables

Producing good tables and referencing these tables within a R Markdown PDF has been a hassle but got much better. Examples that you may use are shown below. The way you reference tables is slightly different, e.g., for `stargazer` the label is contained in the function, for `kable` it's contained in the chunk name.

3.1 stargazer(): Summary and regression tables

Table 3 shows summary stats of your data.[1] I normally use `stargazer()` (Hlavac 2013) which offers extreme flexibility regarding table output (see `?stargazer`).

[1] To reference the table where you set the identifier in the stargazer function you only need to use the actual label, i.e., Â´tab1Â´.

```r
library(stargazer)
stargazer(cars,
          title = "Summary table with stargazer",
          label="tab1",
          table.placement = "H",
          header=FALSE)
```

Table 3: Summary table with stargazer

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

Table 4 shows the output for a regression table. Make sure you name all your models and explicitly refer to model names (M1, M2 etc.) in the text.

```r
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 4: 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		

4 Figures

4.1 R base graphs

Inserting figures can be slightly more complicated. Ideally, we would produce and insert them directly in the `.rmd` file. It's relatively simple to insert R base graphs as you can see in Figure 1.

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

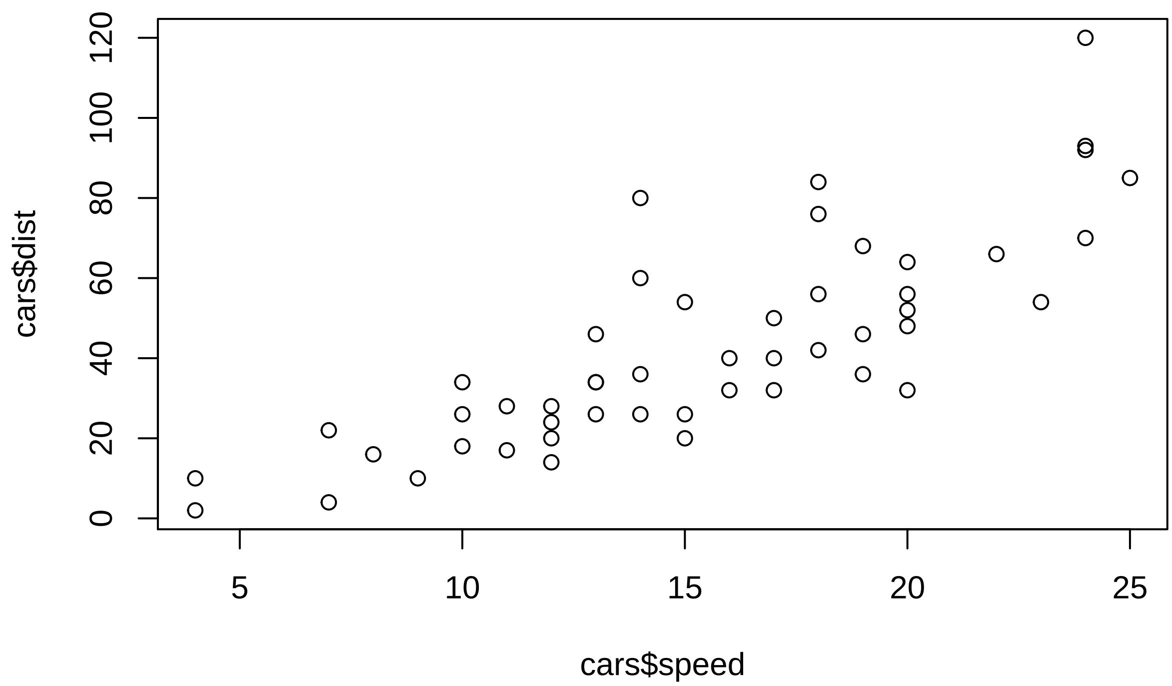


Figure 1: Scatterplot of Speed and Distance

But it turns out that it doesn't always work so well.

4.2 ggplot2 graphs

Same is true for ggplot2 as you can see in Figure 2.

```
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()
```

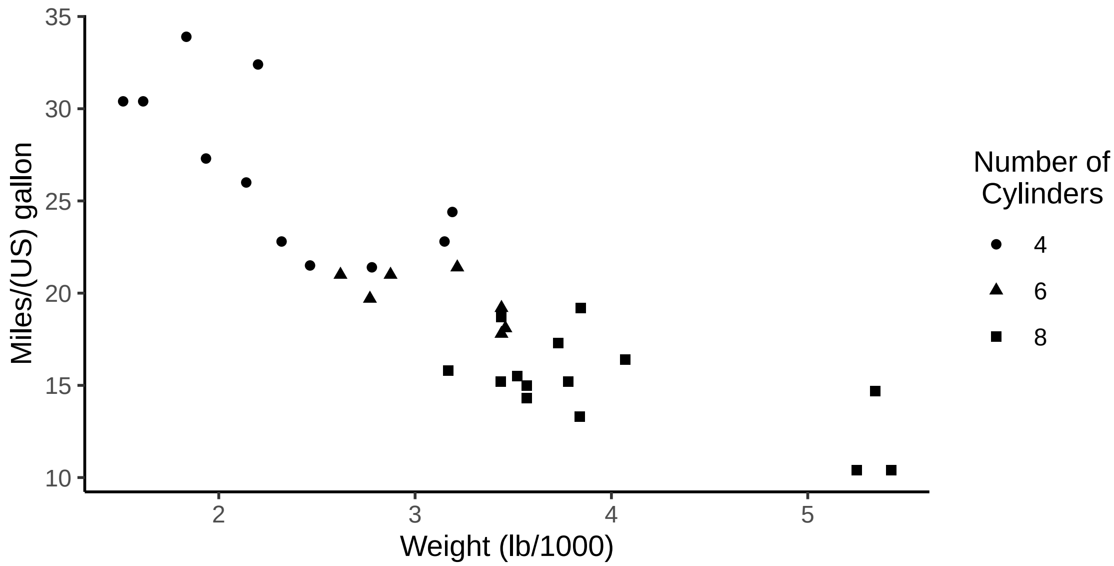


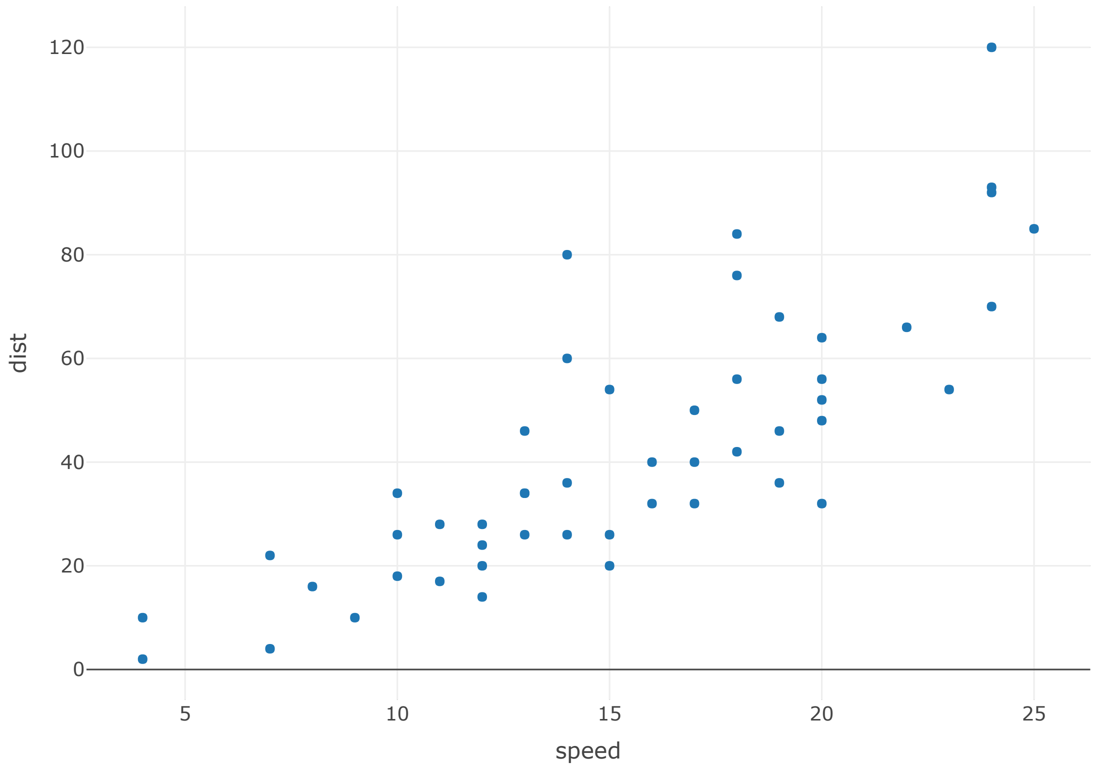
Figure 2: Miles per gallon according to the weight

4.3 Plotly graphs

Plotly is a popular graph engine that let's you also produce interactive graphs that you can embed in html webpages or documents (e.g., see here). I am a big fan. For some time there was no easy, automatic way to insert high resolution Plotly graphs into your R Markdown PDF. However, this changed since Plotly provided Orca, a command line application for generating static images from Plotly graphs. The installation is a bit tricky (see here: https://github.com/plotly/orca#installation) but once you get it running you can produce beautiful graphs and include them in your RMarkdown PDF using some simple latex as shown below in Figure 3. Potentially, in case you did not install the command line application this part may fail. If so simply exclude the chunk and the latex code.

```
library(plotly)
p <- plot_ly(cars, type = "scatter", mode="markers",
        x=~speed,
        y=~dist)
Sys.setenv('MAPBOX_TOKEN' = '12423423') # set arbitrary token
orca(p, "plotly-plot.pdf")
```

Figure 3: An plotly plot that was exported as PDF with orca before



5 Python

5.1 API data download using Python

```
import sys
print(sys.version)
```

```
3.8.0 (v3.8.0:fa919fdf25, Oct 14 2019, 10:23:27)
[Clang 6.0 (clang-600.0.57)]
```

```
import json
##from json.decoder import JSONDecodeError
import requests
import numpy as np
import pandas as pd
```

```python
## INE: https://www.ine.pt/ine/json_indicador/pindica.jsp?
## op=2&varcd=0008074&Dim1=S7A2015&Dim2=200&Dim3=3&lang=PT

# api-endpoint

URL = "https://www.ine.pt/ine/json_indicador/pindica.jsp"

# define parameters

OP="2"
VARCD="0008074"
DIM1="S7A2015"
DIM2="200"
DIM3="3"
LANG="PT"


# defining a params dict for the parameters to be sent to the API
PARAMS = {'op':OP,'varcd':VARCD,'Dim1':DIM1,'Dim2':DIM2,'Dim3':DIM3,'lang':LANG}

# sending get request and saving the response as response object
r = requests.get(url = URL,params=PARAMS)

# extracting data in json format
data = r.json()

valor = data[0]['Dados']['2015'][0]['valor']

valor
```

```
'1.8'
```

5.2 Import data from PDF files

```
['', 'PORTARIAS 111111111 DE REGULAMENTAGAO DO TRABALHO', 'PORTARIAs de EXTENSAO 4444444
```

```
FILE:  sample_text_v4
match 1
match 4
```

```
match 1
match 4
match 1
match 4
match 3
match 1
match 4
['zzzz', 'PE dasalteragoes do, CCTentre a Assoc. Nacional  dos, Opticos e a FETESE -- Fe

FILE:  sample_text_v5
-> match 5
PE dasalteragoes do, CCTentre a Assoc. Nacional  dos, Opticos e a FETESE -- Feder. dos S
99999

   linha  ...          source
0      1  ...  sample_text_v4
1      2  ...  sample_text_v4
2      3  ...  sample_text_v4
3      6  ...  sample_text_v4
4      9  ...  sample_text_v4
5      1  ...  sample_text_v5

[6 rows x 4 columns]
```

And now we use Stata to explore the data.

```
quiet cd "/Users/miguelportela/Documents/GitHub/prjs/logs"
quiet import delimited "/Users/miguelportela/Documents/GitHub/prjs/data/PE.csv", encodin
tab source
```

```
 command window is unrecognized
r(199);

        source |      Freq.     Percent        Cum.
---------------+-----------------------------------
sample_text_v4 |          5       83.33       83.33
sample_text_v5 |          1       16.67      100.00
---------------+-----------------------------------
         Total |          6      100.00
```

6 Julia experiments

6.1 Computations

```
1.4142135623730951
```

6.2 Grab results in R

```
[1] 1.414214
```

```
Julia Object of type FixedEffectModel.
                           Fixed Effect Model
=========================================================================
Number of obs:                 147715   Degrees of freedom:         67180
R2:                             0.978   R2 Adjusted:                0.960
F Statistic:                   23.362   p-value:                    0.000
R2 within:                      0.001   Iterations:                   419
Converged:                       true
=========================================================================
             Estimate   Std.Error t value Pr(>|t|)   Lower 95%  Upper 95%
-------------------------------------------------------------------------
education  0.00155631 0.000597587 2.60432    0.009 0.000385043 0.00272758
lnsales    0.00622989 0.000987569 6.30831    0.000  0.00429426 0.00816552
=========================================================================
```

The estimated return to education is 0.2%. The model has an R^2 of 0.9782.

6.3 Output Julia's table for HDFE

7 Miguel's tests

7.1 Tasks

Produzir um relatório com base no NLSWORK, desde estatística descritiva, com os valores inseridos automaticamente no texto, gráficos e regressões. Com o Python corremos o EDA, Julia o REGHDFE for speed, com R o RMarkdown + functions & Stata ??? functions???

WORKSHOP: fazer uma acta do evento no formato de um 'package' com a replicabilidade, markdown, ...

Python: explorar o Pandas e o Numpy

	lnrealwage	
	(1)	(2)
education	0.006***	0.002**
	(0.000)	(0.001)
lnsales	0.013***	0.006***
	(0.001)	(0.001)
workerid	Yes	Yes
year	Yes	Yes
firmid		Yes
Estimator	OLS	OLS
N	147,715	147,715
R^2	0.970	0.978

7.2 R

Table 6 . . . See Section 7.3

Example of an equation

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

Example of a matrix

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

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

$$

See Equation (1).

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

Table 5: Summary table

Statistic	N	Pctl(75)	St. Dev.
idcode	28,534	3,881	1,487.359
year	28,534	83	6.384
birth_yr	28,534	51	3.013
age	28,510	34.000	6.701
race	28,534	2	0.482
msp	28,518	1.000	0.489
nev_mar	28,518	0.000	0.421
grade	28,532	14.000	2.324
collgrad	28,534	0	0.374
not_smsa	28,526	1.000	0.450
c_city	28,526	1.000	0.479
south	28,526	1.000	0.492
ind_code	28,193	11.000	2.994
occ_code	28,413	6.000	3.065
union	19,238	0.000	0.424
wks_ue	22,830	0.000	7.294
ttl_exp	28,534	9.128	4.652
tenure	28,101	4.167	3.751
hours	28,467	40.000	9.870
wks_work	27,831	72.000	29.032
ln_wage	28,534	1.964	0.478

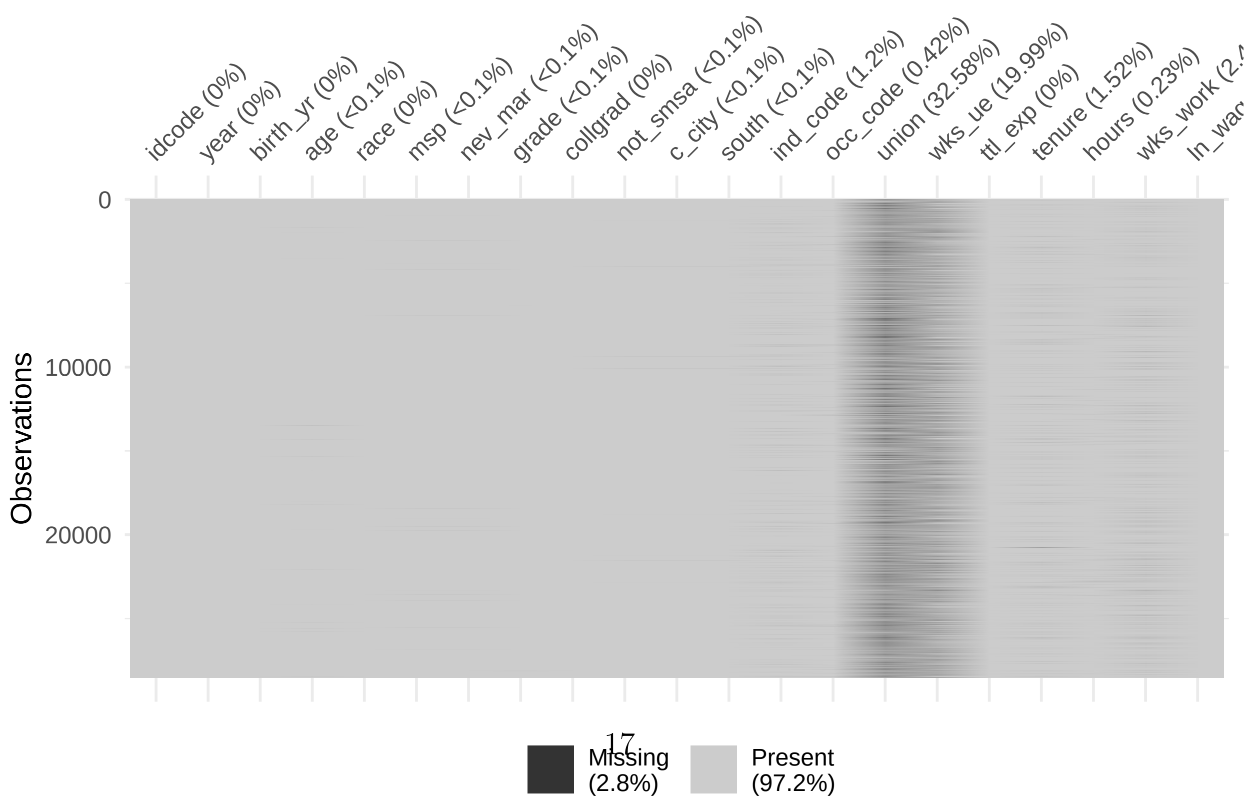


Table 6: Regression table with stargazer

	Dependent variable:		
	price		
	M1	M2	M3
mpg	−49.512	−52.217	−63.210
	(86.156)	(83.740)	(84.218)
weight	1.747***	2.111***	2.442***
	(0.641)	(0.619)	(0.688)
rep78			
Observations	74	69	69
R^2	0.293	0.365	0.376
Adjusted R^2	0.273	0.335	0.337
Residual Std. Error	2,514.029 (df = 71)	2,374.370 (df = 65)	2,370.832 (df = 64)
F Statistic	14.740*** (df = 2; 71)	12.437*** (df = 3; 65)	9.654*** (df = 4; 64)
Note:			*p<0.1; **p<0.05; ***p<0.01

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

Table 7: 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

7.3 Stata

This a Stata example, Arellano (2003). See also Arellano and Bond (1991) and Blundell and Bond (1998). While ... (check Arellano and Bover 1995).

```
 command window is unrecognized
r(199);

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
       price |         74    6165.257    2949.496       3291      15906

     Repair |
Record 1978 |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |          2        2.90        2.90
          2 |          8       11.59       14.49
          3 |         30       43.48       57.97
          4 |         18       26.09       84.06
          5 |         11       15.94      100.00
------------+-----------------------------------
      Total |         69      100.00
```

```
(file /Users/miguelportela/Documents/GitHub/prjs/logs/density.pdf written in PD
> F format)

      Source |       SS           df       MS      Number of obs   =       234
-------------+----------------------------------   F(7, 226)       =     46.99
       Model |  145.879747         7  20.8399639   Prob > F        =    0.0000
    Residual |  100.230749       226  .443498888   R-squared       =    0.5927
-------------+----------------------------------   Adj R-squared   =    0.5801
       Total |  246.110496       233  1.05626822   Root MSE        =    .66596

------------------------------------------------------------------------------
       lngdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   education |   .2136664   .0193553    11.04   0.000     .1755265    .2518063
         lnk |   .1978085   .0308039     6.42   0.000     .1371089    .2585082
       openk |   .0062439   .0011852     5.27   0.000     .0039085    .0085794
             |
        year |
       1975  |  -.0694608   .1387178    -0.50   0.617    -.3428064    .2038849
```

```
     1980  |   -.177992   .1401702    -1.27   0.205    -.4541996    .0982156
     1985  |  -.2226975   .1400607    -1.59   0.113    -.4986894    .0532943
     1990  |    -.34965   .1425169    -2.45   0.015    -.6304819   -.0688182
           |
     _cons |    3.38917   .7508785     4.51   0.000     1.909552    4.868789
------------------------------------------------------------------------------
```

The mean is `s $xx` …

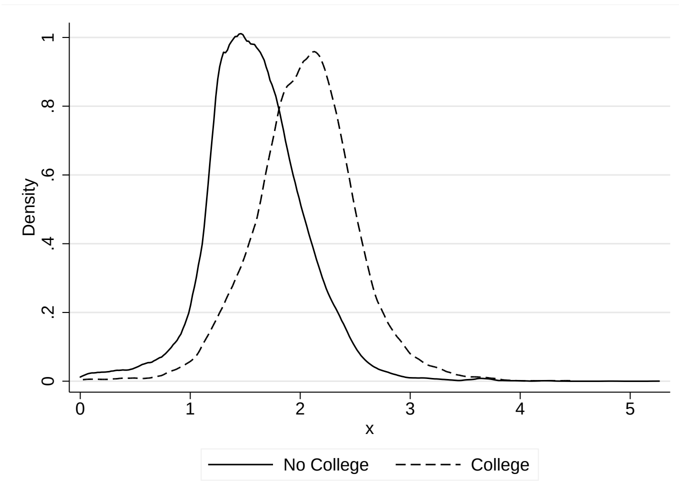


Figure 4: Wage density

Table 8: Regression analysis

	Simple model	Include capital	Full model
Education	0.3169***	0.212***	0.2***
	(0.0093)	(0.020)	(0.0)
Capital		0.125***	0.2***
		(0.029)	(0.0)
Openness degree			0.0***
			(0.0)
R^2	0.58	0.54	0.59
RMSE	0.78	0.70	0.67
N	857	234	234

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

We now export a set of statistics to an Excel file.

```
 command window is unrecognized
r(199);


/Users/miguelportela/Documents/GitHub/prjs/logs



Variable   Obs Unique      Mean       Min       Max  Label
-------------------------------------------------------------------------------
country    839    106         .         .         .  Country name
year       839      9  1980.906      1960      2000  Year of observation
education  839    574  4.794076       .04     12.25  Education
lngdp      839    838  9.308131  5.983335  12.51058  Log Real GDP per Worker
open       839      2  .4982122         0         1  1 = high degree of open...
gdp        839    838  20100.66  396.7612  271192.2  GDP level
-------------------------------------------------------------------------------


Note: file will be replaced when the first putexcel command is issued


`"a"' `"b"' `"c"' `"d"' `"e"' `"f"' `"g"' `"h"' `"i"' `"j"' `"k"' `"l"' `"m"' `
> "n"' `"p"' `"r"' `"s"' `"t"' `"u"' `"v"' `"z"'




Country's first letter:     a

    Insufficient number of countries; n countries = 5




Country's first letter:     b

    Number of countries:    11
```

```
Country's first letter:     c

    Number of countries:    9



Country's first letter:     d

    Insufficient number of countries; n countries = 2



Country's first letter:     e

    Insufficient number of countries; n countries = 5



Country's first letter:     f

    Insufficient number of countries; n countries = 3



Country's first letter:     g

    Insufficient number of countries; n countries = 4



Country's first letter:     h

    Insufficient number of countries; n countries = 4
```

```
Country's first letter:     i

    Number of countries:    7


Country's first letter:     j

    Insufficient number of countries; n countries = 3


Country's first letter:     k

    Insufficient number of countries; n countries = 2


Country's first letter:     l

    Insufficient number of countries; n countries = 2


Country's first letter:     m

    Number of countries:    8


Country's first letter:     n

    Number of countries:    6
```

```
Country's first letter:     p

    Number of countries:    7



Country's first letter:     r

    Insufficient number of countries; n countries = 2



Country's first letter:     s

    Number of countries:    14



Country's first letter:     t

    Insufficient number of countries; n countries = 5



Country's first letter:     u

    Insufficient number of countries; n countries = 4



Country's first letter:     v

    Insufficient number of countries; n countries = 1
```

```
Country's first letter:     z

    Insufficient number of countries; n countries = 2
```

```
x = 5  # radius of a circle
```

For a circle with the radius 5, its area is 78.5398163.

See Figure 5.

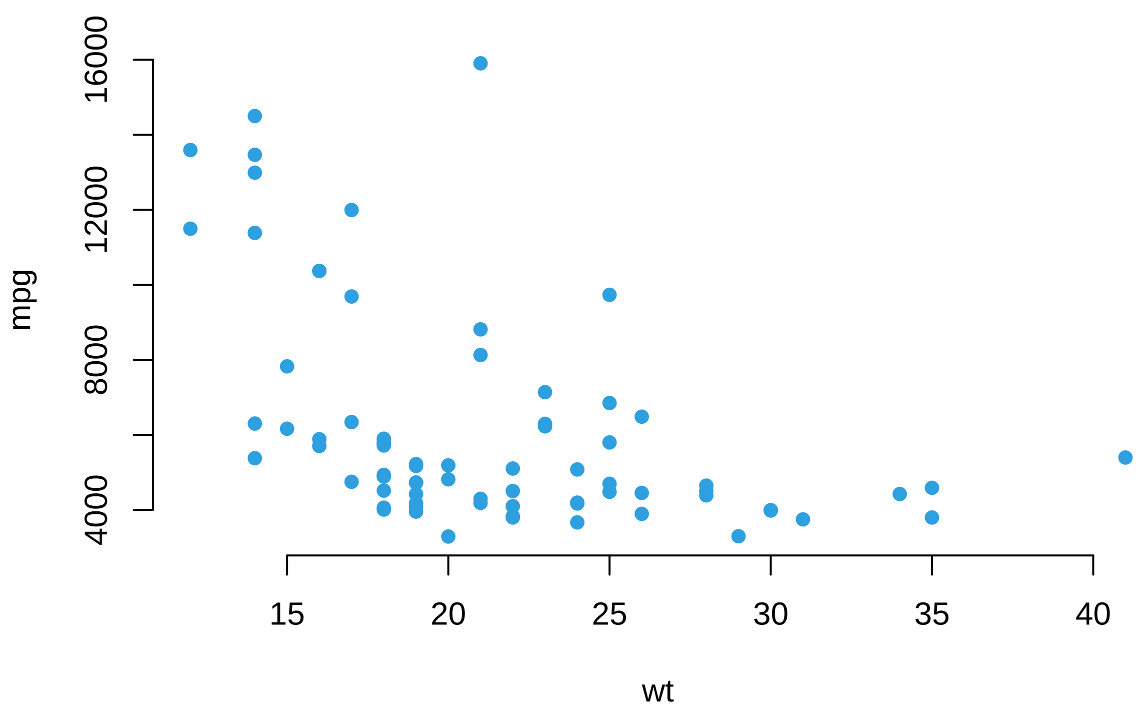


Figure 5: Scatterplot test MP

8 Final remarks

9 Appendix

9.1 Software versioning

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

```
# R version 3.6.1 (2019-07-05)
# Platform: x86_64-apple-darwin15.6.0 (64-bit)
# Running under: macOS Catalina 10.15.2
#
# Matrix products: default
# BLAS:   /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRblas.0.dylib
# LAPACK: /Library/Frameworks/R.framework/Versions/3.6/Resources/lib/libRlapack.dylib
#
# locale:
# [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
#
# attached base packages:
# [1] stats     graphics  grDevices utils     datasets  methods   base
#
# other attached packages:
#  [1] JuliaCall_0.17.1    plotly_4.9.1        ggplot2_3.2.1
#  [4] dlookr_0.3.12       mice_3.6.0          lattice_0.20-38
#  [7] dplyr_0.8.3         naniar_0.4.2        visdat_0.5.3
# [10] haven_2.1.1         ExPanDaR_0.4.0      Statamarkdown_0.3.9
# [13] stargazer_5.2.2     reticulate_1.13
#
# loaded via a namespace (and not attached):
#   [1] readxl_1.3.1          backports_1.1.5       Hmisc_4.2-0
#   [4] corrplot_0.84         plyr_1.8.4            lazyeval_0.2.2
#   [7] splines_3.6.1         crosstalk_1.0.0       digest_0.6.20
#  [10] htmltools_0.4.0       gdata_2.18.0          fansi_0.4.0
#  [13] memoise_1.1.0         magrittr_1.5          checkmate_1.9.4
#  [16] cluster_2.1.0         ROCR_1.0-7            openxlsx_4.1.0.1
#  [19] readr_1.3.1           xts_0.11-2            sandwich_2.5-1
#  [22] askpass_1.1           colorspace_1.4-1      blob_1.2.0
#  [25] rvest_0.3.5           pan_1.6               xfun_0.11
#  [28] tcltk_3.6.1           libcoin_1.0-5         crayon_1.3.4
#  [31] jsonlite_1.6          lme4_1.1-21           zeallot_0.1.0
```

```
#  [34] survival_2.44-1.1     zoo_1.8-6             glue_1.3.1
#  [37] kableExtra_1.1.0      smbinning_0.9         gtable_0.3.0
#  [40] webshot_0.5.1         UpSetR_1.4.0          car_3.0-4
#  [43] quantmod_0.4-15       jomo_2.6-9            abind_1.4-5
#  [46] scales_1.0.0          mvtnorm_1.0-11        DBI_1.0.0
#  [49] Rcpp_1.0.3            viridisLite_0.3.0     xtable_1.8-4
#  [52] htmlTable_1.13.2      bit_1.1-14            foreign_0.8-72
#  [55] Formula_1.2-3         sqldf_0.4-11          DT_0.9
#  [58] htmlwidgets_1.5.1     httr_1.4.1            gplots_3.0.1.1
#  [61] RColorBrewer_1.1-2    acepack_1.4.1         ellipsis_0.3.0
#  [64] pkgconfig_2.0.3       nnet_7.3-12           utf8_1.1.4
#  [67] tidyselect_0.2.5      labeling_0.3          rlang_0.4.0
#  [70] later_1.0.0           munsell_0.5.0         cellranger_1.1.0
#  [73] tools_3.6.1           cli_1.1.0             gsubfn_0.7
#  [76] generics_0.0.2        moments_0.14          RSQLite_2.1.2
#  [79] broom_0.5.2           evaluate_0.14         stringr_1.4.0
#  [82] fastmap_1.0.1         yaml_2.2.0            processx_3.4.1
#  [85] bit64_0.9-7           knitr_1.26            shinycssloaders_0.2.0
#  [88] zip_2.0.4             caTools_1.17.1.2      purrr_0.3.3
#  [91] mitml_0.3-7           nlme_3.1-141          mime_0.7
#  [94] tictoc_1.0            xml2_1.2.2            compiler_3.6.1
#  [97] rstudioapi_0.10       curl_4.2              e1071_1.7-2
# [100] tibble_2.1.3          stringi_1.4.3         ps_1.3.0
# [103] forcats_0.4.0         Matrix_1.2-17         classInt_0.4-2
# [106] nloptr_1.2.1          vctrs_0.2.0           RcmdrMisc_2.5-1
# [109] pillar_1.4.2          lifecycle_0.1.0       data.table_1.12.6
# [112] bitops_1.0-6          httpuv_1.5.2          R6_2.4.0
# [115] latticeExtra_0.6-28   bookdown_0.16         promises_1.1.0
# [118] KernSmooth_2.23-16    gridExtra_2.3         rio_0.5.16
# [121] boot_1.3-23           MASS_7.3-51.4         gtools_3.8.1
# [124] assertthat_0.2.1      chron_2.3-54          proto_1.0.0
# [127] openssl_1.4.1         withr_2.1.2           nortest_1.0-4
# [130] DMwR_0.4.1            parallel_3.6.1        hms_0.5.1
# [133] grid_3.6.1            prettydoc_0.3.0       rpart_4.1-15
# [136] tidyr_1.0.0           class_7.3-15          minqa_1.2.4
# [139] inum_1.0-1            rmarkdown_2.0         carData_3.0-2
# [142] TTR_0.23-5            partykit_1.2-5        shiny_1.4.0
# [145] base64enc_0.1-3       tinytex_0.18
```

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

9.2 All the code in the paper

To simply attach all the code you used in the PDF file in the appendix see the R chunk in the underlying `.rmd` file:

```
knitr::opts_chunk$set(cache = FALSE)
# Use chache = TRUE if you want to speed up compilation

# A function to allow for showing some of the inline code
rinline <- function(code){
  html <- '<code  class="r">``` `r CODE` ```</code>'
  sub("CODE", code, html)

  ##https://opensource.com/article/19/5/python-3-default-mac

  Sys.setenv(RETICULATE_PYTHON = "/usr/local/bin/python3")

##install.packages("reticulate")
library(reticulate)
##use_python("/Library/Frameworks/Python.framework/Versions/3.8/bin/python3")

use_virtualenv("/Users/miguelportela/.pyenv/version")

##knitr::opts_chunk$set(python.reticulate=FALSE)

library(JuliaCall)

library(Statamarkdown)
stataexe <- "/Applications/Stata15/StataMP.app/Contents/MacOS//stata-mp"
knitr::opts_chunk$set(engine.path=list(stata=stataexe))

}
Sys.setenv(RETICULATE_PYTHON = "/usr/local/bin/python3")
library(reticulate)
use_virtualenv("/Users/miguelportela/.pyenv/version")
library(stargazer)
library(Statamarkdown)
```

```
stataexe <- "/Applications/Stata15/StataMP.app/Contents/MacOS//stata-mp"
knitr::opts_chunk$set(engine.path=list(stata=stataexe))


## ExPanDaR: Explore Panel Data Interactively

  library(ExPanDaR)

    ## type ExPanD() in the Console

setwd("/Users/miguelportela/Dropbox/1.miguel/bdp/4.code_ados/dados_descricao/data_descri

library(haven)

nlswork <- read_dta("/Users/miguelportela/Dropbox/1.miguel/bdp/4.code_ados/dados_descric

nls<-data.frame(nlswork)

attach(nlswork)

head(nlswork)

library(stargazer)
stargazer(nls,
          title = "Summary statistics",
          label="tab:tab1nls",
          table.placement = "ht",
          header=FALSE)

library(stargazer)
stargazer(cars,
          title = "Summary table with stargazer",
          label="tab1",
          table.placement = "H",
          header=FALSE)

library("visdat")

vis_dat(nlswork)
```

```
d <- density(ln_wage)
plot(d)

## Missing values

library(naniar)

## https://cran.r-project.org/web/packages/naniar/vignettes/naniar-visualisation.html

vis_miss(nlswork)

gg_miss_upset(nlswork)

library("dplyr")
dplyr::glimpse(nlswork$ln_wage)



###########

library(dlookr)
library(dplyr)

##eda_report(nlswork,output_dir = "/Users/miguelportela/Dropbox/1.miguel/bdp/4.code_ad

library(stargazer)
stargazer(cars,
          title = "Summary table with stargazer",
          label="tab1",
          table.placement = "H",
          header=FALSE)
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)
plot(cars$speed, cars$dist)
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()
library(plotly)
p <- plot_ly(cars, type = "scatter", mode="markers",
        x=~speed,
        y=~dist)
Sys.setenv('MAPBOX_TOKEN' = '12423423') # set arbitrary token
orca(p, "plotly-plot.pdf")
import sys
print(sys.version)


import json
##from json.decoder import JSONDecodeError
import requests
import numpy as np
import pandas as pd

## INE: https://www.ine.pt/ine/json_indicador/pindica.jsp?
## op=2&varcd=0008074&Dim1=S7A2015&Dim2=200&Dim3=3&lang=PT

# api-endpoint

URL = "https://www.ine.pt/ine/json_indicador/pindica.jsp"

# define parameters

OP="2"
VARCD="0008074"
DIM1="S7A2015"
DIM2="200"
DIM3="3"
LANG="PT"
```

```
# defining a params dict for the parameters to be sent to the API
PARAMS = {'op':OP,'varcd':VARCD,'Dim1':DIM1,'Dim2':DIM2,'Dim3':DIM3,'lang':LANG}

# sending get request and saving the response as response object
r = requests.get(url = URL,params=PARAMS)

# extracting data in json format
data = r.json()

valor = data[0]['Dados']['2015'][0]['valor']

valor

import os
import numpy as np
import pandas as pd
import re

## CHECK PyPDF2

## wget -A pdf -m -p -E -k -K -np https://joram.madeira.gov.pt/joram/4serie/
## find . -name '*.pdf' -print0 | xargs -0 -n1 pdfsandwich -gray
## find . -name '*ocr.pdf' -print0 | xargs -0 -n1 pdftotext

# Create list with .txt files for the specified folder
files_list = list()
for (dirpath, dirnames, filenames) in os.walk('/Users/miguelportela/Documents/bte/pdfs_t
    files_list += [os.path.join(dirpath, file)
                   for file in filenames if file.endswith('.txt')]


##print("START:FILES -- list")

##print(files_list)

##print("END:FILES -- list")

p1 = r'PORTARIA'
p2 = r'EXTENSAO'
p3 = r'Materiais'
```

```
p5 = r'PE das'

linha = []
output = []
other = []
palavra = []
source = []

for file in files_list:

    f = open(file, "r", encoding='latin8')
    data = f.read()
    f.close()

    line = []
    nh = 0

    tmp1 = str(data)
    #print(tmp1)
    tmp2 = tmp1.splitlines()
    #print(tmp2)
    for n,tmp3 in enumerate(tmp2):
        #print(tmp3)
        if (tmp3.find("PE das") == 0):
            tmp4 = tmp3 + tmp2[2]
            line.append(tmp4)
            #print(n)
            nh = 1
        elif (nh == 1):
            nh = 0
            continue
        elif (nh == 0):
            line.append(tmp3)

    print(line)

    print("   ")

    print("FILE: ", file[46:-4])
```

```
    for num, word in enumerate(line):
            if num == 0:
                continue
            else:
                match1 = re.search(p1, word)
                match2 = re.search(p2, word)
                match3 = re.search(p3, word)
                match4 = re.search(r'\d{9}', word)
                match5 = re.search(p5, word)
                ##print("   ")
                ##print("START: ",num)

                if match1:
                        ##print("   ")
                        print("match 1")
                        if match4:
                            ##print("   ")
                            print("match 4")
                            linha.append(num)
                            output.append(re.search(r'\d{9}', word).group())
                            other.append("vazio")
                            palavra.append(p1)
                            source.append(file[46:-4])
                elif match2:
                            ##print("   ")
                            print("match 2")
                            linha.append(num)
                            output.append(re.search(r'\d{9}', word).group())
                            other.append("vazio")
                            palavra.append(p2)
                            source.append(file[46:-4])
                elif match3:
                            ##print("   ")
                            print("match 3")
                            linha.append(num)
                            output.append(re.search(r'\d{9}', word).group())
                            other.append("vazio")
                            palavra.append(p3)
                            source.append(file[46:-4])
                elif match5:
```

```
                              ##print("   ")
                              print("-> match 5")
                              ##word.sub(" e o ", " e a ",1)
                              print(word)
                              linha.append(num)

                              if (word.find(" e o ") > 0):
                                  print("11111")
                                  output.append((word.split("re a", 1)[1]).split(" e o ",
                                  other.append((word.split("re a", 1)[1]).split(" e o ",
                              elif (word.find(" e a ") > 0):
                                  print("99999")
                                  output.append((word.split("re a", 1)[1]).split(" e a ",
                                  other.append((word.split("re a", 1)[1]).split(" e a ",

                              palavra.append(p5)
                              source.append(file[46:-4])
## o parágrafo tem de estar na mesma linha e temos de ter 'e a' em vez de 'e o'
df = pd.DataFrame({'linha': linha, 'output': output,
                   'outra': other, 'source': source})
print(df)

df.to_csv('data/PE.csv', index=False)
df.to_stata('data/PE.dta', write_index = False)


quiet cd "/Users/miguelportela/Documents/GitHub/prjs/logs"
quiet import delimited "/Users/miguelportela/Documents/GitHub/prjs/data/PE.csv", encodir
tab source
## This is a julia language chunk.
## In julia, the command without ending semicolon will trigger the display
## so is JuliaCall package.
## The julia display will follow immediately after the corresponding command
## just as the R code in R Markdown.

a = sqrt(2);
a = sqrt(2)

using ReadStat
using StatFiles
```

```
using StatsBase
using DataFrames
using FixedEffectModels

@time results_hdfe1 = reg(DataFrame(load("/Users/miguelportela/Documents/GitHub/prjs/dat

@time results_hdfe2 = reg(DataFrame(load("/Users/miguelportela/Documents/GitHub/prjs/dat



using RegressionTables
regtable(results_hdfe1,results_hdfe2; renderSettings = latexOutput("hdfe_output.tex"))

library(JuliaCall)

julia_eval("a")

  julia_eval("results_hdfe2")

betas <- julia_eval("coef(results_hdfe2)")
r2 <- julia_eval("r2(results_hdfe2)")
library(stargazer)
library(Statamarkdown)
stataexe <- "/Applications/Stata15/StataMP.app/Contents/MacOS//stata-mp"
knitr::opts_chunk$set(engine.path=list(stata=stataexe))

setwd("/Users/miguelportela/Documents/GitHub/prjs/logs")
rm(list = ls())
library(haven)
nlswork <- read_dta("../data/nlswork.dta")

auto <- read_dta("../data/auto.dta")

attach(nlswork)

regs1 <- lm(auto$price ~ auto$mpg + auto$weight)
regs2 <- lm(auto$price ~ auto$mpg + auto$weight + auto$rep78)
regs3 <- lm(auto$price ~ auto$mpg + auto$weight + auto$rep78 + auto$trunk)

regs4 <- lm(ln_wage ~ union)
```

```r
regs5 <- lm(ln_wage ~ union + collgrad)
regs6 <- lm(ln_wage ~ union + collgrad + age)

##summary(auto)
##summary(regs1)

## https://www.jakeruss.com/cheatsheets/stargazer/

nls<-data.frame(nlswork)

stargazer(nls, summary.stat = c("n", "p75", "sd"), summary.logical = FALSE,
          title = "Summary table",
          label="tab23",
          table.placement = "ht",
          header=FALSE)


stargazer(regs1, regs2, regs3,
          title = "Regression table with stargazer",
          label="tab3",
          table.placement = "ht",
          column.labels = c("M1", "M2", "M3"),
          model.numbers = FALSE,
          header=FALSE,keep=c(0,1,2,3))

attach(auto)


library(naniar)
vis_miss(nlswork)

# plot(y=price,x=mpg)

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

```
sum price

tab rep78

global xx = r(N)

quiet cd "/Users/miguelportela/Documents/GitHub/prjs/logs"

quiet use ../data/nlswork, clear

twoway (kdensity ln_wage if collgrad == 0) || (kdensity ln_wage if collgrad == 1), scher

graph export "/Users/miguelportela/Documents/GitHub/prjs/logs/density.pdf", replace

use ../data/data_full, clear
        quiet generate lngdp = ln(rgdpwok)
        quiet ge lnk = ln(capital)

        label var rgdpwok "Real GDP per worker"
        label var education "Education (in years)"
        label var capital "Capital"
        label var open "Degree of openness"

// # regression analysis

    quiet reg lngdp education
        estimates store r1

    quiet reg lngdp education lnk
        est store r2

    reg lngdp education lnk openk i.year
        est store r3

outreg, clear
    quiet estimates restore r1
        outreg using growth_analysis_frag, tex fragment replace rtitles("Education" \ ""
               */ drop(_cons) /*
               */ ctitle("","Simple model") /*
               */ nodisplay varlabels bdec(4) se starlevels(10 5 1) starloc(1) summsta
```

```
    quiet estimates restore r2
        outreg using growth_analysis_frag, tex fragment merge rtitles("Education" \ "" \
                */ drop(_cons) /*
                */ ctitle("","Include capital") /*
                */ nodisplay varlabels bdec(3) se starlevels(10 5 1) starloc(1) summsta

    quiet estimates restore r3
        outreg using growth_analysis_frag, tex fragment merge rtitles("Education" \ "" \
                */ drop(_cons 1975.year 1980.year 1985.year 1990.year) /*
                */ ctitle("","Full model") /*
                */ nodisplay varlabels bdec(1) se starlevels(10 5 1) starloc(1) summsta



cd "/Users/miguelportela/Documents/GitHub/prjs/logs"

quiet use ../data/graph_data, clear
    codebook, compact

            putexcel clear
            putexcel set descriptives.xlsx, sheet("Avg. Educ. & desc.") replace


gen first = substr(country,1,1)

    levelsof first,local(ff)

    foreach vv of local ff {

        di _new(3) "Country's first letter: `vv'"

        preserve
        quiet keep if first == "`vv'"

        quiet unique country

            if r(unique) > 5 {
            di _new(2) "    Number of countries:    " r(unique) _new(1)
            quietly {
                collapse (mean) lngdp education,by(country)
```

```
                    putexcel set descriptives.xlsx, sheet("FIRST LETTER `vv'") modify

                    regress lngdp education

                            matrix list r(table)

                        matrix results = r(table)
                            mat l results

                        mat b = results[1,1...]'
                        mat t = results[3,1...]'

                        putexcel C2="Coef." F2="t"
                        putexcel B3 = matrix(b), rownames nformat(number_d2) right
                        putexcel D3 = matrix(t),nformat("0.00")
                }
            }

            if r(unique) <= 5 {
                di _new(2) "    Insufficient number of countries; n countries = " r(uniq
            }

        restore

    }

x = 5  # radius of a circle
plot(x = mpg, y = price,
     pch = 16, frame = FALSE,
     xlab = "wt", ylab = "mpg", col = "#2E9FDF")
cat(paste("#", capture.output(sessionInfo()), "\n", collapse =""))
  # or use message() instead of cat()
```

9.3 Exploratory data analysis report

REPORT SERIES WITH DLOOKR

Exploratory Data Analysis Report

Author:
dlookr package

Version:
0.3.12

December 16, 2019

Contents

Chapter 1

Introduction

The EDA Report provides exploratory data analysis information on objects that inherit data.frame and data.frame.

1.1 Information of Dataset

The dataset that generated the EDA Report is an 'data.frame' object. It consists of 28,534 observations and 21 variables.

1.2 Information of Variables

Table 1.1: Information of Variables

variables	types	missing_count	missing_percent	unique_count	unique_rate
idcode	numeric	0	0.0000000	4711	0.1651013
year	numeric	0	0.0000000	15	0.0005257
birth_yr	numeric	0	0.0000000	14	0.0004906
age	numeric	24	0.0841102	34	0.0011916
race	numeric	0	0.0000000	3	0.0001051
msp	numeric	16	0.0560735	3	0.0001051
nev_mar	numeric	16	0.0560735	3	0.0001051
grade	numeric	2	0.0070092	20	0.0007009
collgrad	numeric	0	0.0000000	2	0.0000701
not_smsa	numeric	8	0.0280367	3	0.0001051
c_city	numeric	8	0.0280367	3	0.0001051
south	numeric	8	0.0280367	3	0.0001051
ind_code	numeric	341	1.1950655	13	0.0004556
occ_code	numeric	121	0.4240555	14	0.0004906
union	numeric	9296	32.5786781	3	0.0001051
wks_ue	numeric	5704	19.9901871	62	0.0021728
ttl_exp	numeric	0	0.0000000	4744	0.1662578
tenure	numeric	433	1.5174879	271	0.0094974
hours	numeric	67	0.2348076	86	0.0030139
wks_work	numeric	703	2.4637275	106	0.0037149
ln_wage	numeric	0	0.0000000	8173	0.2864302

The target variable of the data is 'NULL', and the data type of the variable is NULL(You did not specify a target variable).

1.3 About EDA Report

EDA reports provide information and visualization results that support the EDA process. In particular, it provides a variety of information to understand the relationship between the target variable and the rest of the variables of interest.

Chapter 2

Univariate Analysis

2.1 Descriptive Statistics

edaData
21 Variables 28534 Observations

---

idcode : NLS ID Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28534	0	4711	1	2601	1717	259.7	518.0	1327.0	2606.0	3881.0	4656.0	4889.0

```
lowest :    1    2    3    4    5, highest: 5155 5156 5157 5158 5159
```

---

year : interview year Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28534	0	15	0.995	77.96	7.339	69	70	72	78	83	87	88

```
Value         68    69    70    71    72    73    75    77    78    80    82    83    85    87
Frequency   1375  1232  1686  1851  1693  1981  2141  2171  1964  1847  2085  1987  2085  2164
Proportion 0.048 0.043 0.059 0.065 0.059 0.069 0.075 0.076 0.069 0.065 0.073 0.070 0.073 0.076

Value         88
Frequency   2272
Proportion 0.080
```

---

birth_yr : birth year Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28534	0	14	0.991	48.09	3.455	43	44	46	48	51	52	53

```
Value         41    42    43    44    45    46    47    48    49    50    51    52    53    54
Frequency     26   574  1522  2095  2311  2707  3040  3017  3095  2718  2765  2722  1935     7
Proportion 0.001 0.020 0.053 0.073 0.081 0.095 0.107 0.106 0.108 0.095 0.097 0.095 0.068 0.000
```

---

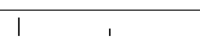
age : age in current year Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28510	24	33	0.998	29.05	7.682	19	21	23	28	34	38	41

```
lowest : 14 15 16 17 18, highest: 42 43 44 45 46
```

---

race Format:%8.0g



n	missing	distinct	Info	Mean	Gmd
28534	0	3	0.624	1.303	0.4351

```
Value          1     2     3
Frequency  20180  8051   303
Proportion 0.707 0.282 0.011
```

---

msp : 1 if married, spouse present Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
28518	16	2	0.718	17194	0.6029	0.4788

---

nev_mar : 1 if never married Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
28518	16	2	0.531	6550	0.2297	0.3539

---

grade : current grade completed Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28532	2	19	0.874	12.53	2.374	9	10	12	12	14	16	17

Value	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency	21	6	4	2	36	41	161	262	671	889	1518	1781	14252	1734
Proportion	0.001	0.000	0.000	0.000	0.001	0.001	0.006	0.009	0.024	0.031	0.053	0.062	0.500	0.061

Value	14	15	16	17	18
Frequency	1751	950	2681	851	921
Proportion	0.061	0.033	0.094	0.030	0.032

---

collgrad : 1 if college graduate Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
28534	0	2	0.419	4795	0.168	0.2796

---

not_smsa : 1 if not SMSA Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
28526	8	2	0.608	8057	0.2824	0.4054

---

c_city : 1 if central city Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
28526	8	2	0.689	10190	0.3572	0.4592

---

south : 1 if south Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
28526	8	2	0.725	11683	0.4096	0.4837

---

ind_code : industry of employment Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28193	341	12	0.957	7.693	3.355	4	4	5	7	11	11	12

Value	1	2	3	4	5	6	7	8	9	10	11	12
Frequency	241	52	252	5845	1420	4952	2427	849	1712	215	8480	1748
Proportion	0.009	0.002	0.009	0.207	0.050	0.176	0.086	0.030	0.061	0.008	0.301	0.062

---

occ_code : occupation Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28413	121	13	0.934	4.778	3.225	1	1	3	3	6	8	13

Value	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency	3008	1494	10974	1323	438	4309	571	4300	6	144	194	7	1645
Proportion	0.106	0.053	0.386	0.047	0.015	0.152	0.020	0.151	0.000	0.005	0.007	0.000	0.058

---

union : 1 if union Format:%8.0g

n	missing	distinct	Info	Sum	Mean	Gmd
19238	9296	2	0.538	4510	0.2344	0.359

---

wks_ue : weeks unemployed last year Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
22830	5704	61	0.558	2.548	4.537	0	0	0	0	0	8	17

```
lowest :  0  1  2  3  4, highest: 56 62 73 75 76
```

---

ttl_exp : total work experience Format:%9.0g

```
      n  missing distinct      Info      Mean       Gmd       .05       .10       .25       .50
  28534        0     4744         1     6.215     5.147    0.6667    1.0385    2.4615    5.0577
    .75      .90      .95
 9.1282  13.2801  15.3269

lowest :  0.00000000  0.01923077  0.03846154  0.05769231  0.05769231
highest: 26.53846169 26.84615135 27.19230461 27.46153831 28.88461494
```

---

tenure : job tenure, in years Format:%9.0g

```
      n  missing distinct      Info      Mean       Gmd       .05       .10       .25       .50
  28101      433      270         1     3.124     3.638   0.08333   0.16667   0.50000   1.66667
    .75      .90      .95
4.16667  8.41667 11.41667

lowest :  0.00000000  0.08333334  0.16666667  0.25000000  0.33333334
highest: 23.08333397 23.33333397 24.50000000 24.75000000 25.91666603
```

---

hours : usual hours worked Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28467	67	85	0.842	36.56	9.175	15	20	35	40	40	44	48

```
lowest :   1   2   3   4   5, highest:  99 100 105 112 168
```

---

wks_work : weeks worked last year Format:%8.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
27831	703	105	0.996	53.99	32.48	6	14	36	52	72	98	104

```
lowest :   0   1   2   3   4, highest: 100 101 102 103 104
```

---

ln_wage : ln(wage/GNP deflator) Format:%9.0g

n	missing	distinct	Info	Mean	Gmd	.05	.10	.25	.50	.75	.90	.95
28534	0	8173	1	1.675	0.5237	0.9928	1.1661	1.3615	1.6405	1.9641	2.2757	2.4562

```
lowest : 0.000000000 0.004487075 0.004939650 0.008032188 0.017654561
highest: 4.349081993 4.349225998 4.499809742 4.828313828 5.263916016
```

2.2 Normality Test of Numerical Variables

2.2.1 Statistics and Visualization of (Sample) Data

idcode

normality test : Shapiro-Wilk normality test
statistic : 0.95577, p-value : 1.79068E-36

type	skewness	kurtosis
original	-0.0197	1.8137
log transformation	-2.3132	11.3522
sqrt transformation	-0.6023	2.4766

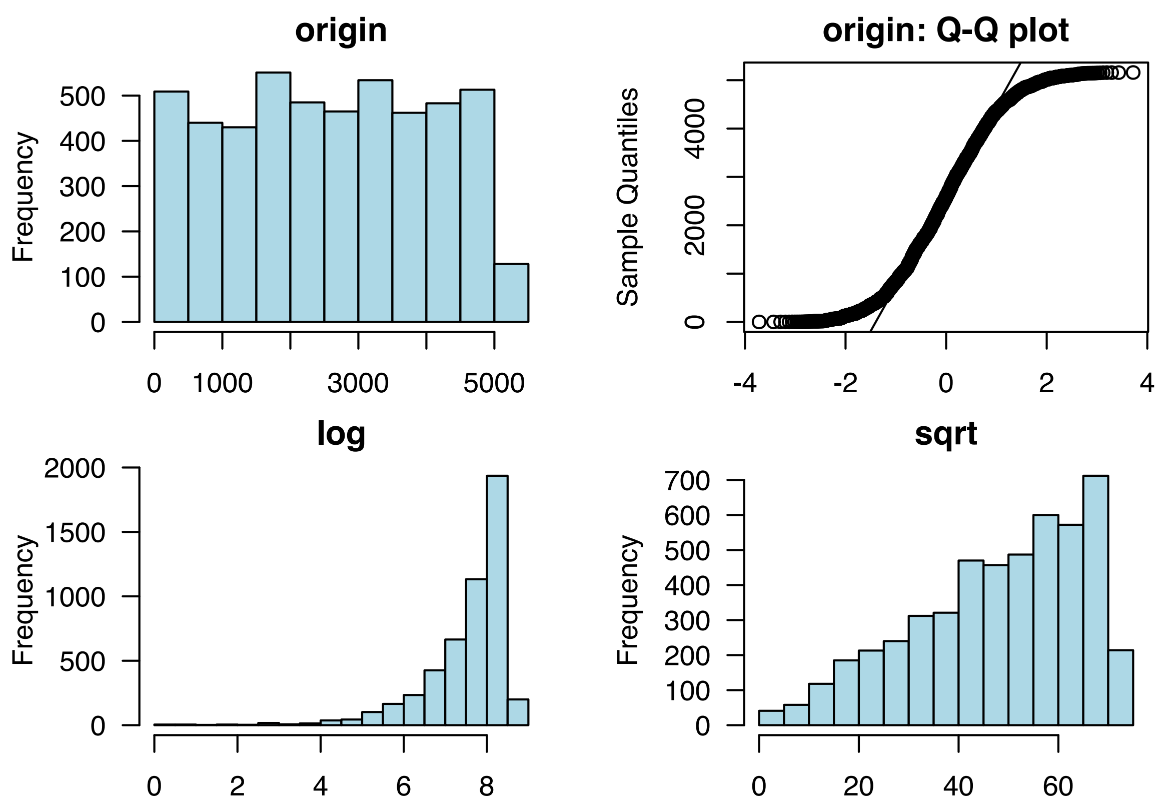


Figure 2.1: idcode

year

normality test : Shapiro-Wilk normality test
statistic : 0.93183, p-value : 5.56401E-43

type	skewness	kurtosis
original	0.0688	1.6982
log transformation	-0.0160	1.6958
sqrt transformation	0.0264	1.6950

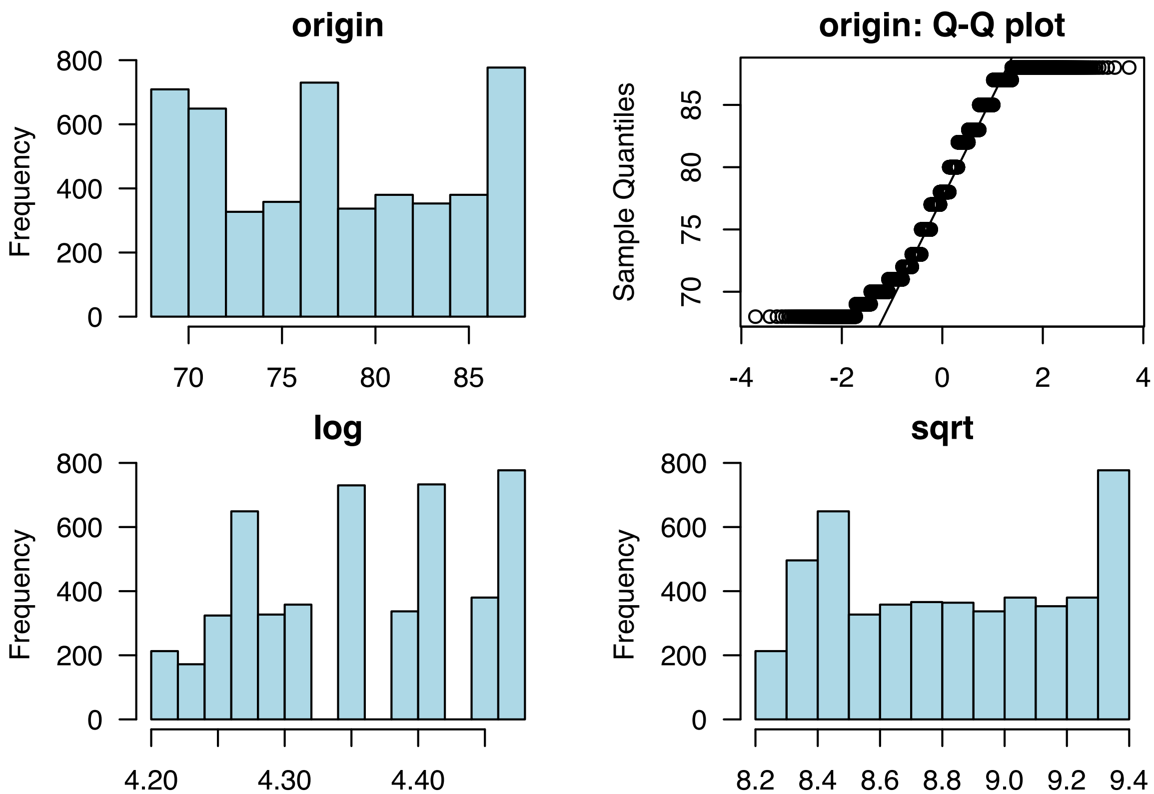


Figure 2.2: year

birth_yr

normality test : Shapiro-Wilk normality test
statistic : 0.96165, p-value : 1.88666E-34

type	skewness	kurtosis
original	-0.1206	2.0355
log transformation	-0.2185	2.0924
sqrt transformation	-0.1693	2.0610

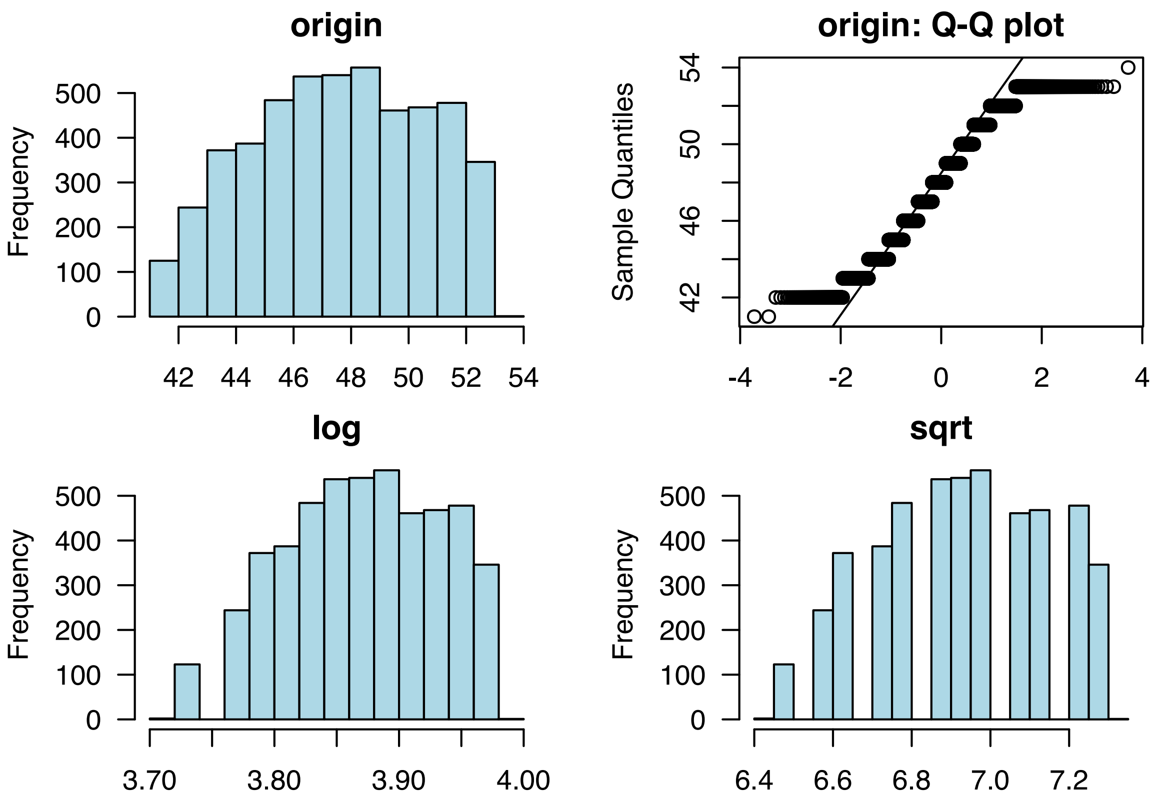


Figure 2.3: birth_yr

age

normality test : Shapiro-Wilk normality test
statistic : 0.97039, p-value : 6.19944E-31

type	skewness	kurtosis
original	0.2225	2.0776
log transformation	-0.1337	2.0386
sqrt transformation	0.0454	2.0154

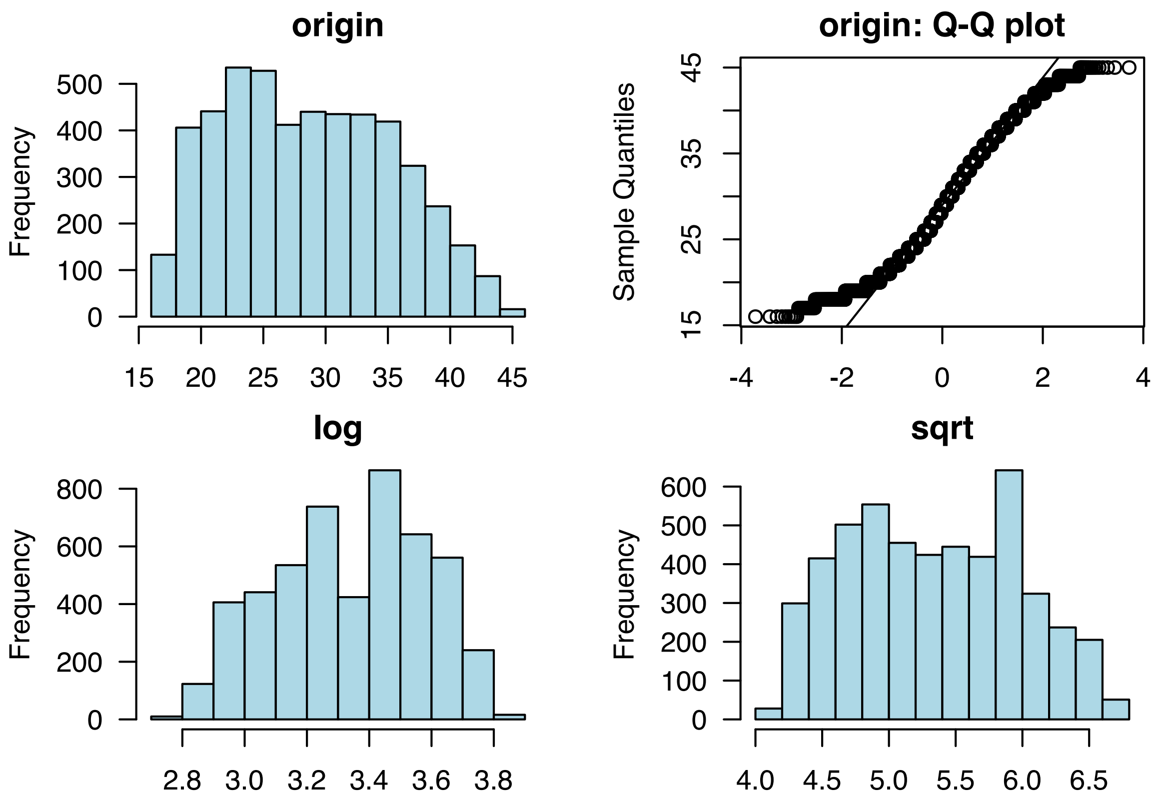


Figure 2.4: age

msp

normality test : Shapiro-Wilk normality test
statistic : 0.61745, p-value : 1.8183E-74

type	skewness	kurtosis
original	-0.4683	1.2193
log transformation		
sqrt transformation	-0.4683	1.2193

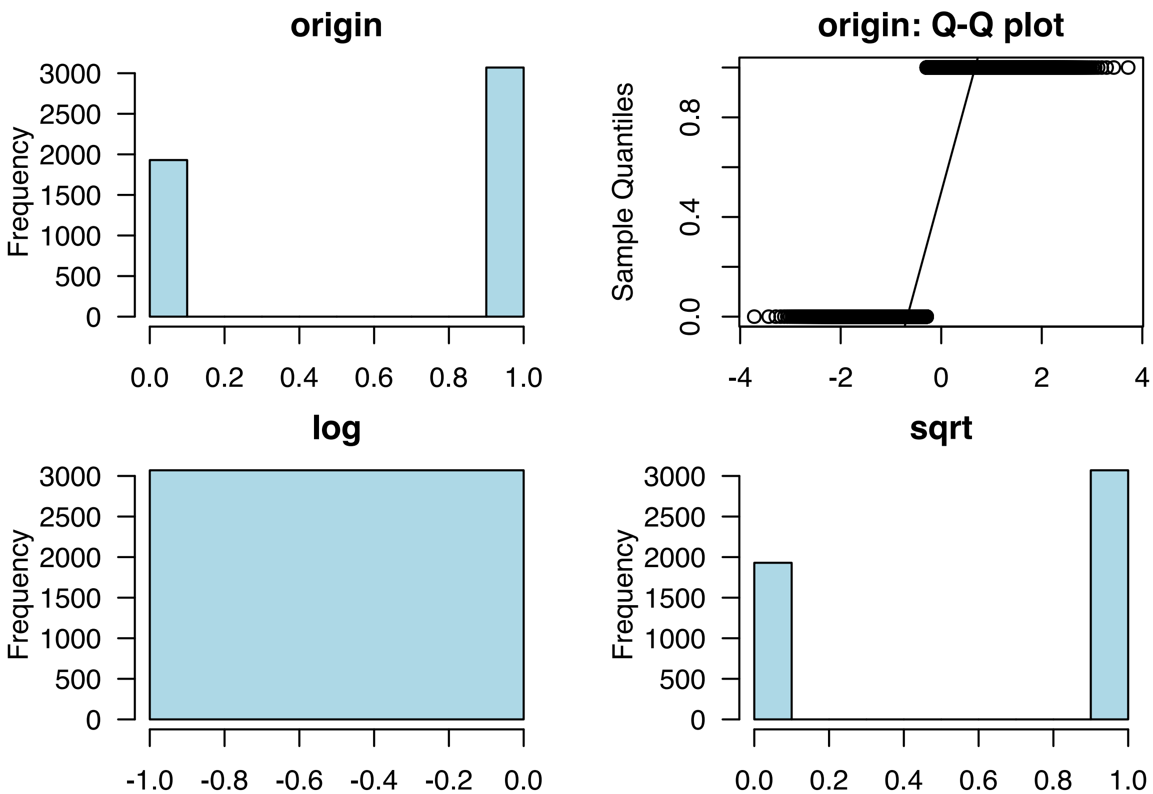


Figure 2.5: msp

nev_mar

normality test : Shapiro-Wilk normality test
statistic : 0.5197, p-value : 2.81181E-79

type	skewness	kurtosis
original	1.2896	2.6630
log transformation		
sqrt transformation	1.2896	2.6630

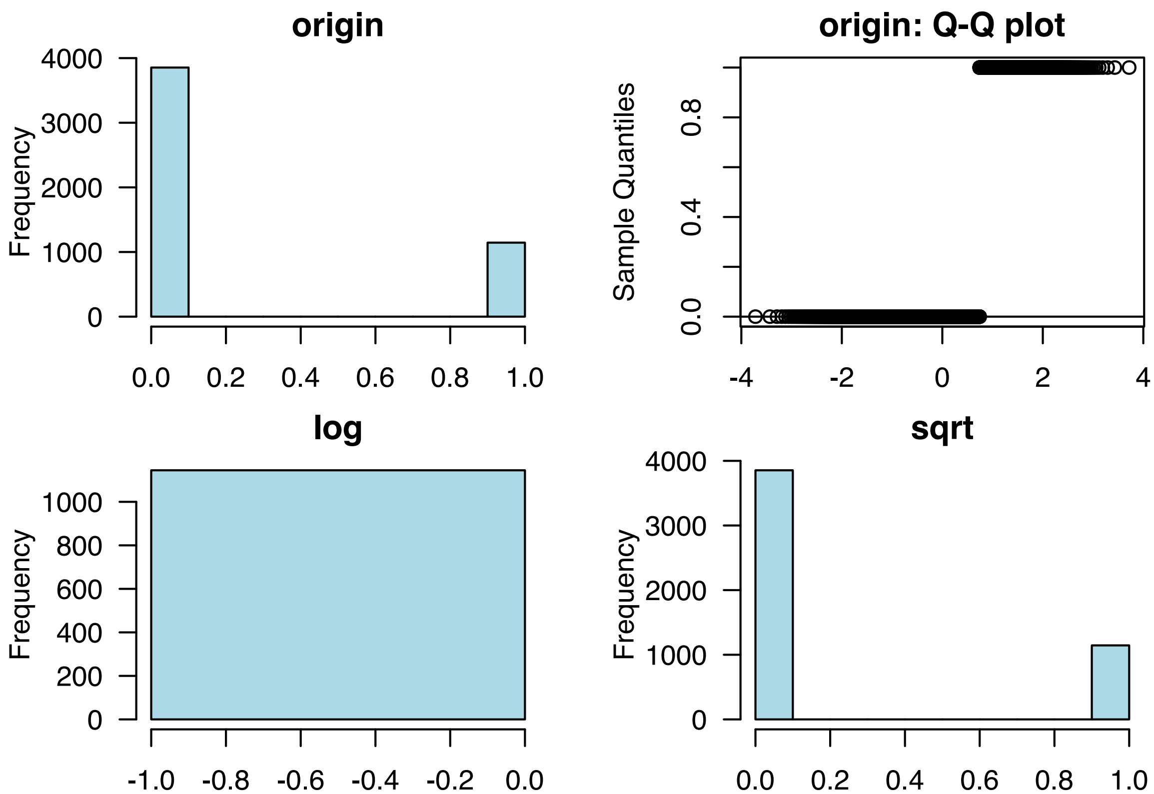


Figure 2.6: nev_mar

grade

normality test : Shapiro-Wilk normality test
statistic : 0.87934, p-value : 2.01112E-52

type	skewness	kurtosis
original	0.1832	4.4419
log transformation		
sqrt transformation	-0.9099	12.0912

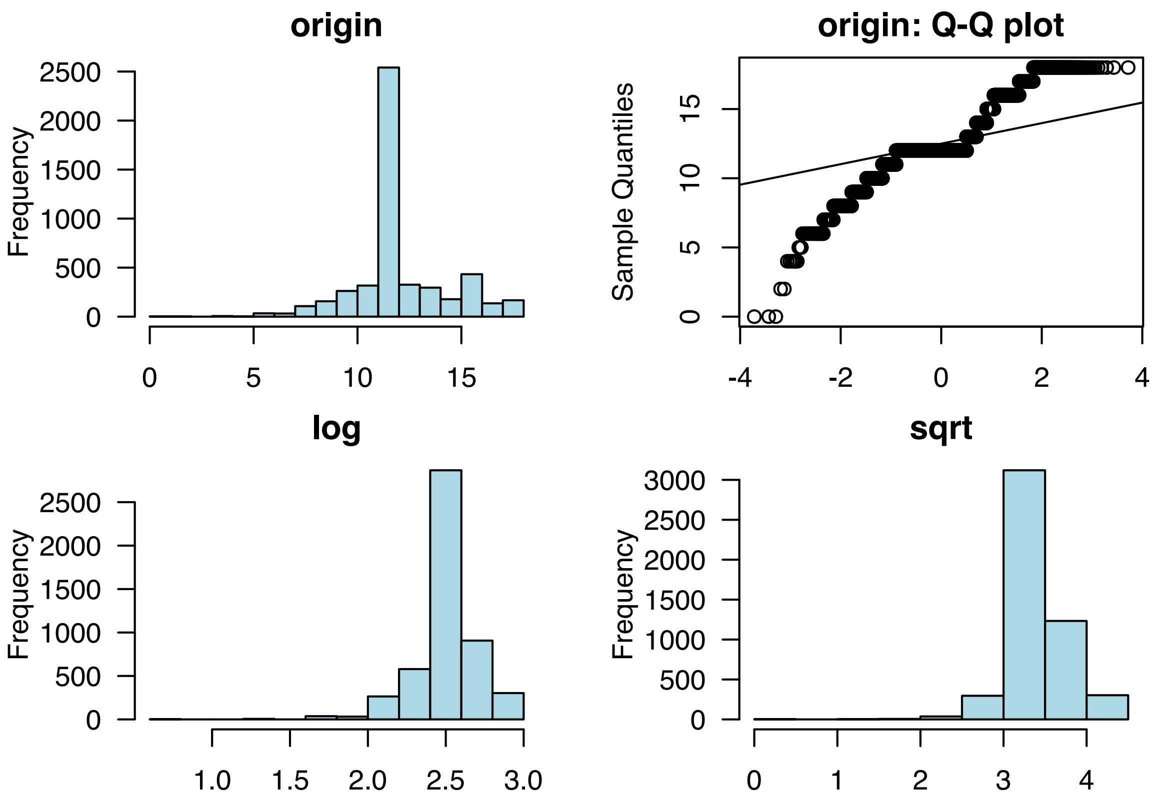


Figure 2.7: grade

collgrad

normality test : Shapiro-Wilk normality test
statistic : 0.44481, p-value : 1.98196E-82

type	skewness	kurtosis
original	1.8228	4.3225
log transformation		
sqrt transformation	1.8228	4.3225

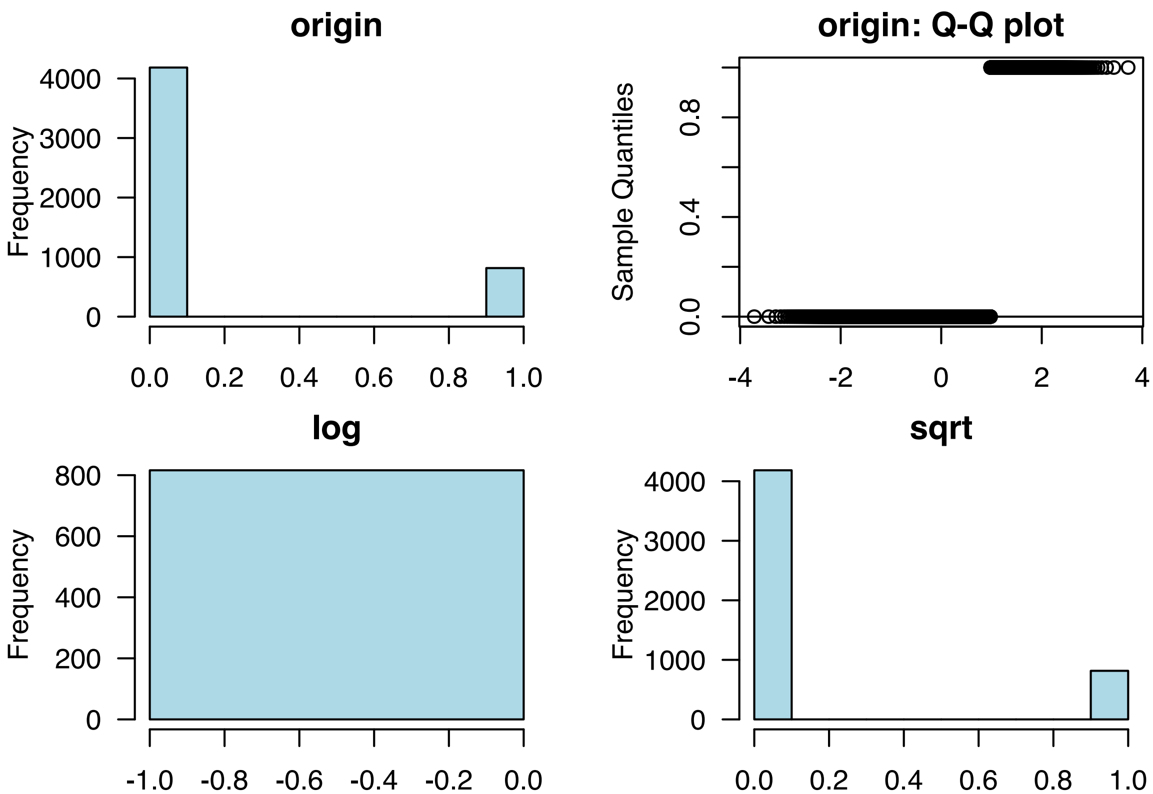


Figure 2.8: collgrad

not_smsa

normality test : Shapiro-Wilk normality test
statistic : 0.5623, p-value : 2.73849E-77

type	skewness	kurtosis
original	0.9782	1.9569
log transformation		
sqrt transformation	0.9782	1.9569

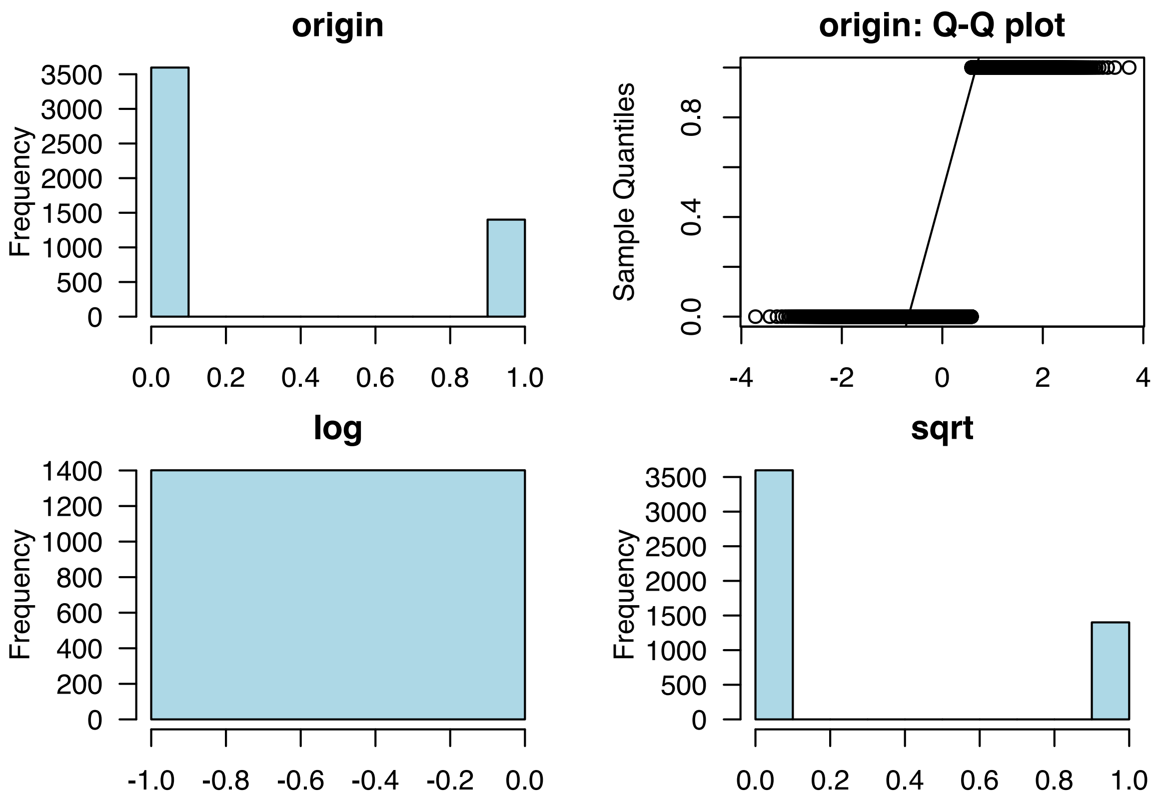


Figure 2.9: not_smsa

c_city

normality test : Shapiro-Wilk normality test
statistic : 0.60303, p-value : 3.13554E-75

type	skewness	kurtosis
original	0.6292	1.3960
log transformation		
sqrt transformation	0.6292	1.3960

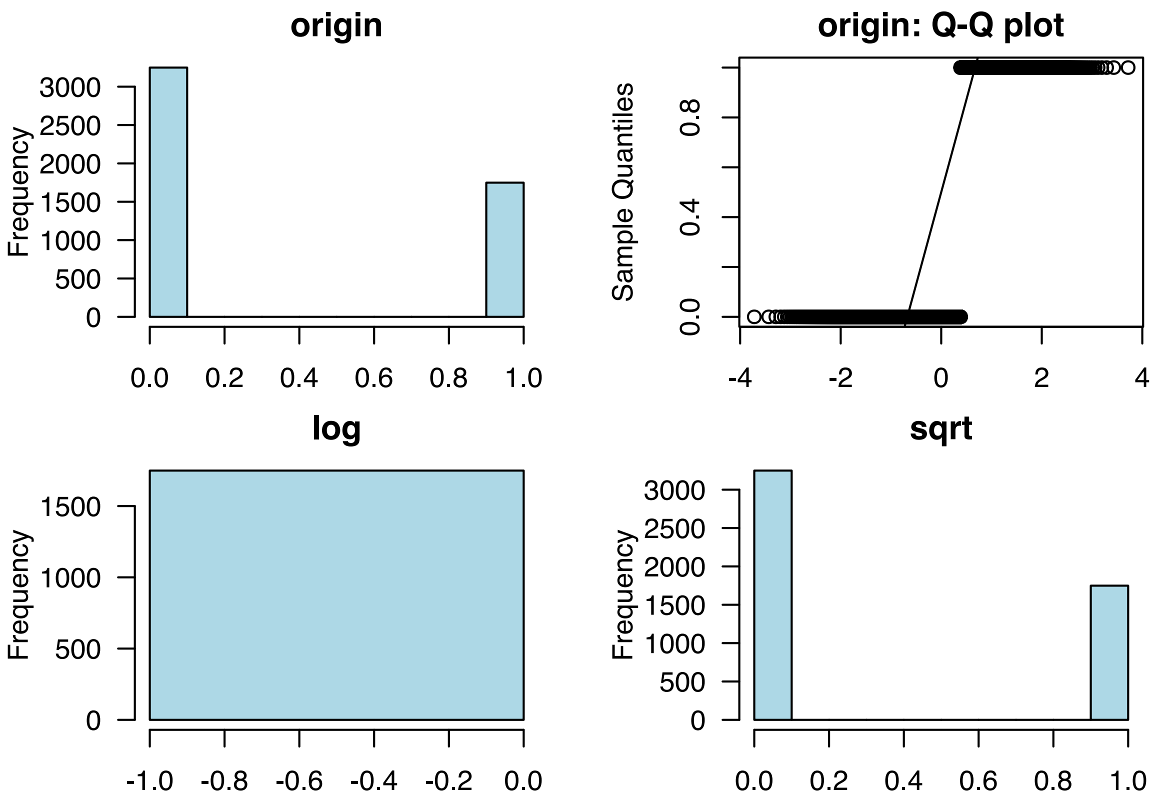


Figure 2.10: c_city

south

normality test : Shapiro-Wilk normality test
statistic : 0.62199, p-value : 3.32655E-74

type	skewness	kurtosis
original	0.4072	1.1658
log transformation		
sqrt transformation	0.4072	1.1658

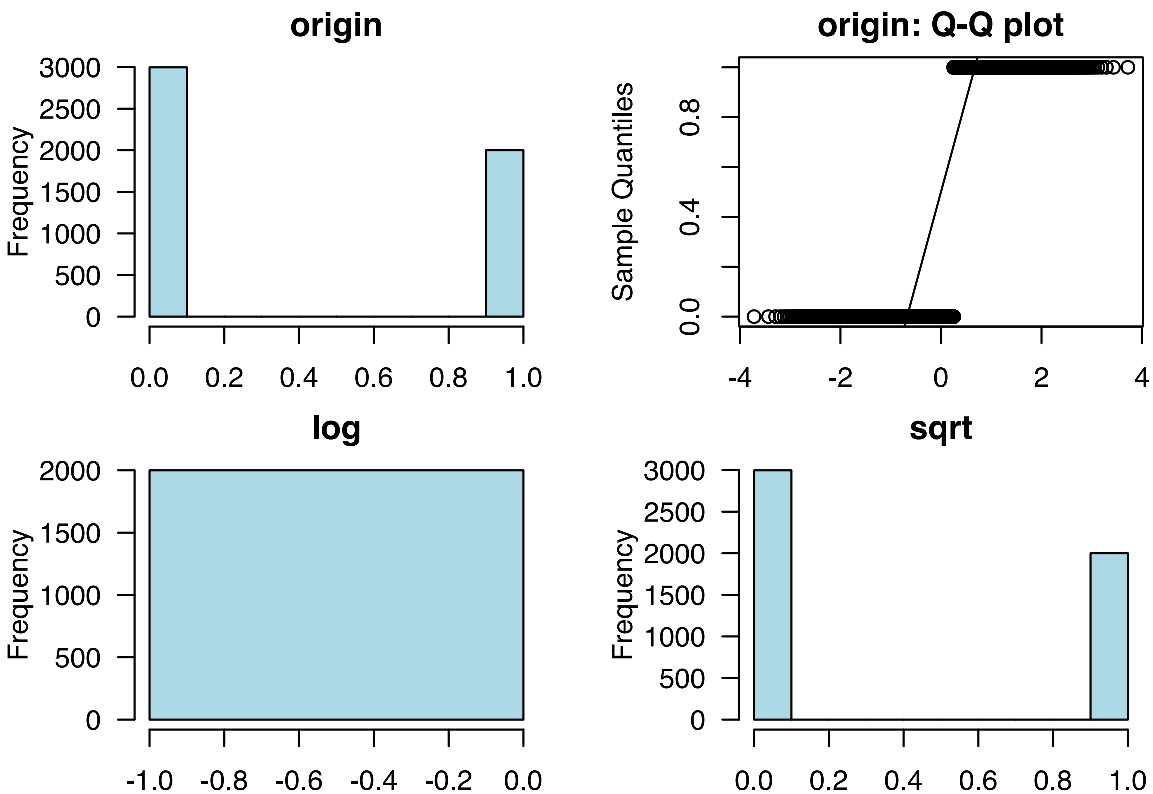


Figure 2.11: south

ind_code

normality test : Shapiro-Wilk normality test
statistic : 0.86895, p-value : 1.12466E-53

type	skewness	kurtosis
original	-0.0091	1.5282
log transformation	-0.7807	4.0123
sqrt transformation	-0.2565	1.9775

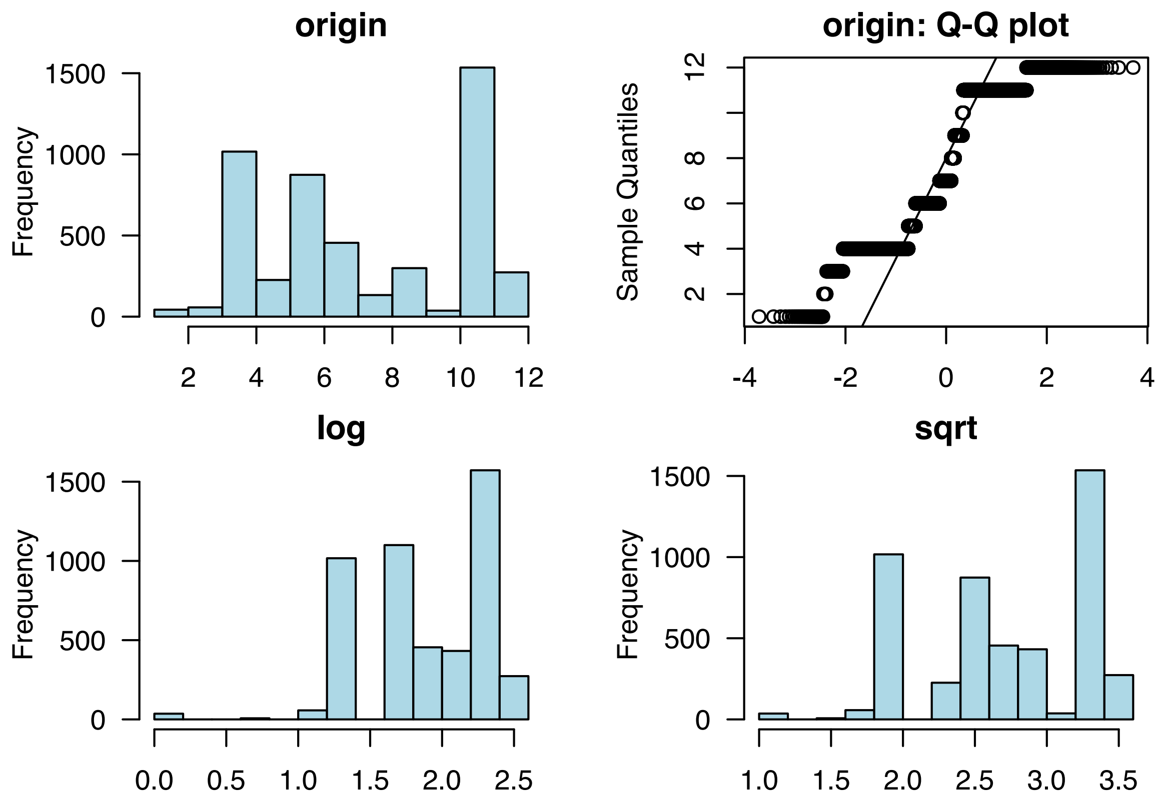


Figure 2.12: ind_code

occ_code

normality test : Shapiro-Wilk normality test
statistic : 0.85431, p-value : 1.17692E-55

type	skewness	kurtosis
original	1.0725	3.6598
log transformation	-0.3061	2.6630
sqrt transformation	0.4364	2.6148

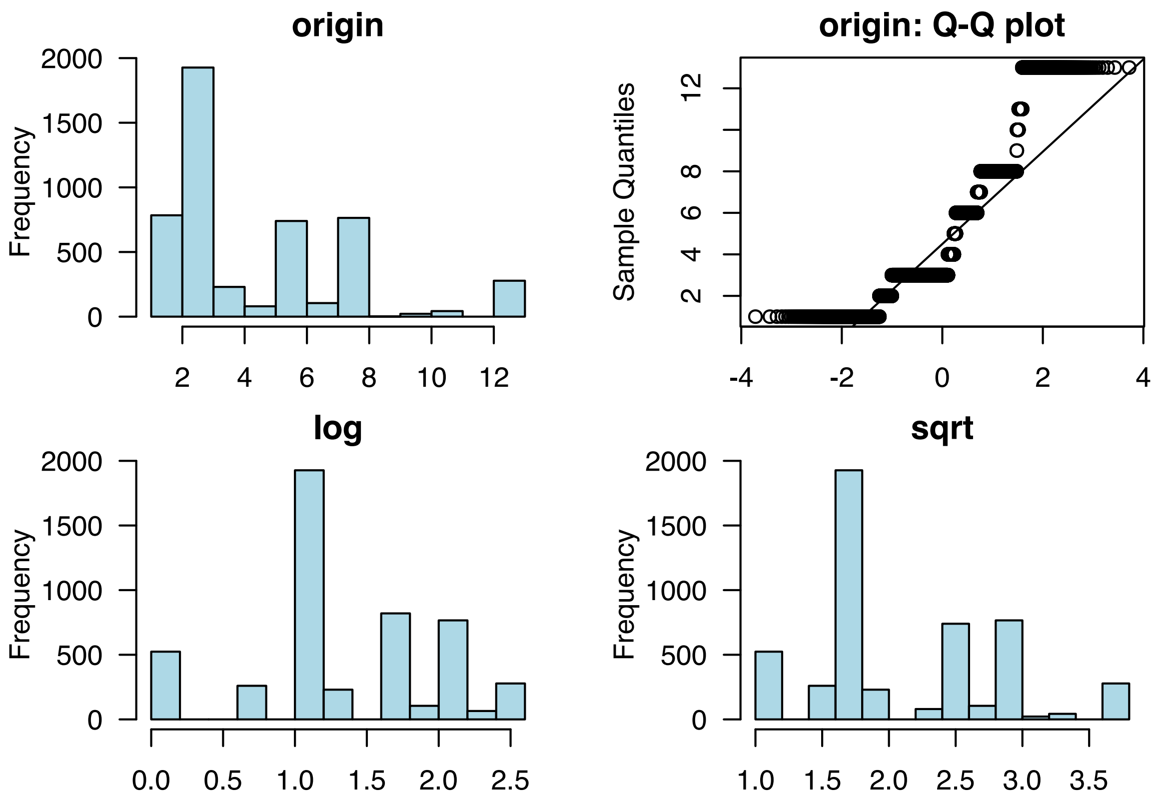


Figure 2.13: occ_code

union

normality test : Shapiro-Wilk normality test
statistic : 0.52296, p-value : 6.61572E-70

type	skewness	kurtosis
original	1.2664	2.6038
log transformation		
sqrt transformation	1.2664	2.6038

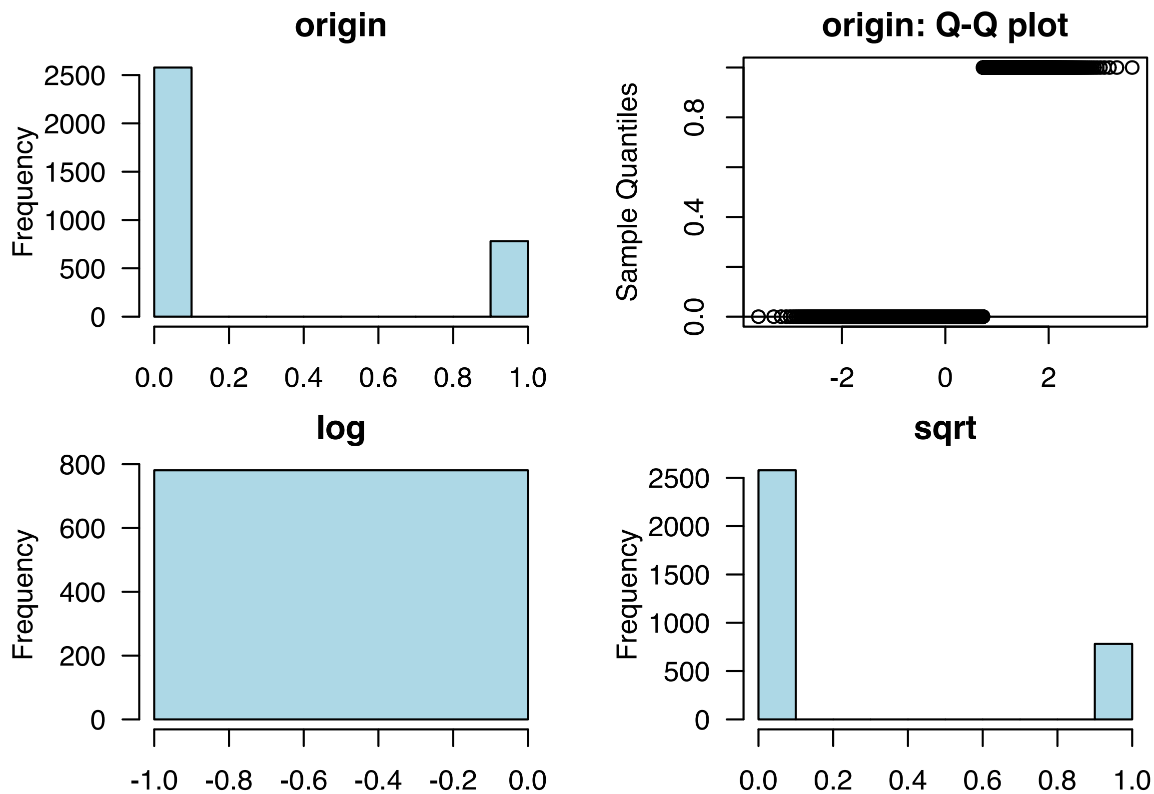


Figure 2.14: union

wks_ue

normality test : Shapiro-Wilk normality test
statistic : 0.42001, p-value : 6.49128E-78

type	skewness	kurtosis
original	3.8091	19.3596
log transformation		
sqrt transformation	2.2365	7.3800

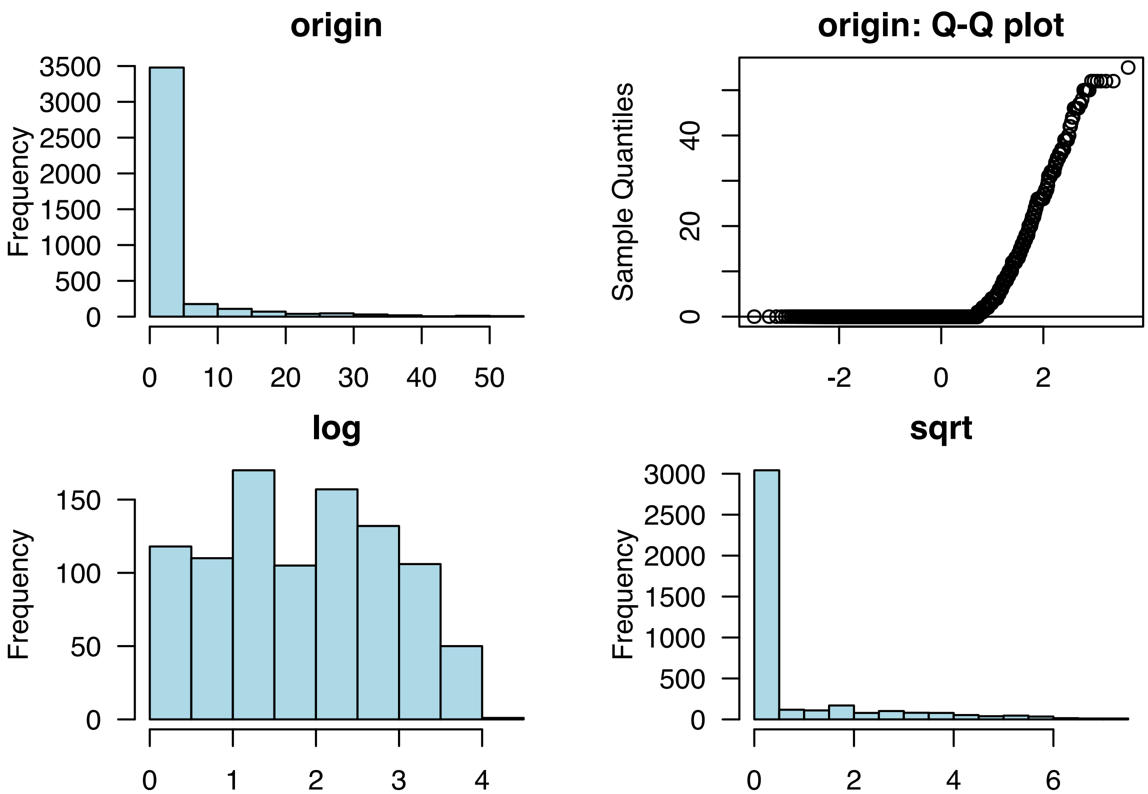


Figure 2.15: wks_ue

ttl_exp

normality test : Shapiro-Wilk normality test
statistic : 0.92709, p-value : 4.83001E-44

type	skewness	kurtosis
original	0.8390	3.0262
log transformation	-0.9583	4.0385
sqrt transformation	0.1344	2.2322

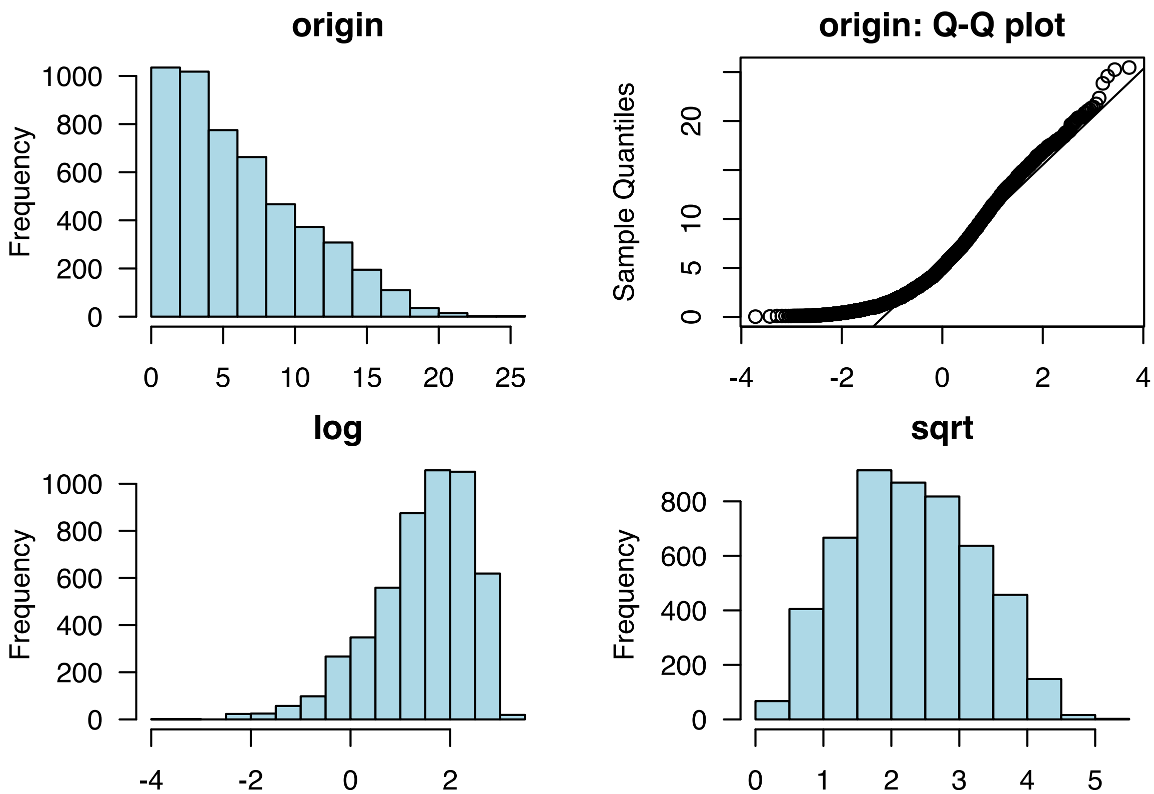


Figure 2.16: ttl_exp

tenure

normality test : Shapiro-Wilk normality test
statistic : 0.77474, p-value : 1.54979E-63

type	skewness	kurtosis
original	1.8492	6.3967
log transformation		
sqrt transformation	0.7408	2.9651

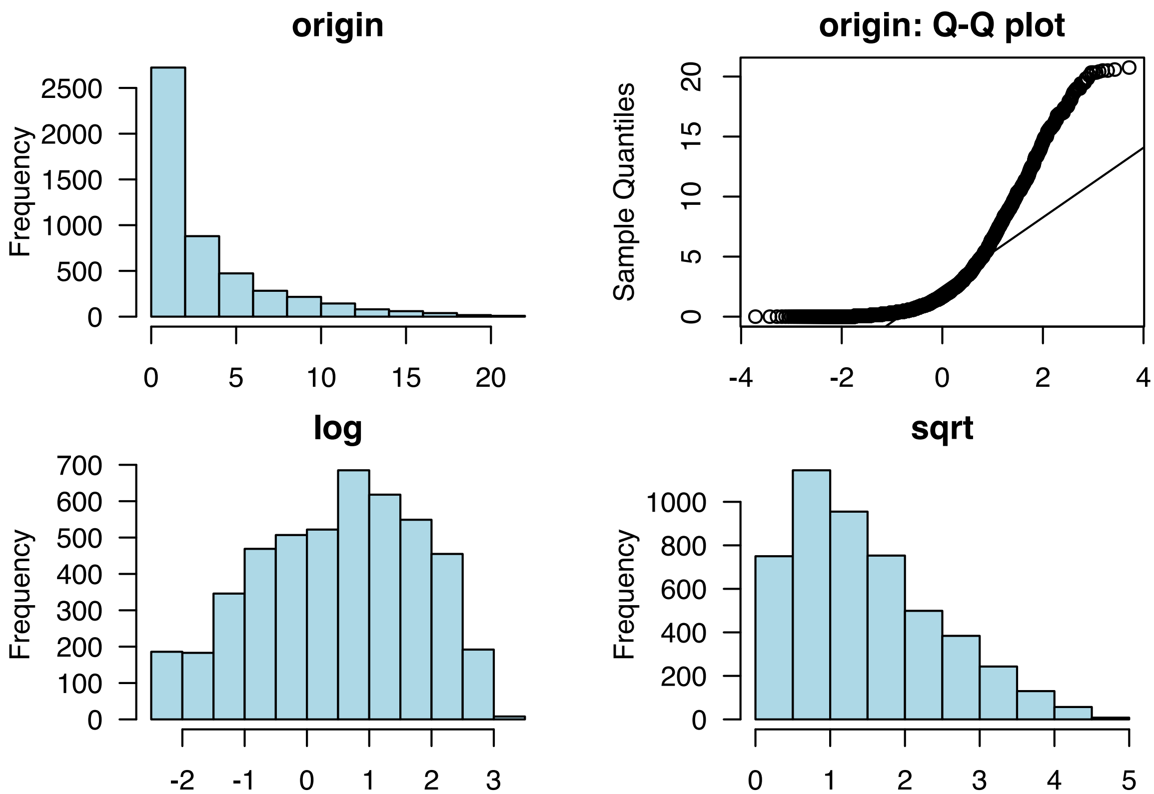


Figure 2.17: tenure

hours

normality test : Shapiro-Wilk normality test
statistic : 0.76294, p-value : 8.26327E-65

type	skewness	kurtosis
original	-0.5803	12.2148
log transformation	-3.2102	16.6244
sqrt transformation	-1.9003	8.6759

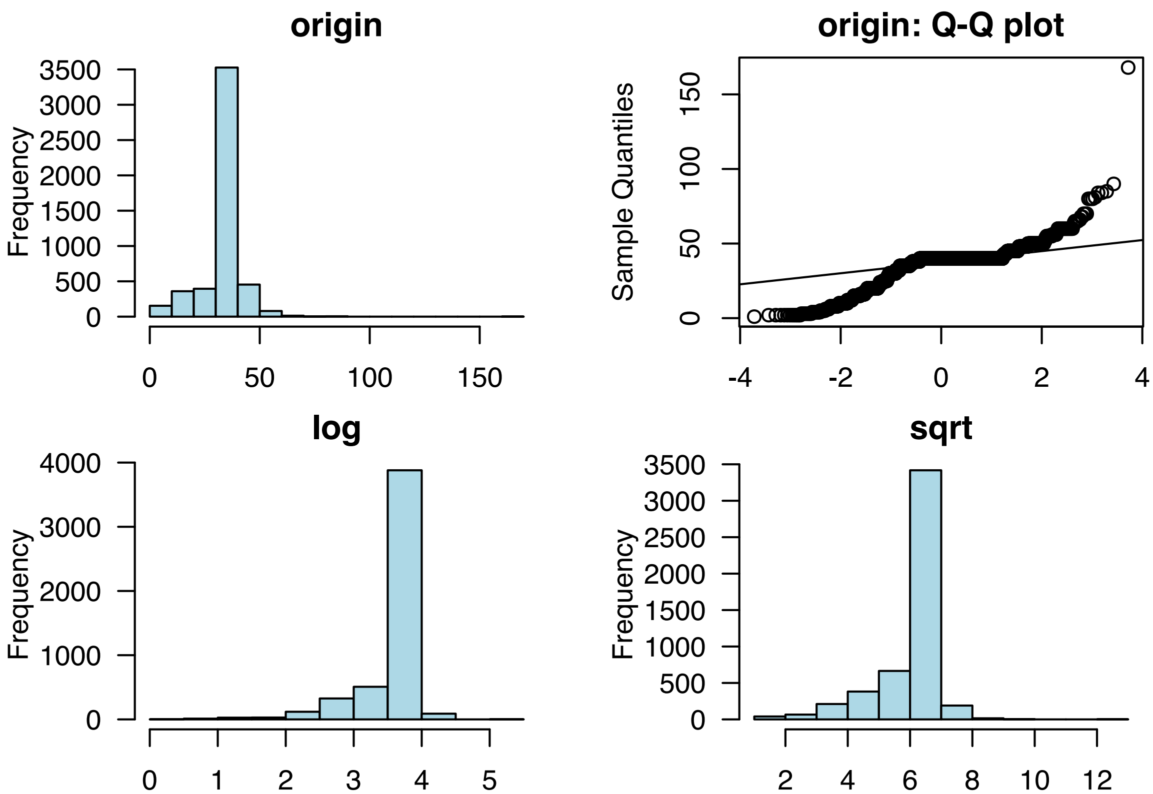


Figure 2.18: hours

wks_work

normality test : Shapiro-Wilk normality test
statistic : 0.93709, p-value : 2.52751E-41

type	skewness	kurtosis
original	0.1956	2.3285
log transformation		
sqrt transformation	-0.7896	3.5910

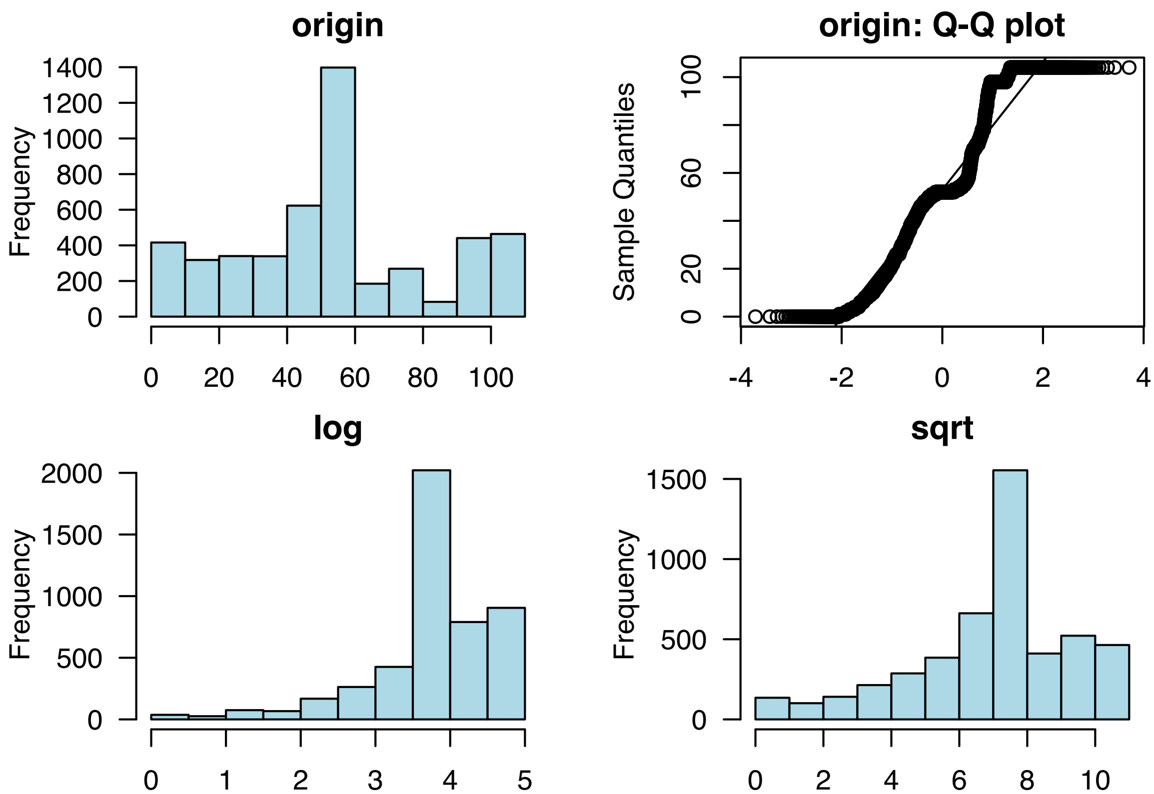


Figure 2.19: wks_work

ln_wage

normality test : Shapiro-Wilk normality test
statistic : 0.98225, p-value : 1.45277E-24

type	skewness	kurtosis
original	0.3349	4.6155
log transformation	-3.5202	35.0785
sqrt transformation	-0.6646	6.3659

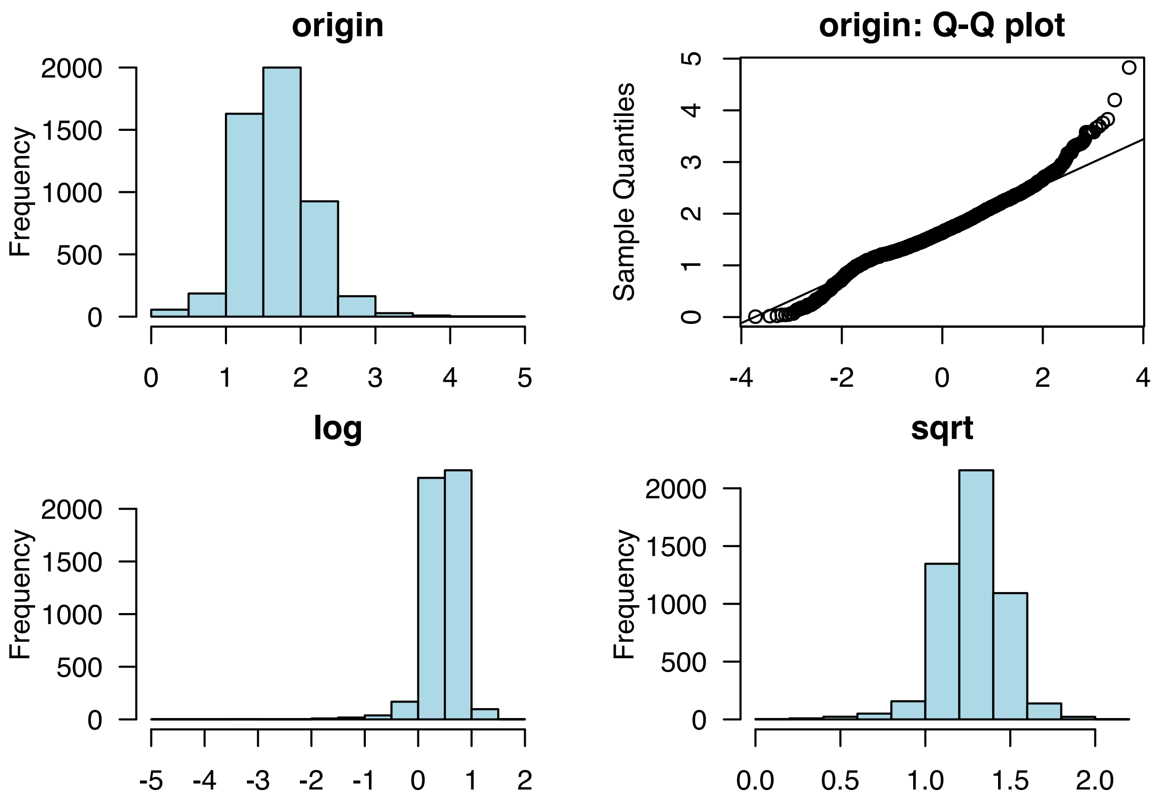


Figure 2.20: ln_wage

Chapter 3

Relationship Between Variables

3.1 Correlation Coefficient

3.1.1 Correlation Coefficient by Variable Combination

Table 3.1: The correlation coefficients (0.5 or more)

Variable1	Variable2	Correlation Coefficient
age	year	0.895
ttl_exp	year	0.777
collgrad	grade	0.757
ttl_exp	age	0.756
tenure	ttl_exp	0.674
nev_mar	msp	-0.673
wks_work	ttl_exp	0.630
wks_work	year	0.565
wks_work	age	0.525

3.1.2 Correlation Plot of Numerical Variables

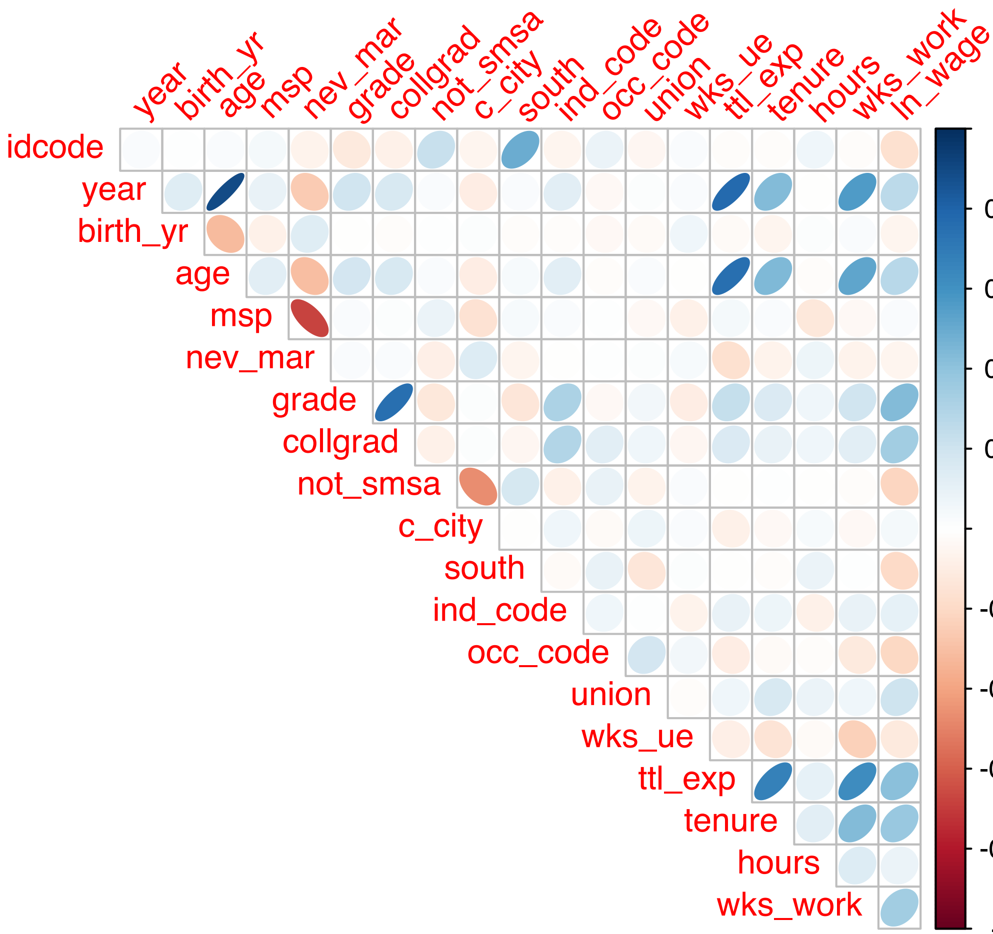


Figure 3.1: The correlation coefficient of numerical variables

Chapter 4

Target based Analysis

4.1 Grouped Descriptive Statistics

4.1.1 Grouped Numerical Variables

There is no target variable.

4.1.2 Grouped Categorical Variables

There is no target variable.

4.2 Grouped Relationship Between Variables

4.2.1 Grouped Correlation Coefficient

There is no target variable.

4.2.2 Grouped Correlation Plot of Numerical Variables

There is no target variable.

References

Arellano, Manuel. 2003. *Panel Data Econometrics.* Oxford University Press.

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Arellano, Manuel and Olympia Bover. 1995. "Another Look at the Instrumental Variable Estimation of Error-Components Models." *Journal of Econometrics* 68(1):29–51.

Blundell, Richard and Stephen Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87(1):115–43.

Hlavac, Marek. 2013. "Stargazer: LaTeX Code and Ascii Text for Well-Formatted Regression and Summary Statistics Tables." *URL: Http://CRAN. R-Project. Org/Package= Stargazer.*