

(Fast) Introduction to R

Jump into a notebook

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My beamer

BlaBlaBla

Outline

1. Motivation
2. Data
3. Conceptual discussion

3. Import data (from an excel file)

Load your data using point and click

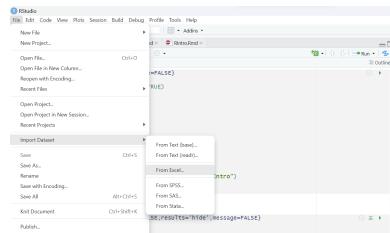


Figure 1: Point and click

which corresponds to the following code

```
nlswork <- as.data.frame(read_excel("nlswork.xlsx"))
# nlswork <- read_dta("nlswork.dta") # in case you have a Stata data source
```

4. Data manipulation – check the pipe operator, %>%

4.1. Select a subset of variables

```
nlswork_s<- nlswork %>%
  select(idcode, ln_wage)
```

4.2. Rename variables

```
nlswork_r <- nlswork %>%  
  rename(cae = ind_code)
```

4.3. Filter a subset of observations

```
nlswork_f<- nlswork %>%  
  filter(age > 40)
```

4.4. Mutate: create variables

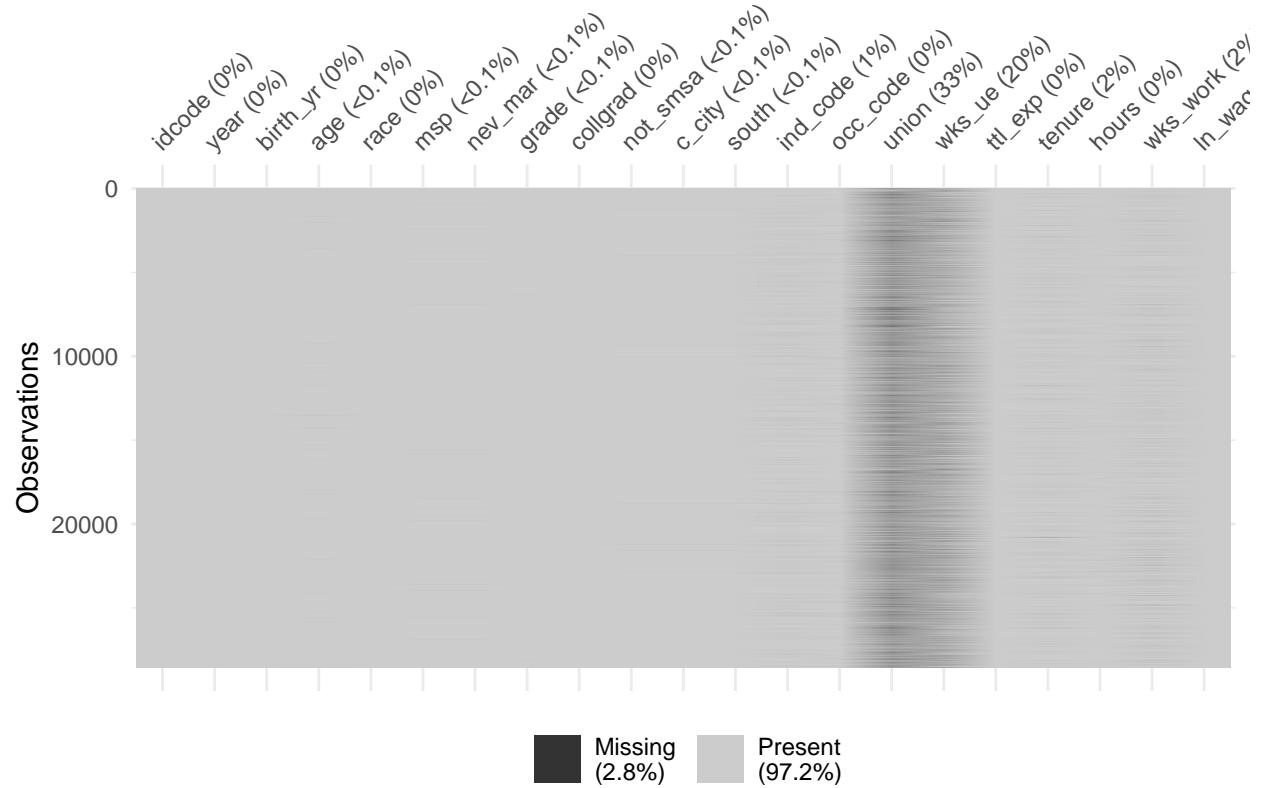
```
nlswork_m <- nlswork %>%  
  mutate(ln_asd=log(age))
```

4.5. Manipulate the data in a single sequence

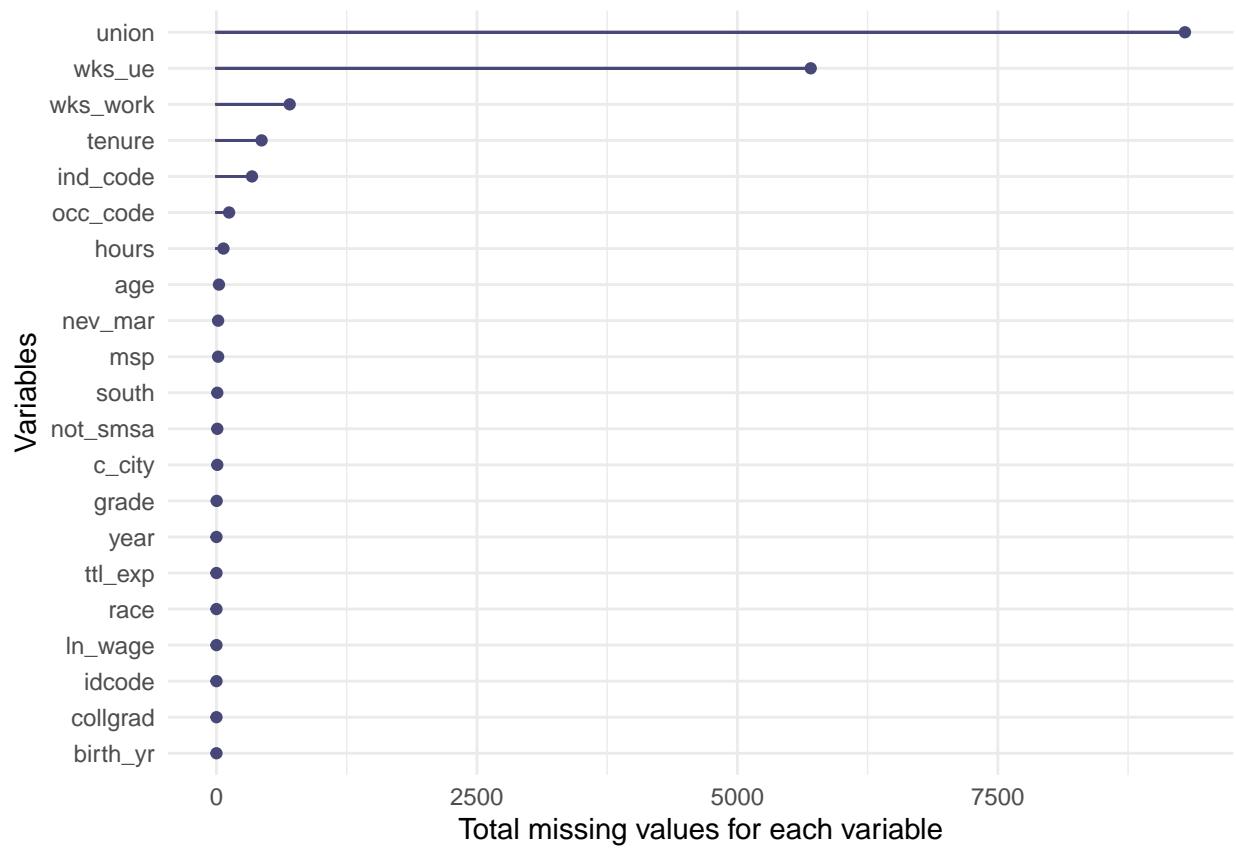
```
nlswork1<- nlswork %>%  
  rename(cae = ind_code) %>%  
  select(idcode, ln_wage, age) %>%  
  filter(age > 40) %>%  
  mutate(age2=age^2)
```

5. Visualize missing information:

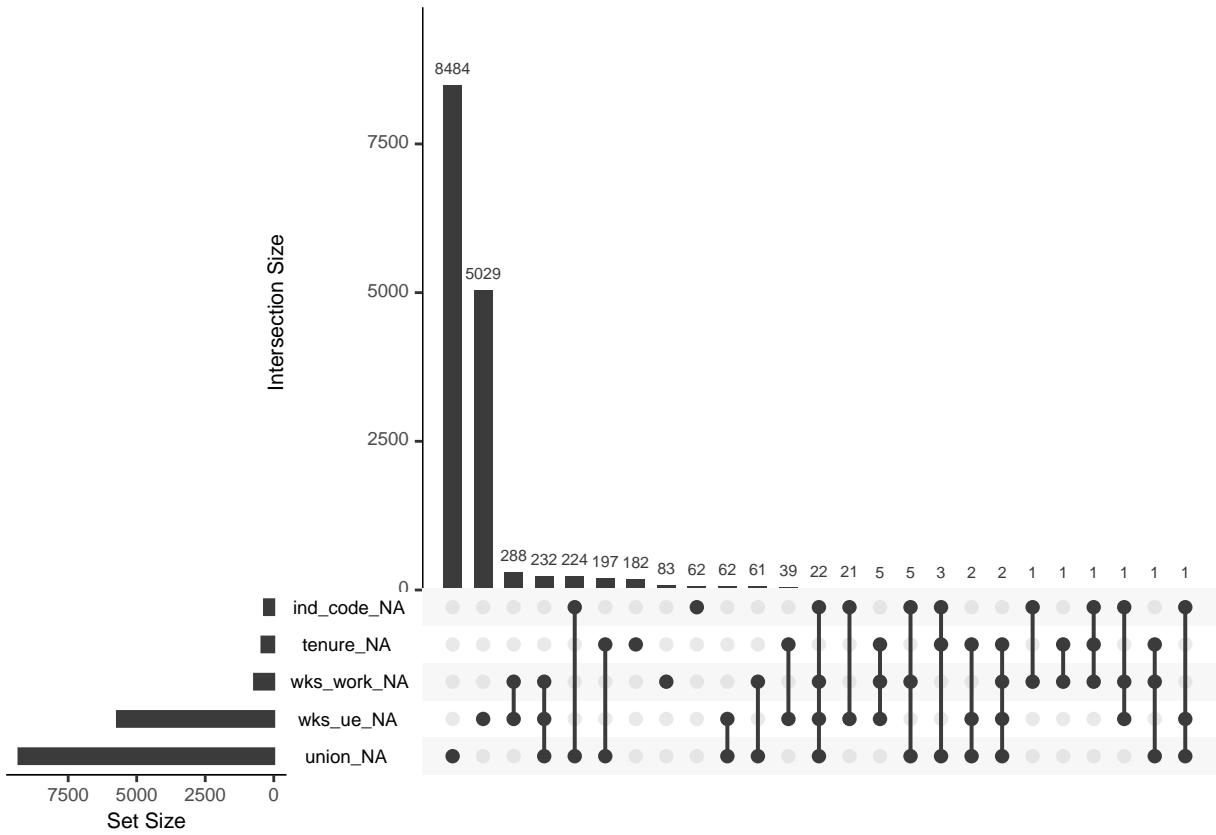
```
vis_miss(nlswork)
```



```
gg_miss_var(nlswork) + labs(y = "Total missing values for each variable")
```



```
gg_miss_upset(nlswork)
```

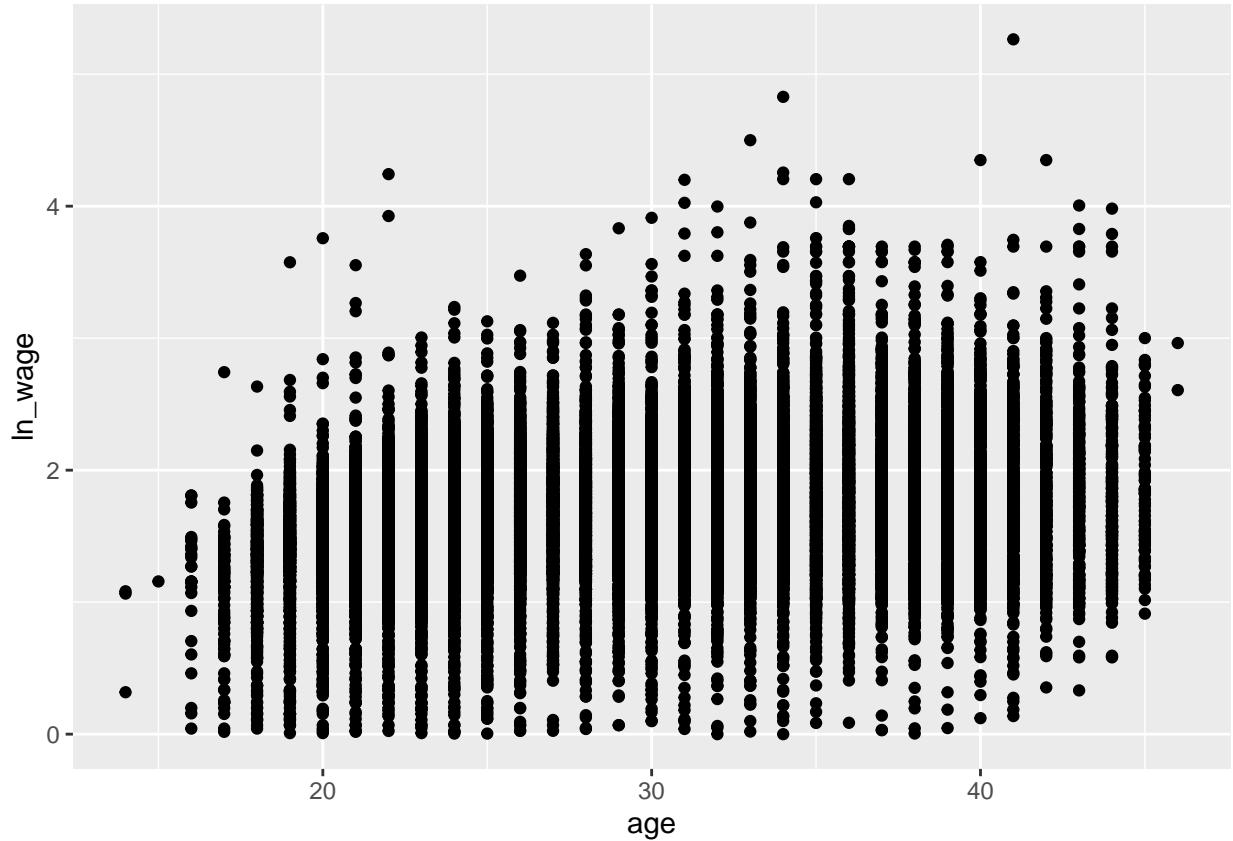


```
n_var_miss(nlswork)

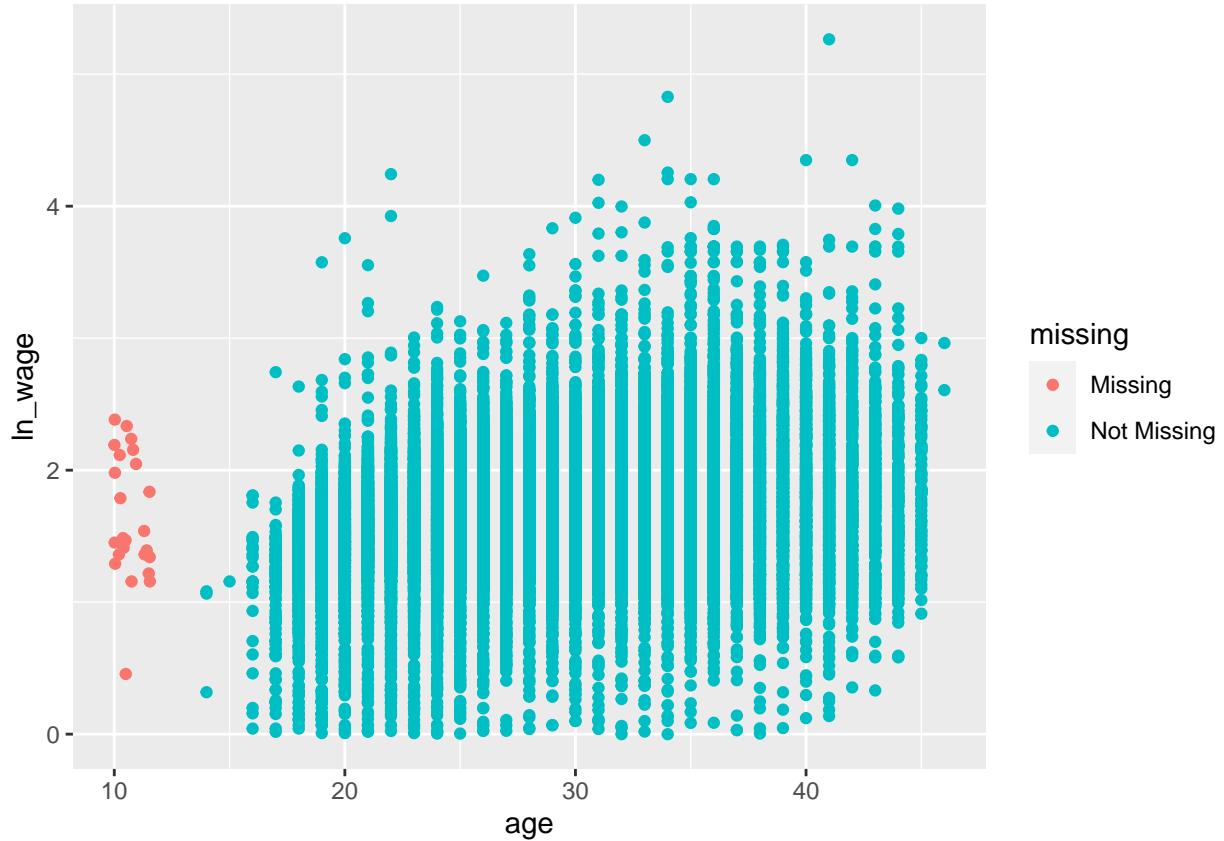
## [1] 14

ggplot(nlswork,aes(x=age,y=ln_wage))+
  geom_point()

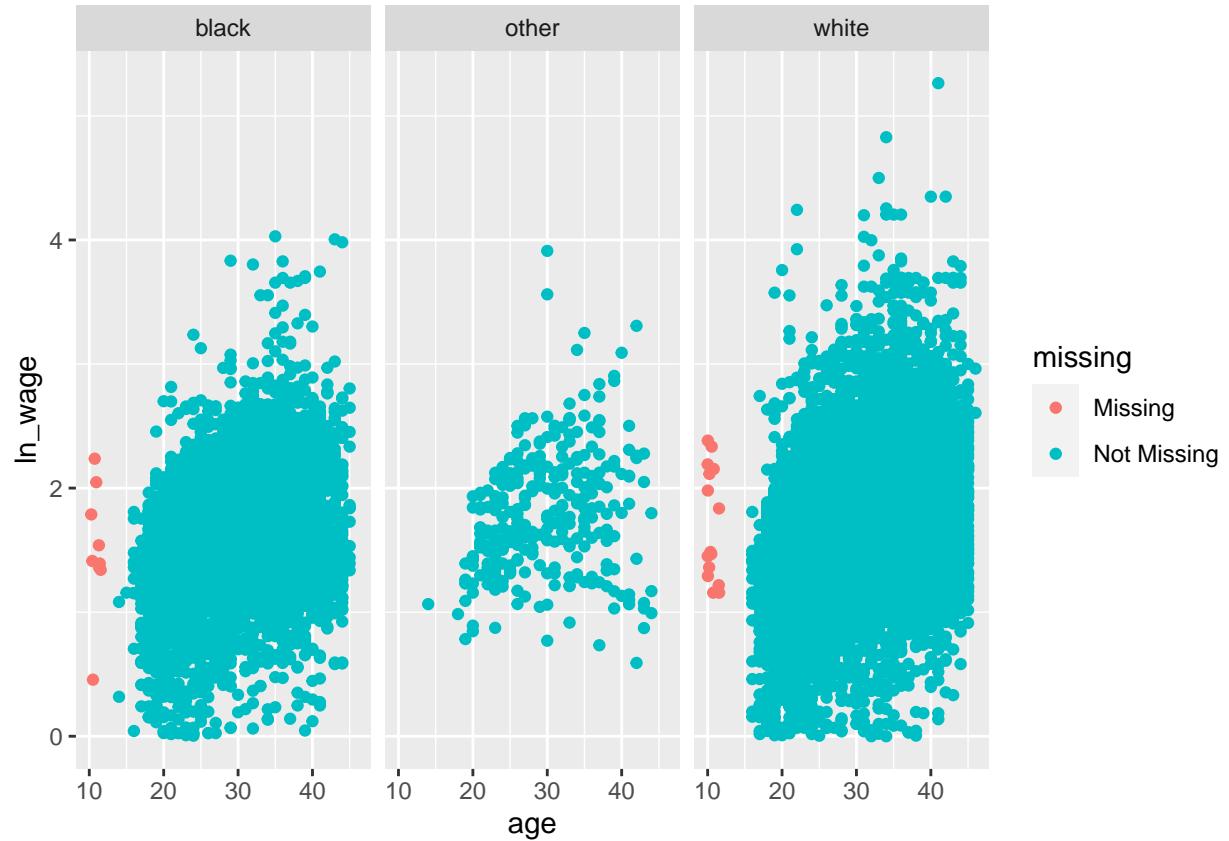
## Warning: Removed 24 rows containing missing values (`geom_point()`).
```

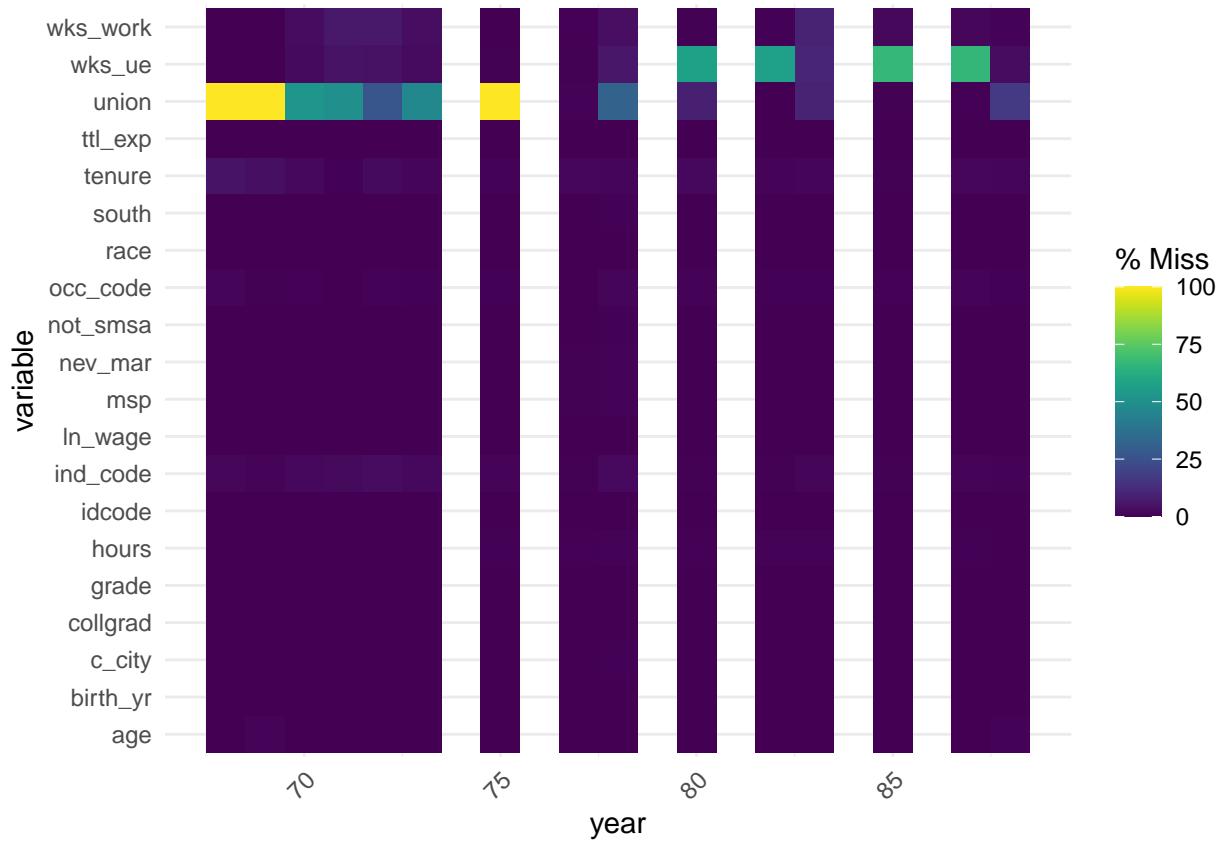


```
ggplot(nlswork,aes(x=age,y=ln_wage))+
  geom_miss_point()
```



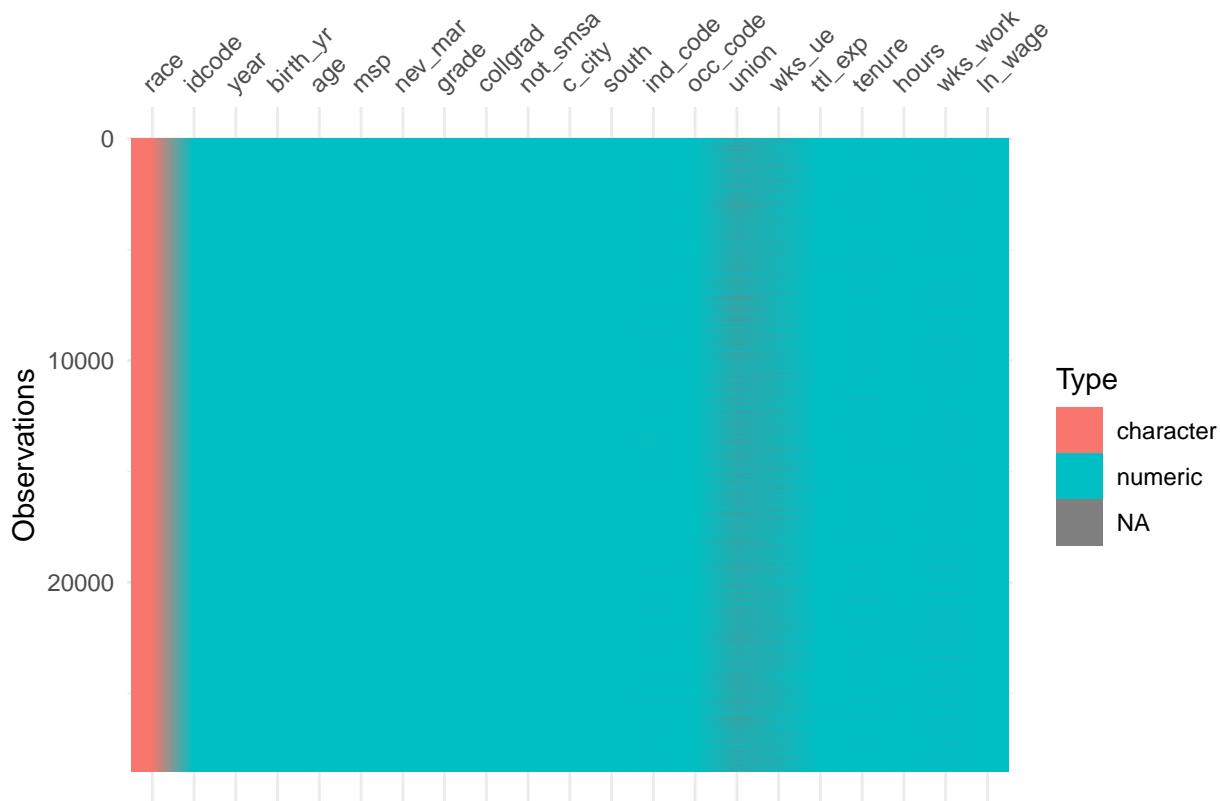
```
ggplot(nlswork,aes(x=age,y=ln_wage))+
  geom_miss_point() +
  facet_wrap(~race)
```





Alternative

```
vis_dat(nlswork)
```



6. Handling Missing Data

Handling missing data is a crucial step in the exploratory data analysis. Depending on the nature and mechanism of the missingness, we might decide to impute missing values or to exclude the observations with missing data.

6.1 Filling Missing Data

In some situations, we may opt to fill in the missing data. For instance, one common method involves replacing missing values with the mean of the variable.

```
# Filling Missing Data
nlswork_filled <- nlswork %>%
  mutate(across(c("union"), ~ ifelse(is.na(.), mean(., na.rm = TRUE), .)))
```

6.2 Excluding rows with missing data

```
# Or excluding rows with missing data
nlswork_no_na <- na.omit(nlswork)
```

7. Descriptive statistics

```
summary(nlswork_no_na)
```

```
##      idcode      year     birth_yr      age
##  Min.   : 1   Min.   :70.00   Min.   :41.00   Min.   :16.0
##  1st Qu.:1280  1st Qu.:73.00  1st Qu.:46.00  1st Qu.:25.0
##  Median :2594   Median :78.00   Median :48.00   Median :30.0
##  Mean   :2589   Mean   :79.12   Mean   :48.11   Mean   :30.2
##  3rd Qu.:3859  3rd Qu.:83.00  3rd Qu.:51.00  3rd Qu.:35.0
##  Max.   :5159   Max.   :88.00   Max.   :54.00   Max.   :46.0
##      race       msp      nev_mar      grade
##  Length:13452   Min.   :0.0000   Min.   :0.0000   Min.   : 0.00
##  Class :character  1st Qu.:0.0000  1st Qu.:0.0000  1st Qu.:12.00
##  Mode  :character  Median :1.0000  Median :0.0000  Median :12.00
##                                         Mean   :0.6257  Mean   :0.2081  Mean   :12.68
##                                         3rd Qu.:1.0000 3rd Qu.:0.0000  3rd Qu.:14.00
##                                         Max.   :1.0000  Max.   :1.0000  Max.   :18.00
##      collgrad    not_smsa     c_city      south
##  Min.   :0.0000   Min.   :0.000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.0000  1st Qu.:0.000  1st Qu.:0.0000  1st Qu.:0.0000
##  Median :0.0000  Median :0.000  Median :0.0000  Median :0.0000
##  Mean   :0.1887  Mean   :0.284  Mean   :0.3417  Mean   :0.4081
##  3rd Qu.:0.0000  3rd Qu.:1.000 3rd Qu.:1.0000  3rd Qu.:1.0000
##  Max.   :1.0000  Max.   :1.000  Max.   :1.0000  Max.   :1.0000
##      ind_code    occ_code      union      wks_ue
##  Min.   : 1.000   Min.   : 1.000   Min.   :0.0000   Min.   : 0.000
##  1st Qu.: 5.000   1st Qu.: 3.000   1st Qu.:0.0000   1st Qu.: 0.000
##  Median : 7.000   Median : 3.000   Median :0.0000   Median : 0.000
##  Mean   : 7.842   Mean   : 4.839   Mean   :0.2286   Mean   : 2.112
##  3rd Qu.:11.000   3rd Qu.: 6.000   3rd Qu.:0.0000   3rd Qu.: 0.000
##  Max.   :12.000   Max.   :13.000   Max.   :1.0000   Max.   :75.000
##      ttl_exp      tenure      hours      wks_work
##  Min.   : 0.000   Min.   : 0.0000   Min.   : 1.0   Min.   : 0.00
##  1st Qu.: 3.417   1st Qu.: 0.8333  1st Qu.: 35.0  1st Qu.: 43.00
##  Median : 5.635   Median : 2.0833  Median : 40.0  Median : 52.00
##  Mean   : 6.773   Mean   : 3.4475  Mean   : 36.2  Mean   : 50.73
##  3rd Qu.: 9.263   3rd Qu.: 4.5000  3rd Qu.: 40.0  3rd Qu.: 58.00
##  Max.   :28.885   Max.   :25.9167  Max.   :168.0  Max.   :103.00
##      ln_wage
##  Min.   :0.000
##  1st Qu.:1.397
##  Median :1.690
##  Mean   :1.714
##  3rd Qu.:2.001
##  Max.   :5.264
```

```
summary(nlswork_no_na[,c("grade","union","ln_wage")])
```

```
##      grade      union      ln_wage
##  Min.   : 0.00   Min.   :0.0000   Min.   :0.000
##  1st Qu.:12.00  1st Qu.:0.0000  1st Qu.:1.397
##  Median :12.00  Median :0.0000  Median :1.690
##  Mean   :12.68  Mean   :0.2286  Mean   :1.714
##  3rd Qu.:14.00  3rd Qu.:0.0000  3rd Qu.:2.001
```

```

##  Max.    :18.00   Max.    :1.0000   Max.    :5.264
str(nlswork_no_na)

## 'data.frame': 13452 obs. of 21 variables:
## $ idcode : num 1 1 1 1 1 1 2 2 2 2 ...
## $ year   : num 72 77 80 85 87 88 71 77 78 83 ...
## $ birth_yr: num 51 51 51 51 51 51 51 51 51 51 ...
## $ age    : num 20 25 28 33 35 37 19 25 26 31 ...
## $ race   : chr "black" "black" "black" "black" ...
## $ msp    : num 1 0 0 0 0 0 1 1 1 1 ...
## $ nev_mar: num 0 0 0 0 0 0 0 0 0 0 ...
## $ grade  : num 12 12 12 12 12 12 12 12 12 12 ...
## $ collgrad: num 0 0 0 0 0 0 0 0 0 0 ...
## $ not_smsa: num 0 0 0 0 0 0 0 0 0 0 ...
## $ c_city : num 1 1 1 1 0 0 1 1 1 1 ...
## $ south  : num 0 0 0 0 0 0 0 0 0 0 ...
## $ ind_code: num 4 12 5 5 5 5 4 4 4 4 ...
## $ occ_code: num 6 8 6 6 6 6 3 6 6 6 ...
## $ union  : num 1 0 1 1 1 0 1 1 1 1 ...
## $ wks_ue : num 0 0 0 0 0 19 0 0 12 ...
## $ ttl_exp : num 2.26 3.78 5.29 7.16 8.99 ...
## $ tenure : num 0.917 1.5 1.833 1.917 3.917 ...
## $ hours  : num 40 32 45 42 45 48 40 40 40 38 ...
## $ wks_work: num 51 52 75 97 95 70 13 52 52 37 ...
## $ ln_wage : num 1.59 1.78 2.55 2.61 2.54 ...
## - attr(*, "na.action")= 'omit' Named int [1:15082] 1 2 4 5 7 9 14 15 16 19 ...
## ..- attr(*, "names")= chr [1:15082] "1" "2" "4" "5" ...

```

Shorter statistics

Statistic Min Mean St. Dev. Max

Collage Graduate 0 0.19 0.39 1

Experience 0.00 6.77 4.41 28.88 Hours 1 36.20 10.03 168

7.1. Export descriptive statistics table to html, with 2 digits

```

nlswork_no_na %>%
  dplyr::select(age, collgrad, ttl_exp, union, hours) %>%
  stargazer(title="Shorter statistics",
             type= "text", out = "Statistics_output.html",
             digits = 2)

##
## Shorter statistics
## -----
## Statistic N     Mean   St. Dev. Min   Max
## -----
## age      13,452 30.20   6.41    16   46
## collgrad 13,452 0.19    0.39     0    1
## ttl_exp  13,452 6.77    4.41    0.00 28.88
## union    13,452 0.23    0.42     0    1
## hours    13,452 36.20   10.03   1    168

```

```
## -----
```

7.2. Export descriptive statistics table to txt, with 3 digits

```
nlswork_no_na %>%
  dplyr::select(age, collgrad, ttl_exp, union, hours) %>%
  stargazer(title="Shorter statistics",
            type= "text", out = "Statistics_output.txt",
            digits = 3)

## 
## Shorter statistics
## =====
## Statistic   N      Mean   St. Dev.   Min   Max
## -----
## age        13,452 30.203   6.414     16     46
## collgrad   13,452 0.189    0.391      0     1
## ttl_exp    13,452 6.773    4.409    0.000 28.885
## union      13,452 0.229    0.420      0     1
## hours      13,452 36.199   10.034     1    168
## -----
```

7.3. Transposing the descriptive statistics table

```
nlswork_no_na %>%
  dplyr::select(age, collgrad, ttl_exp, union, hours) %>%
  stargazer(title="Shorter statistics",
            type= "text", out = "Statistics_output2.txt",
            digits = 3, flip=TRUE)

## 
## Shorter statistics
## =====
## Statistic   age   collgrad   ttl_exp   union   hours
## -----
## N          13,452 13,452 13,452 13,452 13,452
## Mean       30.203 0.189  6.773  0.229  36.199
## St. Dev.   6.414  0.391  4.409  0.420  10.034
## Min        16      0      0.000  0      1
## Max        46      1      28.885 1      168
## -----
```

7.4. Export to pdf

```
nlswork_no_na %>%
  dplyr::select(age, collgrad, ttl_exp, union, hours) %>%
  stargazer(title="Shorter statistics",
            type= "latex",
            digits = 3, flip=TRUE)
```

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: qua, out 11, 2023 - 12:26:27

Table 1: Shorter statistics

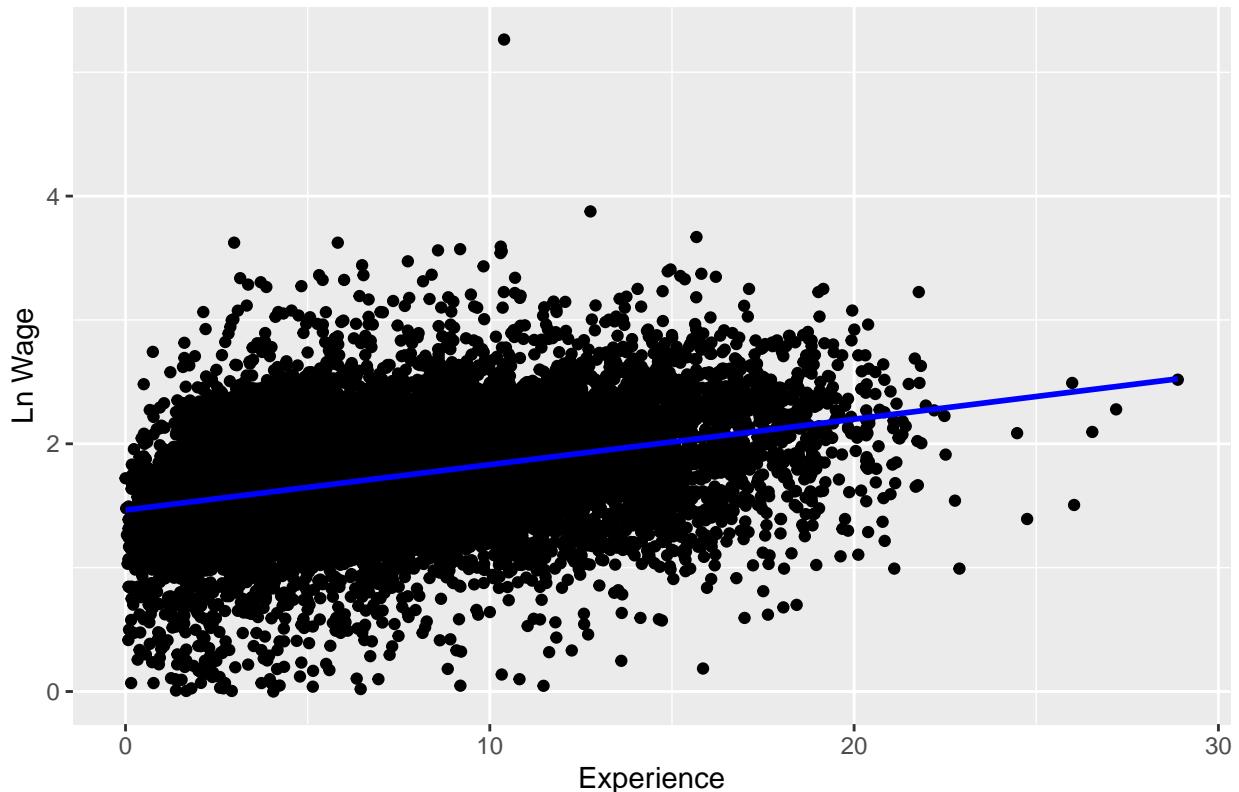
Statistic	age	collgrad	ttl_exp	union	hours
N	13,452	13,452	13,452	13,452	13,452
Mean	30.203	0.189	6.773	0.229	36.199
St. Dev.	6.414	0.391	4.409	0.420	10.034
Min	16	0	0.000	0	1
Max	46	1	28.885	1	168

8. Visualisation to explore your data

8.1. Relationships Between Continuous Variables

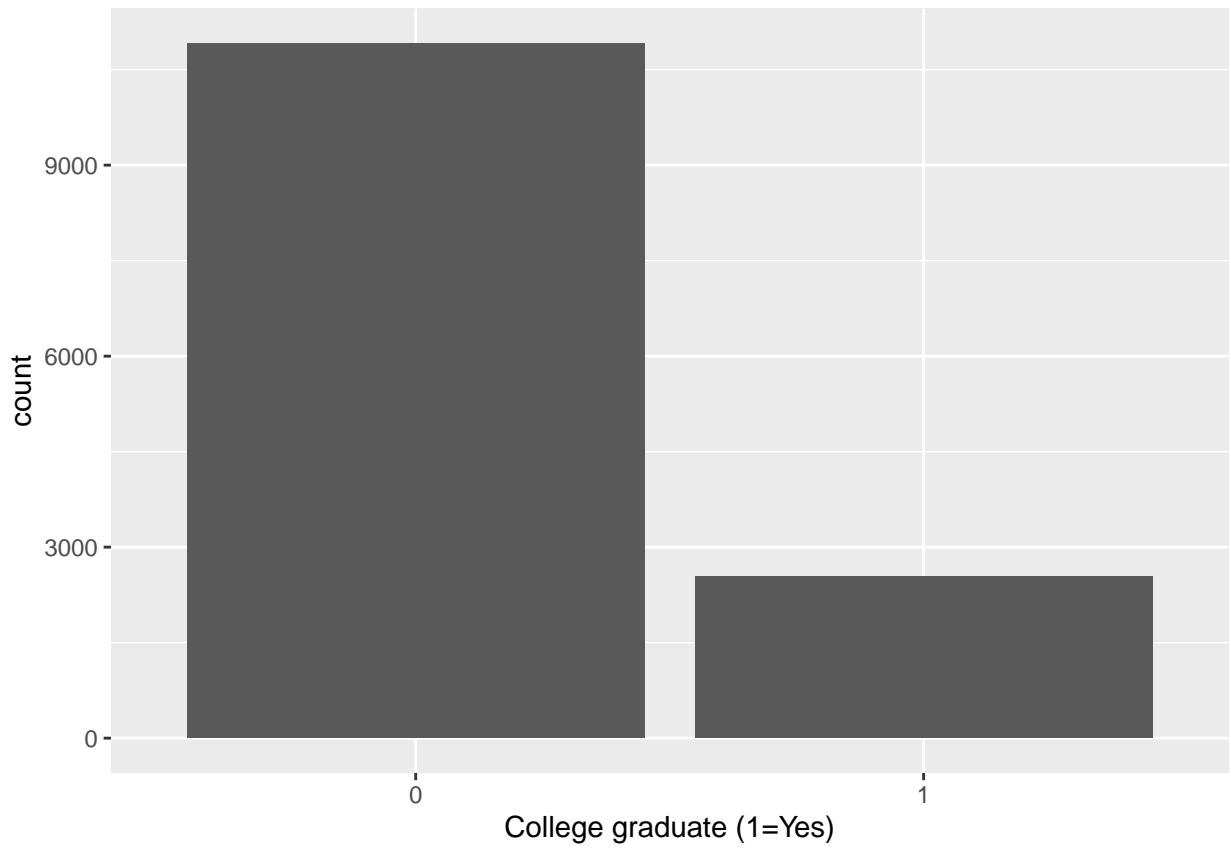
```
## `geom_smooth()` using formula = 'y ~ x'
```

Ln Wage vs. Experience



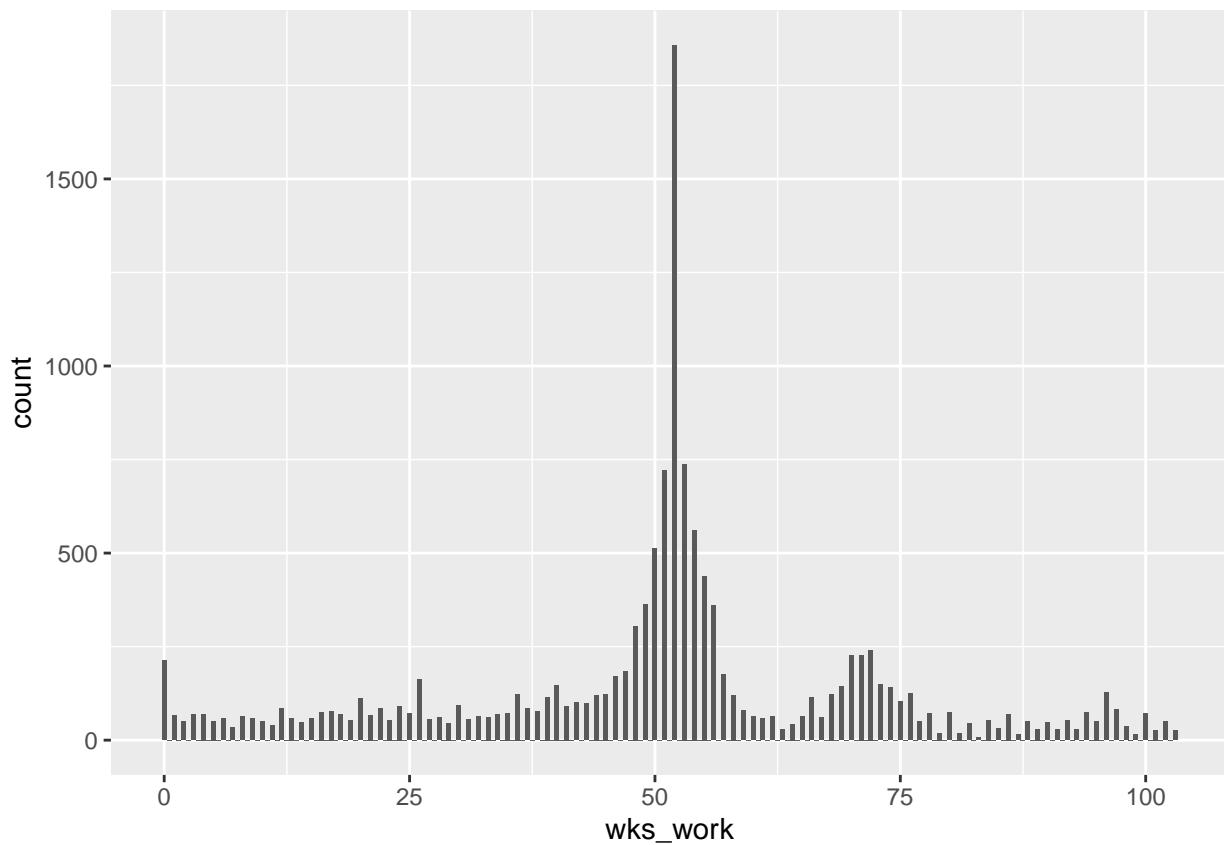
8.2. Categorical variable

```
ggplot(data = nlswork_no_na) +
  geom_bar(mapping=aes(x=as.factor(collgrad))) +
  xlab("College graduate (1=Yes)")
```



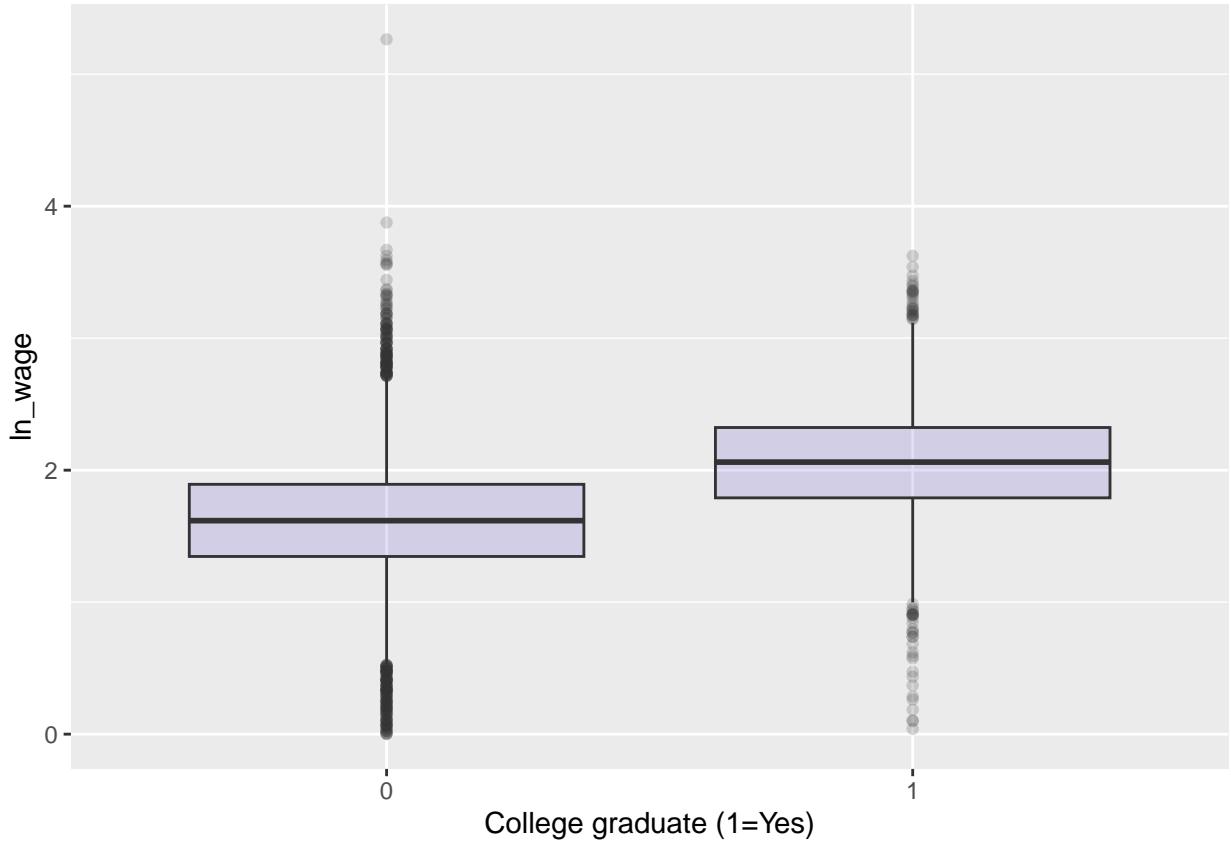
8.3. Continuous Variable Distributions

```
ggplot(data = nlswork_no_na) +
  geom_histogram(mapping = aes(x = wks_work), binwidth = 0.5)
```



8.4 Categorical and continuous variables

```
nlswork_no_na %>% ggplot(aes(x=as.factor(collgrad), y=ln_wage)) +
  geom_boxplot(fill="slateblue", alpha=0.2) +
  xlab("College graduate (1=Yes)")
```

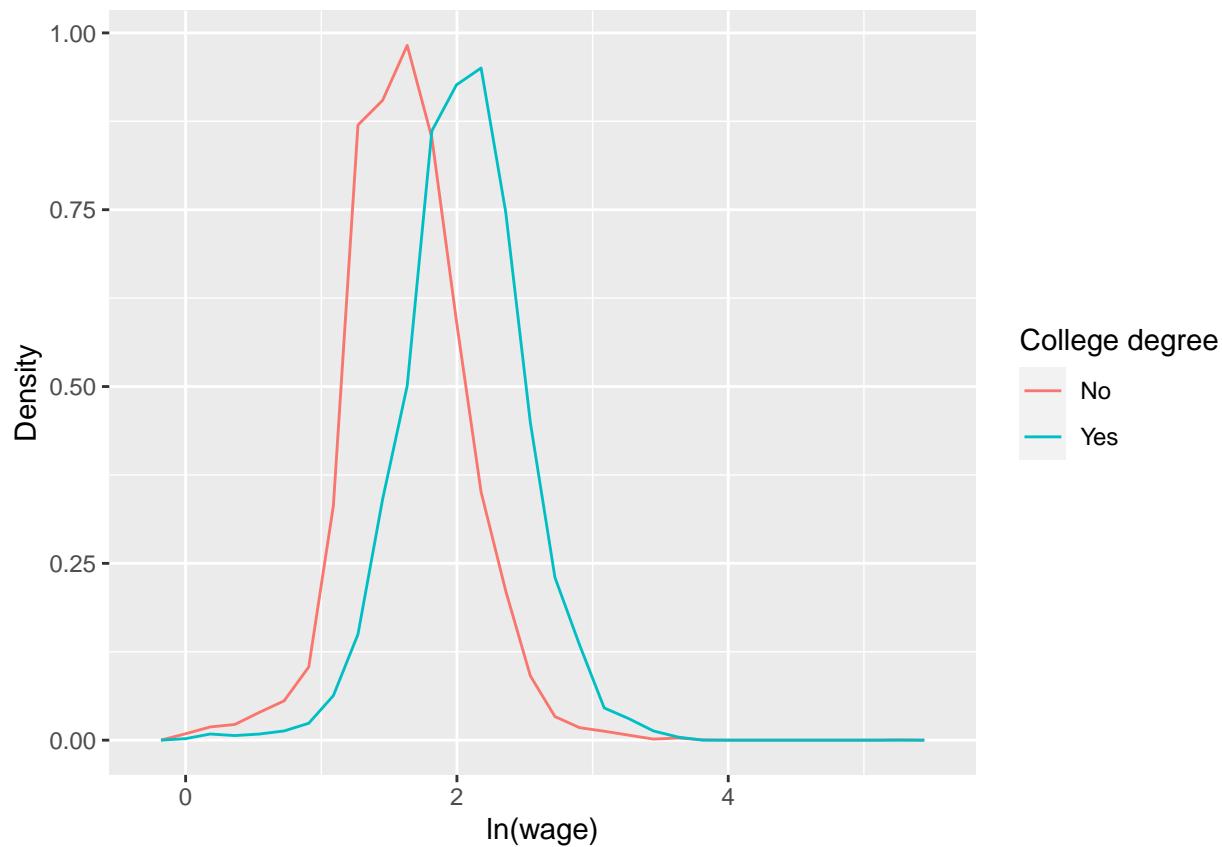


```

nlswork_no_na %>% ggplot(mapping = aes(x = ln_wage, y = ..density...)) +
  xlab("ln(wage)") +
  ylab("Density") +
  geom_freqpoly(mapping = aes(colour = factor(collgrad, labels=c("No", "Yes")))) +
  labs(color ="College degree")

## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.

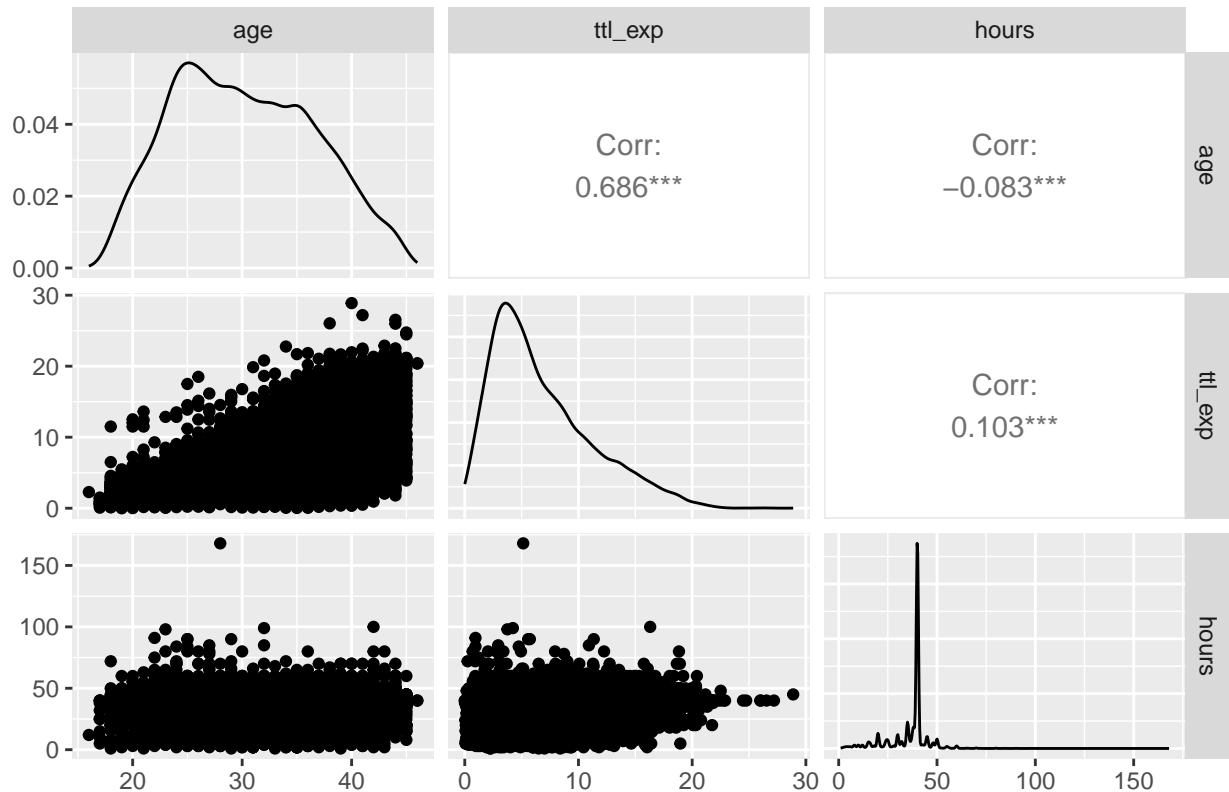
```



9. Correlation

```
ggpairs(nlswork_no_na[, c("age","ttl_exp","hours")], title="Correlogram with ggpairs()")
```

Correlogram with ggpairs()



10. Assessment

Problem 1: Data Importing

Import the “card” dataset.

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 2: Visualizing Missing Data

Graphically show which variables have the most missing values.

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 3: Handling Missing Data

Adopt a strategy to handle the missing values. How many observations were lost?

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 4: Descriptive Statistics after Missing Data Handling

Present statistics of the dataset that has been treated for missing values.

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 5: Relationship Visualization

Graphically show the relationship between age and salary. Does the relationship between the variables make sense?

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 6: Age Distribution

Display the distribution of age.

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 7: Correlation

What is the correlation value between age and salary?

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```

Problem 8:

In the nlswork_no_na dataset, can you identify any patterns or trends in the data related to unionized workers and their salaries?

```
#BEGIN SOLUTION
```

```
#END SOLUTION
```