Lab 03: Descriptive Statistics and Visualization

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> **!** Due date
>
> This lab is due on **Monday, September 29 at 11:59pm**. To be considered on time, the following must be done by the due date:
>
> - Final `.qmd` and `.pdf` files pushed to your GitHub repo
> - Final `.pdf` file submitted on Gradescope

Introduction

The main goal is to practice version control using Github. Most of these labs is adopted from happygitwithr.com materials.

Learning goals

By the end of the lab, you will:

1. Create GitHub repository from an R project
2. Collaborate with teammates in a project via GitHub
3. Produce descriptive statistics
4. Produce data visualizations

Setup Packages

```r
# load and install package
knitr::opts_chunk$set(warning = FALSE, message = FALSE)
if (!require("pacman")) install.packages("pacman")
pacman::p_load(
  tidyverse,
  probstats4econ,
  kableExtra,
  RColorBrewer,
  curl,
  usethis)
```

Exercise 1: Creating your Own GitHub Repository

Make sure you have already created your Labs R Project folder. The name of your folder should be `ECON2250_Labs_LastName_FirstName`. One way to check if you're doing it correctly is if a files with `.Rproj` extension exists in your Files window in RStudio. If this is not yet done, you need to create this (follow steps explained in Lab 1).

Now, we are going to our own GitHub repository from this existing R projects. Follow these steps:

1. Ask one of your classmates to be your partner. These labs session is a group work.
2. Make sure you install all the packages listed above.
3. Install git on you computer. And check if it shows up in Rstudio, if not go to **Tools** → **Version Control** and select **Git**.
4. Create your GitHub Token:

```r
usethis::create_github_token()
```

5. Set your GitHub credentials

```r
gitcreds::gitcreds_set()
```

6. Create your GitHub repository

```r
usethis::use_github()
```

Exercise 2: Collaborating with GitHub

Now, we are going to learn how to collaborate using GitHub. Follow these steps:

1. Go to your GitHub repo on GitHub.com, go to *Settings* → *Collaborators* → *Add people*, then look for your teammates GitHub profile. Each teammates must do this, so you both will be collaborators on each Labs repository.
2. Now as a collaborators you can collaborate with your teammates repository, by cloning their repository. Go to their repository and copy the HTTPS url to clone their repository, this will looks like this:

   `https://github.com/theirGitHubUserName/ECON2250_Labs_LastName_FirstName.git`.

   Then in RStudio, go to *File* → *New Project* → *Version Control* → *Git* and paste the Repository URL, and place it in a different folder than your original Rproject. Open the new R project in new window so that you keep your own project open.
3. Now we can try several command in the Terminal: `git status`, `git commit`, `git push`, `git fetch`, and `git push`. See here if you want to know more than this. Now, let's try to type something below in your collaborators repository, then commmit, and push it. Check your repo as well.

Type line below here:

To complete these exercise, you have to have at least one contributions from your teammates in your repository.

Exercise 3: Creating Descriptive Statistics

Single Variable

A subsample of the 2019 Current Population Survey (CPS)

```
cps%>%glimpse()
```

```
Rows: 4,013
Columns: 17
$ statefips   <fct> CA, AK, MT, NY, SC, TN, AL, CO, MD, TX, TX, MA, AZ, IL, WY~
$ age         <int> 50, 34, 50, 30, 40, 35, 56, 42, 55, 58, 39, 59, 39, 58, 34~
$ hrslastwk   <int> 40, 40, NA, 44, NA, 30, 40, 25, 40, 46, 41, 44, 30, 8, 60,~
$ unempwks    <int> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA~
$ wagehr      <dbl> 12.00, NA, NA, NA, NA, NA, 25.00, 8.00, NA, NA, 22.78, 31.~
```

```
$ earnwk      <dbl> 576.92, 3048.59, NA, 2500.00, NA, 300.00, 1000.00, 1000.00~
$ ownchild    <int> 0, 1, 4, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 2, 2, 2, 0, 0~
$ educ        <dbl> 14.0, 18.0, 16.0, 18.0, 12.0, 12.0, 12.0, 7.5, 12.0, 13.0,~
$ gender      <fct> Male, Female, Male, Female, Female, Male, Male, Female, Fe~
$ metro       <fct> Metro, Metro, Metro, Metro, Metro, Metro, Metro, Metro, Me~
$ race        <fct> Black, White, White, White, Black, White, White, Black, Ot~
$ hispanic    <fct> Non-hispanic, Non-hispanic, Hispanic, Non-hispanic, Non-hi~
$ marstatus   <fct> Never married, Married, Married, Never married, Never marr~
$ lfstatus    <fct> Employed, Employed, Not in LF, Employed, Not in LF, Employ~
$ ottipcomm   <fct> No, No, NA, No, NA, No, No, No, No, No, No, No, No, No, No~
$ hourly      <fct> Hourly, Non-hourly, NA, Non-hourly, NA, Non-hourly, Hourly~
$ unionstatus <fct> Non-union, Non-union, NA, Non-union, NA, Non-union, Non-un~
```

Categorical Data: Example

A subsample of the 2019 Current Population Survey (CPS)

```
table(cps$lfstatus)
```

```
  Employed  Not in LF Unemployed
      2809       1098        106
```

```
table(cps$lfstatus)/nrow(cps)
```

```
  Employed  Not in LF Unemployed
0.69997508 0.27361077 0.02641415
```

Table of sample count and sample proportion of 2019 CPS by labor force status

```
count_sum<-cps|>group_by(lfstatus)|>
  summarize('Sample Count'=n(),
            'Sample Proportion (%)'=round(100*n()/nrow(cps),2))|>
  add_row(lfstatus="Total", 'Sample Count'=nrow(cps), 'Sample Proportion (%)'=100)|>
  rename('Labor Force Status'=lfstatus)
kbl(count_sum, booktabs = T) %>%
  kable_styling(position = "center")
```

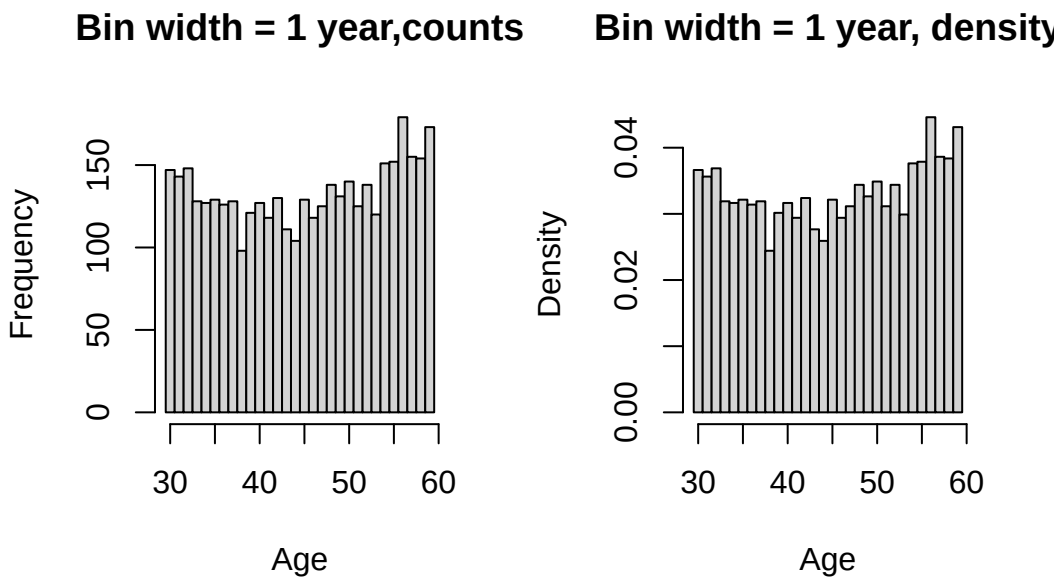
Bar charts of sample count and sample proportion of 2019 CPS by labor-force status

Labor Force Status	Sample Count	Sample Proportion (%)
Employed	2809	70.00
Not in LF	1098	27.36
Unemployed	106	2.64
Total	4013	100.00

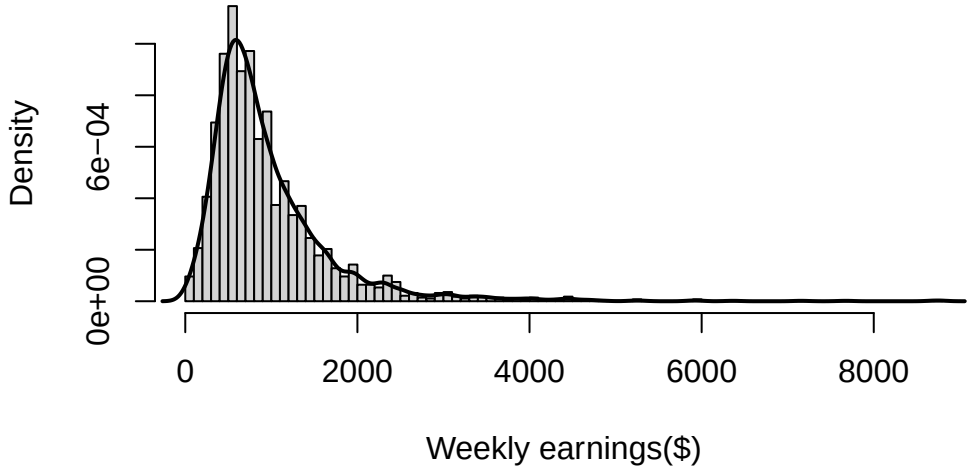
```
par(mfrow = c(1,2))
# barchartwithsamplecounts
barplot(table(cps$lfstatus), ylim=c(0,3000), main="Bar chart (counts) of
labor-force status")
# barchartwithsampleproportions
barplot(table(cps$lfstatus)/nrow(cps), ylim=c(0,0.8), main="Bar chart (proportions)
of labor-force status")
```

Numerical Data: Example

Histogram of 2019 CPS age distribution



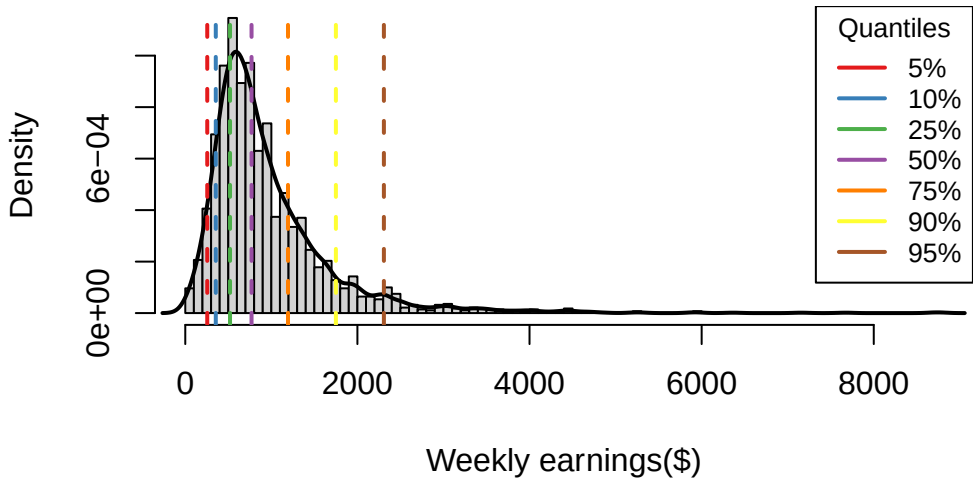
Histogram and density plot of 2019 CPS weekly earnings distribution of employed individuals



Sample quantiles: Example

Sample quantiles of 2019 CPS weekly earnings quantiles

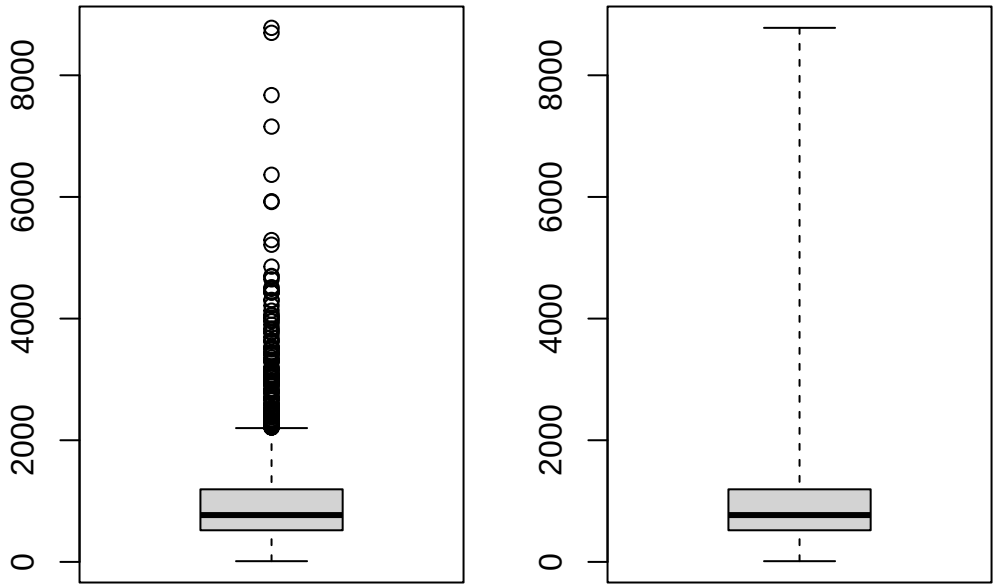
```
# Histogram with density
hist(cpsemployed$earnwk, breaks=92, freq=FALSE,
     main="", xlab="Weekly earnings($)")
lines(density(cpsemployed$earnwk), lwd=2, lty=1)

# Quantiles
qs <- quantile(cpsemployed$earnwk, probs=c(0.05, 0.10, 0.25,
                                           0.50, 0.75, 0.90, 0.95),
               na.rm=TRUE)

# Brewer palette with 7 distinct colors
cols <- brewer.pal(n=7, name="Set1")

# Add vertical lines with colors
for (i in seq_along(qs)) {
  abline(v=qs[i], col=cols[i], lwd=2, lty=2)
}

# Legend
legend("topright", legend=names(qs),
       col=cols, lwd=2, lty=1, cex=0.8,
       title="Quantiles")
```



Boxplot: Example

2019 CPS weekly earnings

```
par(mfrow = c(1,2), pin=c(2,3))
# box plot with whiskers and outliers (the default in R)
boxplot(cpsemployed$earnwk, ylab="Weekly earnings",
main="Box plot (whiskers and outliers)")
# box plot with whiskers at min and max values
boxplot(cpsemployed$earnwk, range=0,ylab="Weekly earnings",
main="Box plot (whiskers at min/max)")
```



Descriptive statistics: Example

2019 CPS Union vs Non-union worker's wage

```
union_summary<-cpsemployed%>%
  group_by(unionstatus)%>%
  summarise(
    n = n(),
    mean = round(mean(earnwk, na.rm = TRUE),2),
    MAD = round(mean(abs(earnwk - mean(earnwk, na.rm = TRUE)), na.rm = TRUE),2),
    variance = round(var(earnwk, na.rm = TRUE),2),    # uses n-1 in denominator
```

Table 1: Union vs non-union worker's wage (CPS, 2019)

Union Status	Sample Size (n)	Mean ($\overline{x}$)	MAD	Variance (s_x^2)	Std. Dev. (s_x)
Non-union	2533	946.50	488.79	562120.3	749.75
Union	276	1197.65	532.42	518378.8	719.99

Note:
Here is a general notes for this table.

```
    sd = round(sd(earnwk, na.rm = TRUE),2)
  )
union_summary
```

```
# A tibble: 2 x 6
  unionstatus     n  mean   MAD variance    sd
  <fct>       <int> <dbl> <dbl>    <dbl> <dbl>
1 Non-union    2533  946.  489.  562120.  750.
2 Union         276 1198.  532.  518379.  720.
```

```
kbl(union_summary, format="latex", booktabs = T, escape=F,
    align=c("l","c","c","c","c","c"),
    caption = "Union vs non-union worker's wage (CPS, 2019)",
    col.names = c("Union Status", "Sample Size ($n$)", "Mean ($\\overline{x}$)",
                  "MAD", "Variance ($s_x^2$)", "Std. Dev. ($s_x$)")) %>%
  kable_styling(position = "center")%>%
footnote(general = "Here is a general notes for this table.")
```

2019 CPS Male vs female worker's wage

```
gender_summary<-cpsemployed%>%
  group_by(gender)%>%
  summarise(
     n = n(),
    mean = round(mean(earnwk, na.rm = TRUE),2),
    MAD = round(mean(abs(earnwk - mean(earnwk, na.rm = TRUE)), na.rm = TRUE),2),
    variance = round(var(earnwk, na.rm = TRUE),2),   # uses n-1 in denominator
    sd = round(sd(earnwk, na.rm = TRUE),2)
  )
gender_summary
```

```
# A tibble: 2 x 6
```

Table 2: Male vs female worker's wage (CPS, 2019)

Gender	Sample Size (n)	Mean ($\overline{x}$)	MAD	Variance (s_x^2)	Std. Dev. (s_x)
Female	1308	803.49	415.14	457066.4	676.07
Male	1501	1117.30	529.94	610217.8	781.16

	Black	Other	White	Sum
Employed	324	241	2244	2809
Not in LF	136	99	863	1098
Unemployed	16	9	81	106
Sum	476	349	3188	4013

```
  gender     n  mean   MAD variance    sd
  <fct>  <int> <dbl> <dbl>    <dbl> <dbl>
1 Female  1308  803.  415.  457066.  676.
2 Male    1501 1117.  530.  610218.  781.
```

```
kbl(gender_summary,format="latex", booktabs = T, escape=F,
    align=c("l","c","c","c","c","c"),
    caption = "Male vs female worker's wage (CPS, 2019)",
    col.names = c("Gender", "Sample Size ($n$)", "Mean ($\\overline{x}$)",
                  "MAD", "Variance ($s_x^2$)", "Std. Dev. ($s_x$)")) %>%
  kable_styling(position = "center")
```

Multiple variable

Joint sample counts or proportion: Example

Joint sample count for labor-force status and race

```
joint_count<-addmargins(table(cps$lfstatus, cps$race))
kbl(joint_count, booktabs = T) %>%
  kable_styling(position = "center")
```

Joint sample proportion for labor-force status and race

```
joint_proportion<-round(addmargins(table(cps$lfstatus, cps$race))/nrow(cps),3)
kbl(joint_proportion, booktabs = T) %>%
  kable_styling(position = "center")
```

	Black	Other	White	Sum
Employed	0.081	0.060	0.559	0.700
Not in LF	0.034	0.025	0.215	0.274
Unemployed	0.004	0.002	0.020	0.026
Sum	0.119	0.087	0.794	1.000

	Black	Other	White
Employed	0.681	0.691	0.704
Not in LF	0.286	0.284	0.271
Unemployed	0.034	0.026	0.025

Sample proportions of labor-force status conditional on race

```
joint_proportion_race<-round(prop.table(table(cps$lfstatus, cps$race),margin=2),3)
kbl(joint_proportion_race, booktabs = T) %>%
  kable_styling(position = "center")
```

Sample proportions of race conditional on labor-force status

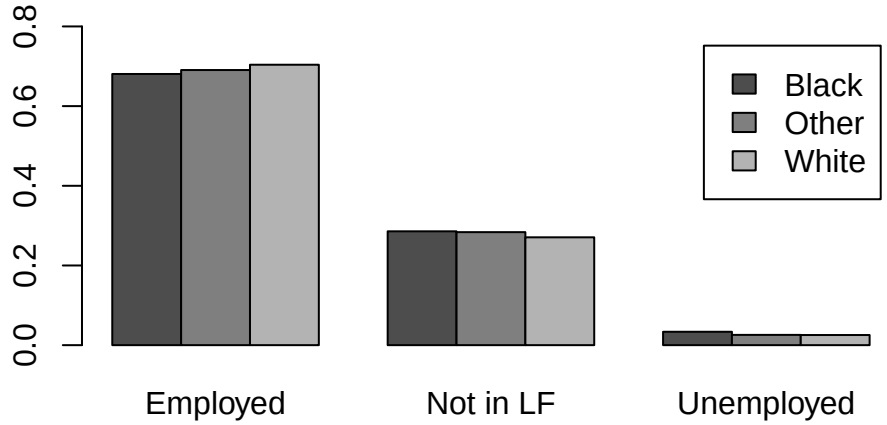
```
joint_proportion_lfstatus<-round(prop.table(table(cps$lfstatus, cps$race),margin=1),3)
kbl(joint_proportion_lfstatus, booktabs = T) %>%
  kable_styling(position = "center")
```

Bar charts: Example

Labor-force status proportions by race

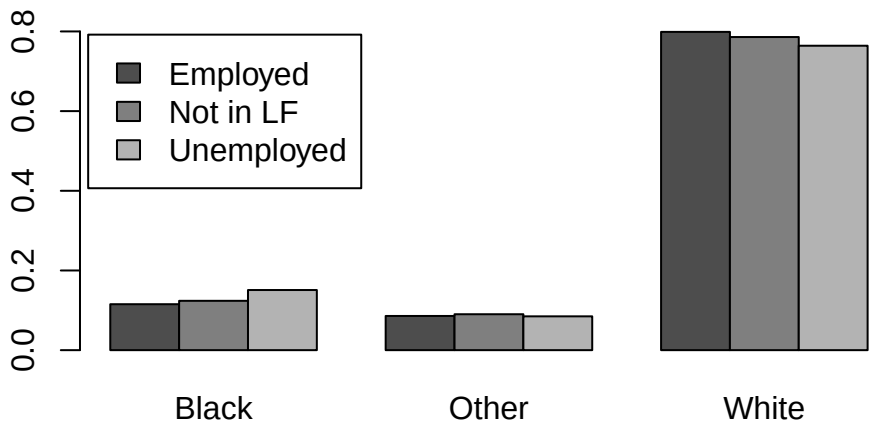
```
# create sample count table for race and labor-force status variables
tbl_racelf <- table(cps$race, cps$lfstatus)
# barplot command --- categories on x-axis are based upon columns (lfstatus) of the table
barplot(prop.table(tbl_racelf, margin=1), ylim=c(0,0.8), col=c("gray30","gray50", "gray70"),
legend.text=rownames(tbl_racelf), beside=TRUE, main="")
```

	Black	Other	White
Employed	0.115	0.086	0.799
Not in LF	0.124	0.090	0.786
Unemployed	0.151	0.085	0.764



Race proportions by labor-force status* {.smaller auto-animate="true"}

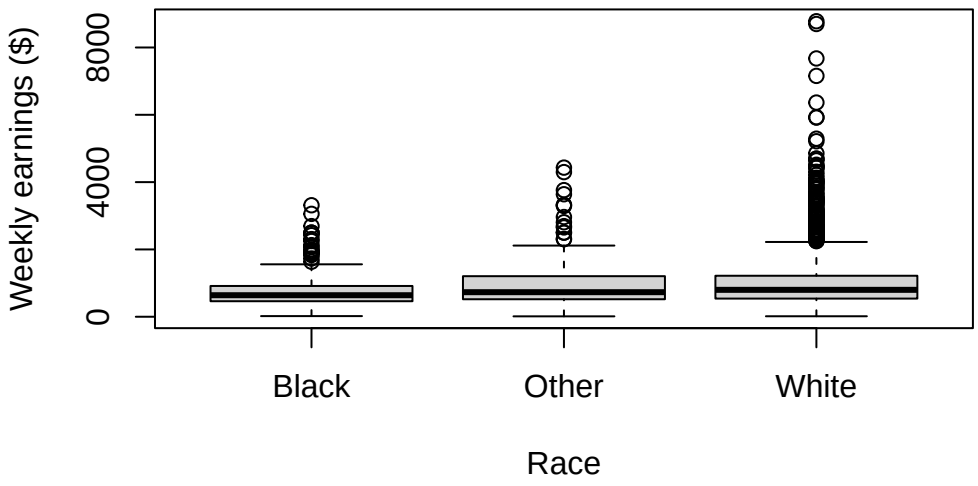
```
# create sample count table table for race and labor-force status variables
tbl_lfrace <- table(cps$lfstatus, cps$race)
# barplot command --- categories on x-axis are based upon columns (race) of the table
barplot(prop.table(tbl_lfrace, margin=1), ylim=c(0,0.8), col=c("gray30","gray50", "gray70"),
legend.text=rownames(tbl_lfrace), beside=TRUE,
args.legend = list(x="topleft",inset=0.01), main="")
```



Showing distribution for different category: Example

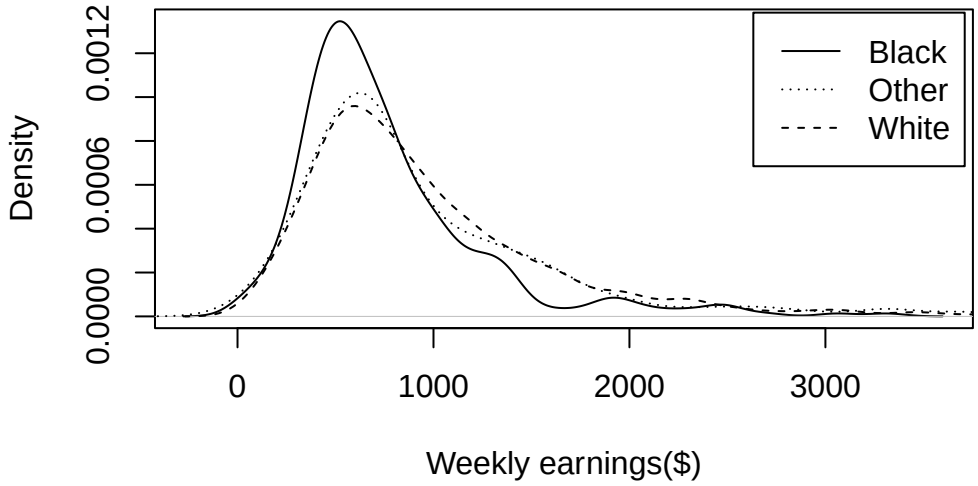
Box plots of weekly earnings by race

```
boxplot(cps$earnwk~cps$race, ylab="Weekly earnings ($)", xlab="Race")
```



Density of weakly earnings by race

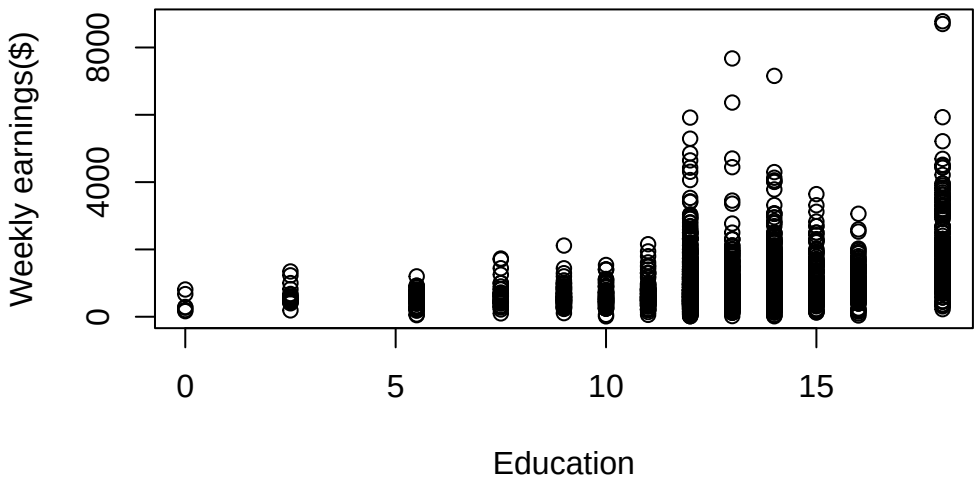
```
# createweeklyearningsvectorsforthethreesubsamples,byrace
earnwk_black <-cpsemployed[cpsemployed$race=="Black","earnwk"]
earnwk_other <-cpsemployed[cpsemployed$race=="Other","earnwk"]
earnwk_white <-cpsemployed[cpsemployed$race=="White","earnwk"]
# firstplotthedensityofweeklyearningsforblackindividuals
plot(density(earnwk_black), main="",xlab="Weekly earnings($)")
# overlaythedensityofweeklyearningsforother-raceindividuals
lines(density(earnwk_other), lty=3)
# overlaythedensityofweeklyearningsforwhiteindividuals
lines(density(earnwk_white), lty=2)
# drawthelegend
legend("topright", legend=c("Black","Other","White"), lty=c(1,3,2), inset=0.01)
```



Scatterplot: Example

Weekly earnings versus years of education

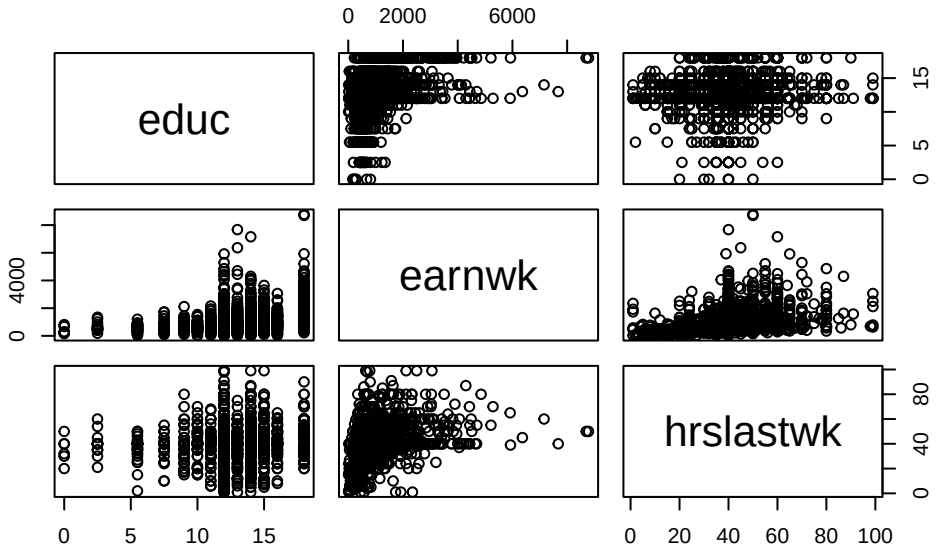
```
# scatterplotofweeklyearningsversusyearsofeducation
plot(cps$educ, cps$earnwk,xlab="Education",ylab="Weekly earnings($)")
```



Expanded scatterplot: Example

Weekly earnings vs years of education vs weekly hours worked

```
# expandedscatterplot,withweeklyearnings,yearsofeducation,andweeklyhoursworked
plot(cps[,c("educ","earnwk","hrslastwk")])
```



Exercise 4: Performing better data visualization

There is website that host a collection of beautiful charts you might want to visit: `https://r-graph-gallery.com/`. This exercise will require you to use the `cps` data we used above or other datasets from the textbooks package (see at `https://probstats4econ.com/datasets.html`), then produce the data visualization by replicating the code you find in the websites. Choose two graph that you really like and try to replicate it in the following code chunks. Remember to install the packages needed to produce the graph by putting the package name in the `package manager` chunk.

Visualization replication 1

Visualization replication 2

Wrapping up

Team Member 1: Render the document and confirm that the changes are visible in the PDF. Then, commit (with an informative commit message) both the .qmd and PDF documents, and finally push the changes to GitHub. Make sure to commit and push all changed files so that your Git pane is empty afterwards.

All other team members: Once Team Member 2 is done rendering, committing, and pushing, confirm that the changes are visible on GitHub in your team's lab repo. Then, in RStudio, click the Pull button in the Git pane to get the updated document. You should see the final version of your .qmd file.

Submission

You will submit the PDF documents for labs in to Gradescope as part of your final submission.

> **Warning**
>
> Before you wrap up the assignment, make sure all documents are updated on your GitHub repo. We will be checking these to make sure you have been practicing how to commit and push changes.
> Remember – you must turn in a PDF file to the Gradescope page before the submission deadline for full credit.

To submit your assignment:

- Access Gradescope
- Click on the assignment, and you'll be prompted to submit it.
- Mark the pages associated with each exercise. All of the pages of your lab should be associated with at least one question (i.e., should be "checked").
- Select the first page of your .PDF submission to be associated with the *"Workflow & formatting"* section.

Grading

Component	Points
Exercise 1	5
Exercise 2	5
Exercise 3	80
Exercise 4	5
Workflow & formatting (Pushing to GitHub and Submit to Gradescope)	5

The "Workflow & formatting" grade is to assess the reproducible workflow and collaboration. This includes having at least one meaningful commit from each team member and updating the team name and date in the YAML.