

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

```
# 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,gt)

```

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:

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

5. Set your GitHub credentials

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

6. Create your GitHub repository

```
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 look 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 commit, and push it. Check your repo as well.

Type line below here:

Hello!

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, NA, NA~ |
| \$ wagehr | <dbl> | 12.00, NA, 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")
```

| 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 |

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

```
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")
```

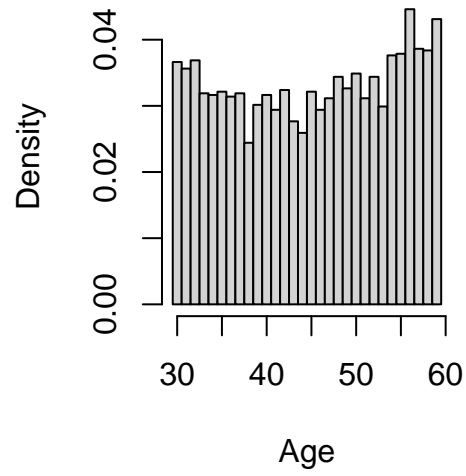
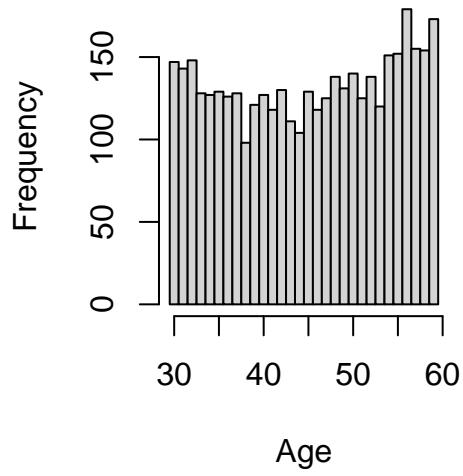


Numerical Data: Example

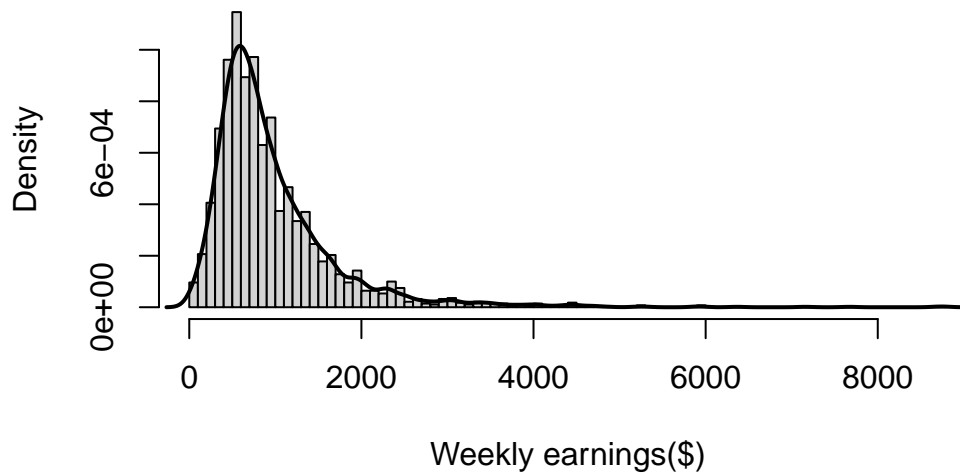
Histogram of 2019 CPS age distribution

Bin width = 1 year,counts

Bin width = 1 year, density



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



Sample quantiles: Example

Sample quantiles of 2019 CPS weekly earnings quantiles

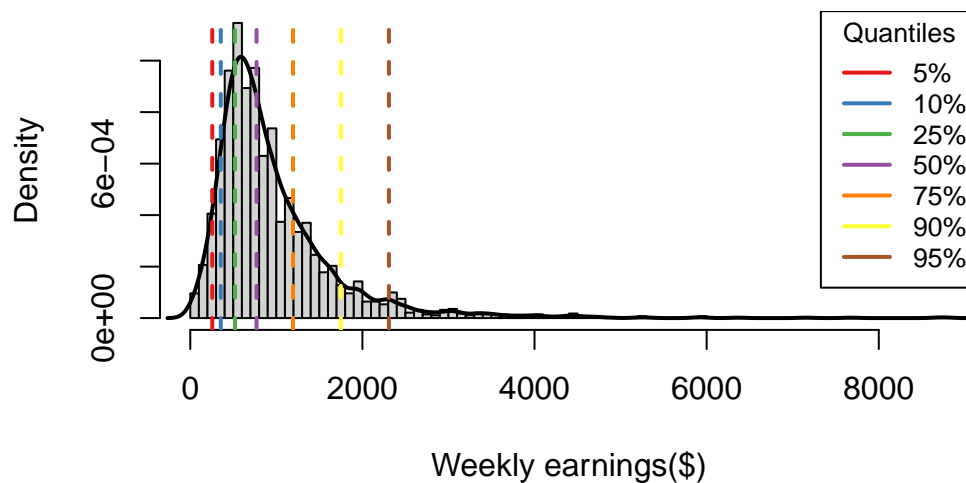
```
# Histogram with density
hist(cpsemployed$earnwk, breaks=92, freq=FALSE,
     main="", xlab="Weekly earnings($)")
lines(density(cpsemployed$earnwk), lwd=2, lty=1)

# 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)
}

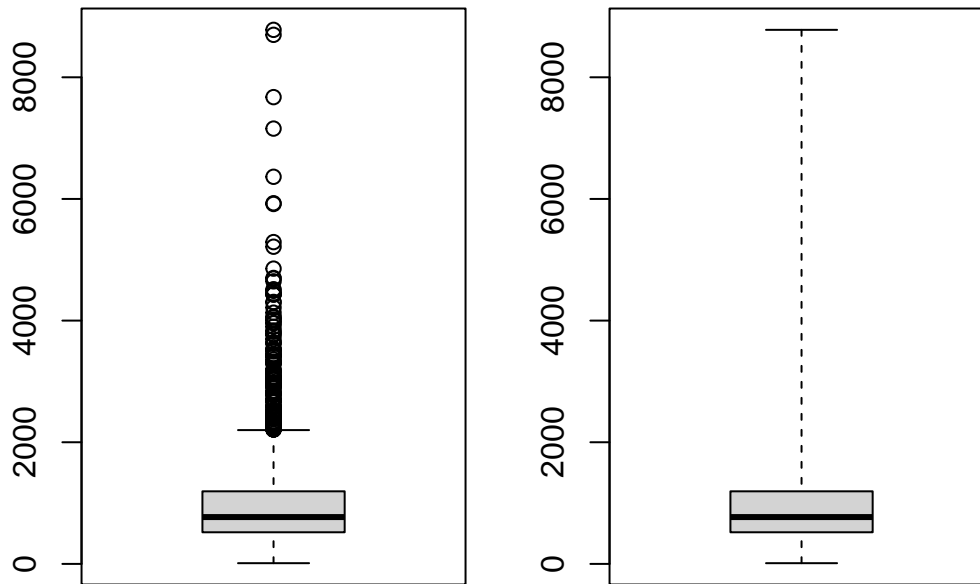
# Legend
legend("topright", legend=names(qs),
      col=cols, lwd=2, lty=1, cex=0.8,
      title="Quantiles")
```



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 (\bar{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 (\bar{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

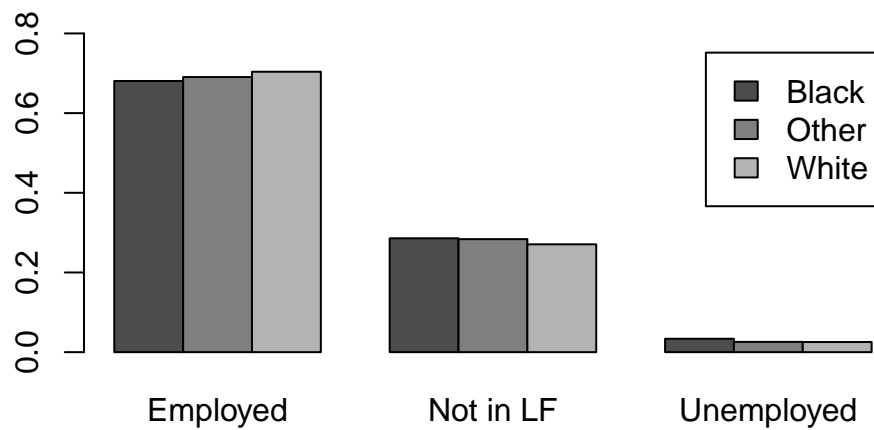
```
joint_proportion_lfstatus<-round(prop.table(table(cps$lfstatus, cps$race),margin=1),3)
kbl(joint_proportion_lfstatus, booktabs = T) %>%
  kable_styling(position = "center")
```

Bar charts: Example

Labor-force status proportions by race

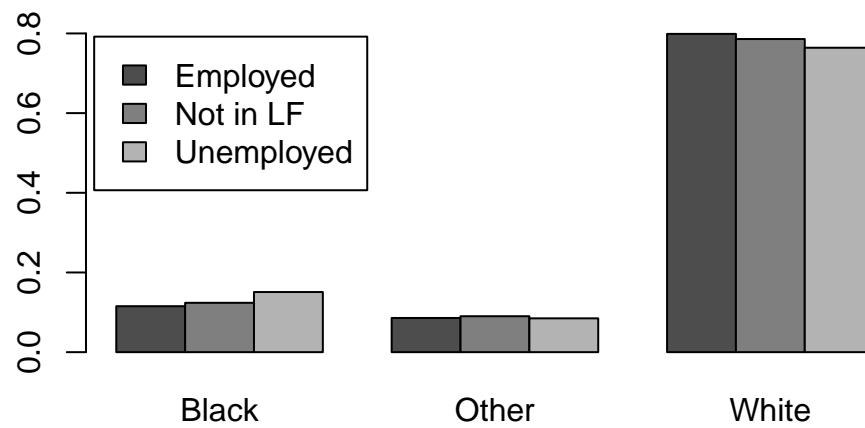
```
# create sample count table for race and labor-force status variables
tbl_racelf <- table(cps$race, cps$lfstatus)
# barplot command --- categories on x-axis are based upon columns (lfstatus) of the table
barplot(prop.table(tbl_racelf, margin=1), ylim=c(0,0.8), col=c("gray30","gray50", "gray70"),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

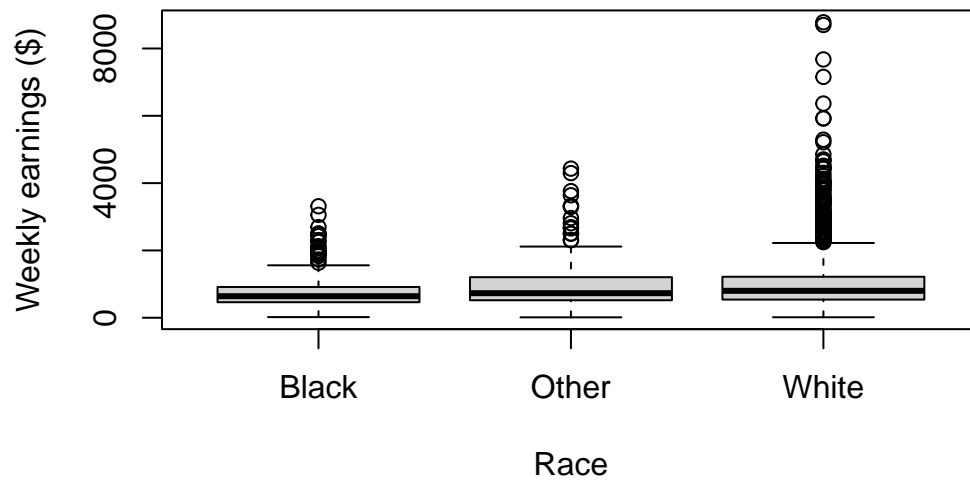
```
# create sample count table for race and labor-force status variables
tbl_lfrace <- table(cps$lfstatus, cps$race)
# barplot command --- categories on x-axis are based upon columns (race) of the table
barplot(prop.table(tbl_lfrace, margin=1), ylim=c(0,0.8), col=c("gray30","gray50", "gray70"),
legend.text=row.names(tbl_lfrace),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



Showing distribution for different category: Example

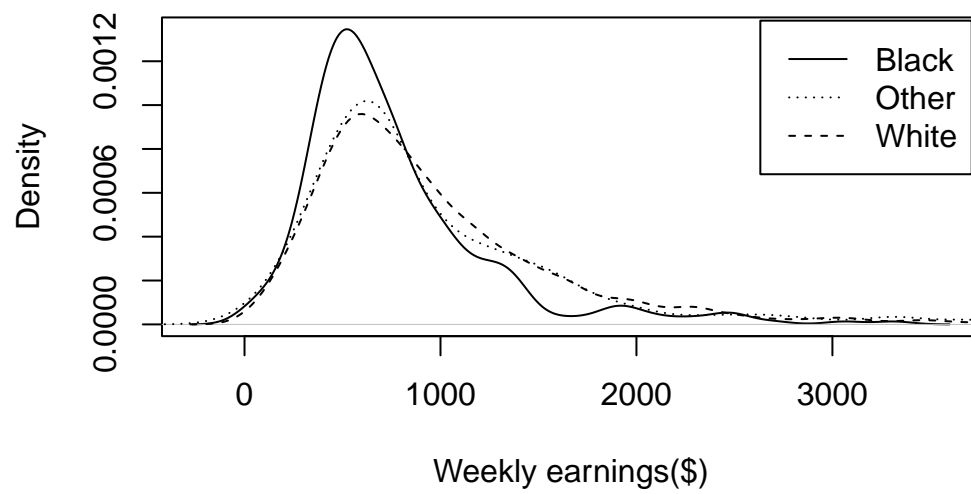
Box plots of weekly earnings by race

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



Density of weakly earnings by race

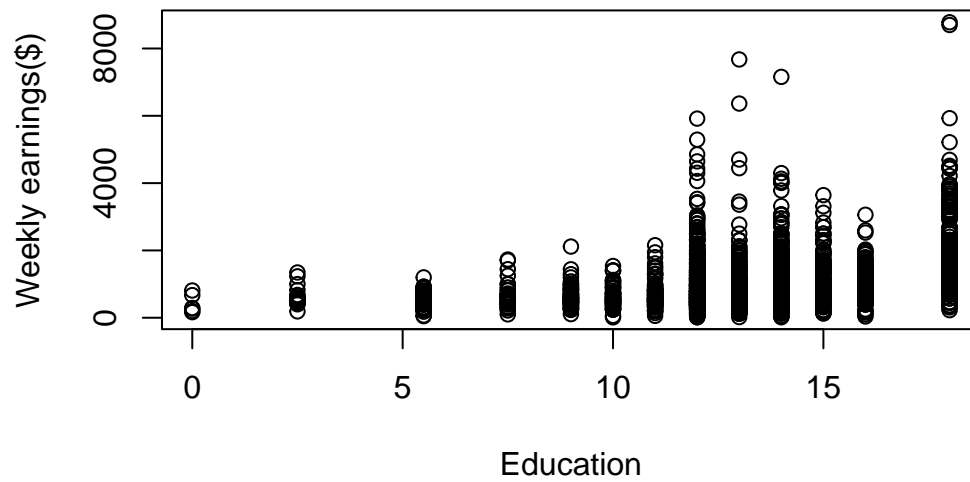
```
# create weekly earnings vectors for the three subsamples, by race
earnwk_black <- cpsemployed[cpsemployed$race=="Black", "earnwk"]
earnwk_other <- cpsemployed[cpsemployed$race=="Other", "earnwk"]
earnwk_white <- cpsemployed[cpsemployed$race=="White", "earnwk"]
# first plot the density of weekly earnings for black individuals
plot(density(earnwk_black), main="", xlab="Weekly earnings ($)")
# overlay the density of weekly earnings for other-race individuals
lines(density(earnwk_other), lty=3)
# overlay the density of weekly earnings for white individuals
lines(density(earnwk_white), lty=2)
# draw the legend
legend("topright", legend=c("Black", "Other", "White"), lty=c(1, 3, 2), inset=0.01)
```



Scatterplot: Example

Weekly earnings versus years of education

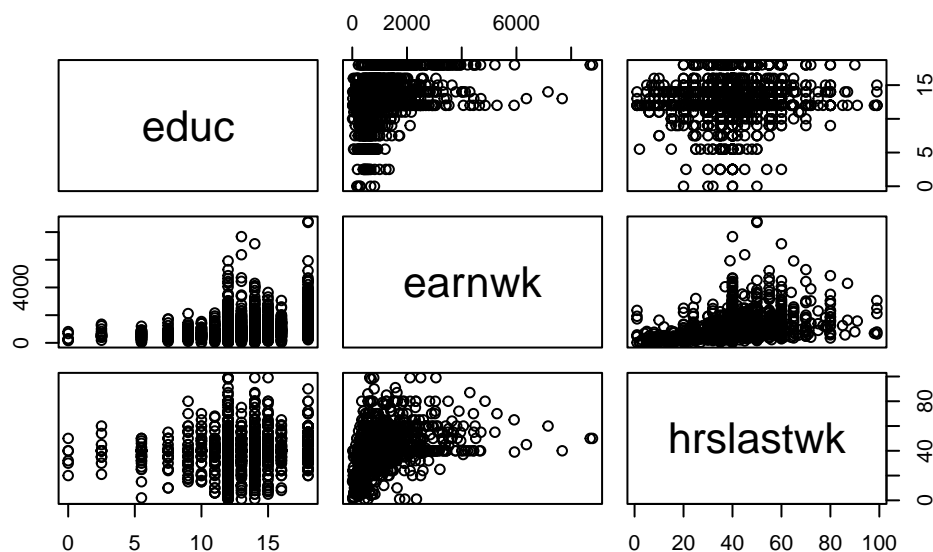
```
# scatterplotofweeklyearningsversusyearsofeducation  
plot(cps$educ, cps$earnwk,xlab="Education",ylab="Weekly earnings($)")
```



Expanded scatterplot: Example

Weekly earnings vs years of education vs weekly hours worked

```
# expandedscatterplot, with weekly earnings, years of education, and weekly hours worked
plot(cps[,c("educ", "earnwk", "hrs1astwk")])
```

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

```
library(gt)
library(dplyr)

# Create a simple data frame
data("cps", package = "probstats4econ")

# Alternatively you can do (same output):
#gt(data)

# Use the gt function
cps %>%
```

| statefips | age | hrslastwk | unempwks | wagehr | earnwk | ownchild | educ | gender | metro | race |
|-----------|-----|-----------|----------|--------|---------|----------|------|--------|-------|-------|
| CA | 50 | 40 | NA | 12 | 576.92 | 0 | 14 | Male | Metro | Black |
| AK | 34 | 40 | NA | NA | 3048.59 | 1 | 18 | Female | Metro | White |
| MT | 50 | NA | NA | NA | NA | 4 | 16 | Male | Metro | White |
| NY | 30 | 44 | NA | NA | 2500.00 | 0 | 18 | Female | Metro | White |
| SC | 40 | NA | NA | NA | NA | 0 | 12 | Female | Metro | Black |

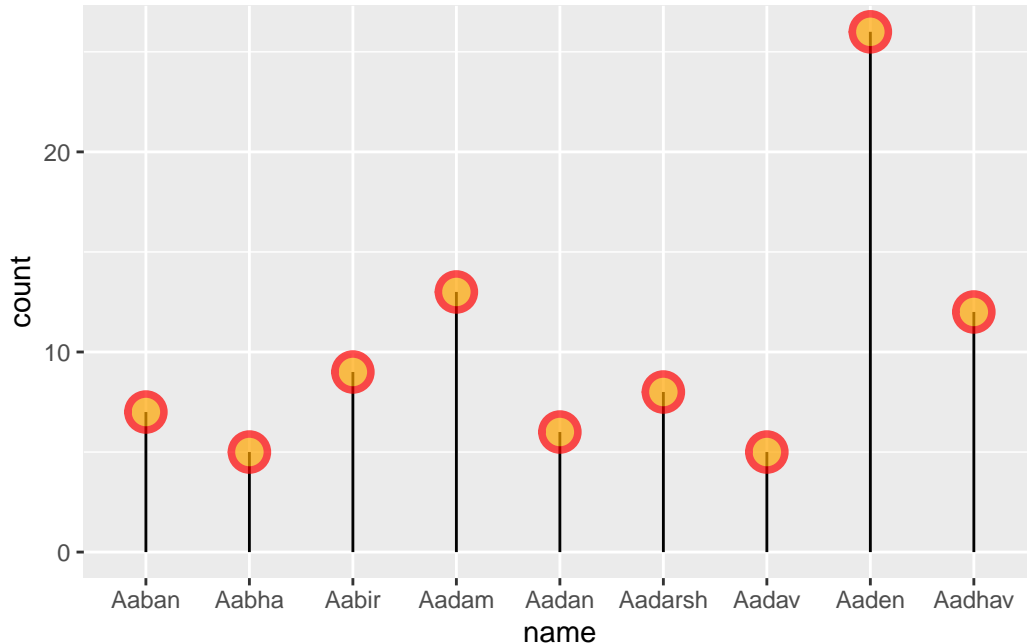
```
slice_head(n=5) %>%
gt()
```

Visualization replication 2 p

```
library(tidyverse)
data("babynames", package = "probstats4econ")

datal <- babynames %>%
  slice_head(n=9)

ggplot(datal, aes(x=name, y=count)) +
  geom_segment(aes(x=name, xend=name, y=0, yend=count)) +
  geom_point(size=5, color="red", fill=alpha("orange", 0.3), alpha=0.7, shape=21, stroke=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 |

| Component | Points |
|--|--------|
| 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.