Homework_2

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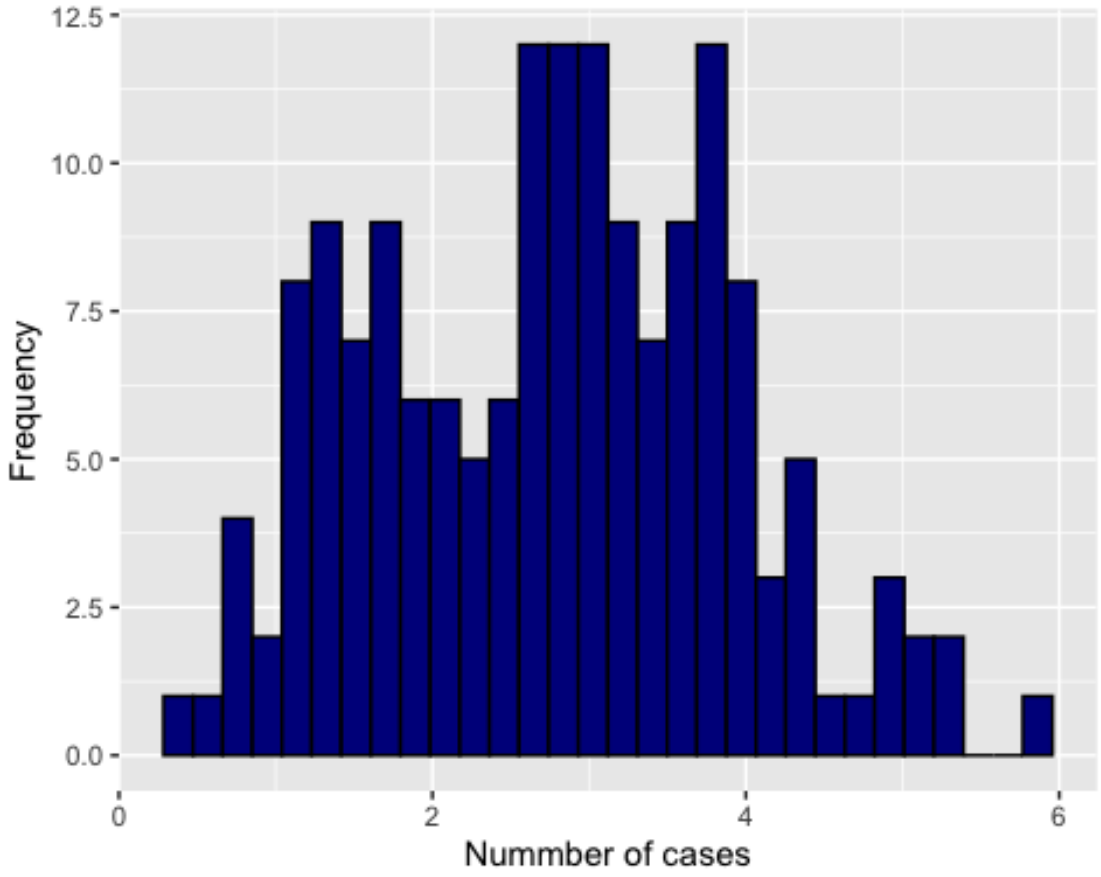
Quantitative Methods in Political Science
Leiden University

```
rawData <-
read.csv("https://raw.githubusercontent.com/nathaliehanner/LU_QA_2020/master/datasets/Corona_mergedV-Dem.csv")

library(ggplot2)
library(GGally)

## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

1.a.

```
summary(rawData$cases_log)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.301   1.827   2.818   2.761   3.532   5.785

ggplot(rawData,
       aes(x = cases_log)) +
  geom_histogram(col='black', fill='dark blue') +
labs(x = "Nummber of cases", y = "Frequency")

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

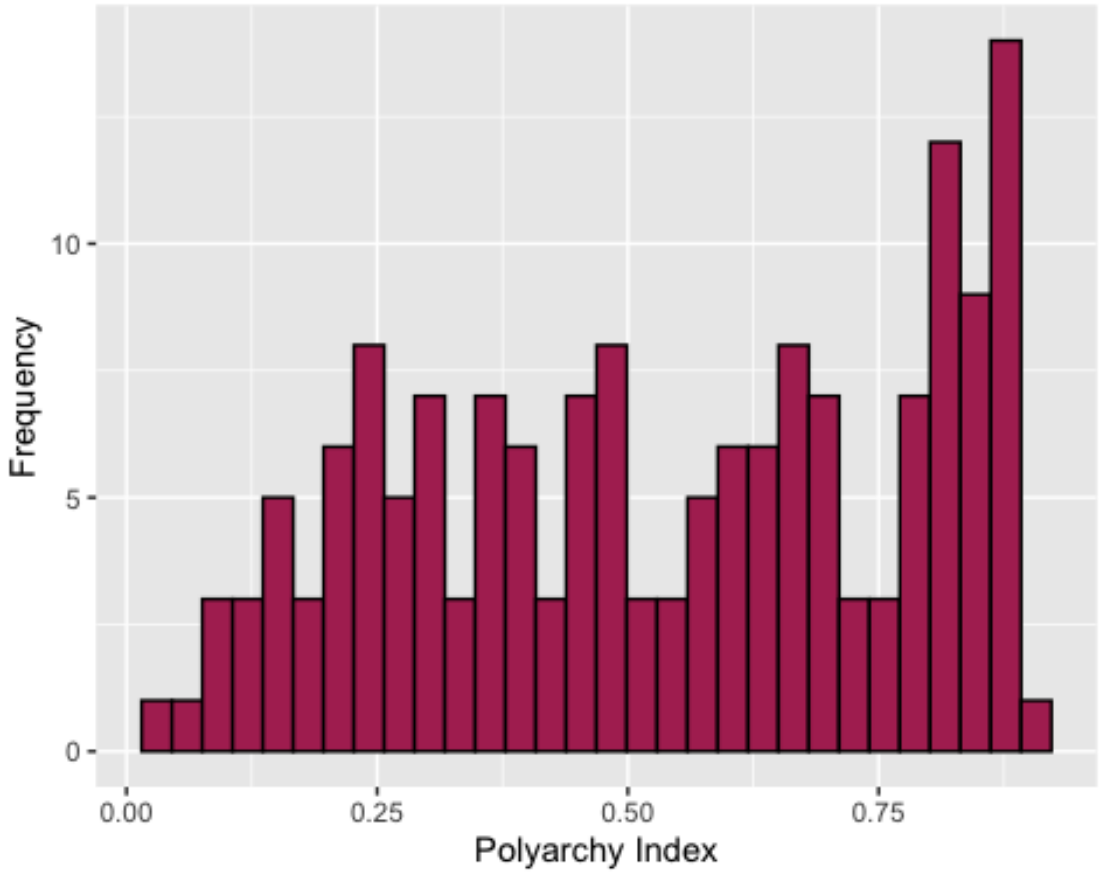



```
summary(rawData$v2x_polyarchy)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0230  0.3115  0.5580  0.5350  0.7835  0.9000
```

```
ggplot(rawData,
       aes(x = v2x_polyarchy)) +
  geom_histogram(col='black', fill='maroon') +
labs(x = "Polyarchy Index", y = "Frequency")
```

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

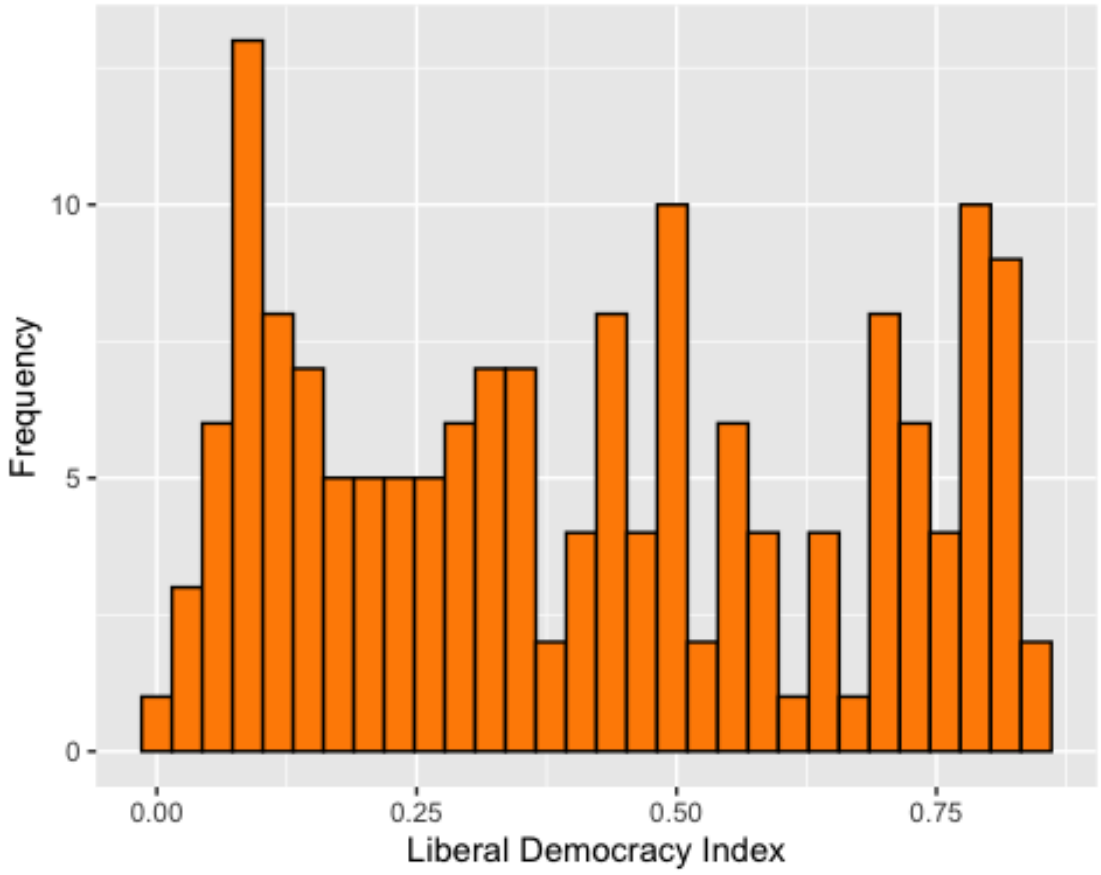



```
summary(rawData$v2x_libdem)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0120  0.1755  0.3960  0.4148  0.6480  0.8580
```

```
ggplot(rawData,
       aes(x = v2x_libdem)) +
  geom_histogram(col='black', fill='dark orange') +
labs(x = "Liberal Democracy Index", y = "Frequency")
```

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

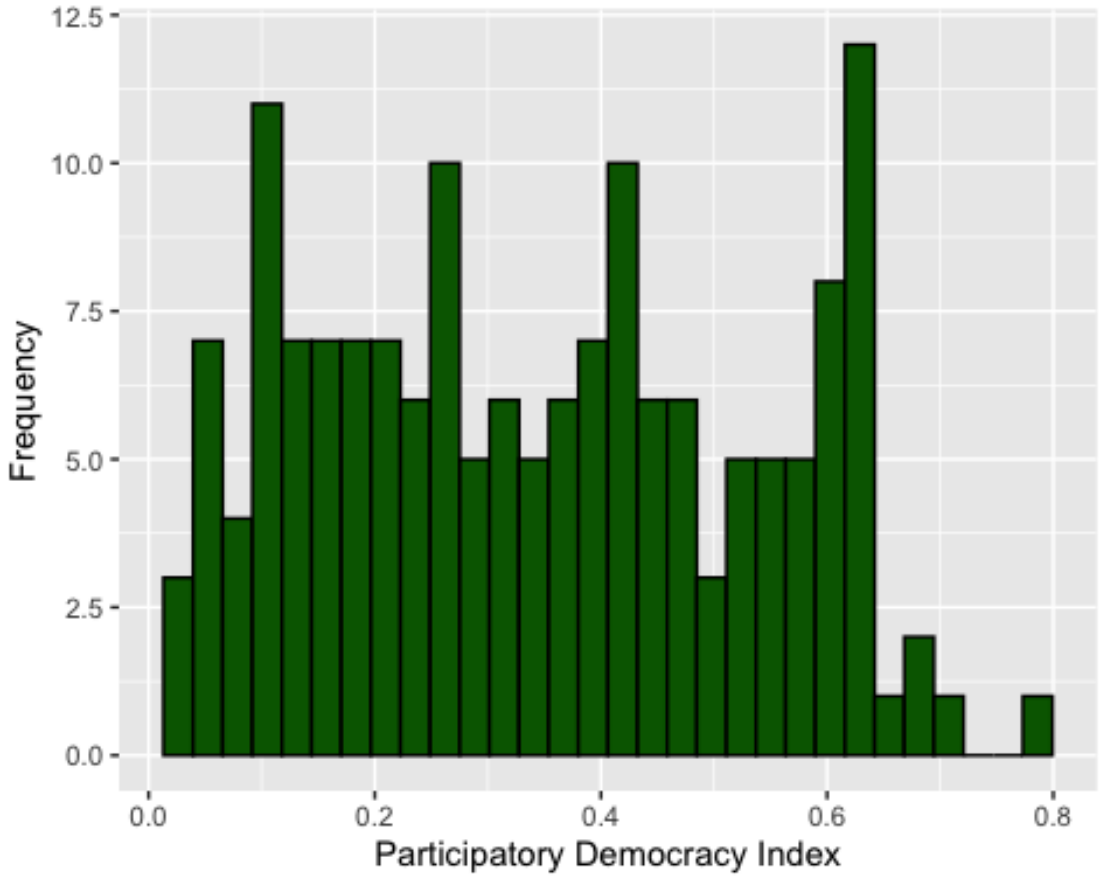



```
summary(rawData$v2x_partipdem)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0160  0.1735  0.3300  0.3437  0.5025  0.7760
```

```
ggplot(rawData,
       aes(x = v2x_partipdem)) +
  geom_histogram(col='black', fill='dark green') +
labs(x = "Participatory Democracy Index", y = "Frequency")
```

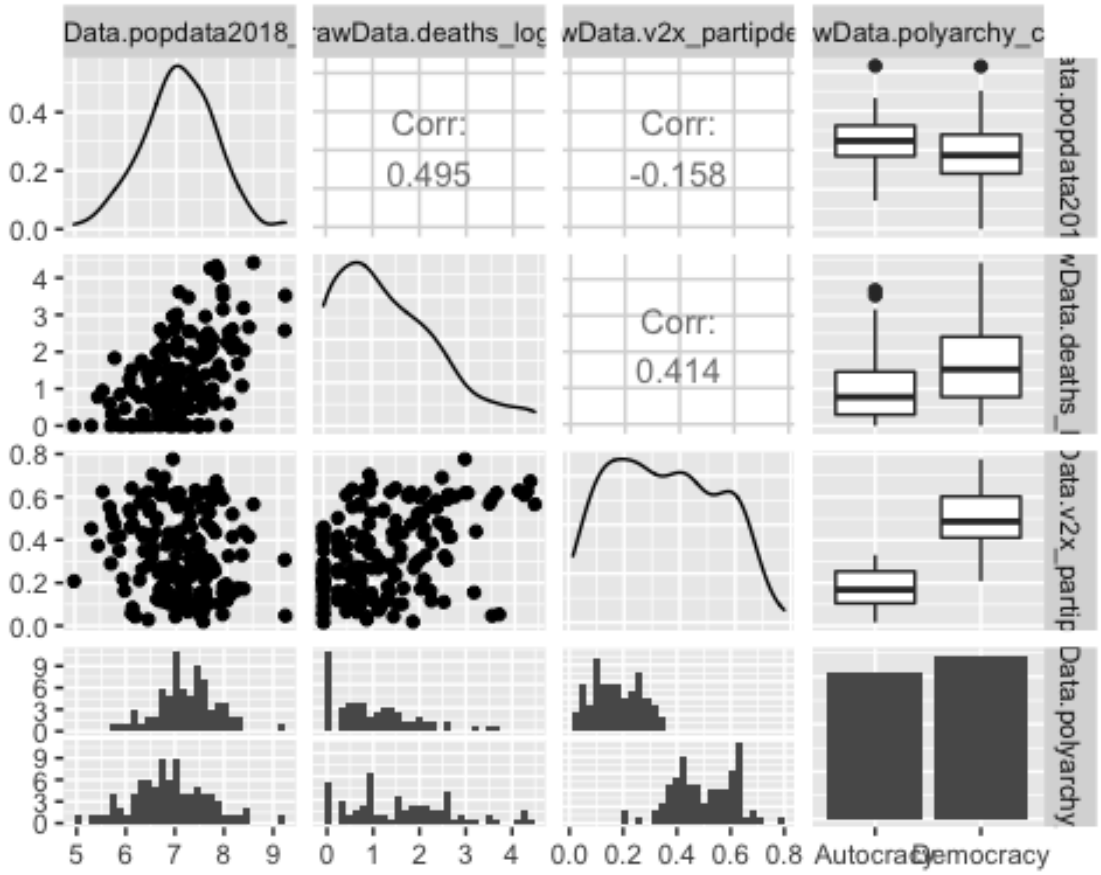
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



1.b.

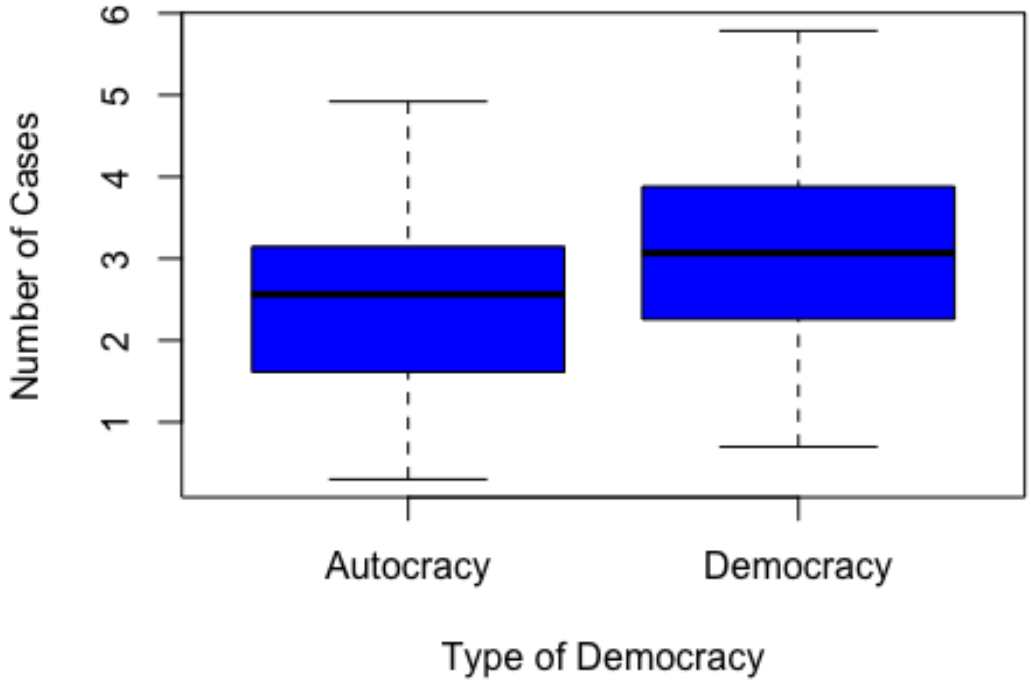
```
# If v2x_polyarchy>.5: democracy(1); v2x_polyarchy<.5: nodemocracy(0)
rawData$polyarchy_cat=ifelse(rawData$v2x_polyarchy > .5, "Democracy",
"Autocracy")
rawData$v2x_polyarchy<-factor(rawData$polyarchy_cat)

matrix_data=data.frame(rawData$popdata2018_log,
                       rawData$deaths_log,
                       rawData$v2x_partipdem,
                       rawData$polyarchy_cat)

ggpairs(matrix_data)

## Warning: Removed 1 rows containing non-finite values (stat_density).

## Warning in (function (data, mapping, alignPercent = 0.6, method =
"pearson", :
## Removing 1 row that contained a missing value

## Warning in (function (data, mapping, alignPercent = 0.6, method =
"pearson", :
## Removing 1 row that contained a missing value

## Warning: Removed 1 rows containing non-finite values (stat_boxplot).
```

```
## Warning: Removed 1 rows containing missing values (geom_point).

## Warning: Removed 1 rows containing missing values (geom_point).

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

## Warning: Removed 1 rows containing non-finite values (stat_bin).

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

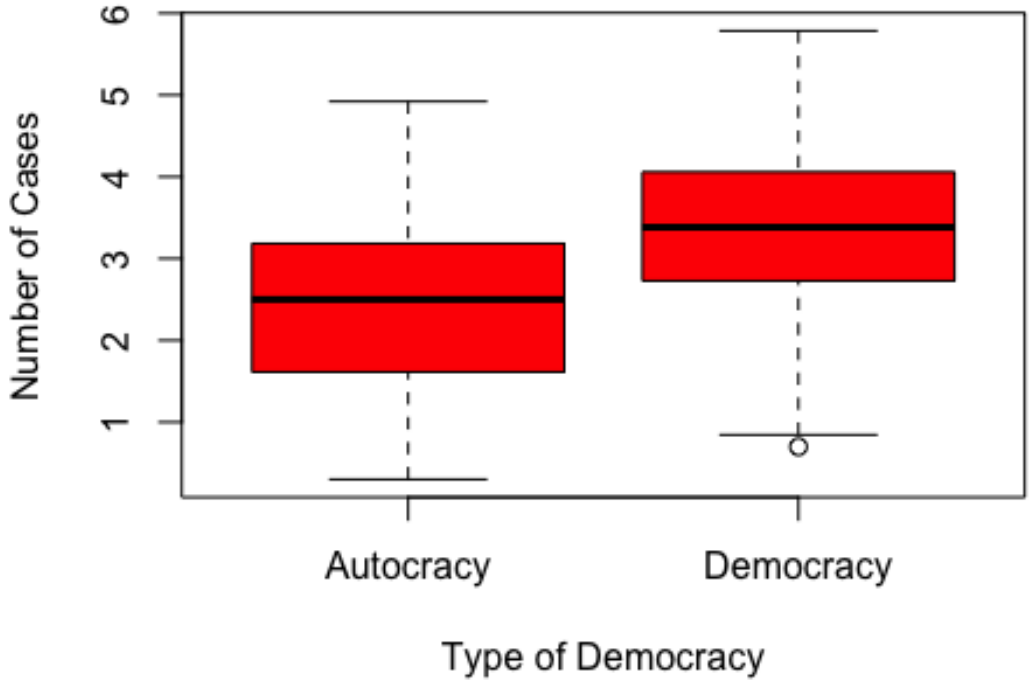


1.c.

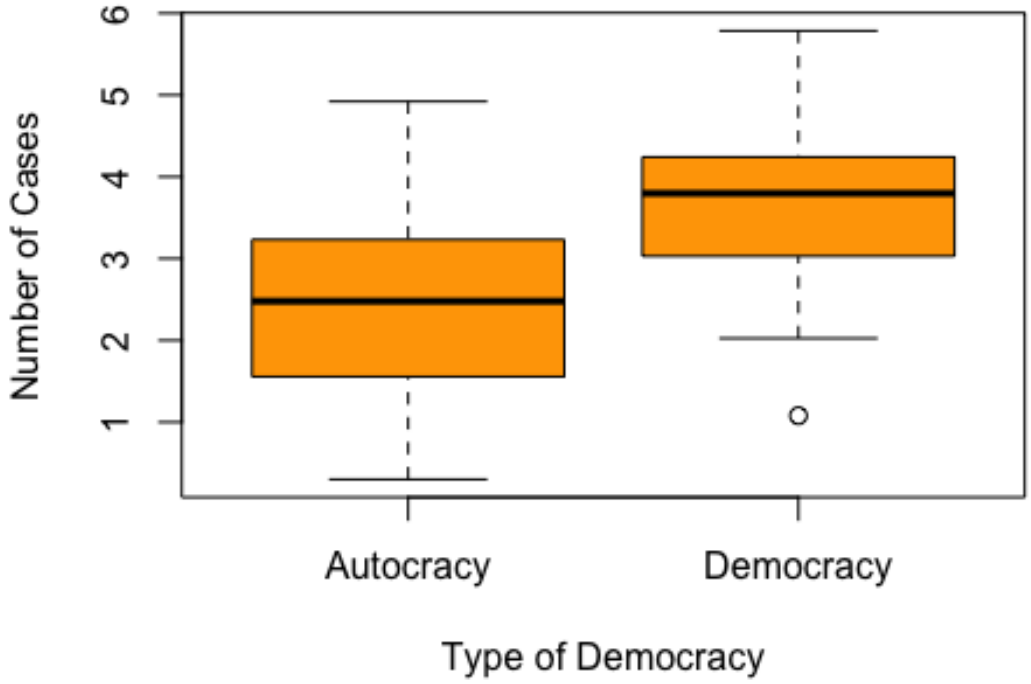
```
# Polyarchy
# If polyarchy_cat>.5: democracy(1); cases_log<.5: nodemocracy(0)

rawData$polyarchy_cat<-factor(rawData$polyarchy_cat)

boxplot(rawData$cases_log~rawData$polyarchy_cat,
        col='blue',
        xlab='Type of Democracy', ylab='Number of Cases')
```




```r
# Liberal Democracy
# If libdem_cat>.5: democracy(1); cases_log<.5: nodemocracy(0)
rawData$libdem_cat=ifelse(rawData$v2x_libdem > .5, "Democracy", "Autocracy")

rawData$libdem_cat<-factor(rawData$libdem_cat)

boxplot(rawData$cases_log~rawData$libdem_cat,
        col='red',
        xlab='Type of Democracy', ylab='Number of Cases')
```




```
# Participatory Democracy
# If partipdem_cat>.5: democracy(1); cases_log<.5: nodemocracy(0)
rawData$partipdem_cat=ifelse(rawData$v2x_partipdem > .5, "Democracy",
"Autocracy")

rawData$partipdem_cat<-factor(rawData$partipdem_cat)

boxplot(rawData$cases_log~rawData$partipdem_cat,
        col='orange',
        xlab='Type of Democracy', ylab='Number of Cases')
```

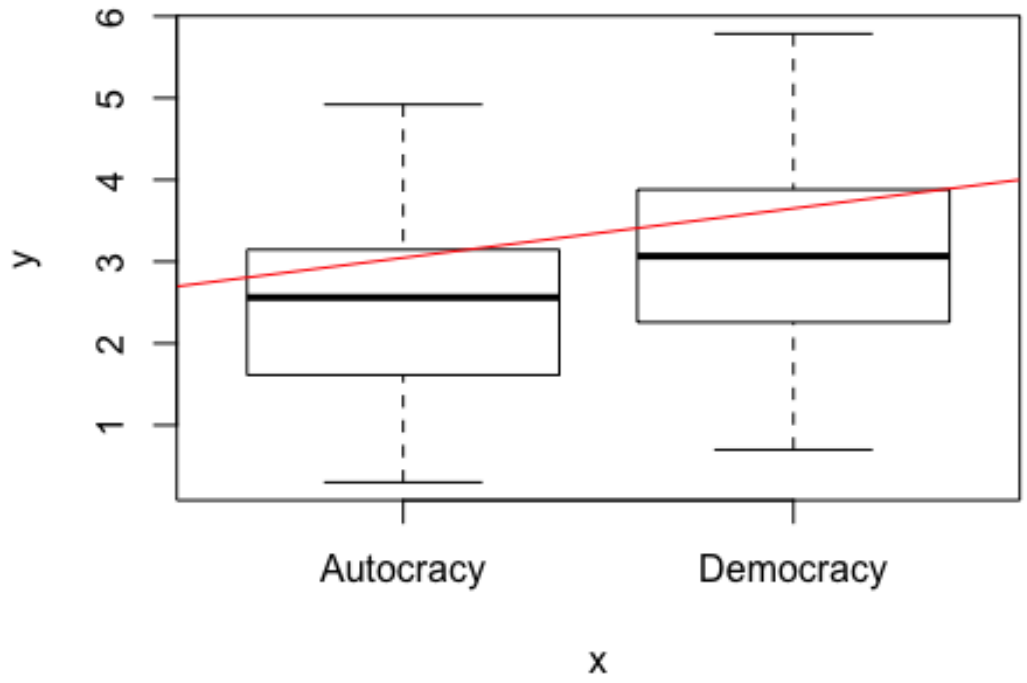


1.d.

```
# Functions 1 - 4
OLS_m1=lm(cases_log~v2x_polyarchy, data=rawData)
summary(OLS_m1)
```

```
##
## Call:
## lm(formula = cases_log ~ v2x_polyarchy, data = rawData)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.34741 -0.82451  0.04033  0.78109  2.73860
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)               2.4425     0.1267  19.274  < 2e-16 ***
## v2x_polyarchyDemocracy    0.6039     0.1745   3.461 0.000689 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.112 on 161 degrees of freedom
## Multiple R-squared:  0.06925,    Adjusted R-squared:  0.06347
## F-statistic: 11.98 on 1 and 161 DF,  p-value: 0.0006888
```

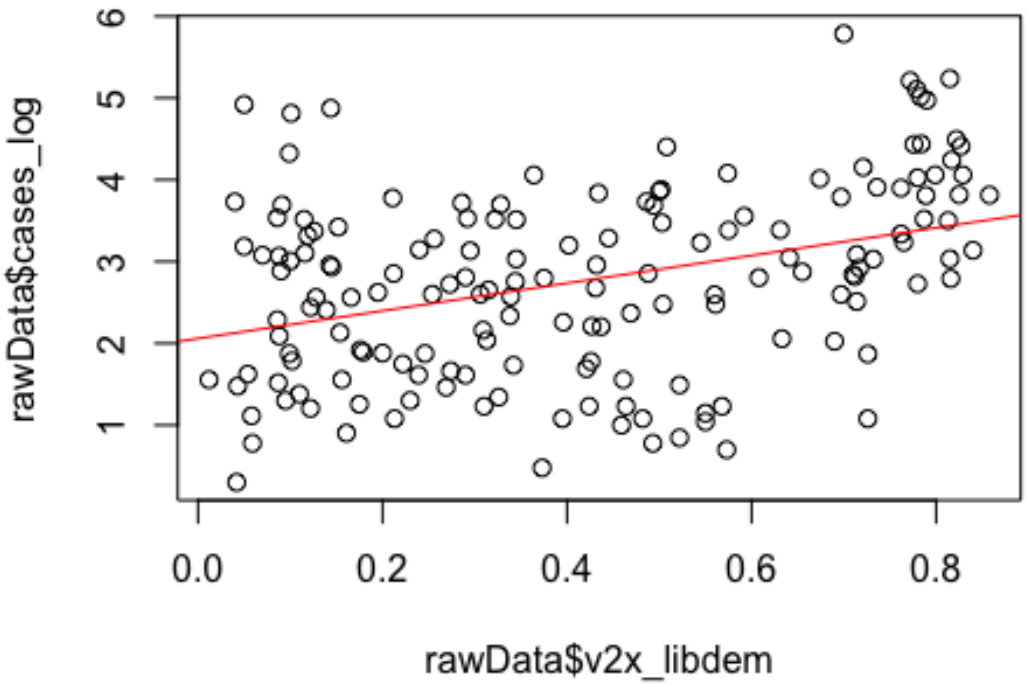
```r
plot(rawData$v2x_polyarchy,rawData$cases_log,)

abline(lm(rawData$cases_log ~ rawData$v2x_polyarchy), col = "red")
```




```r
OLS_m2=lm(cases_log~v2x_libdem, data=rawData)
summary(OLS_m2)
```

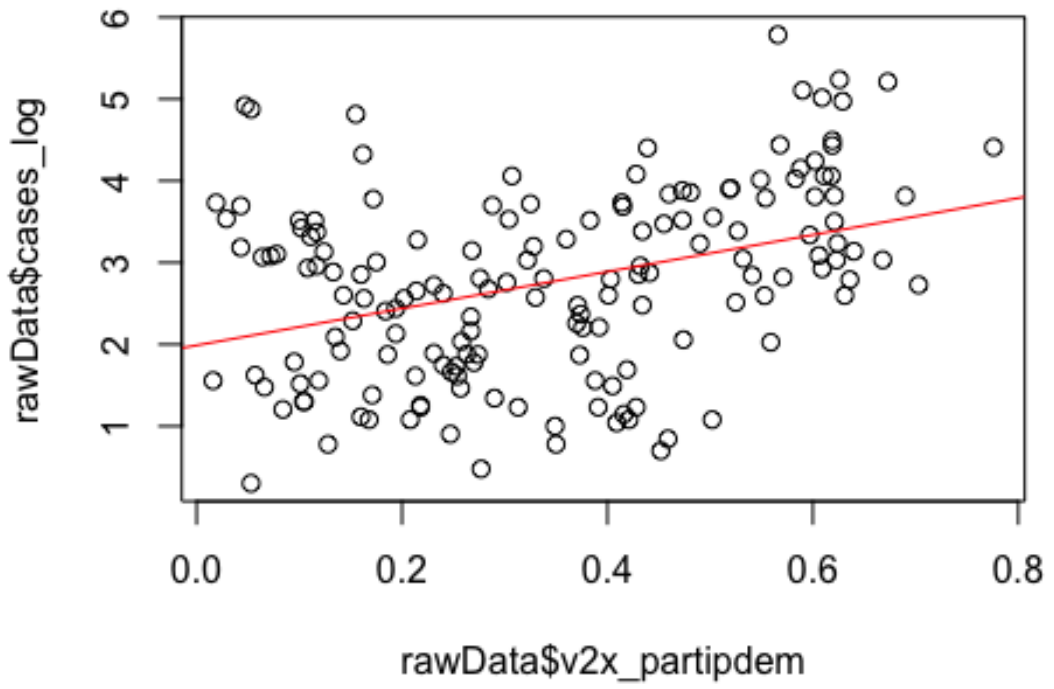
```
##
## Call:
## lm(formula = cases_log ~ v2x_libdem, data = rawData)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.32986 -0.67076  0.06097  0.79488  2.77711
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.0592     0.1605  12.828  < 2e-16 ***
## v2x_libdem    1.6922     0.3302   5.125 8.44e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.069 on 161 degrees of freedom
## Multiple R-squared:  0.1402, Adjusted R-squared:  0.1349
## F-statistic: 26.26 on 1 and 161 DF,  p-value: 8.441e-07
```

```r
plot(rawData$v2x_libdem, rawData$cases_log)

abline(lm(rawData$cases_log ~ rawData$v2x_libdem), col = "red")
```




```r
OLS_m3=lm(cases_log~v2x_partipdem, data=rawData)
summary(OLS_m3)

##
## Call:
## lm(formula = cases_log ~ v2x_partipdem, data = rawData)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.30577 -0.71433  0.00464  0.77544  2.82720
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)     1.9880     0.1725  11.523  < 2e-16 ***
## v2x_partipdem   2.2494     0.4389   5.125 8.43e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.069 on 161 degrees of freedom
## Multiple R-squared:  0.1403, Adjusted R-squared:  0.1349
## F-statistic: 26.27 on 1 and 161 DF,  p-value: 8.434e-07
```

```r
plot(rawData$v2x_partipdem,rawData$cases_log)
abline(lm(rawData$cases_log ~ rawData$v2x_partipdem), col = "red")
```




```r
OLS_m4=lm(cases_log~v2x_polyarchy+v2x_libdem+v2x_partipdem, data=rawData)
summary(OLS_m4)
```

```
##
## Call:
## lm(formula = cases_log ~ v2x_polyarchy + v2x_libdem + v2x_partipdem,
##     data = rawData)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.3865 -0.7387  0.0137  0.7141  2.8757
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)               1.8996     0.1861  10.206   <2e-16 ***
## v2x_polyarchyDemocracy   -0.5112     0.3212  -1.592    0.113
## v2x_libdem                1.3528     1.1503   1.176    0.241
## v2x_partipdem             1.6587     1.5079   1.100    0.273
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.065 on 159 degrees of freedom
```

```
## Multiple R-squared:  0.1569, Adjusted R-squared:  0.141
## F-statistic: 9.864 on 3 and 159 DF,  p-value: 5.285e-06

# Function 5
OLS_m5=lm(cases_log~v2x_polyarchy+popdata2018, data=rawData)

summary(OLS_m5)

##
## Call:
## lm(formula = cases_log ~ v2x_polyarchy + popdata2018, data = rawData)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.2602 -0.7505  0.0652  0.8185  2.3569
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.344e+00  1.254e-01  18.696  < 2e-16 ***
## v2x_polyarchyDemocracy 6.147e-01  1.679e-01   3.661 0.000341 ***
## popdata2018            2.119e-09  5.364e-10   3.951 0.000117 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.066 on 159 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:   0.15,  Adjusted R-squared:  0.1394
## F-statistic: 14.03 on 2 and 159 DF,  p-value: 2.437e-06

rawData$norm_case=rawData$cases_log/rawData$popdata2018_log

OLS_m6=lm(norm_case~v2x_polyarchy, data=rawData)

summary(OLS_m6)

##
## Call:
## lm(formula = norm_case ~ v2x_polyarchy, data = rawData)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.30384 -0.10771  0.02277  0.10061  0.27905
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)              0.33696    0.01614  20.880  < 2e-16 ***
## v2x_polyarchyDemocracy  0.09816    0.02215   4.432 1.73e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1407 on 160 degrees of freedom
##   (1 observation deleted due to missingness)
```

```
## Multiple R-squared:  0.1093, Adjusted R-squared:  0.1038
## F-statistic: 19.64 on 1 and 160 DF,  p-value: 1.728e-05
```

```
OLS_m7=lm(norm_case~v2x_polyarchy+popdata2018, data=rawData)

summary(OLS_m7)
```

```
##
## Call:
## lm(formula = norm_case ~ v2x_polyarchy + popdata2018, data = rawData)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.29789 -0.10531  0.01706  0.09922  0.27474
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            3.294e-01  1.639e-02  20.105  < 2e-16 ***
## v2x_polyarchyDemocracy 9.969e-02  2.194e-02   4.544 1.09e-05 ***
## popdata2018            1.446e-10  7.011e-11   2.062   0.0408 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1393 on 159 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:  0.1325, Adjusted R-squared:  0.1216
## F-statistic: 12.15 on 2 and 159 DF,  p-value: 1.233e-05
```

```
OLS_m8=lm(norm_case~v2x_libdem+popdata2018, data=rawData)

summary(OLS_m8)
```

```
##
## Call:
## lm(formula = norm_case ~ v2x_libdem + popdata2018, data = rawData)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.301008 -0.094800  0.008121  0.104198  0.300637
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 2.643e-01  2.037e-02  12.975  < 2e-16 ***
## v2x_libdem  2.788e-01  4.077e-02   6.837 1.64e-10 ***
## popdata2018 1.833e-10  6.588e-11   2.782  0.00606 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1301 on 159 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:  0.2426, Adjusted R-squared:  0.233
## F-statistic: 25.46 on 2 and 159 DF,  p-value: 2.556e-10
```

```r
OLS_m9=lm(norm_case~v2x_partipdem+popdata2018, data=rawData)

summary(OLS_m9)
```

```
##
## Call:
## lm(formula = norm_case ~ v2x_partipdem + popdata2018, data = rawData)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.28866 -0.08974  0.00522  0.09845  0.32615
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.560e-01  2.203e-02  11.616  < 2e-16 ***
## v2x_partipdem 3.608e-01  5.468e-02   6.599 5.86e-10 ***
## popdata2018   1.807e-10  6.637e-11   2.722  0.00721 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1312 on 159 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:  0.2306, Adjusted R-squared:  0.2209
## F-statistic: 23.83 on 2 and 159 DF,  p-value: 8.899e-10
```

```r
# Interpretation
# Overall, there seems to be a positive correlation between the number of
confirmed Corona cases and the level of democracy. The coefficient of the
slope for polyarchy (1.5), however, is slightly lower than the one of liberal
democracy (1.7), and this is again lower than the one for participatory
democracy (1.25). Accordingly, it seems like the type of democracy makes a
minor difference which could be related to the degree of freedom and civil
liberties in place in the respective country. For some countries, containment
of Corona might be easier than for others because of constitutional
restrictions or barriers. In other words, for some states it is easier to
impose limits to its citizen's freedoms than in others. The intercept of them
is almost the same in all cases and the summarised function 4 illustrates
this. Accordingly, the assumption that democracies are vulnerable to the
spread of corona seems true.

# The latter part of 1d dealing with the normalised numbers increases the
errors. When using the logarithm as before with cases_log, the results are
more precise.
```