1.) Completed
2.) Completed
3.)

```
> #check the dimension and structure of data
> glimpse(Freedom)
Observations: 1,458
Variables: 121
```

Int: 20
Fct: 3
Dbl: 98

After only considering the significant predictors:

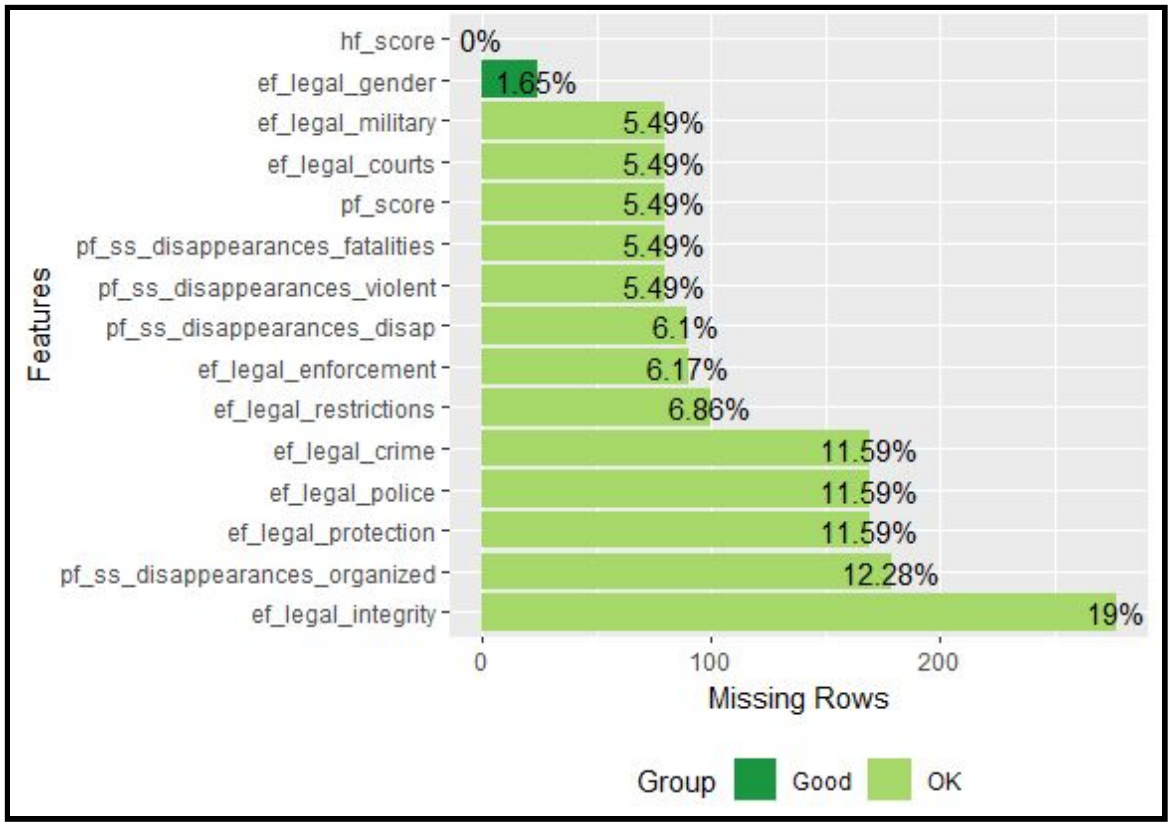
```
> glimpse(FreedomHuman)
Observations: 1,458
Variables: 15
```

Int: 1
Dbl: 14

4.)

```
Observations: 729
Variables: 15
$ hf_score                      <dbl> 57.27675, 26.37733, 52.43790, 70.78655, 33.65508, 49.96295, 51.05720, 45.40722, ...
$ pf_ss_disappearances_disap    <int> 10, 10, 10, 10, 5, 10, 10, 10, 10, 10, 10, 5, 10, 10, 10, 0, 0, 10, 10, 10, 0, 1...
$ pf_ss_disappearances_violent  <dbl> 10.000000, 9.294030, 10.000000, 10.000000, 9.916130, 10.000000, 10.000000, 10.00...
$ pf_ss_disappearances_organized <dbl> 10.0, 5.0, 7.5, 10.0, 5.0, NA, NA, 7.5, 7.5, 5.0, NA, 2.5, 7.5, 10.0, 10.0, 5.0,...
$ pf_ss_disappearances_fatalities <dbl> 10.000000, 9.926119, 9.316196, 10.000000, 9.844535, 10.000000, 10.000000, 10.000...
$ pf_score                      <dbl> 10.938456, 6.373456, 9.528719, 14.532810, 6.411743, 11.171113, 10.592838, 10.730...
$ ef_legal_courts               <dbl> 3.145462, 4.327113, 4.197569, 5.482200, 3.418128, 4.110034, 4.200000, 4.098691, ...
$ ef_legal_protection           <dbl> 4.512228, 4.689952, 5.664317, 8.092565, 5.083290, 6.498498, 7.385106, 4.988822, ...
$ ef_legal_military             <dbl> 8.333333, 4.166667, 5.833333, 10.000000, 4.166667, 9.800000, 6.400000, 6.300000,...
$ ef_legal_integrity            <dbl> 2.806444, 3.480690, 3.480690, 7.268676, 2.113010, NA, NA, NA, 2.806444, NA, 6.04...
$ ef_legal_enforcement          <dbl> 4.3874441, 4.5075380, 5.1966925, 6.2209926, 0.9411483, 3.8030033, 3.3290656, 1.0...
$ ef_legal_restrictions         <dbl> 25.343240, 26.566935, 62.198737, 41.143906, 4.897859, 22.762294, 32.696256, 26.1...
$ ef_legal_police               <dbl> 6.933500, 6.136845, 5.714028, 8.501867, 3.754961, 7.495682, 3.329000, 5.510088, ...
$ ef_legal_crime                <dbl> 6.2154007, 6.7373832, 7.0076537, 7.1949093, 4.7281476, 4.8959750, 4.7670100, 4.9...
$ ef_legal_gender               <dbl> 0.9487179, 0.8205128, 1.0000000, 1.0000000, 0.7948718, 0.8717949, 0.8378378, 0.6...
>
```

5.)
After only taking the relevant and significant predictors.



Here the values that are missing will have to be imputed because these are significant predictors and will have a major impact on the results. We will have to create a recipe to accomplish this purpose.

6.)

```
> Htrain <- training(train_test_split)
> Htest  <- testing(train_test_split)
>
> dim(Htest)
[1] 729  15
>
```

8 & 9)
Running the Linear Regression:

```
Call:
lm(formula = hf_score ~ ., data = train_clean)

Residuals:
     Min       1Q   Median       3Q      Max
-12.2142  -1.7913   0.0292   1.9988   7.2354

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -1.17516    1.33440  -0.881   0.3789
pf_ss_disappearances_disap       0.02992    0.05242   0.571   0.5683
pf_ss_disappearances_violent    -0.19441    0.14615  -1.330   0.1840
pf_ss_disappearances_organized   0.21082    0.08296   2.541   0.0113 *
pf_ss_disappearances_fatalities -0.10260    0.18589  -0.552   0.5812
pf_score                         4.01410    0.09563  41.976  < 2e-16 ***
ef_legal_courts                  0.12804    0.18803   0.681   0.4962
ef_legal_protection              1.32211    0.21329   6.199 1.16e-09 ***
ef_legal_military                0.14712    0.08255   1.782   0.0753 .
ef_legal_integrity              -0.30051    0.15871  -1.894   0.0588 .
ef_legal_enforcement             0.23053    0.11250   2.049   0.0409 *
ef_legal_restrictions            0.06945    0.01053   6.595 1.06e-10 ***
ef_legal_police                  0.16219    0.18081   0.897   0.3701
ef_legal_crime                  -0.12969    0.12462  -1.041   0.2985
ef_legal_gender                  0.29855    1.49396   0.200   0.8417
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.011 on 517 degrees of freedom
  (197 observations deleted due to missingness)
Multiple R-squared:  0.9557,    Adjusted R-squared:  0.9545
F-statistic: 796.3 on 14 and 517 DF,  p-value: < 2.2e-16
```

These are the 8 (including Hf_score) relevant predictors after going through the regression.

```
> glimpse(NewFreedomHuman)
Observations: 729
Variables: 8
$ hf_score                     <dbl> 57.27675, 26.37733, 52.43790, 70.78655, 33.65508, 49.96295, 51.05720, 45.40722, 45.13670, 52.28...
$ pf_ss_disappearances_organized <dbl> 10.0, 5.0, 7.5, 10.0, 5.0, NA, NA, 7.5, 7.5, 5.0, NA, 2.5, 7.5, 10.0, 10.0, 5.0, 5.0, 7.5, 10.0,...
$ pf_score                     <dbl> 10.938456, 6.373456, 9.528719, 14.532810, 6.411743, 11.171113, 10.592838, 10.730638, 10.129096,...
$ ef_legal_protection          <dbl> 4.512228, 4.689952, 5.664317, 8.092565, 5.083290, 6.498498, 7.385106, 4.988822, 3.412518, 3.628...
$ ef_legal_military            <dbl> 8.333333, 4.166667, 5.833333, 10.000000, 4.166667, 9.800000, 6.400000, 6.300000, 5.000000, 5.10...
$ ef_legal_integrity           <dbl> 2.806444, 3.480690, 3.480690, 7.268676, 2.113010, NA, NA, NA, 2.806444, NA, 6.044290, NA, NA, 6...
$ ef_legal_enforcement         <dbl> 4.3874441, 4.5075380, 5.1966925, 6.2209926, 0.9411483, 3.8030033, 3.3290656, 1.0687470, 4.49157...
$ ef_legal_restrictions        <dbl> 25.343240, 26.566935, 62.198737, 41.143906, 4.897859, 22.762294, 32.696256, 26.173446, 27.69570...
>
```

9) a)

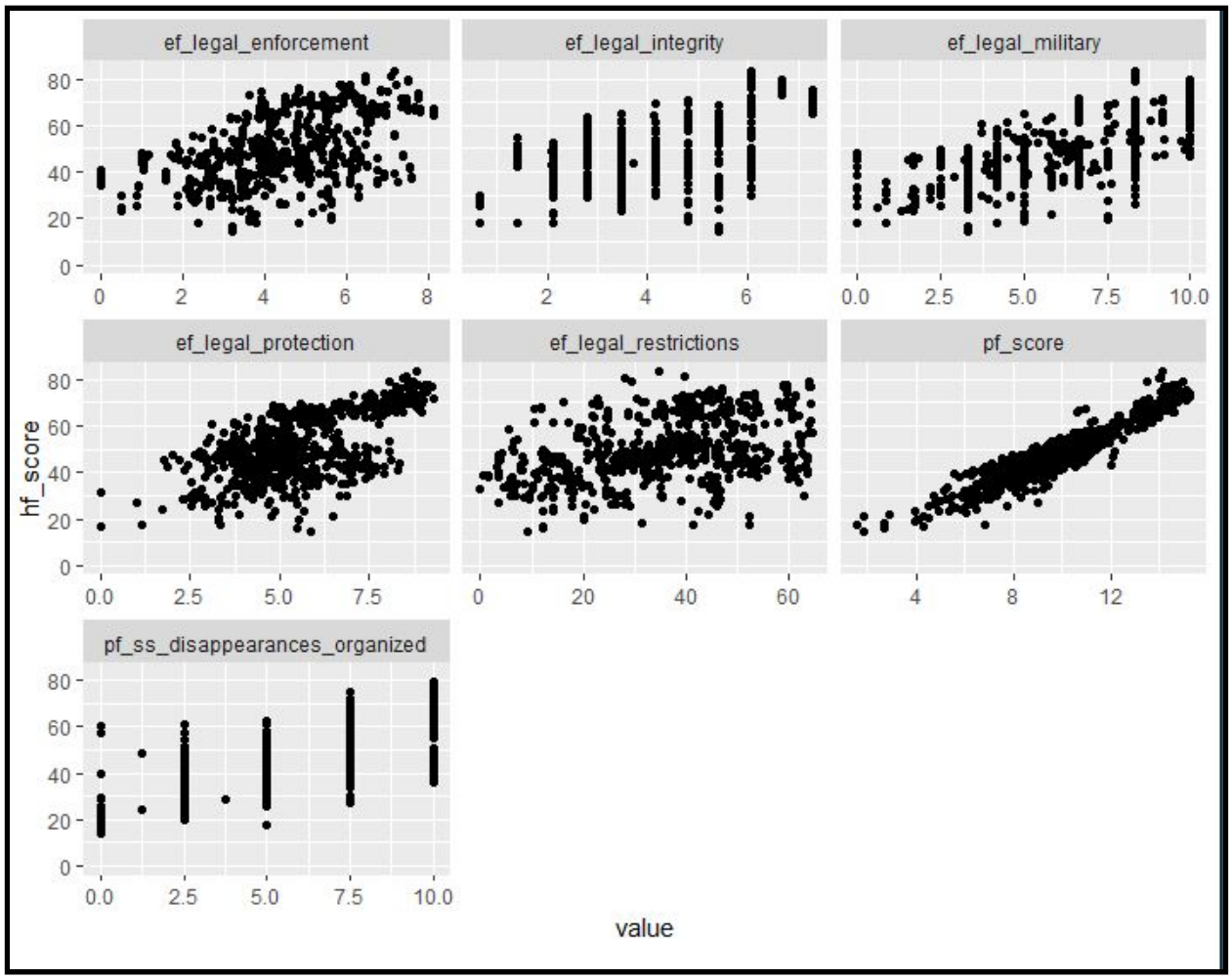
```
                          hf_score pf_ss_disappearances_organized pf_score ef_legal_protection ef_legal_military ef_legal_integrity
hf_score                         1                       Pearson  Pearson            Pearson          Pearson           Pearson
pf_ss_disappearances_organized   0.6905                        1  Pearson            Pearson          Pearson           Pearson
pf_score                         0.9551                   0.6442        1            Pearson          Pearson           Pearson
ef_legal_protection              0.6119                    0.508   0.4691                  1          Pearson           Pearson
ef_legal_military                0.7066                   0.6277   0.6467             0.6241                1           Pearson
ef_legal_integrity               0.5785                   0.4289   0.5109             0.7063           0.6094                 1
ef_legal_enforcement              0.433                   0.3734   0.3572             0.4161           0.3563            0.5072
ef_legal_restrictions            0.3812                   0.3646   0.2737             0.3348           0.3765            0.3005
                         ef_legal_enforcement ef_legal_restrictions
hf_score                             Pearson                Pearson
pf_ss_disappearances_organized       Pearson                Pearson
pf_score                             Pearson                Pearson
ef_legal_protection                  Pearson                Pearson
ef_legal_military                    Pearson                Pearson
ef_legal_integrity                   Pearson                Pearson
ef_legal_enforcement                       1                Pearson
ef_legal_restrictions                0.506                      1
```

The relationships with correlations > .7 are:

Hf_score to pf_score = 0.9551

Hf_score to ef_legal_military = 0.7066
Ef_legal_protection to Ef_legal_integrity = 0.7063

9b)



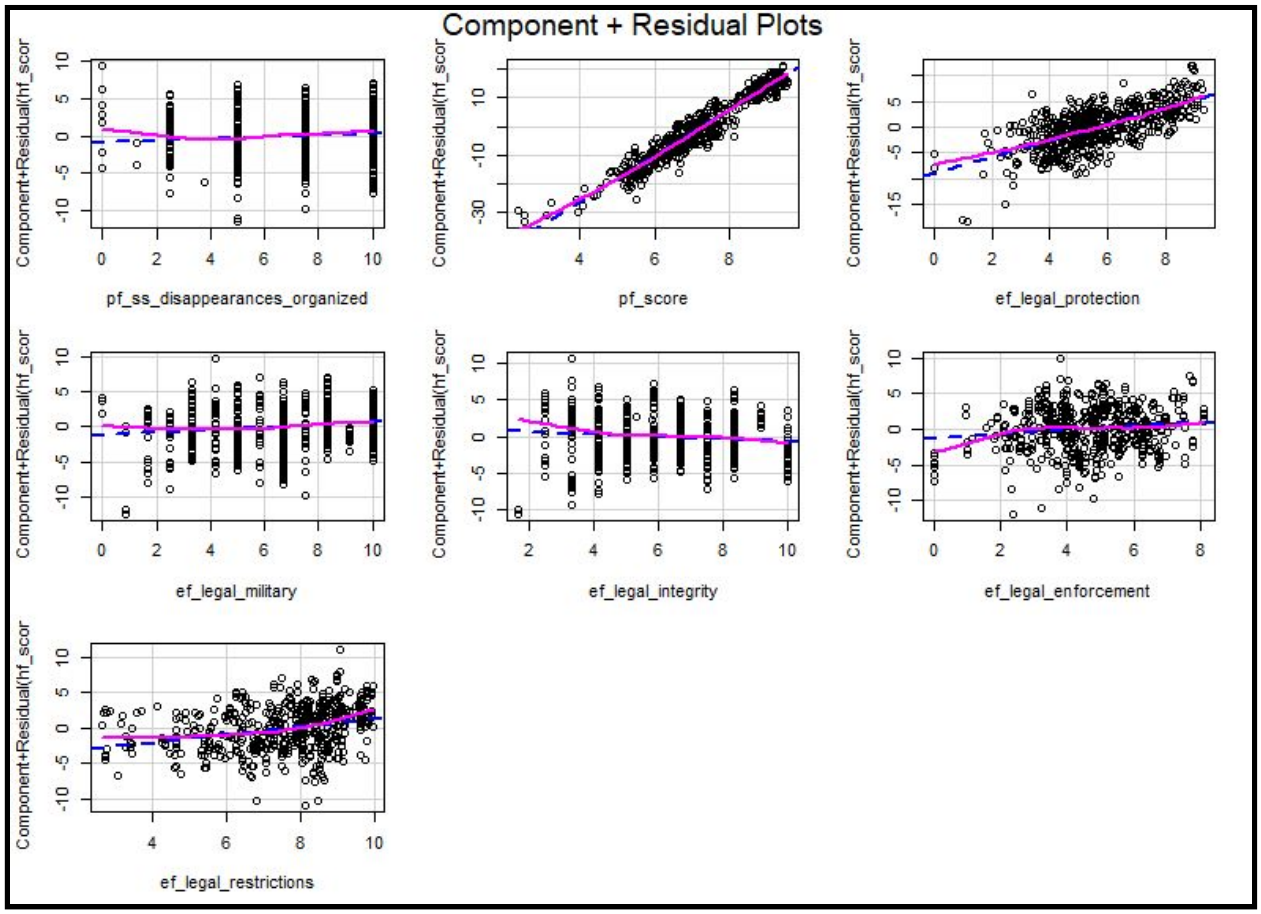
10)

```
> lm.fit2= lm(hf_score ~ pf_ss_disappearances_organized + pf_score + ef_legal_protection + ef_legal_military + ef_legal_integ
rity + ef_legal_enforcement+ ef_legal_restrictions, data = Htrain)
> summary(lm.fit2)

Call:
lm(formula = hf_score ~ pf_ss_disappearances_organized + pf_score +
    ef_legal_protection + ef_legal_military + ef_legal_integrity +
    ef_legal_enforcement + ef_legal_restrictions, data = Htrain)

Residuals:
     Min       1Q   Median       3Q      Max
-11.2312  -2.0584   0.0892   2.2678  10.2522

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                   -22.96261    0.90905 -25.260  < 2e-16 ***
pf_ss_disappearances_organized  0.13324    0.07506   1.775   0.0765 .
pf_score                        8.03087    0.13732  58.484  < 2e-16 ***
ef_legal_protection             1.59575    0.12226  13.052  < 2e-16 ***
ef_legal_military               0.18845    0.08355   2.255   0.0245 *
ef_legal_integrity             -0.15550    0.10310  -1.508   0.1321
ef_legal_enforcement            0.28309    0.11086   2.554   0.0109 *
ef_legal_restrictions           0.54431    0.09909   5.493 6.17e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.104 on 524 degrees of freedom
  (197 observations deleted due to missingness)
Multiple R-squared:  0.9523,    Adjusted R-squared:  0.9516
F-statistic:  1493 on 7 and 524 DF,  p-value: < 2.2e-16
```

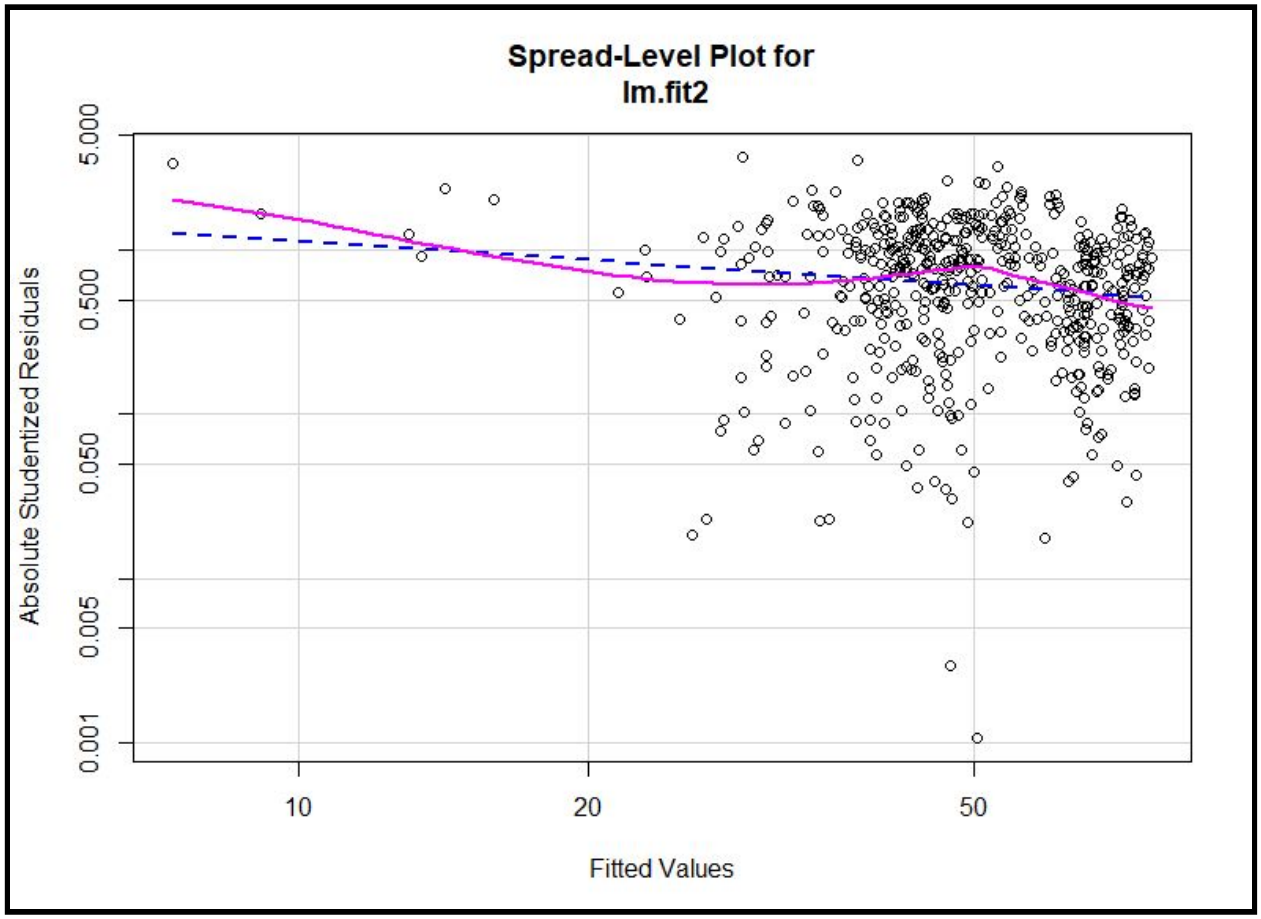
R-squared is 0.9516

11.)

a. Nonlinearity:



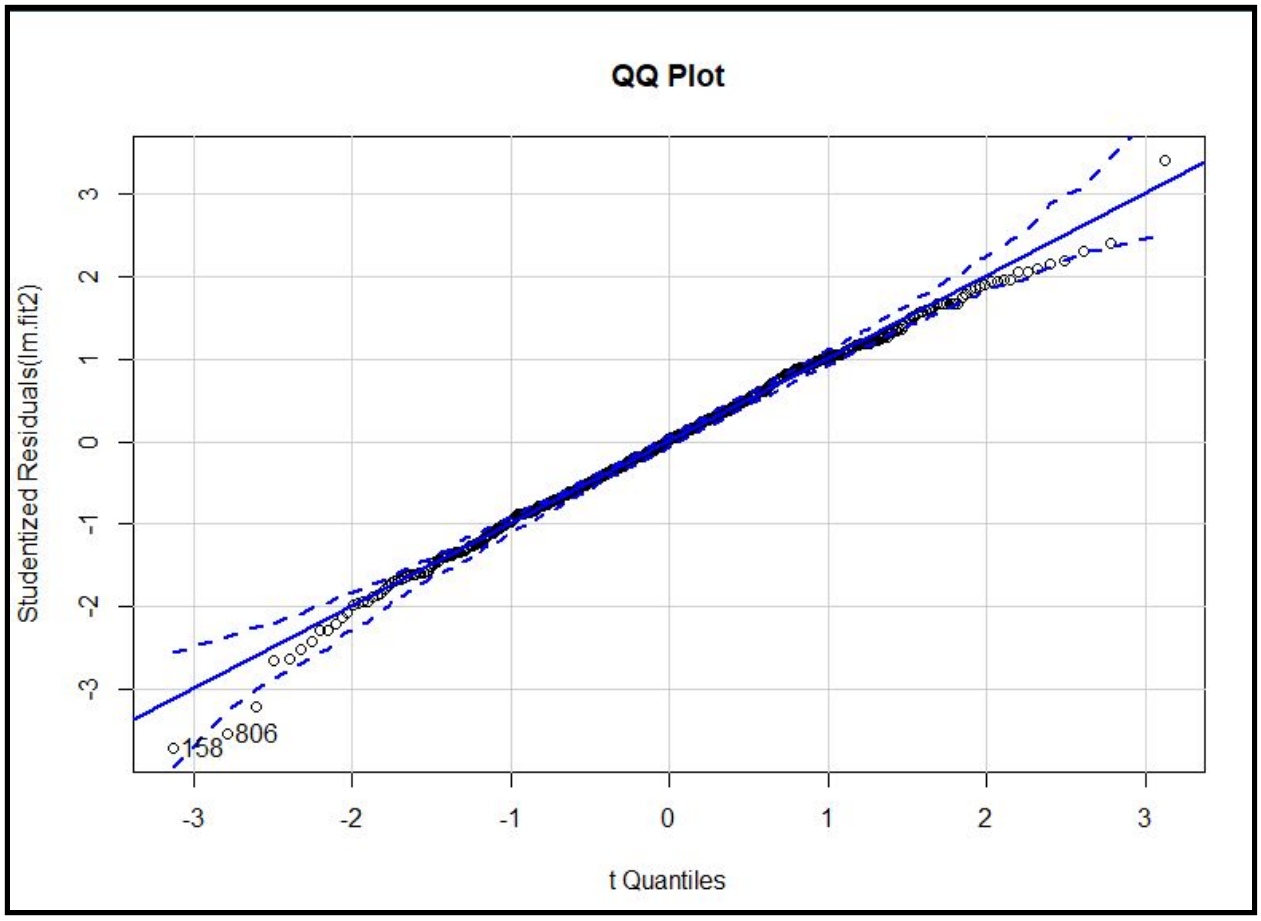
b. Heteroscedasticity:



c. Non-normality of predictors:

shapiro.test(Human_Freedom$pf_ss_disappearances_organized) **= p-value < 2.2e-16, normal**
shapiro.test(Human_Freedom$pf_score) **= p-value = 1.598e-15, normal**
shapiro.test(Human_Freedom$ef_legal_protection) **= p-value = 9.666e-11, normal**
shapiro.test(Human_Freedom$ef_legal_military) **= p-value < 2.2e-16, normal**
shapiro.test(Human_Freedom$ef_legal_integrity) **= p-value < 2.2e-16, normal**
shapiro.test(Human_Freedom$ef_legal_enforcement) **= p-value = 4.569e-07, normal**
shapiro.test(Human_Freedom$ef_legal_restrictions) **= p-value < 2.2e-16, normal**

d. Non-normality of residuals:



e. Autocorrelation of error terms:

```
> # Autocorrelation of Error Terms
> durbinWatsonTest(lm.fit2)
 lag Autocorrelation D-W Statistic p-value
   1    -0.008879448       2.01101   0.848
 Alternative hypothesis: rho != 0
```

f. Multicollinearity:

```
> vif(lm.fit2)
pf_ss_disappearances_organized                       pf_score             ef_legal_protection
                      2.128309                       2.096461                       2.390926
            ef_legal_military             ef_legal_integrity             ef_legal_enforcement
                      2.574475                       2.570611                       1.663601
       ef_legal_restrictions
                      1.457272
>
```

Since all values are less than 5 i.e. general rule of thumb (pg 101. An introduction to statistical Learning).

g. Outliers:

```
> outlierTest(lm.fit2)
No Studentized residuals with Bonferonni p < 0.05
Largest |rstudent|:
     rstudent unadjusted p-value Bonferonni p
158 -3.707692         0.00023149      0.12315
> |
```

12.) There are no outliers and the variance inflation factors do not point any major multicollinearity issues. At the same time, we see a good model accuracy of around 95% R squared, which is why I decided not to proceed any further with any operations on the data.

13) Based on the data above it is evident that world leaders need to understand the importance of personal freedom to increase their human freedom score. The data may be outdated so it may not represent real time updated scores, however given the information it is visible that events like organized disappearances can reduce the human freedom in a country. We see that nations where there are disappearances of social justice activists, journalists or even everyday citizens, there is a fear in the society preventing it to speak up for itself. There should be a legalized military equipped with state of the art defense systems to readily defend the sovereignty of the nation because if a nation can not defend its borders, it is always at risk of foreign interventions. Furthermore, the citizens of the nation should have access to inexpensive legal services, there should be a legal body such as the parliament or senate etc, and institutions that uphold the constitution. Every citizen should have equal rights under the constitution and there should be rules set aside to govern the life of everyday citizens.

“I’m for truth, no matter who tells it. I’m for justice, no matter who it is for or against. I’m a human being, first and foremost, and as such I’m for whoever and whatever benefits humanity as a whole.” - Malcolm X