HW2_rka

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Homework 2

Problem 2

Part A

Since I am submitting this homework at the end of semester, I am writing what I learned in this class. Even though I had been using other programming languages like Python, Matlab, and Java for several years, I learned R and used R for the first time in this class. I found the book recommended for the class, "R for data science" very helpful. I also learned to write the R Markdown files, and learned to write using LaTex. Overall, it was really helpful class to learn the R.

Part B

I have listed some distribution function as following.

Lognormal Density Function:

$$f\left(x|\mu,\sigma^2\right)=\frac{1}{\sqrt{2\pi}\sigma}\frac{e^{-(\log x-\mu)^2/\left(2\sigma^2\right)}}{x};0\leq x<\infty;-\infty<\mu<\infty \tag{1}$$

Gamma Density Function:

$$f\left(x|\alpha,\beta\right)=\frac{1}{\Gamma\left(\alpha\right)\beta^{\alpha}}x^{\alpha-1}e^{-x/\beta};0\leq x<\infty;\alpha,\beta>0 \tag{2}$$

Chi squared Density Function:

$$f\left(x|p\right)=\frac{1}{\Gamma\left(p/2\right)2^{p/2}}x^{(p/2)-1}e^{-x/2};0\leq x<\infty;p=1,2,... \tag{3}$$

Problem 3

1. Track steps to record how all results were produced
    - Challenges: These results are often produced through a lot of trial and error , so it can be difficult to separate the steps that were important and those that were unnecessary.

2. Do not manually manipulate data
    - Challenges: Some machines may not be able to read specific data types, but opening the file with a different type may change the data without your knowledge.
3. Archive (or keep track of) the exact versions of all programs used
    - Challenges: Even if you do archive the program, some updates will automatically delete older versions on the computer, possibly rendering past research useless.
4. Version control all scripts(use github/bitbucket)
    - Challenges: It can be difficult to know when to store versions of code and when not to. Too many versions of code can still make the correct version difficult to find, and too few means you are less likely to have the exact code that you want.
5. Record all intermediate results and standardize if possible
    - Challenges: Intermediate steps might not be in a data form that is easy to save, so it might not be possible to keep track of all intermediate steps.
6. Note seeds used for analyses that include randomness
    - Challenges: Using seeds for randomness may not be appropriate in the context of the experiment.
7. Store raw data used to make plots
    - Challenges: Large data sets may require more storage space than what is available.
8. Keep and inspect all layers of detail of the data
    - Challenges: Amount of data to inspect can grow quickly if there are a lot of layers of data.
9. Connect statements to the results that inspired them
    - Challenges: Research in a specialized field can be difficult to explain to the general public.
10. Provide public access to all data used, programs written, and results discovered
    - Challenges: Some data is not publicly available and perhaps must be purchased, so it cannot be included with the paper.

Problem 4

```
#install.packages('data.table')
library(data.table)
covid_raw = fread("https://opendata.ecdc.europa.eu/covid19/casedistribution/csv")
us = covid_raw[covid_raw$countriesAndTerritories == 'United_States_of_America',]
us_filtered = us[us$month %in% c(6:7),]
us_filtered$index = rev(1:dim(us_filtered)[1])
fit=lm(`Cumulative_number_for_14_days_of_COVID-19_cases_per_100000`~index, data=us_filtered)
```

Part A

```
library(knitr)
kable(summary(us_filtered))
```

Part 1

dateRep	day	month	year	cases	deaths	countriesAndTerritories	geoId	countryterritoryCode	popData2019	continentExp	Cumulative_number_for_14_days_of_COVID-19_cases_per_100000	index
Length:61	Min. : 1.00	Min. :6.000	Min. :2020	Min. :18665	Min. : 242.0	Length:61	Length:61	Length:61	Min. :329064917	Length:61	Min. : 89.76	Min. : 1
Class :character	1st Qu.: 8.00	1st Qu.:6.000	1st Qu.:2020	1st Qu.:25640	1st Qu.: 500.0	Class :character	Class :character	Class :character	1st Qu.:329064917	Class :character	1st Qu.: 92.43	1st Qu.:16
Mode :character	Median :16.00	Median :7.000	Median :2020	Median :45221	Median : 767.0	Mode :character	Mode :character	Mode :character	Median :329064917	Mode :character	Median :150.94	Median :31
NA	Mean :15.75	Mean :6.508	Mean :2020	Mean :44666	Mean : 791.6	NA	NA	NA	Mean :329064917	NA	Mean :170.16	Mean :31
NA	3rd Qu.:23.00	3rd Qu.:7.000	3rd Qu.:2020	3rd Qu.:61796	3rd Qu.: 982.0	NA	NA	NA	3rd Qu.:329064917	NA	3rd Qu.:247.01	3rd Qu.:46
NA	Max. :31.00	Max. :7.000	Max. :2020	Max. :78427	Max. :2437.0	NA	NA	NA	Max. :329064917	NA	Max. :282.72	Max. :61

This data is limited to 61 time points from June 2020 to July 2020. There are no missing points, since there are 30 days in June and 31 in July, so that gives a total of 61 days to survey.

```
library(stargazer)
```

Part 2

```
##
## Please cite as:

##  Hlavac, Marek (2018). stargazer: Well-Formatted Regression and Summary Statistics Tables.

##  R package version 5.2.2. https://CRAN.R-project.org/package=stargazer
```

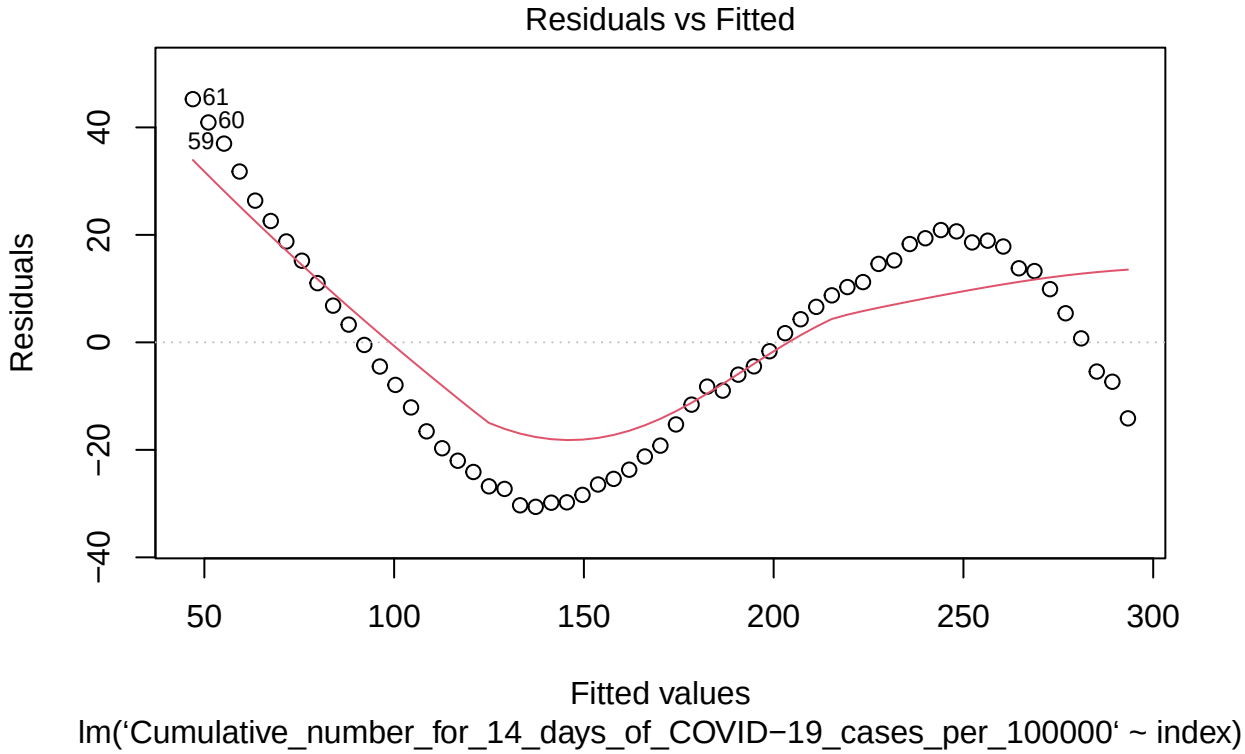
```
#stargazer(fit)
```

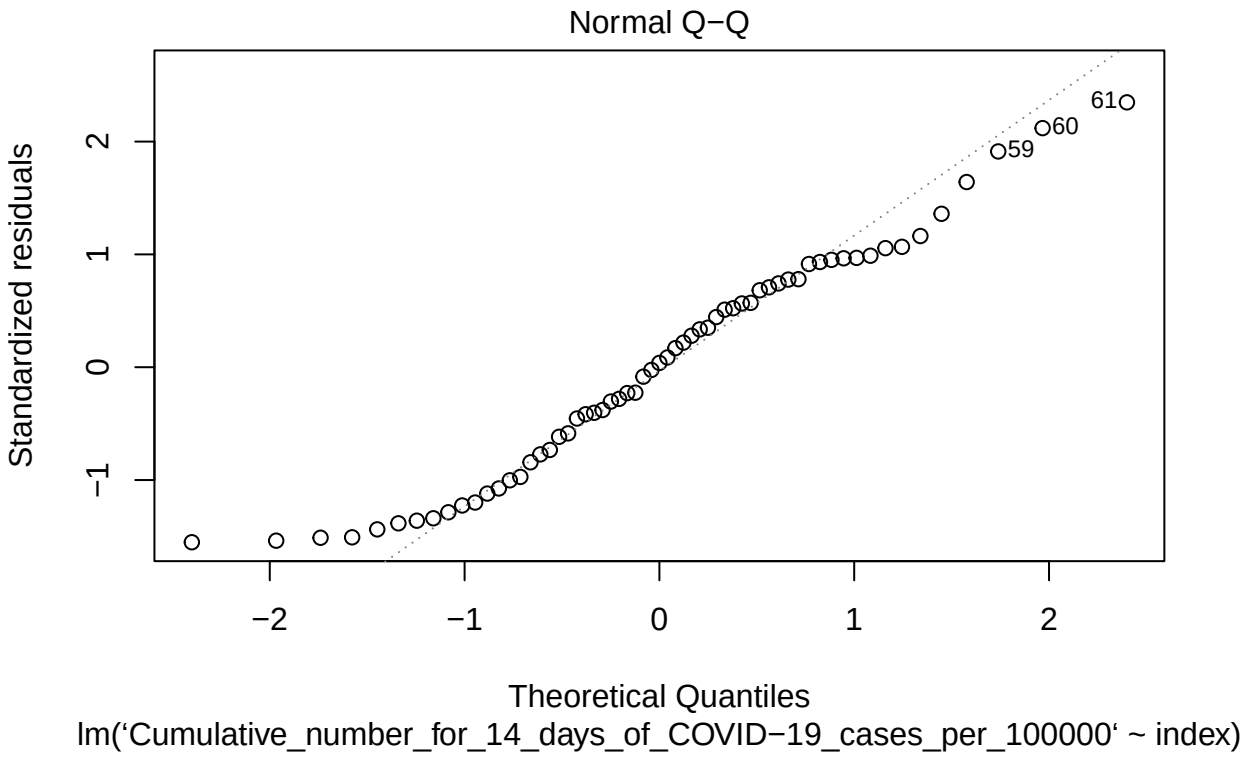
Part B

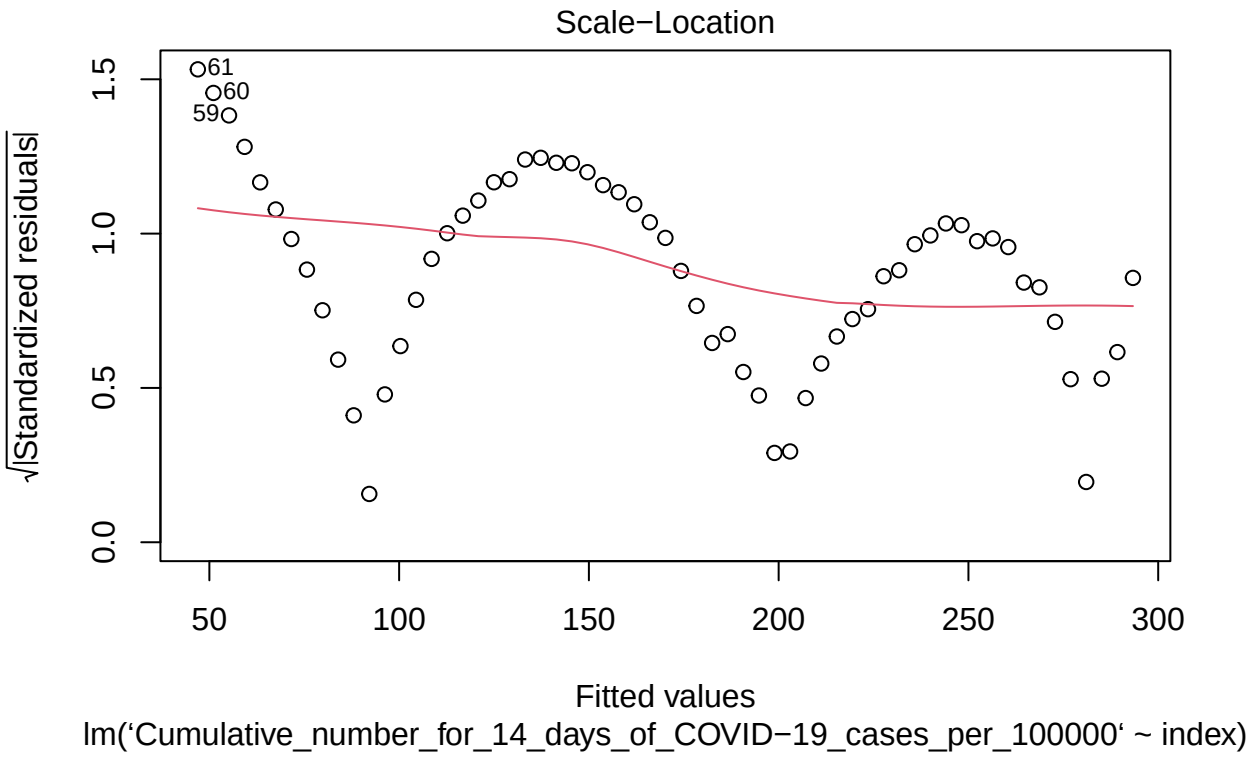
Table 2:

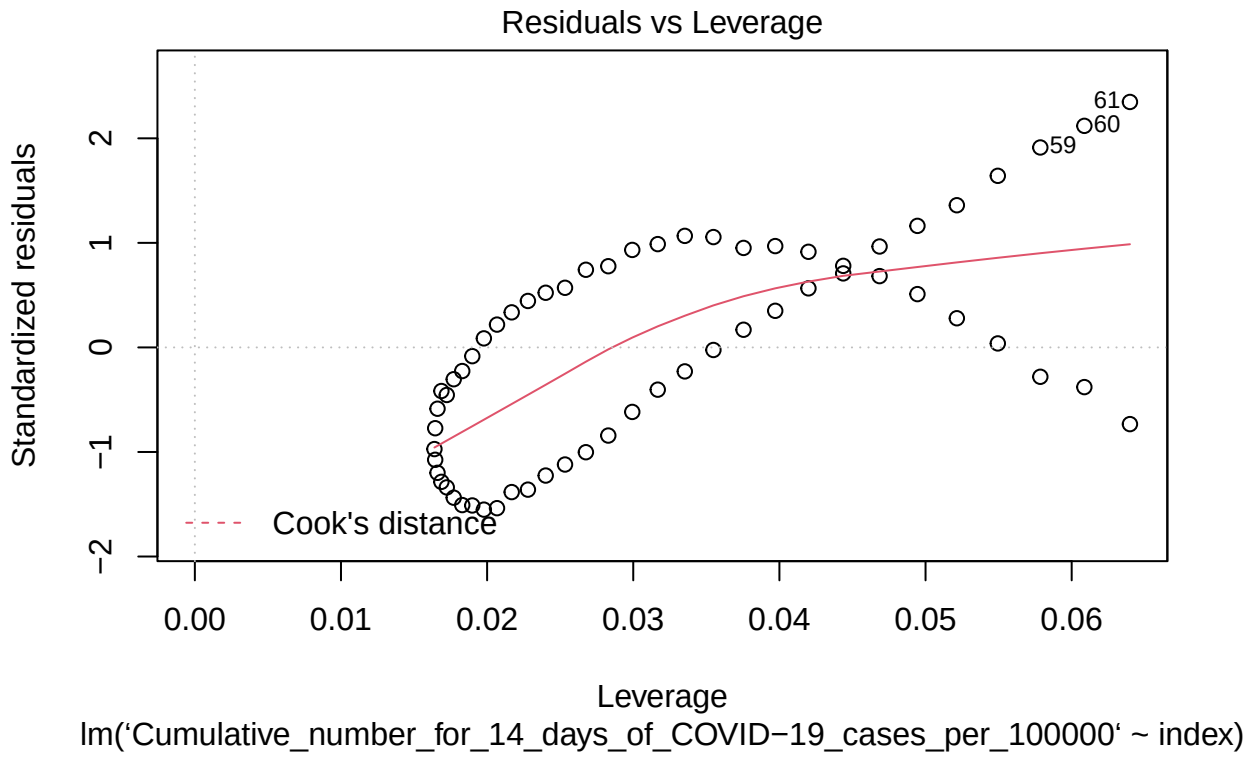
	Dependent variable:
	‘Cumulative_number_for_14_days_of_COVID-19_cases_per_100000‘
index	4.107***
	(0.145)
Constant	42.853***
	(5.165)
Observations	61
R^2	0.932
Adjusted R^2	0.930
Residual Std. Error	19.922 (df = 59)
F Statistic	803.464*** (df = 1; 59)
Note:	*p<0.1; **p<0.05; ***p<0.01

```
#install.packages("broom")
fit.diags <- broom::augment(fit)
plot(fit,c(1:3,5))
```



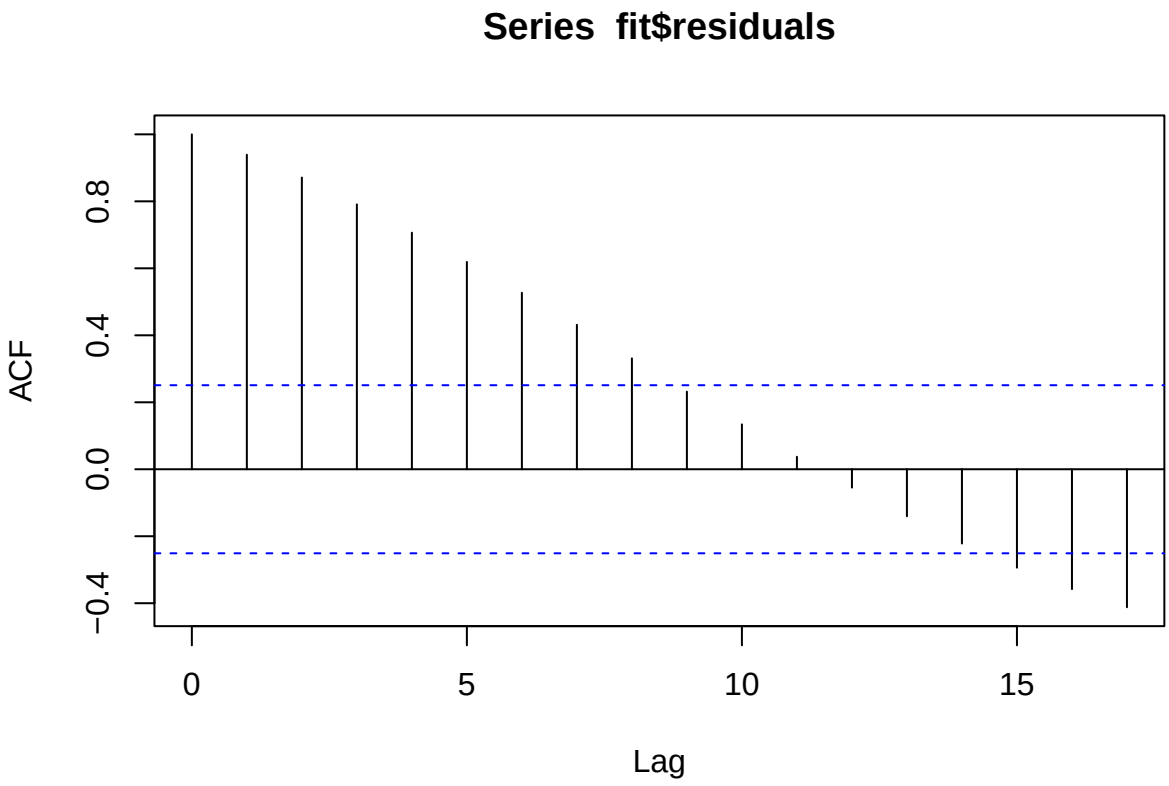

Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(‘Cumulative_number_for_14_days_of_COVID−19_cases_per_100000‘ ~ index)
61
60
59
−2
−1
0
1
2


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
61
60
59
50
100
150
200
250
300
Fitted values
lm(‘Cumulative_number_for_14_days_of_COVID−19_cases_per_100000‘ ~ index)



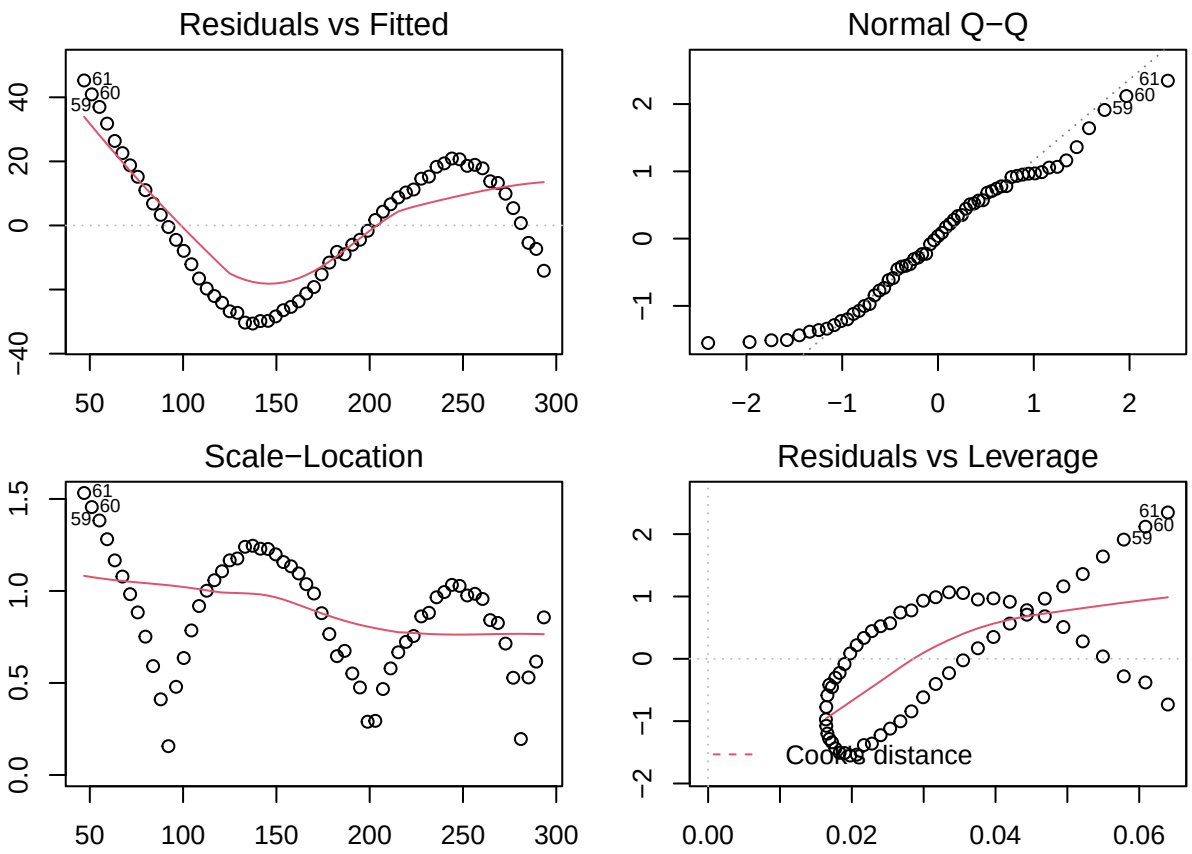
Part C

```
acf(fit$residuals)
```



Problem 5

```
par(mfrow=c(2,2))
par(mar=c(2,2,2,2))
plot(fit, c(1:3,5))
```


Residuals vs Fitted
Normal Q−Q
Scale−Location
Residuals vs Leverage
Cook's distance
61
60
59