Mathematical Biosciences and Engineering

MBE, 19(7): 7032–7054.
DOI: 10.3934/mbe.2022332
Received: 28 December 2021
Revised: 11 April 2022
Accepted: 25 April 2022
Published: 12 May 2022

http://www.aimspress.com/journal/MBE

Research article

Measuring the mobility impact on the COVID-19 pandemic

Thyago Celso C. Nepomuceno[1,2,*], Thalles Vitelli Garcez[2], Lúcio Câmara e Silva[2] and Artur Paiva Coutinho[2]

[1] Dipartimento di Ingegneria Informatica Automatica e Gestionale Antonio Ruberti, Sapienza University of Rome, Via Ariosto, 25, Roma, Italy
[2] Núcleo de Tecnologia, Federal University of Pernambuco, Km 59, s/n, Nova Caruaru, Caruaru, PE, Brazil

* **Correspondence:** Email: thyago.nepomuceno@ufpe.br; Tel: +55-81-99637-6262.

Supplementary

Codes

Packages
```
install.packages("devtools") #install the stable version
devtools::install_github("dustinfife/flexplot") #install the development version
devtools::install_github("dustinfife/flexplot", ref="development")
library("flexplot")
install.packages("MuMIn")
library(zoo)
install.packages("olsrr")
library(olsrr)
```

Variable Definitions (Data Avaliable on request to thyago.nepomuceno@ufpe.br)
```
Mob_Data <- read.csv("G:/Meu Drive/Drive (UFPE)/2. Research/z - Papers & Submissions - z/Time
```

```
Series & Interventions/COVID-19/Data/2020_Final_Dataset_COVID19_Mobility.csv")
attach(Mob_Data)
View(Mob_Data)
Mob_Data$date <- as.Date(Mob_Data$date, "%d/%m/%Y")
View(Mob_Data)
Y1 <- Mob_Data$New.Cases..2.weeks.later.
Y2 <- Mob_Data$Total.Cases..2.weeks.later.
y1 <- Mob_Data$New.Cases..2.weeks.before.
y2 <- Mob_Data$Total.Cases..2.weeks.before.
X1 <- Mob_Data$retail_and_recreation_percent_change_from_baseline_week
X2 <- Mob_Data$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- Mob_Data$parks_percent_change_from_baseline_week
X4 <- Mob_Data$transit_stations_percent_change_from_baseline_week
X5 <- Mob_Data$workplaces_percent_change_from_baseline_week
X6 <- Mob_Data$residential_percent_change_from_baseline_week
X7 <- Mob_Data$recovered_week
y1X1 <- y1*X1
y1X2 <- y1*X2
y1X3 <- y1*X3
y1X4 <- y1*X4
y1X5 <- y1*X5
y1X6 <- y1*X6
y2X1 <- y2*X1
y2X2 <- y2*X2
y2X3 <- y2*X3
y2X4 <- y2*X4
y2X5 <- y2*X5
y2X6 <- y2*X6
Y1X1 <- Y1*X1
Y1X2 <- Y1*X2
Y1X3 <- Y1*X3
Y1X4 <- Y1*X4
Y1X5 <- Y1*X5
Y1X6 <- Y1*X6
Y2X1 <- Y2*X1
Y2X2 <- Y2*X2
Y2X3 <- Y2*X3
Y2X4 <- Y2*X4
Y2X5 <- Y2*X5
Y2X6 <- Y2*X6
```

Descriptive Statistics

```
summary(Mob_Data) # Mean, Median, Min, Max
fivenum(X1)       # Tukey min, 25th and 75th Quartile, Median, Max
sd(Y1)            # Standard Deviation for X1
sd(Y2)            # Standard Deviation for X2
sd(y1)            # Standard Deviation for X3
sd(y2)            # Standard Deviation for Y
sd(X1)            # Standard Deviation for X1
sd(X2)            # Standard Deviation for X2
sd(X3)            # Standard Deviation for X3
sd(X4)            # Standard Deviation for X4
sd(X5)            # Standard Deviation for X5
sd(X6)            # Standard Deviation for X6
sd(X7)            # Standard Deviation for X7
cor.test(X1, X2)      # Pearson correlation for the samples X1 and X2
cor.test(X1, X3)      # Pearson correlation for the samples X1 and X3
cor.test(X2, X3)      # Pearson correlation for the samples X2 and X3
cor.test(Y, X1)       # Pearson correlation for the samples Y and X1
cor.test(Y, X2)       # Pearson correlation for the samples Y and X2
cor.test(Y, X3)       # Pearson correlation for the samples Y and X3
```

Visualizations

```
par(mfrow = c(1, 1))    # Visualization with 1 row, 1 column
## Boxplots
boxplot(X1)                  #Boxplot vusialization for the input X1
boxplot(X2)                  #Boxplot vusialization for the input X2
boxplot(X3)                  #Boxplot vusialization for the input X3
boxplot(Y1)                   #Boxplot vusialization for the output Y1
boxplot(X1, X2, X3, Y)    #Boxplot vusialization for all variables
boxplot(X1, X2, X3, X4, X5, X6, notch = TRUE, names = c("Retail & Recreation", "Grocery & Pharmacy", "Parks ", "Transit Stations", "Workplaces", "Residences"))
boxplot(X1, X2, X3, Y, names = c("Costs", "Beds", "Personnel", "Hospitalizations"))
boxplot(X2, X3, Y, names = c("Beds", "Personnel", "Hospitalizations"))
boxplot(X2, X3, names = c("Beds", "Personnel"))
boxplot(X2, X3, notch = TRUE, outline = FALSE, names = c("Beds", "Personnel"))    # notch = TRUE for some evidence of median equality, outline = false for removing outliers
```

Estimation

```
model1 <- lm(Y1 ~ y1 + X1+ X2 + X3 + X4 + X5 + X6)
summary(model1)
model2 <- lm(Y1 ~ y1 * X1 * X2 * X3 * X4 * X5 * X6)
summary(model2)
model3 <- lm(Y1 ~ X1 * X3 * X5 * X6 * X7 + X2 + X3)
```

```
summary(model3)
model4 <- glm(formula =    Y1 ~ X1 + X1 * X2 * X3 * X4 * X5 * X6 * X7 - 1, family = poisson(link = "log"))
summary(model4)
model5 <- glm(formula =    Y1 ~ X1 + X1 * X2 * X3 * X4 * X5 * X6 * X7 - 1, family = poisson(link = "log"))
summary(model5)
modelf1 <- lm(Y1 ~ y1 + y1*X1 + y1*X2 + y1*X3 + y1*X4 + y1*X5 + y1*X6)
summary(modelf1)
modelf2 <- lm(Y1 ~ y2 + y1*X1 + y1*X2 + y1*X3 + y1*X4 + y1*X5 + y1*X6)
summary(modelf2)
modelf3 <- lm(Y2 ~ y2 + y2*X1 + y2*X2 + y2*X3 + y2*X4 + y2*X5 + y2*X6)
summary(modelf3)
modelf4 <- lm(Y2 ~ y1 + y1*X1 + y1*X2 + y1*X3 + y1*X4 + y1*X5 + y1*X6)
summary(modelf4)
modelf5 <- lm(Y2 ~ y2 + y1*X1 + y1*X2 + y1*X3 + y1*X4 + y1*X5 + y1*X6)
summary(modelf5)
modelf6 <- lm(Y2 ~ y1 + y2*X1 + y2*X2 + y2*X3 + y2*X4 + y2*X5 + y2*X6)
summary(modelf6)
modelf1 <- lm(Y1 ~ y1 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf1)
modelf2 <- lm(Y1 ~ y2 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf2)
modelf3 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y2X6)
summary(modelf3)
modelf4 <- lm(Y1 ~ y2 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y2X6)
summary(modelf4)
modelf5 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf5)
modelf6 <- lm(Y2 ~ y2 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y2X6)
summary(modelf6)
modelf7 <- lm(Y2 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y2X6)
summary(modelf7)
modelf8 <- lm(Y2 ~ y2 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf8)
modelf9 <- lm(Y2 ~ y1 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf9)
modelf10 <- lm(Y2 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf10)
modelf17 <- lm(Y1 ~ X7 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf17)
modelf21 <- lm(Y1 ~ y1 + X7 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
```

```
summary(modelf21)
modelf1 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf1)
modelf2 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf2)
modelf3 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf3)
modelf4 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf4)
modelf5 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf5)
modelf6 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf6)
modelf7 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf7)
modelf8 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf8)
modelf9 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf9)
modelf10 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf10)
modelf11 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf11)
modelf12 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf12)
modelf13 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf13)
modelf14 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf14)
modelf15 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf15)
modelf16 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf16)
modelf17 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf17)
modelf18 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf18)
modelf19 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf19)
modelf20 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf20)
modelf21 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
```

```
summary(modelf21)
modelf22 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf22)
modelf23 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf23)
modelf24 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf24)
modelf25 <- lm(Y1 ~ X7 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf25)
modelf26 <- lm(Y1 ~ X7 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y2X6)
summary(modelf26)
modelf27 <- lm(Y1 ~ X7 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf27)
modelf28 <- lm(Y1 ~ X7 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y2X6)
summary(modelf28)
modelf29 <- lm(Y1 ~ y1 + X7 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y1X6)
summary(modelf29)
modelf30 <- lm(Y1 ~ y1 + X7 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y2X6)
summary(modelf30)
modelf31 <- lm(Y1 ~ y1 + X7 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf31)
modelf32 <- lm(Y1 ~ y1 + X7 + y1X1 + y1X2 + y1X3 + y1X4 + y1X5 + y2X6)
summary(modelf32)
AIC(modelf1)
AIC(modelf2)
AIC(modelf3)
AIC(modelf4)
AIC(modelf5)
AIC(modelf6)
AIC(modelf7)
AIC(modelf8)
AIC(modelf9)
AIC(modelf10)
AIC(modelf11)
AIC(modelf12)
AIC(modelf13)
AIC(modelf14)
AIC(modelf15)
AIC(modelf16)
AIC(modelf17)
AIC(modelf18)
AIC(modelf19)
```

```
AIC(modelf20)
AIC(modelf21)
AIC(modelf22)
AIC(modelf23)
AIC(modelf24)
AIC(modelf25)
AIC(modelf26)
AIC(modelf27)
AIC(modelf28)
AIC(modelf29)
AIC(modelf30)
AIC(modelf31)
AIC(modelf32)
mean(X1)
mean(X2)
mean(X3)
mean(X4)
mean(X5)
mean(X6)

N1 <- Mob_Data[Mob_Data$date >= "2020-03-14" & Mob_Data$date <= "2020-08-01",]
View(N1)
N2 <- Mob_Data[Mob_Data$date >= "2020-08-01" & Mob_Data$date <= "2020-10-24",]
View(N2)
N3 <- Mob_Data[Mob_Data$date >= "2020-10-24" & Mob_Data$date <= "2020-12-31",]
View(N3)

########### For the first growth (N = 1)
Y1 <- N1$New.Cases..2.weeks.later.
Y2 <- N1$Total.Cases..2.weeks.later.
y1 <- N1$New.Cases..2.weeks.before.
y2 <- N1$Total.Cases..2.weeks.before.
X1 <- N1$retail_and_recreation_percent_change_from_baseline_week
X2 <- N1$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- N1$parks_percent_change_from_baseline_week
X4 <- N1$transit_stations_percent_change_from_baseline_week
X5 <- N1$workplaces_percent_change_from_baseline_week
X6 <- N1$residential_percent_change_from_baseline_week
X7 <- N1$recovered_week
X <- matrix(c(X1, X2, X3, X4, X5, X6, X7), ncol = 7, nrow = 567)
Y1X1 <- Y1*X1
Y1X2 <- Y1*X2
```

```
Y1X3 <- Y1*X3
Y1X4 <- Y1*X4
Y1X5 <- Y1*X5
Y1X6 <- Y1*X6
Y2X1 <- (Y2-X7)*X1
Y2X2 <- (Y2-X7)*X2
Y2X3 <- (Y2-X7)*X3
Y2X4 <- (Y2-X7)*X4
Y2X5 <- (Y2-X7)*X5
Y2X6 <- (Y2-X7)*X6
summary(X)
modelf1 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf1)
modelf2 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf2)
modelf3 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf3)
modelf4 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf4)
modelf5 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf5)
modelf6 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf6)
modelf7 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf7)
modelf8 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf8)
modelf9 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf9)
modelf10 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf10)
modelf11 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf11)
modelf12 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf12)
modelf13 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf13)
modelf14 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf14)
modelf15 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf15)
modelf16 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
```

```
summary(modelf16)

modelf17 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf17)
modelf18 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf18)
modelf19 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf19)
modelf20 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf20)
modelf21 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf21)
modelf22 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf22)
modelf23 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf23)
modelf24 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf24)
AIC(modelf17)
AIC(modelf18)
AIC(modelf19)
AIC(modelf20)
AIC(modelf21)
AIC(modelf22)
AIC(modelf23)
AIC(modelf24)

#### For the first decay (N = 2)
Y1 <- N2$New.Cases..2.weeks.later.
Y2 <- N2$Total.Cases..2.weeks.later.
y1 <- N2$New.Cases..2.weeks.before.
y2 <- N2$Total.Cases..2.weeks.before.
X1 <- N2$retail_and_recreation_percent_change_from_baseline_week
X2 <- N2$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- N2$parks_percent_change_from_baseline_week
X4 <- N2$transit_stations_percent_change_from_baseline_week
X5 <- N2$workplaces_percent_change_from_baseline_week
X6 <- N2$residential_percent_change_from_baseline_week
X7 <- N2$recovered_week
X <- matrix(c(X1, X2, X3, X4, X5, X6, X7), ncol = 7)
Y1X1 <- Y1*X1
Y1X2 <- Y1*X2
```

```
Y1X3 <- Y1*X3
Y1X4 <- Y1*X4
Y1X5 <- Y1*X5
Y1X6 <- Y1*X6

Y2X1 <- (Y2-X7)*X1
Y2X2 <- (Y2-X7)*X2
Y2X3 <- (Y2-X7)*X3
Y2X4 <- (Y2-X7)*X4
Y2X5 <- (Y2-X7)*X5
Y2X6 <- (Y2-X7)*X6
summary(X)
modelf1 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf1)
modelf2 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf2)
modelf3 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf3)
modelf4 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf4)
modelf5 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf5)
modelf6 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf6)
modelf7 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf7)
modelf8 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf8)
modelf9 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf9)
modelf10 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf10)
modelf11 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf11)
modelf12 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf12)
modelf13 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf13)
modelf14 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf14)
modelf15 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf15)
```

```
modelf16 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf16)
modelf17 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf17)
modelf18 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf18)
modelf19 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf19)
modelf20 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf20)
modelf21 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf21)
modelf22 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf22)
modelf23 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf23)
modelf24 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf24)
AIC(modelf17)
AIC(modelf18)
AIC(modelf19)
AIC(modelf20)
AIC(modelf21)
AIC(modelf22)
AIC(modelf23)
AIC(modelf24)
```

For the second growth (N = 3)

```
Y1 <- N3$New.Cases..2.weeks.later.
Y2 <- N3$Total.Cases..2.weeks.later.
y1 <- N3$New.Cases..2.weeks.before.
y2 <- N3$Total.Cases..2.weeks.before.
X1 <- N3$retail_and_recreation_percent_change_from_baseline_week
X2 <- N3$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- N3$parks_percent_change_from_baseline_week
X4 <- N3$transit_stations_percent_change_from_baseline_week
X5 <- N3$workplaces_percent_change_from_baseline_week
X6 <- N3$residential_percent_change_from_baseline_week
X7 <- N3$recovered_week
X <- matrix(c(X1, X2, X3, X4, X5, X6, X7), ncol = 7)
Y1X1 <- Y1*X1
Y1X2 <- Y1*X2
```

```
Y1X3 <- Y1*X3
Y1X4 <- Y1*X4
Y1X5 <- Y1*X5
Y1X6 <- Y1*X6
Y2X1 <- (Y2-X7)*X1
Y2X2 <- (Y2-X7)*X2
Y2X3 <- (Y2-X7)*X3
Y2X4 <- (Y2-X7)*X4
Y2X5 <- (Y2-X7)*X5
Y2X6 <- (Y2-X7)*X6
summary(X)
modelf1 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf1)
modelf2 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf2)
modelf3 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf3)
modelf4 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf4)
modelf5 <- lm(Y1 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf5)
modelf6 <- lm(Y1 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf6)
modelf7 <- lm(Y1 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf7)
modelf8 <- lm(Y1 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf8)
modelf9 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf9)
modelf10 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf10)
modelf11 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf11)
modelf12 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf12)
modelf13 <- lm(Y2 ~ y1 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf13)
modelf14 <- lm(Y2 ~ y2 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf14)
modelf15 <- lm(Y2 ~ y1 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf15)
modelf16 <- lm(Y2 ~ y2 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
```

```
summary(modelf16)
modelf17 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf17)
modelf18 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf18)
modelf19 <- lm(Y1 ~ X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf19)
modelf20 <- lm(Y1 ~ X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf20)
modelf21 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y1X6)
summary(modelf21)
modelf22 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y2X6)
summary(modelf22)
modelf23 <- lm(Y1 ~ y1 + X7 + Y2X1 + Y2X2 + Y2X3 + Y2X4 + Y2X5 + Y1X6)
summary(modelf23)
modelf24 <- lm(Y1 ~ y1 + X7 + Y1X1 + Y1X2 + Y1X3 + Y1X4 + Y1X5 + Y2X6)
summary(modelf24)

######################

NORTE <- read.csv("E:/Meu Drive/Drive (UFPE)/2. Research/z - Papers & Submissions - z/Time Series & Interventions/COVID-19/Data/2020_NORTE - Final_Dataset_COVID19_Mobility.csv")
attach(NORTE)
View(NORTE)
NORDESTE <- read.csv("G:/Meu Drive/Drive (UFPE)/2. Research/z - Papers & Submissions - z/Time Series & Interventions/COVID-19/Data/2020_NORTDESTE - Final_Dataset_COVID19_Mobility.csv")
attach(NORDESTE)
View(NORDESTE)
CENTRO <- read.csv("E:/Meu Drive/Drive (UFPE)/2. Research/z - Papers & Submissions - z/Time Series & Interventions/COVID-19/Data/2020_CENTRO - Final_Dataset_COVID19_Mobility.csv")
attach(CENTRO)
View(CENTRO)
SULDESTE <- read.csv("E:/Meu Drive/Drive (UFPE)/2. Research/z - Papers & Submissions - z/Time Series & Interventions/COVID-19/Data/2020_SUDESTE - Final_Dataset_COVID19_Mobility.csv")
attach(SULDESTE)
View(SULDESTE)
SUL <- read.csv("E:/Meu Drive/Drive (UFPE)/2. Research/z - Papers & Submissions - z/Time Series & Interventions/COVID-19/Data/2020_SUL - Final_Dataset_COVID19_Mobility.csv")
attach(SUL)
View(SUL)
Y1 <- NORDESTE$New.Cases..2.weeks.later.
```

```
Y2 <- NORDESTE$Total.Cases..2.weeks.later.
y1 <- NORDESTE$New.Cases..2.weeks.before.
y2 <- NORDESTE$Total.Cases..2.weeks.before.
X1 <- NORDESTE$retail_and_recreation_percent_change_from_baseline_week
X2 <- NORDESTE$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- NORDESTE$parks_percent_change_from_baseline_week
X4 <- NORDESTE$transit_stations_percent_change_from_baseline_week
X5 <- NORDESTE$workplaces_percent_change_from_baseline_week
X6 <- NORDESTE$residential_percent_change_from_baseline_week
y1X1 <- y1*X1
y1X2 <- y1*X2
y1X3 <- y1*X3
y1X4 <- y1*X4
y1X5 <- y1*X5
y1X6 <- y1*X6
y2X1 <- y2*X1
y2X2 <- y2*X2
y2X3 <- y2*X3
y2X4 <- y2*X4
y2X5 <- y2*X5
y2X6 <- y2*X6
modelf5 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf5)
Y1 <- NORTE$New.Cases..2.weeks.later.
Y2 <- NORTE$Total.Cases..2.weeks.later.
y1 <- NORTE$New.Cases..2.weeks.before.
y2 <- NORTE$Total.Cases..2.weeks.before.
X1 <- NORTE$retail_and_recreation_percent_change_from_baseline_week
X2 <- NORTE$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- NORTE$parks_percent_change_from_baseline_week
X4 <- NORTE$transit_stations_percent_change_from_baseline_week
X5 <- NORTE$workplaces_percent_change_from_baseline_week
X6 <- NORTE$residential_percent_change_from_baseline_week
y1X1 <- y1*X1
y1X2 <- y1*X2
y1X3 <- y1*X3
y1X4 <- y1*X4
y1X5 <- y1*X5
y1X6 <- y1*X6
y2X1 <- y2*X1
y2X2 <- y2*X2
y2X3 <- y2*X3
```

```
y2X4 <- y2*X4
y2X5 <- y2*X5
y2X6 <- y2*X6
modelf5 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf5)
Y1 <- CENTRO$New.Cases..2.weeks.later.
Y2 <- CENTRO$Total.Cases..2.weeks.later.
y1 <- CENTRO$New.Cases..2.weeks.before.
y2 <- CENTRO$Total.Cases..2.weeks.before.
X1 <- CENTRO$retail_and_recreation_percent_change_from_baseline_week
X2 <- CENTRO$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- CENTRO$parks_percent_change_from_baseline_week
X4 <- CENTRO$transit_stations_percent_change_from_baseline_week
X5 <- CENTRO$workplaces_percent_change_from_baseline_week
X6 <- CENTRO$residential_percent_change_from_baseline_week

y1X1 <- y1*X1
y1X2 <- y1*X2
y1X3 <- y1*X3
y1X4 <- y1*X4
y1X5 <- y1*X5
y1X6 <- y1*X6
y2X1 <- y2*X1
y2X2 <- y2*X2
y2X3 <- y2*X3
y2X4 <- y2*X4
y2X5 <- y2*X5
y2X6 <- y2*X6
modelf5 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf5)
Y1 <- SULDESTE$New.Cases..2.weeks.later.
Y2 <- SULDESTE$Total.Cases..2.weeks.later.
y1 <- SULDESTE$New.Cases..2.weeks.before.
y2 <- SULDESTE$Total.Cases..2.weeks.before.
X1 <- SULDESTE$retail_and_recreation_percent_change_from_baseline_week
X2 <- SULDESTE$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- SULDESTE$parks_percent_change_from_baseline_week
X4 <- SULDESTE$transit_stations_percent_change_from_baseline_week
X5 <- SULDESTE$workplaces_percent_change_from_baseline_week
X6 <- SULDESTE$residential_percent_change_from_baseline_week
y1X1 <- y1*X1
y1X2 <- y1*X2
```

```
y1X3 <- y1*X3
y1X4 <- y1*X4
y1X5 <- y1*X5
y1X6 <- y1*X6
y2X1 <- y2*X1
y2X2 <- y2*X2
y2X3 <- y2*X3
y2X4 <- y2*X4
y2X5 <- y2*X5
y2X6 <- y2*X6
modelf5 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf5)
Y1 <- SUL$New.Cases..2.weeks.later.
Y2 <- SUL$Total.Cases..2.weeks.later.
y1 <- SUL$New.Cases..2.weeks.before.
y2 <- SUL$Total.Cases..2.weeks.before.

X1 <- SUL$retail_and_recreation_percent_change_from_baseline_week
X2 <- SUL$grocery_and_pharmacy_percent_change_from_baseline_week
X3 <- SUL$parks_percent_change_from_baseline_week
X4 <- SUL$transit_stations_percent_change_from_baseline_week
X5 <- SUL$workplaces_percent_change_from_baseline_week
X6 <- SUL$residential_percent_change_from_baseline_week
y1X1 <- y1*X1
y1X2 <- y1*X2
y1X3 <- y1*X3
y1X4 <- y1*X4
y1X5 <- y1*X5
y1X6 <- y1*X6
y2X1 <- y2*X1
y2X2 <- y2*X2
y2X3 <- y2*X3
y2X4 <- y2*X4
y2X5 <- y2*X5
y2X6 <- y2*X6
modelf5 <- lm(Y1 ~ y1 + y2X1 + y2X2 + y2X3 + y2X4 + y2X5 + y1X6)
summary(modelf5)
```

Codes for the section 3.3. “Aggregate Mobility Impact on the First Growth” per region and for the country

```
######### Brasil Estimations ###################

Brasil174 <- read.csv2("(…).csv")
attach(Brasil174)
View(Brasil174)

Brasil173 <- Brasil174[c(1:173), c(3:8, 14, 18, 21)]
View(Brasil173)
attach(Brasil173)

##ModeloBrasil <- glm(Brasil173$NOVO_COVID_n.3 ~ Brasil173$NOVO_COVID_n + Brasil173$COVID_TOTAL_n * Brasil173$retail * Brasil173$grocery + Brasil173$parks * Brasil173$transit * Brasil173$workplaces * Brasil173$residential-1, family = poisson(link = "log"))

ModeloBrasil <- glm(formula =  NOVO_COVID_n.3 ~ NOVO_COVID_n + COVID_TOTAL_n * retail * grocery * parks * transit * workplaces * residential - 1, family = poisson(link = "log"))
predict(ModeloBrasil, type = "response")

BR174 <- Brasil174[c(174), c(3:8, 14, 18, 21)]
View(BR174)
predict(ModeloBrasil, newdata = BR174, type = "response")

################### R0+

BR174_R00 <- data.frame(BR174[-c(8)], NOVO_COVID_n = 812.4815)
#View(BR174_R00)
BRPrediction_R00 <- predict(ModeloBrasil, newdata = BR174_R00, type = "response")
BRPrediction_R00

BR_R00 <- BRPrediction_R00-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_R00

################### R0

BR174_R0 <- data.frame(BR174[-c(7)], COVID_TOTAL_n = 2168)
#View(BR174_R0)
BRPrediction_R0 <- predict(ModeloBrasil, newdata = BR174_R0, type = "response")
BRPrediction_R0

BR_R0 <- BRPrediction_R0-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_R0
```

```
################### Retail

BR174_Rtl <- data.frame(BR174[-c(1)], retail = -57.66038)
#View(BR174_Rtl)
BRPrediction_Rtl <- predict(ModeloBrasil, newdata = BR174_Rtl, type = "response")
BRPrediction_Rtl

BR_Rtl <- BRPrediction_Rtl-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_Rtl

################### Grocery

BR174_Rg <- data.frame(BR174[-c(2)], grocery = -19.95667       )
#View(BR174_Rg)
BRPrediction_Rg <- predict(ModeloBrasil, newdata = BR174_Rg, type = "response")
BRPrediction_Rg

BR_Rg <- BRPrediction_Rg-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_Rg

################### Parks

BR174_Rp <- data.frame(BR174[-c(3)], parks = -47.82969)
#View(BR174_Rp)
BRPrediction_Rp <- predict(ModeloBrasil, newdata = BR174_Rp, type = "response")
BRPrediction_Rp

BR_Rp <- BRPrediction_Rp-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_Rp

################### Transit

BR174_Rtr <- data.frame(BR174[-c(4)], transit = -58.25297)
#View(BR174_Rtr)
BRPrediction_Rtr <- predict(ModeloBrasil, newdata = BR174_Rtr, type = "response")
BRPrediction_Rtr

BR_Rtr <- BRPrediction_Rtr-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_Rtr

################### Workplaces
```

```
BR174_Rw <- data.frame(BR174[-c(5)], workplaces = -34.53868       )
#View(BR174_Rw)
BRPrediction_Rw <- predict(ModeloBrasil, newdata = BR174_Rw, type = "response")
BRPrediction_Rw

BR_Rw <- BRPrediction_Rw-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_Rw

################## Residences

BR174_Rs <- data.frame(BR174[-c(6)], residential = 15.85285    )
#View(BR174_Rs)
BRPrediction_Rs <- predict(ModeloBrasil, newdata = BR174_Rs, type = "response")
BRPrediction_Rs

BR_Rs <- BRPrediction_Rs-predict(ModeloBrasil, newdata = BR174, type = "response")
BR_Rs


################## P-values

summary(ModeloBrasil)

################## Flexplots

ResultadosBrasil <- read.csv2("G:/Meu Drive/Drive (UFPE)/Research/Socioeconomic Interventions/COVID-19/Data/ResultadosBrasil.csv")
attach(ResultadosBrasil)

library(flexplot)
flexplot(COVID_prediction~retail, data = ResultadosBrasil, method = "Poisson")
flexplot(COVID_prediction~parks|COVID_TOTAL_n, data = ResultadosBrasil, method = "Poisson")
```

######### Norte (North) Estimations ##################

```
NORTE46 <- read.csv2("(…).csv")
attach(NORTE46)
View(NORTE46)
```

```
NORTE41 <- NORTE46[c(1:41), c(3:8, 14, 18, 21)]
View(NORTE41)
attach(NORTE41)

NOVOn3 <- NORTE41$NOVO_COVID_n.3
NOVOn <- NORTE41$NOVO_COVID_n
TOTALn <- NORTE41$COVID_TOTAL_n
rt <- NORTE41$retail
gr <- NORTE41$grocery
pk <- NORTE41$parks
tr <- NORTE41$transit
wp <- NORTE41$workplaces
rs <- NORTE41$residential

#ModeloNorte <- glm(NOVOn3 ~ TOTALn * rt * gr + pk * tr * wp * rs, family = poisson)

#ModeloNorte <- glm(NORTE41$NOVO_COVID_n.3 ~ NORTE41$NOVO_COVID_n + NORTE41$COVID_TOTAL_n * NORTE41$retail * NORTE41$grocery + NORTE41$parks * NORTE41$transit * NORTE41$workplaces * NORTE41$residential, family = poisson)

ModeloNorte <- glm(NOVn3 ~ NOVn + COVn * ret * gro * par * tra * wor * res - 1, family = poisson)

predict(ModeloNorte, type = "response")

N46 <- NORTE46[c(46), c(3:8, 14, 18, 21)]

NOVOn3 <- N46$NOVO_COVID_n.3
NOVOn <- N46$NOVO_COVID_n
TOTALn <- N46$COVID_TOTAL_n
rt <- N46$retail
gr <- N46$grocery
pk <- N46$parks
tr <- N46$transit
wp <- N46$workplaces
rs <- N46$residential

View(N46)
predict(ModeloNorte, newdata = N46, type = "response")

################## R0+

N46_R00 <- data.frame(N46[-c(8)], NOVOn = 494.8571)
```

```
#View(N46_R00)
NPrediction_R00 <- predict(ModeloNorte, newdata = N46_R00, type = "response")
NPrediction_R00

N_R00 <- NPrediction_R00-predict(ModeloNorte, newdata = N46, type = "response")
N_R00

################### R0

N46_R0 <- data.frame(N46[-c(7)], TOTALn = 983.8571)
#View(N46_R0)
NPrediction_R0 <- predict(ModeloNorte, newdata = N46_R0, type = "response")
NPrediction_R0

N_R0 <- NPrediction_R0-predict(ModeloNorte, newdata = N46, type = "response")
N_R0

################### Retail

N46_Rtl <- data.frame(N46[-c(1)], rt = -52.20408) #1%
#View(N46_Rtl)
NPrediction_Rtl <- predict(ModeloNorte, newdata = N46_Rtl, type = "response")
NPrediction_Rtl

N_Rtl <- NPrediction_Rtl-predict(ModeloNorte, newdata = N46, type = "response")
N_Rtl

################### Grocery

N46_Rg <- data.frame(N46[-c(2)], gr = -15.06122) #1%
#View(N46_Rg)
NPrediction_Rg <- predict(ModeloNorte, newdata = N46_Rg, type = "response")
NPrediction_Rg

N_Rg <- NPrediction_Rg-predict(ModeloNorte, newdata = N46, type = "response")
N_Rg

################### Parks

N46_Rp <- data.frame(N46[-c(3)], pk = -39.06122) #1%
#View(N46_Rp)
NPrediction_Rp <- predict(ModeloNorte, newdata = N46_Rp, type = "response")
```

```
NPrediction_Rp

N_Rp <- NPrediction_Rp-predict(ModeloNorte, newdata = N46, type = "response")
N_Rp

################## Transit

N46_Rt <- data.frame(N46[-c(4)], tr = -60.55102) #1%
#View(N46_Rt)
NPrediction_Rt <- predict(ModeloNorte, newdata = N46_Rt, type = "response")
NPrediction_Rt

N_Rt <- NPrediction_Rt-predict(ModeloNorte, newdata = N46, type = "response")
N_Rt

################## Workplaces

N46_Rw <- data.frame(N46[-c(5)], wp = -30.14286) #1%
#View(N46_Rw)
NPrediction_Rw <- predict(ModeloNorte, newdata = N46_Rw, type = "response")
NPrediction_Rw

N_Rw <- NPrediction_Rw-predict(ModeloNorte, newdata = N46, type = "response")
N_Rw

################## Residences

N46_Rs <- data.frame(N46[-c(6)], rs = 14.97959) #1%
#View(N46_Rs)
NPrediction_Rs <- predict(ModeloNorte, newdata = N46_Rs, type = "response")
NPrediction_Rs

N_Rs <- NPrediction_Rs-predict(ModeloNorte, newdata = N46, type = "response")
N_Rs

##############################################

N45 <- NORTE46[c(45), c(3:8, 14, 18, 21)]

NOVOn3 <- N45$NOVO_COVID_n.3
NOVOn <- N45$NOVO_COVID_n
TOTALn <- N45$COVID_TOTAL_n
```

```
rt <- N45$retail
gr <- N45$grocery
pk <- N45$parks
tr <- N45$transit
wp <- N45$workplaces
rs <- N45$residential

View(N45)
predict(ModeloNorte, newdata = N45, type = "response")

################### R0+

N45_R00 <- data.frame(N45[-c(8)], NOVOn = 251)
#View(N45_R00)
NPrediction_R00 <- predict(ModeloNorte, newdata = N45_R00, type = "response")
NPrediction_R00

N_R00 <- NPrediction_R00-predict(ModeloNorte, newdata = N45, type = "response")
N_R00

################### R0

N45_R0 <- data.frame(N45[-c(7)], TOTALn = 983.8571)
#View(N45_R0)
NPrediction_R0 <- predict(ModeloNorte, newdata = N45_R0, type = "response")
NPrediction_R0

N_R0 <- NPrediction_R0-predict(ModeloNorte, newdata = N45, type = "response")
N_R0

################### Retail

N45_Rtl <- data.frame(N45[-c(1)], rt = -52.20408) #1%
#View(N45_Rtl)
NPrediction_Rtl <- predict(ModeloNorte, newdata = N45_Rtl, type = "response")
NPrediction_Rtl

N_Rtl <- NPrediction_Rtl-predict(ModeloNorte, newdata = N45, type = "response")
N_Rtl

################### Grocery
```

```
N45_Rg <- data.frame(N45[-c(2)], gr = -15.06122) #1%
#View(N45_Rg)
NPrediction_Rg <- predict(ModeloNorte, newdata = N45_Rg, type = "response")
NPrediction_Rg

N_Rg <- NPrediction_Rg-predict(ModeloNorte, newdata = N45, type = "response")
N_Rg

################### Parks

N45_Rp <- data.frame(N45[-c(3)], pk = -39.06122) #1%
#View(N45_Rp)
NPrediction_Rp <- predict(ModeloNorte, newdata = N45_Rp, type = "response")
NPrediction_Rp

N_Rp <- NPrediction_Rp-predict(ModeloNorte, newdata = N45, type = "response")
N_Rp

################### Transit

N45_Rt <- data.frame(N45[-c(4)], tr = -60.55102) #1%
#View(N45_Rt)
NPrediction_Rt <- predict(ModeloNorte, newdata = N45_Rt, type = "response")
NPrediction_Rt

N_Rt <- NPrediction_Rt-predict(ModeloNorte, newdata = N45, type = "response")
N_Rt

################### Workplaces

N45_Rw <- data.frame(N45[-c(5)], wp = -30.14286) #1%
#View(N45_Rw)
NPrediction_Rw <- predict(ModeloNorte, newdata = N45_Rw, type = "response")
NPrediction_Rw

N_Rw <- NPrediction_Rw-predict(ModeloNorte, newdata = N45, type = "response")
N_Rw

################### Residences

N45_Rs <- data.frame(N45[-c(6)], rs = 14.97959) #1%
#View(N45_Rs)
```

```
NPrediction_Rs <- predict(ModeloNorte, newdata = N45_Rs, type = "response")
NPrediction_Rs

N_Rs <- NPrediction_Rs-predict(ModeloNorte, newdata = N45, type = "response")
N_Rs


################### P-values

summary(ModeloNorte)

######### The remaining codes are just replications of the last one for the remaining regions
```

AIMS Press