# 11.- Causal Anaysis_04_19_vacunacion_completo_v_01

June 8, 2023

#

CU04_Optimización de vacunas

Citizenlab Data Science Methodology > II - Data Processing Domain *** > # 11.- ECA - Exploratory Causal Analysis

Exploratory causal analysis (ECA) is the process of discovering the root causes of problems in order to identify appropriate solutions.

## 0.1 Tasks

Define the key challenge or setback

Determine the causes and effects of the key challenge

Use a diagram or graph to organize information

Formulate a response to the primary causes of your challenge

Review your process and address new causes and effects

## 0.2 File

- Input File: CU_04_08_20_vacunacion_gripe_train_and_test.csv
- No aplica

### 0.2.1 Encoding

Con la siguiente expresión se evitan problemas con el encoding al ejecutar el notebook. Es posible que deba ser eliminada o adaptada a la máquina en la que se ejecute el código.

[1]:
```
Sys.setlocale(category = "LC_ALL", locale = "es_ES.UTF-8")
```

```
Warning message in Sys.setlocale(category = "LC_ALL", locale = "es_ES.UTF-8"):
"OS reports request to set locale to "es_ES.UTF-8" cannot be honored"
```

”

## 0.3 Settings

### 0.3.1 Libraries to use

[2]:
```
library(readr)
library(dplyr)
library(tidyr)
library(stringr)
```

```
Attaching package: ‘dplyr’


The following objects are masked from ‘package:stats’:

    filter, lag


The following objects are masked from ‘package:base’:

    intersect, setdiff, setequal, union
```

### 0.3.2 Paths

[3]:
```
iPath <- "Data/Input/"
oPath <- "Data/Output/"
```

## 0.4 Data Load

OPCION A: Seleccionar fichero en ventana para mayor comodidad

Data load using the {tcltk} package. Ucomment the line if using this option

[4]:
```
# file_data <- tcltk::tk_choose.files(multi = FALSE)
```

OPCION B: Especificar el nombre de archivo

[5]:
```
iFile <- "CU_04_08_20_vacunacion_gripe_train_and_test.csv"
file_data <- paste0(iPath, iFile)

if(file.exists(file_data)){
    cat("Se leerán datos del archivo: ", file_data)
} else{
    warning("Cuidado: el archivo no existe.")
}
```

```
Se leerán datos del archivo:
Data/Input/CU_04_08_20_vacunacion_gripe_train_and_test.csv
```

**Data file to dataframe** Usar la función adecuada según el formato de entrada (xlsx, csv, json, ...)

[6]:
```
data <- read_csv(file_data)
```

```
Rows: 21736 Columns: 49
  Column specification



Delimiter: ","
chr  (3): GEOCODIGO, DESBDT, nombre_zona
dbl (45): ano, semana, n_vacunas, n_citas, tmed, prec, velmedia,
presMax, be…
lgl  (1): is_train

 Use `spec()` to retrieve the full column specification for this
data.
 Specify the column types or set `show_col_types = FALSE` to quiet
this message.
```

Visualizo los datos.

Estructura de los datos:

[7]:
```
data |> glimpse()
```

```
Rows: 21,736
Columns: 49
$ GEOCODIGO         <chr> "259", "260", "041", "025", "046",
"159", "065", "09…
$ DESBDT            <chr> "V Centenario", "Valdeacederas",
"Canillejas", "Bara…
$ ano               <dbl> 2022, 2022, 2022, 2022, 2022, 2022,
2022, 2021, 2023…
$ semana            <dbl> 34, 8, 9, 49, 24, 3, 8, 47, 1, 2,
52, 39, 16, 50, 34…
$ n_vacunas         <dbl> 0, 0, 0, 292, 0, 524, 0, 248, 204,
205, NA, 0, 0, 51…
$ n_citas           <dbl> 0, 0, 0, 280, 0, 498, 0, 228, 198,
187, NA, 0, 0, 51…
$ tmed              <dbl> 27.278748, 9.577289, 8.536554,
9.065363, 29.905728, …
$ prec              <dbl> 0.169955881, 1.264910043,
3.122881160, 7.313886680, …
$ velmedia          <dbl> 2.297067, 1.890425, 2.418071,
1.562328, 2.564749, 1.…
$ presMax           <dbl> 940.0420, 944.1770, 949.7179,
941.8342, 940.5669, 95…
```

```
$ benzene           <dbl> 0.1764413, 0.4591543, 0.4099159,
0.4224172, 0.195865…
$ co                <dbl> 0.4987735, 0.3960647, 0.3951587,
NA, 0.2891224, 0.50…
$ no                <dbl> NA, 6.611337, 9.331224, 14.007722,
4.063517, 24.4756…
$ no2               <dbl> 14.21113, 34.67671, 30.29999,
32.54832, 26.06913, 44…
$ nox               <dbl> 18.00109, 48.94660, 45.22346,
56.75574, 30.35311, 74…
$ o3                <dbl> 80.90659, 42.06663, 48.88088,
26.68276, 64.55205, 31…
$ pm10              <dbl> 20.117087, 15.042152, 14.002432,
18.032354, 55.79346…
$ pm2.5             <dbl> 10.628064, 5.539590, 7.124192,
6.793868, 19.520373, …
$ so2               <dbl> 2.794934, 3.507164, 2.692125,
2.351139, 3.397640, 2.…
$ campana           <dbl> NA, NA, NA, 2022, NA, 2021, NA,
2021, 2022, 2021, 20…
$ scampana          <dbl> NA, NA, NA, 14, NA, 20, NA, 12, 18,
19, 17, 4, NA, 1…
$ capacidad_zona    <dbl> 7957, 6537, 7167, 5633, 3864,
12583, 8544, 5077, 494…
$ prop_riesgo       <dbl> 0.11393237, 0.15763986, 0.25500690,
0.14452370, 0.26…
$ tasa_riesgo       <dbl> 0.013477754, 0.015731142,
0.009177382, 0.013099129, …
$ tasa_mayores      <dbl> 0.023033610, 0.032817374,
0.028147027, 0.020829657, …
$ poblacion_mayores <dbl> 0.10330662, 0.14362062, 0.23161874,
0.13058449, 0.24…
$ nombre_zona       <chr> "V Centenario", "Valdeacederas",
"Canillejas", "Bara…
$ nsec              <dbl> 17, 18, 22, 13, 14, 42, 32, 13, 17,
11, NA, 15, 15, …
$ t3_1              <dbl> 36.73039, 41.41412, 45.44882,
39.78001, 46.13171, 46…
$ t1_1              <dbl> 31778, 26202, 28658, 22492, 15450,
50478, 34148, 202…
$ t2_1              <dbl> 0.5084658, 0.5329728, 0.5316594,
0.5189021, 0.551191…
$ t2_2              <dbl> 0.4915342, 0.4670272, 0.4683406,
0.4810979, 0.448809…
$ t4_1              <dbl> 0.22551283, 0.12790298, 0.12603707,
0.18104432, 0.11…
$ t4_2              <dbl> 0.6711962, 0.7284970, 0.6423306,
0.6883785, 0.641173…
```

```
$ t4_3              <dbl> 0.10330662, 0.14362062, 0.23161874,
0.13058449, 0.24…
$ t5_1              <dbl> 0.1063332, 0.2295250, 0.1655070,
0.1266086, 0.165893…
$ t6_1              <dbl> 0.1706875, 0.3477631, 0.2511757,
0.1998911, 0.261480…
$ t7_1              <dbl> 0.05131106, 0.04606911, 0.04379644,
0.05585777, 0.06…
$ t8_1              <dbl> 0.03892836, 0.03586418, 0.03207779,
0.04434976, 0.05…
$ t9_1              <dbl> 0.5151383, 0.3863876, 0.3129631,
0.4611972, 0.701812…
$ t10_1             <dbl> 0.09258503, 0.13151901, 0.13926119,
0.10460043, 0.06…
$ t11_1             <dbl> 0.6406787, 0.5451465, 0.4600730,
0.5920292, 0.471769…
$ t12_1             <dbl> 0.7028586, 0.6277335, 0.5346482,
0.6590530, 0.502531…
$ area              <dbl> 2100118.9, 1164622.0, 1597474.5,
3816572.0, 870986.8…
$ densidad_hab_km   <dbl> 15131.52443, 22498.28643,
17939.56640, 5893.24662, 1…
$ tuits_gripe       <dbl> 60, 56, 72, 196, 46, 382, 56, 280,
24, 508, NA, 126,…
$ interes_gripe     <dbl> 24, 15, 24, 77, 21, 42, 15, 64, 64,
69, NA, 42, 40, …
$ Target            <dbl> 0, 0, 0, 292, 0, 524, 0, 248, 204,
205, NA, 0, 0, 51…
$ is_train          <lgl> TRUE, TRUE, TRUE, TRUE, TRUE, TRUE,
TRUE, TRUE, TRUE…
```

Muestra de los primeros datos:

[8]:
```
data |> slice_head(n = 5)
```

A spec_tbl_df: 5 × 49

| GEOCODIGO <chr> | DESBDT <chr> | ano <dbl> | semana <dbl> | n_vacunas <dbl> | n_citas <dbl> | tmed <dbl> | p |
|---|---|---|---|---|---|---|---|
| 259 | V Centenario | 2022 | 34 | 0 | 0 | 27.278748 | 0 |
| 260 | Valdeacederas | 2022 | 8 | 0 | 0 | 9.577289 | 1 |
| 041 | Canillejas | 2022 | 9 | 0 | 0 | 8.536554 | 3 |
| 025 | Barajas | 2022 | 49 | 292 | 280 | 9.065363 | 7 |
| 046 | Castelló | 2022 | 24 | 0 | 0 | 29.905728 | 0 |

## 0.5 Exploratory causal analysis

**REFERENCE** https://bookdown.org/paul/applied-causal-analysis/

Select columns

[9]:
```
# Seleccionamos las variables a analizar.
cols <-␣
 ↪c('GEOCODIGO','DESBDT','ano','semana','n_vacunas','n_citas','tmed','prec','velmedia','presM
 ↪5','so2','campana','scampana','capacidad_zona','prop_riesgo','tasa_riesgo','tasa_mayores','
```

[10]:
```
# If not already installed, install the ggplot2 package
if(!require(ggplot2)) install.packages('ggplot2')

# Load the ggplot2 package
library(ggplot2)

# Create scatterplots
for (col in cols) {
  if (is.numeric(data[[col]])) {
    p <- ggplot(data, aes_string(x = col, y = 'Target')) +
      geom_point() +
      geom_smooth(method = "lm", se = FALSE, color = "red") +
      theme_minimal() +
      ggtitle(paste("Scatterplot of", col, "and Target"))
    print(p)
  }
}
```

```
Loading required package: ggplot2

Warning message:
"`aes_string()` was deprecated in ggplot2 3.0.0.
 Please use tidy evaluation idioms with `aes()`.
 See also `vignette("ggplot2-in-packages")` for more information."
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 868 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 868 rows containing missing values (`geom_point()`)."
`geom_smooth()` using formula = 'y ~ x'
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Warning message:
"Removed 868 rows containing missing values (`geom_point()`)."
```
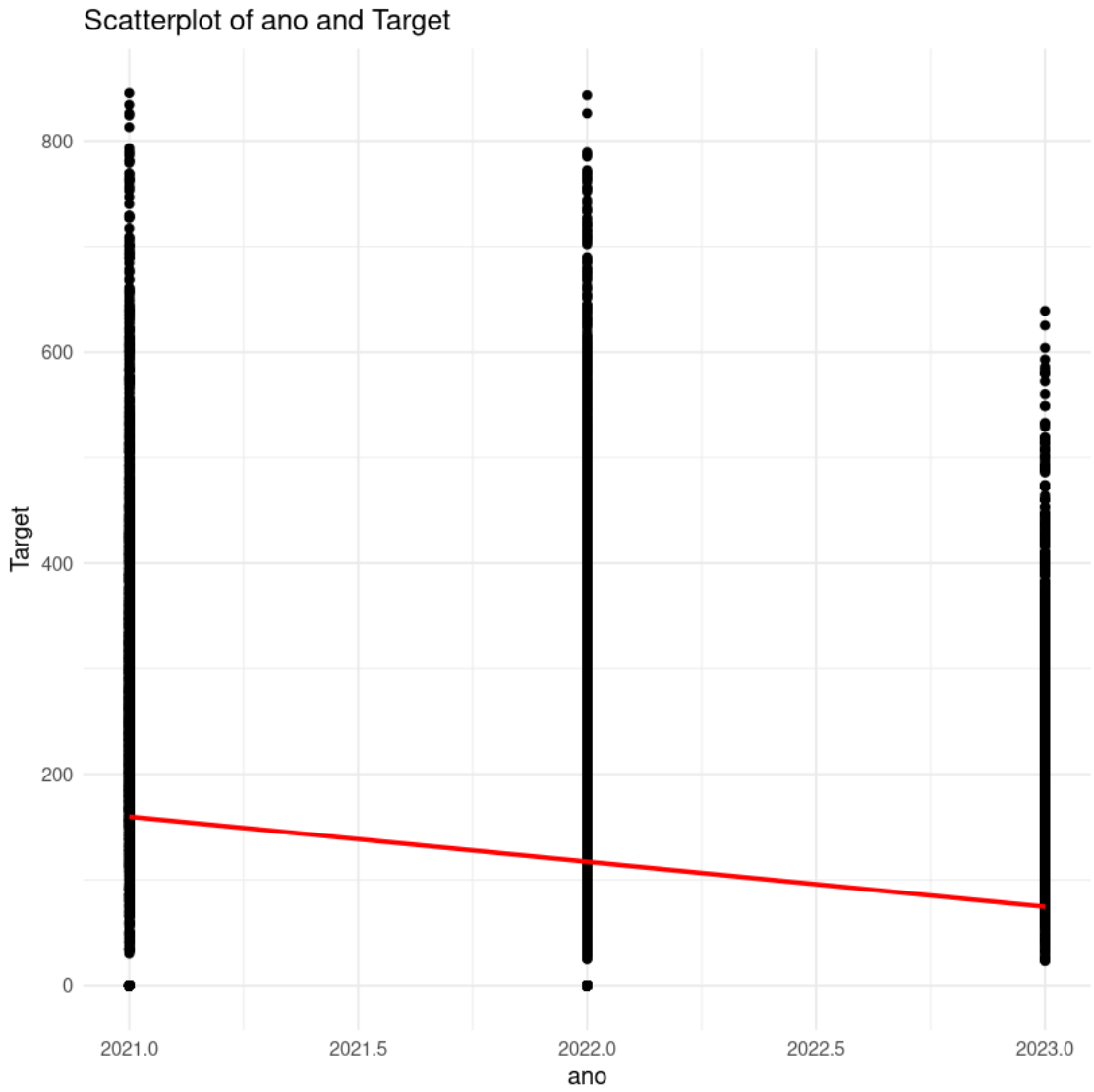
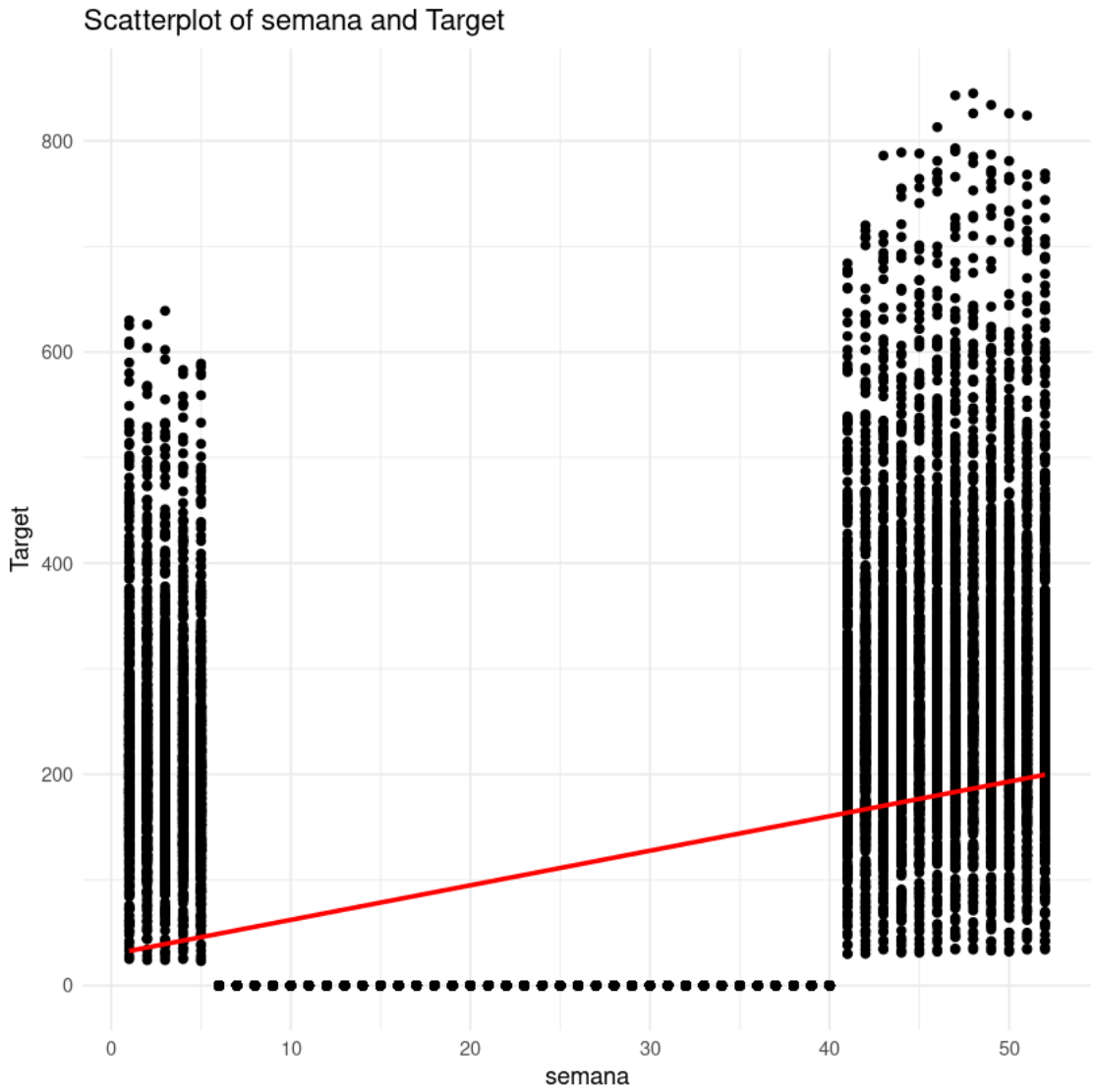




```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 868 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 868 rows containing missing values (`geom_point()`)."
```




```
`geom_smooth()` using formula = 'y ~ x'
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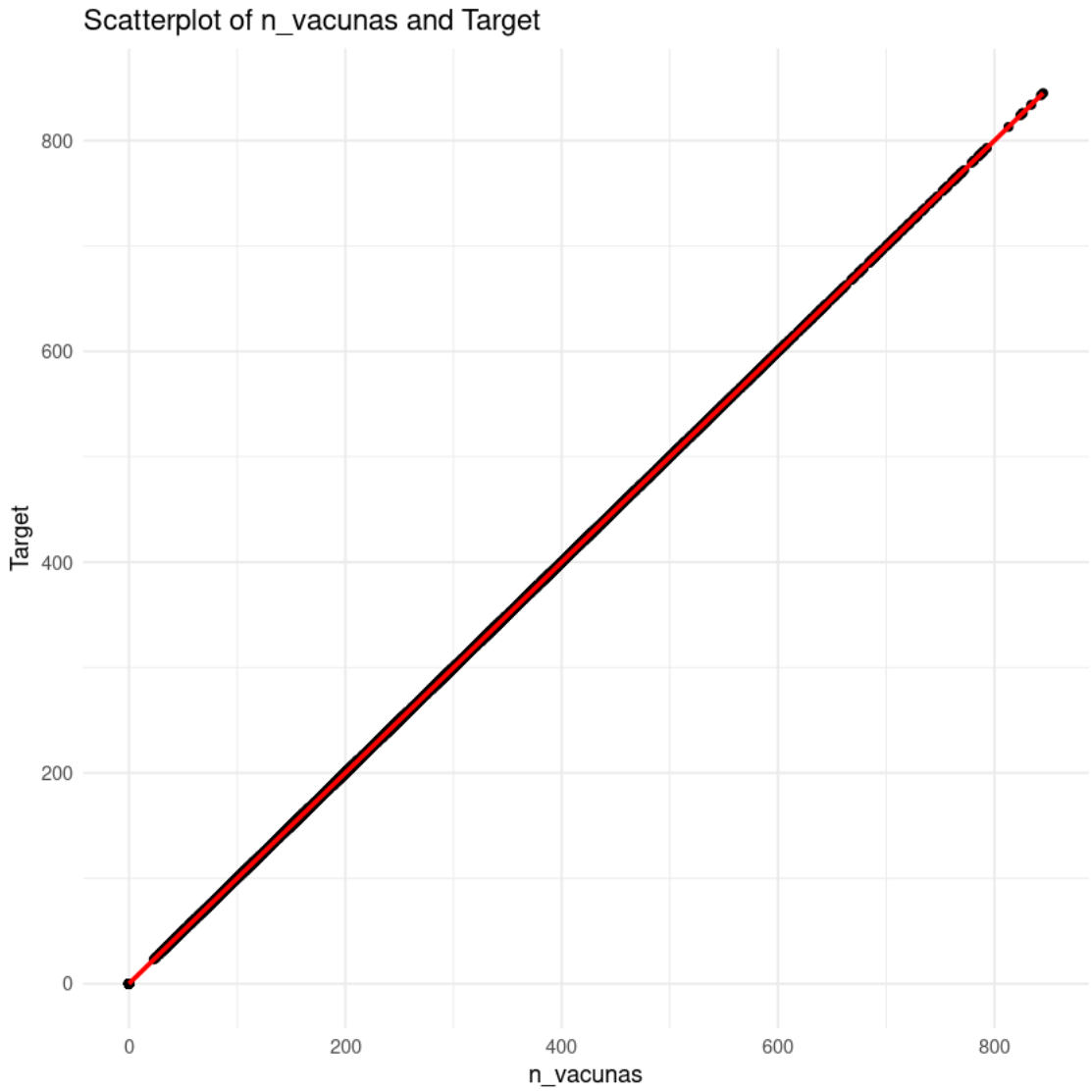


```
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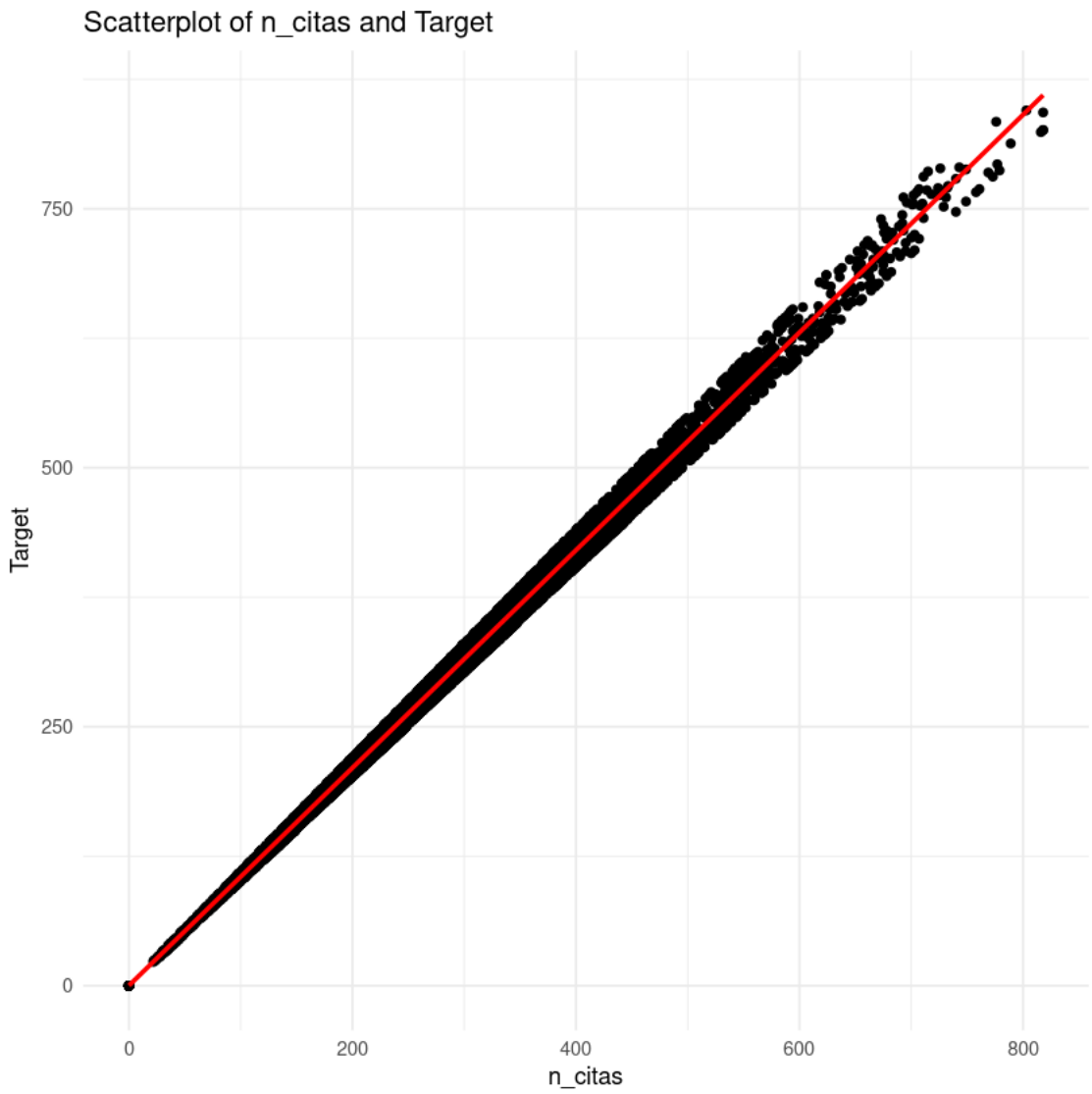
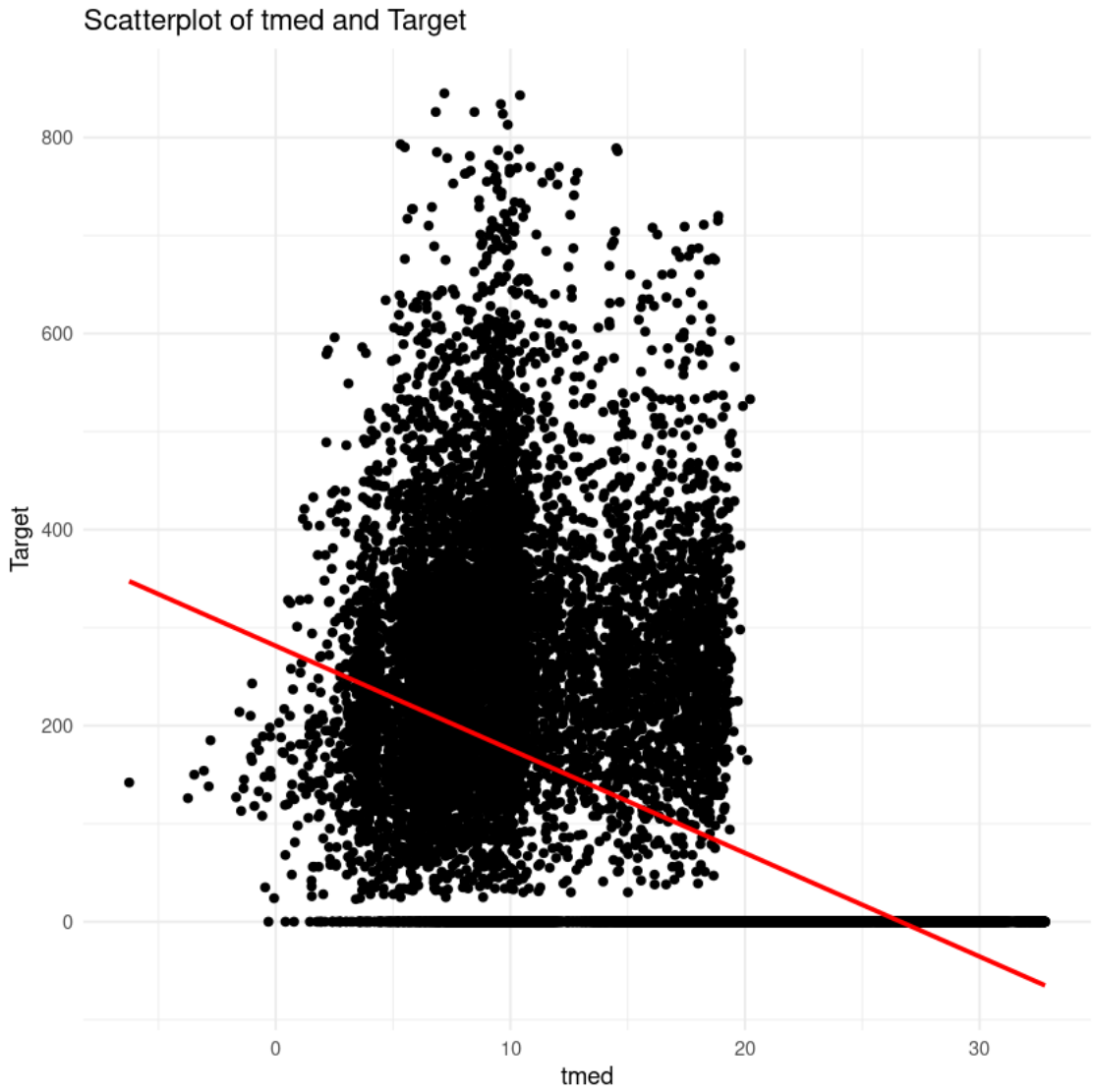
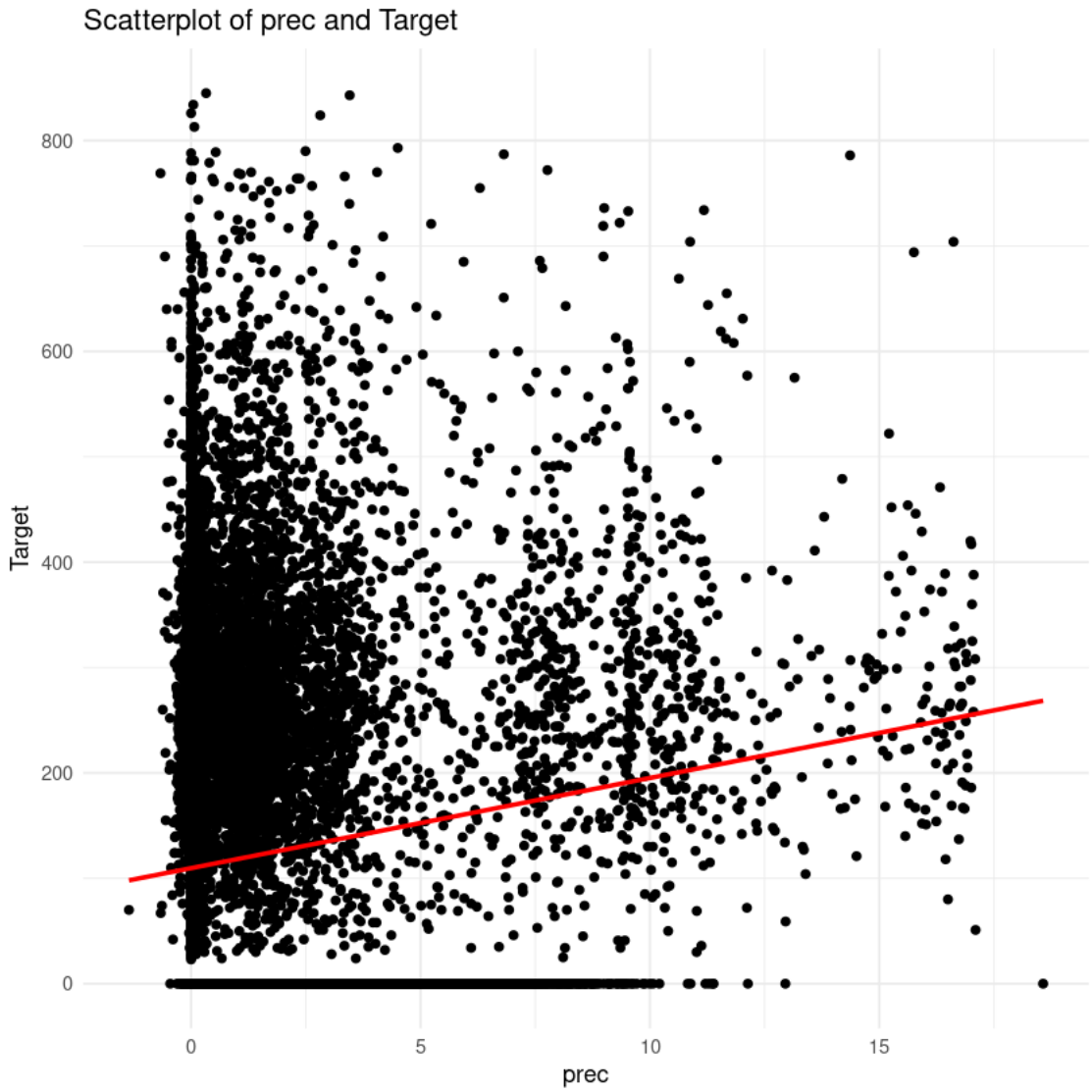


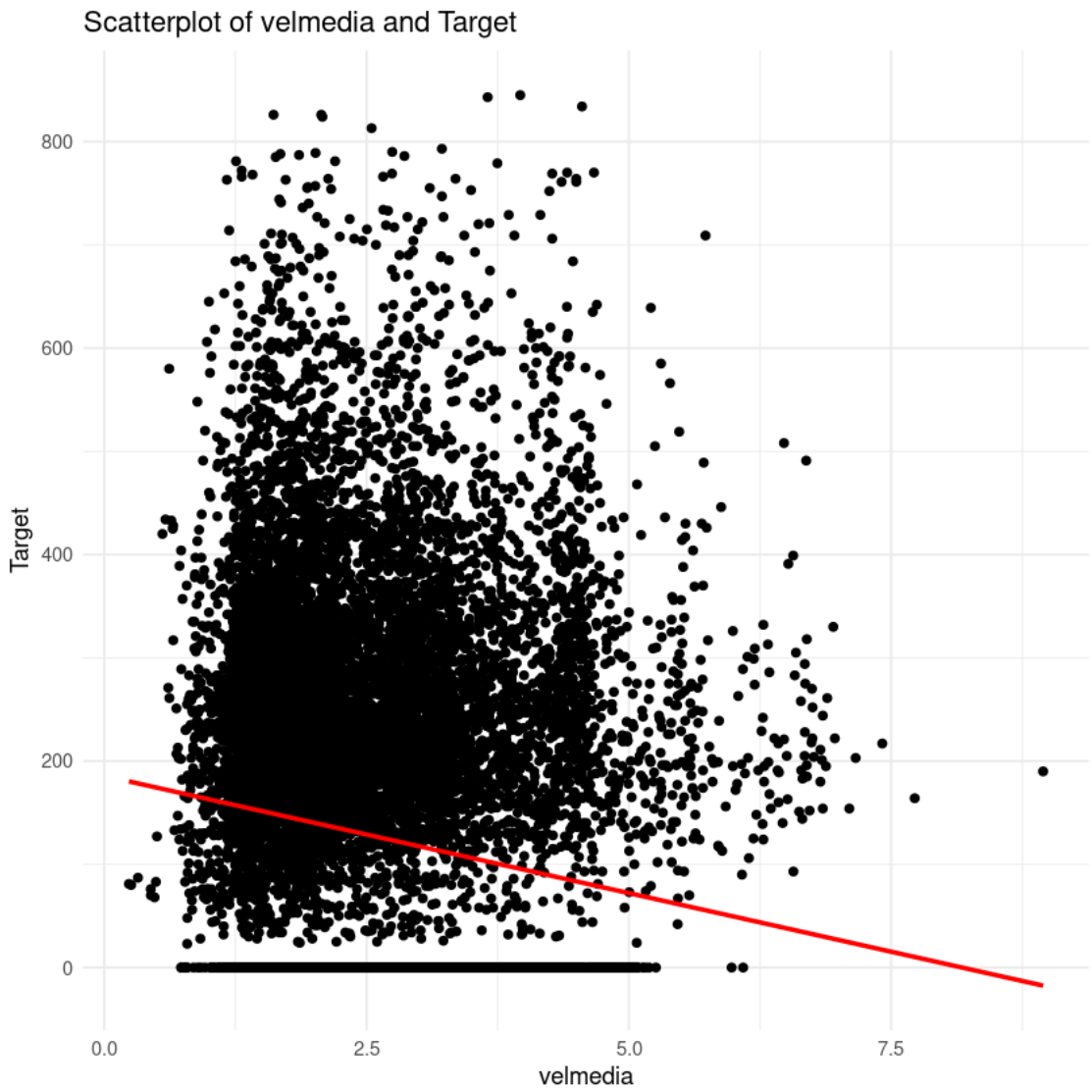

```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1150 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1150 rows containing missing values (`geom_point()`)."
```



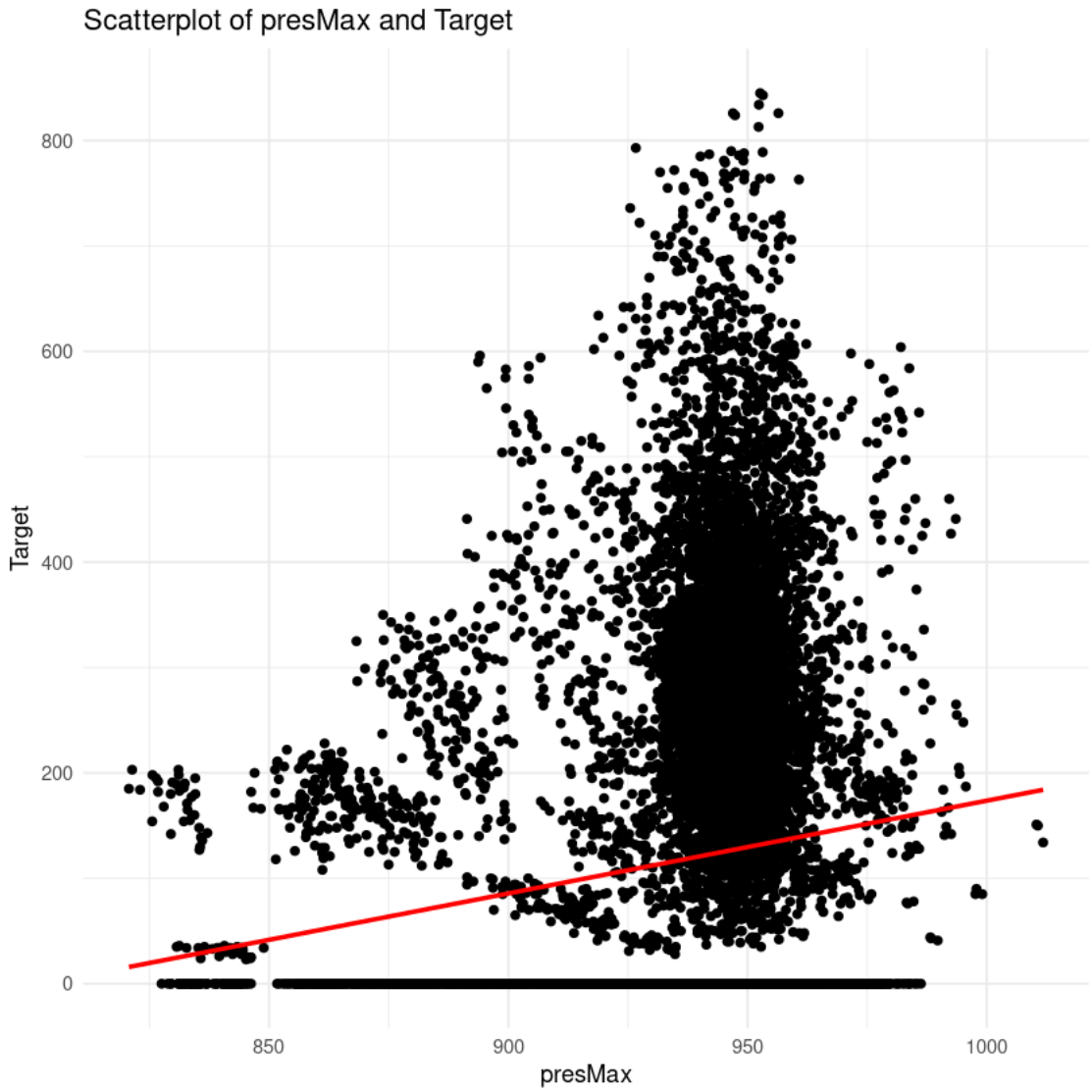

```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1150 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1150 rows containing missing values (`geom_point()`)."
```



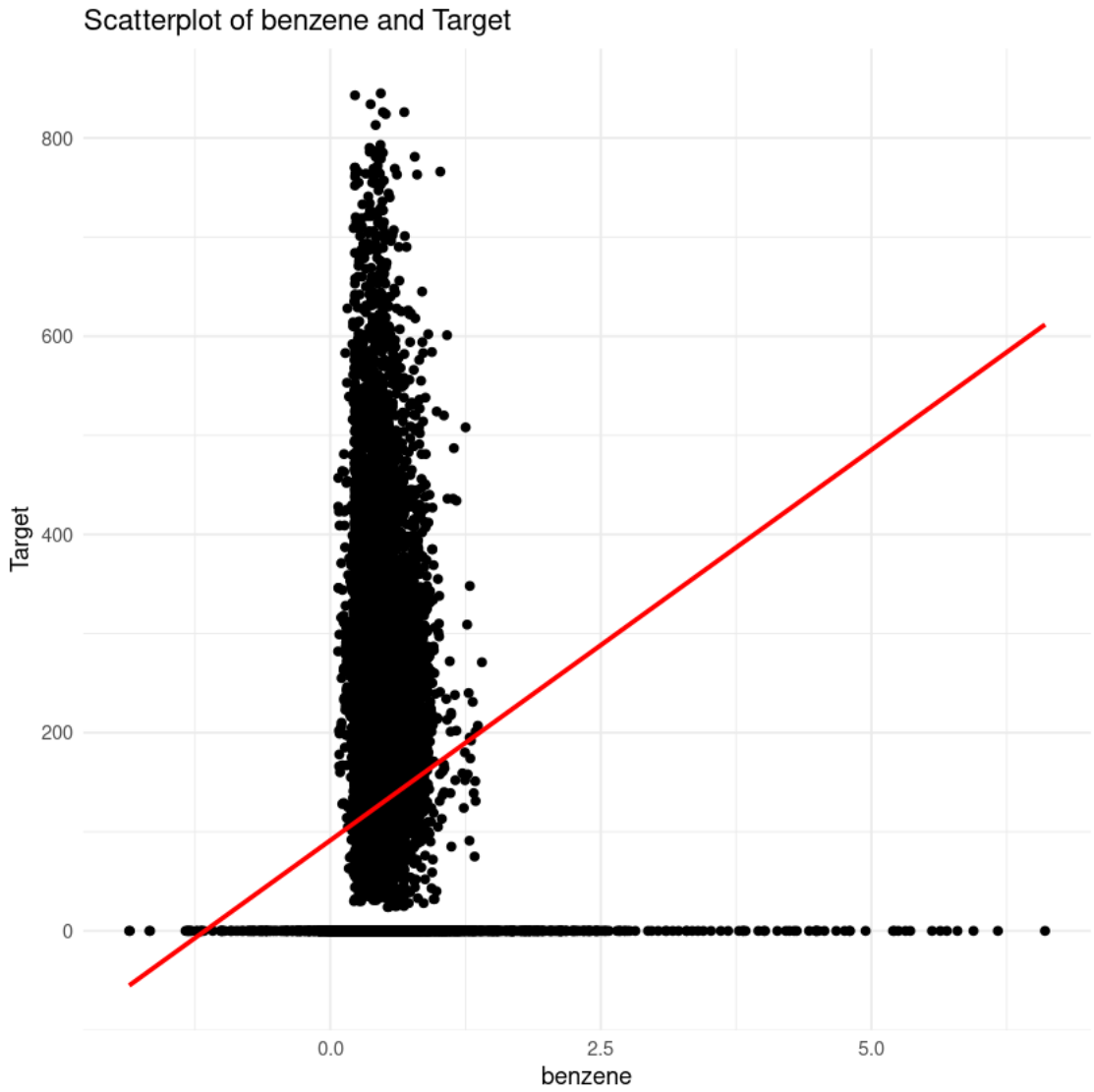

```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1150 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1150 rows containing missing values (`geom_point()`)."
```



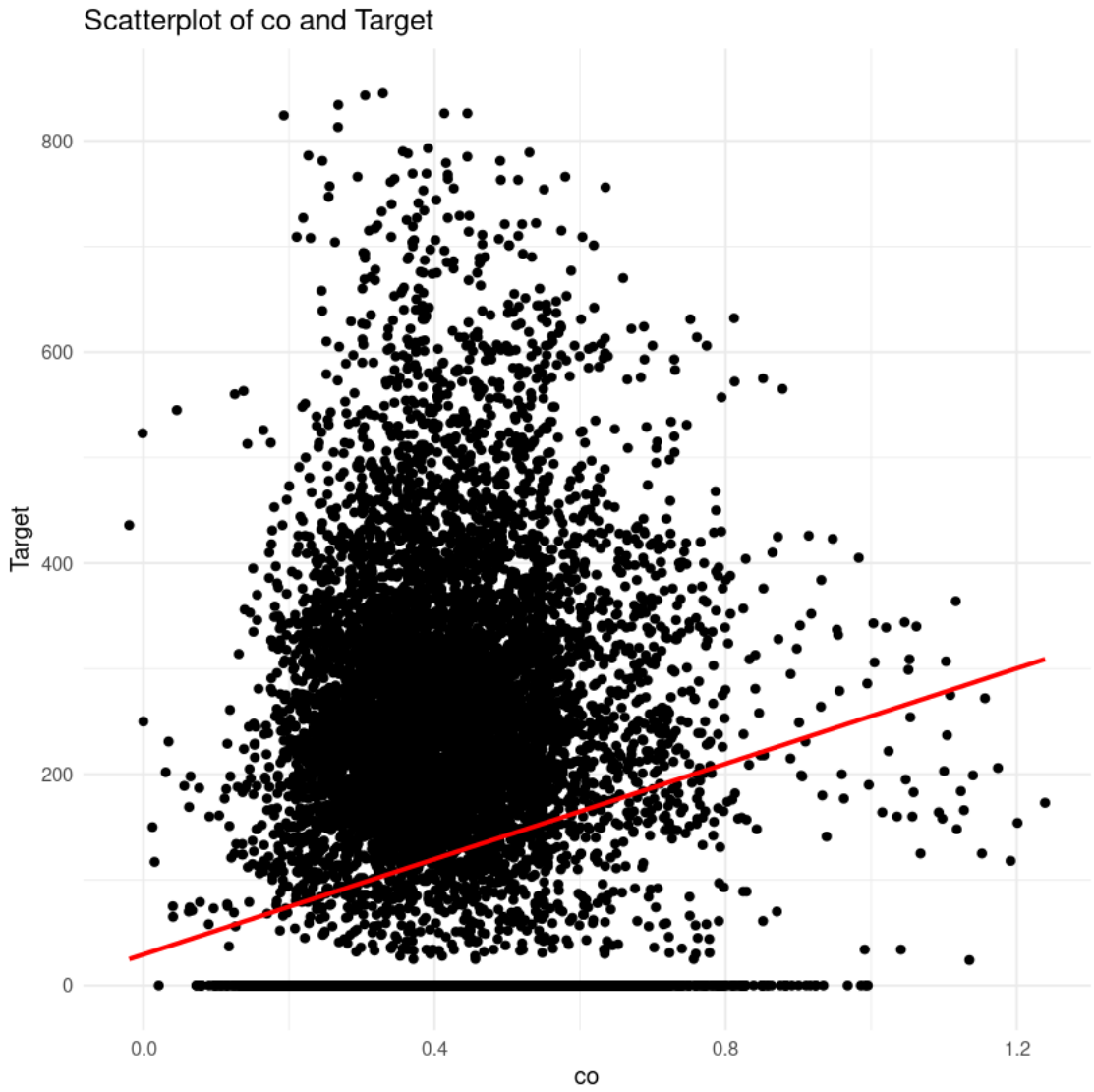

```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1432 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1432 rows containing missing values (`geom_point()`)."
```



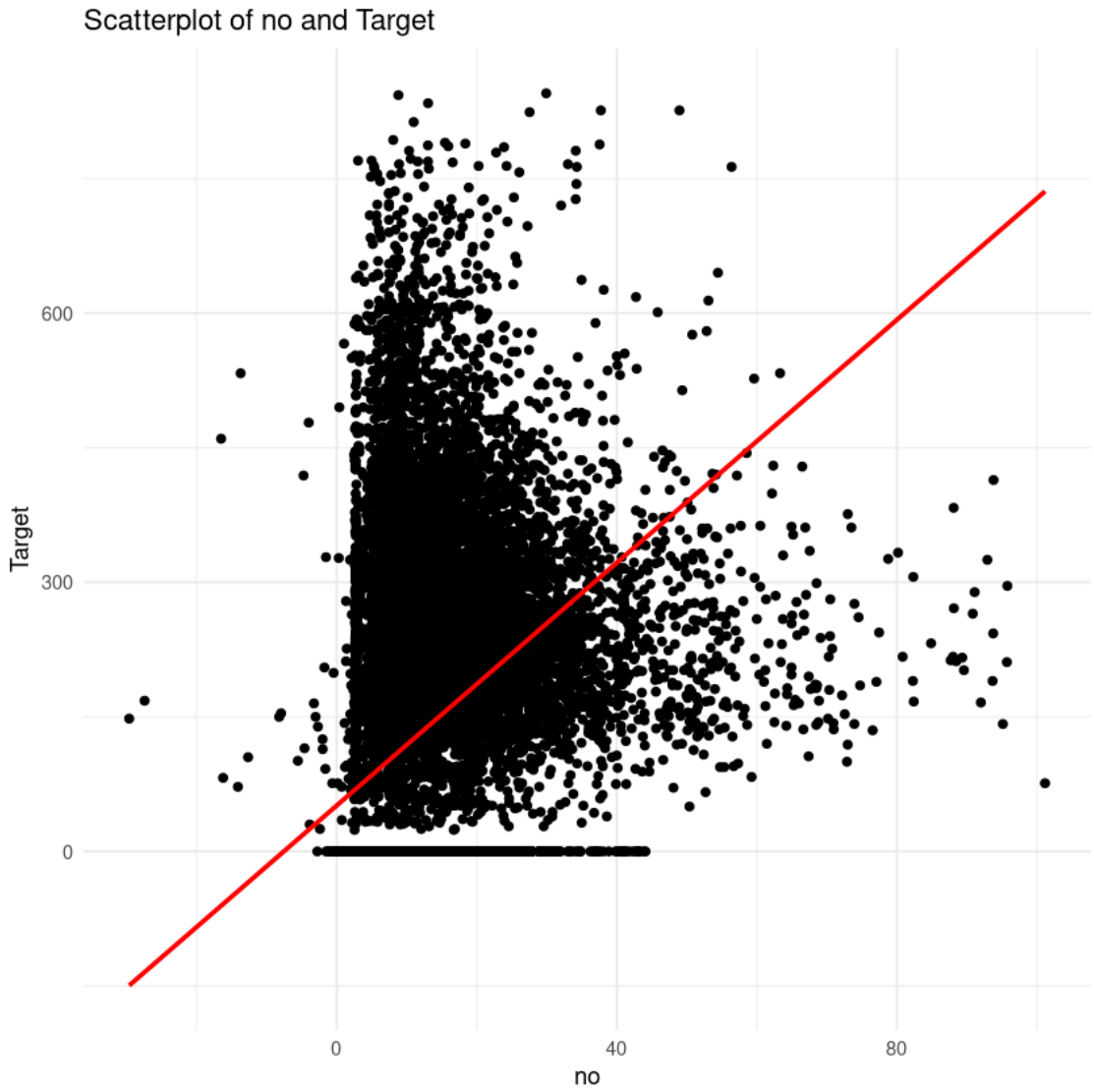

```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 2842 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 2842 rows containing missing values (`geom_point()`)."
```




```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1714 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1714 rows containing missing values (`geom_point()`)."
```




```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1996 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1996 rows containing missing values (`geom_point()`)."
```




```
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Warning message:
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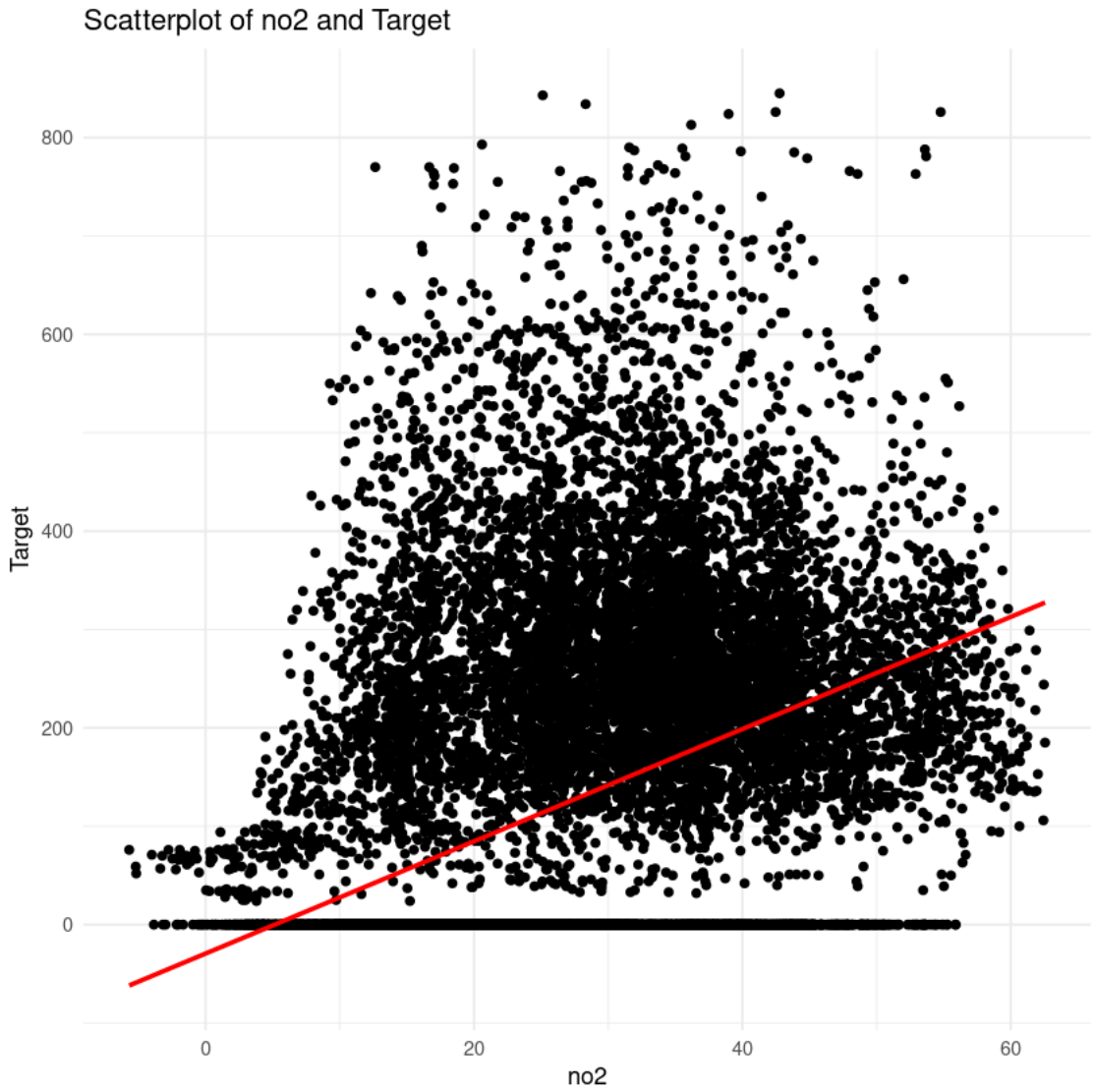
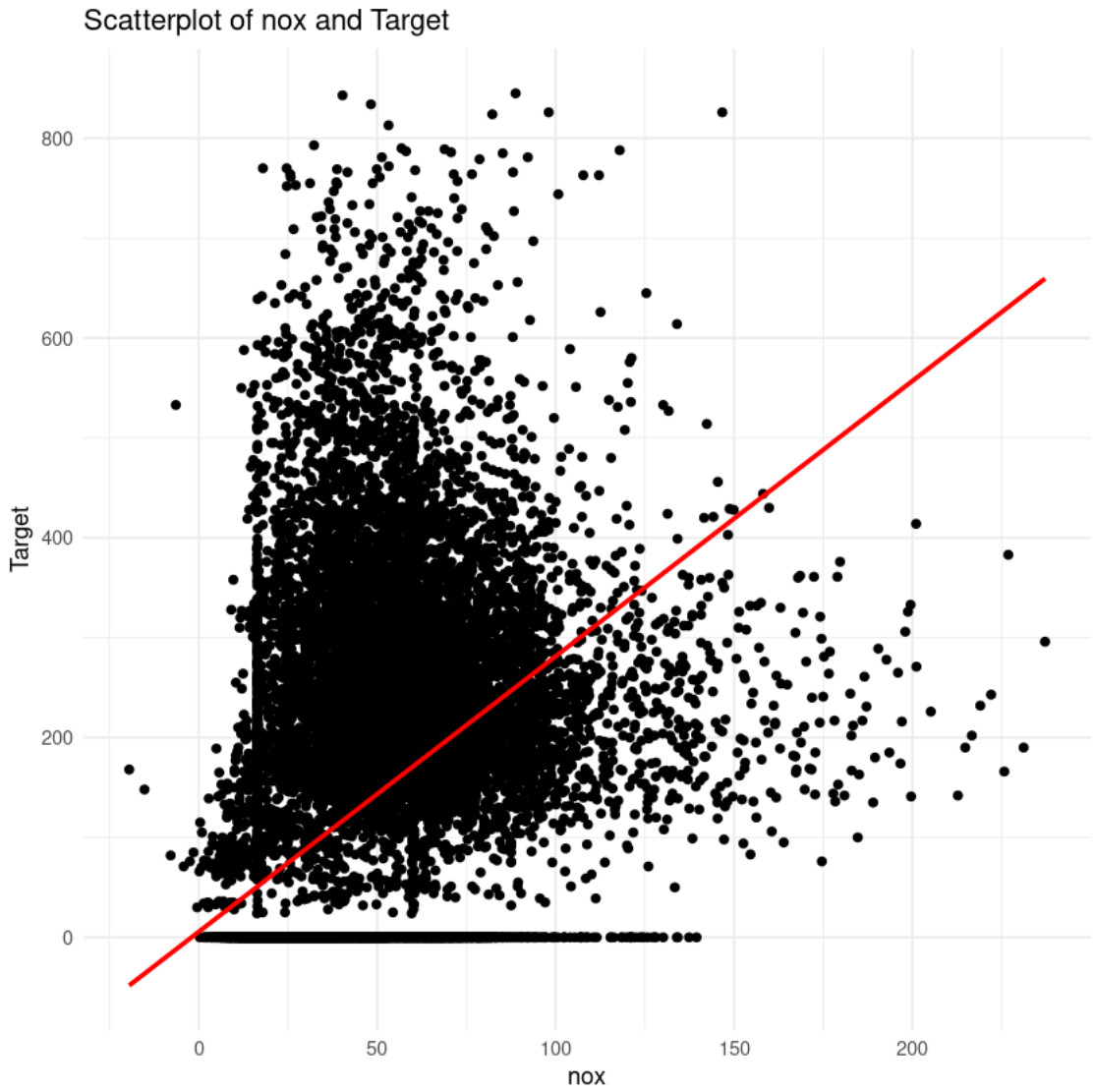



```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 1714 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 1714 rows containing missing values (`geom_point()`)."
```

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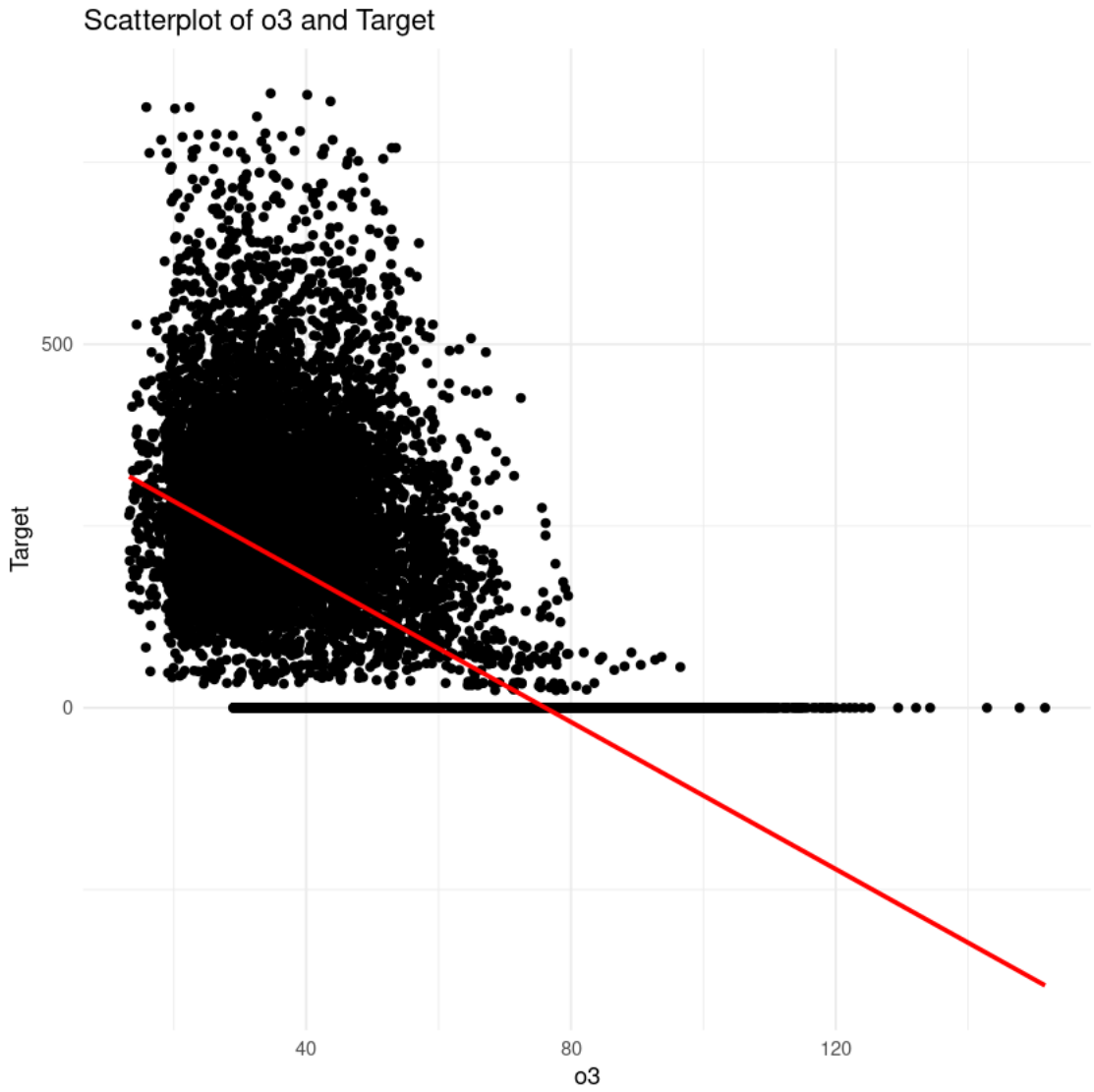


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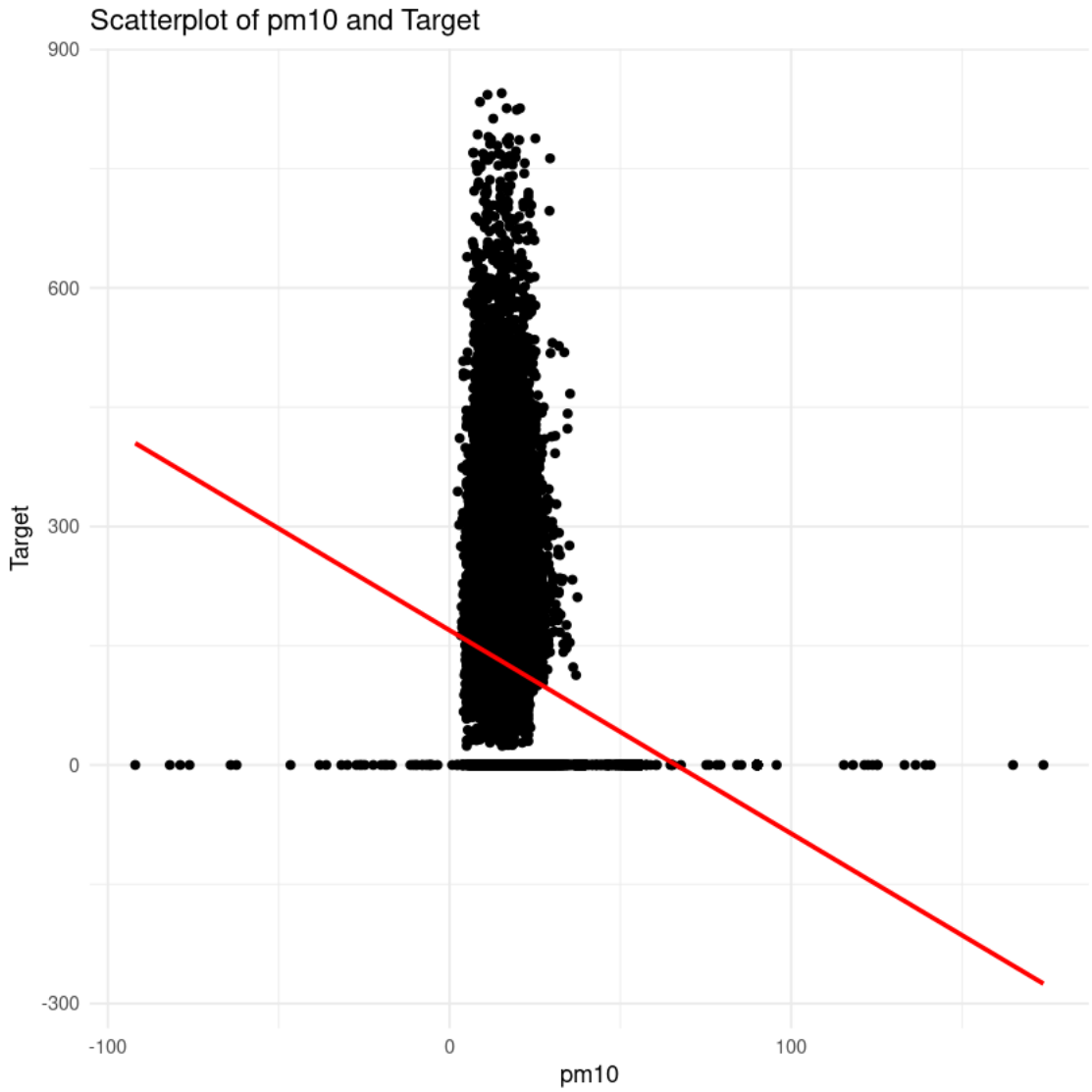


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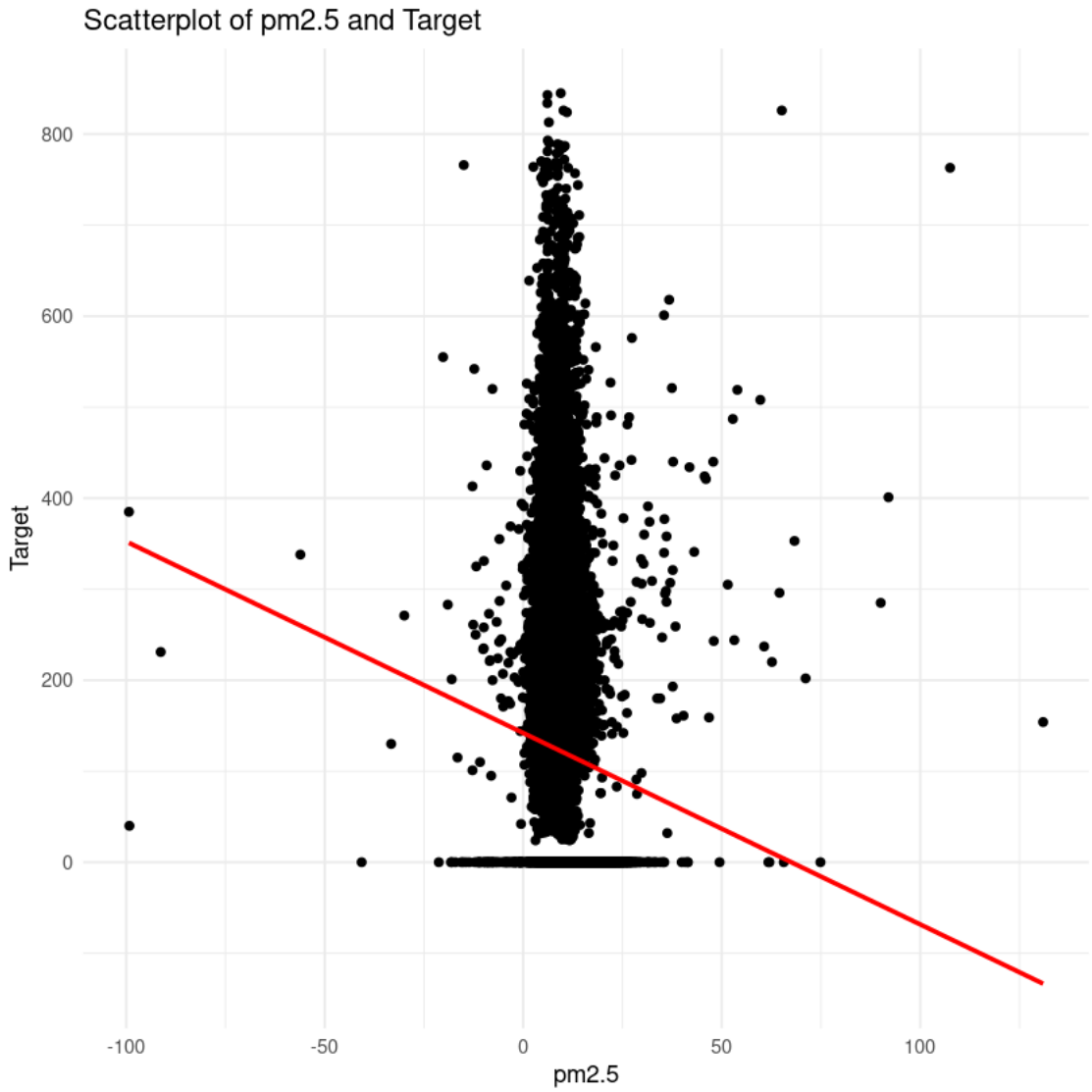
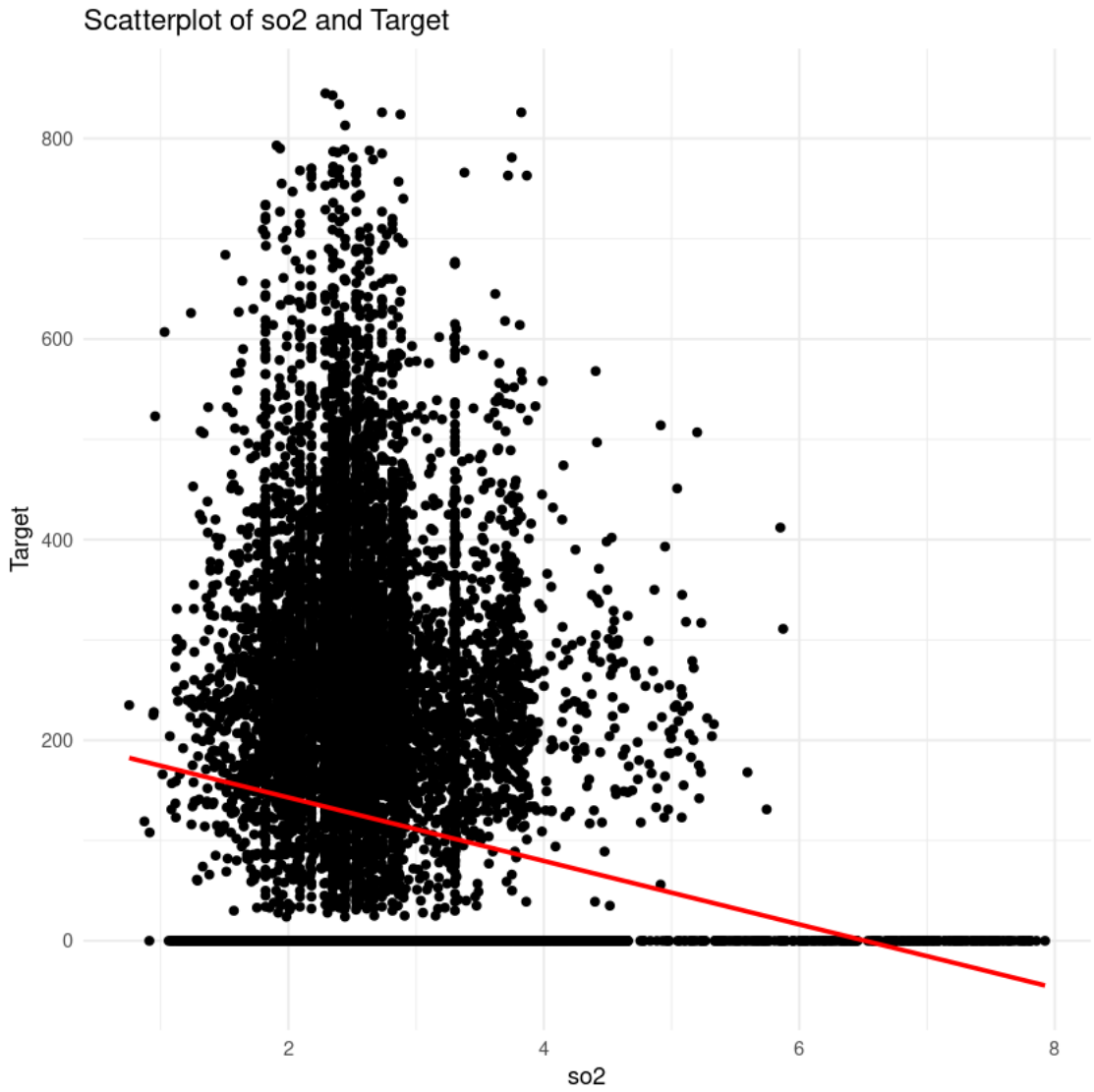



```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 9328 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 9328 rows containing missing values (`geom_point()`)."
```




```
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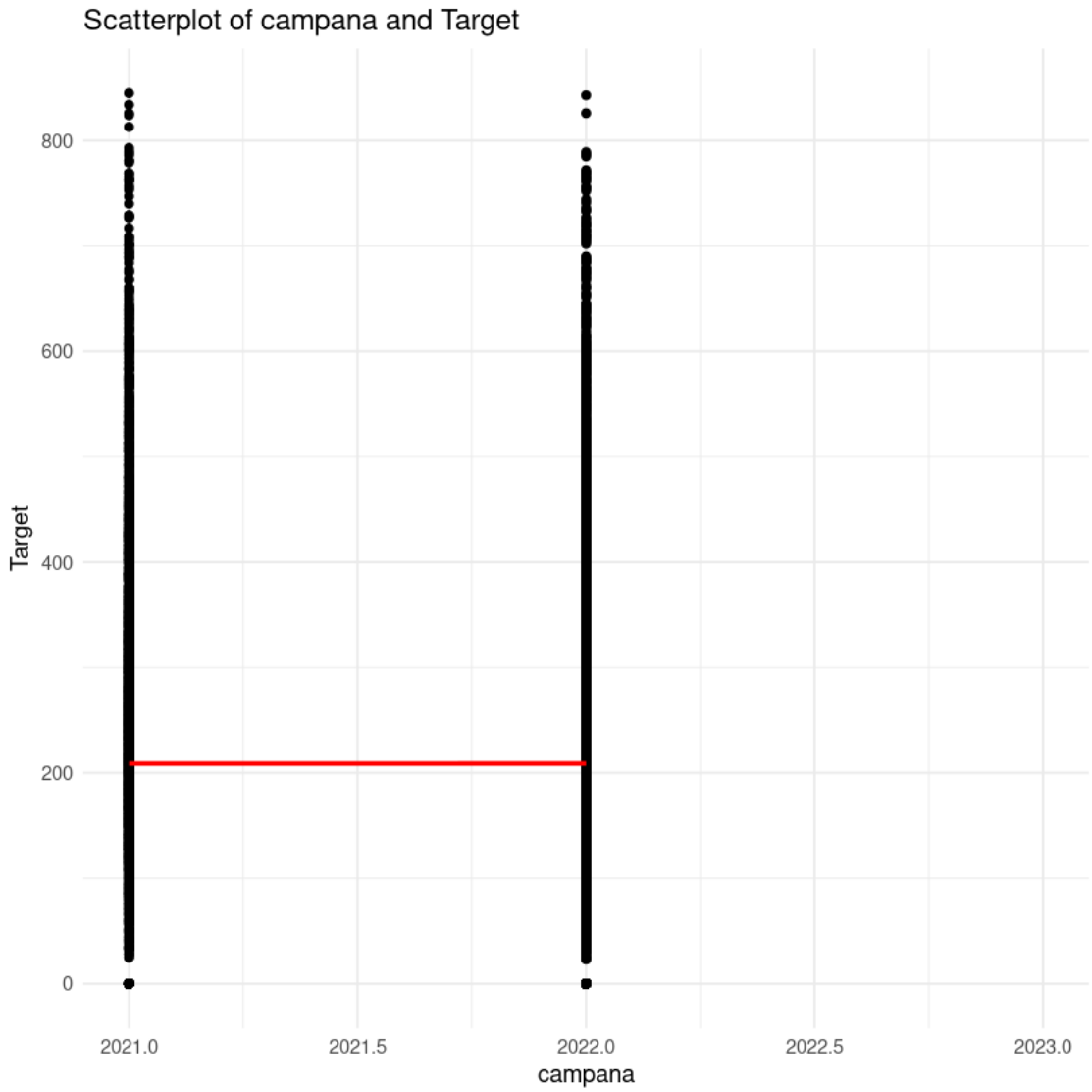
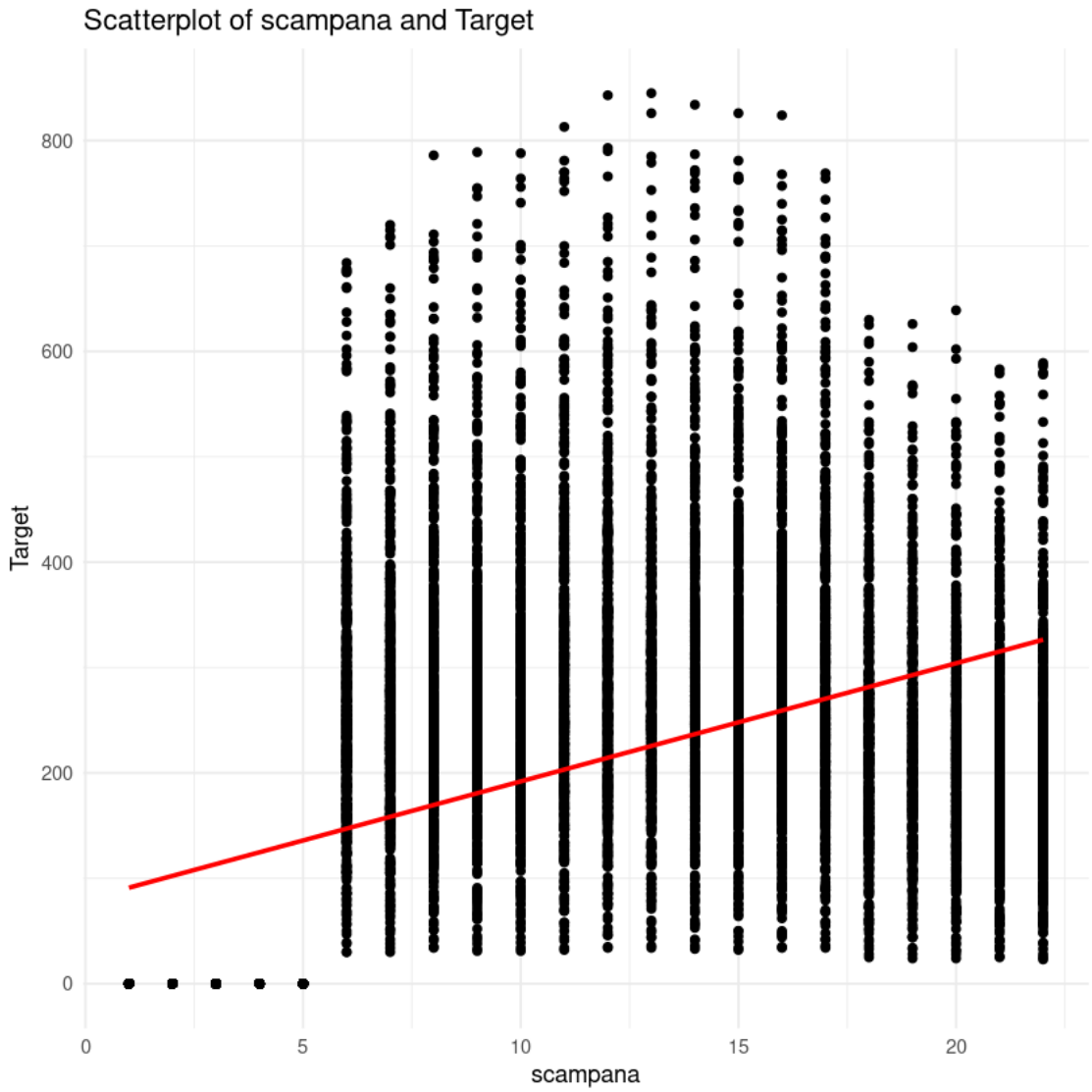
Warning message:
"Removed 9328 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 9328 rows containing missing values (`geom_point()`)."
```




```
`geom_smooth()` using formula = 'y ~ x'
Warning message:
"Removed 868 rows containing non-finite values (`stat_smooth()`)."
Warning message:
"Removed 868 rows containing missing values (`geom_point()`)."
```




```
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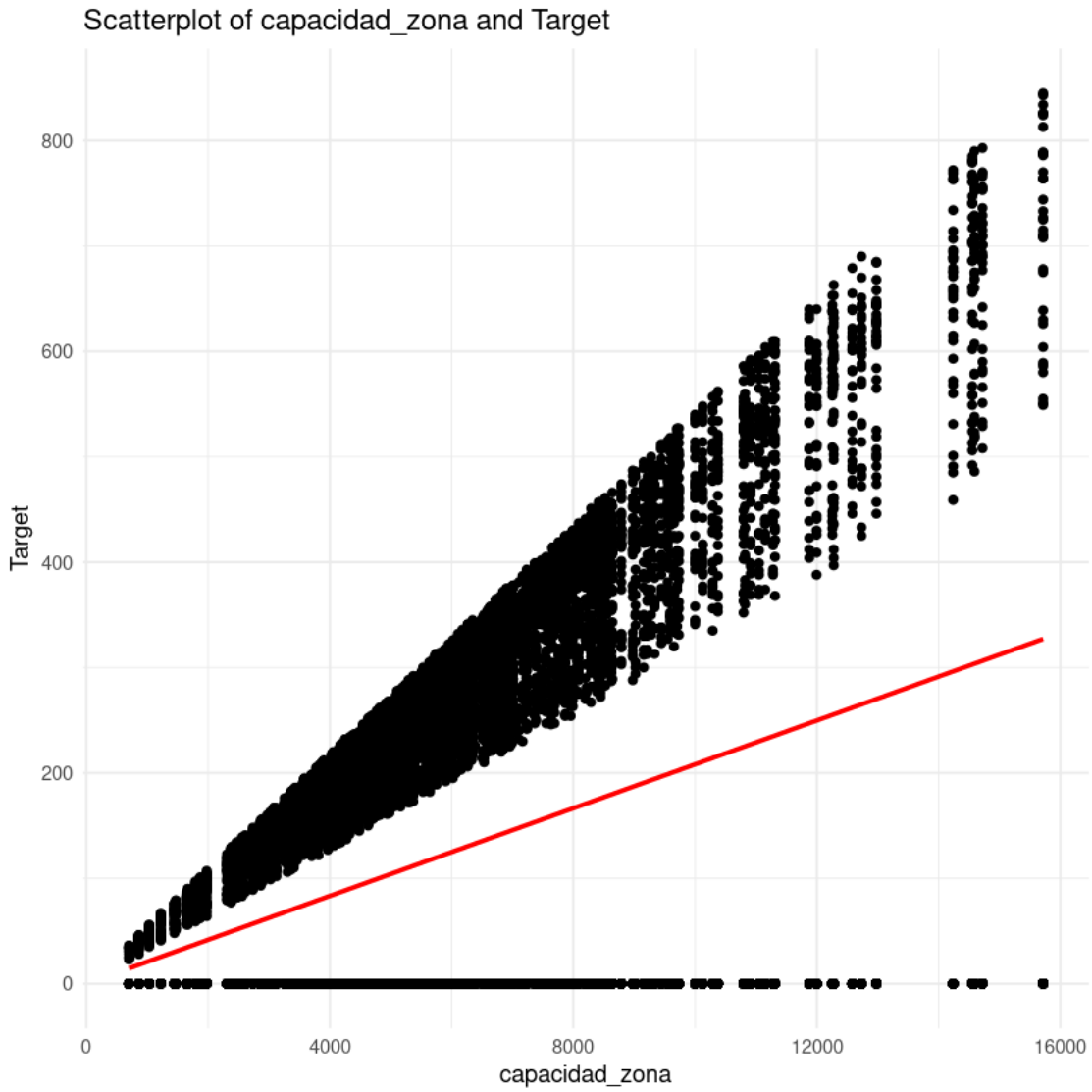
"Removed 868 rows containing missing values (`geom_point()`)."
```




```
`geom_smooth()` using formula = 'y ~ x'
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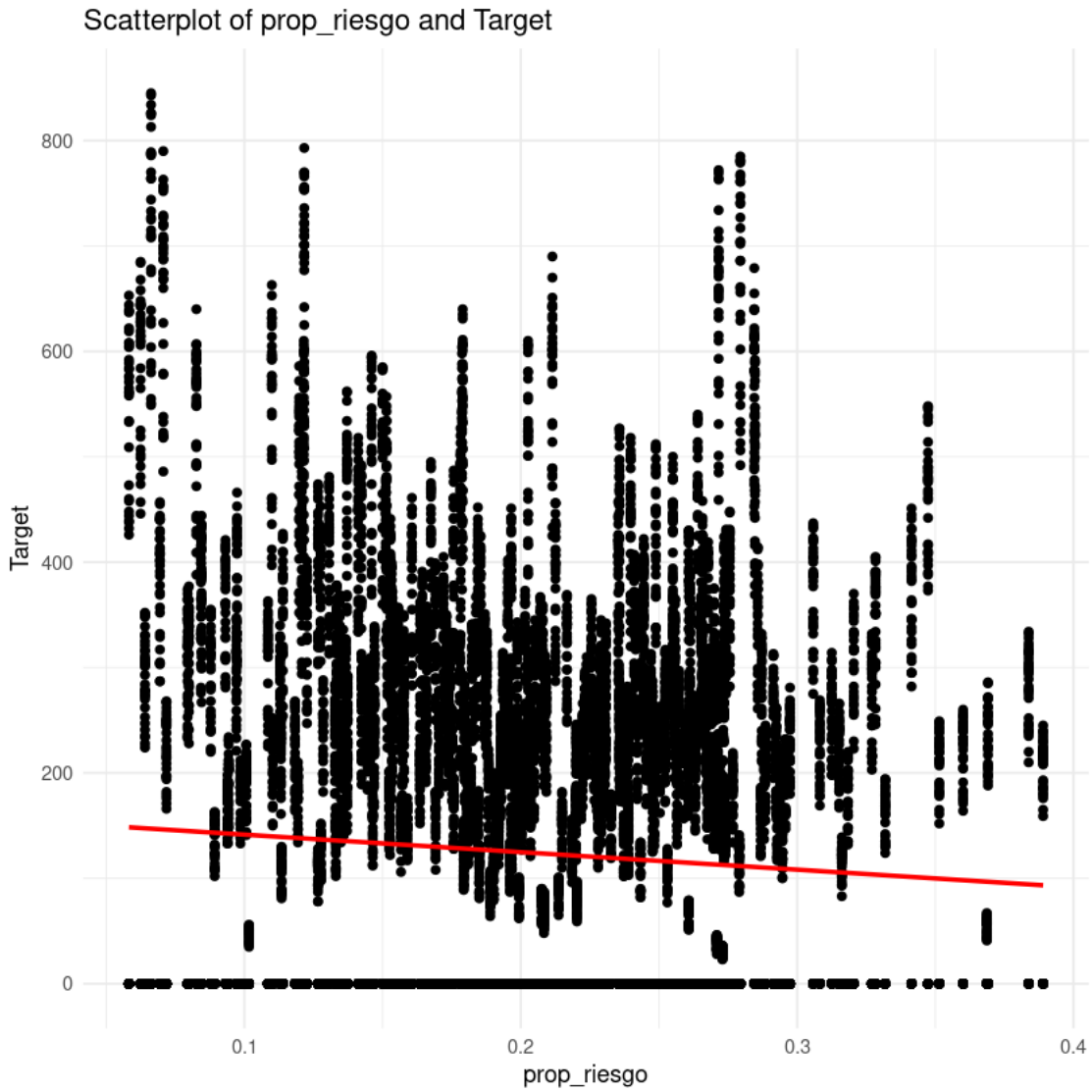


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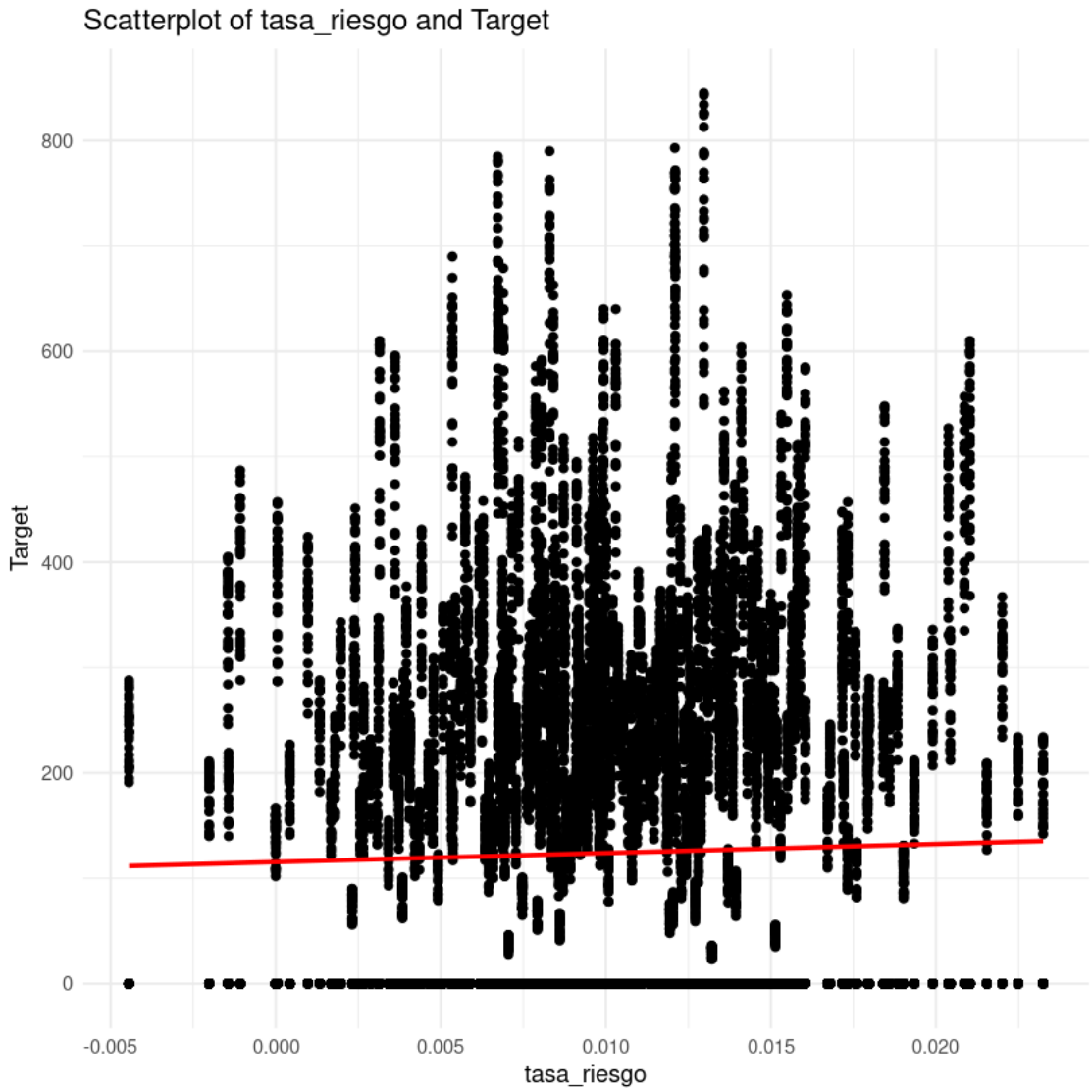


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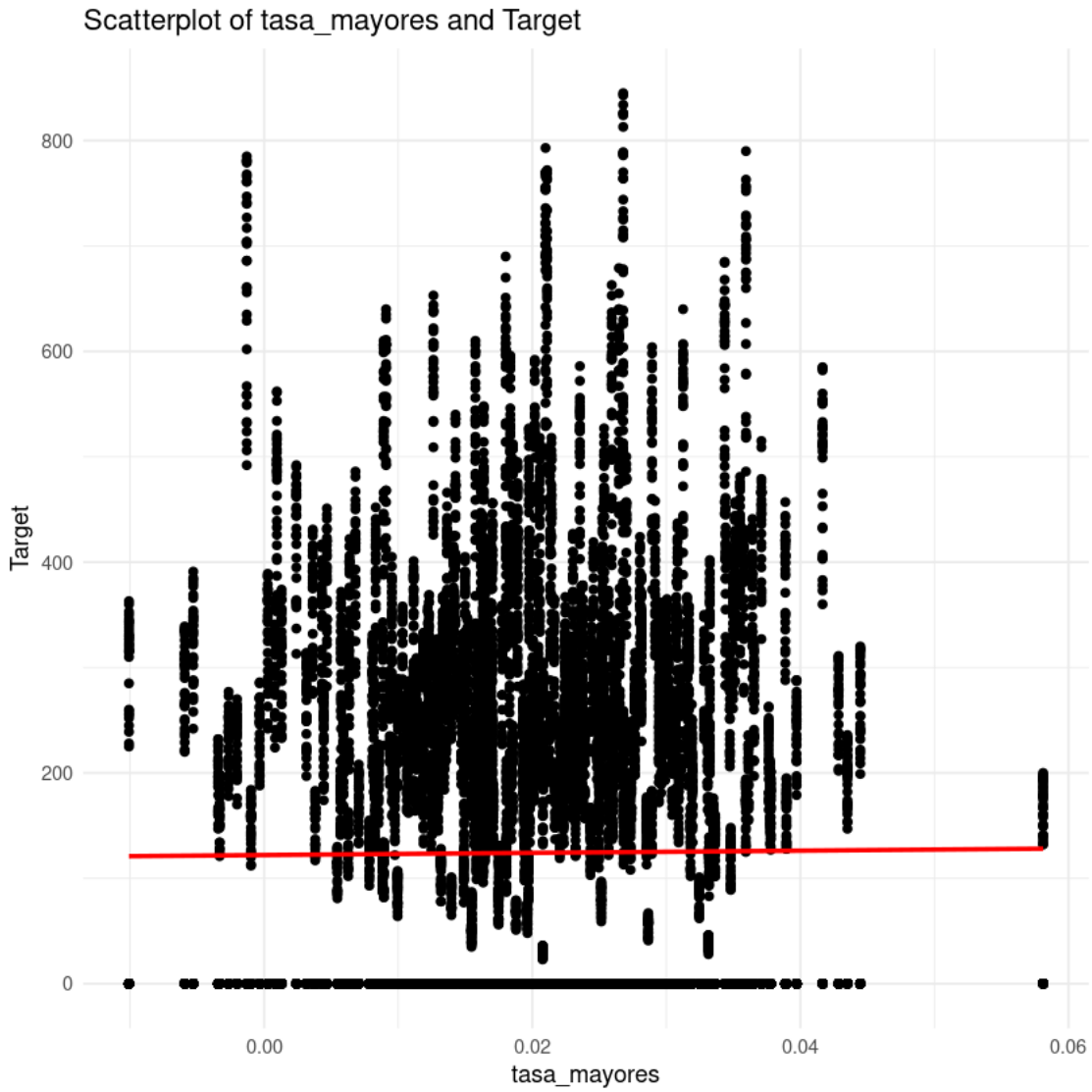


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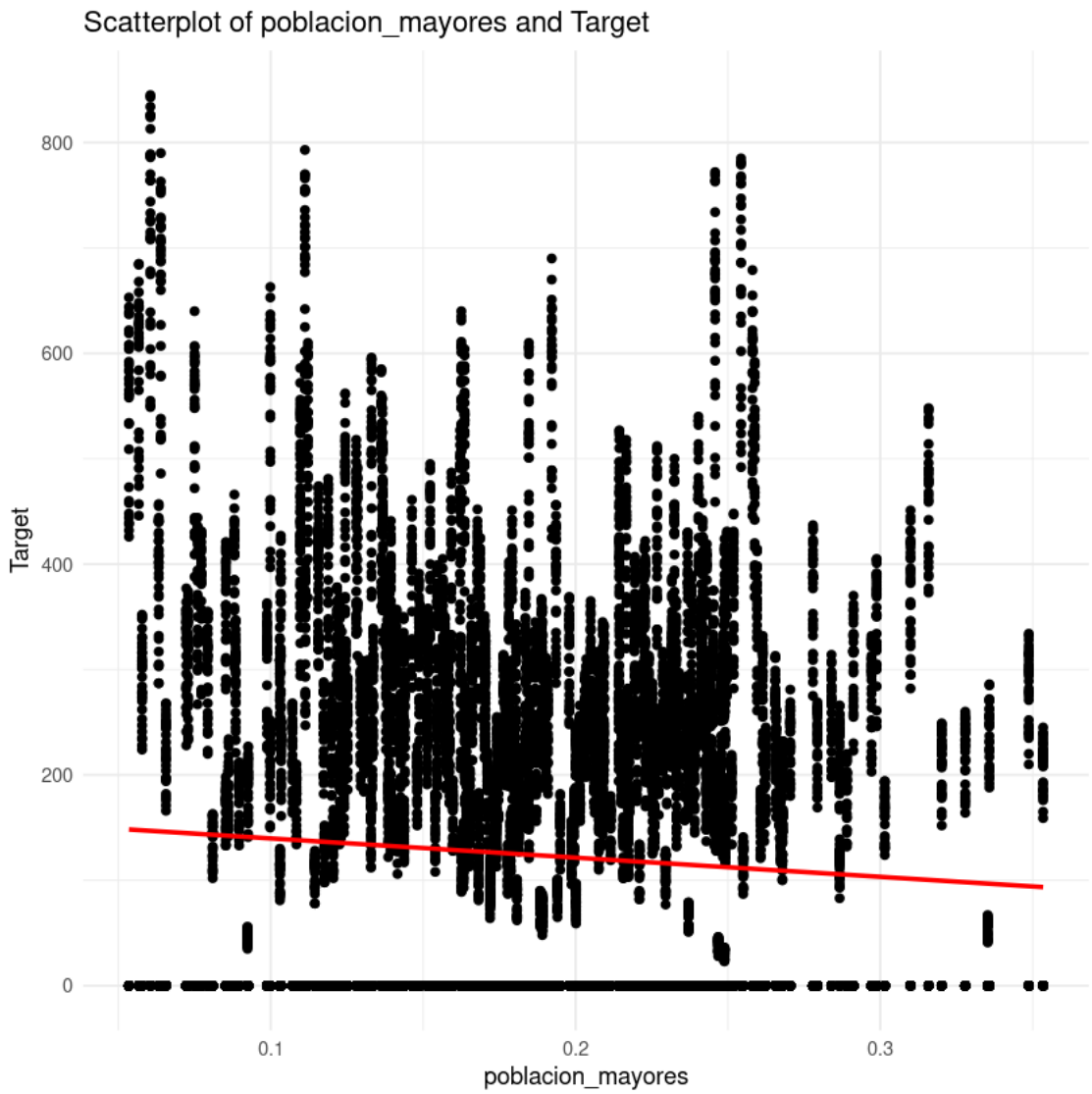


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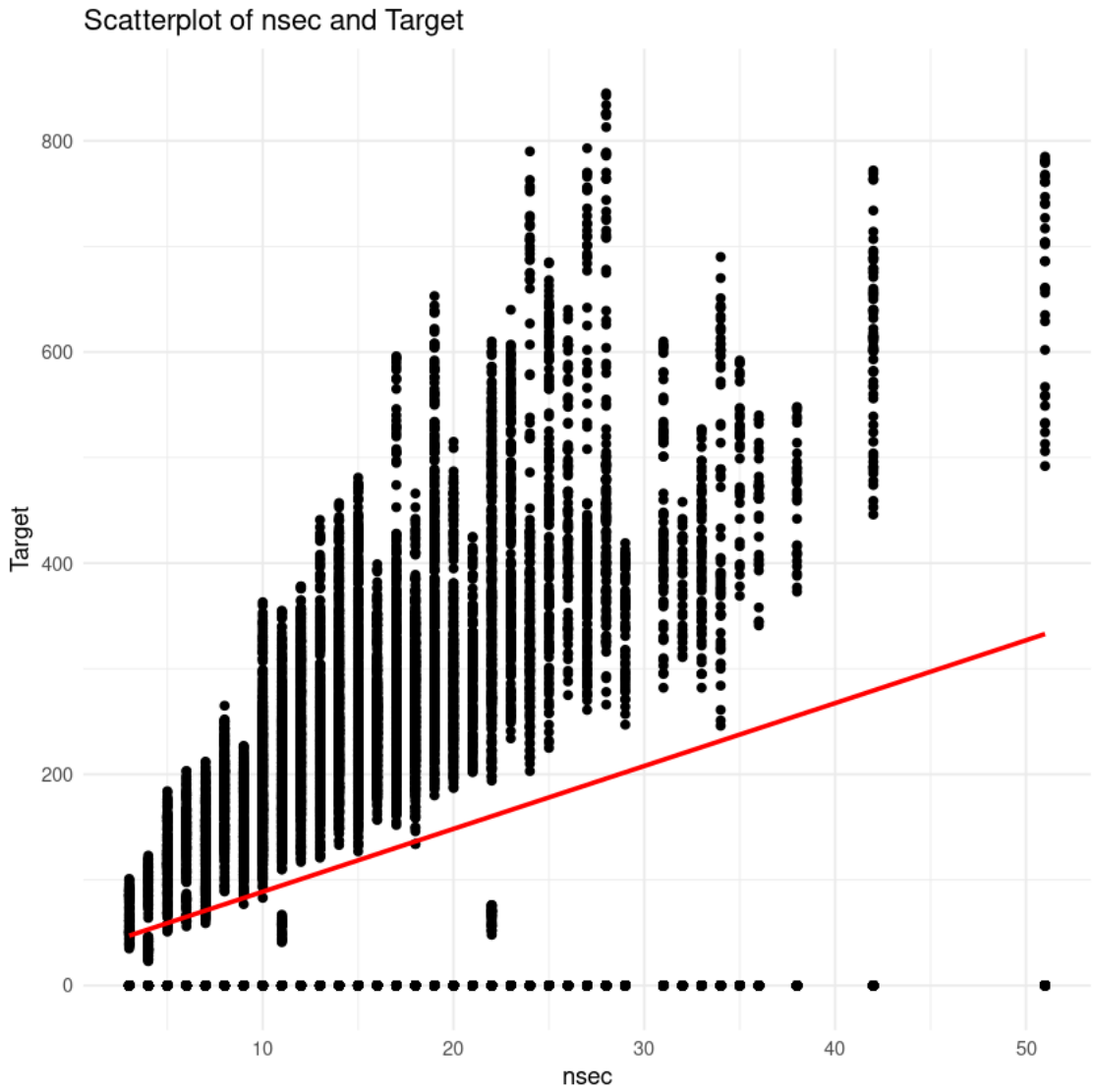


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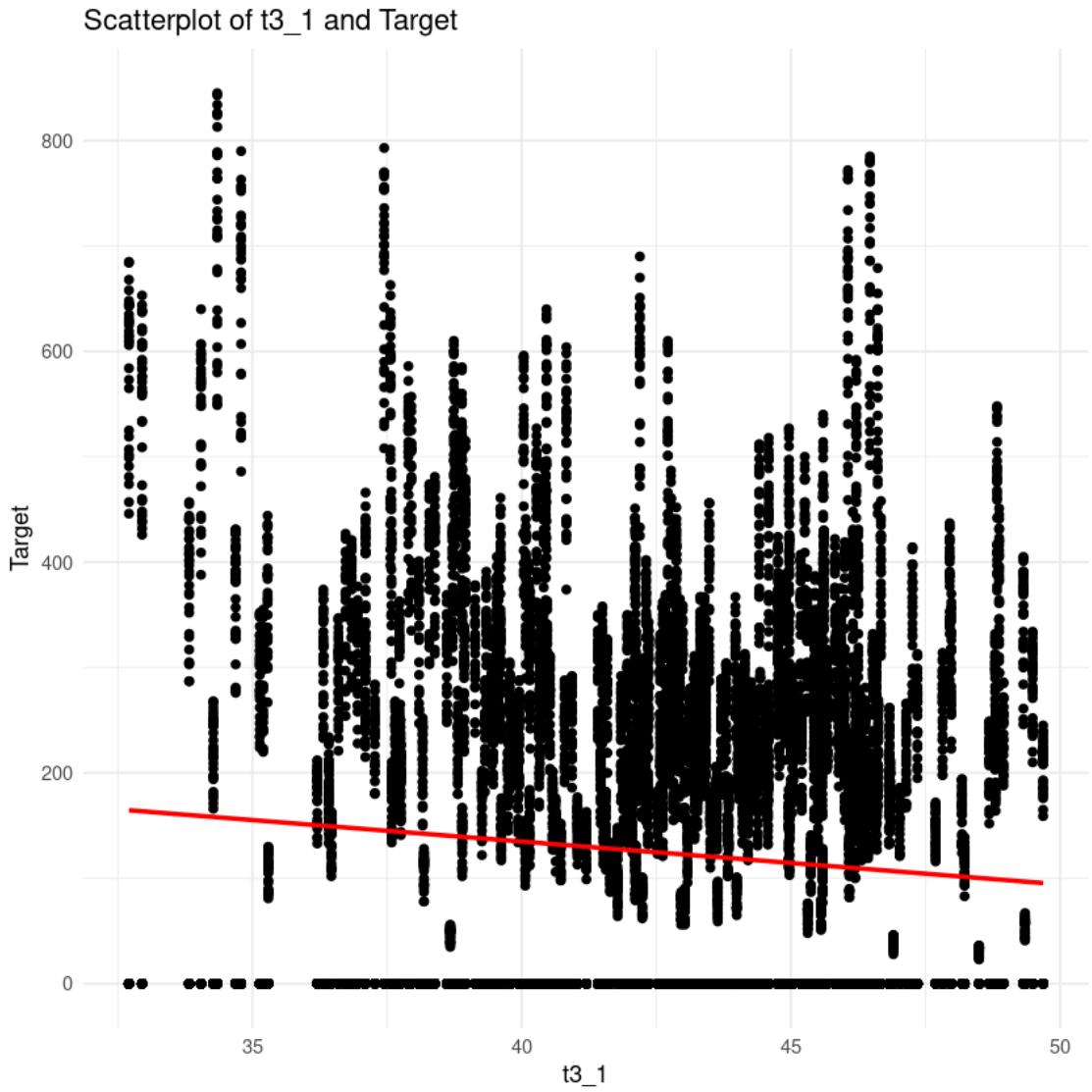


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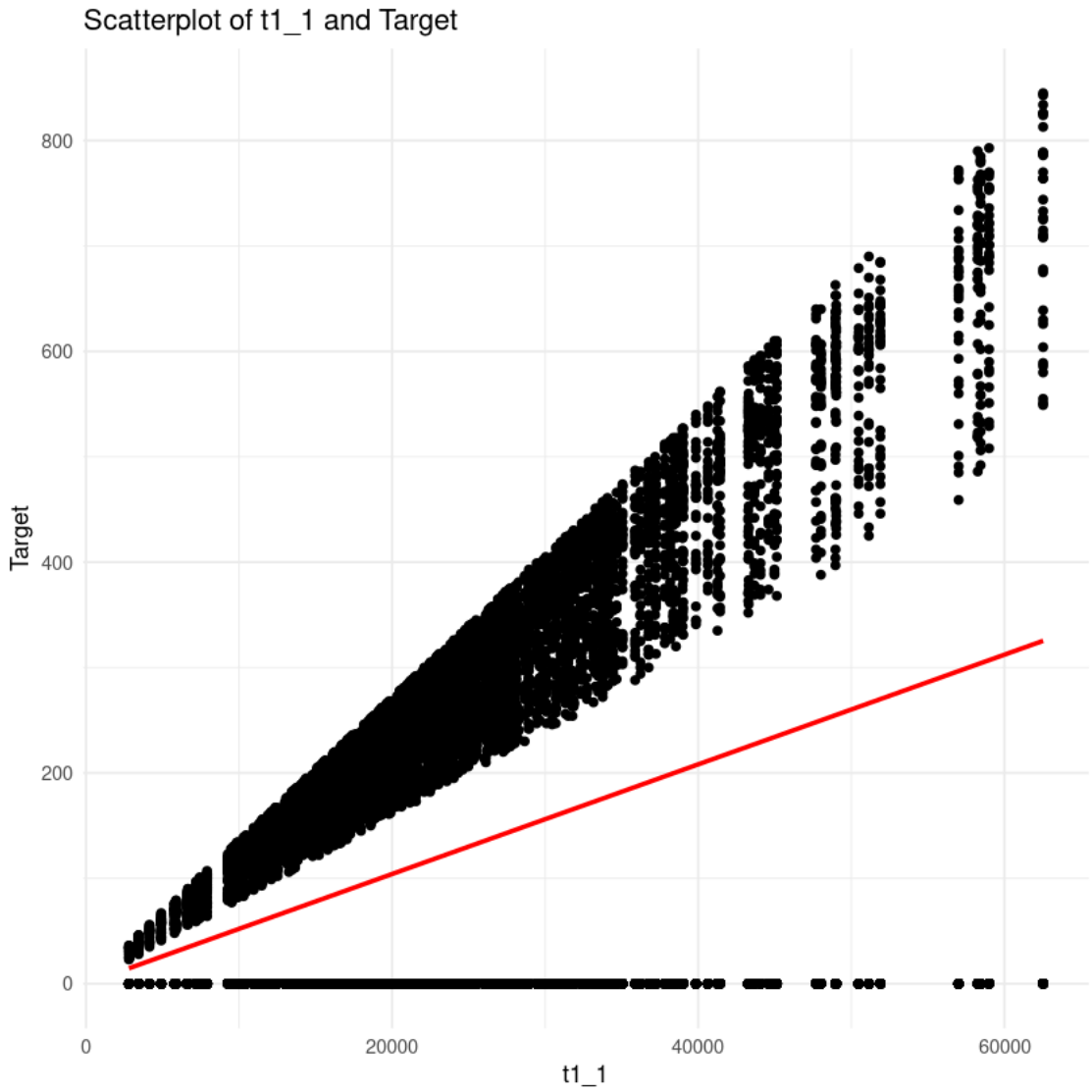


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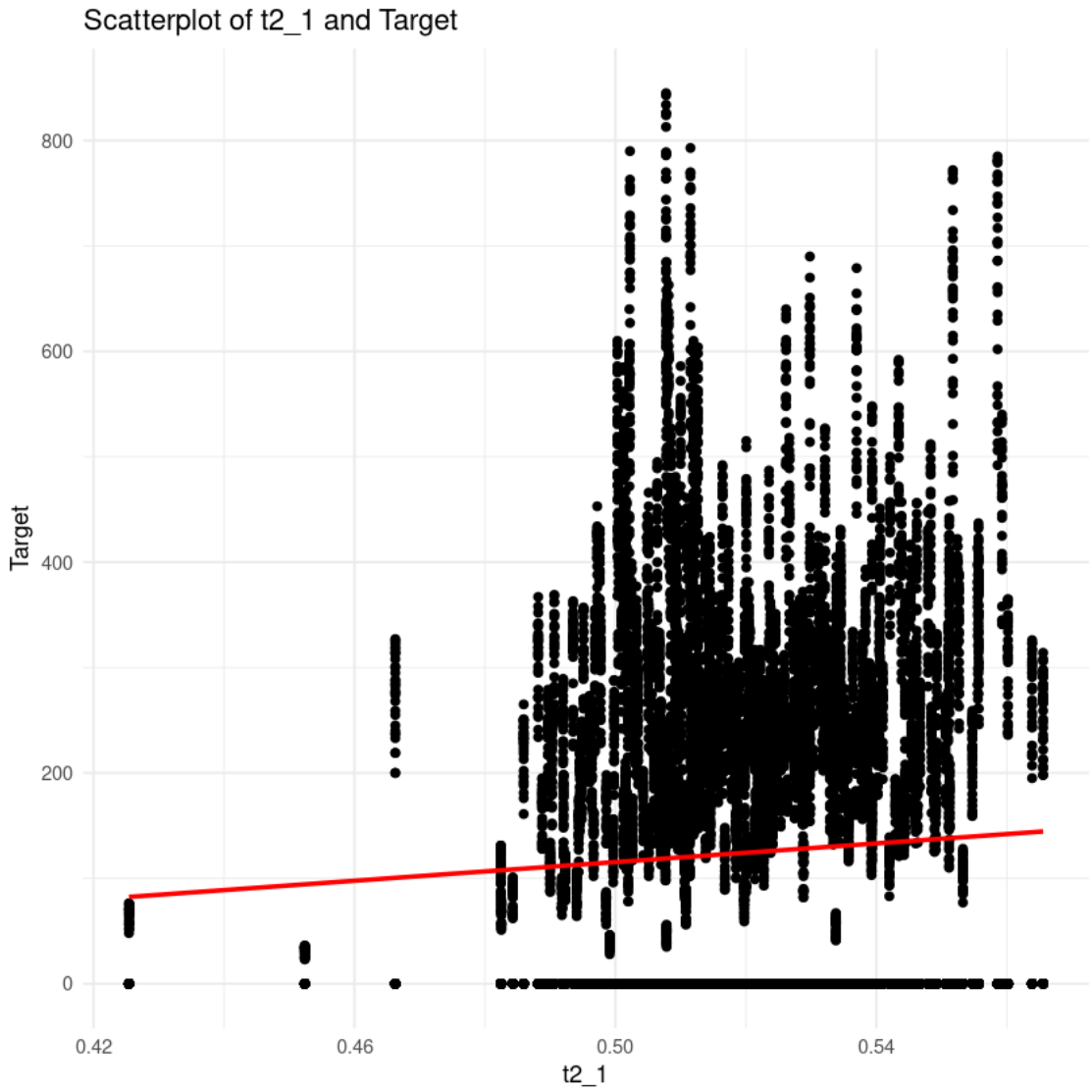


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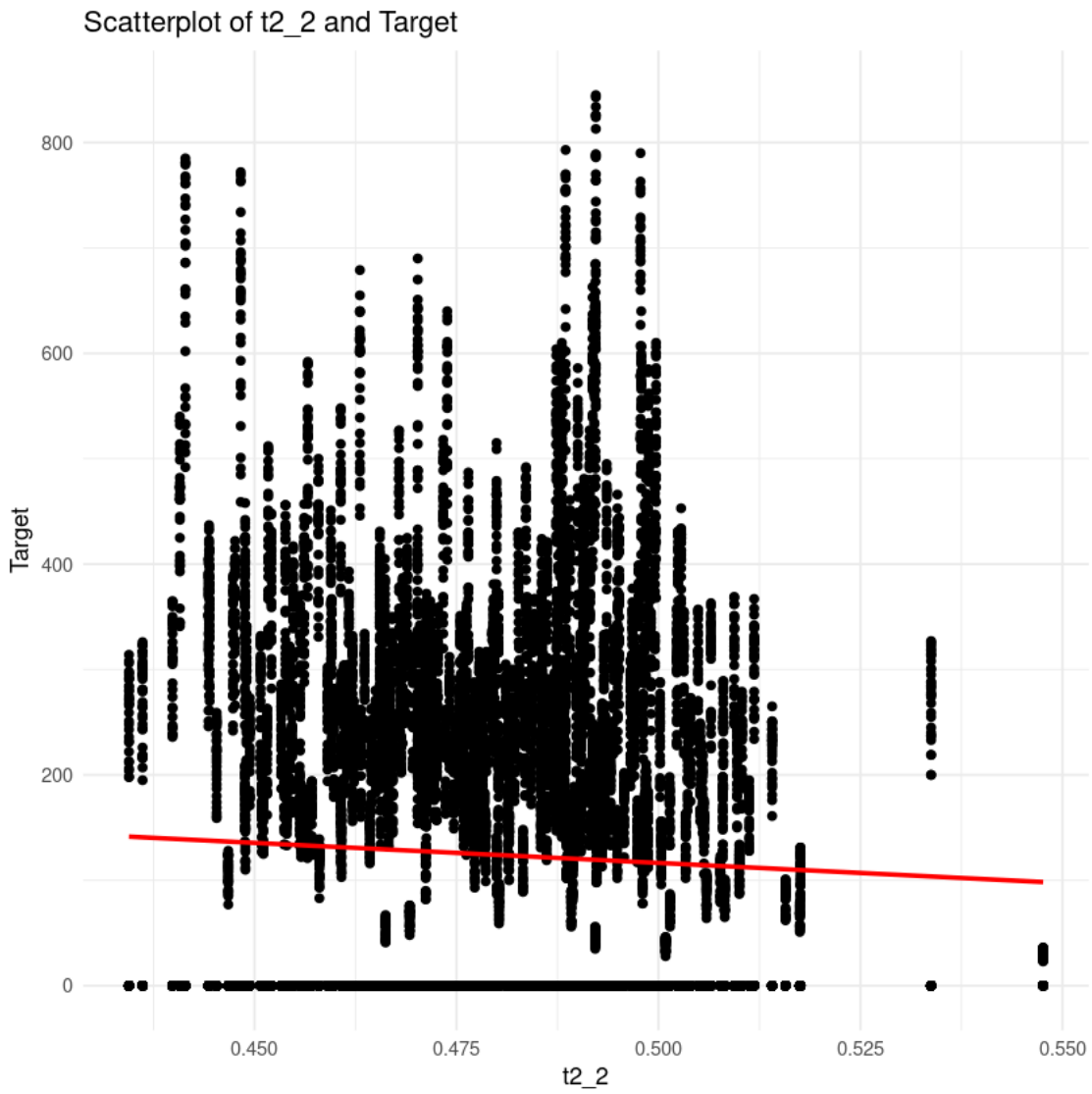


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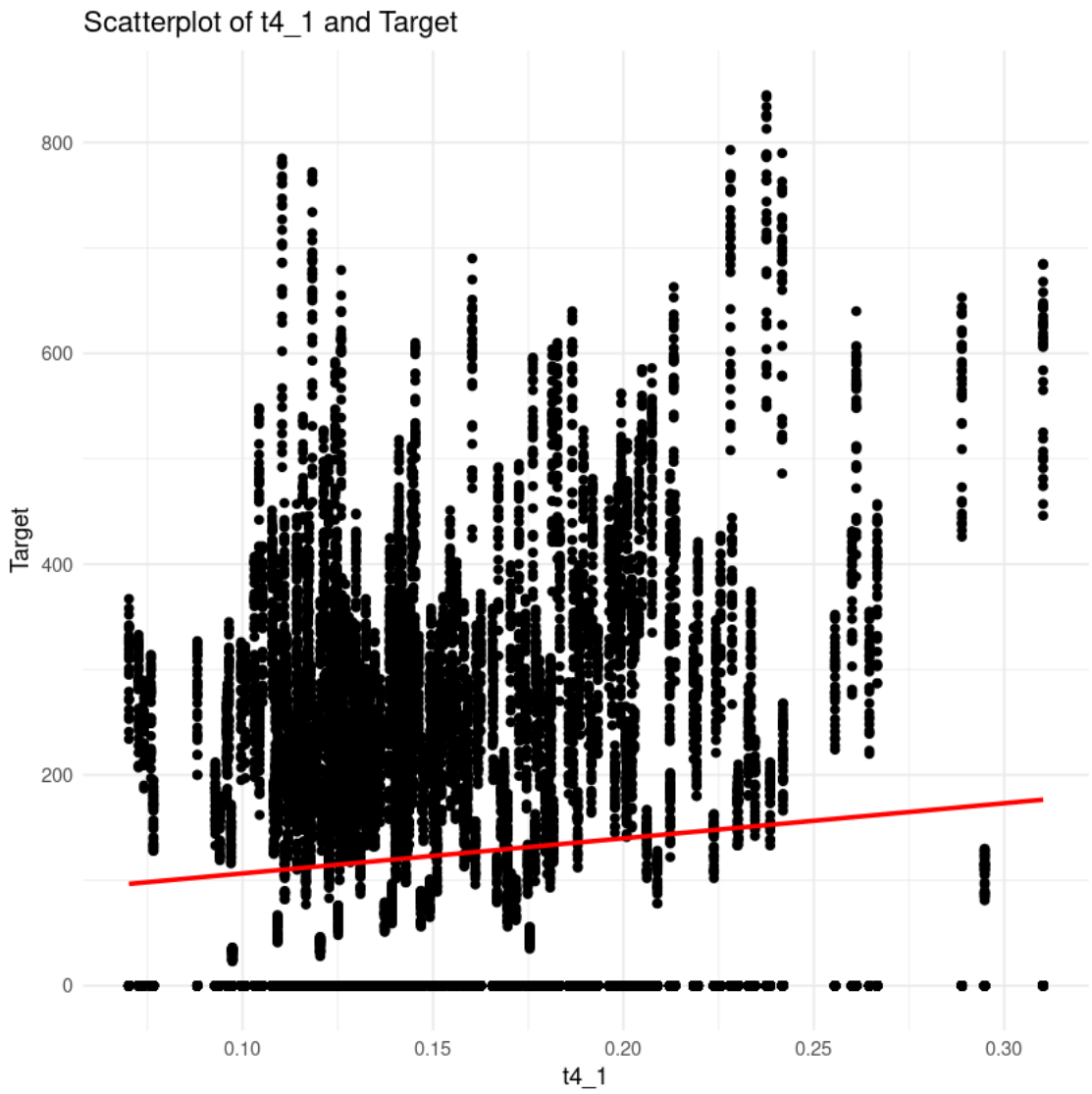


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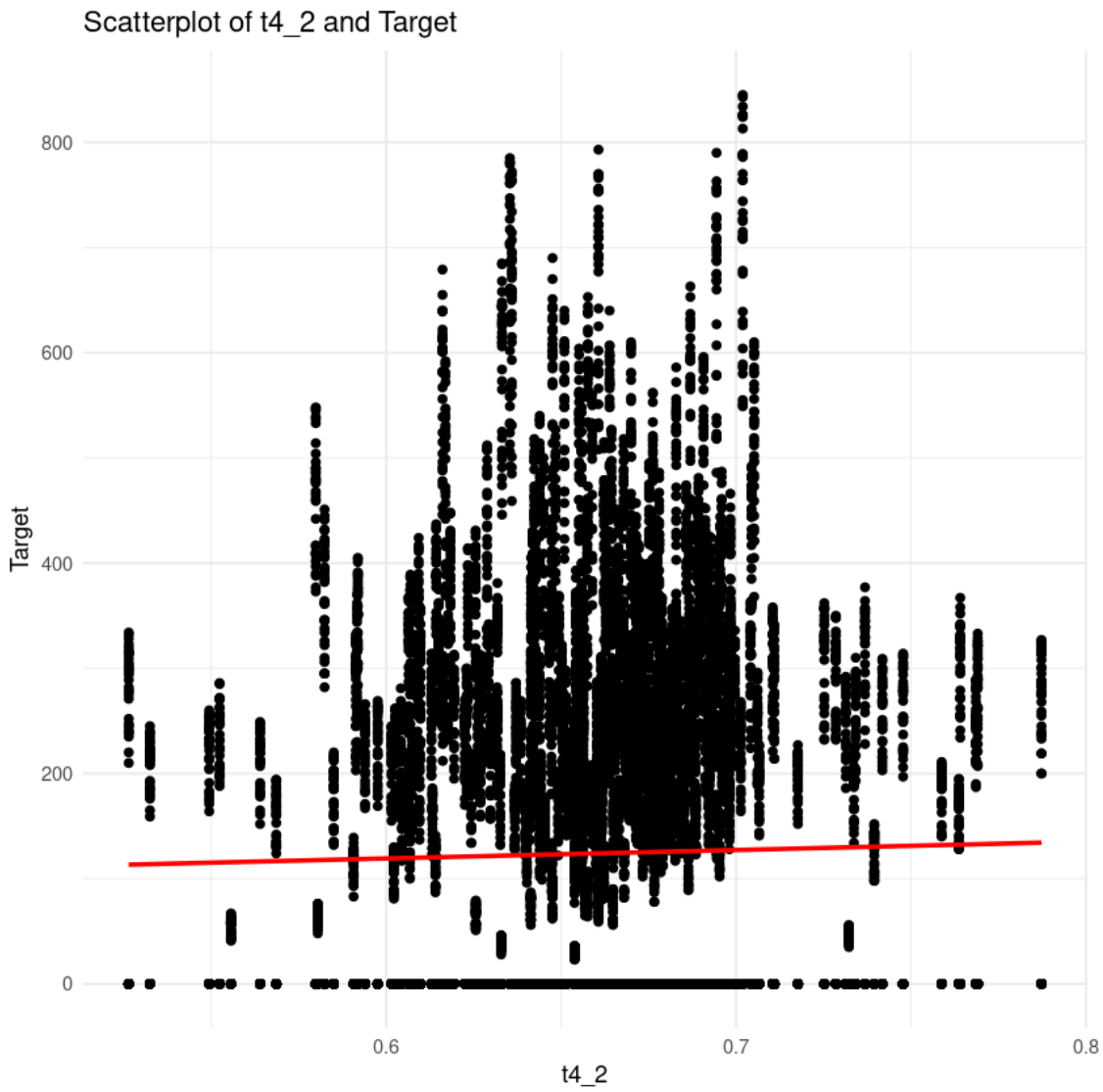


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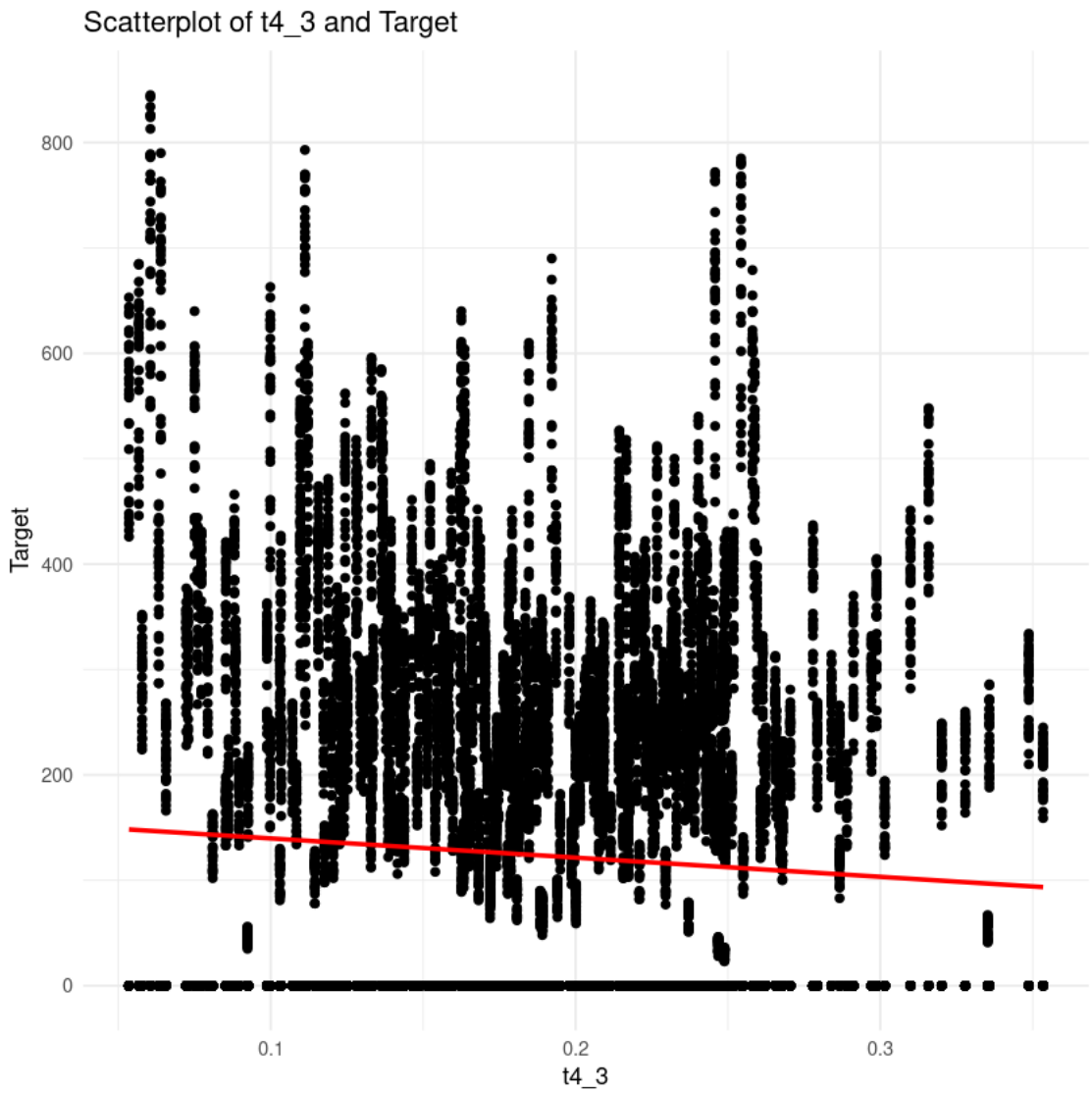


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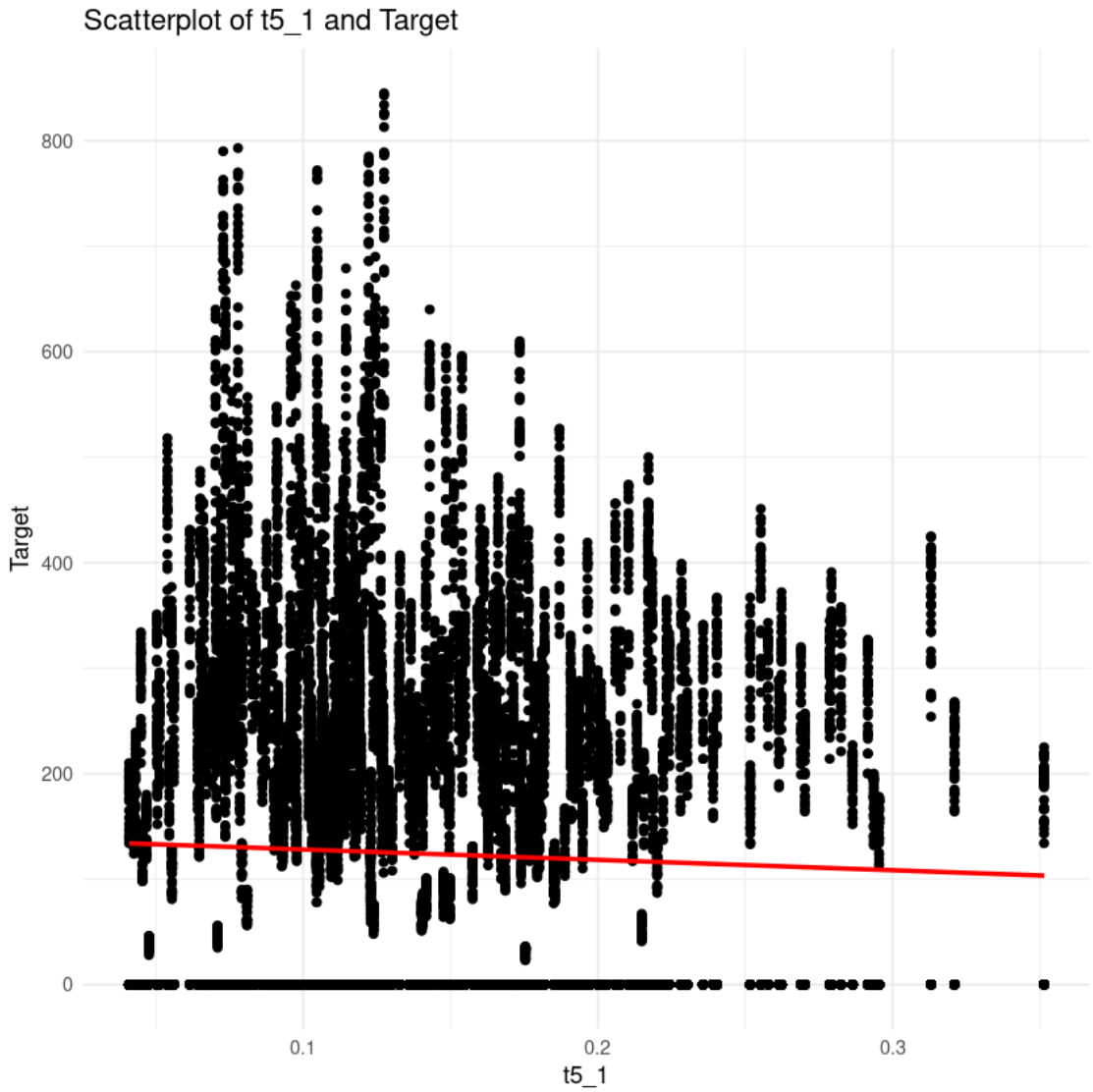


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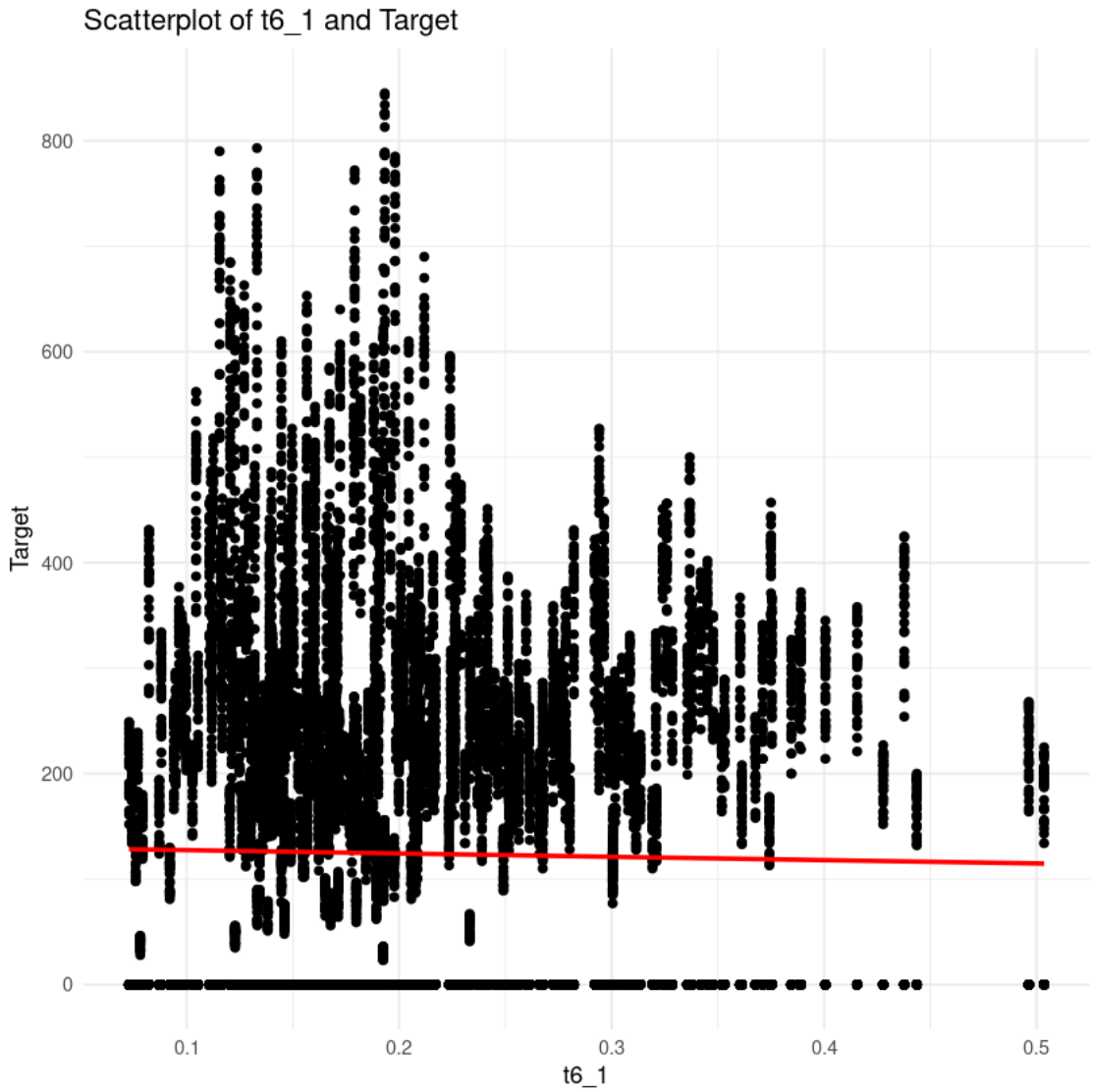


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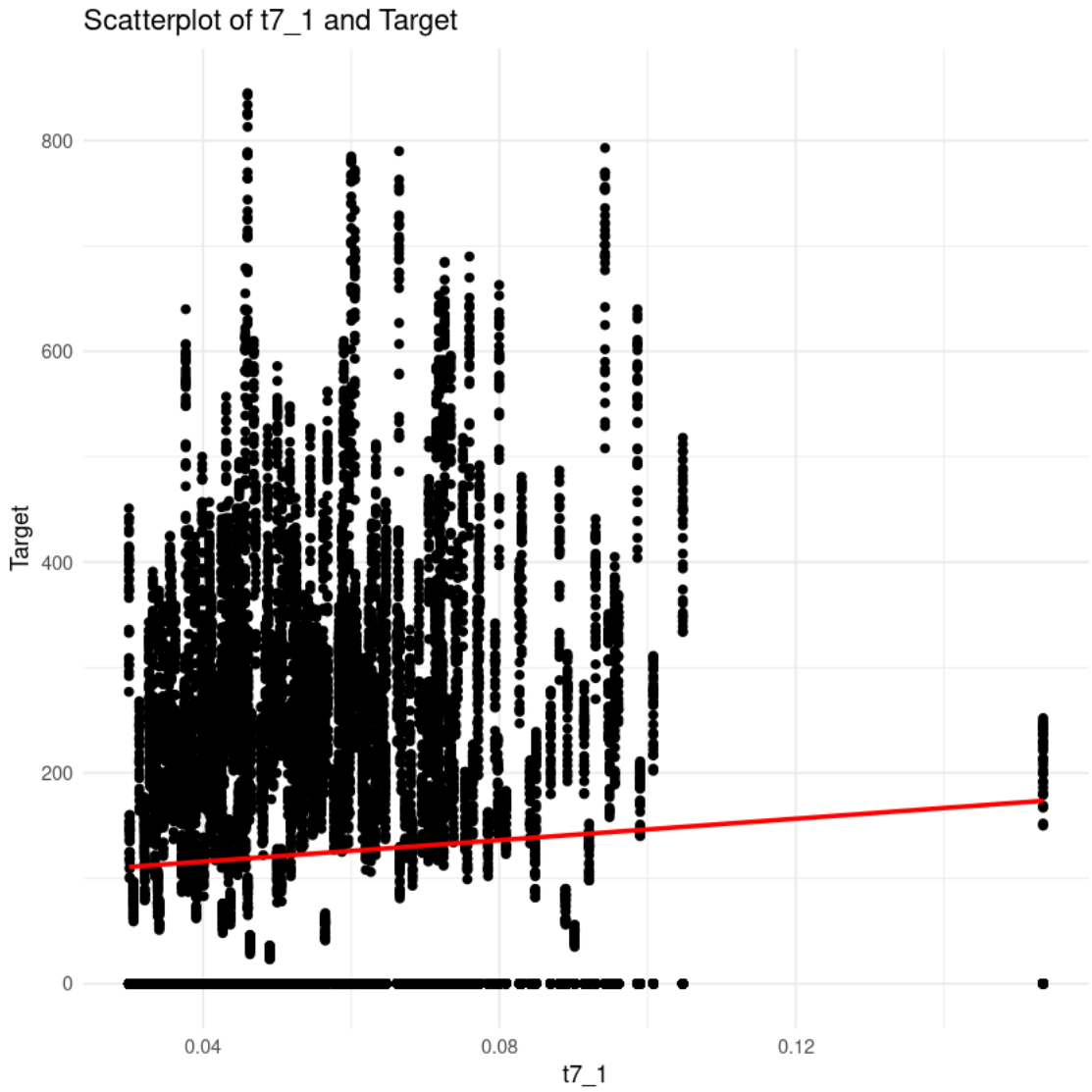


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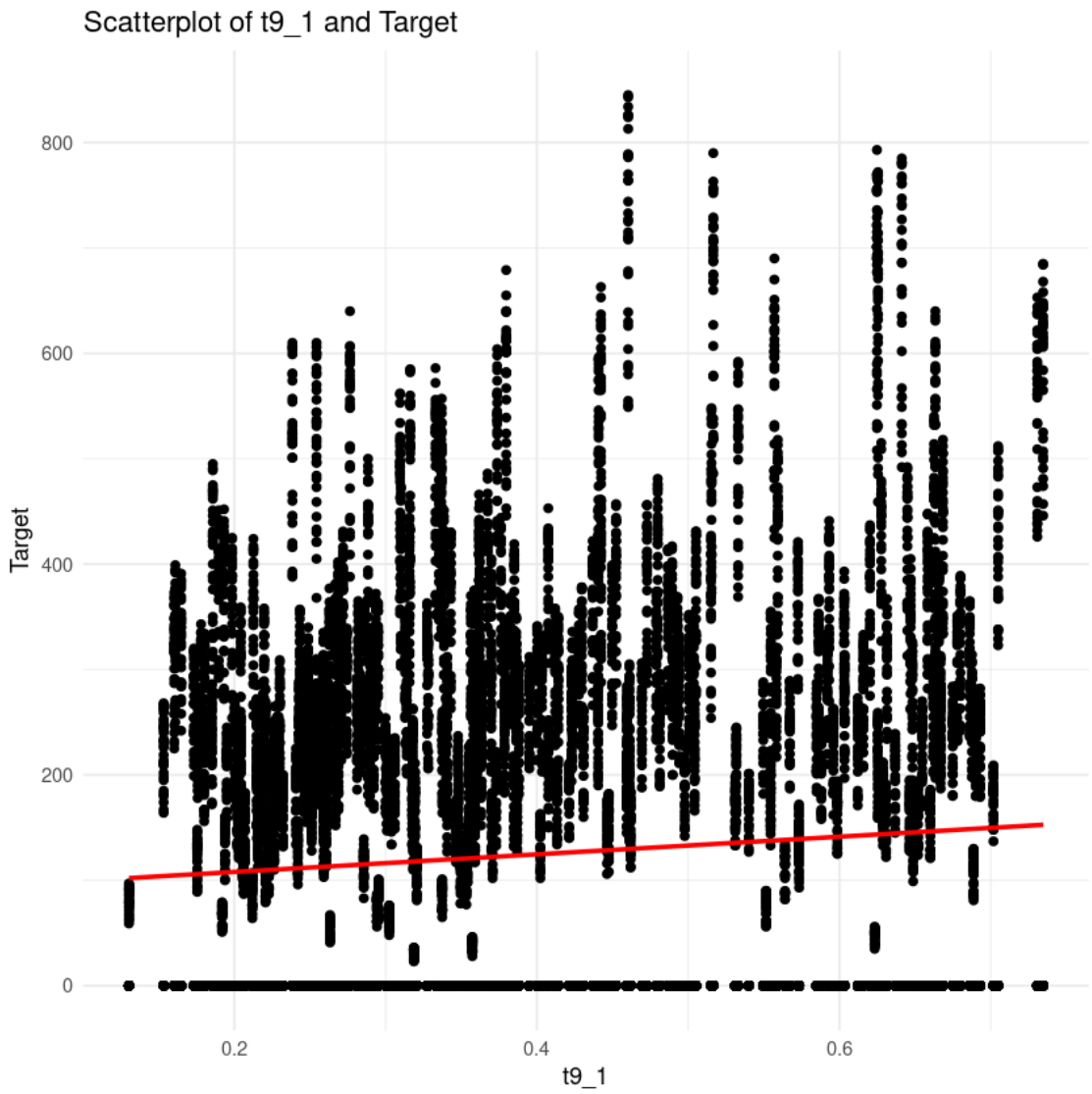


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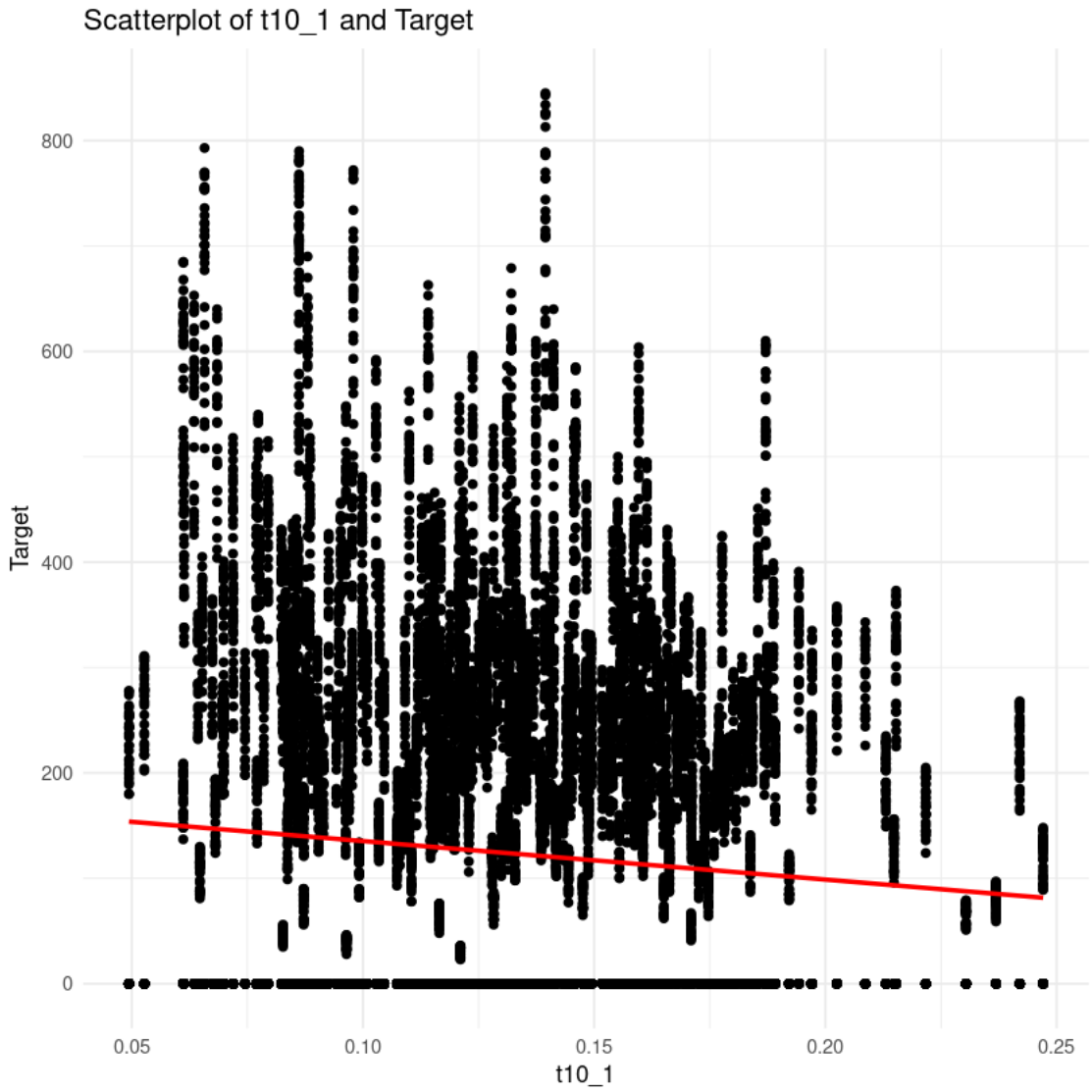


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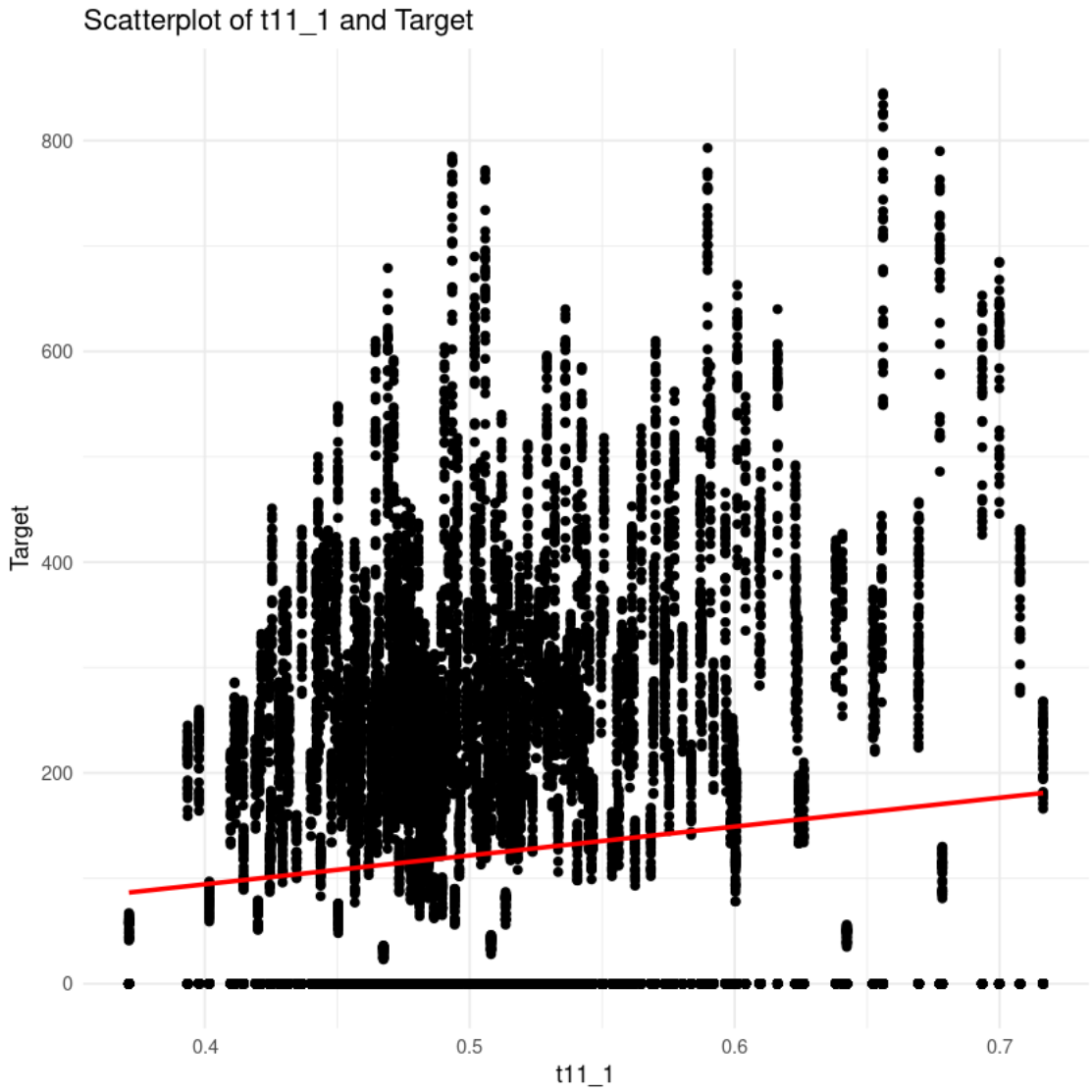


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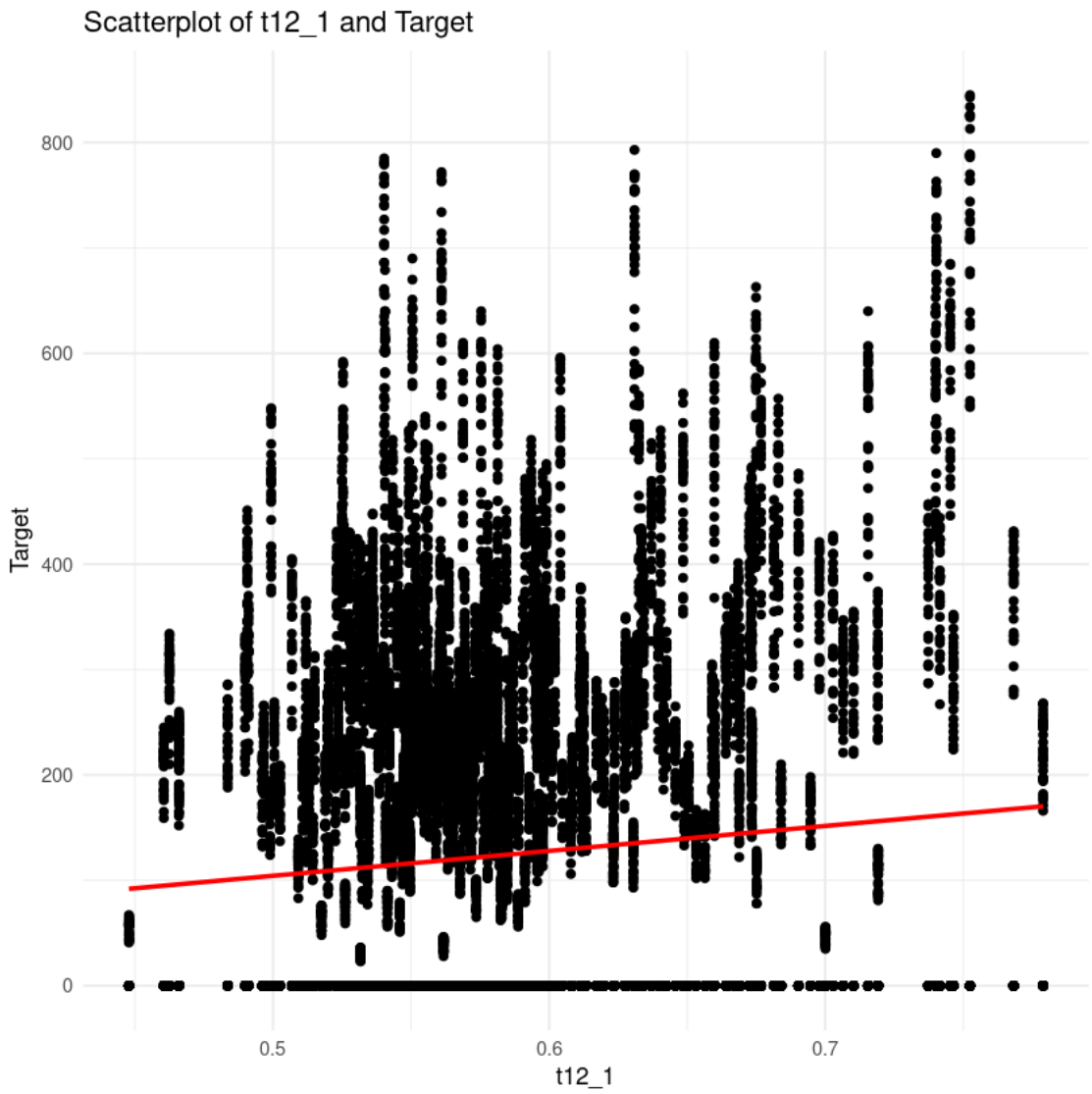


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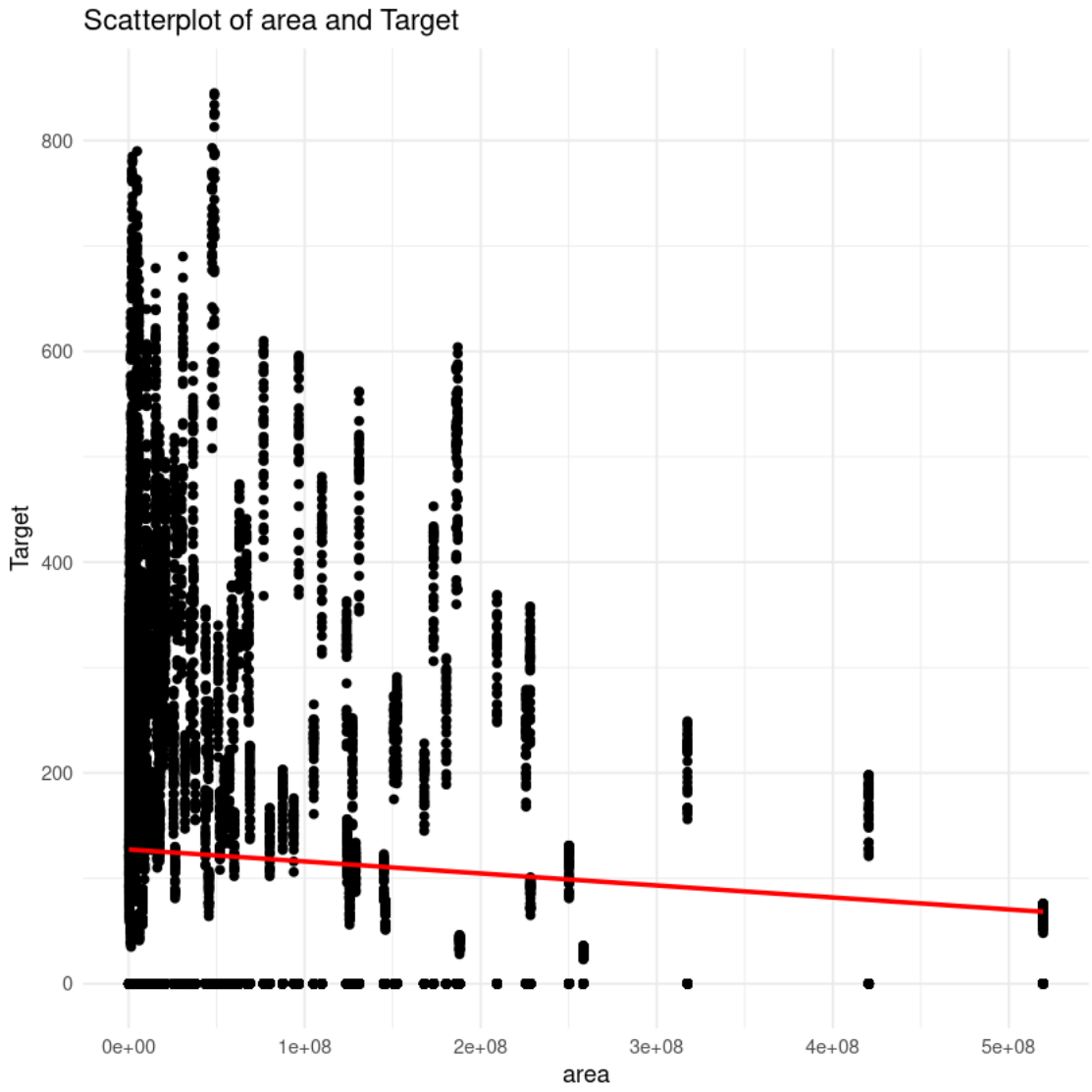


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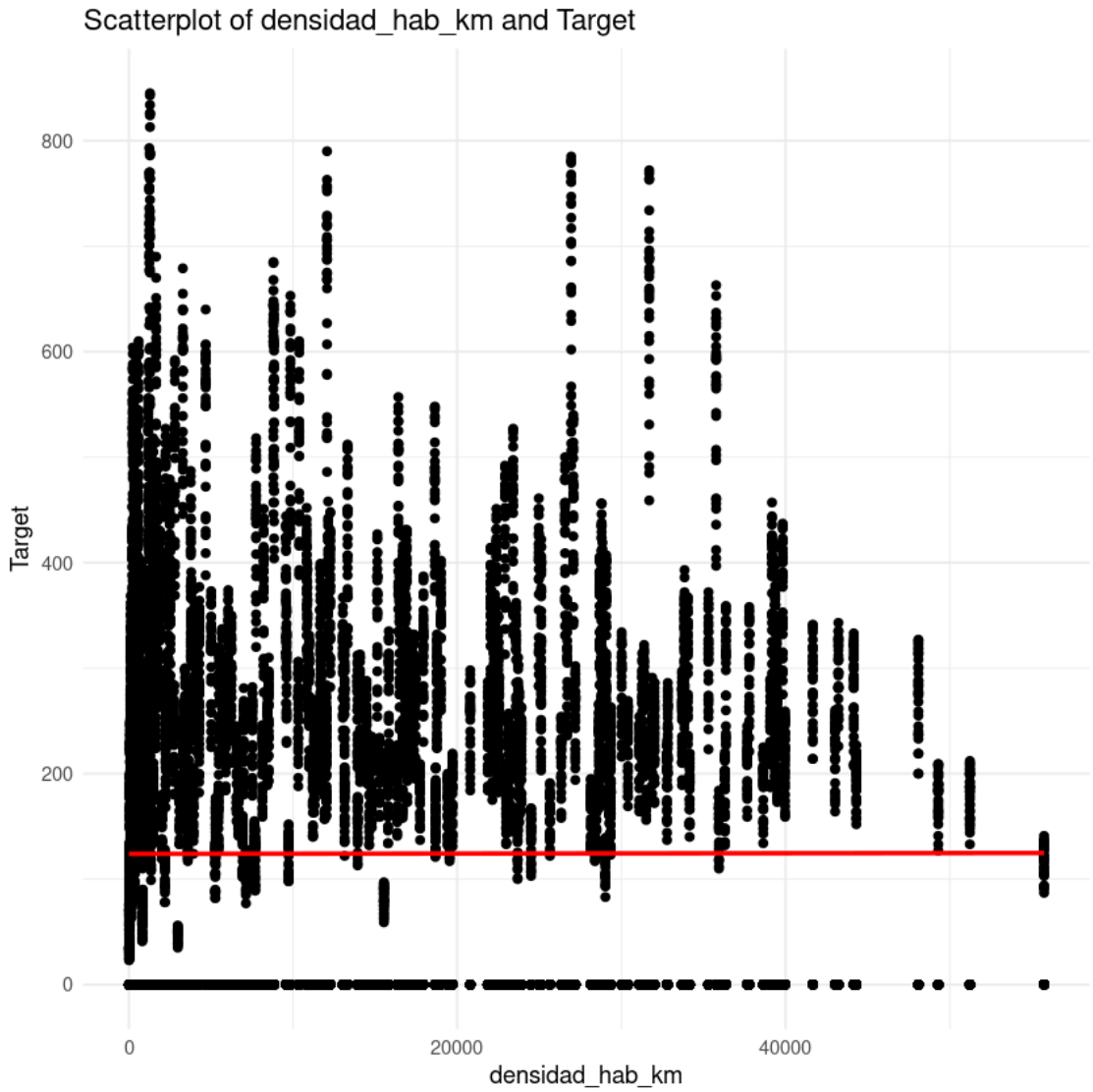


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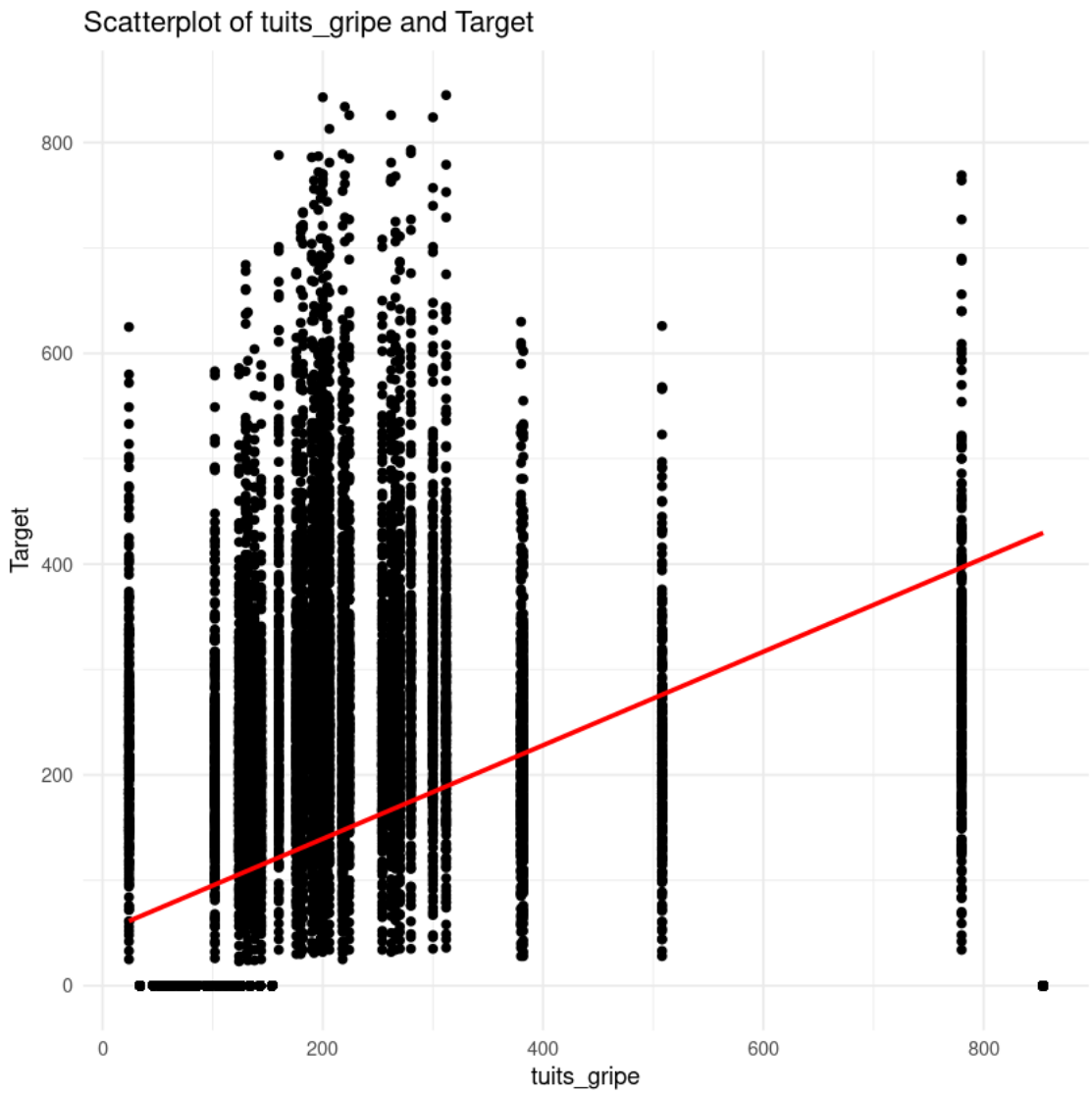
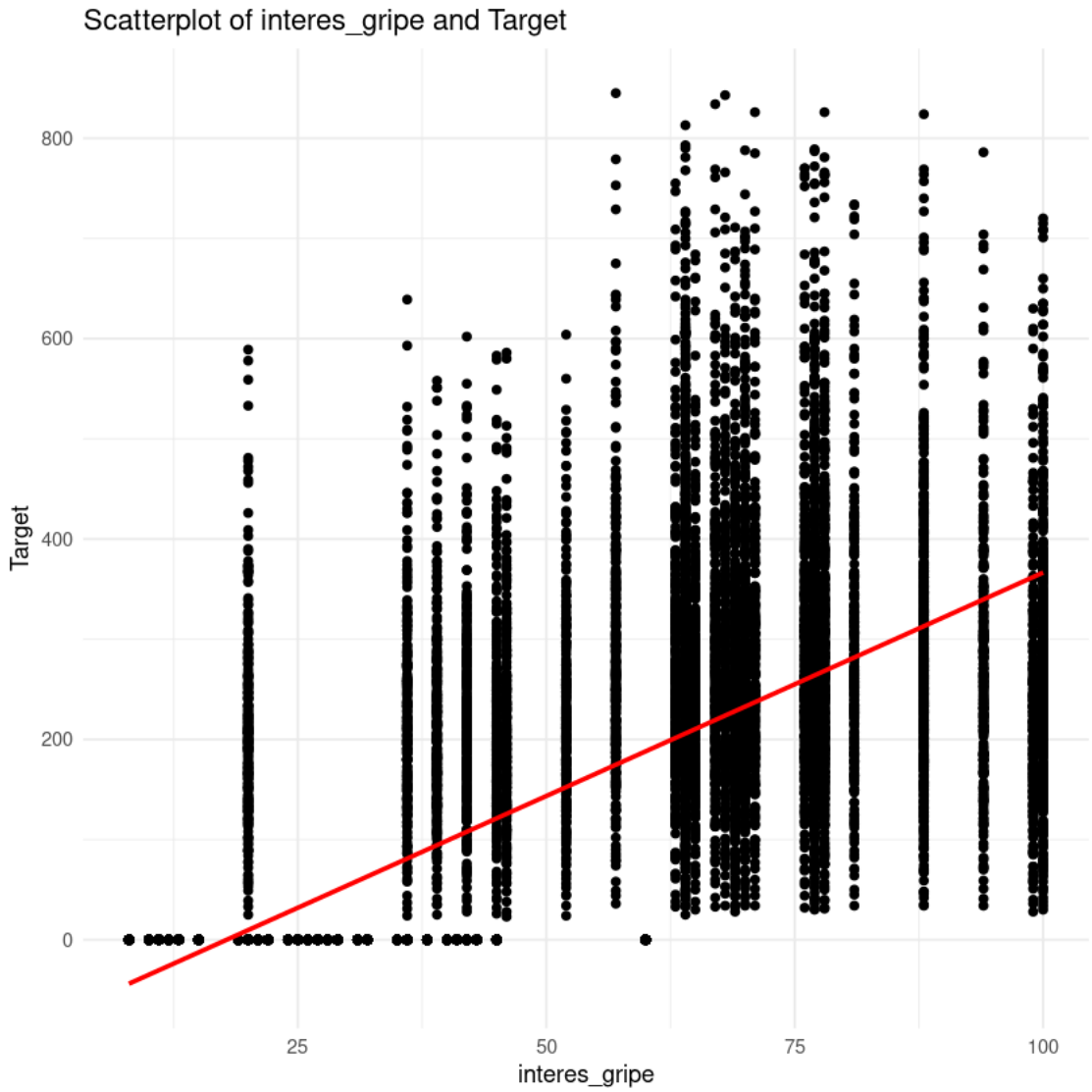

Scatterplot of tuits_gripe and Target
Target
tuits_gripe
0
200
400
600
800




## 0.6 REPORT

A continuación se realizará un informe de las acciones realizadas

## 0.7 Main Actions Carried Out

- Se ha realizado un análisis causal básico

## 0.8 Main Conclusions

- Los datos son adecuados para los modelos que se preveen

## 0.9 CODE TO DEPLOY (PILOT)

A continuación se incluirá el código que deba ser llevado a despliegue para producción, dado que se entiende efectúa operaciones necesarias sobre los datos en la ejecución del prototipo

Description

- No hay nada que desplegar en el piloto, ya que estos datos son estáticos o en todo caso cambian con muy poca frecuencia, altamente improbable durante el proyecto.

CODE

[ ]: