Democracia e COVID-19 – Replicacao e Extensao

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```r
# Pacotes necessarios
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.3.3
```

```
##
## 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
```

```r
library(readr)
```

```
## Warning: package 'readr' was built under R version 4.3.3
```

```r
library(readxl)
```

```
## Warning: package 'readxl' was built under R version 4.3.3
```

```r
library(countrycode)
```

```
## Warning: package 'countrycode' was built under R version 4.3.3
```

```r
library(democracyData)
library(WDI)
```

```
## Warning: package 'WDI' was built under R version 4.3.3
```

```r
library(broom)
library(ggplot2)
library(sandwich)
```

```
## Warning: package 'sandwich' was built under R version 4.3.3
```

```r
library(lmtest)
```

```
## Warning: package 'lmtest' was built under R version 4.3.3
```

```
## Carregando pacotes exigidos: zoo
```

```
## Warning: package 'zoo' was built under R version 4.3.3
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```r
# 1. CARREGAR BASES DE DADOS

# V-Dem 2020
vdem <- readRDS("C:/Users/galva/Downloads/Vdem13/V-Dem-CY-Core-v13.rds")
vdem_2020 <- vdem %>%
  filter(year == 2020) %>%
  select(country_name, v2x_libdem, v2mecenefm, v2x_freexp_altinf)

# COVID-19 Our World in Data
covid <- read_csv("C:/Users/galva/Downloads/owid-covid-data.csv")
```

```
## Rows: 429435 Columns: 67
## -- Column specification ---------------------------------------------------
## Delimiter: ","
## chr   (4): iso_code, continent, location, tests_units
## dbl  (62): total_cases, new_cases, new_cases_smoothed, total_deaths, new_dea...
## date  (1): date
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
covid_2020 <- covid %>%
  filter(lubridate::year(date) == 2020) %>%
  group_by(location) %>%
  summarize(
    mortality_per_million = max(total_deaths_per_million, na.rm = TRUE),
    gdp_per_capita = max(gdp_per_capita, na.rm = TRUE),
    median_age = max(median_age, na.rm = TRUE),
    population_density = max(population_density, na.rm = TRUE),
    continent = first(continent)
  ) %>%
  rename(country_name = location)
```

```
## Warning: There were 154 warnings in `summarize()`.
## The first warning was:
```

```
## i In argument: `mortality_per_million = max(total_deaths_per_million, na.rm =
##   TRUE)`.
## i In group 66: `location = "England"`.
## Caused by warning in `max()`:
## ! nenhum argumento não faltante para max; retornando -Inf
## i Run `dplyr::last_dplyr_warnings()` to see the 153 remaining warnings.
```

```r
# Health expenditure (% PIB) - World Bank
health_exp <- WDI(
  country = "all",
  indicator = "SH.XPD.CHEX.GD.ZS",
  start = 2020, end = 2020
) %>%
  rename(country_name = country, health_expenditure_percent_gdp = SH.XPD.CHEX.GD.ZS) %>%
  select(country_name, health_expenditure_percent_gdp)

# Polity5 2020
polity_2020 <- download_polity_annual() %>%
  filter(year == 2020) %>%
  select(country_name = polity_annual_country, polity_score = polity2) %>%
  mutate(country_name = countrycode(country_name, "country.name", "country.name"))
```

```
## Downloading polity data...
## Trying http://www.systemicpeace.org/inscr/p5v2018.sav ...
## The downloaded polity dataset has 17574 rows
## Original dataset has 17574 rows.
## Processing the Polity 5 data - adding state system info...
## The following different countries/country codes match to a single country unit in the destination sys
```

```
##
##
## |country       | ccode|extended_country_name           | GWn| cown| min_date| max_date| n|
## |:-------------|-----:|:-------------------------------|---:|----:|--------:|--------:|--:|
## |Ethiopia      |   529|Ethiopia                        | 530| 530|     1993|     1993| 1|
## |Ethiopia      |   530|Ethiopia                        | 530| 530|     1993|     1993| 1|
## |Italy         |   325|Italy/Sardinia                  | 325| 325|     1861|     1861| 1|
## |Russia        |   365|Russia (Soviet Union)           | 365| 365|     1922|     1922| 1|
## |Sardinia      |   324|Italy/Sardinia                  | 325| 325|     1861|     1861| 1|
## |Sudan         |   625|Sudan                           | 625| 625|     2011|     2011| 1|
## |Sudan-North   |   626|Sudan                           | 625| 625|     2011|     2011| 1|
## |USSR          |   364|Russia (Soviet Union)           | 365| 365|     1922|     1922| 1|
## |Vietnam       |   818|Vietnam, Democratic Republic of | 816| 816|     1976|     1976| 1|
## |Vietnam North |   816|Vietnam, Democratic Republic of | 816| 816|     1976|     1976| 1|
## |Yugoslavia    |   345|Yugoslavia                      | 345| 345|     1991|     1991| 1|
## |Yugoslavia    |   347|Yugoslavia                      | 345| 345|     1991|     1991| 1|
```

```
## The following country names are different in the destination system:
```

```
##
##
## |country             | ccode|extended_country_name              | GWn| cown| min_date| max_da
## |:-------------------|-----:|:----------------------------------|---:|----:|--------:|-------
## |Belarus             |   370|Belarus (Byelorussia)              | 370| 370|     1991|     20
```

```
## |Bosnia                 |    346|Bosnia-Herzegovina                        |  346|  346|  1992|  20
## |Burkina Faso           |    439|Burkina Faso (Upper Volta)                |  439|  439|  1960|  20
## |Cambodia               |    811|Cambodia (Kampuchea)                      |  811|  811|  1953|  20
## |Congo Brazzaville      |    484|Congo                                     |  484|  484|  2005|  20
## |Congo Kinshasa         |    490|Congo, Democratic Republic of (Zaire)     |  490|  490|  1960|  20
## |Congo-Brazzaville      |    484|Congo                                     |  484|  484|  1960|  200
## |Germany                |    255|German Federal Republic                   |  260|  255|  1945|  20
## |Germany                |    255|Germany (Prussia)                         |  255|  255|  1868|  194
## |Germany East           |    265|German Democratic Republic                |  265|  265|  1945|  199
## |Germany West           |    260|German Federal Republic                   |  260|  260|  1945|  199
## |Gran Colombia          |     99|Great Colombia                            |   99|   NA|  1821|  183
## |Iran                   |    630|Iran (Persia)                             |  630|  630|  1800|  20
## |Italy                  |    325|Italy/Sardinia                            |  325|  325|  1861|  20
## |Ivory Coast            |    437|Cote D'Ivoire                             |  437|  437|  2014|  20
## |Korea North            |    731|Korea, People's Republic of               |  731|  731|  1948|  20
## |Korea South            |    732|Korea, Republic of                        |  732|  732|  1948|  20
## |Kyrgyzstan             |    703|Kyrgyz Republic                           |  703|  703|  1991|  20
## |Macedonia              |    343|Macedonia (Former Yugoslav Republic of)   |  343|  343|  1991|  20
## |Madagascar             |    580|Madagascar (Malagasy)                     |  580|  580|  1960|  20
## |Prussia                |    255|Germany (Prussia)                         |  255|  255|  1800|  18
## |Russia                 |    365|Russia (Soviet Union)                     |  365|  365|  1800|  20
## |Sardinia               |    324|Italy/Sardinia                            |  325|  325|  1815|  18
## |Serbia and Montenegro  |    347|Yugoslavia                                |  345|  345|  2003|  200
## |Slovak Republic        |    317|Slovakia                                  |  317|  317|  1993|  20
## |South Vietnam          |    817|Vietnam, Republic of                      |  817|  817|  1955|  197
## |Sri Lanka              |    780|Sri Lanka (Ceylon)                        |  780|  780|  1948|  20
## |Sudan-North            |    626|Sudan                                     |  625|  625|  2011|  20
## |Suriname               |    115|Surinam                                   |  115|  115|  1975|  20
## |Tanzania               |    510|Tanzania/Tanganyika                       |  510|  510|  1961|  20
## |Timor Leste            |    860|East Timor                                |  860|  860|  2002|  20
## |Turkey                 |    640|Turkey (Ottoman Empire)                   |  640|  640|  1800|  20
## |Two Sicilies           |    329|Sicily (Two Sicilies)                     |  329|  329|  1816|  18
## |UAE                    |    696|United Arab Emirates                      |  696|  696|  1971|  20
## |USSR                   |    364|Russia (Soviet Union)                     |  365|  365|  1922|  199
## |United Province CA     |     89|United Provinces of Central America       |   89|   NA|  1824|  183
## |United States          |      2|United States of America                  |    2|    2|  1776|  20
## |Vietnam                |    818|Vietnam, Democratic Republic of           |  816|  816|  1976|  20
## |Vietnam North          |    816|Vietnam, Democratic Republic of           |  816|  816|  1954|  197
## |Wuerttemburg           |    271|Wurttemberg                               |  271|  271|  1800|  18
## |Yemen                  |    679|Yemen (Arab Republic of Yemen)            |  678|  679|  1990|  20
## |Yemen North            |    678|Yemen (Arab Republic of Yemen)            |  678|  678|  1918|  199
## |Yemen South            |    680|Yemen, People's Republic of               |  680|  680|  1967|  199
## |Zimbabwe               |    552|Zimbabwe (Rhodesia)                       |  552|  552|  1980|  20
```

```
## Resulting dataset after processing has 17574 rows.
## Changing the name of the original country column from country to polity_annual_country...
## Ensuring year column is numeric...
## Changing the name of the original code column from ccode to polity_annual_ccode...
```

```r
# Freedom House 2020
fh_data <- download_fh()
```

```
## Downloading  data...
```

```
## Trying https://freedomhouse.org/sites/default/files/2023-02/Country_and_Territory_Ratings_and_Statuse
## The downloaded  dataset has 205 rows
## Original dataset has 205 rows, but is not in country-year format
## Processing the FH 2022 data - putting it in country-year format, adding state system info...


## Warning in download_fh(): NAs introduzidos por coerção


## Warning in download_fh(): NAs introduzidos por coerção


## The following country names are different in the destination system:


##
##
## |country                         |extended_country_name                   | GWn| cown| min_date| max_
## |:-------------------------------|:---------------------------------------|---:|----:|--------:|-----
## |Antigua and Barbuda             |Antigua & Barbuda                       |  58|   58|     1982|
## |Belarus                         |Belarus (Byelorussia)                   | 370|  370|     1991|
## |Bosnia and Herzegovina          |Bosnia-Herzegovina                      | 346|  346|     1992|
## |Burkina Faso                    |Burkina Faso (Upper Volta)              | 439|  439|     1972|
## |Cabo Verde                      |Cape Verde                              | 402|  402|     1975|
## |Cambodia                        |Cambodia (Kampuchea)                    | 811|  811|     1972|
## |Congo (Brazzaville)             |Congo                                   | 484|  484|     1972|
## |Congo (Kinshasa)                |Congo, Democratic Republic of (Zaire)   | 490|  490|     1972|
## |East Germany                    |German Democratic Republic              | 265|  265|     1972|
## |Eswatini                        |Swaziland                               | 572|  572|     1972|
## |Germany                         |German Federal Republic                 | 260|  255|     1990|
## |Germany, W.                     |German Federal Republic                 | 260|  260|     1972|
## |Iran                            |Iran (Persia)                           | 630|  630|     1972|
## |Italy                           |Italy/Sardinia                          | 325|  325|     1972|
## |Kyrgyzstan                      |Kyrgyz Republic                         | 703|  703|     1991|
## |Madagascar                      |Madagascar (Malagasy)                   | 580|  580|     1972|
## |Micronesia                      |Federated States of Micronesia          | 987|  987|     1991|
## |Myanmar                         |Myanmar (Burma)                         | 775|  775|     1972|
## |North Korea                     |Korea, People's Republic of             | 731|  731|     1972|
## |North Macedonia                 |Macedonia (Former Yugoslav Republic of) | 343|  343|     1992|
## |Russia                          |Russia (Soviet Union)                   | 365|  365|     1991|
## |Samoa                           |Samoa/Western Samoa                     | 990|  990|     1972|
## |Serbia and Montenegro           |Yugoslavia                              | 345|  345|     2003|
## |South Korea                     |Korea, Republic of                      | 732|  732|     1972|
## |South Vietnam                   |Vietnam, Republic of                    | 817|  817|     1972|
## |South Yemen                     |Yemen, People's Republic of             | 680|  680|     1972|
## |Sri Lanka                       |Sri Lanka (Ceylon)                      | 780|  780|     1972|
## |St. Kitts and Nevis             |Saint Kitts and Nevis                   |  60|   60|     1983|
## |St. Lucia                       |Saint Lucia                             |  56|   56|     1979|
## |St. Vincent and the Grenadines  |Saint Vincent and the Grenadines        |  57|   57|     1979|
## |Suriname                        |Surinam                                 | 115|  115|     1975|
## |Tanzania                        |Tanzania/Tanganyika                     | 510|  510|     1972|
## |The Gambia                      |Gambia                                  | 420|  420|     1972|
## |Timor-Leste                     |East Timor                              | 860|  860|     1999|
## |Turkey                          |Turkey (Ottoman Empire)                 | 640|  640|     1972|
## |USSR                            |Russia (Soviet Union)                   | 365|  365|     1972|
## |United States                   |United States of America                |   2|    2|     1972|
## |Vietnam                         |Vietnam, Democratic Republic of         | 816|  816|     1976|
```

```
## |Vietnam, N.                       |Vietnam, Democratic Republic of                | 816| 816|   1972|
## |Yemen                             |Yemen (Arab Republic of Yemen)                 | 678| 679|   1990|
## |Yemen, N.                         |Yemen (Arab Republic of Yemen)                 | 678| 678|   1972|
## |Zimbabwe                          |Zimbabwe (Rhodesia)                            | 552| 552|   1972|
```

```
## Resulting dataset after processing has 9045 rows.
## Changing the name of the original country column from country to fh_country...
## Ensuring year column is numeric...
```

```r
freedom_2020 <- fh_data %>%
  filter(year == 2020) %>%
  select(country_name = fh_country, fh_total) %>%
  mutate(country_name = countrycode(country_name, "country.name", "country.name"))
```

```
## Warning: There was 1 warning in `mutate()`.
## i In argument: `country_name = countrycode(country_name, "country.name",
##   "country.name")`.
## Caused by warning:
## ! Some values were not matched unambiguously: Micronesia
```

```r
# 3. PADRONIZAR NOMES DE PAISES

padroniza_paises <- function(df, coluna = "country_name") {
  df %>%
    mutate(
      {{coluna}} := case_when(
        .data[[coluna]] == "Burma/Myanmar" ~ "Myanmar",
        .data[[coluna]] == "United States of America" ~ "United States",
        .data[[coluna]] == "Ivory Coast" ~ "Côte d'Ivoire",
        .data[[coluna]] == "Democratic Republic of the Congo" ~ "Congo - Kinshasa",
        .data[[coluna]] == "Republic of the Congo" ~ "Congo - Brazzaville",
        .data[[coluna]] == "Sao Tome and Principe" ~ "São Tomé & Príncipe",
        .data[[coluna]] == "Trinidad and Tobago" ~ "Trinidad & Tobago",
        .data[[coluna]] %in% c("Palestine/West Bank", "Palestine/Gaza") ~ "Palestinian Territories",
        TRUE ~ .data[[coluna]]  # mantém os outros nomes
      )
    )
}

# Aplicando em todas as bases
vdem_2020    <- padroniza_paises(vdem_2020)
covid_2020   <- padroniza_paises(covid_2020)
polity_2020  <- padroniza_paises(polity_2020)
freedom_2020 <- padroniza_paises(freedom_2020)
```

```r
head(vdem_2020$country_name, 200)  # mostra os 00 primeiros
```

```
##    [1] "Mexico"             "Suriname"
##    [3] "Sweden"             "Switzerland"
##    [5] "Ghana"              "South Africa"
##    [7] "Japan"              "Myanmar"
##    [9] "Russia"             "Albania"
```

6

```
##  [11] "Egypt"                     "Yemen"
##  [13] "Colombia"                  "Poland"
##  [15] "Brazil"                    "United States"
##  [17] "Portugal"                  "El Salvador"
##  [19] "Bangladesh"                "Bolivia"
##  [21] "Haiti"                     "Honduras"
##  [23] "Mali"                      "Pakistan"
##  [25] "Peru"                      "Senegal"
##  [27] "South Sudan"               "Sudan"
##  [29] "Vietnam"                   "Afghanistan"
##  [31] "Argentina"                 "Ethiopia"
##  [33] "India"                     "Kenya"
##  [35] "North Korea"               "South Korea"
##  [37] "Kosovo"                    "Lebanon"
##  [39] "Nigeria"                   "Philippines"
##  [41] "Tanzania"                  "Taiwan"
##  [43] "Thailand"                  "Uganda"
##  [45] "Venezuela"                 "Benin"
##  [47] "Bhutan"                    "Burkina Faso"
##  [49] "Cambodia"                  "Indonesia"
##  [51] "Mozambique"                "Nepal"
##  [53] "Nicaragua"                 "Niger"
##  [55] "Zambia"                    "Zimbabwe"
##  [57] "Guinea"                    "Côte d'Ivoire"
##  [59] "Mauritania"                "Canada"
##  [61] "Australia"                 "Botswana"
##  [63] "Burundi"                   "Cape Verde"
##  [65] "Central African Republic" "Chile"
##  [67] "Costa Rica"                "Timor-Leste"
##  [69] "Ecuador"                   "France"
##  [71] "Germany"                   "Guatemala"
##  [73] "Iran"                      "Iraq"
##  [75] "Ireland"                   "Italy"
##  [77] "Jordan"                    "Latvia"
##  [79] "Lesotho"                   "Liberia"
##  [81] "Malawi"                    "Maldives"
##  [83] "Mongolia"                  "Morocco"
##  [85] "Netherlands"               "Panama"
##  [87] "Papua New Guinea"          "Qatar"
##  [89] "Sierra Leone"              "Spain"
##  [91] "Syria"                     "Tunisia"
##  [93] "Turkey"                    "Ukraine"
##  [95] "United Kingdom"            "Uruguay"
##  [97] "Algeria"                   "Angola"
##  [99] "Armenia"                   "Azerbaijan"
## [101] "Belarus"                   "Cameroon"
## [103] "Chad"                      "China"
## [105] "Congo - Kinshasa"          "Congo - Brazzaville"
## [107] "Djibouti"                  "Dominican Republic"
## [109] "Eritrea"                   "Gabon"
## [111] "The Gambia"                "Georgia"
## [113] "Guinea-Bissau"             "Jamaica"
## [115] "Kazakhstan"                "Kyrgyzstan"
## [117] "Laos"                      "Libya"
```

```
## [119] "Madagascar"               "Moldova"
## [121] "Namibia"                  "Palestinian Territories"
## [123] "Rwanda"                   "Somalia"
## [125] "Sri Lanka"                "Eswatini"
## [127] "Tajikistan"               "Togo"
## [129] "Trinidad & Tobago"        "Turkmenistan"
## [131] "Palestinian Territories"  "Somaliland"
## [133] "Uzbekistan"               "Austria"
## [135] "Bahrain"                  "Barbados"
## [137] "Belgium"                  "Bosnia and Herzegovina"
## [139] "Bulgaria"                 "Comoros"
## [141] "Croatia"                  "Cuba"
## [143] "Cyprus"                   "Czechia"
## [145] "Denmark"                  "Equatorial Guinea"
## [147] "Estonia"                  "Fiji"
## [149] "Finland"                  "Greece"
## [151] "Guyana"                   "Hong Kong"
## [153] "Iceland"                  "Israel"
## [155] "Kuwait"                   "Lithuania"
## [157] "Luxembourg"               "North Macedonia"
## [159] "Malaysia"                 "Malta"
## [161] "Mauritius"                "Montenegro"
## [163] "New Zealand"              "Norway"
## [165] "Oman"                     "Paraguay"
## [167] "Romania"                  "São Tomé & Príncipe"
## [169] "Saudi Arabia"             "Serbia"
## [171] "Seychelles"               "Singapore"
## [173] "Slovakia"                 "Slovenia"
## [175] "Solomon Islands"          "Vanuatu"
## [177] "United Arab Emirates"     "Hungary"
## [179] "Zanzibar"
```

```r
# 4. INTEGRACAO DAS BASES E TRATAMENTO DE NAs PARA REGRESSAO
library(dplyr)

# Integrar as bases
merged_data <- vdem_2020 %>%
  left_join(covid_2020, by = "country_name") %>%
  left_join(health_exp, by = "country_name") %>%
  left_join(polity_2020, by = "country_name") %>%
  left_join(freedom_2020, by = "country_name") %>%
  # Criar variáveis novas e limpar dados
  mutate(
    mortality_per_million = ifelse(mortality_per_million < 0, NA, mortality_per_million),
    log_mortality = log(pmax(mortality_per_million, 0) + 1),  # evita NaN
    health_exp_ratio = health_expenditure_percent_gdp / median_age,
    gdp_per_capita = ifelse(is.na(gdp_per_capita), mean(gdp_per_capita, na.rm = TRUE), gdp_per_capita),
    median_age = ifelse(is.na(median_age), mean(median_age, na.rm = TRUE), median_age),
    population_density = ifelse(is.na(population_density), mean(population_density, na.rm = TRUE), popul
    health_expenditure_percent_gdp = ifelse(is.na(health_expenditure_percent_gdp),
                                            mean(health_expenditure_percent_gdp, na.rm = TRUE),
                                            health_expenditure_percent_gdp),
    polity_score = ifelse(is.na(polity_score), mean(polity_score, na.rm = TRUE), polity_score)
  )
```

```r
# Substituir NA em 'total' (Freedom House), se existir
if("total" %in% colnames(merged_data)){
  merged_data <- merged_data %>%
    mutate(total = ifelse(is.na(total), mean(total, na.rm = TRUE), total))
}

# Criar pasta, se não existir
dir.create("C:/Users/galva/Documents/Pamella_trabalhos/Desafio_da_replicacao_segunda_versao",
           showWarnings = FALSE, recursive = TRUE)

# Salvar a base final
saveRDS(merged_data,
        file = "C:/Users/galva/Documents/Pamella_trabalhos/Desafio_da_replicacao_segunda_versao/merged_

# Verificar linhas e primeiras observações
cat("Linhas apos integracao e tratamento de NAs:", nrow(merged_data), "\n")
```

```
## Linhas apos integracao e tratamento de NAs: 179
```

```r
head(merged_data)
```

```
##   country_name v2x_libdem v2mecenefm v2x_freexp_altinf mortality_per_million
## 1       Mexico      0.406     -0.179             0.766               1118.78
## 2     Suriname      0.640      0.716             0.856                190.96
## 3       Sweden      0.873      3.400             0.969                888.98
## 4  Switzerland      0.857      3.185             0.979                816.86
## 5        Ghana      0.620      2.175             0.880                 10.11
## 6 South Africa      0.575      0.814             0.842                425.16
##   gdp_per_capita median_age population_density       continent
## 1       17336.47       29.3             66.44 North America
## 2       13767.12       29.6              3.61 South America
## 3       46949.28       41.0             24.72        Europe
## 4       57410.17       43.1            214.24        Europe
## 5        4227.63       21.1            126.72        Africa
## 6       12294.88       27.3             46.75        Africa
##   health_expenditure_percent_gdp polity_score fh_total log_mortality
## 1                       6.053740            5        7      7.020888
## 2                       6.675842            5        4      5.257287
## 3                      11.332970            5        2      6.791199
## 4                      12.004041            5        2      6.706691
## 5                       4.433171            5        4      2.407846
## 6                       9.013292            5        4      6.054815
##   health_exp_ratio
## 1        0.2066123
## 2        0.2255352
## 3        0.2764139
## 4        0.2785160
## 5        0.2101029
## 6        0.3301572
```

```r
# 5. REGRESSOES LINEARES
library(dplyr)
library(broom)
library(ggplot2)
library(sandwich)
library(lmtest)

# Filtra apenas casos validos para regressoes
merged_clean <- merged_data %>%
  filter(
    !is.na(v2x_libdem) & !is.infinite(v2x_libdem),
    !is.na(polity_score) & !is.infinite(polity_score),
    !is.na(mortality_per_million) & !is.infinite(mortality_per_million),
    !is.na(gdp_per_capita) & !is.infinite(gdp_per_capita),
    !is.na(median_age) & !is.infinite(median_age),
    !is.na(population_density) & !is.infinite(population_density),
    # Só filtra 'total' se ela existir
    if("total" %in% colnames(merged_data)) !is.na(total) & !is.infinite(total) else TRUE
  ) %>%
  mutate(
    log_mortality = log(mortality_per_million + 1)
  )


# Ver quantas linhas sobraram
cat("Linhas apos limpeza para regressoes:", nrow(merged_clean), "\n")
```

```
## Linhas apos limpeza para regressoes: 162
```

```r
# --- REGRESSAO LINEAR PARA V-DEM ---
model_vdem <- lm(log_mortality ~ v2x_libdem + gdp_per_capita + median_age + population_density,
                 data = merged_clean)
summary(model_vdem)
```

```
##
## Call:
## lm(formula = log_mortality ~ v2x_libdem + gdp_per_capita + median_age +
##     population_density, data = merged_clean)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.1150 -0.7243  0.2607  1.1621  3.4983
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        2.714e-01  5.338e-01   0.508   0.6119
## v2x_libdem         1.028e+00  6.594e-01   1.559   0.1211
## gdp_per_capita     5.973e-06  9.615e-06   0.621   0.5354
## median_age         1.157e-01  2.222e-02   5.207 5.95e-07 ***
## population_density -4.853e-04  2.209e-04  -2.197   0.0295 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 1.749 on 157 degrees of freedom
## Multiple R-squared:  0.3622, Adjusted R-squared:  0.346
## F-statistic: 22.29 on 4 and 157 DF,  p-value: 1.368e-14
```

```r
tidy(model_vdem)
```

```
## # A tibble: 5 x 5
##   term               estimate  std.error statistic    p.value
##   <chr>                 <dbl>      <dbl>     <dbl>      <dbl>
## 1 (Intercept)           0.271      0.534     0.508 0.612
## 2 v2x_libdem            1.03       0.659     1.56  0.121
## 3 gdp_per_capita        0.00000597 0.00000961   0.621 0.535
## 4 median_age            0.116      0.0222     5.21  0.000000595
## 5 population_density   -0.000485   0.000221  -2.20  0.0295
```

```r
# --- REGRESSAO LINEAR PARA POLITY5 ---
model_polity <- lm(log_mortality ~ polity_score + gdp_per_capita + median_age + population_density,
                   data = merged_clean)
summary(model_polity)
```

```
##
## Call:
## lm(formula = log_mortality ~ polity_score + gdp_per_capita +
##     median_age + population_density, data = merged_clean)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.0438 -0.6929  0.3283  1.1281  3.8201
##
## Coefficients: (1 not defined because of singularities)
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        2.067e-01  5.346e-01   0.387   0.6995
## polity_score              NA         NA      NA       NA
## gdp_per_capita     7.517e-06  9.607e-06   0.783   0.4351
## median_age         1.313e-01  1.994e-02   6.583 6.47e-10 ***
## population_density -5.407e-04  2.190e-04  -2.469   0.0146 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.757 on 158 degrees of freedom
## Multiple R-squared:  0.3523, Adjusted R-squared:   0.34
## F-statistic: 28.65 on 3 and 158 DF,  p-value: 7.553e-15
```

```r
tidy(model_polity)
```

```
## # A tibble: 5 x 5
##   term               estimate   std.error statistic   p.value
##   <chr>                 <dbl>       <dbl>     <dbl>     <dbl>
## 1 (Intercept)           0.207       0.535     0.387  6.99e- 1
## 2 polity_score          NA          NA        NA     NA
## 3 gdp_per_capita        0.00000752  0.00000961   0.783  4.35e- 1
## 4 median_age            0.131       0.0199     6.58   6.47e-10
## 5 population_density   -0.000541    0.000219  -2.47   1.46e- 2
```

```
# --- REGRESSAO LINEAR PARA FREEDOM HOUSE ---
model_fh <- lm(log_mortality ~ fh_total + gdp_per_capita + median_age + population_density,
               data = merged_clean)
summary(model_fh)
```

```
##
## Call:
## lm(formula = log_mortality ~ fh_total + gdp_per_capita + median_age +
##     population_density, data = merged_clean)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.0849 -0.7462  0.2664  1.2189  3.7217
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)        1.367e+00  8.303e-01   1.647   0.1017
## fh_total          -7.551e-02  4.298e-02  -1.757   0.0809 .
## gdp_per_capita     8.222e-06  9.675e-06   0.850   0.3967
## median_age         1.100e-01  2.286e-02   4.811 3.53e-06 ***
## population_density -4.966e-04  2.200e-04  -2.257   0.0254 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.753 on 155 degrees of freedom
##   (2 observations deleted due to missingness)
## Multiple R-squared:  0.3601, Adjusted R-squared:  0.3436
## F-statistic: 21.81 on 4 and 155 DF,  p-value: 2.713e-14
```

```
tidy(model_fh)
```

```
## # A tibble: 5 x 5
##   term                 estimate  std.error statistic   p.value
##   <chr>                   <dbl>      <dbl>     <dbl>     <dbl>
## 1 (Intercept)          1.37       0.830         1.65  0.102
## 2 fh_total            -0.0755     0.0430       -1.76  0.0809
## 3 gdp_per_capita       0.00000822 0.00000967    0.850 0.397
## 4 median_age           0.110      0.0229        4.81  0.00000353
## 5 population_density  -0.000497   0.000220     -2.26  0.0254
```

```
# --- MODELOS ROBUSTOS COM ERROS PADRAO HC1 ---
coeftest(model_vdem, vcov = vcovHC(model_vdem, type = "HC1"))
```

```
##
## t test of coefficients:
##
##                      Estimate  Std. Error t value  Pr(>|t|)
## (Intercept)        2.7137e-01  4.3007e-01  0.6310    0.5290
## v2x_libdem         1.0277e+00  7.0398e-01  1.4599    0.1463
## gdp_per_capita     5.9729e-06  5.9007e-06  1.0122    0.3130
## median_age         1.1569e-01  2.0846e-02  5.5498 1.191e-07 ***
## population_density -4.8533e-04  9.2218e-05 -5.2629 4.590e-07 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
coeftest(model_polity, vcov = vcovHC(model_polity, type = "HC1"))
```

```
##
## t test of coefficients:
##
##                       Estimate  Std. Error t value  Pr(>|t|)
## (Intercept)          2.0673e-01  4.2099e-01  0.4911    0.6241
## gdp_per_capita       7.5175e-06  6.4825e-06  1.1597    0.2479
## median_age           1.3126e-01  1.5861e-02  8.2752 5.040e-14 ***
## population_density  -5.4071e-04  8.5553e-05 -6.3202 2.548e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
coeftest(model_fh, vcov = vcovHC(model_fh, type = "HC1"))
```

```
##
## t test of coefficients:
##
##                       Estimate  Std. Error t value  Pr(>|t|)
## (Intercept)          1.3672e+00  9.0337e-01  1.5134    0.1322
## fh_total            -7.5511e-02  4.9657e-02 -1.5206    0.1304
## gdp_per_capita       8.2225e-06  6.3505e-06  1.2948    0.1973
## median_age           1.0999e-01  2.2298e-02  4.9330 2.068e-06 ***
## population_density  -4.9662e-04  9.4184e-05 -5.2728 4.444e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# --- TABELA COMPARATIVA DE TODOS OS MODELOS ---
comparative_table <- bind_rows(
  tidy(model_vdem) %>% mutate(Modelo = "V-Dem"),
  tidy(model_polity) %>% mutate(Modelo = "Polity5"),
  tidy(model_fh) %>% mutate(Modelo = "Freedom House")
) %>%
  select(Modelo, term, estimate, std.error, statistic, p.value)

print(comparative_table)
```

```
## # A tibble: 15 x 6
##    Modelo     term                 estimate  std.error statistic  p.value
##    <chr>      <chr>                   <dbl>      <dbl>     <dbl>    <dbl>
##  1 V-Dem      (Intercept)             0.271      0.534     0.508  6.12e- 1
##  2 V-Dem      v2x_libdem              1.03       0.659     1.56   1.21e- 1
##  3 V-Dem      gdp_per_capita          0.00000597 0.00000961 0.621  5.35e- 1
##  4 V-Dem      median_age              0.116      0.0222    5.21   5.95e- 7
##  5 V-Dem      population_density     -0.000485   0.000221 -2.20   2.95e- 2
##  6 Polity5    (Intercept)             0.207      0.535     0.387  6.99e- 1
##  7 Polity5    polity_score           NA         NA        NA      NA
##  8 Polity5    gdp_per_capita          0.00000752 0.00000961 0.783  4.35e- 1
##  9 Polity5    median_age              0.131      0.0199    6.58   6.47e-10
```

```
## 10 Polity5       population_density -0.000541   0.000219    -2.47  1.46e- 2
## 11 Freedom House (Intercept)         1.37        0.830        1.65  1.02e- 1
## 12 Freedom House fh_total           -0.0755      0.0430      -1.76  8.09e- 2
## 13 Freedom House gdp_per_capita      0.00000822  0.00000967   0.850  3.97e- 1
## 14 Freedom House median_age          0.110       0.0229       4.81  3.53e- 6
## 15 Freedom House population_density -0.000497    0.000220    -2.26  2.54e- 2
```

```r
# --- GRAFICOS DE DISPERSAO COM LINHA DE REGRESSAO ---
ggplot(merged_clean, aes(x = v2x_libdem, y = log_mortality)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(
    title = "V-Dem x Mortalidade (log)",
    x = "Indice de Democracia V-Dem",
    y = "Mortalidade COVID-19 (log)"
  )
```
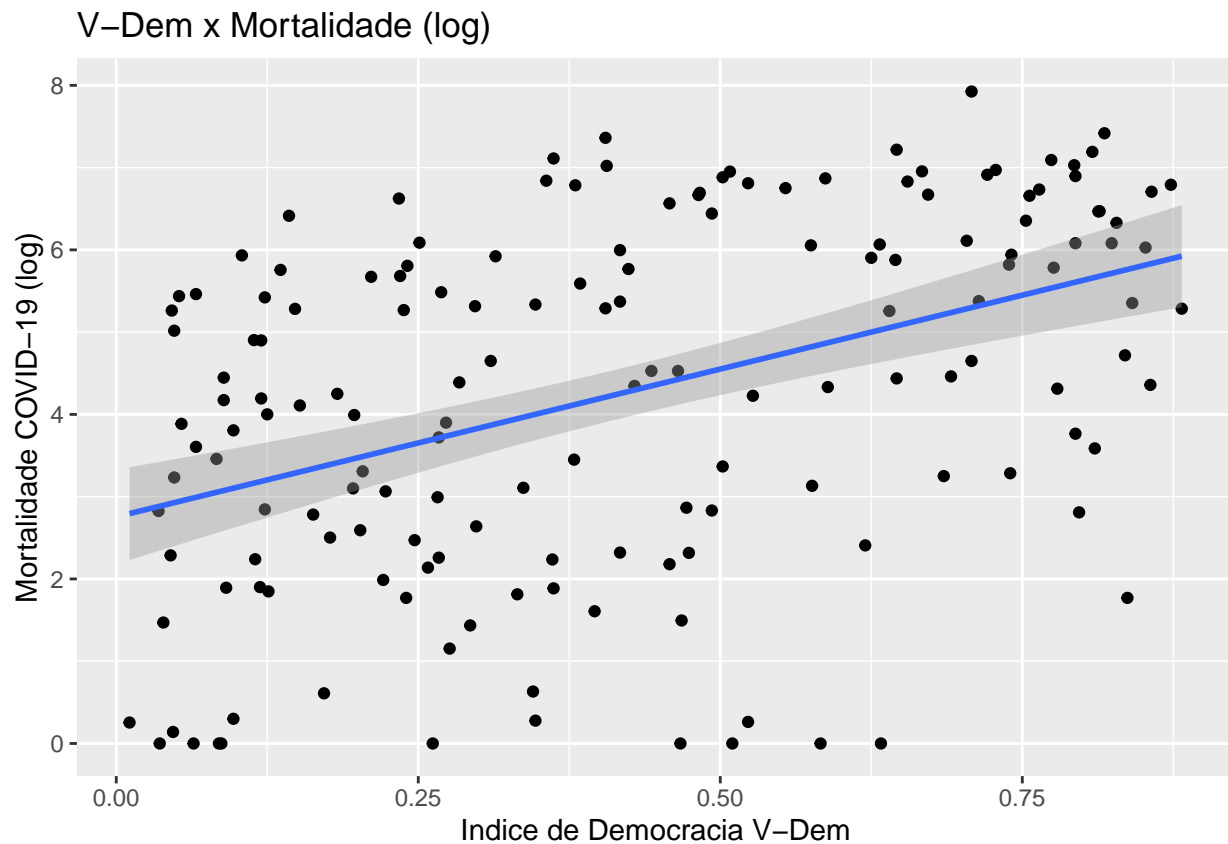
```
## `geom_smooth()` using formula = 'y ~ x'
```


V−Dem x Mortalidade (log)

```r
ggplot(merged_clean, aes(x = polity_score, y = log_mortality)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(
    title = "Polity5 x Mortalidade (log)",
    x = "Indice Polity5",
```

```
    y = "Mortalidade COVID-19 (log)"
  )
```
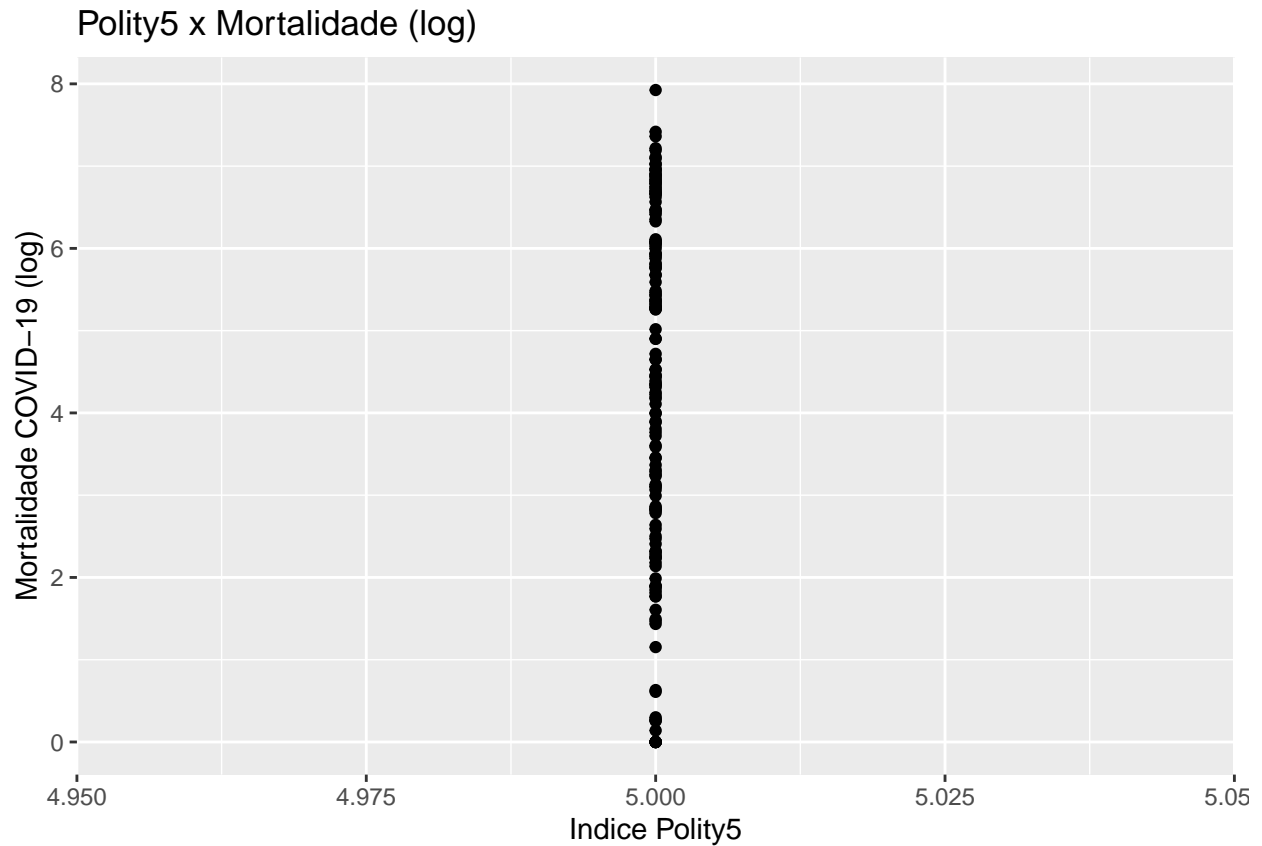
`geom_smooth()` using formula = 'y ~ x'


```
ggplot(merged_clean, aes(x = fh_total, y = log_mortality)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(
    title = "Freedom House x Mortalidade (log)",
    x = "Freedom House Total",
    y = "Mortalidade COVID-19 (log)"
  )
```

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

Warning: Removed 2 rows containing non-finite outside the scale range
(`stat_smooth()`).

Warning: Removed 2 rows containing missing values or values outside the scale range
(`geom_point()`).

Freedom House x Mortalidade (log)
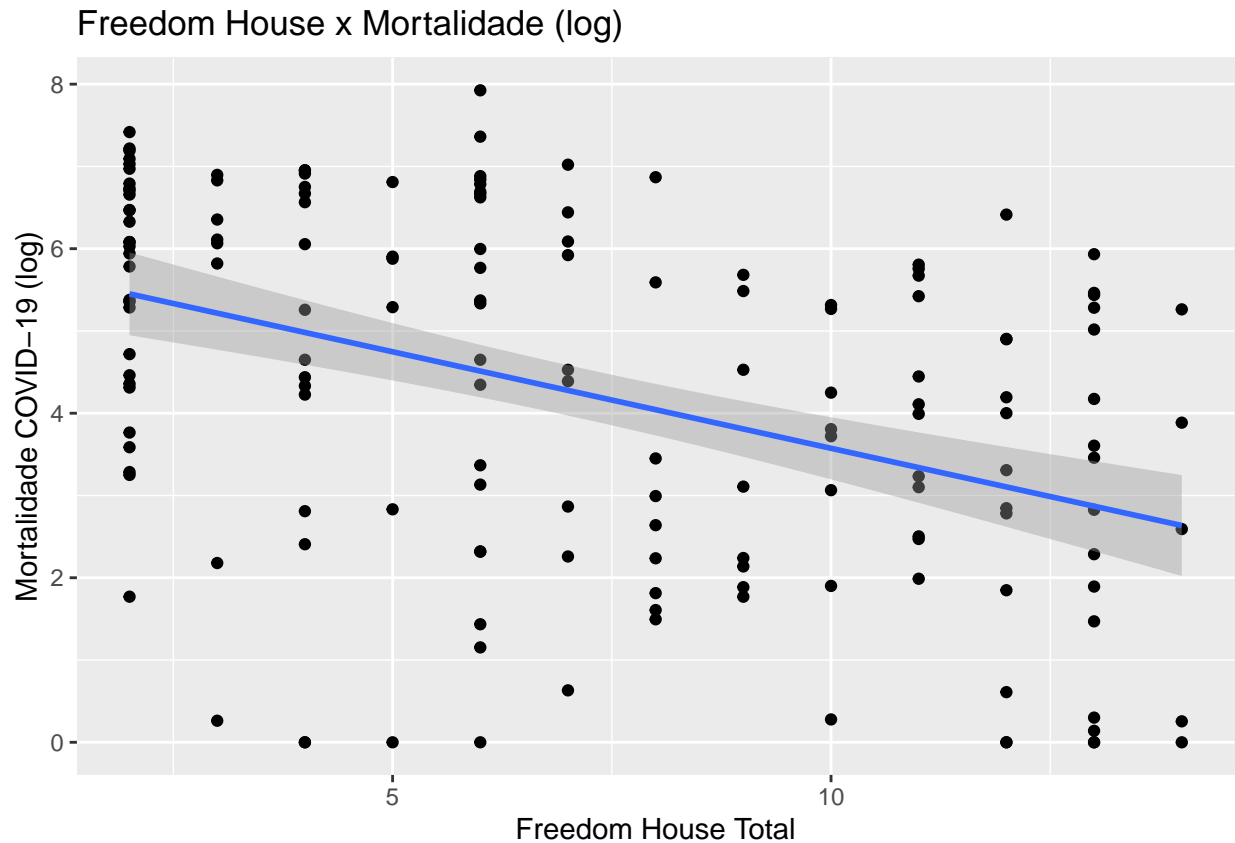

```r
# 6. TABELAS DE RESULTADOS
library(dplyr)
library(broom)

# Já com os modelos que você tem
tidy_vdem <- tidy(model_vdem) %>% mutate(Modelo = "V-Dem")
tidy_polity <- tidy(model_polity) %>% mutate(Modelo = "Polity5")
tidy_fh <- tidy(model_fh) %>% mutate(Modelo = "Freedom House")

# Combinar todas as tabelas
comparative_table <- bind_rows(tidy_vdem, tidy_polity, tidy_fh)

print(comparative_table)
```

```
## # A tibble: 15 x 6
##    term              estimate   std.error statistic  p.value Modelo
##    <chr>                <dbl>       <dbl>     <dbl>    <dbl> <chr>
##  1 (Intercept)          0.271     0.534       0.508  6.12e- 1 V-Dem
##  2 v2x_libdem           1.03      0.659       1.56   1.21e- 1 V-Dem
##  3 gdp_per_capita       0.00000597 0.00000961 0.621  5.35e- 1 V-Dem
##  4 median_age           0.116     0.0222      5.21   5.95e- 7 V-Dem
##  5 population_density  -0.000485   0.000221   -2.20  2.95e- 2 V-Dem
##  6 (Intercept)          0.207     0.535       0.387  6.99e- 1 Polity5
##  7 polity_score         NA        NA          NA     NA       Polity5
##  8 gdp_per_capita       0.00000752 0.00000961 0.783  4.35e- 1 Polity5
```

```
##  9 median_age              0.131      0.0199          6.58   6.47e-10 Polity5
## 10 population_density -0.000541      0.000219        -2.47   1.46e- 2 Polity5
## 11 (Intercept)             1.37       0.830           1.65   1.02e- 1 Freedom House
## 12 fh_total               -0.0755     0.0430         -1.76   8.09e- 2 Freedom House
## 13 gdp_per_capita          0.00000822 0.00000967      0.850  3.97e- 1 Freedom House
## 14 median_age              0.110      0.0229          4.81   3.53e- 6 Freedom House
## 15 population_density -0.000497      0.000220        -2.26   2.54e- 2 Freedom House
```

```r
# 9. GRÁFICOS FINAIS – base limpa

library(ggplot2)

# V-Dem
ggplot(merged_clean, aes(x = v2x_libdem, y = log_mortality)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", color = "darkblue") +
  labs(title = "V-Dem vs Mortalidade Log", x = "Índice de Democracia V-Dem", y = "Log Mortalidade COVID-
```

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



```r
# Polity5
ggplot(merged_clean, aes(x = polity_score, y = log_mortality)) +
  geom_point(color = "green") +
  geom_smooth(method = "lm", color = "darkgreen") +
  labs(title = "Polity5 vs Mortalidade Log", x = "Polity Score", y = "Log Mortalidade COVID-19")
```

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

Polity5 vs Mortalidade Log
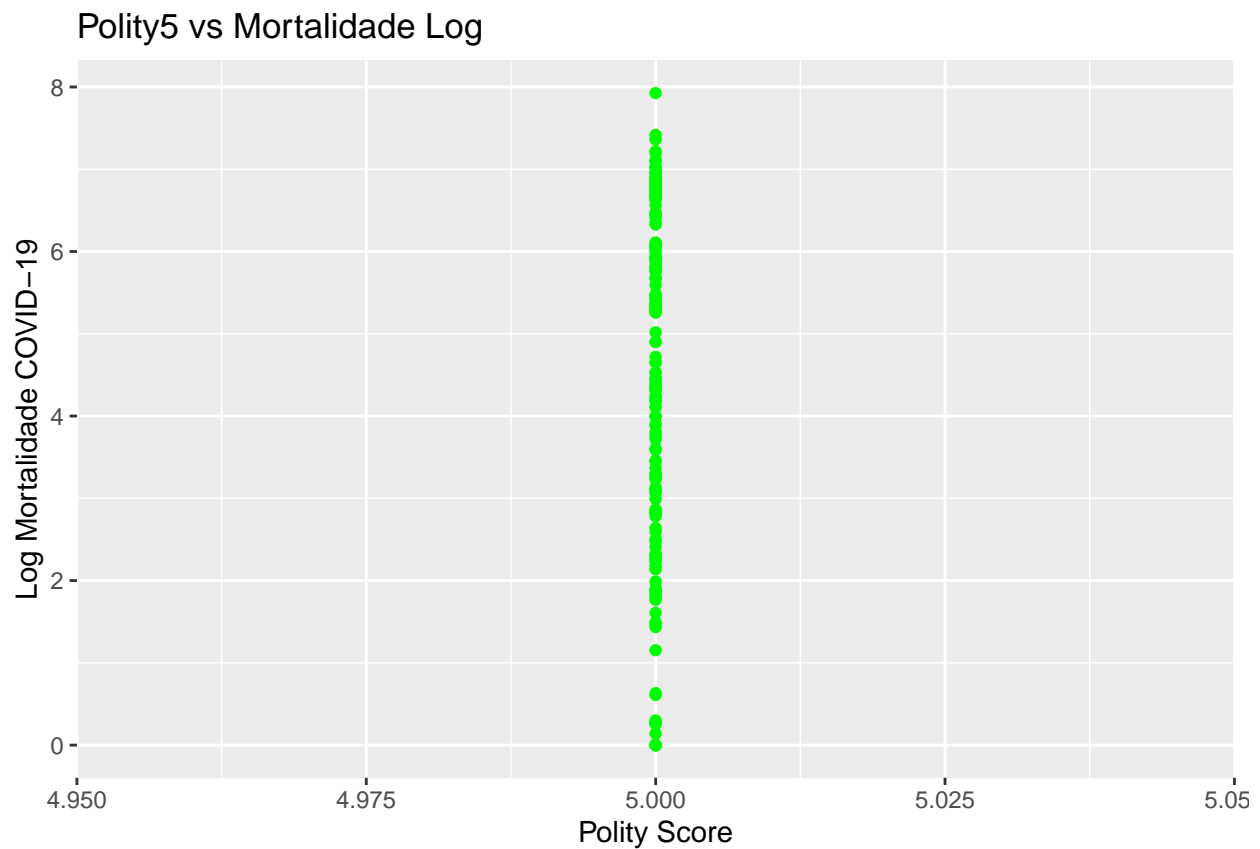

```
# Freedom House
ggplot(merged_clean, aes(x = fh_total, y = log_mortality)) +
  geom_point(color = "red") +
  geom_smooth(method = "lm", color = "darkred") +
  labs(title = "Freedom House vs Mortalidade Log", x = "Freedom House Total", y = "Log Mortalidade COVI
```

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

```
## Warning: Removed 2 rows containing non-finite outside the scale range
## (`stat_smooth()`).
```

```
## Warning: Removed 2 rows containing missing values or values outside the scale range
## (`geom_point()`).
```

Freedom House vs Mortalidade Log
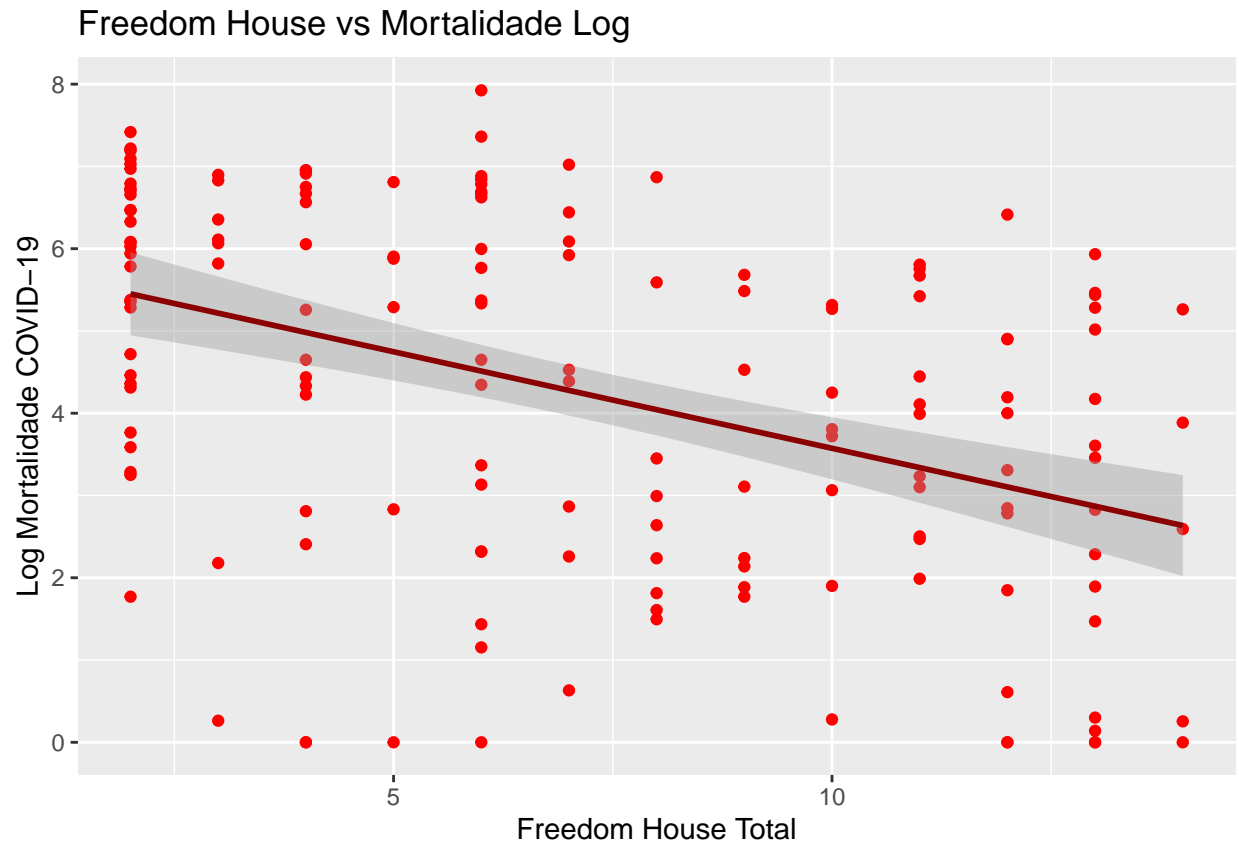

```r
# 10. INFORMAÇÕES DA SESSÃO R
sessionInfo()
```

```
## R version 4.3.1 (2023-06-16 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 11 x64 (build 26100)
##
## Matrix products: default
##
##
## locale:
## [1] LC_COLLATE=Portuguese_Brazil.utf8  LC_CTYPE=Portuguese_Brazil.utf8
## [3] LC_MONETARY=Portuguese_Brazil.utf8 LC_NUMERIC=C
## [5] LC_TIME=Portuguese_Brazil.utf8
##
## time zone: America/Sao_Paulo
## tzcode source: internal
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] lmtest_0.9-40       zoo_1.8-13         sandwich_3.1-1
##  [4] ggplot2_3.5.2       broom_1.0.10       WDI_2.7.9
##  [7] democracyData_0.5.1 countrycode_1.6.1  readxl_1.4.5
```

```
## [10] readr_2.1.5          dplyr_1.1.4
##
## loaded via a namespace (and not attached):
##  [1] tidyselect_1.2.1    farver_2.1.2         R.utils_2.13.0
##  [4] fastmap_1.2.0       digest_0.6.33       timechange_0.3.0
##  [7] lifecycle_1.0.4     Deriv_4.1.6         dcurver_0.9.2
## [10] cluster_2.1.8.1     mirt_1.45.1         magrittr_2.0.3
## [13] compiler_4.3.1      rlang_1.1.1         tools_4.3.1
## [16] utf8_1.2.6          yaml_2.3.10         knitr_1.50
## [19] labeling_0.4.3      curl_6.2.2          bit_4.6.0
## [22] plyr_1.8.9          xml2_1.3.8          withr_3.0.2
## [25] purrr_1.0.4         R.oo_1.27.1         grid_4.3.1
## [28] stats4_4.3.1        colorspace_2.1-1    future_1.58.0
## [31] progressr_0.15.1    GPArotation_2025.3-1 globals_0.18.0
## [34] scales_1.3.0        MASS_7.3-60         cli_3.6.1
## [37] crayon_1.5.3        rmarkdown_2.29      vegan_2.7-1
## [40] generics_0.1.4      rstudioapi_0.17.1   future.apply_1.20.0
## [43] httr_1.4.7          SimDesign_2.21      tzdb_0.5.0
## [46] sessioninfo_1.2.3   pbapply_1.7-2       stringr_1.5.1
## [49] audio_0.1-11        splines_4.3.1       parallel_4.3.1
## [52] cellranger_1.1.0    beepr_2.0           vctrs_0.6.5
## [55] Matrix_1.6-5        jsonlite_2.0.0      hms_1.1.3
## [58] bit64_4.6.0-1       fuzzyjoin_0.1.6.1   listenv_0.9.1
## [61] testthat_3.2.3      clipr_0.8.0         tidyr_1.3.1
## [64] bibtex_0.5.1        glue_1.8.0          parallelly_1.45.0
## [67] RefManageR_1.4.0    codetools_0.2-20    lubridate_1.9.4
## [70] stringi_1.8.7       gtable_0.3.6        munsell_0.5.1
## [73] tibble_3.2.1        pillar_1.11.0       htmltools_0.5.8.1
## [76] brio_1.1.5          R6_2.6.1            vroom_1.6.5
## [79] evaluate_1.0.5      lattice_0.22-7      haven_2.5.4
## [82] R.methodsS3_1.8.2   backports_1.5.0     Rcpp_1.0.14
## [85] gridExtra_2.3       nlme_3.1-168        permute_0.9-8
## [88] mgcv_1.9-3          xfun_0.52           forcats_1.0.0
## [91] pkgconfig_2.0.3
```