Jam

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```r
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ---------------------- tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.0     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
## -- Conflicts --------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(corrplot)
```

```
## corrplot 0.95 loaded
```

```r
library(ggplot2)
library(dbplyr)
```

```
##
## Attaching package: 'dbplyr'
##
## The following objects are masked from 'package:dplyr':
##
##     ident, sql
```

```r
library(colorspace)
library(tidyr)
library(astsa)
library(sf)
```

```
## Linking to GEOS 3.11.2, GDAL 3.8.2, PROJ 9.3.1; sf_use_s2() is TRUE
```

```r
# data upload
age_consent <- read.csv("data/Age-of-Sexual-Consent.csv")
slavery_index <- read.csv("data/Global_Slavery_Index_2023.csv")
marriage <- read.csv("data/Percentage-of-Females-Married-by-15-years-old.csv")
```

```
human_trafficking <- read.csv("data/human-trafficking-victims_new.csv")

inequality <- read.csv("data/Gender_Inequality_Index.csv")

nrow(age_consent) #201
```

```
## [1] 201
```

```
nrow(slavery_index) # 180
```

```
## [1] 180
```

```
nrow(marriage) #202
```

```
## [1] 202
```

```
nrow(human_trafficking) # 364
```

```
## [1] 364
```

```
head(human_trafficking) # 84
```

```
##           Entity Code Year Detected.victims.of.human.trafficking
## 1 Burkina Faso  BFA 2007                                   289
## 2      Colombia  COL 2007                                     6
## 3       Germany  DEU 2007                                     7
## 4          Mali  MLI 2007                                     5
## 5   Netherlands  NLD 2007                                    16
## 6        Norway  NOR 2007                                    19
```

```
unique(human_trafficking$Entity)
```

```
##  [1] "Burkina Faso"           "Colombia"        "Germany"
##  [4] "Mali"                   "Netherlands"     "Norway"
##  [7] "Philippines"            "Romania"         "Serbia"
## [10] "Tajikistan"             "Togo"            "Belarus"
## [13] "Ghana"                  "Mexico"          "Qatar"
## [16] "Armenia"                "Bolivia"         "Nepal"
## [19] "Paraguay"               "Peru"            "United Kingdom"
## [22] "Argentina"              "Egypt"           "Ireland"
## [25] "Myanmar"                "Nigeria"         "United States"
## [28] "Bosnia and Herzegovina" "Bulgaria"        "Congo"
## [31] "Dominican Republic"     "Moldova"         "Venezuela"
## [34] "Canada"                 "Czechia"         "Ecuador"
## [37] "Honduras"               "Italy"           "Jamaica"
## [40] "Mozambique"             "Thailand"        "Uzbekistan"
## [43] "Guinea"                 "Uganda"          "Guatemala"
## [46] "Hungary"                "Laos"            "Austria"
```

```
## [49] "Denmark"            "France"              "Lithuania"
## [52] "Mauritius"          "Niger"               "Turkey"
## [55] "Ukraine"            "Algeria"             "Cote d'Ivoire"
## [58] "Croatia"            "Finland"             "Greece"
## [61] "Slovakia"           "Tunisia"             "Angola"
## [64] "Benin"              "Cameroon"            "India"
## [67] "Kazakhstan"         "Malaysia"            "Morocco"
## [70] "Russia"             "Brazil"              "El Salvador"
## [73] "Estonia"            "Indonesia"           "Namibia"
## [76] "South Africa"       "Spain"               "Sudan"
## [79] "Costa Rica"         "Iraq"                "Lebanon"
## [82] "Portugal"           "North Macedonia"     "Sierra Leone"
```

```
head(age_consent)
```

```
##           Country  Age.Of.Consent
## 1    Afghanistan Must be married
## 2        Albania              14
## 3        Algeria              16
## 4 American Samoa              16
## 5        Andorra              16
## 6         Angola              12
```

```
head(slavery_index)
```

```
##               Country    Population                 Region
## 1         Afghanistan  38,928,000     Asia and the Pacific
## 2             Albania   2,878,000  Europe and Central Asia
## 3             Algeria  43,851,000                   Africa
## 4              Angola  32,866,000                   Africa
## 5 Antigua and Barbuda      98,000                 Americas
## 6           Argentina  45,196,000                 Americas
##   Estimated.prevalence.of.modern.slavery.per.1.000.population
## 1                                                        13.0
## 2                                                        11.8
## 3                                                         1.9
## 4                                                         4.1
## 5                                                          NA
## 6                                                         4.2
##   Estimated.number.of.people.in.modern.slavery
## 1                                       505,000
## 2                                        34,000
## 3                                        84,000
## 4                                       136,000
## 5
## 6                                       189,000
```

```
slavery_index <- slavery_index |>
  rename(Per_1000 = Estimated.prevalence.of.modern.slavery.per.1.000.population) |>
  rename(Num_modern_slavery = Estimated.number.of.people.in.modern.slavery)
```

```
head(marriage)
```

```
##      Countries Percentage.of.Females.Married.by.15.years.old
## 1 Afghanistan                                             10
## 2     Albania                                              1
## 3     Algeria                                              0
## 4     Andorra                                              -
## 5      Angola                                              8
## 6    Anguilla                                              -
```

```
marriage <- marriage |>
  rename(Percent_married_15 = Percentage.of.Females.Married.by.15.years.old) |>
  rename(Country = Countries)

head(human_trafficking)
```

```
##          Entity Code Year Detected.victims.of.human.trafficking
## 1 Burkina Faso  BFA 2007                                    289
## 2     Colombia  COL 2007                                      6
## 3      Germany  DEU 2007                                      7
## 4         Mali  MLI 2007                                      5
## 5  Netherlands  NLD 2007                                     16
## 6       Norway  NOR 2007                                     19
```

```
human_trafficking <- human_trafficking |>
  rename(Detected_Number = Detected.victims.of.human.trafficking) |>
  rename(Country = Entity)

#slavery_index |> group_by(Region)
```

```
slavery_index <- left_join(slavery_index, age_consent, by = "Country")

slavery_index <- left_join(slavery_index, marriage, by = "Country")

#slavery_index <- slavery_index |> mutate(across(everything(), ~replace_na(.x, NA)))

head(slavery_index)
```

```
##                 Country     Population                 Region Per_1000
## 1           Afghanistan  38,928,000     Asia and the Pacific     13.0
## 2               Albania   2,878,000 Europe and Central Asia     11.8
## 3               Algeria  43,851,000                  Africa      1.9
## 4                Angola  32,866,000                  Africa      4.1
## 5   Antigua and Barbuda      98,000                Americas       NA
## 6             Argentina  45,196,000                Americas      4.2
##   Num_modern_slavery  Age.Of.Consent Percent_married_15
## 1            505,000 Must be married                 10
## 2             34,000              14                  1
## 3             84,000              16                  0
## 4            136,000              12                  8
## 5                                 16                  -
## 6            189,000              18                  2
```

```r
# slavery_index <- slavery_index |>
#   mutate(Percent_married_15 = recode(Percent_married_15, - = NA))

#slavery_index[5, "Percent_married_15"]

# Column Prep

slavery_index$Num_modern_slavery <- replace(slavery_index$Num_modern_slavery,
                                   slavery_index$Num_modern_slavery=="", NA)

slavery_index$Num_modern_slavery <- as.numeric(gsub(",","",slavery_index$Num_modern_slavery))

slavery_index$Population <- as.double(gsub(",","",slavery_index$Population))
```

```
## Warning: NAs introduced by coercion
```

```r
slavery_index$Percent_married_15 <- as.double(replace(slavery_index$Percent_married_15, slavery_index$P

slavery_index |> group_by(Region)
```

```
## # A tibble: 180 x 7
## # Groups:   Region [5]
##    Country          Population Region Per_1000 Num_modern_slavery Age.Of.Consent
##    <chr>                 <dbl> <chr>     <dbl>              <dbl> <chr>
##  1 Afghanistan        38928000 Asia ~     13                505000 Must be marri~
##  2 Albania             2878000 Europ~     11.8                34000 14
##  3 Algeria            43851000 Africa      1.9                84000 16
##  4 Angola             32866000 Africa      4.1               136000 12
##  5 Antigua and Bar~      98000 Ameri~     NA                     NA 16
##  6 Argentina          45196000 Ameri~      4.2               189000 18
##  7 Armenia             2963000 Europ~      8.9                26000 16
##  8 Australia          25500000 Asia ~      1.6                41000 16
##  9 Austria             9006000 Europ~      1.9                17000 14
## 10 Azerbaijan         10139000 Europ~     10.6               107000 16
## # i 170 more rows
## # i 1 more variable: Percent_married_15 <dbl>
```

```r
unique(slavery_index$Region)
```

```
## [1] "Asia and the Pacific"     "Europe and Central Asia"
## [3] "Africa"                   "Americas"
## [5] "Arab States"
```

```r
Asia_Pacific_sum <- sum(slavery_index |> filter(Region == "Asia and the Pacific") |> select("Num_modern_

Americas_sum <- sum(slavery_index |> filter(Region == "Americas") |> select("Num_modern_slavery"), na.rm

Euro_Central_Asia_sum <- sum(slavery_index |>
                       filter(Region == "Europe and Central Asia") |>
                       select("Num_modern_slavery"), na.rm = T)
```

```r
Africa_sum <- sum(slavery_index |>
                            filter(Region == "Africa") |>
                            select("Num_modern_slavery"), na.rm = T)

Arab_States_sum <- sum(slavery_index |>
                            filter(Region == "Arab States") |>
                            select("Num_modern_slavery"), na.rm = T)

Regions <- data.frame(
  Region = c("Asia and the Pacific",
             "Americas", "Europe and Central Asia",
             "Africa", "Arab States"),
  Modern_Slavery = c(Asia_Pacific_sum,
                     Americas_sum, Euro_Central_Asia_sum,
                     Africa_sum, Arab_States_sum)
)

(regions_graph <- Regions |> ggplot(aes(x = Region, y = Modern_Slavery)) +
  geom_col(fill = "cornflowerblue", col = "royalblue4"))
```
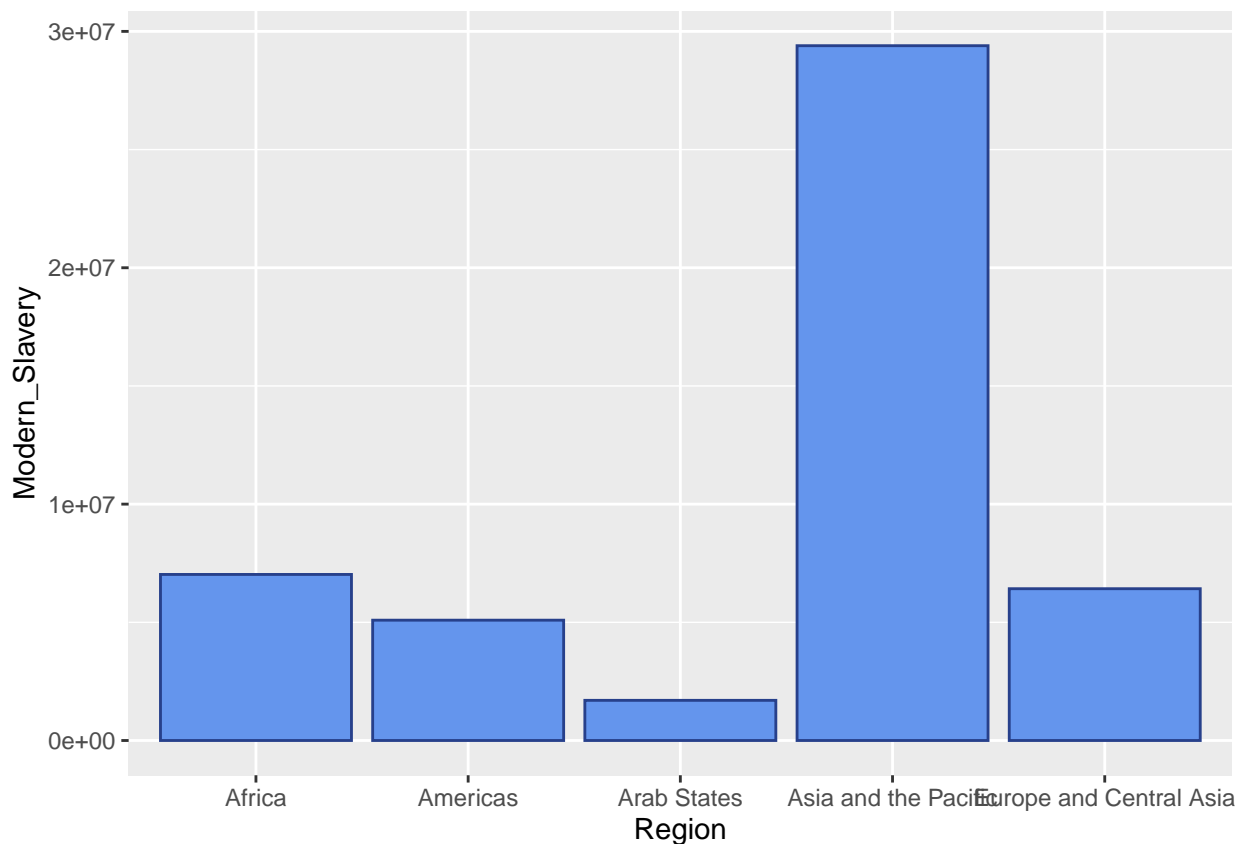


```r
aocplot <- as.double(replace(age_consent$Age.Of.Consent, age_consent$Age.Of.Consent=="Must be married",

df1 <- data.frame(x = aocplot, y = 1:201)

ggplot(df1, aes(x=aocplot)) +
  geom_bar()
```
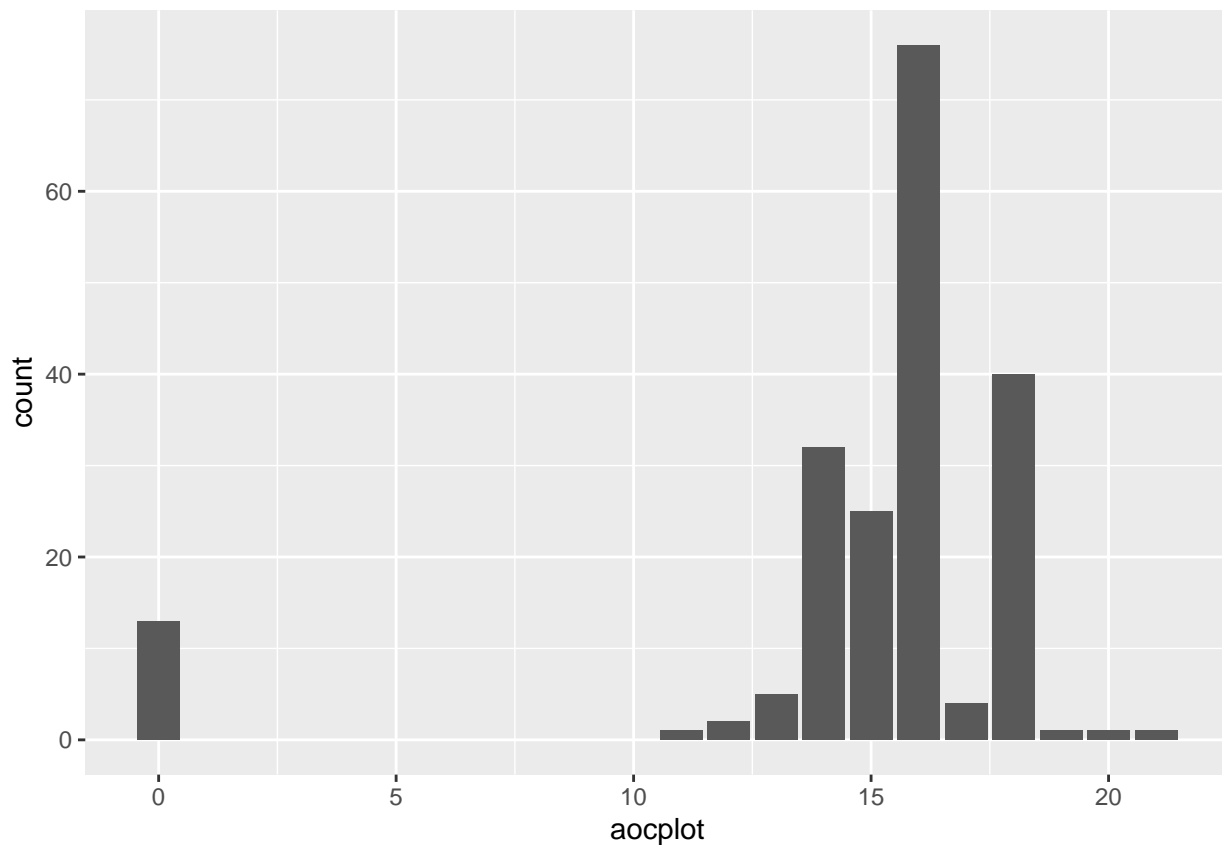
```
country_max <- slavery_index[which.max(slavery_index$Per_1000), ]
country_min <- slavery_index[which.min(slavery_index$Per_1000), ]

slavery_index |> arrange(desc(Per_1000))
```

```
##                        Country Population                Region
## 1                  North Korea   25779000     Asia and the Pacific
## 2                      Eritrea    3546000                   Africa
## 3                   Mauritania    4650000                   Africa
## 4                 Saudi Arabia   34814000              Arab States
## 5                      Türkiye   84339000 Europe and Central Asia
## 6                   Tajikistan    9538000 Europe and Central Asia
## 7         United Arab Emirates    9890000              Arab States
## 8                  Afghanistan   38928000     Asia and the Pacific
## 9                       Kuwait    4271000              Arab States
## 10                      Russia  145934000 Europe and Central Asia
## 11                     Ukraine   43734000 Europe and Central Asia
## 12             North Macedonia    2083000 Europe and Central Asia
## 13                     Myanmar   54410000     Asia and the Pacific
## 14                Turkmenistan    6031000 Europe and Central Asia
## 15                     Albania    2878000 Europe and Central Asia
## 16                     Belarus    9449000 Europe and Central Asia
## 17                  Kazakhstan   18777000 Europe and Central Asia
## 18                  Azerbaijan   10139000 Europe and Central Asia
## 19                    Pakistan  220892000     Asia and the Pacific
## 20             Papua New Guinea    8947000     Asia and the Pacific
```

```
## 21              South Sudan   11194000                     Africa
## 22    Bosnia and Herzegovina    3281000 Europe and Central Asia
## 23                   Jordan   10203000              Arab States
## 24                  Moldova    4034000 Europe and Central Asia
## 25                Venezuela   28436000                 Americas
## 26                  Armenia    2963000 Europe and Central Asia
## 27               Kyrgyzstan    6524000 Europe and Central Asia
## 28                    Syria   17501000              Arab States
## 29                 Bulgaria    6948000 Europe and Central Asia
## 30                    Haiti   11403000                 Americas
## 31               El Salvador   6486000                 Americas
## 32                   Cyprus    1207000 Europe and Central Asia
## 33                    India 1380004000    Asia and the Pacific
## 34                   Kosovo         NA Europe and Central Asia
## 35     Republic of the Congo   5518000                  Africa
## 36                 Colombia   50883000                 Americas
## 37         Equatorial Guinea   1403000                  Africa
## 38                  Georgia    3989000 Europe and Central Asia
## 39                Guatemala   17916000                 Americas
## 40                  Nigeria  206140000                  Africa
## 41              Philippines  109581000    Asia and the Pacific
## 42                 Slovakia    5460000 Europe and Central Asia
## 43                  Ecuador   17643000                 Americas
## 44                    Gabon    2226000                  Africa
## 45                  Lebanon    6825000              Arab States
## 46                  Burundi   11891000                  Africa
## 47                  Romania   19238000 Europe and Central Asia
## 48               Uzbekistan   33469000 Europe and Central Asia
## 49             Côte d'Ivoire  26378000                  Africa
## 50                  Jamaica    2961000                 Americas
## 51                Nicaragua    6625000                 Americas
## 52                  Bolivia   11673000                 Americas
## 53               Bangladesh  164689000    Asia and the Pacific
## 54                 Djibouti     988000                  Africa
## 55                     Iran   83993000    Asia and the Pacific
## 56                     Peru   32972000                 Americas
## 57                 Honduras    9905000                 Americas
## 58                   Serbia    8737000 Europe and Central Asia
## 59                    Libya    6871000                  Africa
## 60                    Qatar    2881000              Arab States
## 61                  Bahrain    1702000              Arab States
## 62                Indonesia  273524000    Asia and the Pacific
## 63       Dominican Republic   10848000                 Americas
## 64                  Hungary    9660000 Europe and Central Asia
## 65                   Mexico  128933000                 Americas
## 66                   Gambia    2417000                  Africa
## 67                     Oman    5107000              Arab States
## 68                Sri Lanka   21413000    Asia and the Pacific
## 69                   Greece   10423000 Europe and Central Asia
## 70                 Paraguay    7133000                 Americas
## 71                 Ethiopia  114964000                  Africa
## 72                 Malaysia   32366000    Asia and the Pacific
## 73                  Somalia   15893000                  Africa
## 74                Lithuania    2722000 Europe and Central Asia
```

```
## 75                       Timor-Leste    1318000    Asia and the Pacific
## 76                             Yemen   29826000             Arab States
## 77                              Chad   16426000                  Africa
## 78                          Cameroon   26546000                  Africa
## 79                          Thailand   69800000    Asia and the Pacific
## 80                              Iraq   40223000             Arab States
## 81                            Poland   37847000 Europe and Central Asia
## 82                              Cuba   11327000                Americas
## 83          Central African Republic    4830000                  Africa
## 84                           Croatia    4105000 Europe and Central Asia
## 85                           Lao PDR    7276000    Asia and the Pacific
## 86                              Mali   20251000                  Africa
## 87                            Zambia   18384000                  Africa
## 88                            Brazil  212559000                Americas
## 89                          Cambodia   16719000    Asia and the Pacific
## 90                             Kenya   53771000                  Africa
## 91                          Zimbabwe   14863000                  Africa
## 92                            Malawi   19130000                  Africa
## 93                            Panama    4315000                Americas
## 94               Trinidad and Tobago    1399000                Americas
## 95                        Madagascar   27691000                  Africa
## 96                             Niger   24207000                  Africa
## 97  Democratic Republic of the Congo   89561000                  Africa
## 98                     Guinea-Bissau    1968000                  Africa
## 99                          Slovenia    2079000 Europe and Central Asia
## 100                            Egypt  102334000                  Africa
## 101                           Rwanda   12952000                  Africa
## 102                        Argentina   45196000                Americas
## 103                          Czechia   10709000 Europe and Central Asia
## 104                           Guyana     787000                Americas
## 105                           Uganda   45741000                  Africa
## 106                           Angola   32866000                  Africa
## 107                          Estonia    1327000 Europe and Central Asia
## 108                         Viet Nam   97339000    Asia and the Pacific
## 109                            China 1439324000    Asia and the Pacific
## 110                           Guinea   13133000                  Africa
## 111                         Mongolia    3278000    Asia and the Pacific
## 112                            Sudan   43849000                  Africa
## 113                           Israel    8656000 Europe and Central Asia
## 114                         Portugal   10197000 Europe and Central Asia
## 115                     Burkina Faso   20903000                  Africa
## 116                         Eswatini    1160000                  Africa
## 117                      South Korea   51269000    Asia and the Pacific
## 118                           Latvia    1886000 Europe and Central Asia
## 119                     Sierra Leone    7977000                  Africa
## 120                            Italy   60462000 Europe and Central Asia
## 121                            Nepal   29137000    Asia and the Pacific
## 122                             Togo    8279000                  Africa
## 123         United States of America  331003000                Americas
## 124                            Chile   19116000                Americas
## 125                       Costa Rica    5094000                Americas
## 126                          Liberia    5058000                  Africa
## 127                            Benin   12123000                  Africa
## 128                       Mozambique   31255000                  Africa
```

```
## 129                            Ghana   31073000                      Africa
## 130                          Senegal   16744000                      Africa
## 131                         Tanzania   59734000                      Africa
## 132                        Hong Kong    7497000    Asia and the Pacific
## 133                     South Africa   59309000                      Africa
## 134                          Namibia    2541000                      Africa
## 135                          Morocco   36911000                      Africa
## 136                            Spain   46755000 Europe and Central Asia
## 137                          Tunisia   11819000                      Africa
## 138                           France   65274000 Europe and Central Asia
## 139                        Singapore    5850000    Asia and the Pacific
## 140                          Algeria   43851000                      Africa
## 141                          Austria    9006000 Europe and Central Asia
## 142                          Uruguay    3474000                    Americas
## 143                         Botswana    2352000                      Africa
## 144                           Canada   37742000                    Americas
## 145                   United Kingdom   67886000 Europe and Central Asia
## 146                           Taiwan   23817000    Asia and the Pacific
## 147                        Australia   25500000    Asia and the Pacific
## 148                          Lesotho    2142000                      Africa
## 149                      New Zealand    4822000    Asia and the Pacific
## 150                        Mauritius    1272000                      Africa
## 151                          Finland    5541000 Europe and Central Asia
## 152                          Ireland    4938000 Europe and Central Asia
## 153                            Japan  126476000    Asia and the Pacific
## 154                          Belgium   11590000 Europe and Central Asia
## 155                          Denmark    5792000 Europe and Central Asia
## 156                          Germany   83784000 Europe and Central Asia
## 157                      Netherlands   17135000 Europe and Central Asia
## 158                           Sweden   10099000 Europe and Central Asia
## 159                           Norway    5421000 Europe and Central Asia
## 160                      Switzerland    8655000 Europe and Central Asia
## 161              Antigua and Barbuda      98000                    Americas
## 162                          Bahamas     393000                    Americas
## 163                         Barbados     287000                    Americas
## 164                           Belize     398000                    Americas
## 165                Brunei Darussalam     437000    Asia and the Pacific
## 166                       Cape Verde         NA                      Africa
## 167                             Fiji     896000    Asia and the Pacific
## 168                          Iceland     341000 Europe and Central Asia
## 169                    Liechtenstein         NA Europe and Central Asia
## 170                       Luxembourg     626000 Europe and Central Asia
## 171                         Maldives     541000    Asia and the Pacific
## 172                            Malta     442000 Europe and Central Asia
## 173                       Montenegro     628000 Europe and Central Asia
## 174                            Palau         NA    Asia and the Pacific
## 175                      Saint Lucia     184000                    Americas
## 176 Saint Vincent and the Grenadines     111000                    Americas
## 177                       Seychelles      98000                      Africa
## 178                  Solomon Islands     687000    Asia and the Pacific
## 179                         Suriname     587000                    Americas
## 180                          Vanuatu     307000    Asia and the Pacific
##     Per_1000 Num_modern_slavery  Age.Of.Consent Percent_married_15
## 1      104.6           2696000              15                 NA
```

10

```
## 2     90.3         320000                18          13.0
## 3     32.0         149000                16          16.0
## 4     21.3         740000 Must be married            NA
## 5     15.6        1320000            <NA>             2.0
## 6     14.0         133000                16           0.0
## 7     13.4         132000 Must be married            NA
## 8     13.0         505000 Must be married           10.0
## 9     13.0          55000 Must be married            NA
## 10    13.0        1899000                16           NA
## 11    12.8         559000                16           0.0
## 12    12.6          26000            <NA>             0.0
## 13    12.1         657000                14           2.0
## 14    11.9          72000                16           0.0
## 15    11.8          34000                14           1.0
## 16    11.3         107000                16           0.0
## 17    11.1         208000                16           0.0
## 18    10.6         107000                16           2.0
## 19    10.6        2349000 Must be married             4.0
## 20    10.3          93000                16           8.0
## 21    10.3         115000                18           9.0
## 22    10.1          33000            <NA>             0.0
## 23    10.0         102000                16           2.0
## 24     9.5          38000                16           NA
## 25     9.5         270000                16           NA
## 26     8.9          26000                16           0.0
## 27     8.7          57000                16           0.0
## 28     8.7         153000                15           NA
## 29     8.5          59000                14           NA
## 30     8.2          94000                18           2.0
## 31     8.1          52000                18           4.0
## 32     8.0          10000                17           NA
## 33     8.0       11050000                18           5.0
## 34     8.0          14000            <NA>             NA
## 35     8.0          44000                18           NA
## 36     7.8         397000                14           5.0
## 37     7.8          11000                18           9.0
## 38     7.8          31000                16           0.0
## 39     7.8         140000                18           6.0
## 40     7.8        1611000                11          12.0
## 41     7.8         859000                12           2.0
## 42     7.7          42000            <NA>             NA
## 43     7.6         135000                14           4.0
## 44     7.6          17000                18           3.0
## 45     7.6          52000                18           1.0
## 46     7.5          89000                18           3.0
## 47     7.5         145000                15           0.5
## 48     7.4         249000                16           0.0
## 49     7.3         193000            <NA>             7.0
## 50     7.3          22000                16           1.0
## 51     7.3          49000                18          10.0
## 52     7.2          83000                14           NA
## 53     7.1        1162000                14          16.0
## 54     7.1           7000                18           1.0
## 55     7.1         597000 Must be married            NA
```

```
## 56      7.1         234000            14               2.0
## 57      7.0          69000            15               9.0
## 58      7.0          61000            14               1.0
## 59      6.8          47000 Must be married              NA
## 60      6.8          20000 Must be married             0.0
## 61      6.7          11000            21               NA
## 62      6.7        1833000            16               2.0
## 63      6.6          72000            18               9.0
## 64      6.6          63000            14               NA
## 65      6.6         850000            17               4.0
## 66      6.5          16000            18               6.0
## 67      6.5          33000 Must be married             1.0
## 68      6.5         139000            16               1.0
## 69      6.4          66000            15               NA
## 70      6.4          46000            14               4.0
## 71      6.3         727000            18              14.0
## 72      6.3         202000            16               NA
## 73      6.2          98000            18               8.0
## 74      6.1          17000            16               0.0
## 75      6.1           8000          <NA>               3.0
## 76      6.0         180000 Must be married             7.0
## 77      5.9          97000            14              24.0
## 78      5.8         155000            16              11.0
## 79      5.7         401000            15               6.0
## 80      5.5         221000            18               7.0
## 81      5.5         209000            15               NA
## 82      5.4          61000            16               5.0
## 83      5.2          25000          <NA>              26.0
## 84      5.2          22000            15               NA
## 85      5.2          38000          <NA>               NA
## 86      5.2         106000            18              16.0
## 87      5.1          94000            16               5.0
## 88      5.0        1053000            14               6.0
## 89      5.0          83000            15               2.0
## 90      5.0         269000            18               2.0
## 91      5.0          74000            16               5.0
## 92      4.9          93000            14               8.0
## 93      4.7          20000            18               7.0
## 94      4.7           7000            16               1.0
## 95      4.6         127000            14              13.0
## 96      4.6         112000            13              28.0
## 97      4.5         407000            14               8.0
## 98      4.5           9000          <NA>               8.0
## 99      4.4           9000            15               NA
## 100     4.3         442000            18               2.0
## 101     4.3          55000            18               0.0
## 102     4.2         189000            18               2.0
## 103     4.2          45000          <NA>               NA
## 104     4.2           3000          <NA>               6.0
## 105     4.2         190000            18               7.0
## 106     4.1         136000            12               8.0
## 107     4.1           5000            14               NA
## 108     4.1         396000          <NA>               1.0
## 109     4.0        5771000            14               0.0
```

```
## 110    4.0      53000               15          17.0
## 111    4.0      13000               16           1.0
## 112    4.0     174000 Must be married           12.0
## 113    3.8      33000               16            NA
## 114    3.8      39000               14            NA
## 115    3.7      77000               13           9.0
## 116    3.6       4000             <NA>           0.0
## 117    3.5     180000               20            NA
## 118    3.4       6000               16            NA
## 119    3.4      27000               18           9.0
## 120    3.3     197000               14            NA
## 121    3.3      97000               16           6.0
## 122    3.3      28000               16           6.0
## 123    3.3    1091000             <NA>            NA
## 124    3.2      61000               18            NA
## 125    3.2      16000               15           2.0
## 126    3.1      16000               18           6.0
## 127    3.0      37000               18           6.0
## 128    3.0      93000             <NA>          17.0
## 129    2.9      91000               16           3.0
## 130    2.9      49000               16           9.0
## 131    2.9     171000               18            NA
## 132    2.8      21000             <NA>            NA
## 133    2.7     158000               16           1.0
## 134    2.4       6000               16           2.0
## 135    2.3      85000             <NA>           1.0
## 136    2.3     108000               16            NA
## 137    2.3      27000               18           0.0
## 138    2.1     135000               15            NA
## 139    2.1      12000               16           0.0
## 140    1.9      84000               16           0.0
## 141    1.9      17000               14            NA
## 142    1.9       7000               15           1.0
## 143    1.8       4000               16            NA
## 144    1.8      69000               16            NA
## 145    1.8     122000               16            NA
## 146    1.7      40000               16            NA
## 147    1.6      41000               16            NA
## 148    1.6       4000               16           1.0
## 149    1.6       8000               16            NA
## 150    1.5       2000               14            NA
## 151    1.4       8000               16            NA
## 152    1.1       5000               17            NA
## 153    1.1     144000               13            NA
## 154    1.0      11000               16           0.0
## 155    0.6       4000               15            NA
## 156    0.6      47000               14            NA
## 157    0.6      10000               16            NA
## 158    0.6       6000               15            NA
## 159    0.5       3000               16           0.0
## 160    0.5       4000               16            NA
## 161     NA         NA               16            NA
## 162     NA         NA               16            NA
## 163     NA         NA               16           8.0
```

```
## 164         NA         NA            16            6.0
## 165         NA         NA          <NA>            NA
## 166         NA         NA            14            NA
## 167         NA         NA            16            0.0
## 168         NA         NA            15            NA
## 169         NA         NA            14            NA
## 170         NA         NA            16            NA
## 171         NA         NA Must be married           0.0
## 172         NA         NA            18            NA
## 173         NA         NA            14            2.0
## 174         NA         NA            16            NA
## 175         NA         NA            16            4.0
## 176         NA         NA            15            NA
## 177         NA         NA            18            NA
## 178         NA         NA            15            6.0
## 179         NA         NA            16            9.0
## 180         NA         NA            16            3.0
```

```r
slavery_index |> filter(Region == "Asia and the Pacific") |> arrange(desc(Per_1000))
```

```
##              Country Population                Region Per_1000
## 1        North Korea   25779000 Asia and the Pacific    104.6
## 2        Afghanistan   38928000 Asia and the Pacific     13.0
## 3            Myanmar   54410000 Asia and the Pacific     12.1
## 4           Pakistan  220892000 Asia and the Pacific     10.6
## 5   Papua New Guinea    8947000 Asia and the Pacific     10.3
## 6              India 1380004000 Asia and the Pacific      8.0
## 7        Philippines  109581000 Asia and the Pacific      7.8
## 8         Bangladesh  164689000 Asia and the Pacific      7.1
## 9               Iran   83993000 Asia and the Pacific      7.1
## 10         Indonesia  273524000 Asia and the Pacific      6.7
## 11         Sri Lanka   21413000 Asia and the Pacific      6.5
## 12          Malaysia   32366000 Asia and the Pacific      6.3
## 13       Timor-Leste    1318000 Asia and the Pacific      6.1
## 14          Thailand   69800000 Asia and the Pacific      5.7
## 15           Lao PDR    7276000 Asia and the Pacific      5.2
## 16          Cambodia   16719000 Asia and the Pacific      5.0
## 17          Viet Nam   97339000 Asia and the Pacific      4.1
## 18             China 1439324000 Asia and the Pacific      4.0
## 19          Mongolia    3278000 Asia and the Pacific      4.0
## 20        South Korea   51269000 Asia and the Pacific      3.5
## 21             Nepal   29137000 Asia and the Pacific      3.3
## 22         Hong Kong    7497000 Asia and the Pacific      2.8
## 23         Singapore    5850000 Asia and the Pacific      2.1
## 24            Taiwan   23817000 Asia and the Pacific      1.7
## 25         Australia   25500000 Asia and the Pacific      1.6
## 26       New Zealand    4822000 Asia and the Pacific      1.6
## 27             Japan  126476000 Asia and the Pacific      1.1
## 28 Brunei Darussalam     437000 Asia and the Pacific       NA
## 29              Fiji     896000 Asia and the Pacific       NA
## 30          Maldives     541000 Asia and the Pacific       NA
## 31             Palau         NA Asia and the Pacific       NA
## 32   Solomon Islands     687000 Asia and the Pacific       NA
## 33           Vanuatu     307000 Asia and the Pacific       NA
```

```
##    Num_modern_slavery Age.Of.Consent Percent_married_15
## 1           2696000              15                 NA
## 2            505000 Must be married                 10
## 3            657000              14                  2
## 4           2349000 Must be married                  4
## 5             93000              16                  8
## 6          11050000              18                  5
## 7            859000              12                  2
## 8           1162000              14                 16
## 9            597000 Must be married                 NA
## 10          1833000              16                  2
## 11           139000              16                  1
## 12           202000              16                 NA
## 13             8000            <NA>                  3
## 14           401000              15                  6
## 15            38000            <NA>                 NA
## 16            83000              15                  2
## 17           396000            <NA>                  1
## 18          5771000              14                  0
## 19            13000              16                  1
## 20           180000              20                 NA
## 21            97000              16                  6
## 22            21000            <NA>                 NA
## 23            12000              16                  0
## 24            40000              16                 NA
## 25            41000              16                 NA
## 26             8000              16                 NA
## 27           144000              13                 NA
## 28               NA            <NA>                 NA
## 29               NA              16                  0
## 30               NA Must be married                  0
## 31               NA              16                 NA
## 32               NA              15                  6
## 33               NA              16                  3
```

```r
# population of top 20
# area for top 20


top_20 <- slavery_index |> arrange(desc(Per_1000)) |> head(n=20)
bottom_20 <- slavery_index |> arrange(Per_1000) |> head(n=20)
```

«««< HEAD

```r
highest_pop <- slavery_index |> arrange(desc(Population))
cutoff <- quantile(slavery_index$Population, probs = 0.992, na.rm = T)
outliers <- slavery_index %>% filter(Population > cutoff)

lowest_pop <- slavery_index |> arrange(Population) |> filter(!is.na(Per_1000))

# biggest countries - don't use
biggest_pop_graph <- head(highest_pop, n=10) |> mutate(Country = as.factor(Country)) |>
  mutate(Country = fct_reorder(Country, Population, .desc = T)) |> ggplot(aes(x = Country, y = Per_1000)
```

```r
  geom_col(fill = "cornflowerblue", col = "royalblue4")

# lowest pop - don't use
lowest_pop_graph <- head(lowest_pop, n=10) |> mutate(Country = as.factor(Country)) |>
  mutate(Country = fct_reorder(Country, Population)) |>
  ggplot(aes(x = Country, y = Per_1000)) +
  geom_col(fill = "cornflowerblue", col = "royalblue4")

# top 20
top_20_graph <- top_20 |> mutate(Country = as.factor(Country))|>
  mutate(Country = fct_reorder(Country, Per_1000)) |>
  ggplot(aes(x = Country, y = Per_1000, fill = Region)) +
  geom_col() +
  coord_flip()

# bottom 20
bottom_20_graph <- bottom_20 |> mutate(Country = as.factor(Country))|>
  mutate(Country = fct_reorder(Country, Per_1000)) |>
  ggplot(aes(x = Country, y = Per_1000, fill = Region)) +
  geom_col() +
  coord_flip()

# population
population_graph <- slavery_index |> ggplot(aes(x=Population, y=Per_1000)) +
  geom_point() +
  geom_point(col = "darkslategray") +
  ylab("Modern Slavery Prevalence per 1000 People")

population_without_outliers_graph <- slavery_index |> filter(!(Country == "China" |
                                        Country == "India" | Country == "Eritrea" |
                                            Country == "North Korea")) |>
  ggplot(aes(x=Population, y=Per_1000)) +
  geom_point(col = "darkslategray") +
  ylab("Modern Slavery Prevalence per 1000 People")

# Age of Consent
age_consent_graph <- slavery_index |> ggplot(aes(x=Age.Of.Consent, y=Per_1000, col = Region)) +
  geom_point() +
  xlab("Age of Consent") +
  ylab("Modern Slavery Prevalence per 1000 People")

# Percent married before 15
percent_married_15_graph <- slavery_index |> ggplot(aes(x=Percent_married_15, y=Per_1000)) +
  geom_col(fill = "darkseagreen") +
  xlab("Percent of Females Married before age 15") +
  ylab("Modern Slavery Prevalence per 1000 People")


# all countries w/ values w/o country labels
all_countries_per_1000 <- slavery_index |> filter(!is.na(Per_1000)) |> mutate(Country = as.factor(Count
  mutate(Country = fct_reorder(Country, Per_1000)) |>
  ggplot(aes(x = Country, y = Per_1000, fill = Region)) +
  geom_col() +
```

```
  coord_flip() +
  theme(
    axis.ticks.y = element_blank(),
    axis.text.y = element_blank()
  ) +
  ylab("Modern Slavery Prevalence per 1000 People")
```

```
# correlation

x_mx <- slavery_index[, !(names(slavery_index) %in% c("Country", "Region"))] |>
  filter(!(Age.Of.Consent == "Must be married")) |> apply(2, as.double)
corr_mx <- cor(x_mx, use = "pairwise.complete.obs")

sorted_corr <- sort(corr_mx[, "Per_1000"])
```

```
slavery_index |> filter(Country == "United Kingdom")
```

```
##           Country Population                 Region Per_1000 Num_modern_slavery
## 1 United Kingdom   67886000 Europe and Central Asia      1.8             122000
##   Age.Of.Consent Percent_married_15
## 1             16                 NA
```

forced labour, forced marriage, debt bondage, human trafficking, and child exploitation

```
climate_change <- read.csv("data/climate_change_indicators.csv")
```

```
head(climate_change)
```

```
##   ObjectId                  Country ISO2 ISO3
## 1        1 Afghanistan, Islamic Rep. of   AF  AFG
## 2        2                      Albania   AL  ALB
## 3        3                      Algeria   DZ  DZA
## 4        4               American Samoa   AS  ASM
## 5        5      Andorra, Principality of   AD  AND
## 6        6                       Angola   AO  AGO
##                                                                              Indicator
## 1 Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
## 2 Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
## 3 Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
## 4 Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
## 5 Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
## 6 Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
##            Unit
## 1 Degree Celsius
## 2 Degree Celsius
## 3 Degree Celsius
## 4 Degree Celsius
## 5 Degree Celsius
## 6 Degree Celsius
##
## 1 Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Clima
## 2 Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Clima
```

```
## 3 Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Clima
## 4 Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Clima
## 5 Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Clima
## 6 Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Clima
##   CTS_Code              CTS_Name
## 1     ECCS Surface Temperature Change
## 2     ECCS Surface Temperature Change
## 3     ECCS Surface Temperature Change
## 4     ECCS Surface Temperature Change
## 5     ECCS Surface Temperature Change
## 6     ECCS Surface Temperature Change
##                                                       CTS_Full_Descriptor
## 1 Environment, Climate Change, Climate Indicators, Surface Temperature Change
## 2 Environment, Climate Change, Climate Indicators, Surface Temperature Change
## 3 Environment, Climate Change, Climate Indicators, Surface Temperature Change
## 4 Environment, Climate Change, Climate Indicators, Surface Temperature Change
## 5 Environment, Climate Change, Climate Indicators, Surface Temperature Change
## 6 Environment, Climate Change, Climate Indicators, Surface Temperature Change
##    F1961  F1962  F1963  F1964  F1965 F1966  F1967  F1968  F1969  F1970  F1971
## 1 -0.113 -0.164  0.847 -0.764 -0.244 0.226 -0.371 -0.423 -0.539  0.813  0.619
## 2  0.627  0.326  0.075 -0.166 -0.388 0.559 -0.074  0.081 -0.013 -0.106 -0.195
## 3  0.164  0.114  0.077  0.250 -0.100 0.433 -0.026 -0.067  0.291  0.116 -0.385
## 4  0.079 -0.042  0.169 -0.140 -0.562 0.181 -0.368 -0.187  0.132 -0.047 -0.477
## 5  0.736  0.112 -0.752  0.308 -0.490 0.415  0.637  0.018 -0.137  0.121 -0.326
## 6  0.041 -0.152 -0.190 -0.229 -0.196 0.175 -0.081 -0.193  0.188  0.248 -0.097
##    F1972  F1973  F1974  F1975  F1976  F1977  F1978 F1979  F1980  F1981  F1982
## 1 -1.124  0.232 -0.489 -0.445 -0.286  0.513  0.129 0.361  0.600  0.483 -0.346
## 2 -0.069 -0.288 -0.139 -0.211 -0.683  0.545 -0.814 0.203 -0.414 -0.351  0.173
## 3 -0.348 -0.015 -0.503 -0.539 -0.782  0.504  0.012 0.654  0.232  0.215  0.399
## 4 -0.067  0.330 -0.308 -0.118 -0.177  0.156  0.092 0.341  0.350  0.179  0.280
## 5 -0.499  0.025 -0.371  0.246 -0.045 -0.093 -0.163 0.058 -0.188  0.178  1.044
## 6 -0.035  0.475 -0.158 -0.029 -0.313  0.272  0.037 0.291  0.279 -0.071  0.164
##    F1983  F1984  F1985  F1986  F1987 F1988  F1989 F1990  F1991  F1992  F1993
## 1  0.164  0.145  0.283 -0.141  0.391 0.919 -0.205 0.730 -0.168 -0.294  0.220
## 2 -0.128 -0.270 -0.103  0.569 -0.106 0.370 -0.066 0.795 -0.269  0.106  0.076
## 3  0.560 -0.004  0.508  0.296  0.975 1.304  0.386 1.266  0.031 -0.312  0.552
## 4  0.313  0.277  0.256  0.394  0.354 0.509  0.143 0.497  0.641  0.344 -0.069
## 5  0.859 -0.157  0.059  0.387  0.397 0.883  1.162 1.736  0.231  0.386  0.174
## 6  0.487  0.631  0.694  0.176  0.689 0.572 -0.055 0.687  0.341  0.466  0.256
##    F1994  F1995  F1996 F1997 F1998 F1999 F2000 F2001 F2002 F2003 F2004 F2005
## 1 0.430  0.359 -0.116 0.471 0.675 1.198 0.993 1.311 1.365 0.587 1.373 0.401
## 2 1.330 -0.172 -0.038 0.075 0.795 0.670 1.065 1.532 0.492 0.970 0.444 0.189
## 3 0.732  0.595  0.846 1.059 1.109 1.476 0.820 1.856 1.258 1.585 0.988 1.264
## 4 0.189  0.755  0.784    NA    NA 0.242 0.626 0.904 1.152 0.716 0.191 0.801
## 5 1.508  1.279  0.570 1.788 1.018 1.055 1.050 1.480 0.835 1.949 0.936 0.851
## 6 0.212  0.753  0.370 0.107 1.064 0.417 0.169 0.295 0.735 0.889 0.414 1.021
##    F2006 F2007 F2008 F2009 F2010 F2011 F2012 F2013 F2014 F2015 F2016 F2017 F2018
## 1 1.720 0.675 0.704 0.895 1.613 1.397 0.223 1.281 0.456 1.093 1.555 1.540 1.544
## 2 0.345 1.316 0.978 0.910 1.191 1.055 1.487 1.333 1.198 1.569 1.464 1.121 2.028
## 3 1.395 1.220 1.185 0.945 2.265 1.398 1.147 1.192 1.690 1.121 1.757 1.512 1.210
## 4 0.403 1.032 0.670    NA 1.311 0.854 0.924 1.257 1.170 1.009 1.539 1.435 1.189
## 5 1.485 1.024 0.946 1.413 0.471 1.677 1.265 0.831 1.946 1.690 1.990 1.925 1.919
## 6 0.561 0.885 0.501 0.708 1.194 0.880 0.552 1.044 0.828 1.331 1.609 0.870 1.395
##    F2019 F2020 F2021 F2022
```

```
## 1 0.910 0.498 1.327 2.012
## 2 1.675 1.498 1.536 1.518
## 3 1.115 1.926 2.330 1.688
## 4 1.539 1.430 1.268 1.256
## 5 1.964 2.562 1.533 3.243
## 6 1.752 1.162 1.553 1.212
```

```r
# Temperature change with respect to a baseline climatology, corresponding to the period 1951-1980
# celcius

climate_change <- climate_change |> select(!c(Source, Unit,
                                     Indicator, ISO2, CTS_Code, CTS_Name, CTS_Full_Descriptor))

climate_2022 <- climate_change |> select(c(Country, ISO3, F2022))

nrow(climate_2022)
```

```
## [1] 225
```

```r
climate_2022 |> arrange(desc(F2022))
```

```
##                             Country ISO3  F2022
## 1            Andorra, Principality of  AND  3.243
## 2                              France  FRA  2.929
## 3                          Luxembourg  LUX  2.926
## 4                             Belgium  BEL  2.807
## 5                         Switzerland  CHE  2.798
## 6                              Monaco  MCO  2.737
## 7                  Kazakhstan, Rep. of  KAZ  2.712
## 8                         Kyrgyz Rep.  KGZ  2.619
## 9                 Uzbekistan, Rep. of  UZB  2.607
## 10                   Netherlands, The  NLD  2.601
## 11                            Germany  DEU  2.596
## 12                      Liechtenstein  LIE  2.534
## 13                       Turkmenistan  TKM  2.528
## 14                            Austria  AUT  2.498
## 15                              Spain  ESP  2.489
## 16                   Slovenia, Rep. of  SVN  2.435
## 17                      New Caledonia  NCL  2.421
## 18                         Czech Rep.  CZE  2.394
## 19                Iran, Islamic Rep. of  IRN  2.370
## 20                           Portugal  PRT  2.318
## 21                            Morocco  MAR  2.303
## 22                            Tunisia  TUN  2.291
## 23                             Kuwait  KWT  2.275
## 24                 Russian Federation  RUS  2.261
## 25                          Gibraltar  GIB  2.228
## 26                            Denmark  DNK  2.219
## 27                   Croatia, Rep. of  HRV  2.209
## 28                           Mongolia  MNG  2.197
## 29                               Iraq  IRQ  2.147
## 30                   Moldova, Rep. of  MDA  2.143
## 31                            Hungary  HUN  2.142
```

```
## 32                           Italy  ITA  2.135
## 33              San Marino, Rep. of  SMR  2.115
## 34                          Sweden  SWE  2.110
## 35          Bosnia and Herzegovina  BIH  2.091
## 36             Azerbaijan, Rep. of  AZE  2.080
## 37             Tajikistan, Rep. of  TJK  2.074
## 38                         Finland  FIN  2.062
## 39                 Poland, Rep. of  POL  2.056
## 40                        Holy See  VAT  2.028
## 41                     Slovak Rep.  SVK  2.018
## 42             Bahrain, Kingdom of  BHR  2.017
## 43       Afghanistan, Islamic Rep. of  AFG  2.012
## 44                  Western Sahara  ESH  1.970
## 45              Estonia, Rep. of  EST  1.961
## 46                       Lithuania  LTU  1.960
## 47                           Malta  MLT  1.955
## 48                           Latvia  LVA  1.953
## 49                          Romania  ROU  1.949
## 50        Saint Pierre and Miquelon  SPM  1.944
## 51               Serbia, Rep. of  SRB  1.938
## 52                         Ukraine  UKR  1.931
## 53             Belarus, Rep. of  BLR  1.922
## 54                          Norway  NOR  1.918
## 55                  United Kingdom  GBR  1.911
## 56          China, P.R.: Mainland  CHN  1.906
## 57                      Montenegro  MNE  1.865
## 58                           Qatar  QAT  1.855
## 59                      Cabo Verde  CPV  1.853
## 60                     Isle of Man  IMN  1.840
## 61                        Bulgaria  BGR  1.831
## 62                         Ireland  IRL  1.764
## 63                   Saudi Arabia  SAU  1.745
## 64        Mauritania, Islamic Rep. of  MRT  1.711
## 65             Armenia, Rep. of  ARM  1.707
## 66                         Algeria  DZA  1.688
## 67                   Saint Helena  SHN  1.686
## 68                Palau, Rep. of  PLW  1.672
## 69                 Korea, Rep. of  KOR  1.659
## 70   Korea, Dem. People's Rep. of  PRK  1.610
## 71                         Liberia  LBR  1.556
## 72                        Djibouti  DJI  1.547
## 73               Syrian Arab Rep.  SYR  1.535
## 74                          Bhutan  BTN  1.523
## 75                         Albania  ALB  1.518
## 76                         Georgia  GEO  1.510
## 77            United Arab Emirates  ARE  1.482
## 78                    Bahamas, The  BHS  1.480
## 79          Congo, Dem. Rep. of the  COD  1.480
## 80                         Vanuatu  VUT  1.479
## 81  Ethiopia, The Federal Dem. Rep. of  ETH  1.455
## 82                         Somalia  SOM  1.449
## 83              Brunei Darussalam  BRN  1.446
## 84                            Cuba  CUB  1.437
## 85                         Myanmar  MMR  1.436
```

```
## 86                    China, P.R.: Hong Kong  HKG  1.432
## 87                       China, P.R.: Macao  MAC  1.432
## 88                               Uganda  UGA  1.416
## 89                            Greenland  GRL  1.413
## 90                          Philippines  PHL  1.405
## 91                              Senegal  SEN  1.405
## 92          North Macedonia, Republic of  MKD  1.404
## 93                        Faroe Islands  FRO  1.396
## 94                                World  WLD  1.394
## 95                             Pakistan  PAK  1.389
## 96              Taiwan Province of China  TWN  1.383
## 97                   Lesotho, Kingdom of  LSO  1.372
## 98                  Eswatini, Kingdom of  SWZ  1.371
## 99                             Malaysia  MYS  1.367
## 100                               Jordan  JOR  1.358
## 101                       Fiji, Rep. of  FJI  1.346
## 102                                Japan  JPN  1.335
## 103                         Sierra Leone  SLE  1.328
## 104                          Gambia, The  GMB  1.323
## 105 São Tomé and Príncipe, Dem. Rep. of  STP  1.321
## 106                          New Zealand  NZL  1.319
## 107             Timor-Leste, Dem. Rep. of  TLS  1.315
## 108                            Singapore  SGP  1.311
## 109                             Suriname  SUR  1.296
## 110                        Guinea-Bissau  GNB  1.295
## 111                              Lebanon  LBN  1.290
## 112                                Kenya  KEN  1.280
## 113                               Canada  CAN  1.268
## 114                       American Samoa  ASM  1.256
## 115                               Mexico  MEX  1.249
## 116              Equatorial Guinea, Rep. of  GNQ  1.247
## 117                     Congo, Rep. of  COG  1.245
## 118                               Cyprus  CYP  1.237
## 119                       Norfolk Island  NFK  1.225
## 120                    Papua New Guinea  PNG  1.221
## 121                        United States  USA  1.217
## 122                           Bangladesh  BGD  1.216
## 123                               Angola  AGO  1.212
## 124                              Iceland  ISL  1.201
## 125                               Guinea  GIN  1.195
## 126                                Samoa  WSM  1.156
## 127                              Jamaica  JAM  1.140
## 128                                Nepal  NPL  1.132
## 129             Lao People's Dem. Rep.  LAO  1.112
## 130                                Haiti  HTI  1.095
## 131                         South Africa  ZAF  1.094
## 132                            Indonesia  IDN  1.085
## 133                               Israel  ISR  1.079
## 134                   West Bank and Gaza  PSE  1.074
## 135                               Guyana  GUY  1.066
## 136                                 Oman  OMN  1.055
## 137                             Cameroon  CMR  1.044
## 138                               Greece  GRC  1.040
## 139                      Solomon Islands  SLB  1.038
```

```
## 140                            Vietnam   VNM   1.033
## 141                  Central African Rep.   CAF   1.032
## 142                            Belize   BLZ   1.031
## 143                          Thailand   THA   1.014
## 144                         Sri Lanka   LKA   1.004
## 145                             Ghana   GHA   0.996
## 146                             Gabon   GAB   0.994
## 147              South Sudan, Rep. of   SSD   0.983
## 148                    Dominican Rep.   DOM   0.982
## 149                              Togo   TGO   0.975
## 150                    Cayman Islands   CYM   0.974
## 151         Wallis and Futuna Islands   WLF   0.951
## 152                          Cambodia   KHM   0.948
## 153         Turks and Caicos Islands   TCA   0.944
## 154                            Brazil   BRA   0.926
## 155                         Guatemala   GTM   0.916
## 156           Tanzania, United Rep. of   TZA   0.911
## 157      United States Virgin Islands   VIR   0.894
## 158                              Mali   MLI   0.887
## 159                             Benin   BEN   0.884
## 160                              Peru   PER   0.878
## 161            British Virgin Islands   VGB   0.875
## 162                          Colombia   COL   0.874
## 163                        Seychelles   SYC   0.872
## 164              Madagascar, Rep. of   MDG   0.860
## 165                       Puerto Rico   PRI   0.848
## 166                             Tonga   TON   0.846
## 167                         Nicaragua   NIC   0.842
## 168                          Anguilla   AIA   0.839
## 169              Mozambique, Rep. of   MOZ   0.834
## 170                            Malawi   MWI   0.816
## 171                       Burkina Faso   BFA   0.802
## 172                           Nigeria   NGA   0.791
## 173                             India   IND   0.790
## 174                          Maldives   MDV   0.784
## 175                        Guadeloupe   GLP   0.773
## 176                             Sudan   SDN   0.773
## 177                Antigua and Barbuda   ATG   0.770
## 178                        Montserrat   MSR   0.770
## 179               St. Kitts and Nevis   KNA   0.770
## 180                         Australia   AUS   0.754
## 181                              Chad   TCD   0.738
## 182                           Ecuador   ECU   0.736
## 183                            Panama   PAN   0.728
## 184                          Honduras   HND   0.723
## 185               Trinidad and Tobago   TTO   0.714
## 186                           Grenada   GRD   0.698
## 187     St. Vincent and the Grenadines   VCT   0.698
## 188                         St. Lucia   LCA   0.689
## 189                          Dominica   DMA   0.688
## 190                            Zambia   ZMB   0.686
## 191                        Martinique   MTQ   0.684
## 192                           Mayotte   MYT   0.678
## 193                            Tuvalu   TUV   0.663
```

```
## 194                       El Salvador  SLV   0.658
## 195               Egypt, Arab Rep. of  EGY   0.655
## 196                          Paraguay  PRY   0.649
## 197                           Bolivia  BOL   0.644
## 198                         Argentina  ARG   0.643
## 199   Micronesia, Federated States of  FSM   0.627
## 200                         Mauritius  MUS   0.595
## 201                             Libya  LBY   0.559
## 202    Venezuela, Rep. Bolivariana de  VEN   0.533
## 203              Eritrea, The State of  ERI   0.530
## 204               Comoros, Union of the  COM   0.521
## 205                      Cook Islands  COK   0.479
## 206                             Niger  NER   0.428
## 207                             Chile  CHL   0.407
## 208                           Uruguay  URY   0.382
## 209                  French Polynesia  PYF   0.359
## 210                           Namibia  NAM   0.239
## 211      Marshall Islands, Rep. of the  MHL   0.007
## 212                          Zimbabwe  ZWE  -0.490
## 213                          Botswana  BWA  -1.305
## 214   Aruba, Kingdom of the Netherlands  ABW     NA
## 215                          Barbados  BRB     NA
## 216                           Burundi  BDI     NA
## 217                        Costa Rica  CRI     NA
## 218         Falkland Islands (Malvinas)  FLK     NA
## 219                          Kiribati  KIR     NA
## 220                   Nauru, Rep. of  NRU     NA
## 221                              Niue  NIU     NA
## 222                   Pitcairn Islands  PCN     NA
## 223                            Rwanda  RWA     NA
## 224                           Tokelau  TKL     NA
## 225                 Yemen, Rep. of  YEM     NA
```

```r
climate_10_20 <- climate_change |> select(Country, ISO3, F2010:F2020) |> rowwise() |>
  mutate(mean_10_20 = mean(c_across(F2010:F2020)))

climate_10_20 |> arrange(desc(mean_10_20))
```

```
## # A tibble: 225 x 14
## # Rowwise:
##     Country    ISO3   F2010 F2011 F2012 F2013 F2014 F2015 F2016 F2017 F2018 F2019
##     <chr>      <chr>  <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1 Russian Fe~ RUS    0.88  1.70  1.93 1.17   1.75  2.25  2.46  2.13  2.04  2.18
##  2 Belarus, R~ BLR    1.46  1.02  1.56 1.21   2.18  2.25  2.20  1.59  2.34  2.69
##  3 Estonia, R~ EST    0.554 1.30  1.47 1.18   2.45  2.38  1.94  1.50  2.41  2.22
##  4 Ukraine    UKR    1.65  0.581 1.96 1.52   1.72  2.08  2.11  1.42  2.24  2.37
##  5 Latvia     LVA    0.704 1.15  1.41 1.08   2.33  2.17  1.95  1.50  2.36  2.46
##  6 Slovenia, ~ SVN    0.769 1.35  1.93 1.23   2.43  2.12  2.05  1.72  2.41  2.34
##  7 Austria    AUT    0.656 1.37  1.78 1.10   2.41  2.17  2.10  1.74  2.52  2.37
##  8 Bahrain, K~ BHR    2.29  1.43  1.38 1.40   1.69  2.24  1.60  2.08  2.25  2.11
##  9 Lithuania  LTU    0.766 0.957 1.37 0.967  2.24  2.10  1.94  1.54  2.43  2.64
## 10 Finland    FIN    0.242 1.35  1.54 1.42   2.59  2.61  2.15  1.49  2.16  1.45
## # i 215 more rows
## # i 2 more variables: F2020 <dbl>, mean_10_20 <dbl>
```

```
climate_10_20 <- climate_10_20 |> rowwise() |>
  mutate(sum_10_20 = sum(c_across(F2010:F2020)))

climate_10_20 |> arrange(desc(sum_10_20))
```

```
## # A tibble: 225 x 15
## # Rowwise:
##     Country      ISO3  F2010 F2011 F2012 F2013 F2014 F2015 F2016 F2017 F2018 F2019
##     <chr>        <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1 Russian Fe~ RUS   0.88  1.70  1.93 1.17  1.75  2.25  2.46  2.13  2.04  2.18
##  2 Belarus, R~ BLR   1.46  1.02  1.56 1.21  2.18  2.25  2.20  1.59  2.34  2.69
##  3 Estonia, R~ EST   0.554 1.30  1.47 1.18  2.45  2.38  1.94  1.50  2.41  2.22
##  4 Ukraine     UKR   1.65  0.581 1.96 1.52  1.72  2.08  2.11  1.42  2.24  2.37
##  5 Latvia      LVA   0.704 1.15  1.41 1.08  2.33  2.17  1.95  1.50  2.36  2.46
##  6 Slovenia, ~ SVN   0.769 1.35  1.93 1.23  2.43  2.12  2.05  1.72  2.41  2.34
##  7 Austria     AUT   0.656 1.37  1.78 1.10  2.41  2.17  2.10  1.74  2.52  2.37
##  8 Bahrain, K~ BHR   2.29  1.43  1.38 1.40  1.69  2.24  1.60  2.08  2.25  2.11
##  9 Lithuania   LTU   0.766 0.957 1.37 0.967 2.24  2.10  1.94  1.54  2.43  2.64
## 10 Finland     FIN   0.242 1.35  1.54 1.42  2.59  2.61  2.15  1.49  2.16  1.45
## # i 215 more rows
## # i 3 more variables: F2020 <dbl>, mean_10_20 <dbl>, sum_10_20 <dbl>
```

```
pivot <- pivot_wider(human_trafficking, names_from = Year, values_from= Detected_Number)

first <- c()
last <- c()

for(i in 1:nrow(pivot)) {
  pivmin <- pivot[i,]
  pivmin2 <- as.vector(pivmin[-c(1,2)])
  first[i] <- pivot[i, 2 + which(!is.na(pivmin2))[1]]
  last[i] <- tail(pivmin2[!is.na(pivmin2)], 1)
}

last <- as.numeric(last)
first <- as.numeric(first)
diffs <- last - first
diffs.noz <- if(length(which(diffs==0)!=0)) diffs[-which(diffs==0)]
diffs.df <- data.frame(diffs.noz[-16])

ggplot(diffs.df, aes(x = diffs.noz[-16])) +
  geom_boxplot(fill = "lightcyan3") +
  xlab("Differences in Trafficking Instances (Most Recent - Oldest)")
```
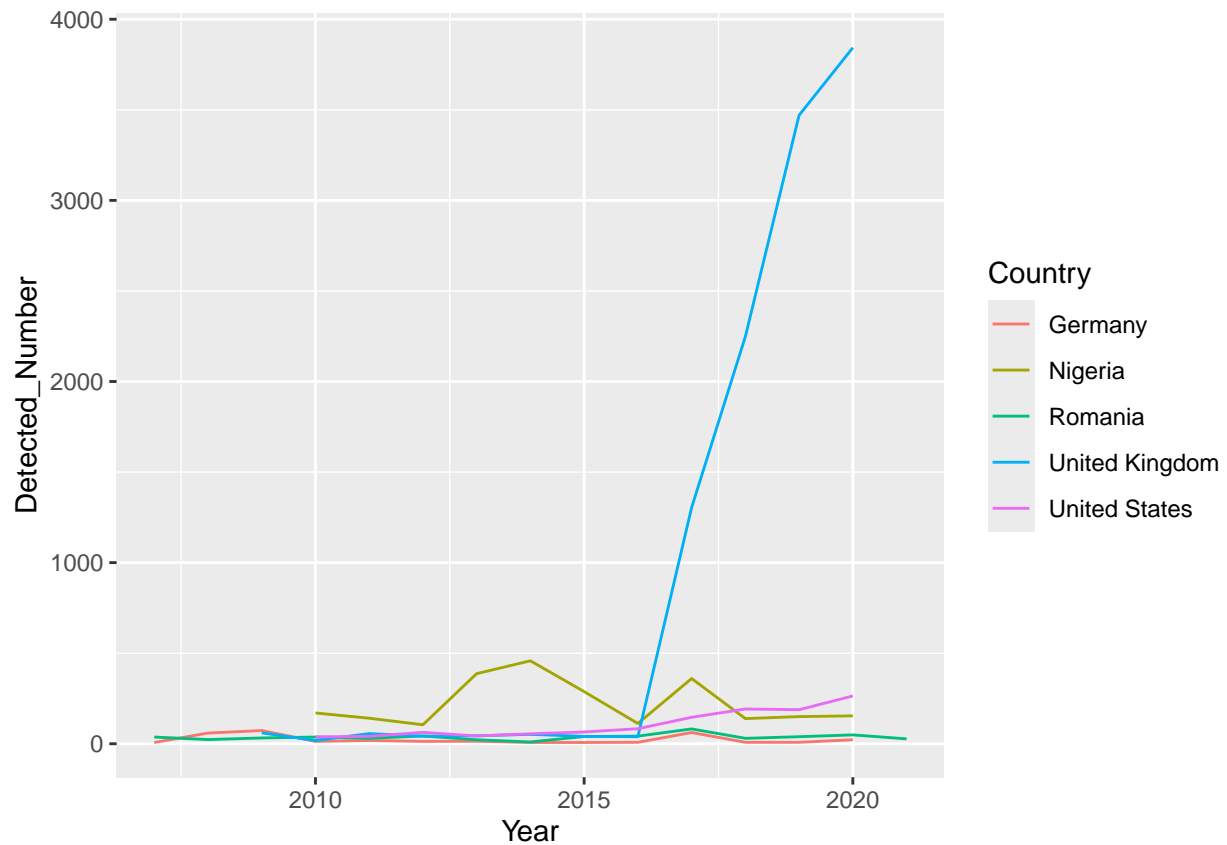
Differences in Trafficking Instances (Most Recent – Oldest)
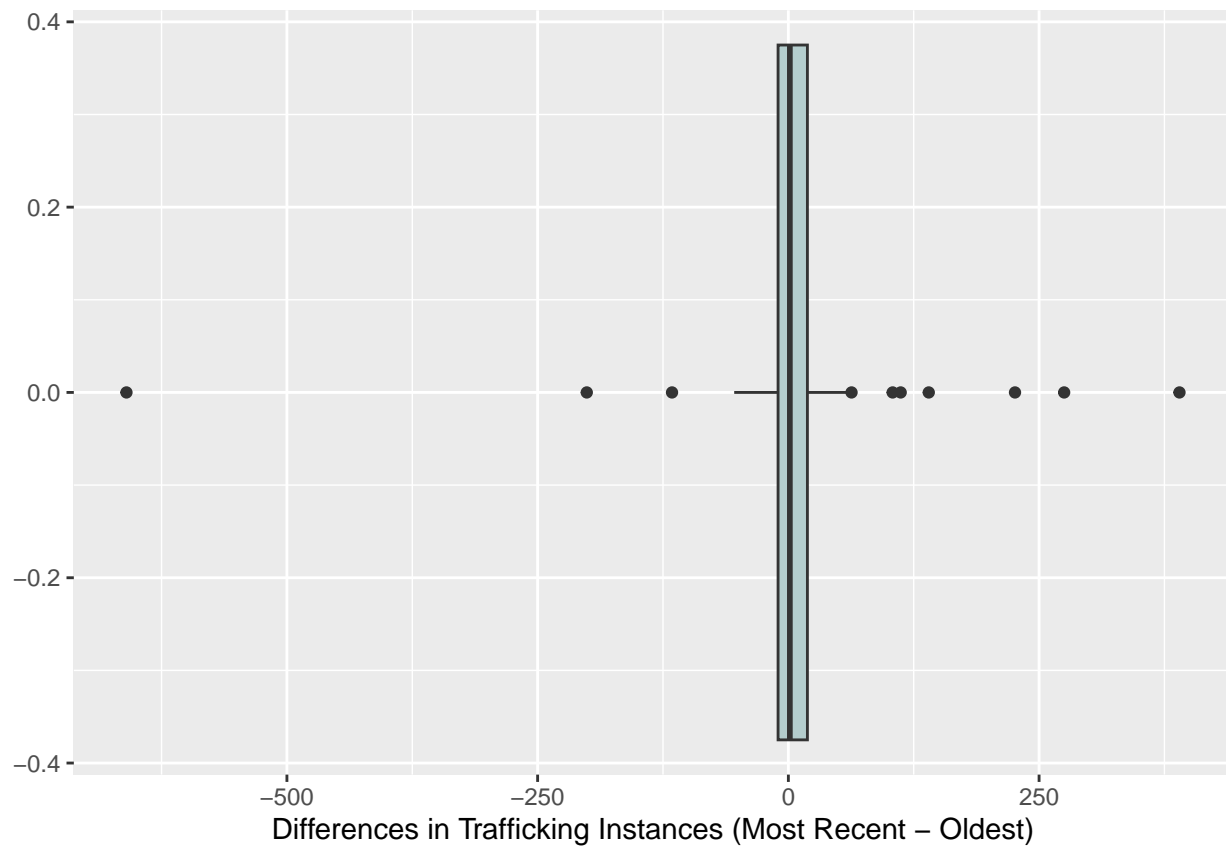
```
human_trafficking %>%
  filter(Code %in% c("USA", "GBR", "DEU", "ROU", "NGA")) %>%
  drop_na() %>%
  ggplot() +
    geom_line(aes(x=Year, y = Detected_Number, col = Country,))
```

```
corr <- left_join(slavery_index, inequality, by="Country")

temp <- data.frame(year = rep(c("1990", "2000", "2010", "2020"), each = nrow(inequality)),
                   values = c(inequality$Gender.Inequality.Index..1990., inequality$Gender.Inequality.I

ggplot(temp, aes(x = year, y = values, fill = year)) +
  geom_boxplot()
```

```
## Warning: Removed 173 rows containing non-finite outside the scale range
## ('stat_boxplot()').
```