Data 607 Project 2_Resubmit

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```r
library(knitr)
library(stringr)
library(tidyr)
library(dplyr)
```

```
##
## 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(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v forcats   1.0.0     v purrr     1.0.2
## v ggplot2   3.5.1     v readr     2.1.5
## v lubridate 1.9.3     v tibble    3.2.1

## -- 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 error
```

```r
library(ggplot2)
```

Data 1 First data is about the World Happiness Report in 2020. This data includes the Happiness Score for 153 countries. The Happiness Score is responses to the main life evaluation question asked in the Gallup World Poll(GWP). The Happiness Score is explained by the following factors: GDP per capita, Healthy Life Expectancy, Social support, Freedom to make life choices, Generosity, Corruption Perception, Residual error.

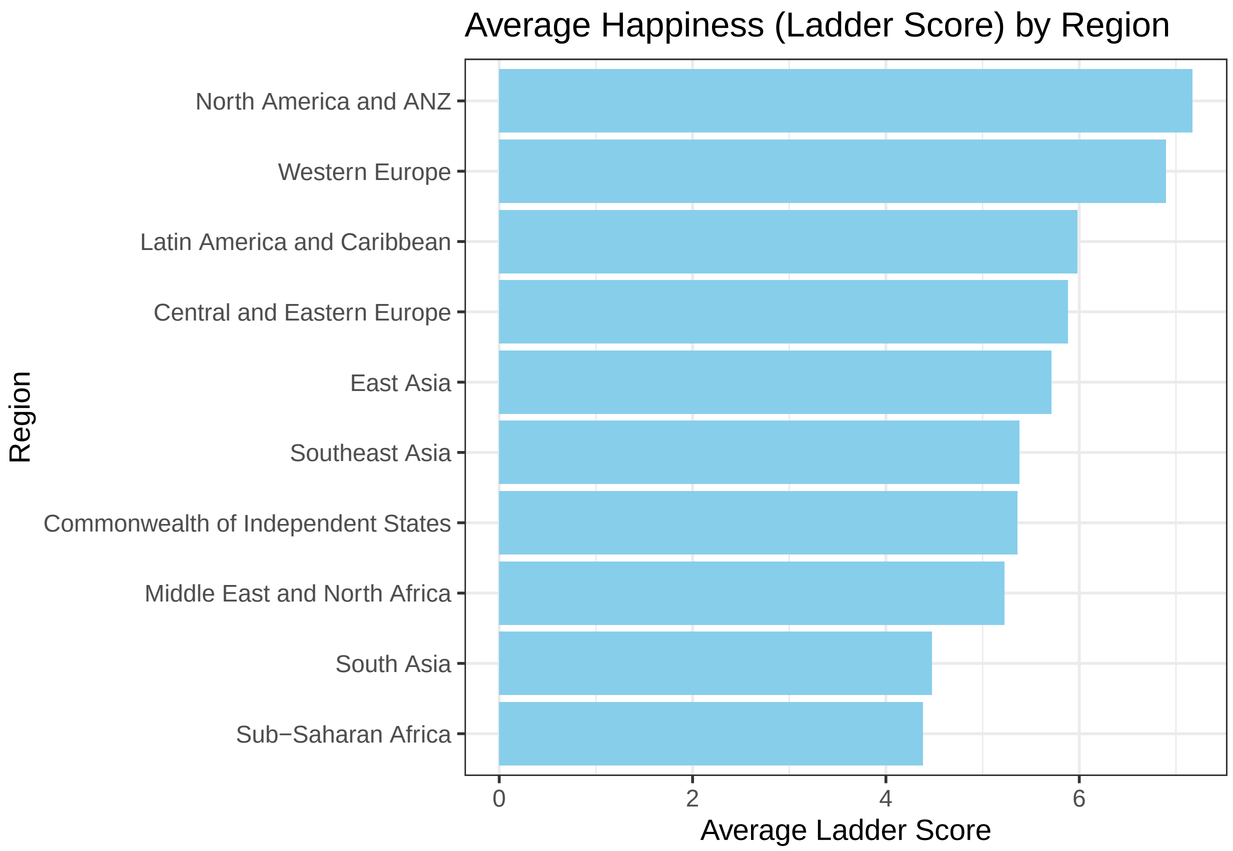
```r
#view data 1

file1 <- "https://raw.githubusercontent.com/Jennyjjxxzz/Data-607_Project2/refs/heads/main/wide_data/Worl
df1 <- read.csv(file1)
head(df1)
```

```
##   Country.name Regional.indicator Ladder.score Standard.error.of.ladder.score
## 1      Finland     Western Europe       7.8087                     0.03115630
## 2      Denmark     Western Europe       7.6456                     0.03349229
## 3  Switzerland     Western Europe       7.5599                     0.03501417
## 4      Iceland     Western Europe       7.5045                     0.05961586
## 5       Norway     Western Europe       7.4880                     0.03483738
## 6  Netherlands     Western Europe       7.4489                     0.02779175
##   upperwhisker lowerwhisker Logged.GDP.per.capita Social.support
## 1     7.869766     7.747634              10.63927      0.9543297
## 2     7.711245     7.579955              10.77400      0.9559908
## 3     7.628528     7.491272              10.97993      0.9428466
## 4     7.621347     7.387653              10.77256      0.9746696
## 5     7.556281     7.419719              11.08780      0.9524866
## 6     7.503372     7.394428              10.81271      0.9391388
##   Healthy.life.expectancy Freedom.to.make.life.choices  Generosity
## 1                71.90083                    0.9491722 -0.05948202
## 2                72.40250                    0.9514443  0.06620178
## 3                74.10245                    0.9213367  0.10591104
## 4                73.00000                    0.9488919  0.24694422
## 5                73.20078                    0.9557503  0.13453263
## 6                72.30092                    0.9085478  0.20761244
##   Perceptions.of.corruption Ladder.score.in.Dystopia
## 1                 0.1954446                 1.972317
## 2                 0.1684895                 1.972317
## 3                 0.3037284                 1.972317
## 4                 0.7117097                 1.972317
## 5                 0.2632182                 1.972317
## 6                 0.3647171                 1.972317
##   Explained.by..Log.GDP.per.capita Explained.by..Social.support
## 1                         1.285190                     1.499526
## 2                         1.326949                     1.503449
## 3                         1.390774                     1.472403
## 4                         1.326502                     1.547567
## 5                         1.424207                     1.495173
## 6                         1.338946                     1.463646
##   Explained.by..Healthy.life.expectancy
## 1                             0.9612714
## 2                             0.9793326
## 3                             1.0405332
## 4                             1.0008434
## 5                             1.0080719
## 6                             0.9756753
##   Explained.by..Freedom.to.make.life.choices Explained.by..Generosity
## 1                                  0.6623167                0.1596704
## 2                                  0.6650399                0.2427934
## 3                                  0.6289545                0.2690558
## 4                                  0.6619807                0.3623302
## 5                                  0.6702009                0.2879851
## 6                                  0.6136265                0.3363176
##   Explained.by..Perceptions.of.corruption Dystopia...residual
## 1                               0.4778573           2.762835
## 2                               0.4952603           2.432741
## 3                               0.4079459           2.350267
## 4                               0.1445408           2.460688
## 5                                0.4341006            2.168266
## 6                                0.3685698            2.352117
```

Question_1: Which region has the highest average happiness (Ladder score)?

```
#group by and plot the average
region_happiness <- df1 %>%
  group_by(Regional.indicator) %>%
  summarize(avg_ladder_score = mean(Ladder.score, na.rm = TRUE)) %>%
  arrange(desc(avg_ladder_score))
```

```
ggplot(region_happiness, aes(x = reorder(Regional.indicator, avg_ladder_score), y = avg_ladder_score)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  coord_flip() +
  labs(title = "Average Happiness (Ladder Score) by Region", x = "Region", y = "Average Ladder Score")+
  theme_bw()
```



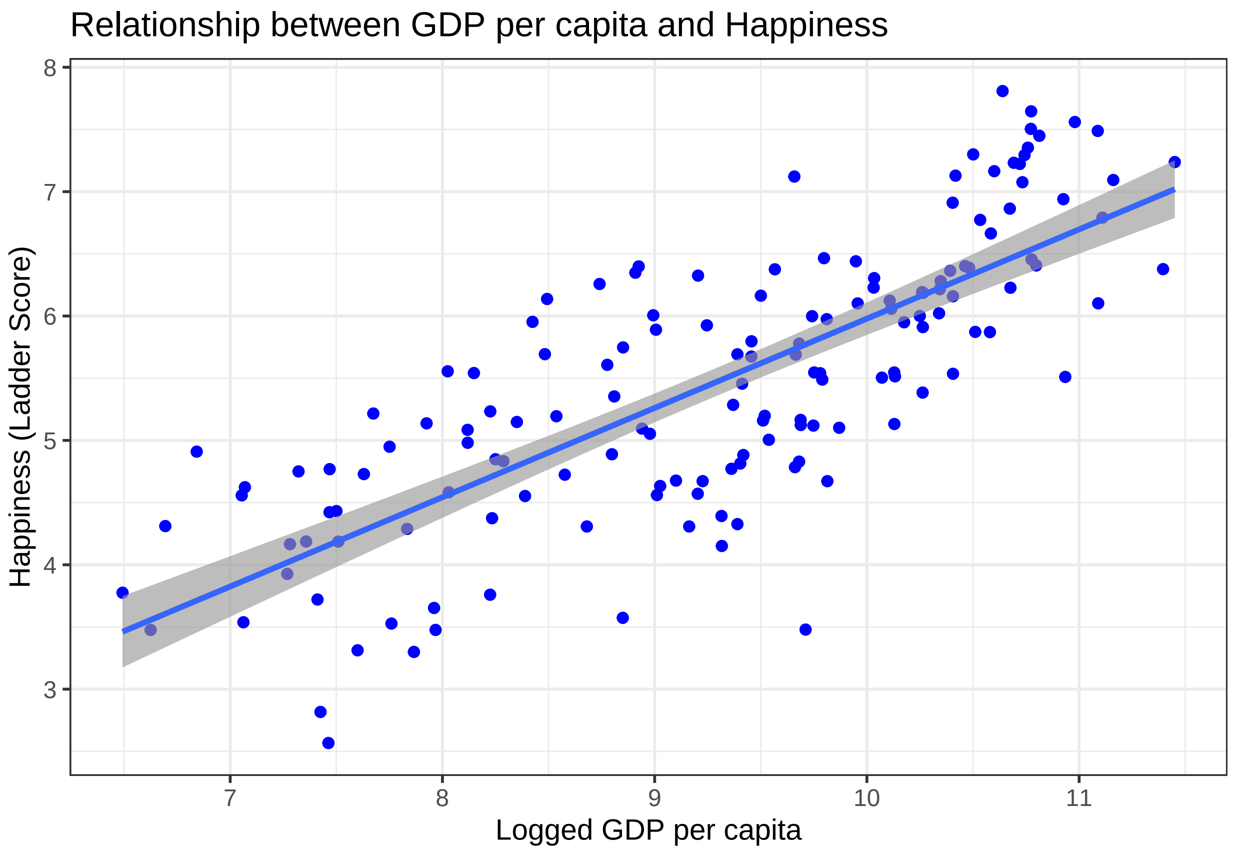
Question_2: Relationship between Ladder score and GDP, social support, and life expectancy

```
# Ladder score correlation analysis
ladder_score_correlations <- df1 %>%
  select(Ladder.score, Logged.GDP.per.capita, Social.support, Healthy.life.expectancy) %>%
  cor(use = "complete.obs")

print(ladder_score_correlations)
```

```
##                          Ladder.score Logged.GDP.per.capita Social.support
## Ladder.score                1.0000000             0.7753744      0.7650008
## Logged.GDP.per.capita       0.7753744             1.0000000      0.7818136
## Social.support              0.7650008             0.7818136      1.0000000
## Healthy.life.expectancy     0.7703163             0.8484686      0.7427441
##                          Healthy.life.expectancy
## Ladder.score                           0.7703163
## Logged.GDP.per.capita                  0.8484686
## Social.support                         0.7427441
## Healthy.life.expectancy                1.0000000
```

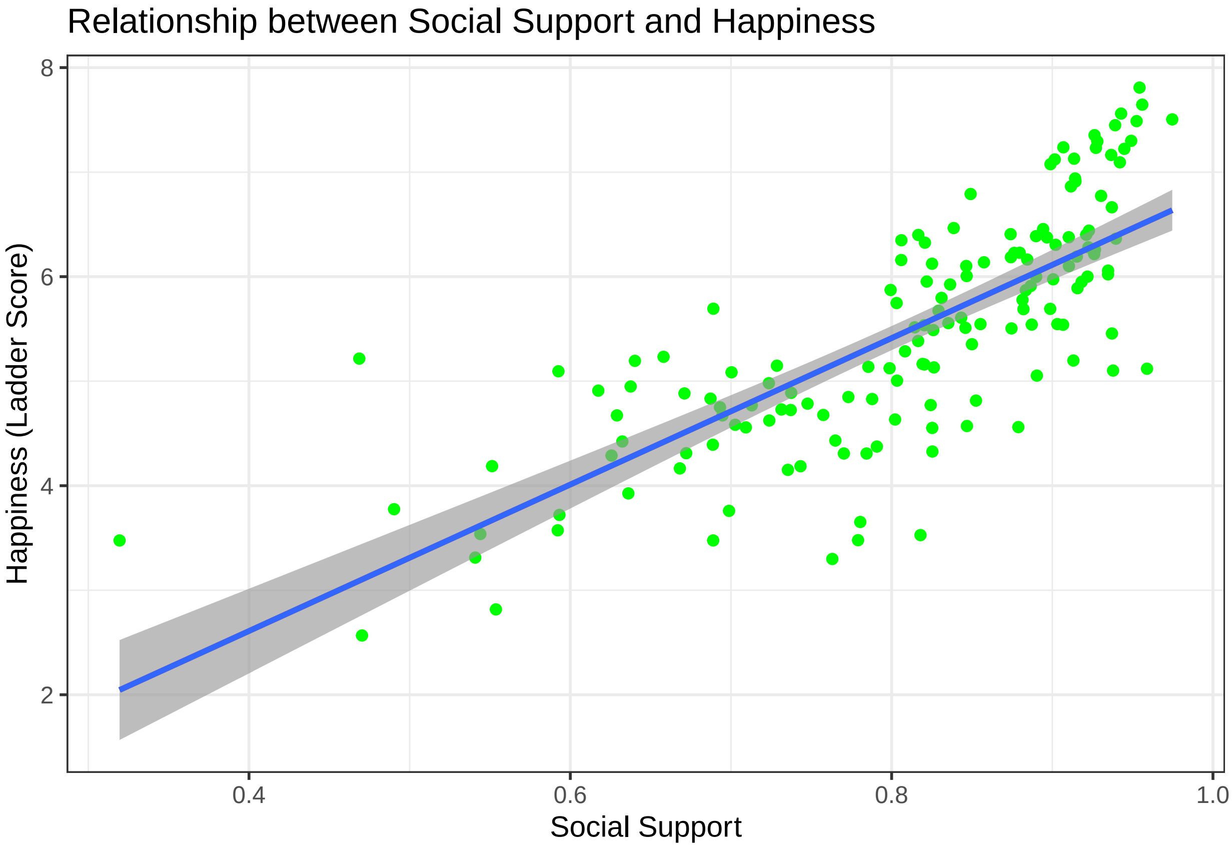
```
# Plot relationship between Ladder score and GDP per capita
ggplot(df1, aes(x = Logged.GDP.per.capita, y = Ladder.score)) +
  geom_point(color = "blue") +
  geom_smooth(method = "lm", col = "red") +
  labs(title = "Relationship between GDP per capita and Happiness", x = "Logged GDP per capita", y = "Ha
  geom_smooth(method = lm)+
  theme_bw()
```

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



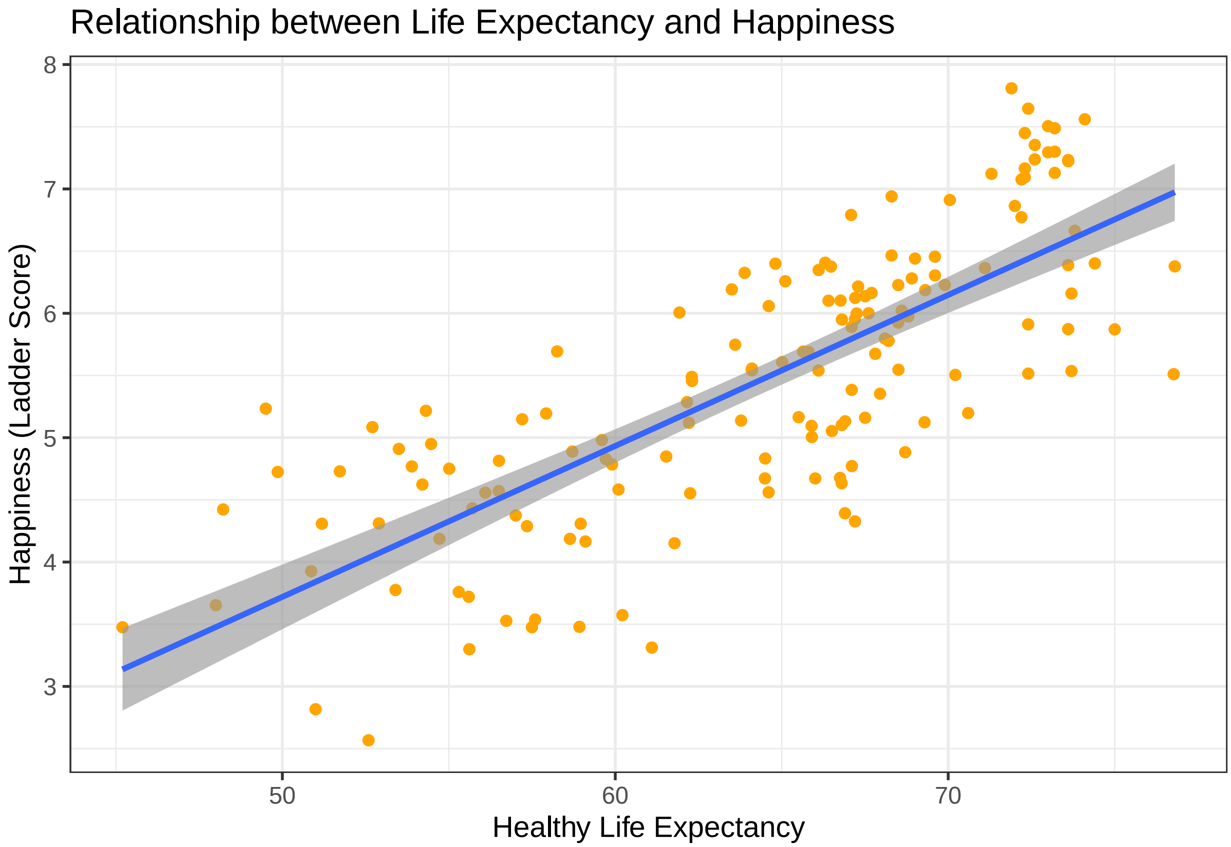
```
# Plot relationship between Ladder score and Social support
ggplot(df1, aes(x = Social.support, y = Ladder.score)) +
  geom_point(color = "green") +
  geom_smooth(method = "lm", col = "red") +
  labs(title = "Relationship between Social Support and Happiness", x = "Social Support", y = "Happines
  geom_smooth(method = lm)+
  theme_bw()
```

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



```
# Plot relationship between Ladder score and Life expectancy
ggplot(df1, aes(x = Healthy.life.expectancy, y = Ladder.score)) +
  geom_point(color = "orange") +
  geom_smooth(method = "lm", col = "red") +
  labs(title = "Relationship between Life Expectancy and Happiness", x = "Healthy Life Expectancy", y =
  geom_smooth(method = lm)+
  theme_bw()
```

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



Result for data 1: The North America and ANZ region ranks as the happiest region globally base on the highest average Ladder Score. Also the data shows a strong relationship between social support. Supported by their community elevated the happiness level.

Data 2 Second data show the ranking of the best universities of the world make by The Times Higher Education for 2020. The data frame consists of Rank char, Score Rank, University name, Country… .

```
#view data 2

file2 <- "https://raw.githubusercontent.com/Jennyjjxxzz/Data-607_Project2/refs/heads/main/wide_data/Wor
df2 <- read.csv(file2)
head(df2)
```

```
##   Rank_Char Score_Rank                            University        Country
## 1         1          1                  University of Oxford United Kingdom
## 2         2          2    California Institute of Technology  United States
## 3         3          3               University of Cambridge United Kingdom
## 4         4          4                   Stanford University  United States
## 5         5          5 Massachusetts Institute of Technology  United States
## 6         6          6                  Princeton University  United States
##   Number_students Numb_students_per_Staff International_Students
## 1          20,664                    11.2                    41%
## 2           2,240                     6.4                    30%
## 3          18,978                    10.9                    37%
## 4          16,135                     7.3                    23%
## 5          11,247                     8.6                    34%
## 6           7,983                     8.1                    25%
##   Percentage_Female Percentage_Male Teaching Research Citations Industry_Income
## 1               46%             54%     90.5     99.6      98.4            65.5
## 2               34%             66%     92.1     97.2      97.9            88.0
## 3               47%             53%     91.4     98.7      95.8            59.3
## 4               43%             57%     92.8     96.4      99.9            66.2
## 5               39%             61%     90.5     92.4      99.5            86.9
## 6               45%             55%     90.3     96.3      98.8            58.6
##   International_Outlook Score_Result Overall_Ranking
## 1                  96.4         95.4           95.40
## 2                  82.5         94.5           94.50
## 3                  95.0         94.4           94.40
## 4                  79.5         94.3           94.30
## 5                  89.0         93.6           93.60
## 6                  81.1         93.2           93.20
```

```
# Pivot the dataset to a tidy format
tidy_df2 <- df2 %>%
  pivot_longer(cols = c(Teaching, Research, Citations, Industry_Income, International_Outlook),
               names_to = "Score_Type",
               values_to = "Score_Value")

tidy_df2
```

```
## # A tibble: 6,980 x 13
##    Rank_Char Score_Rank University                       Country Number_students
##    <chr>          <int> <chr>                            <chr>   <chr>
##  1 1                  1 University of Oxford             United~ 20,664
##  2 1                  1 University of Oxford             United~ 20,664
##  3 1                  1 University of Oxford             United~ 20,664
##  4 1                  1 University of Oxford             United~ 20,664
##  5 1                  1 University of Oxford             United~ 20,664
##  6 2                  2 California Institute of Technol~ United~ 2,240
##  7 2                  2 California Institute of Technol~ United~ 2,240
##  8 2                  2 California Institute of Technol~ United~ 2,240
##  9 2                  2 California Institute of Technol~ United~ 2,240
## 10 2                  2 California Institute of Technol~ United~ 2,240
## # i 6,970 more rows
## # i 8 more variables: Numb_students_per_Staff <dbl>,
## #   International_Students <chr>, Percentage_Female <chr>,
## #   Percentage_Male <chr>, Score_Result <dbl>, Overall_Ranking <chr>,
## #   Score_Type <chr>, Score_Value <dbl>
```

Question_1: Which country has the most universities in the top 100?

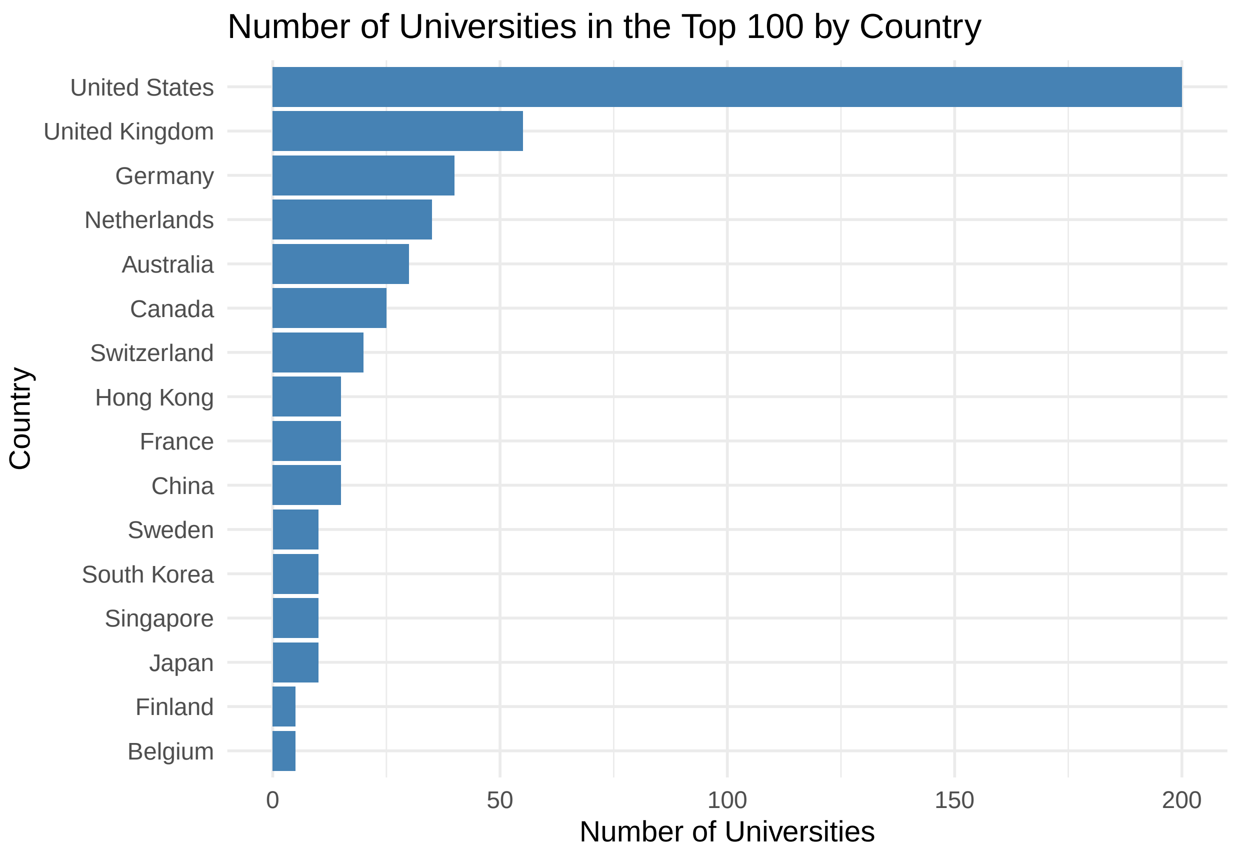
```
#filter the universities ranked in the top 100
df_top100 <- tidy_df2 %>%
  filter(as.numeric(Rank_Char) <= 100)
```

```
## Warning: There was 1 warning in ‘filter()‘.
## i In argument: ‘as.numeric(Rank_Char) <= 100‘.
## Caused by warning:
## ! NAs introduced by coercion
```

```
country_top100 <- df_top100 %>%
  group_by(Country) %>%
  summarize(university_count = n()) %>%
  arrange(desc(university_count))

print(country_top100)
```

```
## # A tibble: 16 x 2
##    Country        university_count
##    <chr>                     <int>
##  1 United States               200
##  2 United Kingdom               55
##  3 Germany                      40
##  4 Netherlands                  35
##  5 Australia                    30
##  6 Canada                       25
##  7 Switzerland                  20
##  8 China                        15
##  9 France                       15
## 10 Hong Kong                    15
## 11 Japan                        10
## 12 Singapore                    10
## 13 South Korea                  10
## 14 Sweden                       10
## 15 Belgium                       5
## 16 Finland                       5
```

```
ggplot(country_top100, aes(x = reorder(Country, university_count), y = university_count)) +
  geom_bar(stat = "identity", fill = "steelblue") +
  coord_flip() +
  labs(title = "Number of Universities in the Top 100 by Country",
       x = "Country",
       y = "Number of Universities")+
  theme_minimal()
```



Answer for question_1: The United States has most number of universities in rank of top 100.

Data 3 Third data is about the population data from 2019 US Census, and also includes latitude and longitude data for each state's capital city.

```
#view data 3

file3 <- "https://raw.githubusercontent.com/Jennyjjxxzz/Data-607_Project2/refs/heads/main/wide_data/2019
df3 <- read.csv(file3)
head(df3)
```

```
##        STATE POPESTIMATE2019      lat       long
## 1    Alabama         4903185 32.37772  -86.30057
## 2     Alaska          731545 58.30160 -134.42021
## 3    Arizona         7278717 33.44814 -112.09696
## 4   Arkansas         3017804 34.74661  -92.28899
## 5 California        39512223 38.57667 -121.49363
## 6   Colorado         5758736 39.73923 -104.98486
```

```
tidy_df3 <- df3 %>%
  pivot_longer(cols = starts_with("POP"),
               names_to = "Year",
               values_to = "Population")
```

Question_1: Which states have the highest and lowest population estimates in 2019?

```r
#The state with the highest population in 2019
highest_population_state <- tidy_df3%>%
  arrange(desc(Population)) %>%
  slice(1)

print(highest_population_state)
```

```
## # A tibble: 1 x 5
##   STATE        lat  long Year            Population
##   <chr>      <dbl> <dbl> <chr>                <int>
## 1 California  38.6 -121. POPESTIMATE2019   39512223
```

```r
#The state with the lowest population in 2019
lowest_population_state <- tidy_df3 %>%
  arrange(Population) %>%
  slice(1)

print(lowest_population_state)
```

```
## # A tibble: 1 x 5
##   STATE     lat  long Year            Population
##   <chr>   <dbl> <dbl> <chr>                <int>
## 1 Wyoming  41.1 -105. POPESTIMATE2019     578759
```