

# Project 1

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## Background

The World Health Organization has recently employed a new data science initiative, *CSIT-165*, that uses data science to characterize pandemic diseases. *CSIT-165* disseminates data driven analyses to global decision makers.

*CSIT-165* is a conglomerate comprised of two fabricated entities: *Global Health Union (GHU)* and *Private Diagnostic Laboratories (PDL)*. Your and your partner's role is to play a data scientist from one of these two entities.

## Data

2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by John Hopkins CSSE Data for 2019 Novel Coronavirus is operated by the John Hopkins University Center for Systems Science and Engineering (JHU CSSE). Data includes daily time series CSV summary tables, including confirmations, recoveries, and deaths. Country/region are countries/regions that conform to World Health Organization (WHO). Lat and Long refer to coordinates references for the user. Date fields are stored in MM/DD/YYYY format.

For this project, we will use global data sets for COVID-19 associated confirmations and deaths.

In order to download these files without cloning the whole repository, enter one of two commands in your terminal depending on your machine:

Windows `wget https://address.to.data/goes/here.csv`

Mac `curl https://address.to.data/goes/here.csv -O`

## Instructions

The World Health Organization has recently employed a new data science initiative, *CSIT-165*, that uses data science to characterize pandemic diseases. *CSIT-165* disseminates data driven analyses to global decision makers.

*CSIT-165* is a conglomerate comprised of two fabricated entities: *Global Health Union (GHU)* and *Private Diagnostic Laboratories (PDL)*. Your and your partner's role is to play a data scientist from one of these two entities. Discuss with your partner to decide who will be part of GHU and PDL.

## Getting Started

One project member per group must create a new repository on GitHub. Initialize this repository with a `readme.md` file that lists each member of the group. If your group decides to collaborate using a centralized workflow (recommended), then the project member that created the repository must declare their partners as collaborators in GitHub. Each project member will clone this repository onto their machine using RStudio. In RStudio, create a project from version control with GitHub using the HTTP address of the repository created by project member.

All project members must first contribute to analyses by uploading data sets respective to the entity they belong to in the CSIT-165 initiative. GHU project members provide time series data counting COVID-19 related recoveries and and deaths. PDL project members provide time series data counting COVID-19 related confirmations.

## Project Objectives

This project will encompass many of the lessons we have learned throughout the course. RMarkdown files must be written such that each time you render the document it will download the necessary data sets for analysis. Please render the RMarkdown file the day it is due to reflect the most recent data sets. With this added functionality, your code must be able to analyze the datasets regardless of the date you render your document.

### Objective 1

CSIT-165's first objective is to determine where COVID-19 originated from. Predict where the origin started based on the area with the greatest number of confirmations and deaths on the first recorded day in the data set. Show this is the origin using an if statement.

```
# Notice: Copyright Wesley C Newcomb Inc.
#confirmed_df<-read.csv("data/time_series_covid19_confirmed_global.csv",
#                        header=TRUE, stringsAsFactors=FALSE)
confirmed_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/
                        confirmed_global.csv",
                        stringsAsFactors=FALSE)
#deaths_df<-read.csv("data/time_series_covid19_deaths_global.csv",
#                    header=TRUE, stringsAsFactors=FALSE)
deaths_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/c
                        ovid19_deaths_global.csv",
                        stringsAsFactors=FALSE)
#recovered_df<-read.csv("data/time_series_covid19_recovered_global.csv",
#                        header=TRUE, stringsAsFactors=FALSE)
recovered_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/
                        recovered_global.csv",
                        stringsAsFactors=FALSE)

## Confirmed Dataset
confirmed_ordered<-select(arrange(confirmed_df, -X1.22.20),
                          Province.State, Country.Region, X1.22.20)
cat("Confirmed Dataset ")
```

## Confirmed Dataset

```
head(confirmed_ordered)
```

```
## Province.State Country.Region X1.22.20
## 1 Hubei China 444
## 2 Guangdong China 26
## 3 Beijing China 14
## 4 Zhejiang China 10
## 5 Shanghai China 9
## 6 Chongqing China 6
```

## Deaths Dataset

```
death_ordered<-select(arrange(deaths_df, -X1.22.20),
                       Province.State, Country.Region, X1.22.20)
cat("Deaths Dataset ")
```

## Deaths Dataset

```
head(death_ordered)
```

```
## Province.State Country.Region X1.22.20
## 1 Hubei China 17
## 2 Afghanistan 0
## 3 Albania 0
## 4 Algeria 0
## 5 Andorra 0
## 6 Angola 0
```

```
## Recovered Dataset
```

```
recovered_ordered<-select(arrange(recovered_df, -X1.22.20),
                             Province.State, Country.Region, X1.22.20)
cat("Recovered Dataset \n")
```

```
## Recovered Dataset
```

```
head(recovered_ordered)
```

```
## Province.State Country.Region X1.22.20
## 1 Hubei China 28
## 2 Thailand 2
## 3 Afghanistan 0
## 4 Albania 0
## 5 Algeria 0
## 6 Andorra 0
```

```
cat(confirmed_ordered[1,1], ", ", confirmed_ordered[1,2],
    " has the most confirmed cases on the first day. \n",
    death_ordered[1,1], ", ", death_ordered[1,2],
    " has the most deaths from the virus on the first day. \n",
    recovered_ordered[1,1], ", ", recovered_ordered[1,2],
    " has the most recovered cases from the virus on the first day. \n",
    sep="")
```

```
## Hubei, China has the most confirmed cases on the first day.
```

```
## Hubei, China has the most deaths from the virus on the first day.
```

```
## Hubei, China has the most recovered cases from the virus on the first day.
```

```
if (confirmed_ordered[1,1] == death_ordered[1,1] &&
    confirmed_ordered[1,1] == recovered_ordered[1,1] &&
    death_ordered[1,1] == recovered_ordered[1,1])
{
  cat(confirmed_ordered[1,1], ", ", confirmed_ordered[1,2],
      " is the most likely origin of the virus. \n", sep="")
}
```

```
## Hubei, China is the most likely origin of the virus.
```

```
# Notice: Copyright Diva Medina Camp Inc.
```

```
# Get csv files from CSSEGISandData/COVID-19 database
```

```
covid_confirmations <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/covid_confirmations.csv")
```

```
covid_deaths <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/covid_deaths.csv")
```

```
covid_recoveries <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/covid_recoveries.csv")
```

```
# Find greatest number of deaths on first day
```

```
for(i in covid_deaths$X1.22.20) {
  if(i > 0) {
```

```

    print(i)
  }
}

## [1] 17
max(covid_deaths$X1.22.20)

## [1] 17
first_city_deaths <- covid_deaths$Province.State[which.max(covid_deaths$X1.22.20)]
# Find greatest number of confirmed cases on first day
max(covid_confirmations$X1.22.20)

## [1] 444
first_city_confirmation <- covid_confirmations$Province.State[which.max(covid_confirmations$X1.22.20)]
# Find and print city of origin
if (first_city_deaths == first_city_confirmation) {
  covid_city_origin <- first_city_confirmation
}
print(covid_city_origin)

## [1] "Hubei"

```

Based on the data above: Hubei, China is the most likely origin of the virus. This is based on Hubei, China having by far the most confirmed cases and is the only region with any recoveries or deaths on the first day of data available. Also, all other regions that have confirmed cases on the first day are regions that are near Hubei. The conditional statement also proves that Hubei is the most likely origin of the virus because it shows that the place with the most deaths, recovered, and confirmed cases on the first day is Hubei.

## Objective 2

Where is the most recent area to have a first confirmed case? To do this, you will need to use a for loop, if statement, and subsets.

```

# Notice: Copyright Wesley C Newcomb Inc.
#confirmed_df<-read.csv("data/time_series_covid19_confirmed_global.csv",
#                        header=TRUE, stringsAsFactors=FALSE)
confirmed_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/
recent_df<-arrange(confirmed_df[confirmed_df[,ncol(confirmed_df)-1] == 0
                    & confirmed_df[,ncol(confirmed_df)] > 0,])

i<-0
# If there are no new cases today loop back to find most recent region
# to have new cases
if (nrow(recent_df) == 0) {
  while (nrow(recent_df) == 0) {
    i<-i+1
    recent_df<-arrange(confirmed_df[confirmed_df[,ncol(confirmed_df)-1-i] == 0
                        & confirmed_df[,ncol(confirmed_df)-i] > 0,])
  }
}

head(select(recent_df, Province.State, Country.Region, ncol(confirmed_df)-1-i,
            ncol(confirmed_df)-i))

##      Province.State Country.Region X7.19.22 X7.20.22

```

```
## 1 Pitcairn Islands United Kingdom 0 4
```

```
# Vector is small enough that loop is reasonable
for(i in 1:nrow(recent_df))
{
  if (recent_df[i,1] == "") {
    cat(recent_df[i,2], "has recently had their first confirmed case. \n")
  } else {
    if (recent_df[i,2] == "") {
      cat(recent_df[i,1], "has recently had their first confirmed case. \n")
    } else {
      cat(recent_df[i,1], ", ", recent_df[i,2],
          " has recently had their first confirmed case. \n", sep="")
    }
  }
}
}
```

```
## Pitcairn Islands, United Kingdom has recently had their first confirmed case.
```

```
# Notice: Copyright Diva Medina Camp Inc.
## Most recent area to have a confirmed case
## Use a for loop, if statement, and subsets.
recent_confirmations <- c()
for (i in 1:nrow(covid_confirmations)) {
  if (covid_confirmations$X3.9.23[i] > covid_confirmations$X3.8.23[i]) {
    recent_confirmations <- c(recent_confirmations, covid_confirmations$Country.Region[i])
  }
}
print(recent_confirmations)
```

```
## [1] "Albania" "Algeria" "Australia"
## [4] "Australia" "Australia" "Australia"
## [7] "Australia" "Australia" "Austria"
## [10] "Azerbaijan" "Bahrain" "Barbados"
## [13] "Belgium" "Bolivia" "Bulgaria"
## [16] "Burma" "Canada" "Canada"
## [19] "Canada" "Chile" "Cote d'Ivoire"
## [22] "Cuba" "Czechia" "Denmark"
## [25] "Ethiopia" "Fiji" "Finland"
## [28] "France" "Germany" "Guatemala"
## [31] "India" "Indonesia" "Iran"
## [34] "Israel" "Jamaica" "Japan"
## [37] "Korea, South" "Kosovo" "Latvia"
## [40] "Lebanon" "Malaysia" "Mali"
## [43] "Mexico" "Montenegro" "Nepal"
## [46] "New Zealand" "Norway" "Pakistan"
## [49] "Philippines" "Poland" "Qatar"
## [52] "Russia" "Saudi Arabia" "Serbia"
## [55] "Slovakia" "Slovenia" "South Africa"
## [58] "Sri Lanka" "Sweden" "US"
## [61] "Ukraine" "United Arab Emirates" "United Kingdom"
## [64] "United Kingdom" "Venezuela"
```

```
# R Solution
```

```
# recent_confirmations <- paste(covid_confirmations$Province.State[which(covid_confirmations$X3.9.23 >  
# covid_confirmations$Country.Region[which(covid_confirmations$X3.9.23 >
```

Most recent territories were found by going through the data and selecting the countries that did not have cases before yesterday and had their first cases today. If there are no regions meeting this check, then each previous day is looked at until there are regions found with new cases.

### Objective 3

How far away are the areas from objective 2 from where the first confirmed case(s) occurred? Please provide answer(s) in terms of miles. Use the function `distm` from the R package `geosphere` to calculate the distance between two coordinates in meters (`geosphere::distm`). You will need to convert the value returned by `distm` from meters to miles (this conversion is simple and can be found online). Please use a table or printed statement to describe what Province/State and Country/Region first confirmed cases occurred as well as the distance (in miles) away from the origin. Please print the following: {recent region} is {distance in miles} away from {origin city, origin country}.

```
# Notice: Copyright Wesley C Newcomb Inc.
origin_df<-arrange(confirmed_df, -X1.22.20)[1,]
#confirmed_df<-read.csv("data/time_series_covid19_confirmed_global.csv",
#                        header=TRUE, stringsAsFactors=FALSE)
confirmed_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/
recent_df<-arrange(confirmed_df[confirmed_df[,ncol(confirmed_df)-1] == 0
                        & confirmed_df[,ncol(confirmed_df)] > 0,])

i<-0

# If there are no new cases today loop back to find most recent region
# to have new cases
if (nrow(recent_df) == 0) {
  while (nrow(recent_df) == 0) {
    i<-i+1
    recent_df<-arrange(confirmed_df[confirmed_df[,ncol(confirmed_df)-1-i] == 0
                        & confirmed_df[,ncol(confirmed_df)-i] > 0,])
  }
}

# Compute distances from origin
distances<-distm(select(recent_df, Long, Lat), select(origin_df, Long, Lat))

# Convert from m to miles
distances<-distances * 0.00062137

# Add distance from origin to dataframe and sort by distance
recent_df$distance<-distances[,1]
recent_df<-arrange(recent_df, distance)

head(select(recent_df, Province.State, Country.Region, Lat, Long, distance))

##      Province.State Country.Region      Lat      Long distance
## 1 Pitcairn Islands United Kingdom -24.3768 -128.3242  8746.96

# Vector is small enough that loop is reasonable
for (i in 1:nrow(recent_df)) {
  city<-recent_df[i, "Province.State"]

  # If there is no city use country
  if (city == "") {
    city<-recent_df[i, "Country.Region"]
  }
}
```

```

cat(city, "is", recent_df[i, "distance"],
     "miles away from the virus origin in",
     paste0(origin_df[1, "Province.State"], ","),
     paste0(origin_df[1, "Country.Region"], "."), "\n")
}

## Pitcairn Islands is 8746.96 miles away from the virus origin in Hubei, China.
# Notice: Copyright Diva Medina Camp
# Inc.
library("geosphere")
# How far away are the areas from
# objective 2 from where the first
# confirmed case(s) occurred?
first_city_confirmation_index <- which.max(covid_confirmations$X1.22.20)
area_df <- data.frame(Long = covid_confirmations$Long[which(covid_confirmations$X3.9.23 >
  covid_confirmations$X3.8.23)], Lat = covid_confirmations$Lat[which(covid_confirmations$X3.9.23 >
  covid_confirmations$X3.8.23)])
area_df_matrix <- as.matrix(area_df)

# First City Coordinates
First_City_Coords <- data.frame(Long = covid_confirmations$Long[first_city_confirmation_index],
  Lat = covid_confirmations$Lat[first_city_confirmation_index])
First_City_Coords_matrix <- as.matrix(First_City_Coords)

# Find distance between cities Use
# function distm distm(x, y)
dist <- distm(area_df_matrix, First_City_Coords_matrix)

# Convert from meters to miles
dist_miles <- round(dist/1609.34, 2)

# Please print the following: {recent
# region} is {distance in miles} away
# from {origin city, origin country}
distance_from_origin <- data.frame(City = covid_confirmations$Province.State[which(covid_confirmations$
  covid_confirmations$X3.8.23)], Country = covid_confirmations$Country.Region[which(covid_confirmations$
  covid_confirmations$X3.8.23)], Distance = dist_miles)
for (i in 1:length(distance_from_origin$City)) {
  print(paste(distance_from_origin$City[i],
    distance_from_origin$Country[i],
    " is ", distance_from_origin$Distance[i],
    "miles away from", covid_confirmations$Province.State[first_city_confirmation_index],
    covid_confirmations$Country.Region[first_city_confirmation_index]))
}

## [1] " Albania is 4960.44 miles away from Hubei China"
## [1] " Algeria is 6327.14 miles away from Hubei China"
## [1] "Australian Capital Territory Australia is 5156.88 miles away from Hubei China"
## [1] "New South Wales Australia is 5132.81 miles away from Hubei China"
## [1] "Northern Territory Australia is 3231.78 miles away from Hubei China"
## [1] "South Australia Australia is 4846.19 miles away from Hubei China"
## [1] "Tasmania Australia is 5547.63 miles away from Hubei China"
## [1] "Victoria Australia is 5181.72 miles away from Hubei China"

```

## [1] " Austria is 5015.91 miles away from Hubei China"  
 ## [1] " Azerbaijan is 3618.98 miles away from Hubei China"  
 ## [1] " Bahrain is 3722.86 miles away from Hubei China"  
 ## [1] " Barbados is 9345.19 miles away from Hubei China"  
 ## [1] " Belgium is 5297.24 miles away from Hubei China"  
 ## [1] " Bolivia is 11387.03 miles away from Hubei China"  
 ## [1] " Bulgaria is 4665.79 miles away from Hubei China"  
 ## [1] " Burma is 1185.83 miles away from Hubei China"  
 ## [1] "British Columbia Canada is 5592.11 miles away from Hubei China"  
 ## [1] "Ontario Canada is 6669.8 miles away from Hubei China"  
 ## [1] "Quebec Canada is 6642.87 miles away from Hubei China"  
 ## [1] " Chile is 12042.48 miles away from Hubei China"  
 ## [1] " Cote d'Ivoire is 7554.68 miles away from Hubei China"  
 ## [1] " Cuba is 8759.71 miles away from Hubei China"  
 ## [1] " Czechia is 4907.37 miles away from Hubei China"  
 ## [1] " Denmark is 4928.15 miles away from Hubei China"  
 ## [1] " Ethiopia is 4822.45 miles away from Hubei China"  
 ## [1] " Fiji is 5503.47 miles away from Hubei China"  
 ## [1] " Finland is 4251.24 miles away from Hubei China"  
 ## [1] " France is 5561.51 miles away from Hubei China"  
 ## [1] " Germany is 5061.55 miles away from Hubei China"  
 ## [1] " Guatemala is 8887.15 miles away from Hubei China"  
 ## [1] " India is 2185.45 miles away from Hubei China"  
 ## [1] " Indonesia is 2187.16 miles away from Hubei China"  
 ## [1] " Iran is 3407.35 miles away from Hubei China"  
 ## [1] " Israel is 4487.71 miles away from Hubei China"  
 ## [1] " Jamaica is 8996.19 miles away from Hubei China"  
 ## [1] " Japan is 1536.31 miles away from Hubei China"  
 ## [1] " Korea, South is 956.32 miles away from Hubei China"  
 ## [1] " Kosovo is 4883.7 miles away from Hubei China"  
 ## [1] " Latvia is 4379.19 miles away from Hubei China"  
 ## [1] " Lebanon is 4361.62 miles away from Hubei China"  
 ## [1] " Malaysia is 1959.34 miles away from Hubei China"  
 ## [1] " Mali is 7051.8 miles away from Hubei China"  
 ## [1] " Mexico is 8027.44 miles away from Hubei China"  
 ## [1] " Montenegro is 4951.13 miles away from Hubei China"  
 ## [1] " Nepal is 1693.71 miles away from Hubei China"  
 ## [1] "Niue New Zealand is 6205.4 miles away from Hubei China"  
 ## [1] " Norway is 4825.84 miles away from Hubei China"  
 ## [1] " Pakistan is 2540.06 miles away from Hubei China"  
 ## [1] " Philippines is 1384.87 miles away from Hubei China"  
 ## [1] " Poland is 4701.39 miles away from Hubei China"  
 ## [1] " Qatar is 3702.32 miles away from Hubei China"  
 ## [1] " Russia is 2133.37 miles away from Hubei China"  
 ## [1] " Saudi Arabia is 4096.29 miles away from Hubei China"  
 ## [1] " Serbia is 4838.64 miles away from Hubei China"  
 ## [1] " Slovakia is 4766.42 miles away from Hubei China"  
 ## [1] " Slovenia is 5040.05 miles away from Hubei China"  
 ## [1] " South Africa is 7226.35 miles away from Hubei China"  
 ## [1] " Sri Lanka is 2580.62 miles away from Hubei China"  
 ## [1] " Sweden is 4515.04 miles away from Hubei China"  
 ## [1] " US is 7129.09 miles away from Hubei China"  
 ## [1] " Ukraine is 4277.99 miles away from Hubei China"  
 ## [1] " United Arab Emirates is 3594.43 miles away from Hubei China"



```
## [1] "Turks and Caicos Islands United Kingdom is 8798.46 miles away from Hubei China"
## [1] " United Kingdom is 5383.81 miles away from Hubei China"
## [1] " Venezuela is 9857.19 miles away from Hubei China"
```

## Objective 4

CSIT-165 characterizes diseases using risk scores. Risk scores are calculated as the ratio of deaths to confirmations, that is  $\text{Riskscore} = 100 \times \frac{\text{deaths}}{\text{confirmations}}$ . Risk scores equal to 100 indicate the highest risk while risk scores equal to 0 indicate the lowest risk. Areas are characterized as being especially vulnerable to loss if they have higher risk scores. For this assignment, exclude cruise ships (hint: they have lat and long coordinates of 0 or NA in this data set, filter this out before calculating risk scores).

Which area of the world currently has the lowest risk score (if more than one, display the one with the most confirmations)? Which area of the world currently has the highest risk score (if more than one, display the one with the most confirmations)? How do risk scores in these areas compare to global risk score? Why might it be helpful to calculate metrics like risk scores for different areas of the world and what would their limitations be (what assumptions does risk score make and what important variables might be left out)?

```
# Notice: Copyright Wesley C Newcomb Inc.
# Datasets represent a cumulative sum by date, so last column represents
# summation for region
#confirmed_df<-read.csv("data/time_series_covid19_confirmed_global.csv",
#
header=TRUE, stringsAsFactors=FALSE)
confirmed_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/csse_covid_19_data/time_series_202003-202005-confirmed.csv",
confirmed_df<-select(confirmed_df, Province.State,
Country.Region, ncol(confirmed_df))
names(confirmed_df)[3] <- "confirmed"
#deaths_df<-read.csv("data/time_series_covid19_deaths_global.csv",
#
header=TRUE, stringsAsFactors=FALSE)
deaths_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/csse_covid_19_data/time_series_202003-202005-deaths.csv",
deaths_df<-select(deaths_df, Province.State,
Country.Region, ncol(deaths_df))
names(deaths_df)[3] <- "deaths"
#recovered_df<-read.csv("data/time_series_covid19_recovered_global.csv",
#
header=TRUE, stringsAsFactors=FALSE)
recovered_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/csse_covid_19_data/time_series_202003-202005-recovered.csv",
recovered_df<-select(recovered_df, Province.State,
Country.Region, ncol(recovered_df))
names(recovered_df)[3] <- "recovered"

# Combine the datasets into one and fill NA with 0
combined_df<-full_join(confirmed_df, recovered_df,
by=c("Province.State", "Country.Region"))
combined_df<-full_join(combined_df, deaths_df,
by=c("Province.State", "Country.Region"))
combined_df[is.na(combined_df)] <- 0

# Assignment is unclear if we are to consider state and region or
# just region. Based on how data is formatted, I think it is cleaner
# and makes more sense to use region only. For instance, in confirmed
# dataset, Canada is broken up by region, but in recovered dataset it
# uses Canada as a whole. There are numerous examples of this in
# the data
```

```
grouped_df<-as.data.frame(summarise_each(group_by(
  select(combined_df, -Province.State), Country.Region), sum))
```

## Objective 4.1

```
## Warning: `summarise_each()` was deprecated in dplyr 0.7.0.
## i Please use `across()` instead.
## i The deprecated feature was likely used in the dplyr package.
## Please report the issue at <https://github.com/tidyverse/dplyr/issues>.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
# Compute risk and burden by region
```

```
grouped_df$risk<-grouped_df$deaths / grouped_df$recovered
grouped_df$burden<-grouped_df$confirmed * grouped_df$risk
```

```
cat("Highest risk scores ")
```

```
## Highest risk scores
```

```
head(arrange(grouped_df, -risk, -confirmed))
```

```
## Country.Region confirmed recovered deaths risk burden
## 1 US 103802702 0 1123836 Inf Inf
## 2 India 44690738 0 530779 Inf Inf
## 3 France 39866718 0 166176 Inf Inf
## 4 Germany 38249060 0 168935 Inf Inf
## 5 Brazil 37076053 0 699276 Inf Inf
## 6 Japan 33320438 0 72997 Inf Inf
```

```
cat("Highest risk scores, that are not infinite ")
```

```
## Highest risk scores, that are not infinite
```

```
head(arrange(grouped_df[grouped_df$risk != Inf,], -risk, -confirmed))
```

```
## Country.Region confirmed recovered deaths risk burden
## NA <NA> NA NA NA NA
## NA.1 <NA> NA NA NA NA
## NA.2 <NA> NA NA NA NA
## NA.3 <NA> NA NA NA NA
## NA.4 <NA> NA NA NA NA
```

```
cat("Lowest Risk Scores ")
```

```
## Lowest Risk Scores
```

```
head(arrange(grouped_df, risk, confirmed))
```

```
## Country.Region confirmed recovered deaths risk burden
## 1 Korea, North 1 0 6 Inf Inf
## 2 MS Zaandam 9 0 2 Inf Inf
## 3 Diamond Princess 712 0 13 Inf Inf
## 4 Kiribati 5014 0 18 Inf Inf
## 5 Nauru 5247 0 1 Inf Inf
## 6 Palau 5991 0 9 Inf Inf
```

```
cat("Lowest risk scores, that are not zero ")

## Lowest risk scores, that are not zero
head(arrange(grouped_df[grouped_df$risk != 0,], risk, confirmed))
```

```
##      Country.Region confirmed recovered deaths risk burden
## 94      Korea, North         1         0      6  Inf     Inf
## 108     MS Zaandam          9         0      2  Inf     Inf
## 50   Diamond Princess     712         0     13  Inf     Inf
## 93      Kiribati        5014         0     18  Inf     Inf
## 127      Nauru         5247         0      1  Inf     Inf
## 138      Palau         5991         0      9  Inf     Inf
```

```
global_confirmed<-sum(grouped_df$confirmed)
global_deaths<-sum(grouped_df$deaths)
global_recovered<-sum(grouped_df$recovered)
global_risk<-global_deaths / global_recovered
global_burden<-global_confirmed * global_risk
```

```
cat("Global Data\n",
    "Confirmed:", global_confirmed, "\n",
    "Deaths:  ", global_deaths, "\n",
    "Recovered:", global_recovered, "\n",
    "Risk:     ", global_risk, "\n",
    "Burden:   ", global_burden, "\n")
```

```
## Global Data
## Confirmed: 676570149
## Deaths:   6881802
## Recovered: 0
## Risk:     Inf
## Burden:   Inf
```

```
# Notice: Copyright Manuel Ricardo Vargas Inc.
```

```
# Import the data for global confirmed cases
```

```
confirmed_url <- "https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covid_19_data"
confirmed_data <- read.csv(confirmed_url, header = TRUE,
    stringsAsFactors = FALSE)
```

```
# Import the data for global deaths
```

```
deaths_url <- "https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covid_19_data"
deaths_data <- read.csv(deaths_url, header = TRUE,
    stringsAsFactors = FALSE)
```

```
# Remove cruise ships from the confirmed cases
```

```
# data
```

```
confirmed_data <- confirmed_data[!(confirmed_data$Lat ==
    0 | is.na(confirmed_data$Lat)), ]
confirmed_data <- confirmed_data[!(confirmed_data$Long ==
    0 | is.na(confirmed_data$Long)), ]
```

```
# Remove cruise ships from the deaths data
```

```
deaths_data <- deaths_data[!(deaths_data$Lat == 0 |
    is.na(deaths_data$Lat)), ]
deaths_data <- deaths_data[!(deaths_data$Long == 0 |
```

```

    is.na(deaths_data$Long)), ]

# Filter both confirmed and deaths data to only
# include common countries
common_countries <- intersect(confirmed_data$Country.Region,
    deaths_data$Country.Region)
confirmed_cases <- confirmed_data[confirmed_data$Country.Region %in%
    common_countries, c("Country.Region", tail(names(confirmed_data),
        n = 1))]
deaths <- deaths_data[deaths_data$Country.Region %in%
    common_countries, c("Country.Region", tail(names(deaths_data),
        n = 1))]

# Calculate risk scores
risk_scores <- round(100 * deaths[, 2]/confirmed_cases[,
    2], 2)

# Create data frame with country names and risk
# scores
risk_scores_df <- data.frame(Country = confirmed_cases$Country.Region,
    RiskScore = risk_scores)

# Sort risk scores by ascending order and select
# first row
lowest_risk <- risk_scores_df[order(risk_scores_df$RiskScore),
    ][1, ]

# If there are multiple areas with lowest risk,
# select the one with most confirmations
if (sum(!is.na(lowest_risk$Confirmations)) > 0) {
    lowest_risk <- lowest_risk[which(lowest_risk$Confirmations ==
        max(lowest_risk$Confirmations, na.rm = TRUE)),
        ]
}

# Display the result
cat("The area with the lowest risk score is", lowest_risk$Country,
    "with a risk score of", lowest_risk$RiskScore,
    "and", lowest_risk$Confirmations, "confirmations.")

```

## The area with the lowest risk score is Antarctica with a risk score of 0 and confirmations.

```

# Sort risk scores by descending order and select
# first row
highest_risk <- risk_scores_df[order(-risk_scores_df$RiskScore),
    ][1, ]

# If there are multiple areas with highest risk,
# select the one with most confirmations
if (sum(!is.na(highest_risk$Confirmations)) > 0) {
    highest_risk <- highest_risk[which(highest_risk$Confirmations ==
        max(highest_risk$Confirmations, na.rm = TRUE)),
        ]
}

```

```
# Display the result
cat("The area with the highest risk score is", highest_risk$Country,
    "with a risk score of", highest_risk$RiskScore,
    "and", highest_risk$Confirmations, "confirmations.")
```

```
## The area with the highest risk score is Korea, North with a risk score of 600 and confirmations.
```

Based on how the equation is written, any region which has had at least one person recover and no deaths will have a risk score of zero. Examples of this can be seen in the “Lowest Risk Scores” table above. When filtering out risk scores of 0, the regions of lowest risk can be seen in “Lowest risk scores, that are not zero” table above. Any region that has no recoveries and yet at least one death will have infinite risk. Examples of this can be seen in the “Highest risk scores” table above. If filtering out regions that have infinite risk, we see that the regions in the “Highest risk scores, that are not infinite” table above. When looking at the global score, it seems like the risk is high when considering it represents the people that have recovered versus those who have died. This value seems especially high when looking at the regions in the “Lowest risk scores, that are not zero” table, but when compared to the “Highest risk scores, that are not infinite” table where the risk scores are extremely high, the global risk seems less significant. This wide range in risk numbers indicates that while the risk in some regions is extremely high, for the most part, the risk is rather low globally.

Risk assessments like this are important because they are good indicators of where danger is located or help is needed that can be used across many industries. For example, the travel industry may wish to impose bans on travelling to and from locations of high risk. The medical field can use these values to determine locations that are in the most need for medical support. Research fields may also use this data to help identify trends. For example, if a region has a high amount of recoveries and almost no deaths, i.e. low risk score, it may be worth looking into what kind of treatment they are using in that region and if it could be used in other locations throughout the world. The thing to be careful though is that risk scores may be a little misleading. For instance, several regions have almost no cases, but one death and no recoveries causing a massive risk score. Even though these regions have pretty much no cases, they are still seen as extremely risky. This is why it could be beneficial to filter out the extremes before considering the data as valid.

**Objective 4.2** You are asked to make two tables with the top 10 countries that have the most COVID-19 related confirmations and and deaths. Make sure to include all of the counts for the country, not just the counts for one area in the country. To do this we will need to sum all of the values for each country, create new data frames from these values, and use the package `kable` to convert those data frames into tables.

Hint: Sum each country’s counts by subsetting the data frame using a list of countries available in the data set. Use a for loop to iterate through the data frame using the list of countries. For each country, calculate the count sum and assign this value to a list.

```
# Notice: Copyright Wesley C Newcomb Inc.
# Datasets represent a cumulative sum by date, so last column represents
# summation for region
confirmed_df<-read.csv("data/time_series_covid19_confirmed_global.csv",
    # header=TRUE, stringsAsFactors=FALSE)
confirmed_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/covid19_time_series/covid19_confirmed_global.csv",
    confirmed_df<-select(confirmed_df, Province.State,
        Country.Region, ncol(confirmed_df))
names(confirmed_df)[3] <- "confirmed"
#deaths_df<-read.csv("data/time_series_covid19_deaths_global.csv",
# header=TRUE, stringsAsFactors=FALSE)
deaths_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data/covid19_time_series/covid19_deaths_global.csv",
    deaths_df<-select(deaths_df, Province.State,
        Country.Region, ncol(deaths_df))
names(deaths_df)[3] <- "deaths"
#recovered_df<-read.csv("data/time_series_covid19_recovered_global.csv",
```

```

#                               header=TRUE, stringsAsFactors=FALSE)
recovered_df <- read.csv("https://raw.githubusercontent.com/Chato1969/COVID-19/master/csse_covid_19_data.csv")
recovered_df<-select(recovered_df, Province.State,
                     Country.Region, ncol(recovered_df))
names(recovered_df)[3] <- "recovered"

# Combine the datasets into one and fill NA with 0
combined_df<-full_join(confirmed_df, recovered_df,
                       by=c("Province.State", "Country.Region"))
combined_df<-full_join(combined_df, deaths_df,
                       by=c("Province.State", "Country.Region"))
combined_df[is.na(combined_df)] <- 0

# Group and combine data by region
grouped_df<-as.data.frame(summarise_each(group_by(
  select(combined_df, -Province.State), Country.Region), sum))

# Compute risk and burden by region
grouped_df$risk<-grouped_df$deaths / grouped_df$recovered
grouped_df$burden<-grouped_df$confirmed * grouped_df$risk

confirmed_tb = kable(arrange(grouped_df, -confirmed)[1:5,])
deaths_tb = kable(arrange(grouped_df, -deaths)[1:5,])
recovered_tb = kable(arrange(grouped_df, -recovered)[1:5,])

cat("Top 5 confirmed regions ")

## Top 5 confirmed regions
confirmed_tb

```

Country.Region	confirmed	recovered	deaths	risk	burden
US	103802702	0	1123836	Inf	Inf
India	44690738	0	530779	Inf	Inf
France	39866718	0	166176	Inf	Inf
Germany	38249060	0	168935	Inf	Inf
Brazil	37076053	0	699276	Inf	Inf

```

cat("Top 5 deaths regions ")

## Top 5 deaths regions
deaths_tb

```

Country.Region	confirmed	recovered	deaths	risk	burden
US	103802702	0	1123836	Inf	Inf
Brazil	37076053	0	699276	Inf	Inf
India	44690738	0	530779	Inf	Inf
Russia	22075858	0	388478	Inf	Inf
Mexico	7483444	0	333188	Inf	Inf

```

cat("Top 5 recovered regions")

## Top 5 recovered regions
recovered_tb

```

Country.Region	confirmed	recovered	deaths	risk	burden
Afghanistan	209451	0	7896	Inf	Inf
Albania	334457	0	3598	Inf	Inf
Algeria	271496	0	6881	Inf	Inf
Andorra	47890	0	165	Inf	Inf
Angola	105288	0	1933	Inf	Inf

```
# Notice: Copyright Manuel Ricardo Vargas Inc.
# Load the CSV files for COVID-19 data
confirmed_cases <- read.csv("https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covid_19_data.csv")
deaths <- read.csv("https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covid_19_data.csv")

# Extract the country names from the data frames
countries <- unique(confirmed_cases$Country.Region)

# Initialize empty lists for the sums of confirmed cases and deaths
confirmed_sums <- list()
death_sums <- list()

# Calculate the sums of confirmed cases and deaths for each country
for (country in countries) {
  confirmed_sums[[country]] <- sum(confirmed_cases[confirmed_cases$Country.Region == country, -(1:4)])
  death_sums[[country]] <- sum(deaths[deaths$Country.Region == country, -(1:4)])
}

# Convert the sums into data frames
confirmed_df <- data.frame(Country = names(confirmed_sums), Confirmed = unlist(confirmed_sums))
death_df <- data.frame(Country = names(death_sums), Deaths = unlist(death_sums))

# Sort the data frames by the values of confirmed cases and deaths, respectively
confirmed_df <- confirmed_df[order(-confirmed_df$Confirmed),]
death_df <- death_df[order(-death_df$Deaths),]

# Select the top 5 countries with the most confirmed cases and deaths
top_5_confirmed <- head(confirmed_df, 5)
top_5_deaths <- head(death_df, 5)

# Convert the data frames into tables using the kable function
library(knitr)
kable(top_5_confirmed)
```

	Country	Confirmed
US	US	53813184406
India	India	29131119694
Brazil	Brazil	21182690594
France	France	16105911886
Germany	Germany	13686043720

## GitHub Log

url: [https://github.com/Chato1969/Project\\_1/tree/Chato1969\\_Branch](https://github.com/Chato1969/Project_1/tree/Chato1969_Branch)

```
# Notice: Copyright Wesley C Newcomb Inc.
#Could not get the above script to work correctly on my system.This is the output from running the above script
#``{bash gitlog}
#By Wesley: git log --pretty=format:"%nSubject: %s%nAuthor: %aN%nDate: %aD%nBody: %b"
```

```
#By Diva: Biscuit:Project_1_Wesv4 miuixtli$ git log --pretty=format:"%nSubject: %s%nAuthor: %aN%nDate: %aD%n"
#` ``
```

```
##
## Subject: Updated responses to be more generic and automatic such that they are created based on data
## pulled automatically from the table. Fixed typos and minor bugs.
## Author: Wesley Newcomb
## Date: Wed, 5 Apr 2023 18:06:15 -0700
## Body:
##
## Subject: Added first rev of readme.md
## Author: Wesley Newcomb
## Date: Wed, 5 Apr 2023 23:28:47 -0700
## Body:
##
## Subject: Added first rev of index.md
## Author: Wesley Newcomb
## Date: Wed, 5 Apr 2023 23:25:33 -0700
## Body:
##
## Subject: Update README.md
## Author: Wesley Newcomb
## Date: Thu, 6 Apr 2023 10:20:17 -0700
## Body: Added names to the README file
##
## Subject: Initial commit
## Author: Wesley Newcomb
## Date: Fri, 7 Apr 2023 19:05:40 -0700
## Body:
##
## Subject: Add files via upload
## Author: Wesley Newcomb
## Date: Fri, 7 Apr 2023 19:14:55 -0700
## Body:
##
## Subject: Update README.md
## Author: Wesley Newcomb
## Date: Fri, 7 Apr 2023 19:20:29 -0700
## Body:
##
## Subject: Merge branch 'new-chart'
## Author: Wesley Newcomb
##
## Subject: Completed Objective_1.
## Author: Diva
## Date: Sat, 8 Apr 2023 13:50:00 -0700
## Body:
##
## Subject: Complete Objective 2 program.
## Author: Diva
## Date: Sat, 8 Apr 2023 14:08:58 -0700
## Body:
##
## Subject: Completed Objective 3.
```



```
## Author: Diva
## Date: Sat, 8 Apr 2023 14:10:48 -0700
## Body:
##
## Subject: Corrected misspelling.
## Author: Diva
## Date: Sat, 8 Apr 2023 14:31:29 -0700
## Body:
##
## Subject Created file.
## Author: Diva
## Date: Sat, 8 Apr 2023 19:39:43 -0700
## Body:
##
## Subject: Merge pull request #1 from Chato1969/Diva_Branch
## Author: Wesley Newcomb
## Date: Sat, 8 Apr 2023 18:18:03 -0700
## Body: Diva branch
```

Additional urls: [https://github.com/DivaMC/Project\\_1](https://github.com/DivaMC/Project_1)

Biscuit:Project\_1 miuixtli\$ git log --pretty=format:"%nSubject: %s%nAuthor: %aN%nDate: %aD%nBody: %b"

```
##
## Subject: White spaces added.
## Author: Diva
## Date: Sat, 8 Apr 2023 20:37:11 -0700
## Body:
##
## Subject: New formatting. White spaces.
## Author: Diva
## Date: Sat, 8 Apr 2023 20:37:00 -0700
## Body:
##
## Subject: Authored Lab Write Up. (Diva's version.)
## Author: Diva
## Date: Sat, 8 Apr 2023 19:26:14 -0700
## Body:
##
## Subject: Added objective 3.
## Author: Diva
## Date: Sat, 8 Apr 2023 14:33:56 -0700
## Body:
##
## Subject: Deleted writeup file.
## Author: Diva
## Date: Sat, 8 Apr 2023 14:32:55 -0700
## Body:
##
## Subject: Merge branch 'main' of https://github.com/DivaMC/Project_1 into main
## Author: Diva
## Date: Sat, 8 Apr 2023 14:32:28 -0700
## Body:
##
```

```

## Subject: Merge pull request #1 from DivaMC/Write_up
## Author: DivaMC
## Date: Sat, 8 Apr 2023 14:26:53 -0700
## Body: Write up
##
## Subject: Merge branch 'Write_Up' into main
## Author: Diva
## Date: Sat, 8 Apr 2023 14:16:05 -0700
## Body:
##
## Subject: Corrected variables.
## Author: Diva
## Date: Sat, 8 Apr 2023 14:11:44 -0700
## Body:
##
## Subject: Corrected variable names.
## Author: Diva
## Date: Sat, 8 Apr 2023 14:00:25 -0700
## Body:
##
## Subject: Added Objective 1 and 2
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:54:25 -0700
## Body:
##
## Subject: Added Objective 4 and outlines Objectives 1-3
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:45:25 -0700
## Body:
##
## Subject: Objective 4 completed
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:42:44 -0700
## Body:
##
## Subject: Created Objective 4
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:40:48 -0700
## Body:
##
## Subject: Completed Objective 5
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:36:31 -0700
## Body:
##
## Subject: Completed Objective 5
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:35:22 -0700
## Body:
##
## Subject: Completed Objective 5
## Author: Manuel Vargas
## Date: Sat, 8 Apr 2023 13:24:27 -0700
## Body:

```

##  
## Subject: Created Objective 4 R file  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 08:27:47 -0700  
## Body:  
##  
## Subject: Added Objective 5  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 08:27:21 -0700  
## Body:  
##  
## Subject: Selecting Top 5 Countries  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 08:12:01 -0700  
## Body:  
##  
## Subject: Added formatting to Rmd file  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 08:10:11 -0700  
## Body:  
##  
## Subject: Created Personal Project Report  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 08:02:06 -0700  
## Body:  
##  
## Subject: Initalized and Calculated Sums of Confirmed Cases and Deaths  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 07:55:08 -0700  
## Body:  
##  
## Subject: Extracting Unique Country Names  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 07:51:25 -0700  
## Body:  
##  
## Subject: Loading CSV files  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 07:49:48 -0700  
## Body:  
##  
## Subject: Created Objective 5 R file  
## Author: Manuel Vargas  
## Date: Sat, 8 Apr 2023 07:48:13 -0700  
## Body:  
##  
## Subject: Renamed file.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 23:43:01 -0700  
## Body:  
##  
## Subject: Deleted markdown file.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 23:21:21 -0700

## Body:  
##  
## Subject: File created.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 23:19:35 -0700  
## Body:  
##  
## Subject: Completed Objective 3.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 23:16:20 -0700  
## Body:  
##  
## Subject: Formatted to make clean.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 23:16:06 -0700  
## Body:  
##  
## Subject: Changed name of variable.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 23:05:08 -0700  
## Body:  
##  
## Subject: Created Objective 3 R file.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 20:09:10 -0700  
## Body:  
##  
## Subject: Small edits.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 20:07:47 -0700  
## Body:  
##  
## Subject: Made Objective 1 R file for just the program.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 20:07:25 -0700  
## Body:  
##  
## Subject: Objective 2 program.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 20:06:58 -0700  
## Body:  
##  
## Subject: Merge branch 'main' of [https://github.com/Divamc/Project\\_1](https://github.com/Divamc/Project_1) into main  
## Author: Diva  
## Date: Fri, 7 Apr 2023 14:13:44 -0700  
## Body:  
##  
## Subject: Removed extra experimental code.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 14:08:27 -0700  
## Body:  
##  
## Subject: Added instructor name.  
## Author: Diva

## Date: Fri, 7 Apr 2023 13:56:39 -0700  
## Body:  
##  
## Subject: Experimental ifelse statement. Experimental command line push.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 13:39:01 -0700  
## Body:  
##  
## Subject: Test push and commit.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 13:14:52 -0700  
## Body:  
##  
## Subject: Experimental upload.  
## Author: Diva  
## Date: Fri, 7 Apr 2023 12:21:21 -0700  
## Body:  
##  
## Subject: First Objective\_1 program draft  
## Author: Diva  
## Date: Fri, 7 Apr 2023 12:18:24 -0700  
## Body:  
##  
## Subject: Uploaded Project 1 instructions  
## Author: DivaMC  
## Date: Tue, 4 Apr 2023 22:41:34 -0700  
## Body:  
##  
## Subject: Update README.md  
## Author: DivaMC  
## Date: Mon, 3 Apr 2023 23:32:27 -0700  
## Body: Wrote each member of the group.  
##  
## Subject: Initial commit  
## Author: DivaMC  
## Date: Mon, 3 Apr 2023 23:29:53 -0700  
## Body: