COVID-19 Response Rankings

# Goal

Using the available data and calculated metrics, create a composite index that can be used to rank a country’s COVID-19 response in order the answer the questions “if a company is looking to diversify their supply chain geographically to combat the effects of a future pandemic outbreaks, which countries would be the best to do so in?”

# Metrics

The following metrics can be used to make this rankings scale:

* **Confounding Metrics (C)**: these metrics are completely unrelated to the COVID-19 data and come from outside sources. They are:
  + Geographic/Societal:
    - Population Density
    - Median Population Age
    - Geographic Region
  + Economic:
    - Government Net Lending/Borrowing
    - Gross Domestic Product
    - Unemployment Rate
    - Income Level
  + Healthcare Quality:
    - WHO Healthcare Index Score
  + Press Freedom
    - Press Freedom Rankings
* **Prior Pandemic Preparedness Metrics (P)**: these metrics come from pandemic preparedness rankings that were released in 2019 (before the COVID-19 pandemic began). They are:
  + Overall Pandemic Preparedness
  + Prevention
  + Detection
  + Respond
  + Health
  + Norms
  + Risk
* **COVID-19 Outbreak Metrics (O)**: these metrics describe the severity of the COVID-19 outbreak in a country based on the country’s reported COVID-19 data. They are:
  + Total Cases per Million
  + Total Deaths per Million
  + Total Tests per Million
  + Case-Death Ratio
  + Test-Case Ratio
  + Cases Avg. Growth Rate
  + Cases Max. Growth Rate
  + Cases Growth Length
  + Cases Avg. Submission Rate
  + Cases Max. Submission Rate
  + Cases Submission Length
  + Cases Total Length
  + Cases Peak Value
  + Cases Valley Value
  + Deaths Avg. Growth Rate
  + Deaths Max. Growth Rate
  + Deaths Growth Length
  + Deaths Avg. Submission Rate
  + Deaths Max. Submission Rate
  + Deaths Submission Length
  + Deaths Total Length
  + Deaths Peak Value
  + Deaths Valley Value
  + Case-Death Pair Peak Ratio
* **Government Response Metrics (R)**: these metrics are taken directly from the government response data and describe the severity of the steps governments took to combat the pandemic. They are:
  + Max Stringency
  + Max Government Response
  + Max Containment Health
  + Max Economic Support
  + Economic Support to Containment Health Ratio
  + Economic Support to Stringency Ratio
  + Economic Support to Government Response Ratio
  + Num Days Some Sectors Closed
  + Num Days All Non-Essential Sectors Closed
  + Num Days Public Transport Closed
  + Num Days Stay-at-Home except for Essential Trips
  + Num Days Stay-at-Home Total Lockdown
  + Num Days Internal Movement Restricted
  + Num Days Int'l Bans for some Countries
  + Num Days Int'l Bans Total Border Closure
* **Government Response/COVID-19 Interaction Metrics (I)**: these metrics relate the stringency of the steps governments took to combat COVID-19 to the severity of the outbreak of COVID-19 in the country. They are:
  + Num Cases Before Some Sectors Closed
  + Avg Case Rate Before Some Sectors Closed
  + Max Case Rate Before Some Sectors Closed
  + Num Cases Before All Non-Essential Sectors Closed
  + Avg Case Rate Before All Non-Essential Sectors Closed
  + Max Case Rate Before All Non-Essential Sectors Closed
  + Num Deaths Before Some Sectors Closed
  + Avg Death Rate Before Some Sectors Closed
  + Max Death Rate Before Some Sectors Closed
  + Num Deaths Before All Non-Essential Sectors Closed
  + Avg Death Rate Before All Non-Essential Sectors Closed
  + Max Death Rate Before All Non-Essential Sectors Closed
  + Num Cases Before Public Transport Closed
  + Avg Cases Rate Before Public Transport Closed
  + Max Case Rate Before Public Transport Closed
  + Num Deaths Before Public Transport Closed
  + Avg Deaths Rate Before Public Transport Closed
  + Max Death Rate Before Public Transport Closed
  + Num Cases Before Stay-at-Home except for Essential Trips
  + Avg Cases Rate Before Stay-at-Home except for Essential Trips
  + Max Case Rate Before Stay-at-Home except for Essential Trips
  + Num Deaths Before Stay-at-Home except for Essential Trips
  + Avg Deaths Rate Before Stay-at-Home except for Essential Trips
  + Max Death Rate Before Stay-at-Home except for Essential Trips
  + Num Cases Before Stay-at-Home Total Lockdown
  + Avg Cases Rate Before Stay-at-Home Total Lockdown
  + Max Case Rate Before Stay-at-Home Total Lockdown
  + Num Deaths Before Stay-at-Home Total Lockdown
  + Avg Deaths Rate Before Stay-at-Home Total Lockdown
  + Max Death Rate Before Stay-at-Home Total Lockdown
  + Num Cases Before Internal Movement Restricted
  + Avg Cases Rate Before Internal Movement Restricted
  + Max Case Rate Before Internal Movement Restricted
  + Num Deaths Before Internal Movement Restricted
  + Avg Deaths Rate Before Internal Movement Restricted
  + Max Death Rate Before Internal Movement Restricted
  + Num Cases Before Int'l Bans for some Countries
  + Avg Cases Rate Before Int'l Bans for some Countries
  + Max Case Rate Before Int'l Bans for some Countries
  + Num Deaths Before Int'l Bans for some Countries
  + Avg Deaths Rate Before Int'l Bans for some Countries
  + Max Death Rate Before Int'l Bans for some Countries
  + Num Cases Before Int'l Bans Total Border Closure
  + Avg Cases Rate Before Int'l Bans Total Border Closure
  + Max Case Rate Before Int'l Bans Total Border Closure
  + Num Deaths Before Int'l Bans Total Border Closure
  + Avg Deaths Rate Before Int'l Bans Total Border Closure
  + Max Death Rate Before Int'l Bans Total Border Closure
  + Num Cases Before Peak Stringency
  + Avg Case Growth Before Peak Stringency
  + Max Case Growth Before Peak Stringency
  + First Max Stringency to Preceding Cases Ratio
  + Num Deaths Before Peak Stringency
  + Avg Death Growth Before Peak Stringency
  + Max Death Growth Before Peak Stringency
  + First Max Stringency to Preceding Deaths Ratio
  + Num Cases Before Peak Containment Health
  + Avg Case Growth Before Peak Containment Health
  + Max Case Growth Before Peak Containment Health
  + First Max Containment Health to Preceding Cases Ratio
  + Num Deaths Before Peak Containment Health
  + Avg Death Growth Before Peak Containment Health
  + Max Death Growth Before Peak Containment Health
  + First Max Containment Health to Preceding Deaths Ratio
  + Num Cases Before Peak Economic Support
  + Avg Case Growth Before Peak Economic Support
  + Max Case Growth Before Peak Economic Support
  + First Max Economic Support to Preceding Cases Ratio
  + Num Deaths Before Peak Economic Support
  + Avg Death Growth Before Peak Economic Support
  + Max Death Growth Before Peak Economic Support
  + First Max Economic Support to Preceding Deaths Ratio
  + Num Cases Before Peak Government Response
  + Avg Case Growth Before Peak Government Response
  + Max Case Growth Before Peak Government Response
  + First Max Government Response to Preceding Cases Ratio
  + Num Deaths Before Peak Government Response
  + Avg Death Growth Before Peak Government Response
  + Max Death Growth Before Peak Government Response
  + First Max Government Response to Preceding Deaths Ratio

# Correlational Statistical Testing

Correlational statistical testing was performed between the following metrics:

* Confounding Metrics vs. COVID-19 Outbreak Metrics
* Confounding Metrics vs. Government Response Metrics
* Confounding Metrics vs. Government Response/COVID-19 Interaction Metrics
* Prior Pandemic Preparedness Metrics vs. COVID-19 Outbreak Metrics
* Prior Pandemic Preparedness Metrics vs. Government Response Metrics
* Prior Pandemic Preparedness Metrics vs. Government Response/COVID-19 Interaction Metrics

From these correlational statistical tests, both the strength of the relationship between the two metrics and the significance of the relationship has been determined. It as performed for every combination of metrics in the sets described above. For example, from conducting the Confounding Metrics vs. COVID-19 Outbreak Metrics tests, we know that there was a strong relationship between the WHO Healthcare Score and Total Tests per Million but a negligible relationship between the Who Healthcare Score and the Case-Death Ratio.

# Index Creation

I think creating the rankings would fall into two steps. The first step would be to create a profile of a country that performed well and a country that did not perform well in relation to the metrics. The second part would be to create the actual index that can be used to rank countries against each other.

## Profile Creation

Using the results of the correlation statistics tests we can make general statements as to what confounding or predictor variable correlate with a country handling the pandemic well (both in terms of outbreak severity and response severity). These would be qualitative in natural. For example, we might say that “because median age was a significant factors in outbreak severity, countries with younger populations will tend to experience less severe pandemic outbreaks”.

## Ranking Creation

Te rankings would be created by using the COVID-19 Outbreak Metrics , Government Response Metrics , and Government Response/COVID-19 Interaction Metrics . They, after being normalized, would be put into a vector and assigned a weight by matrix which would account for both the weight and the scaling factor. The result, , would be the index score of the country.

In order to create the sub-indexes, the process above would be duplicated, but only for the metrics that make up the sub-indexes. Then, the from the different sub-indexes could be combined into a final score.