**"No Need to Panic, It's All Under Control..."**

**A Visual Critique of European Government's COVID-19 Response Strategies**

1. **STATEMENT OF THE QUESTION OR PURPOSE**

*What are we trying to understand?*

The global COVID-19 pandemic has defined the past year. With 63.3m cases causing 1.47m deaths worldwide, governments have fought relentlessly to contain the spread of the virus and reduce fatalities. While some have enforced stringent lockdowns for prolonged periods with high levels of social compliance, others have taken relaxed approaches in an effort to minimise the economic fallout. Since Europe represents a dense cluster of loosely affiliated, highly developed countries each governed autonomously, it is an optimal case study for understanding the role of policy in controlling the outbreak and minimising casualties. Guided by visual analysis, in this project we seek to identify patterns in the mitigation strategies of European governments, and ultimately identify best practices for addressing pandemics of the future. Focusing on European government response strategies, in order of precedence, the guiding questions of our analyses are:

1. Where have COVID-19 response strategies functioned as expected?
2. What mitigation strategies have been most effective at combatting the virus?
3. Which factors are most important in determining the success of mitigation strategies
4. How does the predicted efficacy of mitigation strategies vary between countries?
5. **THE BACKGROUND AND PREPARATION FOR CONDUCTING THE PROJECT**

*What information did you use in developing your ideas from conceptual stage to finished project?*

Having been exposed to endless COVID-19 plots and analyses since arriving at LBS in September, we felt that while we had seen a lot of analyses of the pandemic, the only tangible conclusions were “it starts to get worse once the world thinks it’s getting better” and “every country experienced (and reacted to) the virus differently”. In many instances, COVID-19 cases and deaths hadn’t even been normalised, which means that large and sparse countries like Sweden seemed to have kept the virus under control, when in reality they experienced some of the worst of the pandemic. Since what we had seen so far didn’t seem like enough, we reflected on the vague and descriptive (and not necessarily accurate) knowledge we had about the pandemic so far. We found that besides anecdotal evidence like “Germany has been strict and controlled the virus”, or “Sweden has been relaxed and paid the price”, all the analyses we had seen (and all the news we had heard) told us almost nothing about how European countries’ actions mapped onto outcomes.

There is a clear deficit of analysis, particularly which is visual and readily interpretable, which seeks to translate this vast pool of COVID-19 data into *prescriptive* insights drawn from empirical relationships between Government responses and subsequent outcomes. Following this train of thought, our inspiration for the project emerged from a series of web searches along the lines of “government COVID-19 mitigation strategies”, “COVID-19 containment strategies Europe”, “effective government COVID-19 response, and so on. Unexpectedly, our results returned little insight, until we found exploratory analyses deep-diving into [“Policy Responses to the Coronavirus Pandemic”](https://ourworldindata.org/policy-responses-covid) from Our World in Data. Though this source lacked effective comparison of countries, accounting for *both* the state of their outbreak *and* their policy decisions, it became an invaluable resource as we took our project to completion: introducing us both to the Government Stringency Index, which came to form the backbone of our research, and making it clear to us that our project could not be complete without both geographic and temporal analyses.

1. **METHODOLOGY**

Our analysis was complicated by the fact that all the variables we needed were not captured within a single, clean dataset. Rather, we had to individually clean, then compile, three distinct datasets: the first, from Our World In Data, including the all-important stringency index; the second, which included data on COVID-19 testing; and the third, which contained information on hospitalisation.

*Cleaning*

Broadly, we cleaned each of the three datasets applying the following steps:

1. We identified missingness in variables, and imputed values where possible with data from other sources, such as the World Bank
2. We remove variables in the datasets with no indicator, and remove rows which are entirely missing
3. We pivot the data into appropriately tidy formats, optimised for our further time-series and spatial analyses
4. Sub-setting to Europe, both because this is the focal region of our analysis, and to address extensive missingness due to incomplete reporting in other, non-European, countries

*Enriching*

Next, we enriched the data by creating a number of useful variables for further analysis. Specifically, we define the following variables:

* day0\_cases -> date when daily cases first hit 1000
* day0\_deaths -> date when daily deaths first hit 100
* day0\_cases\_elapsed -> days elapsed from day\_0\_cases
* day0\_deaths\_elapsed -> days elapsed from day\_0\_deaths
* day0\_difference -> days elapsed between when daily cases first hit 1000 and when daily deaths first hit 00

*Analyses*

Now we have created our final dataset, we create the following plots, employing the following techniques:

PLOT 1 *Map of the Most Recent Cases in Europe Spatial Mapping*

PLOT 2 *Map of the Most Recent Total Cases in Europe Spatial Mapping*

PLOT 3a *Time Series of New Daily Cases & Stringency Index Time Series Analysis*

PLOT 3b *Time Series of New Daily Deaths & Stringency Index Time Series Analysis*

PLOT 4 *Time Series of Government Measures, Cases & Tests Time Series Analysis*

PLOT 5 *Model: Factors Associated with Cases/Million Linear Regression Analysis*

**The Stringency Index**

*The Oxford COVID-19 Government Response Tracker (OxCGRT) measures the variation in governments’ responses using its COVID-19 Government Response Stringency Index (Stringency Index). This composite measure is a simple additive score of 9 indicators measured on an ordinal scale, rescaled to vary from 0 to 100. Intended specifically for comparison of the number and strictness of government policies, it is optimal as a summary measure of European government responses to the COVID-19 pandemic, and thus for our investigation.* The specific policy and response categories captured by the Stringency Index are coded as follows:

1. **School closures:**

0 - No measures

1 - recommend closing

2 - Require closing (only some levels or categories,

eg just high school, or just public schools)

3 - Require closing all levels

1. **Workplace closures:**

0 - No measures

1 - recommend closing (or work from home)

2 - require closing (or work from home) for some

sectors or categories of workers

3 - require closing (or work from home) all but essential workplaces (eg grocery stores, doctors)

1. **Cancel public events:**

0- No measures

1 - Recommend cancelling

2 - Require cancelling

1. **Restrictions on gatherings:**

0 - No restrictions

1 - Restrictions on very large gatherings (the limit is above 1000 people)

2 - Restrictions on gatherings between 100-1000 people

3 - Restrictions on gatherings between 10-100 people

4 - Restrictions on gatherings of less than 10 people

1. **Close public transport:**

0 - No measures

1 - Recommend closing (or significantly reduce volume/route/means of transport available)

2 - Require closing (or prohibit most citizens from using it)

1. **Stay at home:**

0 - No measures

1 - recommend not leaving house

2 - require not leaving house with exceptions for daily exercise, grocery shopping, and ‘essential’ trips

3 - Require not leaving house with minimal exceptions (e.g. allowed to leave only once every few days, or only one person can leave at a time, etc.)

1. **Restrictions on internal movement:**

0 - No measures

1 - Recommend movement restriction

2 - Restrict movement

1. **International travel controls:**

0 - No measures

1 - Screening

2 - Quarantine arrivals from high-risk regions

3 - Ban on high-risk regions

4 - Total border closure

1. **Public information campaigns:**

0 - No COVID-19 public information campaign

1 - public officials urging caution about COVID-19

2 - coordinated public information campaign (e.g. across traditional and social media)

**Further Information**

*Coronavirus Government Response Tracker*

[*https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker*](https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker)

*The working paper discussing “Variation in Government Responses to COVID-19*

<https://www.bsg.ox.ac.uk/research/publications/variation-government-responses-covid-19>

*The calculation of the stringency index is summarised in this paper, which summarises the components above as SUM(C1:C8)+H1:* [*https://www.bsg.ox.ac.uk/sites/default/files/2020-11/BSG-WP-2020-032-v9.pdf*](https://www.bsg.ox.ac.uk/sites/default/files/2020-11/BSG-WP-2020-032-v9.pdf)

**The Multiple Linear Regression**

While Plots 1-4 are relatively self-explanatory, the Linear Regression used to create Plot 5 was tuned iteratively, selecting predictors and interactions which were both logically valid and resulted in an increase in Adjusted R2. The resulting model equation is as follows:

Total Cases Per Million = 0.0064 – 0.0451\*Percentage Aged 65+ – 0.783\*Stringency Index + 0.972\*(Stringency Index\*Days Elapsed) + B4\*(Stringency Index\*Location), where B4 is a coefficient representing the relationship between the stringency index and total cases per million, by location.

Since we have two interaction terms involving only continuous variables, we briefly explain how these terms are to be interpreted. Such multiplicative terms represent conditional relationships, meaning that, holding one constant,

1. **RESULTS AND CONCLUSIONS**

This is where you summarise and present your data analyses and communicate your main results. What did you find out? This might include tables, graphs, or verbal summaries. What did you learn about the problem or question you set out to investigate?

1. **DISCUSSION AND CRITIQUE**

What did you learn about the process of carrying out your project? What went wrong, and how could you improve it next time? For instance, did any sources of bias creep into your survey or experiment? What advice would you give future students?