



RSS 2022

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Identifying crucial factors of the impact of COVID-19 on driving behaviour using feature analysis on naturalistic driving data

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Together with:

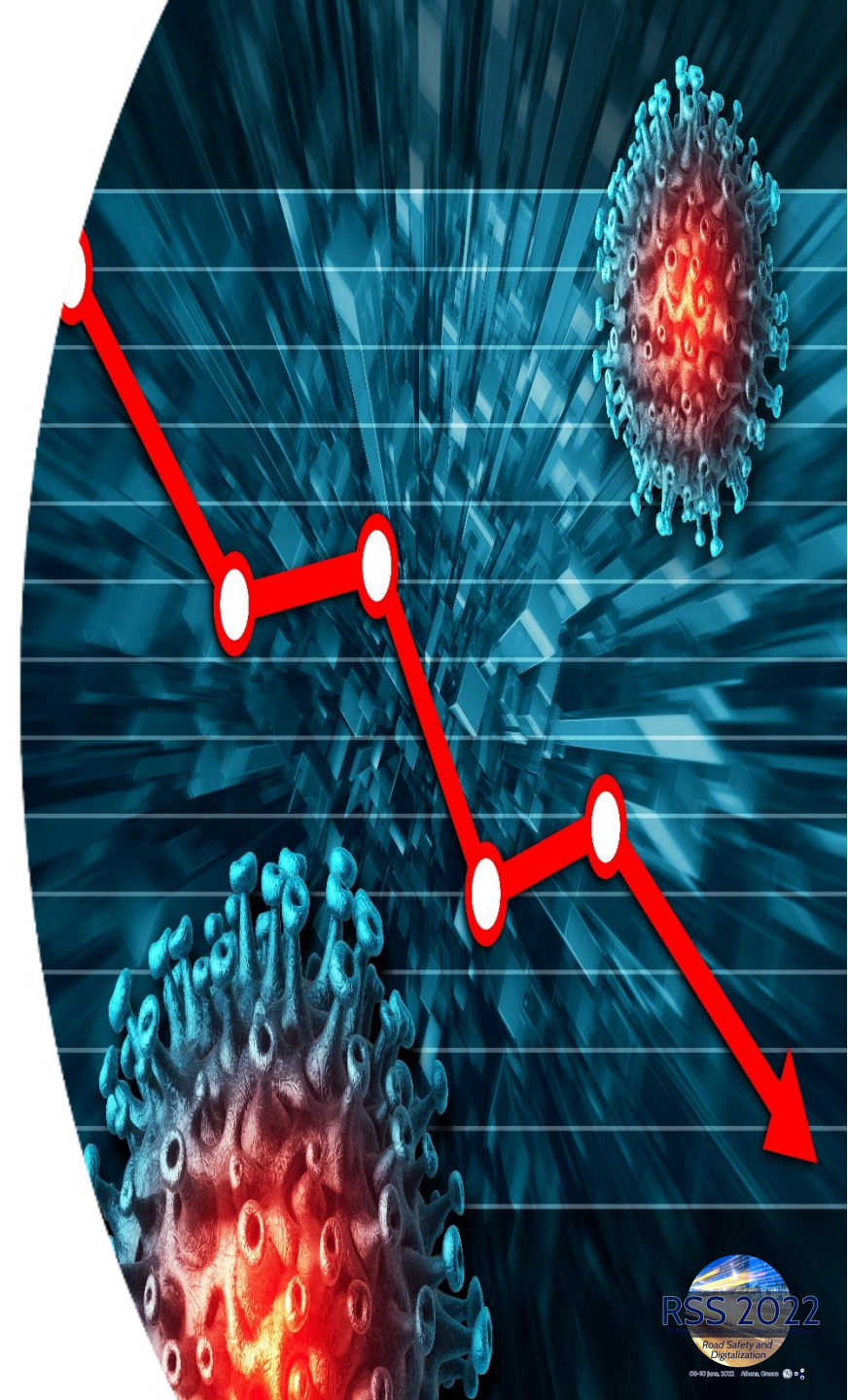
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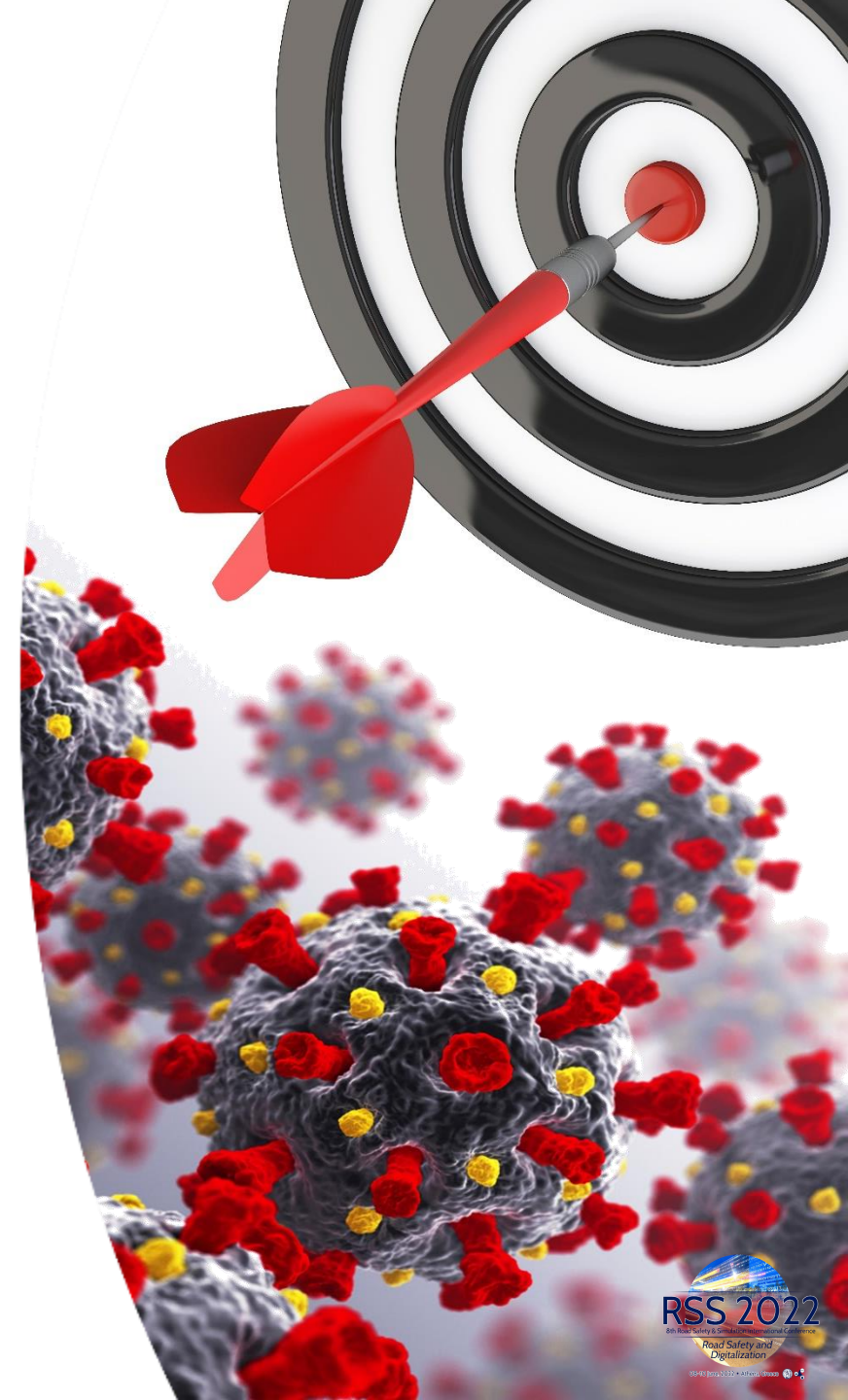
Introduction

- The pandemic of COVID-19 has been affecting **human activity**, since December 2019.
- Governments around the world **implemented lockdowns** in order to decrease human mobility and prevent the pandemic spread.
- Many studies found that **driving behavior** was significantly affected.
- The literature findings revealed that the observed values of **driving behavior indicators** (i.e., average speed, speeding, harsh braking and harsh accelerations per 100 km) were higher during the first lockdown.



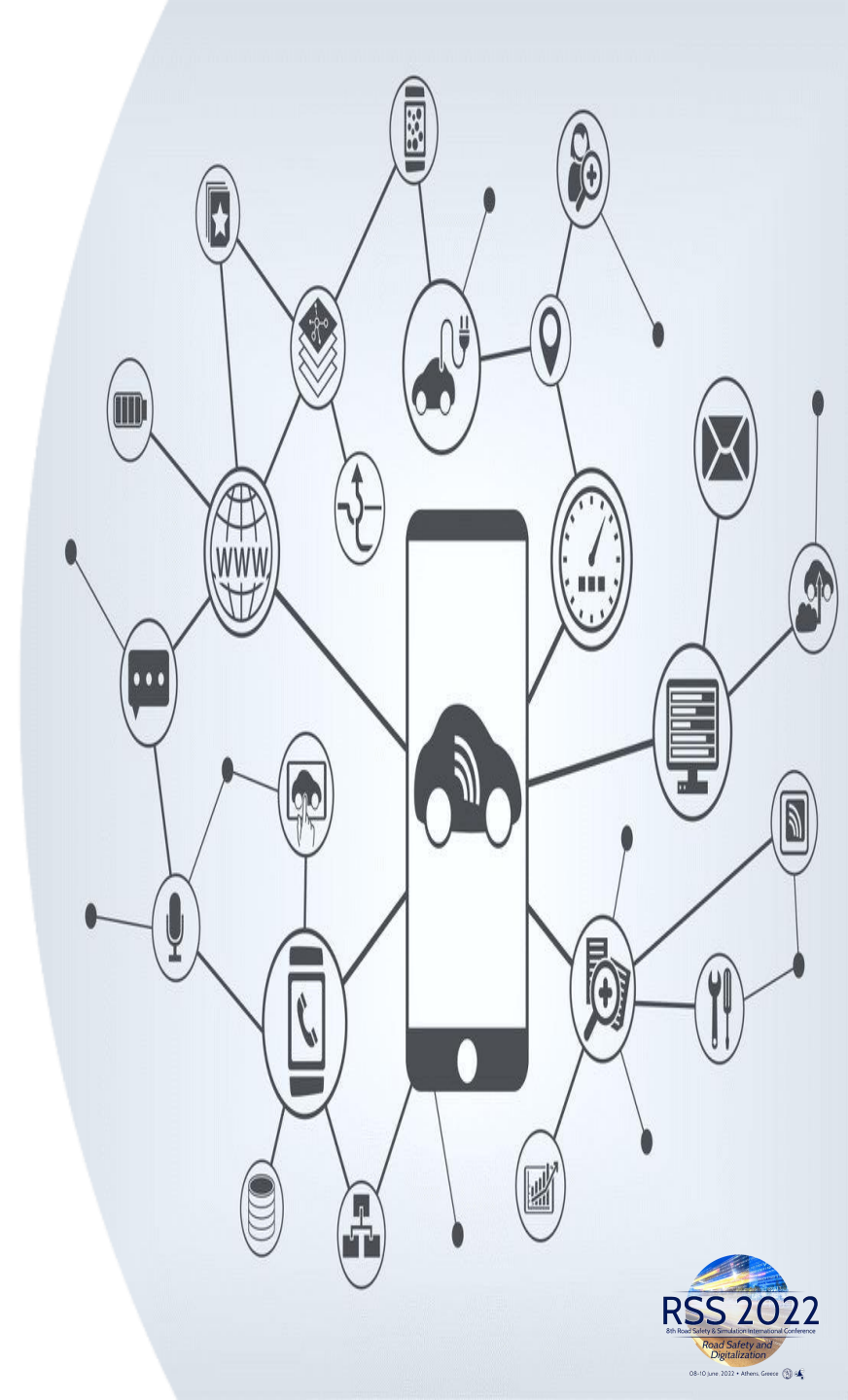
Study Aim

- The current study identified **the most important factors** that influenced driving behavior in the year 2020
- **Naturalistic driving data** along with other 3 open-access databases was analyzed for this purpose.
- The indicators studied were **harsh acceleration and harsh braking events** before, during, and after the imposition of lockdown measures in Greece.



Naturalistic Driving Data

- OSeven Telematics (oseven.io) provided a random dataset with **naturalistic driving trips** from its database in order to associate driving behavior with COVID-19 parameters and restrictions.
- The database covered **305,638 trips** around Greece for the entire year 2020.
- OSeven uses its specially developed **smartphone application** to obtain data from smartphone sensors (i.e., GPS, accelerometer, and gyroscope data).
- **Data** were sent to the OSeven backend infrastructure through Wi-Fi or cellular network which were evaluated using filtering, signal processing, ML algorithms and safety/eco scoring models.



Data Overview (1/2)

Four databases were used for the analysis:

- From the **OSeven dataset**, five variables (i.e., harsh accelerations (HA) /100km, harsh brakings (HB) /100km, mobile use/ driving time, driving during risky hours, distance) were exploited.
- Database of **Our World in Data**, 2020 was exploited to capture the daily evolution of COVID-19 metrics i.e., new cases, new fatalities, and the COVID-19 reproduction rate of the pandemic.



Data Overview (2/2)

Four databases were used for the analysis:

- The response measures of the Greek government were quantified with an index titled “Stringency Index”. This index was obtained and calculated by **Oxford** University. The stringency index ranges between 0 and 100 (i.e., 100 = strictest response).
- Mobility Trends Reports from **Apple** were used to incorporate into the analysis the driving patterns on Greek roads.



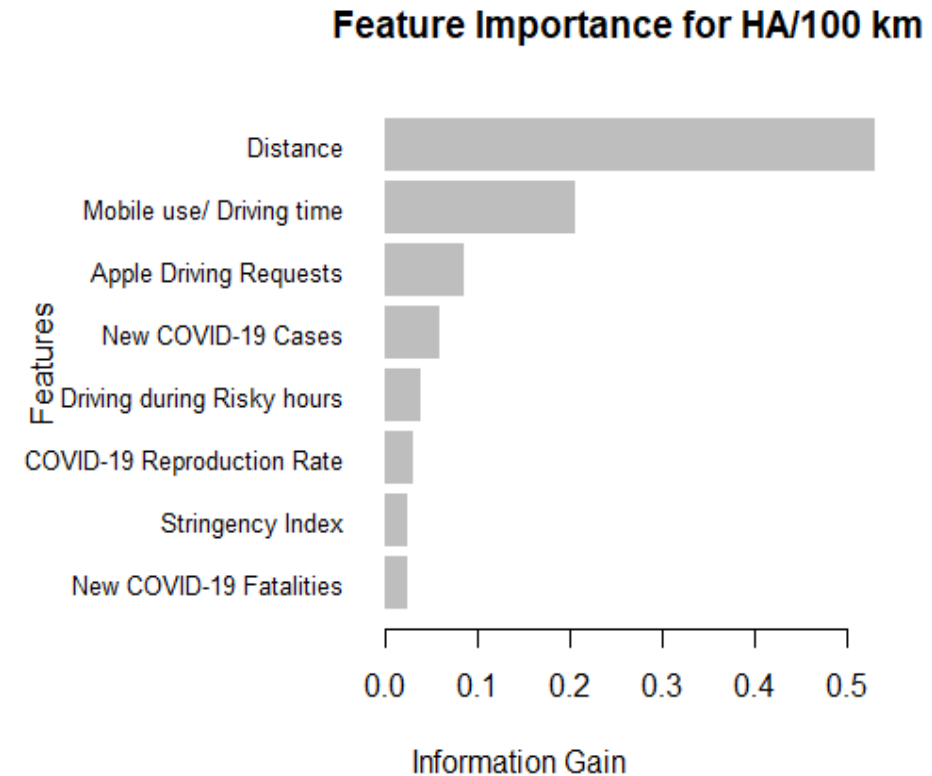
Analysis Method

- The **Extreme Gradient Boosting (XGBoost)** algorithms were chosen in order to evaluate the **feature importance** of the variables i.e., mobility, COVID-19 metrics and restrictions on the naturalistic driving behavior indicators.
- The naturalistic driving behavior indicators were frequency of:
 - **Harsh brakings** per distance (100km)
 - **Harsh accelerations** per distance (100km)



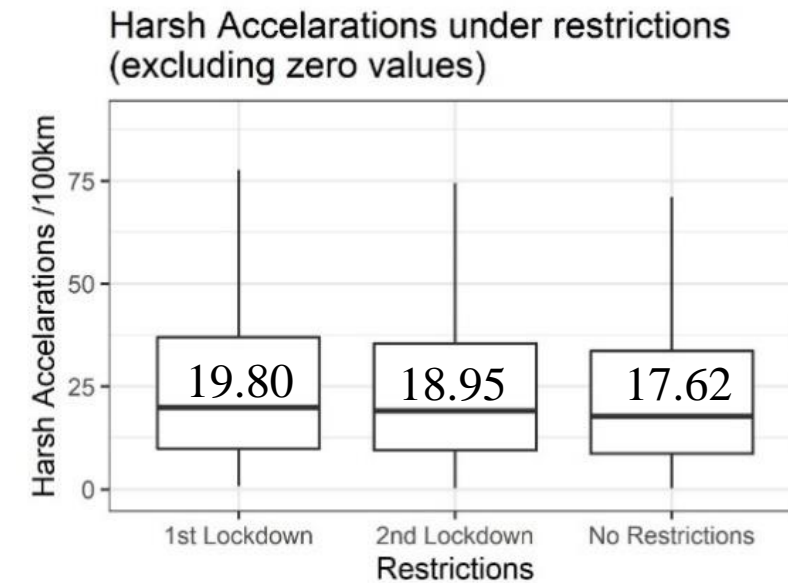
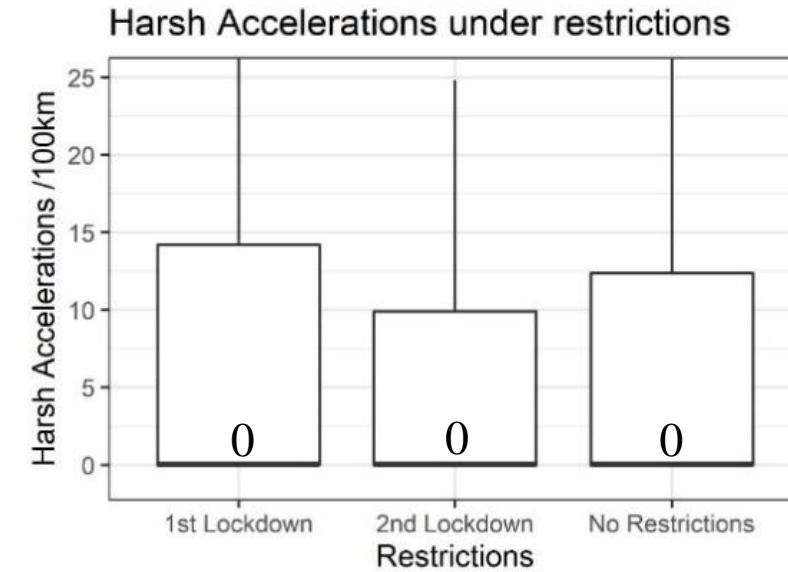
Harsh Acceleration Events

- The **three variables** with the highest impact on the HA/100km model were:
 - Distance
 - Mobile Use/ Driving Time
 - Driving Requests
- The **new COVID-19 cases** in Greece seem to precede compared to other COVID-19-related variables.
- **Other COVID-19-related variables** that influenced the harsh accelerations in Greece were COVID-19 Reproduction Rate, Stringency Index, and New COVID-19 Fatalities.



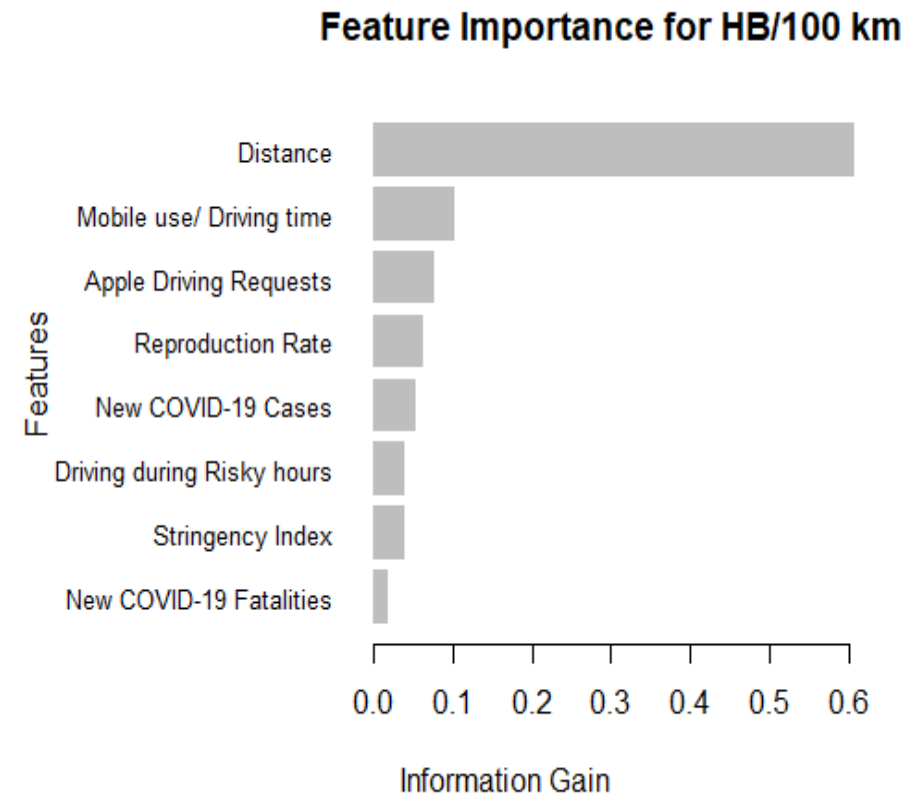
Harsh Acceleration Events

- As can be seen in the upper boxplot, the **median values** for each condition equal zero.
- Hence, the lower boxplot was created with trips **with harsh events occurrence**.
- The **highest median** was observed at the 1st lockdown, then at the 2nd, and then without restrictions.



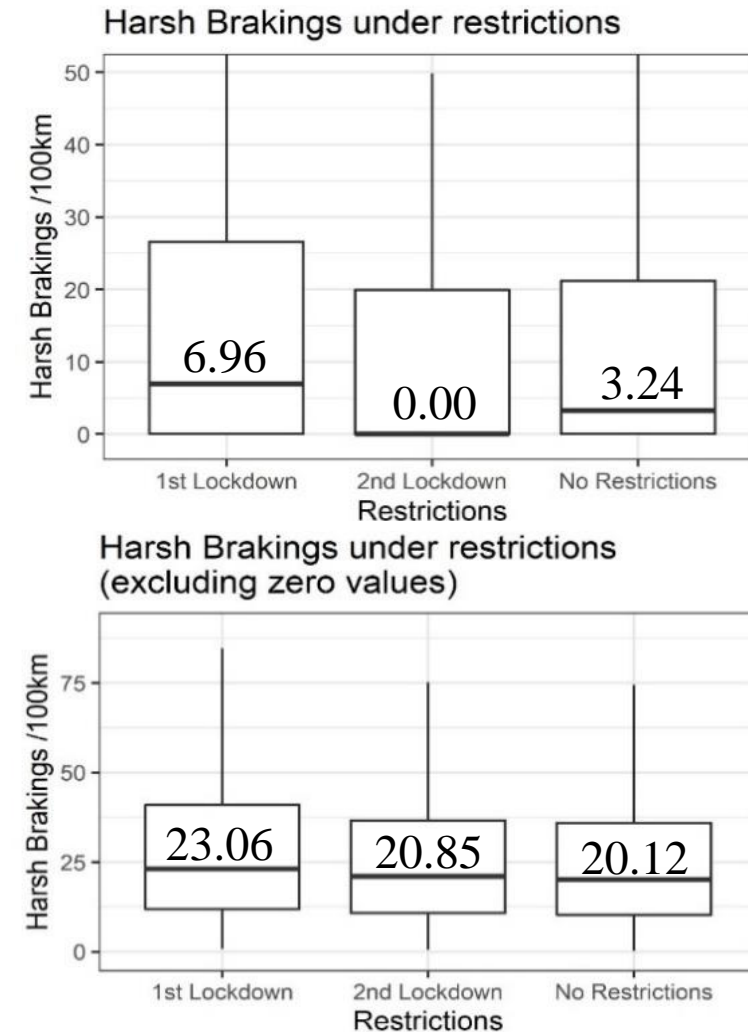
Harsh Braking Events

- Similar to HAs, the **three variables** that impacted HB/100km the most were:
 - Distance
 - Mobile Use/ Driving Time
 - Driving Requests
- Different from HAs, COVID-19 **Reproduction Rate** was found to influence the most HB.
- Other **COVID-19-related variables** that influenced the harsh brakings in Greece were New Cases, Stringency Index, and New Fatalities.



Harsh Braking Events

- As can be seen in the upper boxplot, **the highest median** was observed during the 1st lockdown.
- Then, the conditions without restrictions follow and it is noteworthy that the median for the 2nd lockdown **equals zero**.
- Similar to the HA model, for trips with HB occurrence, **the highest median** was observed at the 1st lockdown, then at the 2nd, and then without restrictions.



Conclusions (1/2)

- The **three variables** that influenced HA and HB events the most were distance, mobile use/ driving time, and Apple driving requests.
- The aforementioned variables are extraneous with COVID-19 variables, and this is clear since the COVID-19 pandemic had **no direct effect** and causality on driving behavior.
- COVID-19-related variables that impacted HAs the most were **New cases** and **Reproduction Rate** for HBs
- **COVID-19-related variables** that influenced the HA and HB events in Greece were Reproduction Rate, Stringency Index, and New Fatalities and Cases.



Conclusions (2/2)

- Considering driving exposure, **traffic volume** during the 1st lockdown was lower.
- With fewer vehicles ahead, the drivers **could accelerate more easily** and maintain higher speeds.
- Hence, it was more probable for the drivers to be involved **in a harsh braking event** with higher speeds.
- With regards to the **2nd lockdown**, the median of HAs and HBs was higher compared to conditions without restriction as a result of the decreased traffic volume but was still lower than the one of the 1st lockdown.





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