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Department of Management
Faculty of Social Sciences
Bar-Ilan University

Bar-Ilan Center for Smart Cities

Key factors of COVID-19 impact on mobility and safety

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Introduction

- COVID-19 disease initially diagnosed in patients in Wuhan, China in December 2019
- Declared as a pandemic on the beginning of March 2020
- The majority of countries in a "lockdown" restricting everyday life activities to only the most essential
- As a result, road traffic volumes and mobility activities in general have immensely dropped

Background

Traffic Volumes

- Travel demand was decreased and many countries have witnessed sizeable drops in car traffic and public transport ridership
- A 37% and 35% decrease in driving days per week and vehicle miles driven, respectively among adolescents was identified

Driving Behavior

- Fixed safety cameras detected that speed violations have been increased by 39% and average driving speed by 6–11%
- Reduced traffic volumes due to lockdown, led to more frequent harsh accelerations and harsh brakings per 100km (up to 12%)

Road Traffic Crashes

- The total number of road traffic crashes, serious and slight injuries was decreased by half, mainly due to the dramatic traffic reduction
- Fewer fatalities were observed but, unfortunately, the rate of reduction has slowed

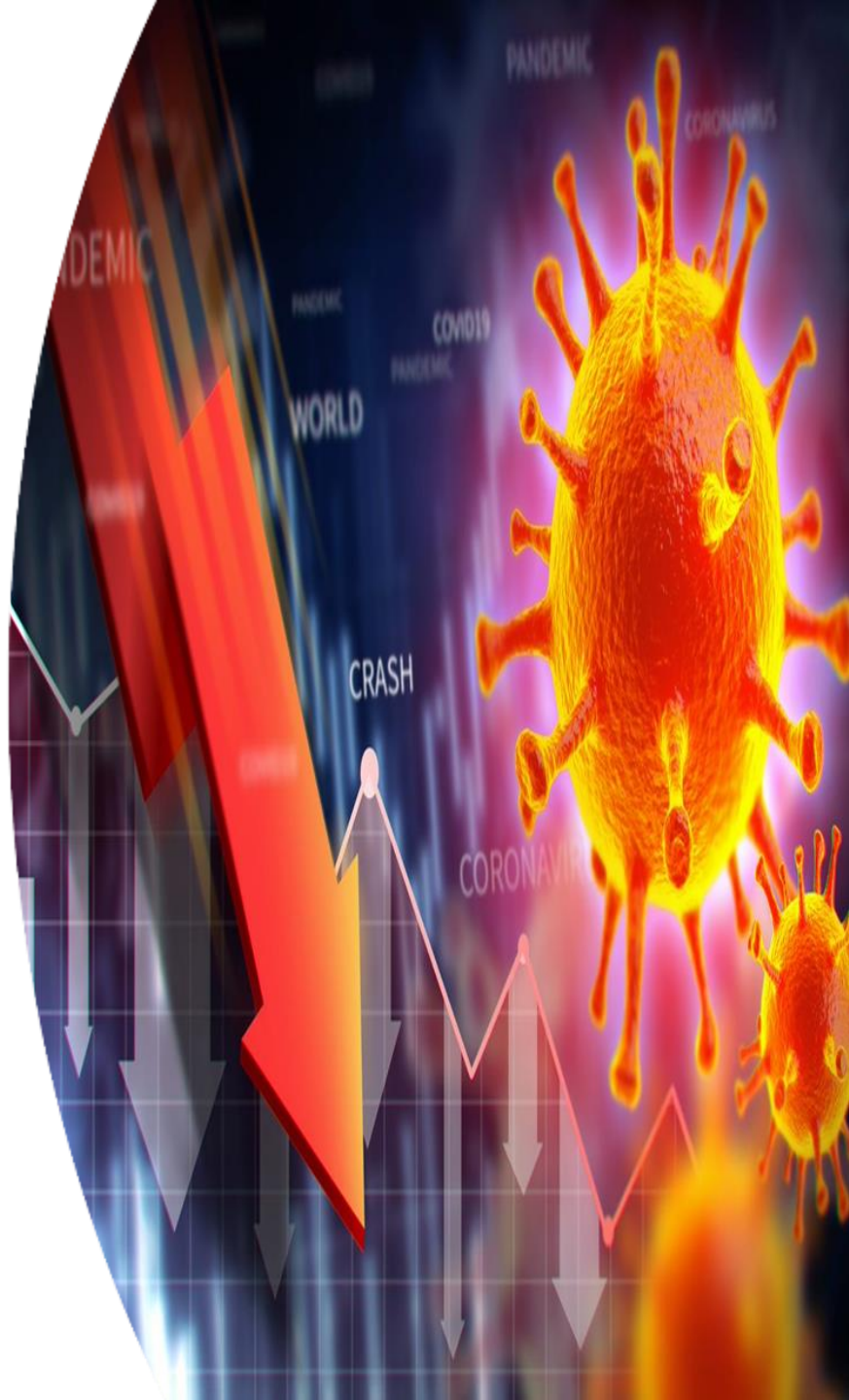
Data Collection and Analyses

- Data from the Mobility Trend Report of Apple

- Data from the smartphone sensors were collected using the smartphone applications technology that has been developed by OSeven

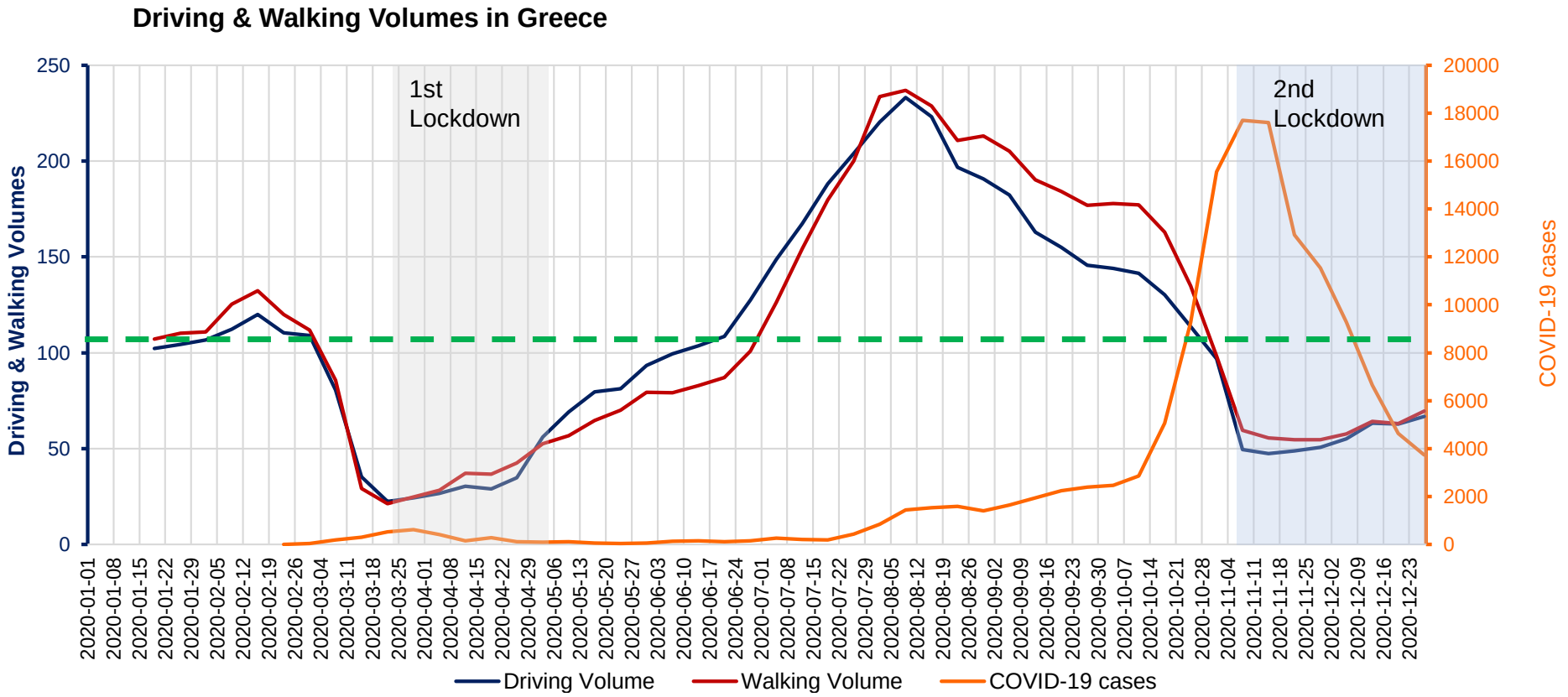
- Monthly road traffic crashes, fatalities, and slight injuries data were derived from the Hellenic Statistical Authority

- Advanced Statistical Analyses
  - Machine Learning (XG Boost, Clustering, Neural Networks)
  - Time-series (ARIMA, SARIMA, SARIMAX)



Traffic Volumes

- The total number of **trips and distance travelled** reduced by 70% (1st lockdown) and 37% (2nd lockdown) for people driving and walking compared to the period before the appearance of COVID-19 pandemic
- Increased **driving and walking volumes**, roughly by 100%, during the 2nd COVID-19 lockdown compared to the 1st one

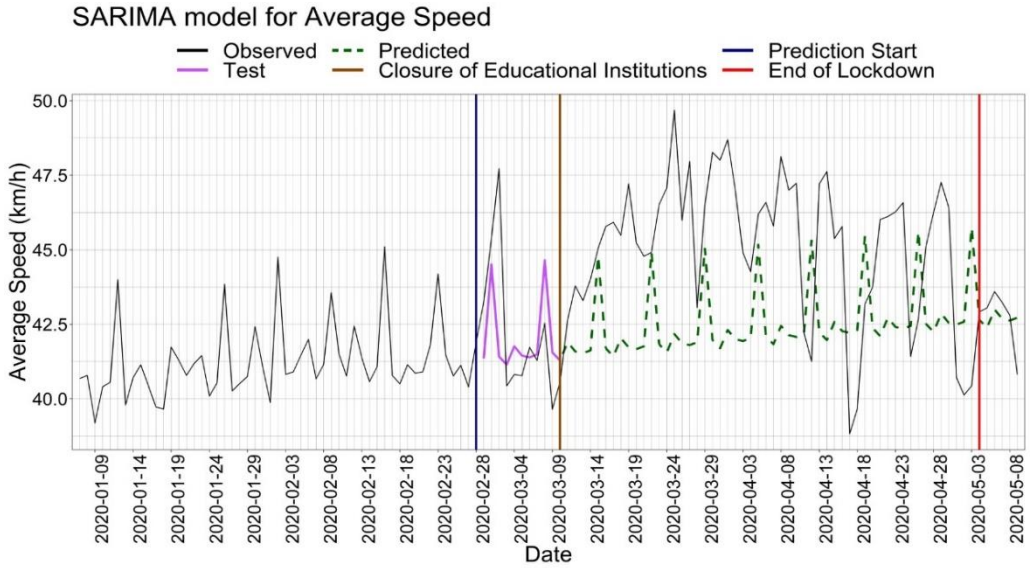


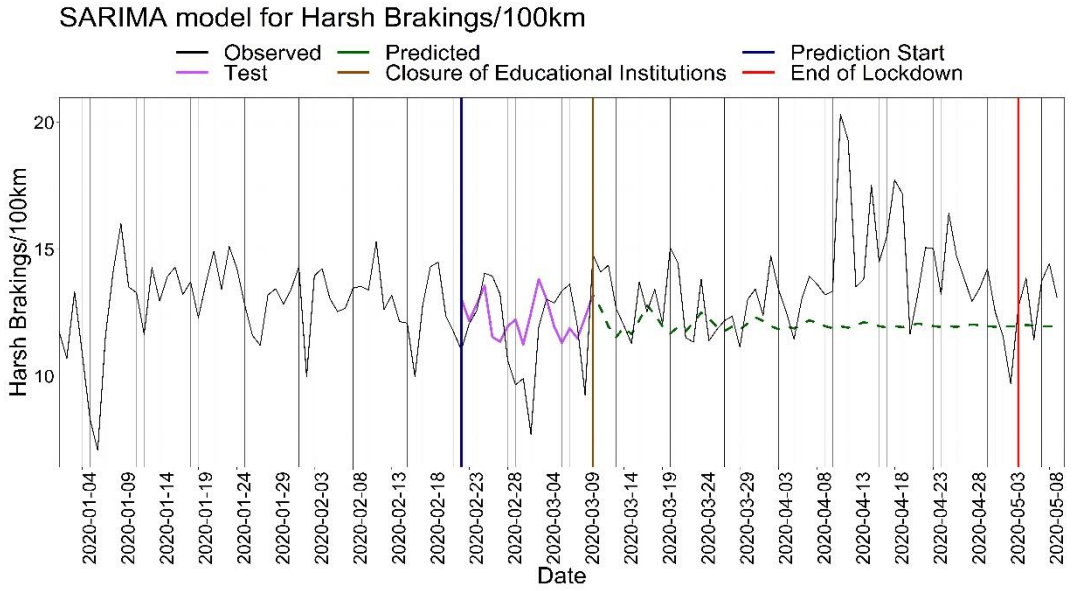
Source: Apple

Driving Behavior

- During the 1st lockdown period, an **overall 10% increase** in average speed was identified compared to the period before the appearance of COVID-19 pandemic. Interestingly, during the 2nd lockdown period, a **3% increase** in average speed was identified in Greece compared to the period before
- **Comparison** between normal evolution and COVID-19 period data

- Higher **speed** values up to 7.5 km/h more than the "normal" time-series evolution
- Values for harsh brakings/100km were **much higher** than the forecasted values

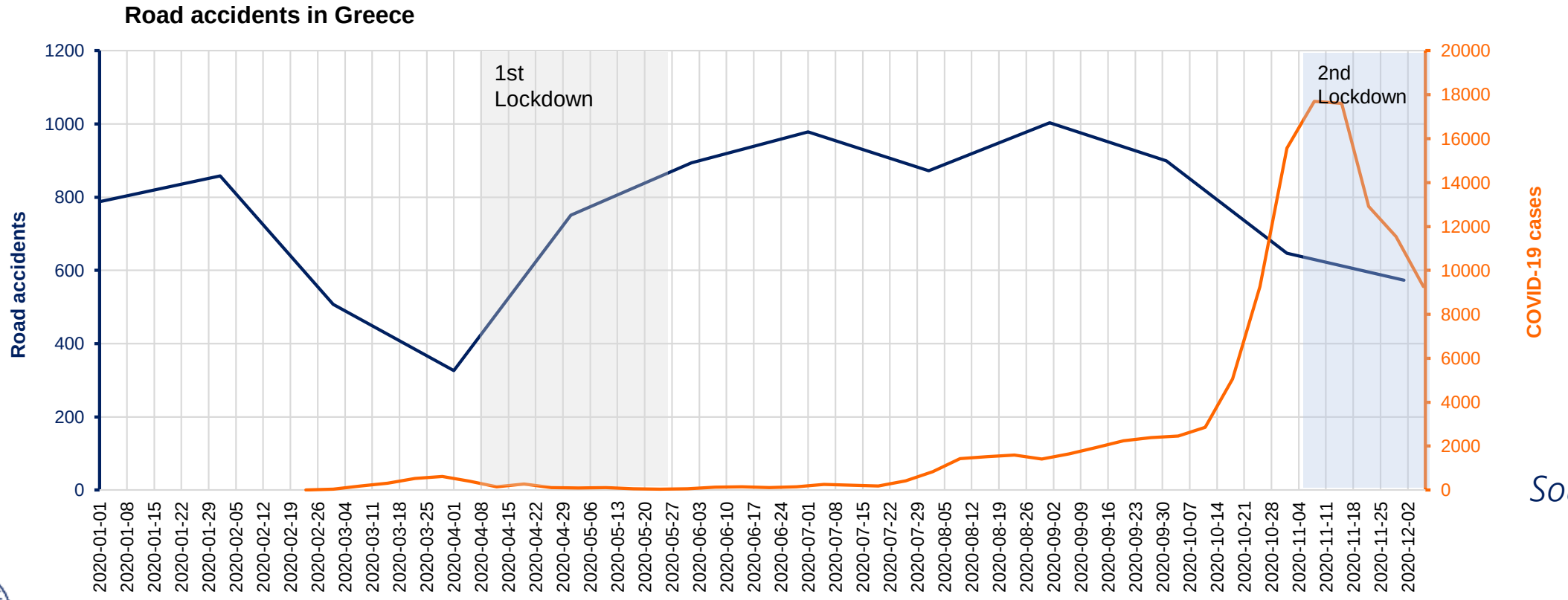




Source: OSeven

Road Traffic Crashes

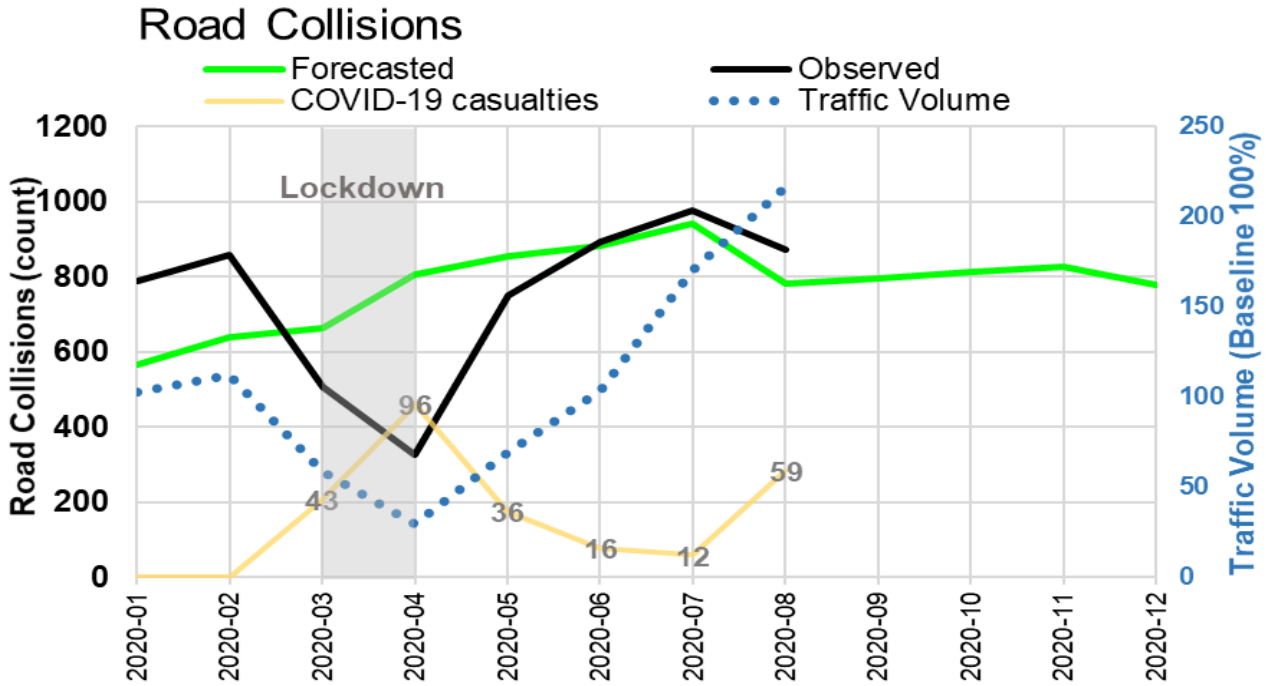
- A significant annual reduction (16%) was recorded in traffic fatalities in 2020 compared to 2019, mostly due to the pandemic
- During the 1st lockdown period, an overall 50% reduction in road traffic crashes was observed compared to the period before the appearance of COVID-19 pandemic
- During the 2nd lockdown period, a 26% decrease in the total number of road traffic crashes was identified compared to the period before the appearance of COVID-19 pandemic



Source: ELSTAT

Road Traffic Crashes – Predicted vs Observed

- Road collisions and fatalities were found to be lower than the forecasted values, as the traffic volume was reduced at the same period
- Bringing traffic volume into account, however, it can be concluded that road safety performance was worsened
- The rate of fatalities per collision was increased in lockdown months (i.e., March and April 2020)
- Empty roads led drivers to be more aggressive and accelerate more, even in terms of sudden events, such as pedestrians crossing an empty road



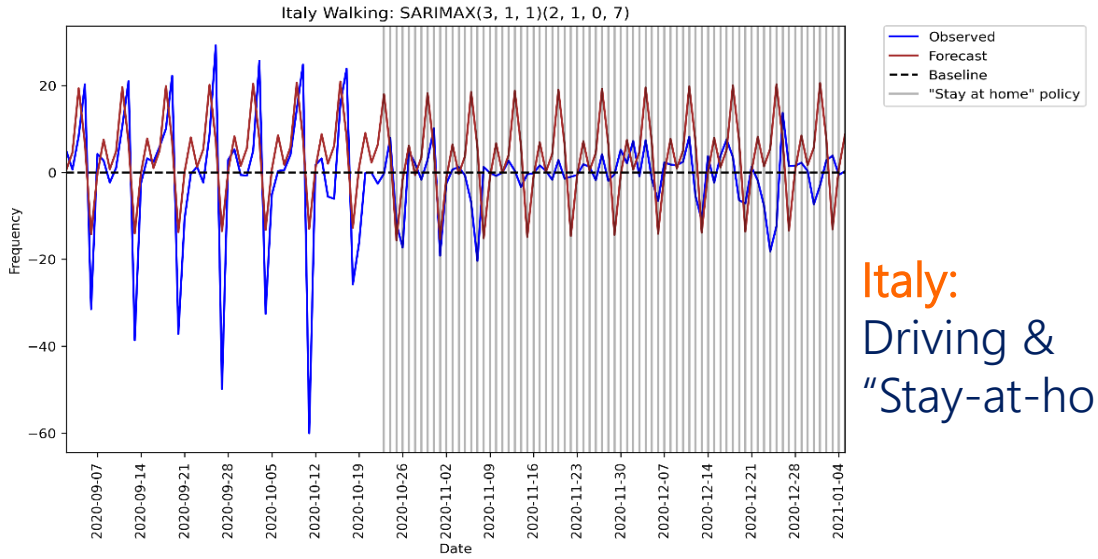
Source: ELSTAT

Mobility and Response Measures – The X factors

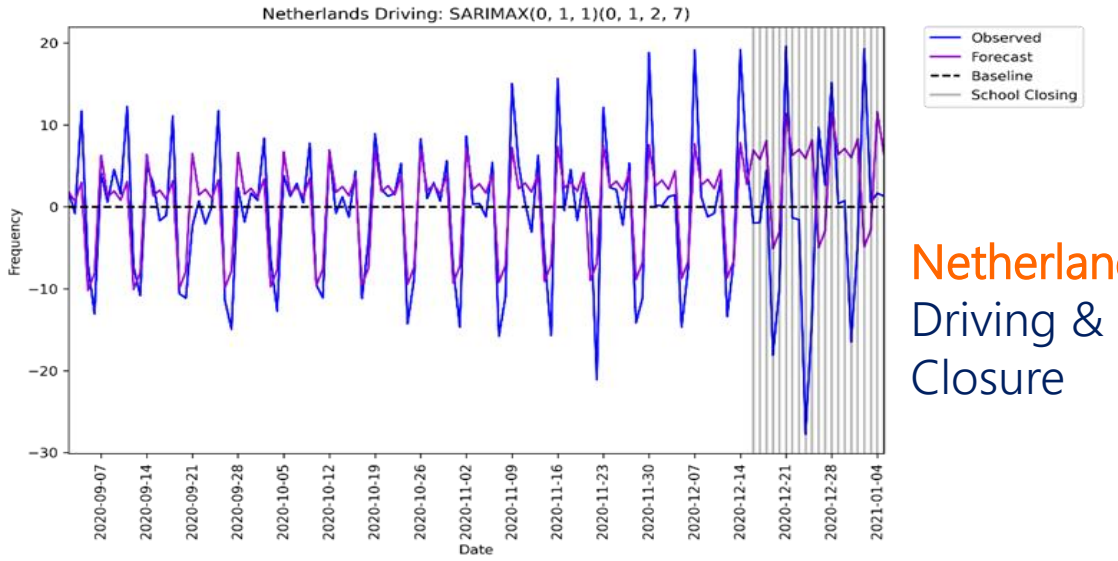
- School closure was the most influential measure
- Lockdown was found to be less significant
- International travel controls was significant for countries with more flexible measures (e.g Slovenia, Latvia, Croatia)
- Countries with flexible measures did not provide reliable results (e.g. Finland, Sweden, Lithuania)
- Mobility in subsequent waves cannot be reliably predicted if first wave was relatively "mild"

n	Country	Endogenous variable	Exogenous variable	n	Country	Endogenous variable	Exogenous variable
1	Austria	Driving	School closing	21	Greece	Driving	"Stay at home" orders
2	Belgium	Driving	School closing	22	Ireland	Driving	"Stay at home" orders
3	Czech Republic	Driving	School closing	23	Slovakia	Driving	"Stay at home" orders
4	Denmark	Driving	School closing	24	Estonia	Walking	"Stay at home" orders
5	France	Driving	School closing	25	Czech Republic	Walking	"Stay at home" orders
6	Hungary	Driving	School closing	26	Germany	Walking	"Stay at home" orders
7	Italy	Driving	School closing	27	Greece	Walking	"Stay at home" orders
8	Netherlands	Driving	School closing	28	Italy	Walking	"Stay at home" orders
9	Poland	Driving	School closing	29	Austria	Driving	International travel controls
10	Portugal	Driving	School closing	30	Belgium	Driving	International travel controls
11	Romania	Driving	School closing	31	Hungary	Driving	International travel controls
12	Spain	Driving	School closing	32	Italy	Driving	International travel controls
13	Austria	Walking	School closing	33	Latvia	Driving	International travel controls
14	Czech Republic	Walking	School closing	34	Netherlands	Driving	International travel controls
15	Denmark	Walking	School closing	35	Croatia	Walking	International travel controls
16	Hungary	Walking	School closing	36	Poland	Walking	International travel controls
17	Italy	Walking	School closing	37	Portugal	Walking	International travel controls
18	Romania	Walking	School closing	38	Slovakia	Walking	International travel controls
19	Spain	Walking	School closing	39	Slovenia	Walking	International travel controls
20	France	Driving	"Stay at home" orders	40	Spain	Walking	International travel controls

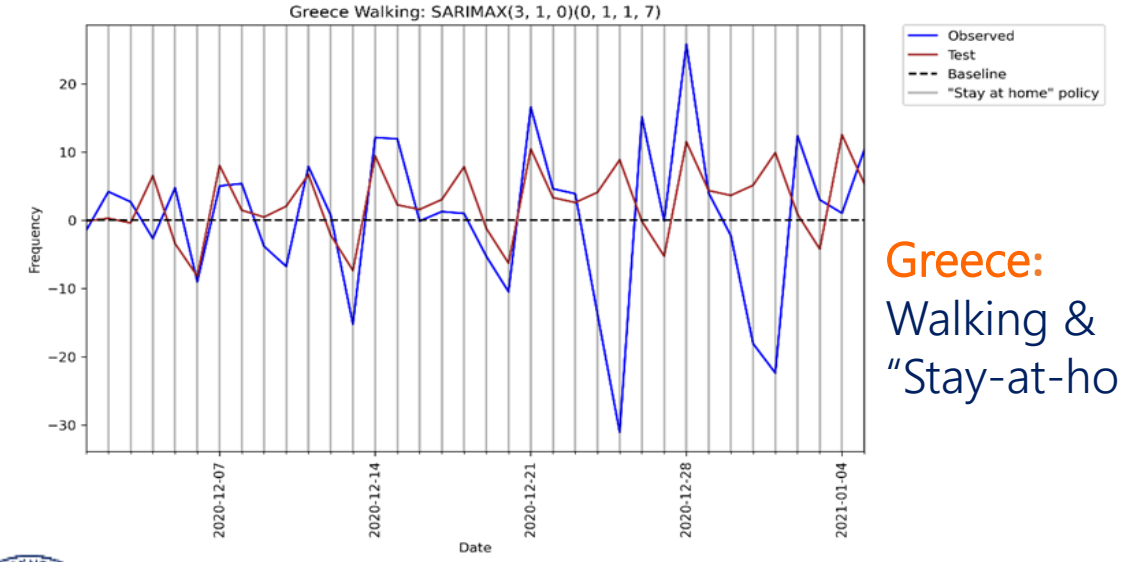
Mobility and Response Measures – Forecasts



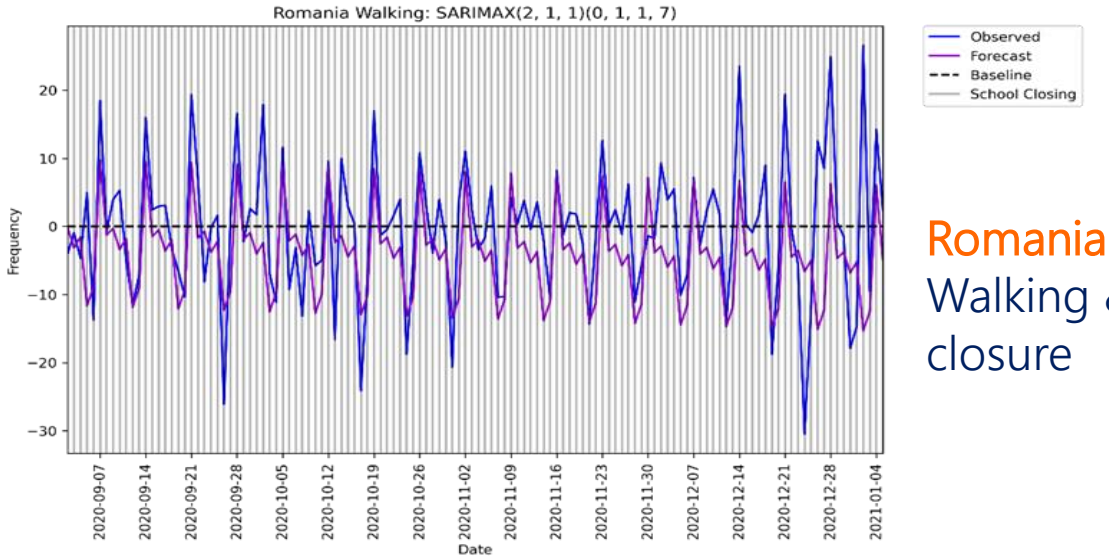
Italy:
Driving &
"Stay-at-home"



Netherlands:
Driving & School Closure



Greece:
Walking &
"Stay-at-home"



Romania:
Walking & school closure

Most Significant Factors for Predicting Mobility Patterns

- Strictness of measures and number of cases were found to be significant mobility predictors
- Number of trips to pharmacies, grocery stores and parks were also found to influence mobility patterns
- Visits to transit stations and retail or recreation spots were usually inisignificant
- A pan-European model for predicting mobility patterns is currently developed

Independent variables	AUT	BEL	BGR	HRV	CZE	DNK	EST
strig.index	strig.index	strig.index	strig.index	strig.index	strig.index	strig.index	strig.index
cases	cases	cases	cases	cases	cases	cases	cases
deaths	deaths	deaths	deaths	deaths	deaths	deaths	deaths
vaccination	vaccination	vaccination	vaccination	vaccination	vaccination	vaccination	vaccination
retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation
grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy
parks	parks	parks	parks	parks	parks	parks	parks
transit.stations	transit.stations	transit.stations	transit.stations	transit.stations	transit.stations	transit.stations	transit.stations
workplaces	workplaces	workplaces	workplaces	workplaces	workplaces	workplaces	workplaces
residential	residential	residential	residential	residential	residential	residential	residential
Independent variables	**IRL**	**ITA**	**LVA**	**LTU**	**LUX**	**NLD**	**NOR**
strig.index	strig.index	strig.index	strig.index	strig.index	strig.index	strig.index	strig.index
cases	cases	cases	cases	cases	cases	cases	cases
deaths	deaths	deaths	deaths	deaths	deaths	deaths	deaths
vaccination	vaccination	vaccination	vaccination	vaccination	vaccination	vaccination	vaccination
retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation	retail.recreation
grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy	grocery.pharmacy
parks	parks	parks	parks	parks	parks	parks	parks
transit.stations	transit.stations	transit.stations	transit.stations	transit.stations	transit.stations	transit.stations	transit.stations
workplaces	workplaces	workplaces	workplaces	workplaces	workplaces	workplaces	workplaces
residential	residential	residential	residential	residential	residential	residential	residential

Overall Findings

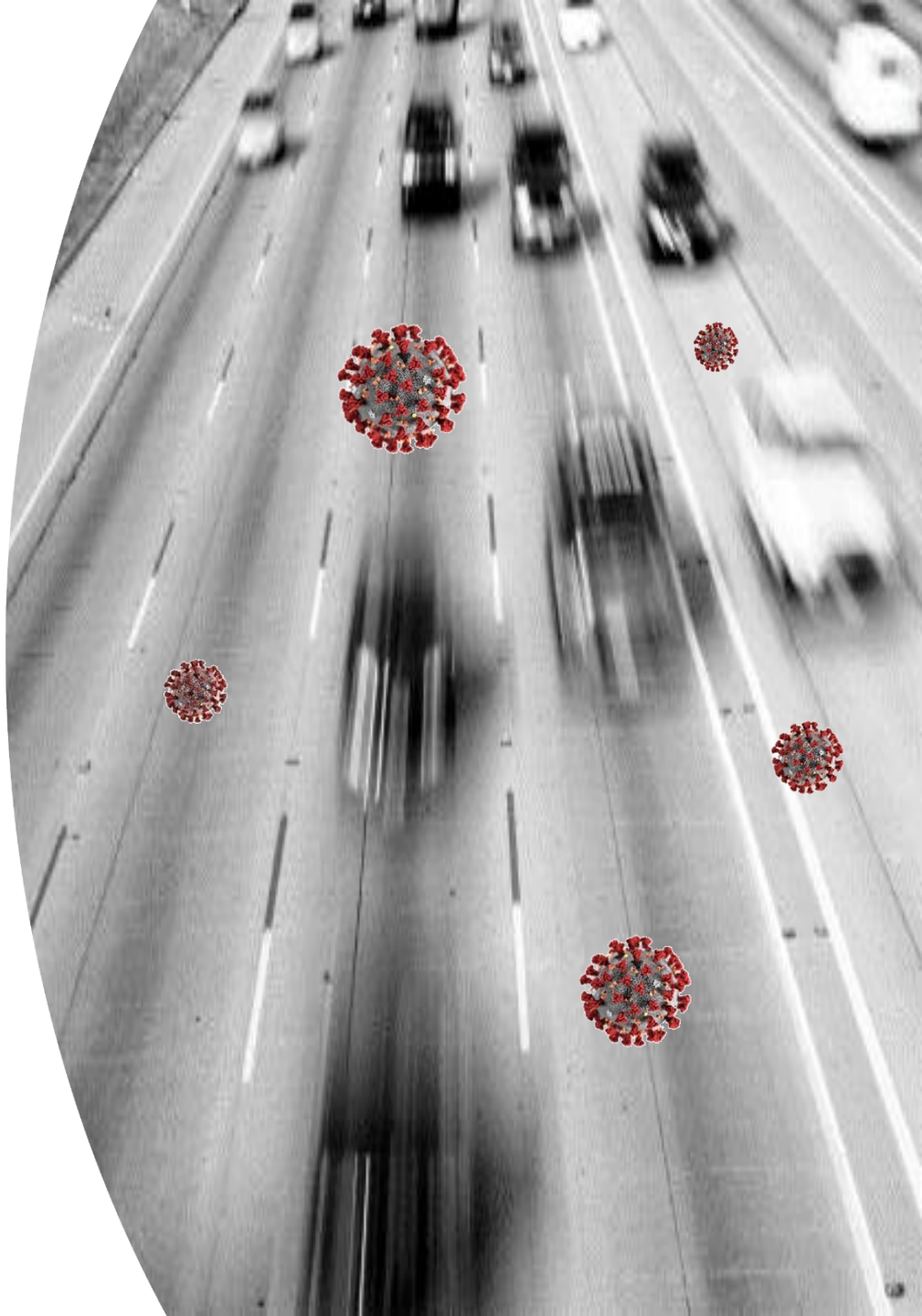
- A dramatic change in traffic was observed and traffic volumes **were substantially increased** when comparing the 1st and the 2nd lockdown
- As traffic levels reduced and police time was spent on other things, **speeding went up** and in some cases **more casualties per traffic** were occurred
- Increased **average speed** and more **frequent harsh events** per distance were demonstrated. This indicates that with fewer vehicles on city streets, slightly more drivers were blowing the speed limit
- The **fatality and slight injuries rates** per collision were increased compared to assumed conditions without COVID-19

Scientific and Social Impact

- The COVID-19 pandemic has shown how quickly global mobility and safety conditions can change
- Road safety is also a pandemic, and should also be treated as such
- On a positive note, as cities put in place new cycling infrastructure, cycling use numbers increased
- After the pandemic, we need to build a safer and more equal system for all road users – giving back separated space for healthier and sustainable active travelling

Key Lessons

- The COVID-19 Pandemic led to major behavioural changes which might stay after the pandemic (as it happened with the economic crisis in Greece)
- The society might embrace the new road safety culture and will not get back to previous unsafe behaviours
- COVID-19 Pandemic might be more the trigger for safety change than just an unusual year
- Authorities should exploit the new opportunities with consistent actions targeting all levels of road safety (behaviour, infrastructure, vehicles)



Key Opportunities

- New patterns of **social responsibility** (triggered by the pandemic) – better respect of the others than before the pandemic
- **Teleworking** with less mobility miles per road user (especially longer distance commuters)
- **Active travelling** increase (walking, cycling) brings up safety in numbers for the Vulnerable Road Users and leads to safer speeds in cities
- Widespread urban zones with **20m/h speed limits** will also lead to safer speeds
- New **recovery and resilience funds** directed also to road safety (infrastructure, vehicles, etc.)

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