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The comparative evaluation of road safety developments in Greek regions

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Background

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- In 2020, Greece recorded **584 fatalities** and **518 serious injuries** in road crashes.
- Over the period 2010-2020, the number of fatalities and serious injuries in road crashes in Greece **declined significantly** by 54% and 70% respectively.
- The level of road safety, however, is **not the same in all regions** of Greece.
- In terms of fatalities per population, the South Aegean region had the worst **road safety performance**, followed by the Peloponnese and the North Aegean regions.
- In this context, it is necessary to better understand and identify the **different road safety patterns** among the Greek regions.

Objectives and Methodology

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- The **objective** of the present study is to investigate the effects of transport and socioeconomic characteristics on road safety in the different regions of Greece.
- Data were collected for the **13 Regions of Greece** over the period 2004-2019 on:
  - road crash fatalities,
  - vehicle fleet and
  - socio-economic characteristics.
- A **two-step cluster analysis** was performed in order to group regions with similar characteristics in wider groups.
- **Mixed linear models** were developed for the whole country and for each of the clusters separately, in which the fatality rate per population was associated with transport and socio-economic indicators.

Data Collection

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- Data were collected for the **13 NUTS-1 regions** in Greece, over the period 2004-2019 from the Hellenic Statistical Authority (ELSTAT):
    - road crash fatalities,
    - population,
    - number of all vehicles in traffic,
    - number of passenger cars in traffic,
    - number of motorcycles in traffic,
    - number of tourist arrivals,
    - GDP per capita,
    - unemployment rate,
    - number of available doctors,
    - number of available hospital beds.

Data Description

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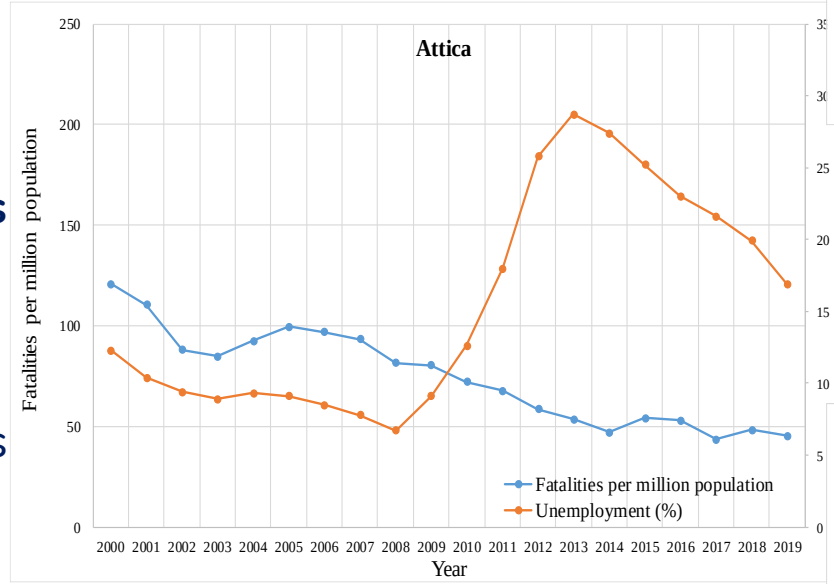
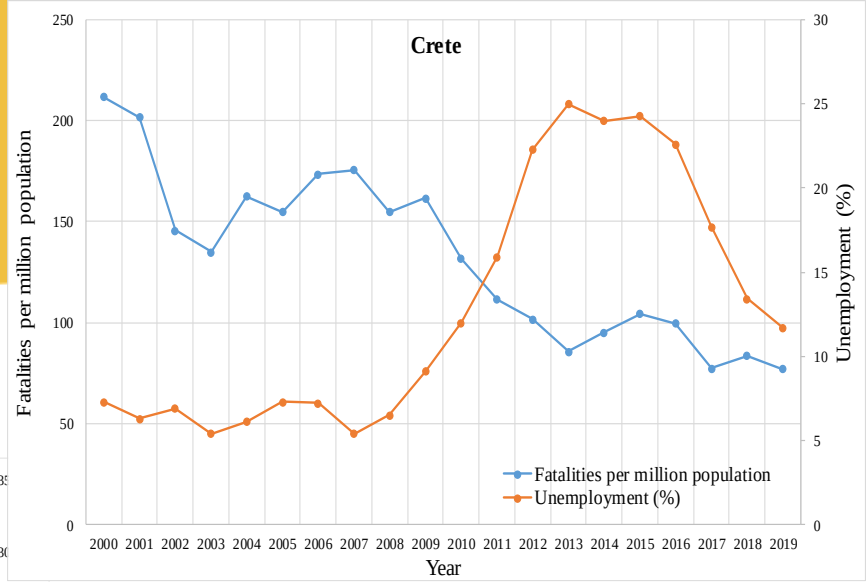
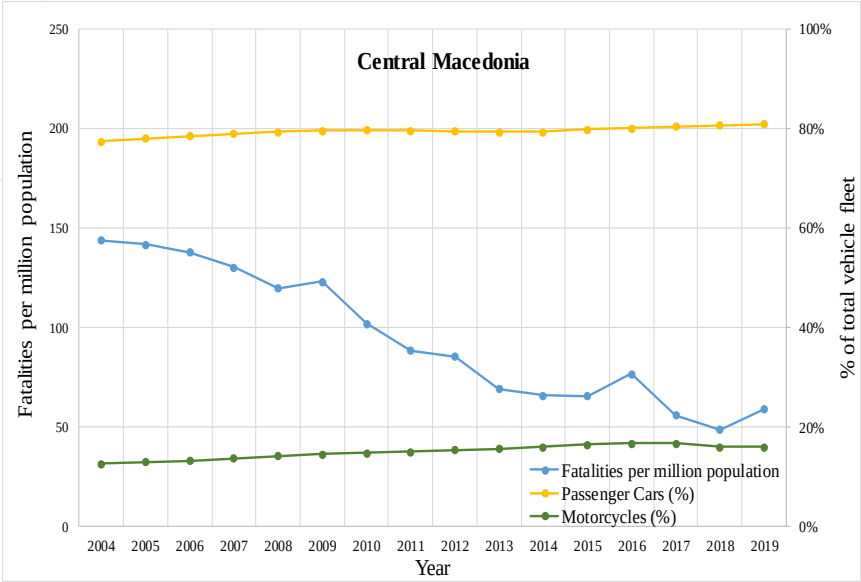
- In all regions, road fatalities present a **clear decreasing trend** over the whole period.
- The **high decrease in road fatalities** occurred between 2008 and 2014, when unemployment rates presented the highest increase.
- After 2018, when the recession was over, the trend of fatalities **varied depending the region**.
- Over the last years, the number of passenger cars had a slightly increasing trend, with the percentage of **motorcycles in traffic being more increased**.







Cluster Analysis

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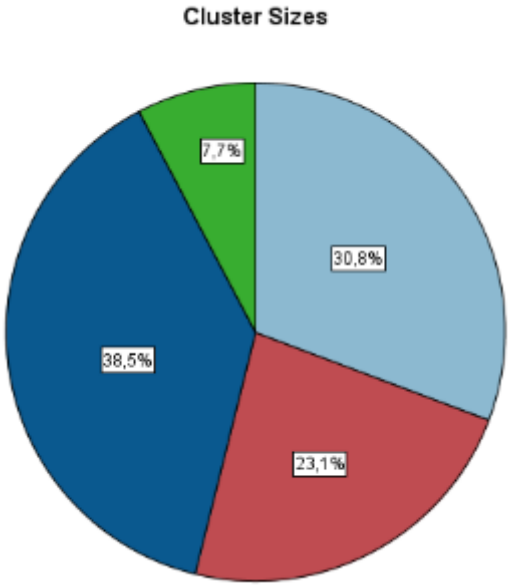
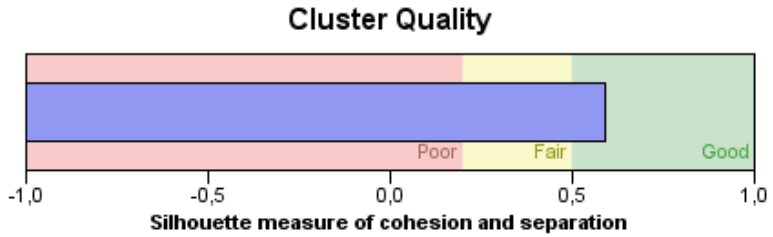
- **Six input variables** were included:
  - population density of region (in inhabitants per km^2),
  - percentage of passenger cars in total vehicle fleet,
  - percentage of motorcycles in total vehicle fleet,
  - ratio of foreign tourist arrivals per the total number of tourist arrivals,
  - available hospital beds per population
  - per capita GDP of each region.
- **Four clusters** were defined:
  - **Cluster 1 (Islands)**: Ionian islands, Crete, S. Aegean, N. Aegean;
  - **Cluster 2 (Western and Southern mainland)**: Western Greece, Peloponnese, Central Greece;
  - **Cluster 3 (Northern mainland)**: East Macedonia & Thrace, Western Macedonia, Central Macedonia, Thessaly, Epirus;
  - **Cluster 4**: Attica.





Mixed Linear Models (1/2)

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- **Four models** were developed:
  - the first includes all regions of Greece
  - three additional models per cluster
- The number of fatalities per population in all clusters of regions is **higher than the respective fatality rates in Attica**, with the highest difference being identified for Western and Southern mainland Greece.
- The **unemployment rate** has a negative relationship with the dependent variable, showing that as unemployment increases, the mortality rate in road crashes decreases.

Mixed Linear Model for mortality rate in all Greek regions

Parameter	Coefficient	t-test	Sig.	e_i
Intercept	5,064	8,215	0,000	-
Cluster 1	0,759	5,499	0,000	-
Cluster 2	1,062	5,999	0,000	-
Cluster 3	0,533	4,615	0,000	-
Cluster 4	0	.	.	-
Unemployment (%)	-0,040	-16,166	0,000	-0,146
LN(Motorc/pop)	-0,196	-3,01	0,003	-0,200
PassengerCar (%)	0,015	2,705	0,008	0,179
HospitalBeds/pop	-0,054	-2,037	0,043	-0,045
-2 Restricted Log Likelihood	17,728			

Mixed Linear Models (2/2)

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Mixed Linear Models for mortality rate per cluster of regions

	Cluster 1 (Islands)				Cluster 2 (Western & Southern mainland)				Cluster 3 (Northern mainland)			
Parameter	Coefficient	t-test	Sig.	e_i	Coefficient	t-test	Sig.	e_i	Coefficient	t-test	Sig.	e_i
Intercept	3,095	9,436	0,000	-	7,980	7,777	0,000		8,776	8,056	0,000	
Unemployment(%)	-0,032	-12,396	0,000	-0,098	-0,022	-3,733	0,001	-0,076	-0,046	-10,602	0,000	·
LN(Motorc/pop)	-0,136	-2,213	0,053	-0,154	-0,862	-3,865	0,000	-0,780	-0,374	-3,363	0,001	·
PassengerCar(%)	0,060	48,581	0,000	0,627	0,017	2,025	0,049	0,156	-0,018	-1,533	0,130	·
HospitalBeds/pop	-0,037	-7,588	0,000	-0,028	-0,240	-3,222	0,002	-0,118	-0,133	-2,348	0,021	·
-2 Restricted Log Likelihood	-15,578				4,997				35,296			

- An increase in the r**ate of motorcycles per population** is associated with a decrease in the fatality rate per population.
- The **percentage of passenger cars in total vehicle fleet** is positively correlated with the number of road fatalities per population, with this effect being higher for the islands.
- The ratio of **available hospital beds per population** is negatively associated with the traffic fatalities in all regions, with the highest effects of this indicator being identified in the regions of Northern mainland Greece.

Conclusions (1/2)

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- Greece presents several **geographical peculiarities**, with many islands, but also several mountainous areas in mainland Greece.
- The different extent and geographical characteristics of the Greek regions and their different economic activities are reflected in **different mobility patterns and road behaviors**, but also in a different degree of the road network development, readiness of emergency services, hospital staffing, etc.
- Clusters included in the study reflect:
  - the different **geographical and demographic characteristics** (in terms of population density),
  - the **mobility opportunities and preferences** of inhabitants (greater network of public transport in capital city vs greater use of passenger cars in mountainous areas and greater use of motorcycles in islands and lowland areas),
  - as well as the **different economic level** and cultural habits.

Conclusions (2/2)

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- The **economic recession** of the last years had also a different impact on the road safety progress in these regions.
- The **increase in unemployment** led to a decrease in the number of fatalities, with the effect of the unemployment on road safety being higher in Northern mainland Greece.
- A **positive relationship** was identified between the **number of motorcycles** in traffic and **road fatalities**, showing that due economic crisis, there has been a significant reduction in road fatalities and a shift towards more economic means of transport and shorter trips.
- Hospital beds per population was used as a proxy of **post-crash care level**; regions with lower available hospital beds per population present increased road crash fatalities.
- The identification of the factors affecting road crash fatalities could support the **decision-making process** to improve the level of road safety at regional level.

Thank you!

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