



Association Rule Mining for Island and Mainland Road Crash Injuries in Greece

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INTRODUCTION

Despite considerable efforts and rapid technological advancements to date, **road safety remains a major issue worldwide**. The pursuit for safer road environments has repercussions throughout all aspects of transport. Over the period 2010-2020, road fatalities have significantly dropped by 36%, but the target to halve this number by 50% has not been met. Road safety performance of Greece still remains at a lower level compared to the European average. More efforts should be made to enhance road safety and reduce fatalities from all transport modes closer to the goal of Vision Zero.

OBJECTIVES

The aim of this study is to employ the association rule approach to **identify underlying patterns of road crash injuries** occurring in Greece, with different examinations for the mainland and island environments. Greek regions were classified as mainland or island areas, while two groups of injured road users were considered according to their severity (i) slight injuries and (ii) fatalities & serious injuries.

DATA COLLECTION

Data on **road crashes in Greece for the period 2017-2019** were collected and subsequently underwent processing and analysis. The required data were collected from the Greek road crash database SANTRA, comprising 41,541 injury crashes, which were separated into killed, serious and slight crash injuries. The analysis quantified several interesting findings concerning the **relationship among geographical division, severity and crash injuries**. The total number of injured road users for the 3-year period is provided in Table 1.

Table 1: Injured road users by severity, transport mode and area type in Greece

Area type	Transport mode	Severity		
		Fatalities	Serious injuries	Slight injuries
Mainland	Passenger Cars	602 (36%)	457 (30%)	10,682 (32%)
	PTW	517 (31%)	719 (47%)	15,612 (47%)
	Bicycles	33 (2%)	32 (2%)	542 (2%)
	Buses	0 (0%)	2 (0%)	386 (1%)
	HGV	16 (1%)	9 (1%)	134 (0%)
	Lorry <3,5 tonnes	101 (6%)	58 (4%)	866 (3%)
	Other	41 (2%)	13 (1%)	197 (1%)
	Pedestrians	355 (21%)	246 (16%)	5074 (15%)
	Total	1,665 (100%)	1,536 (100%)	33,493 (100%)
	Island areas	Passenger Cars	152 (33%)	117 (21%)
PTW		195 (43%)	348 (63%)	2,056 (53%)
Bicycles		12 (3%)	8 (1%)	74 (2%)
Buses		0 (0%)	1 (0%)	15 (0%)
HGV		5 (1%)	1 (0%)	17 (0%)
Lorry <3,5 tonnes		22 (5%)	8 (1%)	118 (3%)
Other		14 (3%)	5 (1%)	47 (1%)
Pedestrians		54 (12%)	61 (11%)	409 (11%)
Total		454 (100%)	549 (100%)	3,844 (100%)

METHODOLOGY

The data-mining technique of association rules was used to obtain insights into the underlying relationships found in crash injury data. **The apriori rule was employed and several informative sets of rules emerged**. After several trials during the modelling process, the most appropriate parameter values of support, confidence and lift were included.

RESULTS

Results revealed that **clear weather and urban area** are dominant interconnected conditions that simultaneously exist in injury crashes. The predominance of **male road users** represented in road crash injuries confirms the more aggressive driving behavior of men, although the respective exposure of male drivers/riders is higher in Greece compared to their female counterparts.

Table 2: Top 10 association rules for killed, seriously and slightly injured road user characteristics in mainland and island areas

Slight injuries in the mainland						Slight injuries in island areas						
Rules	Antecedent	Consequent	Support	Confidence	Lift	Count	Antecedent	Consequent	Support	Confidence	Lift	Count
[1]	{WEATHER=1, AREATYPE=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.439	0.809	1.187	14719	{WEATHER=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.509	0.771	1.083	1958
[2]	{AREATYPE=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.468	0.803	1.178	15669	{WEATHER=1, AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.489	0.770	1.081	1878
[3]	{WEATHER=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.488	0.759	1.114	16361	{WEATHER=1, TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.489	0.732	1.080	1878
[4]	{AREATYPE=1, GENDER=1}	{VEH_NO=2}	0.411	0.706	1.104	13774	{AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.517	0.764	1.073	1989
[5]	{WEATHER=1, AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.578	0.752	1.103	19350	{TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.517	0.727	1.073	1989
[6]	{WEATHER=1, TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.578	0.909	1.096	19350	{GENDER=1}	{TRANS_GROUPED=[2,8]}	0.544	0.763	1.071	2092
[7]	{WEATHER=1, TRANS_GROUPED=[2,8]}	{GENDER=1}	0.488	0.768	1.096	16361	{TRANS_GROUPED=[2,8]}	{GENDER=1}	0.544	0.765	1.071	2092
[8]	{TRANS_GROUPED=[2,8]}	{GENDER=1}	0.522	0.767	1.094	17489	{WEATHER=1, TRANS_GROUPED=[2,8]}	{GENDER=1}	0.509	0.763	1.068	1958
[9]	{GENDER=1}	{TRANS_GROUPED=[2,8]}	0.522	0.745	1.094	17489	{AREATYPE=1}	{VEH_NO=2}	0.410	0.606	1.062	1577
[10]	{TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.616	0.905	1.093	20646	{VEH_NO=2}	{AREATYPE=1}	0.410	0.719	1.062	1577
Fatalities and Serious Injuries in the mainland						Fatalities and Serious Injuries in island areas						
[1]	{WEATHER=1, AREATYPE=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.352	0.830	1.240	1126	{AREATYPE=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.373	0.818	1.118	374
[2]	{AREATYPE=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.378	0.820	1.226	1209	{WEATHER=1, AREATYPE=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.351	0.817	1.116	352
[3]	{WEATHER=1, AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.427	0.816	1.219	1368	{WEATHER=1, TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.441	0.644	1.112	442
[4]	{WEATHER=1, TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.427	0.694	1.215	1368	{WEATHER=1, AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.441	0.805	1.100	442
[5]	{AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.461	0.806	1.204	1475	{AREATYPE=1}	{TRANS_GROUPED=[2,8]}	0.466	0.804	1.098	467
[6]	{TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.461	0.689	1.204	1475	{TRANS_GROUPED=[2,8]}	{AREATYPE=1}	0.466	0.636	1.098	467
[7]	{WEATHER=1, TRANS_GROUPED=[2,8], GENDER=1}	{AREATYPE=1}	0.352	0.677	1.184	1126	{AREATYPE=1, AGE_GROUP=[3,5]}	{TRANS_GROUPED=[2,8]}	0.328	0.799	1.091	329
[8]	{TRANS_GROUPED=[2,8], GENDER=1}	{AREATYPE=1}	0.378	0.669	1.170	1209	{WEATHER=1, AREATYPE=2, AGE_GROUP=[3,5]}	{AGE_GROUP=[3,5]}	0.304	0.816	1.086	305
[9]	{WEATHER=1, GENDER=1}	{TRANS_GROUPED=[2,8]}	0.520	0.723	1.079	1664	{WEATHER=1, AREATYPE=1, AGE_GROUP=[3,5]}	{TRANS_GROUPED=[2,8]}	0.305	0.795	1.086	306
[10]	{VEH_NO=1, WEATHER=1}	{TRANS_GROUPED=[2,8]}	0.354	0.721	1.077	1133	{WEATHER=1, TRANS_GROUPED=[2,8], GENDER=1}	{AREATYPE=1}	0.351	0.629	1.085	352

CONCLUSIONS

The apriori algorithm indicates association or concurrent presence of these factors at various percentages in both mainland and island crashes. Such associations manifest in high frequencies, typically more than 70% or 80% of the total injuries, and provide insights on how certain patterns are expected in road crash injuries due to high exposure. Further research with granular data can **create more comprehensive rules for concurrent circumstances** for injury crashes in Greece.

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