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DEVELOPMENT OF ACCIDENT PREDICTION MODELS

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ABSTRACT

Even in traffic accidents where there are no fatalities or injuries, damage, complications and delays in traffic flows derived from accidents must be accounted for. It is important to study the relationship between accidents, traffic flows and the geometric characteristics of the roads. It is in this context that the development of accident prediction models is most applicable. Traffic accidents represent an enormous cost to society and therefore have been the subject of research over the years. However, due to lack of data on accidents (database incomplete or missing) and on the driving skills of users, it is still not possible to correctly identify the relationship between accident causes and effects. With the development of accident prediction models, a reduction in traffic accidents can be expected because they support corrective interventions. In Portugal, researchers and public administrators are making great efforts to reduce traffic accidents.

CHARACTERISTICS OF ACCIDENT PREDICTION MODELS

A statistical model is, in most cases, a simplified representation of a given reality transformed into equations. Therefore, accident prediction models can represent the reality of road accidents and their evolution over time. In the analysis of stochastic prediction of accidents, it is often assumed that the occurrence of accidents is controlled by a stationary Poisson process. Thus, in recent years the modeling techniques in which the response variable follows a Poisson distribution have been used in accident prediction models. Accident prediction models can be linear or nonlinear, and are usually multiple given that many variables influence the number of accidents. Poisson and negative binomial distributions have been used by several authors. The simplest, and most widely used, are linear models. For this study two models are considered, namely: (i) a generalized Poisson model, and (ii) a generalized negative binomial model. Nationally and internationally there are studies on the relationship between accidents and the main features of the road environment as well as various accident prediction models (Yerpez and Fernandez, 1986; Gettman and Head, 2003).

It is noted that in recent decades accident prediction models have been adapted to the entire road network based on road segments with high rates of accidents, segments with non-representative number of accidents, and also on intersections. However, there is no model that represents the whole system of traffic operation and therefore it is not possible to establish a mechanism that relates, in their entirety, all the environmental variables and the numbers of road accidents. For any study of accident prediction it is necessary to review the characteristics commonly used in current models. In addition to traffic, several studies report the relationship between accidents and the main characteristics of the road (Vogt and Bared, 1998; Gettman and Head, 2003).

DESCRIPTION OF THE DATABASE

This study addresses road segments located in northern Portugal. Six stretches included on national roads 14 (Braga - Famalicão), 101 (Braga - Guimarães, Braga - Vila Verde, Guimarães - Felgueiras) and 206 (Famalicão - Guimarães and Guimarães - Fafe) were selected. These stretches have similar characteristics in regard to the number of straight stretches, the number of curves and the land use in their proximities as all of them are in predominantly residential areas. The importance of studying accidents in this region is justified by the fact that the northern region includes a high concentration of the country's cities and several industrial zones.

Three types of sections of the stretches being studied were considered using the criterion' intersection',

namely: (i) with no intersection, (ii) with an intersection, and (iii) influenced by an intersection (part of the section is located 75 meters or less before or after an intersection). The studied sections have lengths of 200 and 400 meters. These values were defined based on the concept of 'critical point' used in Portugal (ANSR, 2009). The accident data for this study were provided by the *Autoridade Nacional de Segurança Rodoviária* – ANSR (National Highway Authority) considering the period from 1999 to 2010. The ANSR maintains a database with information obtained from the *Boletim Estatístico de Acidentes de Viação* – BEAV (Highway Accident Statistics Sheet) filled in at the time of the accident. Data gathering targeted variables related to road geometry (width of lanes, width of shoulders, number of intersections, radius of horizontal curves, radius of vertical curves, lengths of curves), characteristics of the road environment (rural, urban and peri-urban) and road accident data (running over, crashes and misguide). Other variables examined were the number of pedestrian crossings and number of pedestrians hit. The database used in this study presents an important difference, insofar as it includes information on the stretches that precede the study section. That makes it possible to detect whether that preceding section has any influence on the occurrence of accidents and if such influence is detected enable the preceding stretches to be included in the measures taken regarding the critical (study) sections.

CONCLUSIONS

This paper describes the data collection process for the development of an accident prediction model for roads (14, 101 and 206) in northern Portugal. The results obtained for the variables investigated show that the stretches examined have some intrinsic characteristics in common, such as their horizontal sinuosity. With the database completed, the next step is to identify the correlation between variables and define those that will be used for constructing accident prediction models for the road network targeted by this study.

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