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Formulation and Test of a Model to explain the Complexity of Road Accident Events in South Africa

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Abstract : Whilst several studies indicated that road accident events might be more complex than thought, we have a limited scientific understanding of this complexity in South Africa. The present project proposes and tests a more comprehensive metamodel that integrates multiple causality relationships among variables previously linked to road accidents. This was done by fitting a structural equation model (SEM) to the data collected from various sources. The study also fitted the GARCH Model (Generalized Auto-Regressive Conditional Heteroskedasticity) to predict the future of road accidents in the country. The analysis shows that the number of road accidents has been increasing since 1935. The road fatality rate follows a polynomial shape following the equation: $y = -0.0114x^2+1.2378x-2.2627$ ($R^2=0.76$) with y = death rate and x = year. This trend results in an average death rate of 23.14 deaths per 100,000 people. Furthermore, the analysis shows that the number of crashes could be significantly explained by the total number of vehicles ($P < 0.001$), number of registered vehicles ($P < 0.001$), number of unregistered vehicles ($P = 0.003$) and the population of the country ($P < 0.001$). As opposed to expectation, the number of driver licenses issued and total distance traveled by vehicles do not correlate significantly with the number of crashes ($P > 0.05$). Furthermore, the analysis reveals that the number of casualties could be linked significantly to the number of registered vehicles ($P < 0.001$) and total distance traveled by vehicles ($P = 0.03$). As for the number of fatal crashes, the analysis reveals that the total number of vehicles ($P < 0.001$), number of registered ($P < 0.001$) and unregistered vehicles ($P < 0.001$), the population of the country ($P < 0.001$) and the total distance traveled by vehicles ($P < 0.001$) correlate significantly with the number of fatal crashes. However, the number of casualties and again the number of driver licenses do not seem to determine the number of fatal crashes ($P > 0.05$). Finally, the number of crashes is predicted to be roughly constant overtime at 617,253 accidents for the next 10 years, with the worse scenario suggesting that this number may reach 1 896 667. The number of casualties was also predicted to be roughly constant at 93 531 overtime, although this number may reach 661 531 in the worst-case scenario. However, although the number of fatal crashes may decrease over time, it is forecasted to reach 11 241 fatal crashes within the next 10 years, with the worse scenario estimated at 19 034 within the same period. Finally, the number of fatalities is also predicted to be roughly constant at 14 739 but may also reach 172 784 in the worse scenario. Overall, the present study reveals the complexity of road accidents and allows us to propose several recommendations aimed to reduce the trend of road accidents, casualties, fatal crashes, and death in South Africa.

Keywords : road accidents, South Africa, statistical modelling, trends
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