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Statistical analysis of Australian insurance losses from historical catastrophic disasters

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Abstract: Thousands of natural disasters affect communities around the world yearly, causing catastrophic damages and a widespread impact on society. The extent and unpredictable nature of such disasters not only have a major social impact but also affect economic outputs, availability of resources and everyday business operations. For example, recent events such as the 2023 Turkey-Syria Earthquake and the 2022 Hurricane Ian, have put a global insight into the major losses and financial and human repercussions caused by such catastrophes.

Australia is not spared from being affected by a multitude of natural disasters, including bushfires, floods, and cyclones. These disasters represent an extreme risk across Australia, causing irreparable damages to the natural environment which lead to major insurance losses for Australians yearly. Families and individuals are subject to losing valuable, irreplaceable assets, such as their homes and livestock, and face difficulty in recovering and resuming with their everyday lives.

To counteract the unpredictability and uncertainty associated with the aftermath of natural disasters, many individuals and family protect their valuable assets and lives with insurance plans. Insurance plays a crucial role in managing risks and protecting individuals from unforeseen events that result in financial losses. In relation to natural disasters and their catastrophic losses, the Australian insurance sector is committed to provide positive outcomes for all individuals and the community as a whole.

In this study, we will be examining the data set obtained from the Insurance Council of Australia (https://insurancecouncil.com.au/industry-members/data-hub/) for the Historical Catastrophe Data as of April 2023. This data set contains historical records going back to 1967 about the occurrence of insurance losses in relation to natural disasters in Australia, providing information on a wide range of geographic and financial variables. By analysing this data, it will be possible to model insurance losses. The developed model can then be utilised to enhance future policies, resulting in improved outcomes for both insurance companies and policyholders.

Statistical analysis and modelling of this type of data is quite challenging due to its complex nature and a high rate of missing entries. To cope with these challenges, we first investigate the losses by the type of catastrophic event, for example, studying more about bushfires and floodings, and then we carry out spatial analysis of these events across the country. Recently, McAneney et al. (2019) analysed normalised insurance losses from 1966 to 2017 for the same data set. In our study, we would like to expand on their paper to focus more on spatial analysis and modelling insurance losses using generalised additive models within the GAMLSS framework (see, for example, Stasinopoulos and Rigby (2008)). The GAMLSS approach is very flexible for modelling a general distribution family and highly skewed data, which is a very common feature of insurance losses data.

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