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Probabilistic Flood Loss Models for Companies

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Flood risk assessment strongly relies on accurate and reliable estimation of monetary flood loss. Conventionally, this involves univariable deterministic stage-damage functions. Recent advancements in the field promote the use of multivariable probabilistic loss estimation models which consider damage controlling variables beyond inundation depth. Although companies contribute significantly to total loss figures, multivariable probabilistic modeling approaches for companies are lacking. Scarce data and heterogeneity among companies impedes the development of novel company flood loss models.

We present three multivariable flood loss estimation models for companies that intrinsically quantify prediction uncertainty. Based on object-level loss data (n=1306), we comparatively evaluate the predictive performance of Bayesian networks, Bayesian regression and random forest in relation to established stage-damage functions. The company loss data stems from four post-event surveys after major floods in Germany between 2002 and 2013 and comprises information on flood intensity, company characteristics and private precaution. We examine the performance of the candidate models separately for losses to building, equipment, and goods and stock. Plausibility checks show that the multivariable models are able to identify and reproduce essential relationships of the flood damage processes from the data. The comparison of the prediction capacity reveals that the proposed models outperform stage-damage functions clearly while differences among the multivariable models are small. Even though the presented models improve the accuracy of loss predictions, wide predictive distributions underline the necessity for the quantification of predictive uncertainty. This applies particularly to companies, for which the heterogeneity and variation in the loss data are more pronounced than for private households. Due to their probabilistic nature, the presented multivariable models contribute towards a transparent treatment of uncertainties in flood risk assessment.