Comparative Evaluation of Multivariable Micro-Scale Flood Loss Estimation Models for Companies

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Objective

- Comparative evaluation of probabilistic **flood loss estimation models** for companies which inherently **quantify uncertainties**

Survey Data

- Computer aided telephone interviews with companies after major floods in Germany (2002 – 2013)
- Scale: property-level (n=1306)

Predictor Variables

- Inundation depth
- Inundation duration
- Return period
- Flood experience
- Number of employees
- Business sector
- Precaution
- Spatial situation

Response Variables

- Building loss
- Equipment loss
- Goods/stock loss

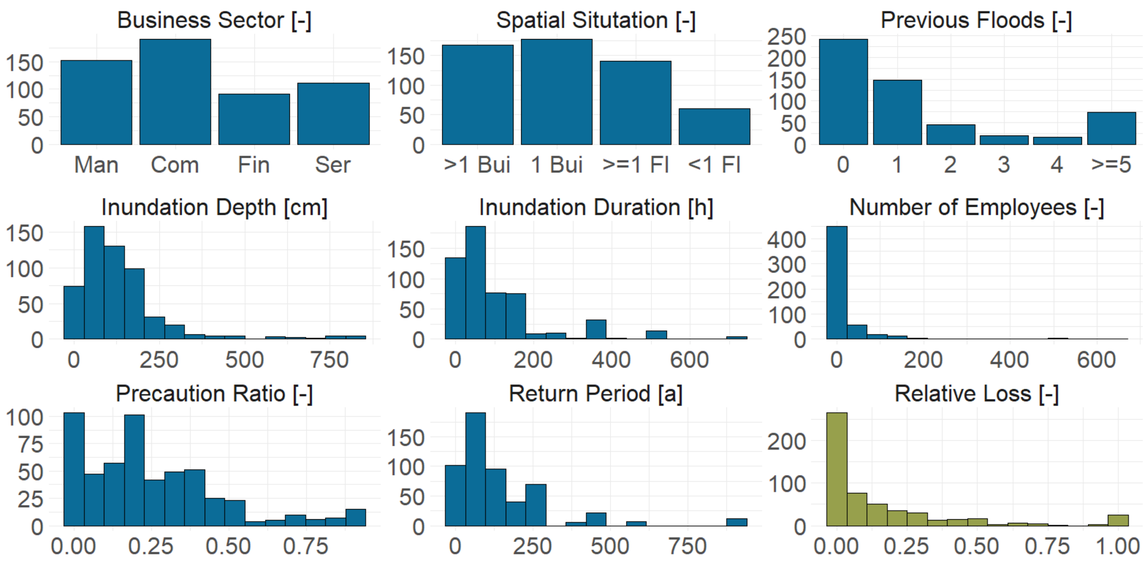
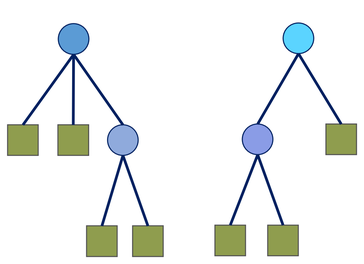


Figure 1: Subset of the survey dataset for losses to buildings (n=545). Predictors (blue) and response (green) variables are characterized by high skewness, varying scaling and bimodality.

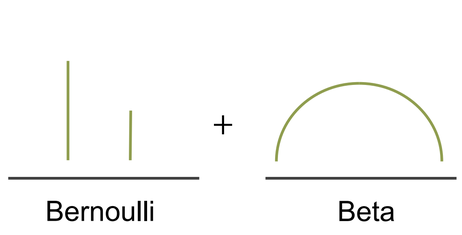
Methods

- Individual modeling of losses to building (**BUI**), equipment (**EQU**) and goods and stock (**GNS**)
- Evaluation of predictive performance of three candidate models

Random Forests (**RF**)



Bayesian Regression (**BR**)



Bayesian Networks (**BN**)

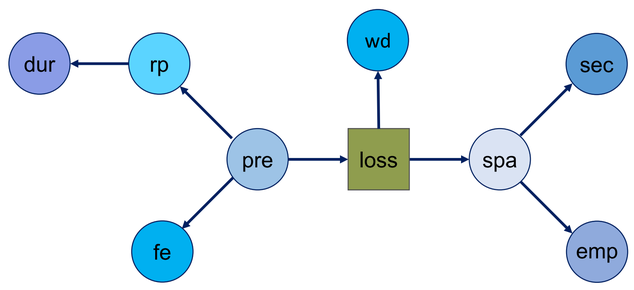


Figure 2: Flood loss models are implemented separately for the three response variables (building, equipment, goods/stock) and return predictive loss distributions for each company.

Results

- Aggregated performance metrics suggest similar predictive skill of loss models
- Response densities reveal systematic model differences in flexibility and accuracy
- Significant uncertainties remain → quantification required

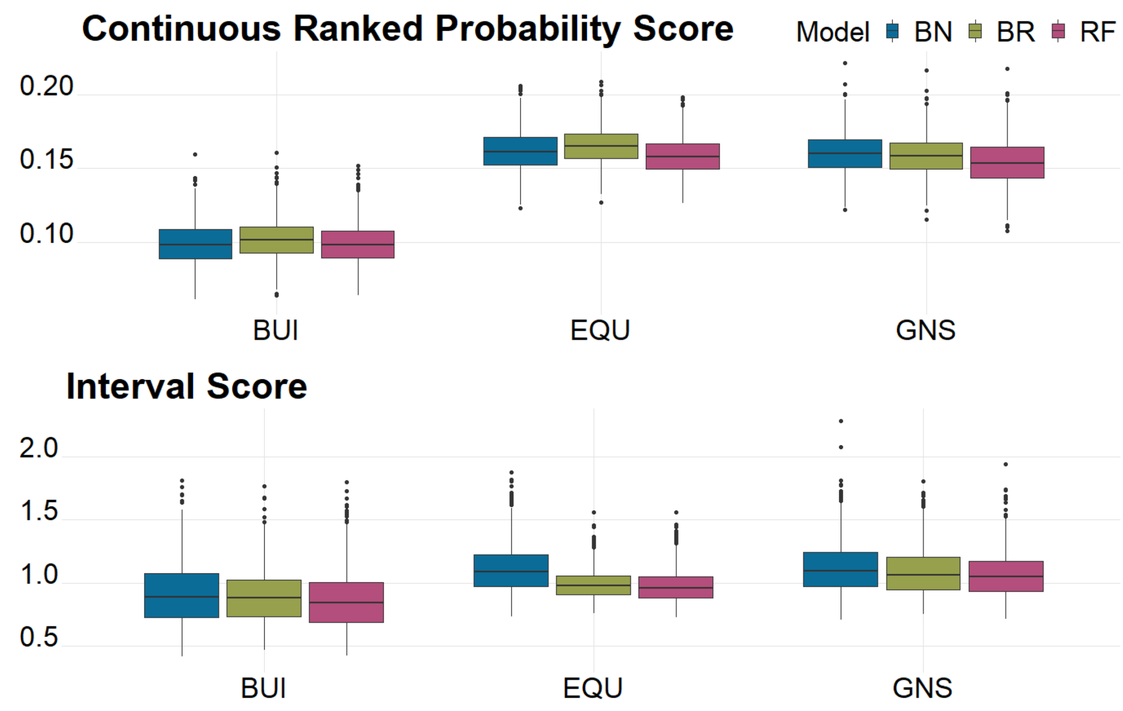


Figure 3: Mean continuous ranked probability score and interval score for all models and response variables. Boxplots contain 100 random iterations of 10-fold cross-validation.

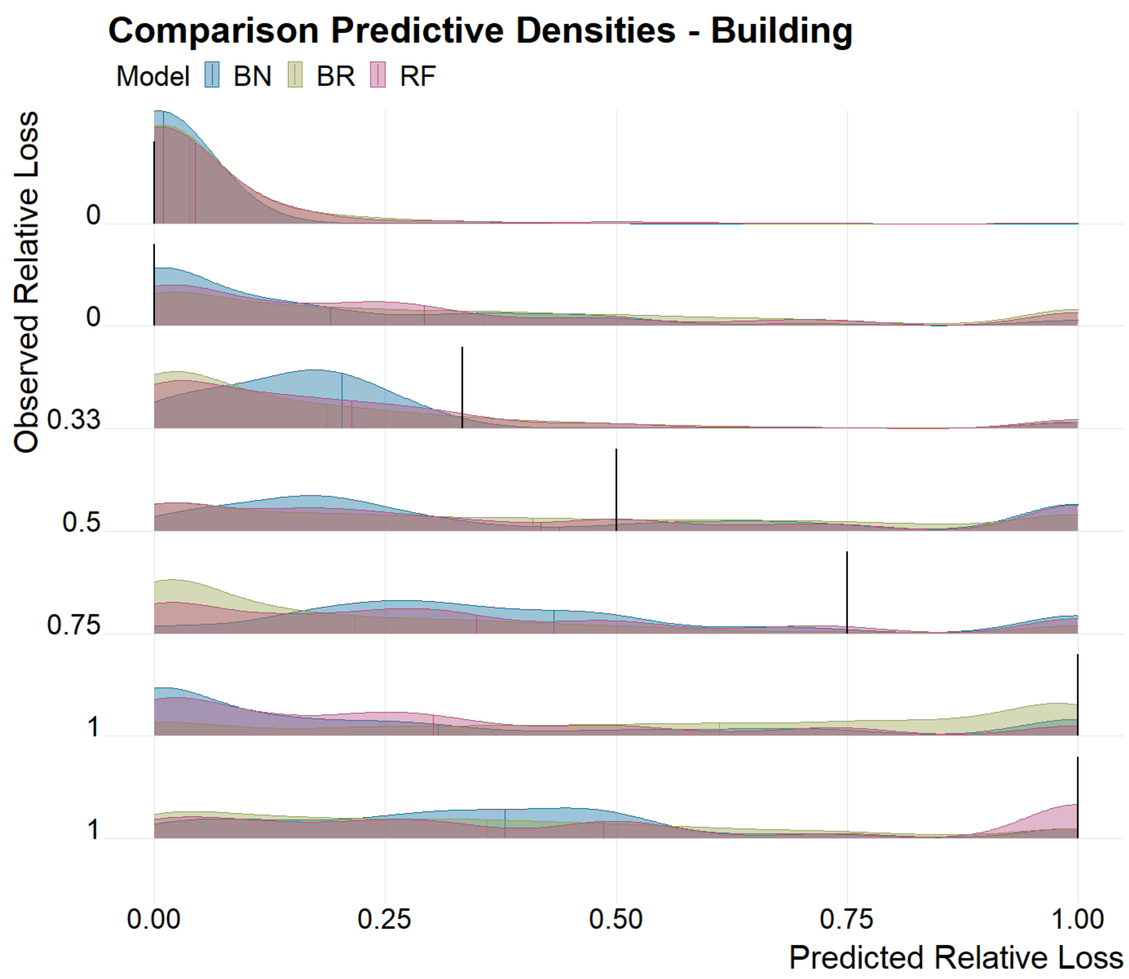


Figure 4: Exemplary predictive densities for 7 companies. Probabilistic model response provides reliability information of loss estimates and reveals differences in model skill.

Outlook

- Incorporation of **business interruption**
- Model transfer to **meso-scale**

Probabilistic models advance the representation of company vulnerability in flood risk analysis