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How to Select Simple-Yet-Accurate Model of Bridge Maintenance?

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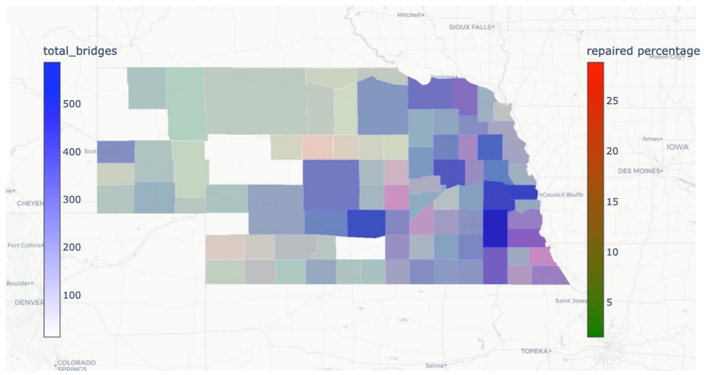
Background

15,376 Bridges

NBI and LTBPP

28 Bridge Features

8 ML Algorithms

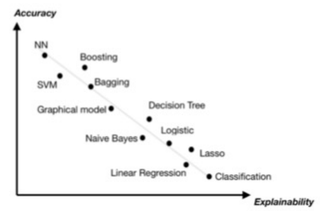


Summary of Bridge Deck Repair by County

Image Credit: Akhil Kodali

Challenge

Challenge 1:
Explainability is inversely proportional to accuracy



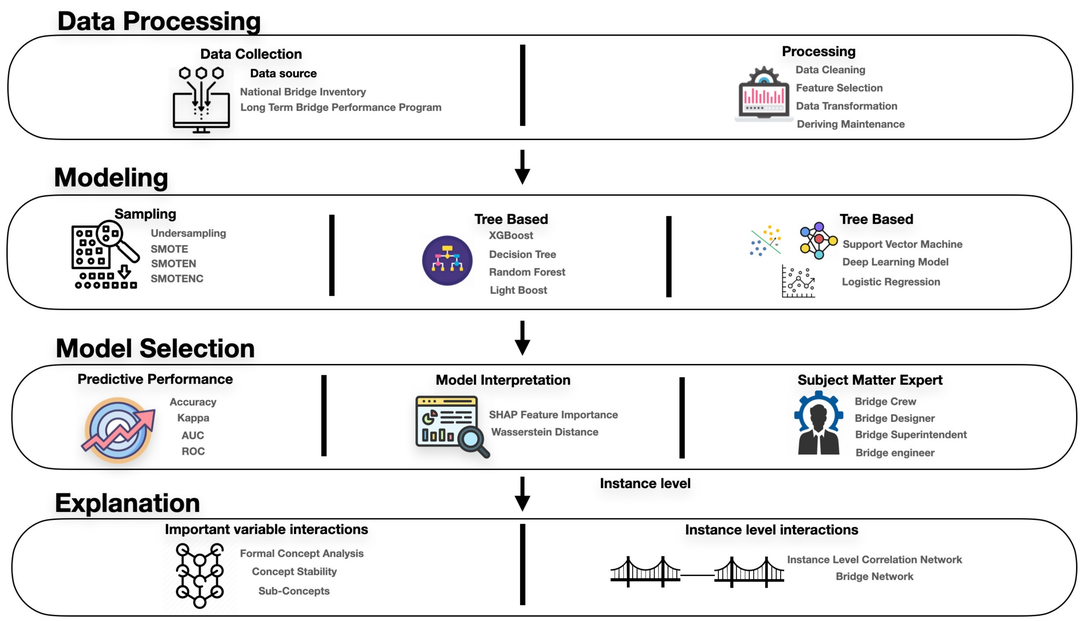
Challenge 2:
Every model tells a different story about bridge health

Table 12. Comparison of influential factors identified throughout literature

Method	Physical	Region	Structural and material	Environmental	Service
Case-based reasoning (Morcous et al. 2002)	✓*	—	✓	—	—
Cox hazards model with LASSO a and stepwise regression (Wettach-Glosser et al. 2020)	✓*	—	✓*	✓*	✓*
Linear regression and Monte Carlo simulation (Hasan and Elwakil 2020)	—	✓*	✓*	✓*	✓*
Bayesian survival analysis (Fleischhacker et al. 2020)	✓*	—	✓*	✓*	✓*
Artificial neural network and *k*-nearest neighbor (Assaad and El-adaway 2020)	✓*	—	✓	—	✓
Logistic regression and classification tree (Chang et al. 2019)	✓*	—	—	—	—
Ordered probit model (Saeed et al. 2017)	✓*	✓	✓	✓	✓
Multiple regression and GIS (Kim and Yoon 2010)	✓*	—	✓*	✓*	✓*
Baseline difference score	✓*	✓*	✓*	✓*	✓*

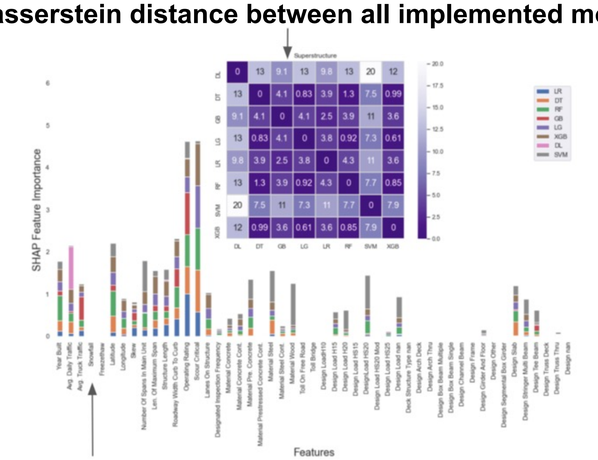
Note: A check mark indicates factor category tested; an asterisk indicates the factor category found to be influential. The text with the bold font is the proposed method in this manuscript.

Methodology

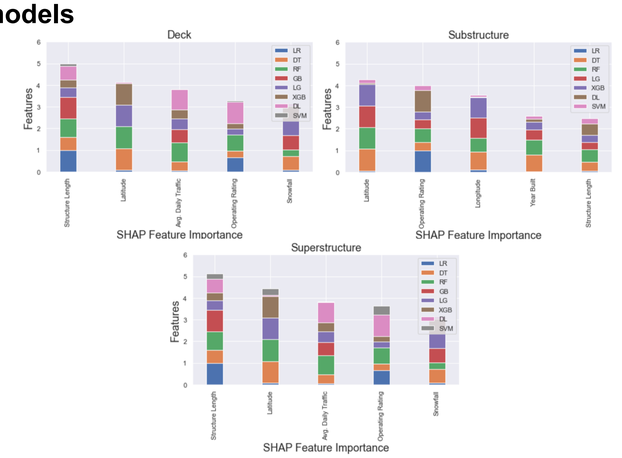


Results

The Similarity between model explanation using Wasserstein distance between all implemented models



Distribution of SHAP Feature importance of all implemented models



Top five influential factors across all bridge components

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