

## Predictive Modeling of Bridge Conditions Using Random Forest

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**Abstract :** The aging of transportation infrastructure presents significant challenges, particularly concerning the monitoring and maintenance of bridges. This study investigates the application of Random Forest algorithms for predictive modeling of bridge conditions, utilizing data from the US National Bridge Inventory (NBI). The research is significant as it aims to improve bridge management through data-driven insights that can enhance maintenance strategies and contribute to overall safety. Random Forest is chosen for its robustness, ability to handle complex, non-linear relationships among variables, and its effectiveness in feature importance evaluation. The study begins with comprehensive data collection and cleaning, followed by the identification of key variables influencing bridge condition ratings, including age, construction materials, environmental factors, and maintenance history. Random Forest is utilized to examine the relationships between these variables and the predicted bridge conditions. The dataset is divided into training and testing subsets to evaluate the model's performance. The findings demonstrate that the Random Forest model effectively enhances the understanding of factors affecting bridge conditions. By identifying bridges at greater risk of deterioration, the model facilitates proactive maintenance strategies, which can help avoid costly repairs and minimize service disruptions. Additionally, this research underscores the value of data-driven decision-making, enabling better resource allocation to prioritize maintenance efforts where they are most necessary. In summary, this study highlights the efficiency and applicability of Random Forest in predictive modeling for bridge management. Ultimately, these findings pave the way for more resilient and proactive management of bridge systems, ensuring their longevity and reliability for future use.

**Keywords :** data analysis, random forest, predictive modeling, bridge management

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