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STAT 596 Project Proposal

Background & Motivation

This project will be based on a topic of research within the Civil/Structural Engineering domain. Specifically, we will be investigating the influence of structural design decisions and parameters on the performance of common highway infrastructure. In the field of Structural Engineering, structures are often over-designed (i.e. built to be stronger than what is necessary) in order to introduce a "factor of safety". This *factor of safety* is in place to minimize the probability of failure under even the most extreme events and is present in most federally mandated design requirements. The bridge design process has many facets of which conservatism may be introduced. Oftentimes, the amount of conservatism is even left to the discretion of the Design Engineer. It is not uncommon for designers to be excessively conservative in the design decisions they make. This excessive conservatism can lead to a significant increase in design/construction cost with no clear (or quantitative) evidence that it produces a commensurate improvement in bridge performance. Thus, there exists a need to develop a comprehensive understanding of the levels of conservatism in bridge design.

Inspiration for the proposed project comes from a previous research that was completed by one of the group members at the Center for Advanced Infrastructure and Transportation at Rugters University. The current project will focus on a problem not investigated under the parent project, namely, identifying the parameters that influence conservatism in design, and estimating the level of conservatism present in common bridge types/designs.

About the Data

The parent of the project falls within the realm of computational engineering. The research team a developed and employed an algorithm capable of automating bridge design subject to the set of constraints specified by Federal Guidelines. This algorithm was used to conduct a multivariate parametric study on a large sample set of valid bridge designs with distributed configurations and design parameters. The research team used a physics-based modeling software to model the bridges, simulate various loading conditions, and extract key structural performance indicators from the model. Thus, the data being analyzed is synthetic. Moreover, the dataset includes three subsets: sampled design parameters (global design parameters explicitly sampled in the study), resulting design parameters (those that were generated as part of the design), and behavioral/performance data (data that indicates how the design performs/behaves).

Methodologies That May Be Used

- Multiple Regression (potentially ridge or lasso)
- Model Selection using forward or backward selection
- Inference methods for determining influential parameters
- Diagnostic methods to test for multi-collinearity, normality, constant variance, and outliers