

Beyond Design Life: Predicting Infrastructure Longevity with Survival Analysis

Habib Tabatabai
University of Wisconsin-Milwaukee

Abstract

Traditional deterministic models often fall short in capturing the inherent uncertainties of infrastructure degradation. This plenary address introduces survival analysis—a powerful statistical framework traditionally utilized in the biomedical and actuarial sciences—as a transformative approach for the civil engineering sector. Instead of attempting to deterministically forecast the time when a component will fail (or cease to function adequately), this methodology allows engineers to accurately estimate the likelihood of an event taking place over a given time horizon.

This presentation will explain time-to-event analysis methods and explore their practical, cross-disciplinary applications. Key case studies will demonstrate how these techniques—such as Accelerated Failure Time (AFT) models—can evaluate service life probabilities in aging bridges, model deterioration cycles in highway pavements, and assess reliability in metal fatigue. This probabilistic approach can help optimize design, inform proactive maintenance strategies, and enhance the long-term resilience of civil infrastructure.