

# **Analyzing Longitudinal Exposure Data Using Threshold Regression: A Comparison with Proportional Hazards Regression**

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Longitudinal survival or reliability data pose an interesting challenge for statistical modeling and inference, especially where the data also require a regression structure. Lee and Whitmore (2006) review a new regression methodology for survival data referred to as threshold regression. The methodology is based on the concept that the degradation of items follows a stochastic process and failure occurs when the process first reaches a failure state or threshold (a first hitting time). Longitudinal data in this context refer to sequential observations on either the level of degradation of an item or its covariates, or both, prior to the failure event. Encounters with this type of data structure abound in practical survival and reliability settings and there is a pressing need for simple regression methods to handle the longitudinal aspect and covariate data. Breaking longitudinal records into series of single records is one strategy that has been proposed. This study looks at the formal conditions that must hold for this so-called uncoupling procedure to be valid. The conditions are examined in terms of both theory and practical application. The uncoupling procedure modifies the time scale for the analysis and can be used in conjunction with an operational time scale (such as an item usage or exposure measure). Practical cases will be used to illustrate the uncoupling conditions and the threshold regression technique.