Proportional Hazards and Threshold Regression:
Their Theoretical and Practical Connections

Mei-Ling Ting Lee
University of Maryland, College Park
MLTLEE@UMD.EDU

Proportional hazards (PH) regression is a standard methodology for analyzing survival and time-to-event data. The proportional hazards assumption of PH regression, however, is not always appropriate. In addition, PH regression focuses mainly on hazard ratios and thus does not offer many insights into underlying determinants of survival. Threshold regression (TR) is one of alternative methodologies (see Lee and Whitmore, 2006, for a review). The connection between PH regression and TR has been examined in previous published work but the investigations have been limited in scope. In this talk, we discuss the connections between these two regression methodologies in depth and show that PH regression is, for most purposes, a special case of TR. We show two methods of construction by which TR models can yield PH functions for survival times, one based on altering the TR time scale and the other based on varying the TR boundary. We discuss how to estimate the TR time scale and boundary, with or without the PH assumption. A case demonstration is used to highlight the greater understanding of scientific foundations that TR can offer in comparison to PH regression. Finally, we discuss the potential benefits of positioning PH regression within the first-hitting-time context of TR regression.