THE GRADUATE SCHOOL
of
THE UNIVERSITY OF COLORADO AT BOULDER

DISSERTATION DEFENSE
of

Yuanting Chen

FOR THE DEGREE

DOCTOR OF PHILOSOPHY

Date/Time: Thursday June 12, 2014 at 10:30am

Bldg./Rm: Engineering Center, ECOT 831

Examining Committee Members:

Vanja M. Dukic
David M. Bortz
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OUTLINE OF STUDIES

Major Field:

Applied Mathematics

BIOGRAPHICAL NOTES

Yuanting Chen was born and raised in Chongqing, China. She received her B.S degree in Mathematics and Applied Mathematics from the University of Science and Technology of China, Hefei in China. Afterwards, she came to the University of Colorado, Boulder for graduate study. Yuanting's research interests include Bayesian analysis, survival analysis, statistical modeling and prediction. Her dissertation work is on Bayesian semi-parametric survival models and applications to clinical trial data. In her spare time, Yuanting enjoys spending time with friends, cooking and reading.

THESIS

Complete title of thesis:

Bayesian Semi-parametric Modeling of Time-to-Event Data

Faculty Advisor:

Vanja M. Dukic

ABSTRACT

The multiresolution estimator, originally a wavelet-based method for density estimation, was recently extended for estimation of hazard functions. The multiresolution hazard (MRH) method's main advantage is its multiscale property, making simultaneous modeling and inference at multiple time scales possible. Additional advantages, stemming from its Bayesian foundation, are its simple computational implementation, estimation and inference procedures, and ability to easily quantify the uncertainty in hazard function estimates (via point-wise or curve-wise credible bands) adjusted for uncertainty in other model parameters, such as covariate effects. In this dissertation, we further extend the MRH methodology to accommodate the case of varying smoothness in the hazard function over time. The proposed pruned multiresolution hazard (PMRH) performs data-driven "fusing" of adjacent hazard intervals, increasing computational efficiency and reducing uncertainty in hazard rate estimation over regions with low event counts. We apply the PMRH method to examine patterns of failure after treatment for prostate cancer, using data from a large-scale randomized clinical trial.

Additionally, one of the main goals of survival analysis centers around how predictors affect the hazard function, and today, more and more datasets have time-varying predictors and biomarkers, which are functions of time. We extend the MRH methodology to handle time-varying covariates. We study several missingness scenarios, and conclude that when there is no missing data our MRH models perform well and efficiently with time-varying covariates as well. When the amount of missing time-varying covariates increases, our results show how increasing L^2 norm of the predictor function's second derivative is related to the bias and variance in the MRH model parameter estimators.