The Statistical Analysis Of Recurrent Events

The Statistical Analysis of Recurrent EventsThe Statistical Analysis of Recurrent EventsPerceived Frequency of Recurrent EventsSome New Results in the Theory of Recurrent EventsPrediction of Recurrent EventsFluctuation Theory of Recurrent EventsAnalysis of Recurrent Event Processes with Dynamic ModelsStatistical Analysis of Recurrent Events by Point ProcessThe Joint Modeling of Recurrent Events and Other Failure Time EventsEvent Dependent Sampling of Recurrent EventsRecurrent Events Data Analysis for Product Repairs, Disease Recurrences, and Other ApplicationsStatistical Methods for Recurrent Events and First Non-fatal Events in Clinical TrialsOn the Asymptotic Behavior of Recurrent and "almost Recurrent" EventsA New Limit Theorem for Recurrent EventsStatistical Analysis of Panel Count DataThe Econometric Analysis of Recurrent Events in Macroeconomics and FinanceBiostatistics in Clinical TrialsProceedings of the First Seattle Symposium in Biostatistics: Survival AnalysisPropensity Score Matching Methods for the Analysis of Recurrent EventsThe Elements of Stochastic Processes with Applications to the Natural Sciences Richard J. Cook Richard J. Cook United States. Defense Research Projects Agency Walter L. Smith Marc Fredette William Feller Kunasekaran Nirmalkanna Gyeongtae Hong Luojun Wang Kajsa Kvist Wayne B. Nelson Jiren Sun John Lamperti Meyer Dwass Jianguo Sun Don Harding Carol K. Redmond Danyu Lin Yasin Khadem Charvadeh Norman T. J. Bailey

Recurrent Events in Macroeconomics and Finance Biostatistics in Clinical Trials Proceedings of the First Seattle Symposium in Biostatistics: Survival Analysis Propensity Score Matching Methods for the Analysis of Recurrent Events The Elements of Stochastic Processes with Applications to the Natural Sciences *Richard J. Cook Richard J. Cook United States. Defense Research Projects Agency Walter L. Smith Marc Fredette William Feller Kunasekaran Nirmalkanna Gyeongtae Hong Luojun Wang Kajsa Kvist Wayne B. Nelson Jiren Sun John Lamperti Meyer Dwass Jianguo Sun Don Harding Carol K. Redmond Danyu Lin Yasin Khadem Charvadeh Norman T. J. Bailey*

this book presents models and statistical methods for the analysis of recurrent event data the authors provide broad detailed coverage of the major approaches to analysis while emphasizing the modeling assumptions that they are based on more general intensity based models are also considered as well as simpler models that focus on rate or mean functions parametric nonparametric and semiparametric methodologies are all covered with procedures for estimation testing and model checking

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the main focus of the work is to obtain approximate formulae for u n the expected number of occurrences of an aperiodic recurrent event at time n the formulae are all of the type u n psi n rho n where psi n is explicitly calculable in terms of known features of the model and rho n is a remainder term tending to zero as n approaches the limit of infinity the thrust of the work lies in showing the way in which assumptions about the underlying model are reflected by rho n

the analysis of past developments of processes through dynamic covariates is useful to understand the present and future of processes generating recurrent events in this study we consider two essential features of recurrent event processes through dynamic models these features are related to monotonic trends and clustering of recurrent events and frequently seen in medical studies we discuss the estimation of these features through dynamic models for event counts we also focus on the settings in which unexplained excess heterogeneity is

present in the data furthermore we show that the violation of the strong assumption of independent gap times may introduce substantial bias in the estimation of these features with models for event counts to address these issues we apply a copula based estimation method for the gap time models our approach does not rely on the strong independent gap time assumption and provides a valid estimation of model parameters we illustrate the methods developed in this study with data on repeated asthma attacks in children finally we propose some goodness of fit procedures as future research

recurrent events are commonly encountered in biomedical research studies and clinical trials many previous studies are done to investigate recurrent event analysis as introduced in chapter 1 some of the early work on recurrent event focuses on survival outcomes and others on longitudinal outcomes if recurrent events arecorrelated with a failure event such as death we no longer should assume independent censoring many reports in the literature incorporate a latent variable model to account for the correlation between the time to event t and the number of recurrent events n t we first jointly model the time to primary outcome and the number of recurrent events with the frailty model using a zero inflated poisson weibull distribution we develop the analytical forms and details in the full parametric setting however such a model may be over parameterized and dicult to apply which limitsus from applying full likelihood based analyses because of the limitation of the frailty model we propose a joint distribution for t n based on conditional distributions we illustrate the use of this joint distribution to model the recurrent events of acute kidney injury aki and time to primary outcome death in patients with and without chronic kidney disease ckd and aki in this fully parametric model we develop the intensity ratio for the recurrent events and the hazard ratios for the failure event among different groups of patients with or without an aki event at the index hospitalization and with or without ckd at the index hospitalization based on our model we then investigate if recurrent aki is predictive of death further we are interested in a non terminal event such as end stage renal disease esrd which may be censored by a terminal event death but not vice versa the previous methods such as a cause specic hazards model and a subdistribution hazards model are based on the independence assumption whichis not appropriate in such case therefore we introduce and develop a semi competing risk approach with a gaussian copula using the tri variate weibull distribution then we illustrate the results from different approaches with a simulated data example finally we compare different tri variate weibull distributionswith gaussian copula clayton copula or under independence via a series of simulation studies two sets of data are generated by tri variate weibull

distributions with either gaussian or clayton copula to test the bias of performances with each method

survival data consist of a single event for each population unit namely end of life which is modeled with a life distribution however many applications involve repeated events data where a unit may accumulate numerous events over time this applied book provides practitioners with basic nonparametric methods for such data

this dissertation addresses four statistical questions related to the analysis of first non fatal events and recurrent events non fatal events that occur repeatedly within the same subject in clinical trials and develops four corresponding statistical methods in the first project we investigate the question how can we quantify the difference between the commonly reported cause specific hazard ratio cshr and the direct effect of treatment on the underlying first non fatal event process in the presence of death to answer this we introduce the proportional principal stratum hazards ppsh model within the principal stratification framework the ppsh model estimates the principal stratum hazard ratio pshr which reflects the direct effect on the underlying first non fatal event process assuming correct model specification by reporting the pshr alongside the cshr researchers can gain a more comprehensive understanding of the direct effect on the underlying first non fatal event process in the second project we address the question how can we improve the precision of area under the curve estimation for the mean cumulative function while preserving its unconditional interpretability to this end we propose a nonparametric covariate adjustment approach that ensures efficiency gains over unadjusted analyses and applies universally to various randomization schemes including both simple and covariate adaptive designs in the third project we explore the question how can we estimate treatment effects under a hypothetical scenario where the intercurrent event post randomization events affecting outcome interpretation or existence does not occur we apply inverse probability weighting to the widely used lin wei yang ying and negative binomial models appropriately adjusting for baseline and internal time varying covariates to obtain unbiased estimates of hypothetical treatment effects simulation studies demonstrate that our approach outperforms alternative analytical methods in terms of bias and power in the final project we examine the question how can we estimate treatment effects on recurrent events and recover the underlying trajectory of recurrent events in the presence of death we propose a parametric shared frailty model that enables formal testing of recurrent event trends and offers greater power than traditional time to first event analyses in

heterogeneous clinical trial populations

consider a recurrent event on the positive integers let n n denote the number of recurrences up to and including time n for 0

panel count data occur in studies that concern recurrent events or event history studies when study subjects are observed only at discrete time points by recurrent events we mean the event that can occur or happen multiple times or repeatedly examples of recurrent events include disease infections hospitalizations in medical studies warranty claims of automobiles or system break downs in reliability studies in fact many other fields yield event history data too such as demographic studies economic studies and social sciences for the cases where the study subjects are observed continuously the resulting data are usually referred to as recurrent event data this book collects and unifies statistical models and methods that have been developed for analyzing panel count data it provides the first comprehensive coverage of the topic the main focus is on methodology but for the benefit of the reader the applications of the methods to real data are also discussed along with numerical calculations there exists a great deal of literature on the analysis of recurrent event data this book fills the void in the literature on the analysis of panel count data this book provides an up to date reference for scientists who are conducting research on the analysis of panel count data it will also be instructional for those who need to analyze panel count data to answer substantive research questions in addition it can be used as a text for a graduate course in statistics or biostatistics that assumes a basic knowledge of probability and statistics

the global financial crisis highlighted the impact on macroeconomic outcomes of recurrent events like business and financial cycles highs and lows in volatility and crashes and recessions at the most basic level such recurrent events can be summarized using binary indicators showing if the event will occur or not these indicators are constructed either directly from data or indirectly through models because they are constructed they have different properties than those arising in microeconometrics and how one is to use them depends a lot on the method of construction this book presents the econometric methods necessary for the successful modeling of recurrent events providing valuable insights for policymakers empirical researchers and theorists it explains why it is inherently difficult to forecast the onset of a recession in a way that provides useful guidance for active stabilization policy with the consequence that policymakers should place more emphasis on making the economy robust to recessions the book offers

a range of econometric tools and techniques that researchers can use to measure recurrent events summarize their properties and evaluate how effectively economic and statistical models capture them these methods also offer insights for developing models that are consistent with observed financial and real cycles this book is an essential resource for students academics and researchers at central banks and institutions such as the international monetary fund

the second volume in the wiley reference series in biostatistics featuring articles from the prestigious encyclopedia of biostatistics many of which have been fully revised and updated to include recent developments biostatistics in clinical trials also includes up to 25 newly commissioned material reflecting the latest thinking in bayesian methods benefit risk assessment cost effectiveness ethics fraud with exceptional contributions from leading experts in academia government and industry biostatistics in clinical trials has been designed to complement existing texts by providing extensive up to date coverage and introducing the reader to the research literature offering comprehensive coverage of all aspects of clinical trials biostatistics in clinical trials includes concise definitions and introductions to numerous concepts found in current literature discusses the software and textbooks available uses extensive cross references helping to facilitate further research and enabling the reader to locate definitions and related concepts biostatistics in clinical trials offers both academics and practitioners from various disciplines and settings such as universities the pharmaceutical industry and clinical research organisations up to date information as well as references to assist professionals involved in the design and conduct of clinical trials

the papers in this volume discuss important methodological advances in several important areas including multivariate failure time data and interval censored data the book will be an indispensable reference for researchers and practitioners in biostatistics medical research and the health sciences

observational studies are often used to investigate the effects of treatments on a specific outcome in many observational studies the event of interest can be of recurrent type which means that subjects may experience the event of interest more than one time during their follow up the lack of random allocation of treatments to subjects in observational studies may induce the selection bias leading to systematic differences in observed and unobserved baseline characteristics between treated and untreated subjects propensity score matching is a popular technique to address this issue it is based on the estimation of conditional probability of treatment assignment given the measured baseline

characteristics the use of the propensity score in the analysis of observational studies with recurrent event outcomes has not been well developed in this study we consider three matching methods called propensity score matching covariate matching and history matching and compare the accuracy of them to estimate the treatment effects in recurrent event rates through monte carlo simulation studies we consider various scenarios under the settings of time fixed and time dependent treatment indicators a synthetic data set is analyzed to illustrate the methods discussed in the thesis

develops an introductory and relatively simple account of the theory and application of the evolutionary type of stochastic process professor bailey adopts the heuristic approach of applied mathematics and develops both theoretical principles and applied techniques simultaneously

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