

CHAPTER 54

STATISTICS

Doctoral Theses

01. ASHOK KUMAR

Optimal Designs for Some Nonlinear Regression Models.

Supervisor : Prof. Poonam singh

Th 25327

Abstract
(Not Verified)

The nonlinear regression models are widely used in different fields such as chemical, biological, biochemical, marketing, business and health. The unknown parameters of the model are to be estimated with as much precision as possible and the precision of estimates depends to a large extent on the design used in the experiment. The goal is to find an optimal design that is a setting of the levels of the factors (predictors or covariates) that estimates the unknown parameters adequately. The task of obtaining optimal designs is quite difficult for nonlinear models because the Fisher information matrix depends on the unknown parameters of the model. In this study, classical and Bayesian optimal designs for some nonlinear regression models are obtained. The local optimality approach is used to obtain the optimal designs for the Exponentiated Pareto II Model; Generalized Exponentiated Pareto Model; Generalized Pareto Model; Beta regression Model with Two Predictors and Beta Regression Models with Random Intercept. The local optimality approach uses a best guess of the parameter values to design an experiment to be efficient. However, when guesses are not close to the true parameters, then the resultant designs may be inefficient. An alternative robust approach is a Bayesian optimal design approach. Bayesian D-optimal designs for beta regression model using genetic algorithm are also obtained.

Contents

1.Introduction 2. D-Optimal designs for exponentiated pareto II and generalized exponentiated pareto models 3.D-,A-and E- optimal design for generalized pareto model 4. D-optimal for beta regression model with two predictors 5. D- optimal designs for beta regression model with random intercept 6. Bayesian D- Optimal design for beta regression model. List of papers out of thesis. References.

02. BHATNAGAR (Anshika)

Contribution to Preliminary Test Estimators for Some Reliability Models.

Supervisors : Prof. Ajit Chaturvedi

Th 25333

Abstract
(Not Verified)

In our Thesis, we have made contributions to Preliminary Test Estimators (PTEs) for some Reliability Models. The Classical estimators namely Uniformly Minimum Variance Unbiased

Estimators (UMVUEs) and Maximum Likelihood Estimators (MLEs) for the measures of Reliability have been discussed for various life time distributions under Progressive Type-II censoring scheme. The Preliminary Test Estimators (PTEs) for the measures of Reliability based on their UMVUEs and MLEs have been developed. The expressions of Bias and Mean Square Error of these PTEs are further obtained. We have developed the Preliminary Test Confidence Intervals (PTCIs) for the parameter and the measures of Reliability based on their UMVUEs and MLEs. The Coverage Probability of PTCL of the parameter is further obtained. We have compared the traditional Classical estimators with our Preliminary Test Estimators under the simulated data set and observed that the PTEs outperform the classical estimators. Further, from the plot of Coverage Probability (CP) of the PTCL of parameter, it is observed that for some specific interval, the CP of PTCL is more than that of the traditional Equal Tail Confidence Interval thereby establishing the superiority of PTCIs introduced by us.

Contents

1. Salient strides of emerging research in the realm of various measure of reliability- a comprehension through docking of reliability-A comprehension through docketing of development voyage 2. Establishment of preliminary test estimators and preliminary test confidence intervals for measures of reliability of exponential distribution, based on progressive type-II censoring scheme 3. Development of preliminary test estimators and preliminary test confidence intervals for measures of reliability of weibull distribution based on progressive type-II censoring scheme 4. Establishment of preliminary test estimators and preliminary test confidence intervals for measure of reliability of exponentiated distribution based on type II censoring scheme 5. Development of preliminary test estimators and preliminary test confidence intervals for measures of reliability of Kumaraswamy-G distributions, based on progressive type-II censoring scheme 6. Development of preliminary test estimators and preliminary test confident intervals for measures of reliability of generalized inverted scale family of distributions based on progressive type II censoring scheme. Bibliography.

03. DEO (Vishal)

Application of Survival and Epidemiological Models in Cost Effectiveness Analysis.

Supervisor : Prof. Gurpreet Grover

Th 25329

Abstract (Not Verified)

Cost-effectiveness analysis (CEA) is a potent methodology for economic evaluation of the interventions (medical or non-medical) and deals with the evaluation of cost per outcome gained. In this thesis, we have explored the existing popular methods of applying survival models in CEA and have developed new techniques to apply dynamic survival models and state-space epidemiological models to conduct CEA. To start with, we have applied and compared two different methods to estimate transition probabilities between the three states of chronic lymphocytic leukaemia and carried out CEA of two types of chemotherapies. The two methods employed are based on- a) time-inhomogeneous Weibull markov model and b) Multinomial-Dirichlet Bayesian model for number of transitions. To address various problems with the existing multi-state decision-analytic approach to CEA, we have presented an alternative method for calculating QALY without using the multi-state model framework. We have also proposed a proxy utility function based on joint-modelling of survival and longitudinal data. Moving ahead, we have extended the proposed methodology for evaluating QALY by introducing two major improvements. Firstly,

we predict expected survival time of each censored patient to find patient-specific lifetime time horizon. And secondly, we have used Metropolis-Hastings algorithm to generate posterior estimates of the random effects which are then used to predict longitudinal covariate of each patient. We have applied a method based on ROC curve to evaluate the accuracy of the simulated longitudinal covariate in predicting the event of interest. Further, to facilitate CEA of extensive random testing in comparison to targeted testing for containing COVID-19, we have developed a new compartmental model, called the susceptible-infected (quarantined/ free)-recovered-deceased [SI(Q/F)RD] model. This model is adopted into a Dirichlet-Beta state-space formulation to account for stochastic uncertainty. We have used self-written R codes to implement all simulation schemes and computations involved in the proposed methodologies.

Contents

1. Introduction 2. CEA of chemoimmunotherapy over chemotherapy for treating chronic lymphocytic leukaemia patients application of multi state decision analytic models 3. A new approach to evaluate quality adjusted life years using proxy utility function an application to HIV/Aids data 4. A more dynamics approach to evaluate QALY in the absence of standard generic utility values 5. Measuring predictive accuracy of joint modeling approach in evaluating quality adjusted life years 6. Cost effectiveness analysis of extensive random testing as as a non medical intervention to contain the COVID-19 epidemic. Significance, limitations and scope for further research. Appendices. References. Bibliography.

04. SHIKHA SEHGAL nee SHIKHA KHANNA
Some Contributions to Moments of Ordered Statistics and Associated Inference.
 Supervisors : Dr. Narinder Pushkarna and Prof. Jagdish Sarna
Th 25331

Abstract (Verified)

The study of this thesis is primarily motivated to establish some recurrence relations for single and product moments of various ordered random variables from some specific continuous distributions. These recurrence relations are very useful in the numerical evaluation of moments of ordered random variables. Further, these moments are utilized to obtain L-moments, TL-moments estimators of the unknown parameters. The thesis consists of seven Chapters. The introductory Chapter 1 gives basic concepts and results to be used in subsequent chapters. In Chapters 2 and 3, we have used the concept of L-moments and TL-moments for estimation of parameters and developed inferential procedures by the comparison of these estimators with the estimators obtained by conventional methods for Topp-Leone distribution and Sushila distribution, respectively. Chapter 4 gives an outline of the concept of mid-truncated distribution. In this chapter, we have obtained several statistical measures and the recurrence relations for single and product moments of order statistics arising from mid-truncated Burr distribution (Type XII) with three parameters and mid-truncated two-parameter Lindley distribution. In Chapter 5, we have obtained the reliability of stress-strength models based on the r th order stress component and k th order strength component, when stress and strength are given by two independent variates following Frechet distribution with different parameters. In Chapter 6 and Chapter 7, we have derived recurrence relations for single and product moments of progressively Type-II right censored order statistics from Bass diffusion model and Power Lomax distribution, respectively. We have used maximum likelihood approach to estimate the parameters of the distributions, which are further used in the estimation of the reliability characteristic. Some expressions and results so obtained are used for the estimation of the parameters, simulation study and real data analysis.

Contents

1. Basic concepts and preliminaries 2. Exact moments of order statistics,MLE,L-moments and TL- moments estimation for Topp=Leone distribution 3. Exact moments of order statistics and L-moments,TL-moments maximum likelihood and method of moments estimators for sushila distribution 4. Mid-truncated distribution and their applications in order statistics 5. Stress strength reliability estimation of $P(Y_{r:n}2 < X_{k:n1})$ for frechet distribution 6. Relationships for moments of progressively type-II right censored order statistics form bass diffusion model and associated inference 6. Relationships for moments of progressively type-II right censored order statistics from power Lomax distribution and associated inference. Appendices. Bibliography.

05. MIDHA (Neha)

Efficient Mixture Designs Using Orthogonal Arrays.

Supervisors : Prof. Poonam Singh and Dr. Vandana Sarin

Th 25326

Abstract (Not Verified)

Varying the proportions of two or more ingredients to get a final product with more desirable properties is a mixture experiment. The proportion in which the q ingredients are present in a mixture experiment must be non-negative and should add up to unity, resulting in a factor space which takes form of a (q-1) dimensional simplex. However, in real-life situations, certain other restrictions are imposed on the proportion of ingredients under study. These additional restrictions or constraints result into a constrained mixture experiment. Such experiments restrict the area of study to a smaller area within the simplex. This thesis proposes an Orthogonal Array Based Mixture Design (OABMD) algorithm, which enables to generate G-efficient designs for a mixture experiment using orthogonal arrays for fitting Scheffé's canonical polynomials. The OABMD algorithm is flexible to deal with fixed or mixed level orthogonal arrays developed from Taguchi's methods, mutually or pairwise orthogonal Latin squares, difference schemes or Galois field. Sufficiently high value of the G-efficiency ensures that the generated designs are useful for practical purpose. The algorithm can be applied to unconstrained and constrained mixture spaces. The initial choice of the orthogonal array and an arbitrary selection of matrix satisfying certain properties assists in yielding enhanced variety of design points that lie not only on the boundary but also explores the interior of the area of the study, thereby overcoming the drawbacks of the extreme vertices designs. The algorithm can deal with situations where multi-component constraints are imposed on the proportion of the ingredients under study. The algorithm aids in regulating the number of design runs, which helps in reducing the time and cost for conducting the statistical experiment. The applicability of the OABMD algorithm has been numerically illustrated for several sets of constraints, varying strengths and variety of factors and levels.

Contents

1. Introduction 2. Mixture design based on Taguchi's fixed elements orthogonal arrays 3. Mixture design constructed using Taguchi's mixed elements orthogonal arrays 4. Mixture designs generated using orthogonal arrays form mutually orthogonal latin squares 5. Mixture designs generated using orthogonal arrays based on pairwise orthogonal latin squares 6. Mixture design generated by orthogonal arrays developed using difference scheme 7. Mixture designs generated with

orthogonal arrays progressed by galois field. Overall conclusion and directions for future research. List of research papers out of thesis. Reference.

06. SACHDEV (Rajesh)
Some Aspects of Order Statistics, Records and Generalized Order Statistics.
 Supervisors : Dr. Narinder Pushkarana and Prof. Jagdish Saran
Th 25330

Abstract
(Not Verified)

The thesis consists of eight chapters and presents the work on recurrence relations for single and product moments of ordered random variables, like ordinary order statistics, generalized order statistics and lower and upper record values from some specific continuous distributions. These recurrence relations on the moments of order statistics are very useful in numerical evaluation of the moments of order statistics in a simple recursive manner. Chapter 1 gives a brief and comprehensive account of the historical development of different models of ordered random variables. Chapter 2 defines the p th order inverse exponential distribution and explore its basic characteristics such as skewness, kurtosis, mode and also compute maximum Likelihood Estimates of unknown parameters of the distribution. Chapter 4 contains the recurrence relations for single and product moments of k th Lower Record Values arising from p th order Inverse Exponential Distribution. We derived explicit expressions for moments through m.g.f. of k th record values arising from left truncated logistic distribution. Chapter 5 deals with expectation identities of left truncated logistic distribution based on generalized order statistics (GOS) [cf. Kamps (1995 a, b)]. Chapter 6 comprises expectation identities for marginal and joint moment generating functions of lower generalized order statistics (LGOS) from p th order inverse exponential distribution. Chapter 7 deals with the explicit expressions for the single and product moments of generalized order statistics (GOS) from a Log Logistic Distribution. Characterization results are obtained. Chapter 8 contains explicit expressions for the single and product moments of Lower generalized order statistics (LGOS) from a Log Logistic Distribution. Characterization is done for the distribution.

Contents

1. Basic concepts and preliminaries 2. p th order inverse exponential distribution and its properties 3. Recurrence relations for single and product moments of ordinary order statistics from p th order inverse exponential distribution and its truncated form 4. Relationships for moments of k th record values from p th order inverse exponential distribution and left truncated logistic distribution 5. Expectation identities of left truncated logistic distribution based on generalized order statistics 6. Expectation identities for marginal and joint moment generating functions of lower generalized order statistics from p th order inverse exponential distribution 7. Explicit expression for single and product moments of generalized from log logistic distribution and characterization 8. Explicit expressions for single and product moments of lower generalized order statistics form log logistic distribution and characterization. Bibliography.

07. SHARMA (Anurag)
On the Estimation of Survival Time While Reducing the Number of Predictors Using Different Correlation Techniques.
 Supervisor : Prof. Gurprit Grover
Th 25332

Abstract
(Not Verified)

In this thesis, we have made an attempt to reduce the number of predictors affecting the survival time of the patients by proposing variable selection techniques. Accelerated Failure Time Model has been used to estimate the survival time. Chapter one provides an overview of predictive modelling with the main focus on various variable selection techniques in high dimensional dataset. Five chapters which discuss five different variable selection techniques are included in this thesis. In chapter two, a variable selection technique is proposed which takes into account the pair-wise correlation/association between two predictors. In chapter three, an attempt is made to reduce the number of predictors by determining the multiple correlation/association among three predictors. In chapter four, another variable selection technique has been proposed using the partial correlation/ association. However, sometimes, the interest lies not in the correlation between two or more variables but between two different sets of variables. Therefore, chapter 5 provides another technique which uses canonical correlation technique to reduce the number of predictors by dividing the data set into two sets of variables. In chapter 6, performance of various variable selection techniques of high dimensional data set has been compared by applying them on a low dimensional data set. The last Chapter 7 is conclusion chapter, which highlights the conclusion and idea of future research.

Contents

1. Introduction 2. Pair wise selection techniques for reduction in number of predictors 3. Examining the effect of reduction of predictors on the estimation of survival time of HIV/AIDS patient while reducing the number of predictors using a partial correlation/association technique 4. Estimating of survival time of HIV/Aids patient while reducing the number of predictors using a partial correlation/association/Association technique 5. Estimating the survival time HIV/AIDS patient by reducing the number of predictors using canonical correlation techniques 6. Comparison of the performance of different high dimensional variable selection techniques on the low dimensional HIV/AIDS data set 7. List of publication. Bibliography.

08. THAKUR (Arpan Kumar)
On the Estimation of Long Term Survivors Under Various Conditions Using Cure Fraction Model.
 Supervisor : Prof. Gurprit Grover
Th 25328

Abstract
(Not Verified)

Quantum leap in clinical oncology and rapid development of ART facilities lead to a long and healthy survival time for the patients suffering from deadly diseases like cancer and AIDS. As a result of this, now a days the survival time data related to cancer and HIV/AIDS are heterogeneous in nature, i.e. data consists of two type of patients : One type of patients are those who succumb to death or on whom underlying treatment is not sufficient enough; Another type of patients are those on whom treatment has a positive impact due to which they remain disease free or at least survive for sufficient period of time. These patients are called long-term survivors or as they have recovered from disease this proportion is also called cured proportion. Traditional survival models like Cox proportional hazard and accelerated failure time models assumes that all patients under consideration are exposed to the risk to death but from above fact it is to be observed that now a days major proportion of

patients recover from disease so assumption of traditional survival model need not hold necessarily. To deal with the emerging conditions like above a cure fraction/rate/proportion model was proposed by Boag (1949) and later developed by Berkson and Gage (1952). Here, in this cure fraction models are developed for various conditions like HIV/AIDS, Cancer, and Coronavirus. The work of this thesis can be broadened to estimate the proportion of long-term survivors in disease like Alzheimer in neurology where failure rates are low, COVID-19 vaccine effectiveness , prophylactic treatment for pertussis, rabies, occupational exposures in COVID-19 like situations and procedural interventions with adjunctive treatments in cardiovascular diseases.

Contents

1. Introduction to cure fraction model 2. Cure fraction model for the estimation of long term survivors of HIV/AIDS patient under ART 3. Estimation of cure fraction in patient with acute Lymphoblastic Leukemia (ALL) 4. Estimation of cure fraction and misclassification probabilities for HIV/AIDS patient under ART using continuous time hidden Markov Model 5. On the estimation of cure fraction and the impact of prognostic factors on the survival time of HIV/AIDS patient using quantile regression 6. On containment plan amid COVID-19 in red zone district of India: using clinical life table and cure fraction model 7. On semi parametric and competing risk cure fraction model in classical estimation set up 7. Final conclusion and future trajectories. List of publications. Bibliography.