*Proceedings of National Seminar on*

***INNOVATIVE APPROACHES IN STATISTICS***

*in conjunction with the*

*ANNUAL CONFERENCE OF THE KERALA STATISTICAL ASSOCIATION, 15 – 17 February 2018*

***Department of Statistics***

***St.Thomas College (Autonomous), Thrissur***

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**WELCOME**

The organizing committee of the National Seminar on INNOVATIVE APPROACHES IN STATISTICS *in conjunction with the* ANNUAL CONFERENCE OF THE KERALA STATISTICAL ASSOCIATION, 15 – 17 February 2018 extend a warm welcome to all participants. It aims to bring forth Academicians, Researchers and Professionals in Statistics into a single forum in order to discuss and debate on the innovative approaches in statistics and acquire more knowledge related to their fields. The department provides robust computational support to meet the needs of students and researchers. Collection, analysis and interpretation of numerical data have significant role in every research programme. The rapid development in information technology and expansion of the means of communication has made the data collection an easy task up to a certain extent. However, the processing and organizing of data pose multifarious problems to researchers and experimenters. Here comes the role of Statistics, as a science to provide powerful tools for the analysis and interpretation at every step of research. The seminar is intended to impart an understanding of the statistical ideas and methods involved in carrying out research for researchers and teachers from various disciplines of learning.

The seminar will comprise of invited talks and as well as the contributed paper presentations.

The Seminar will held at Menachery Hall, Medlycott Hall and Seminar Hall (No.18) of St.Thomas College (Autonomous), Thrissur.

As part of this seminar **Dr. U. S. Nair** **ever rolling trophy** for the All Kerala Quiz competition in Statistics, **Dr.R.N.Pillai Young Statistician Award** and **Dr. T. S. K.Moothathu Best paper award** will be presented during the Seminar. The other major events are ***Prof. K. Ramakrishnapillai Endowment Lecture*** and ***Prof. A. M. Mathai Endowment Lecture***.

We hope that all of you will enjoy the seminar at large.

**Wish you all the best………….**

**Dr. P. O. Jenson Dr. V. M. Chacko Dr. T. A. Sajesh Dr. Rani Sebastian**

Principal HOD (Statistics) Coordinator Coordinator

**About St.Thomas College (Autonomous), Thrissur**

St. Thomas’ College Thrissur is one of the leading academic institutions in the higher education sector of Kerala since 1919. It has a long and proud tradition of excellence in training, teaching and research in many academic disciplines of Science, Arts, Commerce and Humanities. It attracts the brightest minds from all over Kerala and from different parts of the country and Asia. Its alumni have made outstanding contributions to academics, governance and industry. The *University Grants Commission* has granted **Autonomous Status** in 2014 to the college and recognized as **College with Potential for Excellence** in 2016. The college has 14 PG courses and 20 UG courses. All the 9 aided PG departments are Research centers having more than 100 research scholars and 40 research guides.

**About the PG and Research Department of Statistics**

The Degree Course in B.A. Statistics was started in the year 1955 under the Dept. of Mathematics and Statistics affiliated to the University of Madras. In the year 1958 the B.A. Course was converted to three year B.Sc. course in Statistics under the University of Kerala. The Department of Statistics was established in the year 1984 and the M.Sc. course in Statistics commenced in the same year with Operations Research, Numerical Mathematics and Computer Programming as optional subjects. Department was elevated as Research centre of the Calicut university in the year 2013.Prof.Sebastian J Kulathinal (1984 – 1994), Prof. V.D. Johny (1994 – 2000), Prof A P Jose(2000 – 2003), Dr. T.B. Ramkumar(2003 – 2014) served as the Heads of Department. Prof. A. P. Jose was the Vice principal (2001 – 2003) of the college. Eminant teachers Prof . Krishnakumar (NAAC coordinator 2013), Prof. M.K.Jose, Prof. A. S. Raffy, Prof. P. K. Sasidharan and T. D. Xavier served the department for several years. Dr. P. O. Jenson, the Principal, is a member of the department and will be retiring on 2018 April 30. Currently 7 permanent and 3 guest faculty members are working in the department. The department has four research guides and four research scholars. The department offers  *Certificate course in Statistical Computing using SPSS* for UG students and *Certificate course in Statistical Computing using R* for PG students. Moreover department provides UGC coaching, JAM coaching etc.

**About Kerala Statistical Association**

Kerala Statistical Association (KSA) was founded in 1978 to bring together and to provide a forum for those who have an interest in Probability and Statistics. Dr.U.S.Nair ever rolling trophy for the All Kerala Quiz Competition in Statistics, for motivating graduate level students and creating awareness in them about the importance of statistics, Dr.R.N.Pillai Young Statistician Award for the Best Research Paper for motivating young researchers to work actively in their research, to create a skill of writing and presentation and Dr.T.S.K Moothathu Best Paper Award for the best paper published in each volume of the JOKSA will be presented during the seminar. Other major events are Prof.K Ramakrishna Pillai Endowment Lecture and Prof.A.M. Mathai Endowment Lecture. KSA also brings out a journal, Journal of the Kerala Statistical Association (JKSA), ISSN 2249-4553, and the latest issue is volume-28, in 2017. Volume No. 28 will be released at the annual conference of KSA, during 15-17, February 2018.

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12. Dr, Biju Thomas, Department of Statistics, Sree Sankara College, Kalady.   
13. Dr. Sreejith, Department of Statistics, Govt. College for Women, Thiruvananthapuram.   
14. Dr. Joseph Justin Rebello, Department of Statistics, Aquinas College, Edakochi.   
15. Dr. N K Sajeevkumar, Department of Statistics, Govt. College, Karyavattom.   
16. Dr. Jain A Luke, Department of Statistics, Newman College, Thodupuzha.

***Programme Schedule***

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| **15 February 2018** | | |
| **Time** | **Session** | **Name** |
| **9.00-10.00 am** | Registration |  |
| **10.00-11.00 am** | Inauguration |  |
|  | Welcome | **Dr. V. M. Chacko,** Head of the Department |
|  | Presidential Address | **Dr. P. O. Jenson**, Principal |
|  | Inauguration | **His Grace Mar Andrews Thazhath**  Patron & Archbishop of Thrissur Archdiocese |
|  | Felicitations | **Rev. Fr. Varghese Kuthur**, Executive Manager |
|  |  | **Dr. A. M. Mathai,** Emeritus Professor  McGill University, Canada |
|  |  | **Dr. K. Jayakumar**, President,  Kerala Statistical Association & Professor,  Dept. of Statistics, University of Calicut |
|  | Vote of Thanks | **Dr.T.A.Sajesh**, Coordinator |
| **11.00-11.15 am**  **Tea Break** | | |
| **11.15-12.00 pm** | **Technical Session I** (Menachery Hall) | **Chair:**Prof. A. P. Jose, HOD  Department of Statistics, St.Thomas College, Thrissur (Rtd) |
|  | **Key Note Address** | **Dr. A. M. Mathai,** Emeritus Professor, McGill University, Canada |
|  | Topic | *Some Aspects of Matrix-Variate Statistical Distributions* |
| **12.00-1.00 pm** | **Technical Session II** (Menachery Hall) | **Chair:** Prof. Krishnakumar, Asso. Professor  Department of Statistics, St.Thomas College, Thrissur (Rtd) |
|  | **Invited Talk 1** | **Dr. P. G. Sankaran,** Pro-Vice Chancellor,  Cochin University of Science and Technology |
|  | Topic | *Properties of Proportional Hazards Relevation Transform* |
|  | **Invited Talk 2** | **Dr. C. Satheesh Kumar,** Associate Professor, University of Kerala |
|  | Topic | *On Bivariate Stopped Sum Distributions* |
| **1.00-1.45 pm**  **Lunch Break** | | |
| **1.45-3.15.00 pm** | **Technical Session III** (Menachery Hall) | **Chair:**   Dr.T.D.Xavier, HOD  Department of Statistics, St.Thomas College, Thrissur (Rtd) |
|  | **Invited Talk 3** | **Dr. Joby K Jose,** Associate Professor,  Kannur University |
|  | Topic | *Estimation of Stress-Strength Reliability Using Discrete Phase Type Distribution* |
|  | **Invited Talk 4** | **Dr. C. T. Vinu,** Asst. Professor  Indian Institute of Management, Trichi |
|  | Topic | *Netting Overnight and Trading day Returns Improves Volatility and VaR Estimates* |
|  | **Invited Talk 5** | **Dr. K. Jayakumar,** Professor  Department of Statistics, University of Calicut |
|  | Topic | *On Some Recent Generalizations of Exponential Distribution* |
| **3.15-3.30 pm**  **Tea Break** | | |
| **3.30-5.00 pm** | **Technical Session IV**  Contributory Session I  (Menachery Hall) | **Chair:** Dr. Joby K Jose, Associate Professor  Kannur University |
|  | Talk 1 | On Weighted Extropy- A New Concept  **E. I. Abdul Sathar** |
|  | Talk 2 | Process Performance Measures Using Process Capability Indices, **Jane Luke** |
|  | Talk 3 | Estimation of the mean of the Half-Normal distribution with known coefficient of variation using moving extreme ranked set sampling.  **N.K.Sajeevkumar** |
|  | Talk 4 | Lagrangian type zero truncated Poisson distribution  **Shibu D.S** |
|  | Talk 5 | Coefficient of determination in Logistic regression models **Nithya MK, Jayadevan S** |
|  | Talk 6 | Generalization and Application of Normal-Esscher Transformed Laplace Distribution  **Dais George** |
|  | Talk 7 | Application of Esscher Transformed Laplace Distribution in Flood Level Data  **Dais George and Rimsha H** |
|  | Talk 8 | Density Parameter Estimation of Skewed Geometric Stable Distributions,  **T. Sajayan** |
|  | Talk 9 | On a distribution related to Pareto and its Applications  **Bindu Krishnan and Dais George** |
|  | Talk10 | On Odds X – Weibull family of distributions.  **M. Girish Babu, K.Jayakumar** |

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| **16 February 2018** | | |
| **9.30-10.00 am** | **Technical Session V**  Contributory Session II  (Menachery Hall) | **Chair:** Dr. V. M. Chacko, Head  Department of Statistics, St.Thomas College, Thrissur |
|  | Talk 11 | Estimation of parameters of Gompertz Distribution based on Progressive Type-II Censored Data with Binomial Removals  **Rakhi Mohan** **and Manoj Chacko** |
|  | Talk 12 | An Alternative Generalized Yule distribution  **Harisankar. S and C. Satheesh Kumar** |
|  | Talk 13 | On Zero-Inflated Alternative Hyper Poisson Distribution and its Generalization  **Rakhi Ramachandran and C. Satheesh Kumar** |
| **9.30-10.00 am** | **Technical Session VI**  Contributory Session III  (Seminar Hall, 18) | **Chair:** Dr. Davis Antony M, Christ College, Irinjalakkuda |
|  | Talk 14 | Modified Asymmetric Generalized Normal Distribution: Properties and Applications  **G.V. Anila and C. Satheesh Kumar** |
|  | Talk 15 | On Additive Log -Inverse Weibull Distribution  **Subha R. Nair** **and C. Satheesh Kumar** |
|  | Talk 16 | **Maya** |
| **Time** | **Technical Session VII** (Menachery Hall) | **Chair:** Dr. K. Jayakumar, University of Calicut |
| **10.00-10.30 am** | **Prof. K Ramakrishna Pillai Endowment Lecture /Invited Talk 6** | **Dr. Yageen Thomas,** Emeritus Scientist, Department of Statistics, University of Kerala |
|  | **Topic** | *On a Generalized Morgenstern Family of Bivariate Distributions* |
| **10.30-11.00 am** | **Prof. A.M. Mathai Endowment Lecture/ Invited Talk 7** | **Dr. B. Rajeev,** Professor  Indian Statistical Institute, Bangalore. |
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|  | **Topic** | *Variance as a measure of randomness: What we understand by randomness today.* |
| **Tea Break**  **11.00-11.15 am** | | |
| **11.15-11.45 am** | **Invited Talk 8** | **Dr. M. Manoharan,** Professor  Department of Statistics, University of Calicut |
|  | Topic | *Operational and Economic Analysis of Queueing Systems* |
| **11.45-12.30 pm** | Dr. U. S. Nair Quiz Competition | **Quiz Master: Dr. Sreejith V**  Government Women’s College, Trivandrum |
| **12.30-1.15 pm** | Young Statistician Award Competition | **Coordinator: Dr. Davis Antony M**  Secretary, Kerala Statistical Association  **Participants:** Jiju Gillariose, Deepthi K S  Beenu Thomas, Sajana O K |
| **Lunch Break**  **1.15-1.45 pm** | | |
| **1.45-2.00 pm** | Prize Distribution |  |
| **2.00-3.00 pm** | **Technical Session VII (Menachery Hall)** | **Chair:** Dr. M. Manoharan, Professor  Department of Statistics, University of Calicut |
|  | **Invited Talk 9** | **Dr. E.V. Gijo,** Asst. Professor  Indian Statistical Institute, Bangalore |
|  | Topic | *Process Improvement in Higher Education: Opportunities and Challenges* |
| **Tea Break**  **3.00-3.15 am** | | |
| **3.15 -5.00 pm** | Retirement Function & General Body Meeting  Kerala Statistical Association | |

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| **17 February 2018** | | |
| Time | Session | Name |
| **9.30-11.00 am** | **Technical Session VIII**  **Contributory Session III (Menachery Hall)** | **Chair:** Dr. Davis Antony M, Christ College, Irinjalakkuda |
|  | Talk 17 | Estimation of entropy for generalized exponential distribution based on censored data  **Manoj Chacko** |
|  | Talk 18 | On Intervened Modified Alternative Hyper-Poisson Distribution and its Applications  **Emil Ninan and C. Satheesh Kumar** |
|  | Talk 19 | On Generalized Double Lindley Distribution and its Properties  **Rosmi Jose** **and C. Satheesh Kumar** |
|  | Talk 20 | On the Construction of a New Bivariate Distribution with Extreme Value and Burr-Type XII Distributions as Marginals  **Jitto Jose and P Yageen Thomas** |
|  | Talk 21 | On a (a,c,b) Policy Bulk Queue with Multiple Working Vacations  **Sunila V and Baburaj C** |
|  | Talk 22 | Implementation of statistical quality control (s.q.c.) in milk packaging industry  **P.R. Divya, Krishnapriya.T.S and Athira .T** |
|  | Talk 23 | Designing of Variables Single Sampling Plan through Quality Decision Region and Probabilistic Quality Region,  **P.R Divya** |
| **11.00-11.15 am**  **Tea Break** | | |
| **11.15-12.15 pm** | Talk 24 | A Bathtub Shaped Failure Rate Model  **V. M. Chacko, Deepthi K S and Beenu Thomas** |
|  | Talk 25 | Application of Record Ranked Set Sampling in Estimation Problem  **Jerin Paul and P. Yageen Thomas** |
|  | Talk 26 | A New Family of Skewed Slash Reflected Weibull Distribution and its Applications  **Bindu Punathumparambath** |
|  | Talk 27 | Complementary generalized exponential – Poisson distribution : Properties and Applications **K.K.Sankaran** |
|  | Talk 28 | Dirichlet Averages in the Rectangular Matrix-variate Case, **Princy T** |
|  | Talk 29 | Sample Size In analytical Cross-Sectional Studies  **Aji Gopakumar, Jayadevan Sreedharan and C. Subramanian** |
|  | Talk 30 | BCBD: An Exploration of OF Statistics  **Joxy joseph** |
| **12.15-1.15 am** | **Technical Session IX (Menachery Hall)** | **Chair:** Dr. P. O. Jenson, Principal |
|  | **Invited Talk 10** | **Dr. K. K. Jose,** KSCSTE Emeritus Scientist  St.Thomas College, Palai |
|  | Topic | *Big Data Analytics, Data Science and Biostatistics: Emerging Opportunities for Statisticians* |
|  | **Invited Talk 11** | **Dr. S. M. Sunoj,** Professor,  Cochin University of Science and Technology |
|  | Topic | *A quantile-based study on partial moments and its Applications* |
| **Lunch Break**  **1.15 pm-2.00 pm** | | |
| **2.00-3.30 pm** | **Valedictory Session** |  |
|  | Welcome | **Dr. Sajesh T A**, Coordinator |
|  | Presidential Address | **Dr. V. M. Chacko**, Head of the Department |
|  | Inauguration | **His Excellency Mar Tony Neelamkavil**, Manager & Auxiliary bishop, Thrissur Archdiocese |
|  | Memento Presentation to **Dr. P. O. Jenson**, Principal | |
|  | Felicitation | **Rev. Dr. Martin Kolambrath**, Vice-Principal |
|  |  | **Dr. T.D.Xavier**, HOD (Rtd), Department of Statistics, St.Thomas College, Thrissur |
|  |  | **Dr. Ignatius Antony**, Vice-Principal |
|  |  | **Dr. Thomas Paul Kattookkaran**, Vice-Principal |
|  | Reply Speech | **Dr. P. O. Jenson**, Principal |
|  | Vote of Thanks | **Dr. Rani Sebastian**, Coordinator |
| **3.30-4.30 pm** | **Cultural Programmes** |  |

**TITLE OF PAPERS AND AUTHERS**

**INVITED TALKS:**

1. **Some aspects of matrix-variate statistical distributions,** *A.M. Mathai, McGill University, Canada*
2. **Variance as a measure of randomness: What we understand by randomness today,** *B Rajeev, Indian Statistical Institute, Bangalore*
3. **On a Generalized Morgenstern Family of Bivariate Distributions,** *P.Yageen Thomas, University of Kerala*
4. **Reliability Properties of Proportional Hazards Relevation Transform,** *P. G. Sankaran, Cochin University of Science and Technology*
5. **On Bivariate Stopped Sum Distributions,** *C. Satheesh Kumar, University of Kerala*
6. **Netting Overnight and Trading day Returns Improves Volatility and VaR Estimates,** *Vinu C T, Indian Institute of Management , Tiruchirappalli*
7. **Process Improvement in Higher Education: Opportunities and Challenges,** *E V Gijo, Indian Statistical Institute, Bangalore*
8. **Big Data Analytics, Data Science and Biostatistics: Emerging Opportunities for Statisticians,** *K. K. Jose, St.Thomas College, Palai*
9. **Operational and Economic Analysis of Queueing Systems,** *M. Manoharan, University of Calicut*
10. **On Some Recent Generalizations of Exponential Distribution,** *K. Jayakumar, University of Calicut*
11. **A quantile-based study on partial moments and its applications,** *S.M.Sunoj, Cochin University of Science and Technology*
12. **Estimation Of Stress-Strength Reliability Using Discrete Phase Type Distribution,** *Joby K. Jose, Kannur University*

**CONTRIBUTORY TALKS:**

1. **Complementary generalized exponential – Poisson distribution: Properties and Applications,** *K.K.Sankaran & K.Jayakumar, University of Calicut,*
2. **A New Family of Skewed Slash Reflected Weibull Distribution and its Applications,** *Bindu Punathumparambath, Govt. Arts & Science College, Kozhikode*
3. **A bathtub shaped failure rate model,** *V.M.Chacko, Deepthi K S, Beenu Thomas, St.Thomas College (Autonomous), Thrissur*
4. **Coefficient of determination in Logistic regression models,** *Nithya MK, Jayadevan S, Nehru Arts and Science college, Kanhangad.*
5. **Density Parameter Estimation of Skewed Geometric Stable Distributions,** *T. Sajayan & K. Jayakumar, University of Calicut*
6. **Estimation of the mean of the Half-Normal distribution with known coefficient of variation using moving extreme ranked set sampling,** *N. K. Sajeevkumar, Government College Kariavattom Triandrum*
7. **Generalization and Application of Normal-Esscher Transformed Laplace Distribution,** *Dais George, Catholicate College, Pathanamthitta*
8. **Application of Esscher Transformed Laplace Distribution in Flood Level Data,** *Dais George and Rimsha H,, Catholicate College, Pathanamthitta*
9. **Dirichlet Averages in the Rectangular Matrix-variate Case,** *Princy T, Govt. Victoria College, Palakkad*
10. **Lagrangian type zero truncated Poisson distribution,** *Shibu D.S, University College, Thiruvananthapuram*
11. **On weighted extropy- A new concept,** *E. I. Abdul Sathar, University of Kerala,*
12. **Sample size in analytical cross-sectional studies,** *Aji Gopakumar, Jayadevan Sreedharan, C. Subramanian ,Gulf Medical University, UAE*
13. **On Odds X – Weibull family of distributions,** *M. Girish Babu, Govt. Arts & Science College, Kozhikode*
14. **On a (a,c,b) Policy Bulk Queue with Multiple Working Vacations,** *Sunila V, Baburaj C, Govt. College, Kasaragod*
15. **On a distribution related to Pareto and its applications,** *Bindu Krishnanand Dais George, St. Teresa’s College, Ernakulam .*
16. **BCBD: an exploration of statistics,** *Joxy joseph, Aruna P.k., University of Calicut*
17. **Estimation of entropy for generalized exponential distribution based on censored data,** *Manoj Chacko, University of Kerala*
18. **On Some Properties of Extended Generalized Yule Distribution,** *Harisankar. S and C. Satheesh Kumar, University of Kerala*
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20. **On Additive Log-Inverse Weibull Distribution,** *Subha, R. Nairand C. Satheesh Kumar, University of Kerala*
21. **Modified Asymmetric Generalized Normal Distribution: Properties And Applications,** *G.V. Anila and C. Satheesh Kumar, University of Kerala,*
22. **On Generalized Double Lindley Distribution And Its Properties,** *Rosmi Jose and C. Satheesh Kumar, University of Kerala*
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25. **Application of Record Ranked Set Sampling in Estimation Problem,** *Jerin Pauland P. YageenThomas, University of Kerala*
26. **Process Performance Measures Using Process Capability Indices,** *Jane Luke, Newman College, Thodupuzha.*
27. **Designing of Variables Single Sampling Plan through Quality Decision Region and Probabilistic Quality Region,** *P.R Divya,Vimala College, Thrissur*
28. **Implementation Of Statistical Quality Control (S.Q.C.) In Milk Packaging Industry,** *P.R. Divya , Krishnapriya.T.S & Athira .T, Vimala College, Thrissur*
29. **On the Construction of a New Bivariate Distribution with Extreme Value and Burr-Type XII Distributions as Marginals.,** *Jitto Jose and P. Yageen Thomas*

**Dr. R N PILLAI YOUNG STATISTICIAN COMPETITION PAPERS**

1. **A new bathtub shaped failure rate distribution,** *Beenu Thomas, St.Thomas College, Thrissur*
2. **A Generalization of Exponential Distribution with Bathtub Shaped Failure Rate Model,** *Deepthi K S, St.Thomas College (Autonomous), Thrissur*
3. **A Co-median Approach to Multivariate Regression,** *Sajana O.K*

*St. Thomas College (Autonomous), Thrissur*

1. **Inverse Marshall-Olkin Extended Family of Distributions**

*Lishamol Tomy and Jiju Gillariose, St.Thomas College, Pala*

**INVITED TALKS**

**---------------------------------------------------------------------------------------------------**

**Some aspects of matrix-variate statistical distributions**

*A.M. Mathai*

*McGill University, Canada*

**Abstract**

In multivariate statistical analysis, matrix-variate statistical distributions are the backbone. The main distribution there is the Wishart distribution, which is a very special case of matrix-variate gamma density in the general matrix-variate case. Matrix-variate gamma density is available for real positive definite matrix as argument or Hermitian positive definite matrix as argument. Both these cases deal with square matrices. Theory is also available for rectangular matrix-variate gamma density in the real and complex cases, where the argument is a rectangular matrix. Techniques from the theory of functions of matrix argument are the easier one to tackle matrix-variate densities. Statisticians often use very round about methods to tackle the distribution problems. Properties of Wishart and related densities can be discussed easily from Special Functions point of view. Related densities are the matrix-variate type-1 and type-2 beta densities, which are directly derivable from matrix-variate gamma densities. Determinant of the type-1 beta matrix gives the general structure of all lambda criteria in testing hypotheses on one or more parameters of one or more multivariate Gaussian distributions. Determinant of the type-2 beta matrix gives the general structure in the test statistics associated with all analysis of variance and analysis of covariance structures. Some of these aspects will be illustrated in the proposed talk.

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**Variance as a measure of randomness: What we understand by randomness today.**

*B Rajeev*

*Indian Statistical Institute, Bangalore*

**Abstract**

In this talk we will make a survey of some basic concepts that we use in research in areas related to probability. We take a historical view to analyze the evolution of the science of randomness using these concepts. We try to present a unified picture.

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**On a Generalized Morgenstern Family of Bivariate Distributions**

*P.Yageen Thomas*

*Emeritus Scientist, Department of Statistics, University of Kerala*

**Abstract**

In this talk we describe a family of bivariate distributions which includes the well known Morgenstern family of bivariate distributions as its sub family. We discuss about the distribution theory of concomitants of order statistics and concomitants of generalized (k) record values arising from this generalized family of distributions. Some results dealing with the properties of the above concomitants which characterize the considered family will be discussed. We also discuss how the marginal distribution on one variable and the distribution of the concomitant of the extreme order statistic on the other variable together determine the parent bivariate distribution. Similar role of the marginal distribution on one variable and the distribution of concomitant of a record value on the other variable to determine the parent bivariate distribution again will be dealtwith.

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**Reliability Properties of Proportional Hazards Relevation Transform**

*P. G. Sankaran*

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*Cochin 682022, Kerala, India.*

**Abstract**

Relevation transform introduced by Krakowski [1973] is extensively studied in literature. We study the reliability properties of a special case of relevation transform namely proportional hazards relevation transform (PHRT). Some characterizations based on reliability measures are provided. Various Stochastic orders and ageing concepts are discussed. A new lifetime distribution called proportional hazards relevated Weibull (PHRW) is introduced and discussed its applications with two real datasets.

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**On Bivariate Stopped Sum Distributions**

*C. Satheesh Kumar*

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**Abstract**

Univariate stopped sum distributions have received much attention in statistical literature due to their practical relevance in several areas of scientific research, especially in the areas like actuarial science, physical sciences, biological sciences etc. But bivariate stopped sum distributions have not studied much in the literature. The present talk concentrates on this direction and discusses how to develop such bivariate stopped sum models and their related mixture models. Further, we investigate several interesting properties of these classes of distributions.

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**Netting Overnight and Trading day Returns Improves Volatility and VaR Estimates**

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*Pudukkottai Main Road, Chinna Sooriyur Village*

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**Abstract**

We propose a class of Periodic AR-GARCH models for overnight, trading day, and daily re- turns series using opening and closing trading prices. Apart from the timing differences in the overnight (close to open) and trading day (open to close) returns series, in most cases, trading mechanisms are also different in ‘close to open’ and ‘open to close’ periods. The proposed class of models captures the relationship between the two series through mean and variance equations. Properties of the models and estimation of the model parameters are discussed. We have consid- ered normal, Pearson Type IV, and JohnsonSU distributions for the innovations. The proposed models are tested on five different stock indices. It is found that the interrelationship of the two series is significant in all indices.

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**Process Improvement in Higher Education: Opportunities and Challenges**

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**Abstract**

Higher Education sector is a fast growing sector throughout the world. In India also this sector has shown a steady growth during the past decade. As the Higher Education sector is growing rapidly, the challenges faced by Universities/ institutes in meeting the ever increasing requirement of students’ community is also growing rapidly. In this article, the author discusses various challenges faced in Higher Education sector and the possibility of implementation of Lean Six Sigma in this sector.

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**Big Data Analytics, Data Science and Biostatistics: Emerging Opportunities for Statisticians**

*K. K. Jose*

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**Abstract**

Recent advances in data acquisition technologies have led to massive amount of data being collected routinely in the physical, chemical, and engineering sciences as well as information sciences and technology. In addition to volume, the data often have complicated structure. Examples of such Big Data include the data streams obtained from complex engineering systems, image sequences, climate data, website transaction logs, credit card records, and so forth. Because of their big volume and complicated structure, big data are difficult to handle using traditional database management and statistical analysis tools. Data science emphasizes the data problems of the 21st Century, like accessing information from large databases, writing code to manipulate data, and visualizing data. First, people needed to work with datasets, which we now call big data that are larger than pre-computational statisticians could have imagined. Second, industry focused increasingly on making predictions about markets, customer behavior and more for commercial uses. The inventors of data science borrowed from statistics, machine learning and database management to create a whole new set of tools for those working with data. Data Science has made statistical computing useful to manufacturing industry, health sciences, cancer studies, big data analytics, business analytics etc and has opened up wide scope for statisticians with a changed mindset and readiness to take up challenges in the modern data driven world. Biostatistics teaching and research is another emerging area in India. However U.S. and other developed countries are at the forefront in using advanced statistical tools in biostatistics and health sciences. The Medical Council of India has now realized the need for more Biostatistical research centres and collaboration of medical researchers with properly trained to face the challenges of widely emerging diseases like, cancer, cardiovascular disease, diabetics, hypertension, etc. However Medical Colleges and other bio-medical research centres in Kerala have not given much importance to research in Biostatistics and related subjects. The paper analyzes the present scenario as well as emerging opportunities for statisticians in India and abroad.

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**Operational and Economic Analysis of Queueing Systems**

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**Abstract**

Queueing is an aspect of modern life that we encounter at every step in our daily activities. In this paper we examine the key ideas and issues both analytical and economical of single node queueing systems as well as queueing networks. We shall first look into key elements and underlying mathematical concepts of analytical queuing models, calculation and interpretation of the operating characteristics associated with the model. The multiple-server queuing model will also be explored to evaluate performance of practical queuing systems. The obvious implication of customers waiting in long and winding queues could result to prolonged discomfort and economic cost to them; however increasing the service rate will require additional number of severs which implies extra cost to management. This study therefore attempts to find the trade-off between minimizing the total economic cost (waiting cost and service cost) and the provision of a satisfactory and reasonably shortest possible time of service to customers, in order to assist management in deciding the optimal number of severs needed. Some numerical illustrations are also provided.

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**On Some Recent Generalizations of Exponential Distribution**

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**Abstract**

One of the distributions used in life time data analysis is the exponential distribution. Due to the lack of memory property and simple form of the pdf/cdf, this distribution has attracted the attention of many researchers. But recently, a number of generalizations of exponential distribution have appeared in the literature, for eg; Generalized exponential,Transmuted exponential, Kumaraswamy exponential, Marshall-Olkin extended exponential, Mittag-Leffler distribution, etc. In the present talk, we review the literature on these recent generalizations of exponential distribution. Some new results are also presented.

Key words: Exponential distribution, Generalized exponential distribution, Hazard rate, Kumaraswamy G – distributions, Marshall-Olkin extended family of distributions, Transmutation map.

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**A quantile-based study on partial moments and its applications**

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**Abstract**

Partial moments are extensively used in literature for modeling and analysis of lifetime data in actuarial science for the analysis of risks. Since the first order partial moments provide the expected loss in a stop-loss treaty with infinite cover as a function of priority, it is referred as the stop-loss transform. In the present work, we discuss distributional and geometric properties of the first and second order partial moments defined in terms of quantile function. Relationships of the scaled stop-loss transform curve with the Lorenz, Gini, Bonferroni and Leinkuhler curves are developed. The quantile-based partial moments determines the underlying distribution uniquely. Further, the quantile-based measure provides alternate definitions for ageing criteria, useful in reliability analysis.

Key words and Phrases: Partial moments, Quantile function, Stop-loss transform, Lorenz curve, Gini index, Ageing properties

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**Estimation Of Stress-Strength Reliability Using Discrete Phase Type Distribution**

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**Abstract**

Phase type distributions are of great importance in modern probability and have widespread acceptance in recent years, because of its computational properties in applied stochastic modelling. In this paper the stress strength reliability is estimated for both single component and multi-component systems with discrete phase type distribution for both stress and strength components. Matrix based expressions are obtained for stress strength reliability and its maximum likelihood estimate is obtained using EM algorithm.

Key words: Discrete phase type distribution, stress strength reliability, EM algorithm,

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**CONTRIBUTORY TALKS**

**Complementary generalized exponential – Poisson distribution:**

**Properties and Applications**

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**Abstract**

The modern era on distribution theory stresses on problem-solving faced by practitioners and applied researchers and proposes a variety of models so that lifetime dataset can be better assessed and investigated in different fields. The objective for proposing, extending or generalizing (models or their classes) is to explain how the lifetime phenomenon arises in fields like Physics, Computer Science, Insurance, Public health, etc. In this paper, we introduce and study complementary generalized exponential Poisson (CGEP) distribution. We derive some distributional properties such as generating functions, moments, hazard rate and quantiles of the CGEP distribution. Expressions for order statistics and entropy are derived. Estimation of the parameters are done using maximum likelihood method. Two real data sets are analyzed to illustrate the suitability of the proposed model.

Key words: Entropy, Generalized exponential distribution, Maximum likelihood, Order Statistics, Poisson distribution.

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**A New Family of Skewed Slash Reflected Weibull Distribution and its Applications**

*Bindu Punathumparambath*

*Department of Statistics, Govt. Arts & Science College, Kozhikode, Kerala*

**Abstract**

The present study introduces a new family of univariate skewed slash reflected Weibull distributions, which arise as the ratio of skewed reflected Weibull distributions and independent uniform power function distributions. Skewed slash reflected Weibull is derived and the properties of the resulting distributions were studied. Reflected Weibull and slash reflected Weibull are special cases of this new family. The proposed distribution is skewed and heavy tailed. This distribution provides us alternative choices in simulation study and in particular, in fitting skewed data sets with heavy tails. Finally, some possible applications of the models are discussed.

Keywords: slash distribution, skew reflected Weibull distributions, slash reflected Weibull distributions .

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**A bathtub shaped failure rate model**

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*St.Thomas College (Autonomous), Thrissur, Kerala*

**Abstract**

Most real life system exhibit bathtub shapes for their failure rate functions. This paper consider a simple model but exhibiting bathtub shaped failure rate and discuss the failure rate behavior of these distributions. Applications in reliability study is discussed.

Keywords: Bathtub failure rate, Reliability

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**Coefficient of determination in Logistic regression models**

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**Abstract**

Logistic regression is used to measure the relationship between a categorical dependent variable and one or more independent variables, which may be qualitative or quantitative. This paper aims to explain the different types of pseudo R square using in logistic regression.

Logistic regression with two levels for the dependent variable is called the binary logistic regression and it is the most common. Simple binary logistic regression with one dependent (nominal) variable with two levels (male/female, dead/alive, success/failure) and one independent variable. In binary logistic regression, the outcome is usually coded as "0" or "1". Usually the success is coded as “1” and the failure as “0”. Logistic regression with more than two levels for the dependent variable is called multinomial logistic regression. Here the dependent variable has three or more possible groups (like treatment A, treatment B, treatment C).

In both types, the odds of being a case on the basis of the independent variable can be calculated. The odds are the probability of occurrence of the particular outcome. The overall goodness of fit of a logistic regression model has been examined by the test for goodness of fit.

The pseudo R-square is a statistic generated in Ordinary Least Squares (OLS) regression that is often used as a goodness of fit measure. R2 is the square of the correlation coefficient between the dependent and the independent variables. R2 always lies between 0 and 1. If we get the value of R2 is 1, which means that the regression line perfectly fit the data and if the value of R2 is 0, which means that the response variable and regressors are independent. If there is more than one regressor, R2 can be mention as the coefficient of multiple determinations. One of the limitations of R2 is that it does not indicate that the adequacy of the regression model. Sometimes, we will get good model with low R2 and high R2 with model that does not fit the model.

The Coefficient of determination plays an important role in determining the goodness of fit of the model in logistic regression too. Like linear regression we cannot directly use an adjusted R2 measure in logistic regression. There are some direct alternatives to R2, which are called pseudo R-squared. Pseudo R squared is look like R squared in the sense that they are on the same scale, ranging from 0 to1. The commonly used pseudo R-squared are: Cox & Snell, Nagelkerke, and Mc Fadden. These different methods of the pseudo R-squared gives different interpretations and model fit. A pseudo R squared meaningful when it is compared to another pseudo R squared of the same type, on the same data, predicting the same outcome.

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**Density Parameter Estimation of Skewed Geometric Stable Distributions**

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**Abstract**

We propose a procedure for estimating the parameters of the geometric stable distributions. A generalization of the geometric stable law introduced. The proposed estimation procedure also applied to the generalized model.The algorithm is less restrictive, computationally simple and necessary to make these models usable in practice.

Keywords: Geometric stable, Generalized geometric stable.

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**Estimation of the mean of the Half-Normal distribution with known coefficient of variation using moving extreme ranked set sampling.**

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**Abstract**

In this article we have derived the best linear unbiased estimator (BLUE) of the mean of the Half Normal distribution with known coefficient of variation using moving extreme ranked set sampling (MERSS).Efficiency comparison is also made on the proposed estimators with some of the usual estimators.

Kew words: Moving extreme ranked set sampling, Best linear unbiased estimation, Half-Normal distribution.

**Generalization and Application of Normal-Esscher Transformed Laplace Distribution**

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**Abstract**

The convolution technique and its generalizations have many applications in probability, Statistics, computer vision, signal processing, engineering, and di erential equations. In this work, we introduce a new asymmetric and heavy-tailed distribution namely, normal-Esscher transformed Laplace distribution which is the convolution of independent normally distributed and Esscher transformed Laplace distributed components. An autoregressive process with normal- Esscher trans-formed Laplace marginal is also developed. Various properties of the distribution as well as process are studied. A multivariate generalization of this distribution is also considered.

Key words: Autoregressive Processes, Normal-Esscher Transformed Laplace Distribution, Multivariate Normal-Esscher Transformed Laplace Distribution, Multivariate Normal-Geometric Esscher Transformed Laplace Distribution.

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**Application of Esscher Transformed Laplace Distribution in Flood Level Data**

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**Abstract**

Recent literature shows that geometric stable distributions are more suitable for modeling data sets which exhibit the general character of asymmetry, sharp peaks and heavier tails than normal distribution. In this work, we consider a real application of a geometric stable distri-bution namely, the Esscher transformed Laplace distribution in ood level data which will be very helpful for the irrigation department of the state to take precautions against serious disrupt and damage due to ood water at rainy season.

Key words: Autoregressive Processes, Esscher Transformed Laplace Distribution, Geometric Esscher Transformed Laplace Distribution.

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**Dirichlet Averages in the Rectangular Matrix-variate Case**

*Princy T*

*Govt. Victoria College, Palakkad*

**Abstract**

This paper deals with Dirichlet averages or averages of functions over the Dirichlet measure. The classical power mean contains the harmonic mean, arithmetic mean and geometric mean (Hardy, Littlewood and Polya), is generalized to Y-mean by deFinetti and hypergeometric mean by Carlson, see the references herein. Carlson's hypergeometric mean is to average a function over a real scalar variable type-1 Dirichlet measure and this in the current literature is known as Dirichlet average of that function. The present paper deals with Dirichlet averages of several functions in the general rectangular matrix-variate Dirichlet measures. Dirichlet measures are defined when the matrices are rectangular in nature by using matrix transformations over the Stiefel manifold and then various functions are averaged over this generalized Dirichlet measure. Pathway extended rectangular matrix-variate Dirichlet models are also discussed along with averaging of functions in this generalized measure. The results encompass three different families of rectangular matrix-variate distributions.

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**Lagrangian type zero truncated Poisson distribution**

*Shibu D.S*

*Department of Statistics, University College, Thiruvananthapuram*

**Abstract**

Lagrangian probability distributions have a vital role in modeling data. In this paper, certain Lagrangian type zero truncated Poisson distribution is developed and studied some of its important properties. Also an attempt has been made to discuss certain properties of this class of distribution viz. convolution property, moments, equivalence of the two classes of Lagrangian distribution and some limit theorems. Certain subclasses of Lagrangian type zero truncated Poisson distribution such as basic Lagrangian zero truncated Poisson distribution, delta Lagrangian zero truncated Poisson distribution and general Lagrangian zero truncated Poisson distributions are discussed here.

**On weighted extropy- A new concept**

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**Abstract**

In the present paper, we propose nonparametric estimators for the Weighted Extropy, a new information measure. This measure plays important roles in reliability and survival analysis in connection with modeling and analysis of life time data. Asymptotic properties of the estimators are established under suitable regularity conditions. Monte-Carlo simulation studies are carried out to compare the performance of the estimators using the mean-squared error. The methods are illustrated using real data sets.

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**Sample size in analytical cross-sectional studies**

*Aji Gopakumar1, Jayadevan Sreedharan2, C. Subramanian3*

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**Abstract**

Determination of sample size is an important and essential step in any type of research. The sample size calculation mainly dependson the study design. There are various types of study designs available in epidemiological research. Cross sectional study is one of the designs and the primary aim of this design is to determine the prevalence of an exposure or a disease and is generally called descriptive cross-sectional study.

For the calculation of sample size in descriptive cross-sectional studies, usually we consider the prevalence of the disease, level of significance and the margin of error. The power term is not included in the sample size as there is no hypothesis testing in cross section studies. But now a day, this type of study is using to find the risk factors (prevalence Odds Ratio)by estimation and test of hypothesis about exposure and outcome relationships, and is called analytical cross-sectional study.To find the associated factors of an outcome variable, sample size formula should contain power term so that the result of the study can be generalized. If power is not included in the sample size formula, an adequate case group (diseased group) will not be reflected on the selected sample and hence, identified factors that associated with the disease may not be the real factors. This paper discussesthe existing method used to calculate the sample size for descriptive cross-sectional study and a proposedmethod for analytical cross-sectional study.

The existing formula for calculating sample size in descriptive cross-sectional study is

n = (Z^2 pq)/L^2 ------------ (1)

The proposed formulafor calculating sample size in analytical cross-sectional study is

n = pq((Zα+ Z\_β)/(p\_(0 )-p))2 --------- (2)

The OR (Odds Ratio) and its significance using both formula (1 and 2) will be presented in the paper.

The sample size formulaproposed in this paper ensures statistically valid results by incorporating‘power of the test (Zβ)’ in the formula along with other terms such as standard deviation, effect size and level of significance.

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**On Odds X – Weibull family of distributions.**

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**Abstract**

In this paper, we study a new family of continuous distributions called Odds X-Weibull (OXW) distributions using the T − X family concept introduced by Alzaatreh, Lee and Famoye (Metron, 2013). Some of the special models of this family are introduced and one among them, Odds exponential-Weibull (OEW) distribution is studied in detail. This distribution is found to be a competitor for the well-known lifetime models such as Exponential, Weibull, Exponentiated Exponential, Exponentiated Weibull, etc. Some structural properties of the proposed new distributionare studied. The method of maximum likelihood is used for estimating the model parameters and a simulation study is carried out. Two real data sets areused to illustrate the applications and ﬂexibility of the OEW distribution.

Keywords :Entropy, Maximum likelihood, T-X family of distribution

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**On a (a,c,b) Policy Bulk Queue with Multiple Working Vacations**

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**Abstract**

Here we consider an (a, c, b) policy bulk queue with multiple working vacations. The arrivals occur in batches and are served in batches by a single server. If the number of number of customers in the queue is less than c, the server become idle and if the queue size is at least c then the server begins service, serves a maximum of b units in a batch. If after a service completion epoch the queue size is less than c but not less than a server continue to serve in batches. If the queue size is less than a (a≤ c≤ b) the server goes for multiple working vacations. The model is analyzed by supplementary variable technique and obtained generating functions of the system states. The expected queue length is also obtained.

Keywords: bulk arrival, bulk service, (a, c, b) policy, multiple working vacation, supplementary, Variable technique.

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**On a distribution related to Pareto and its applications**

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*2Catholicate College, Pathanamthitta, Kerala.*

**Abstract**

The family of Pareto distribution is well known in the literature for its capability in modellingthe heavy-tailed distributions. In this article, we introduce a new heavy-tailed distribution that competes with Pareto distribution of third kind. Various structural properties of the new distribution are obtained. The method of maximum likelihood is used for estimation of model parameters and simulation study is conducted to evaluate its performance. A data analysis is carried out to show the performance of this new distribution over Pareto distribution. An autoregressive minification process for the new model is also developed.

Key Words:Heavy-tailed distribution, Minification Process,Pareto Distribution

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**BCBD: an exploration of statistics**

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*Prof.(Dr.) Aruna P.k.*

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**Abstract**

Statistics done an essential part in Global development. It’s the basement of planning of each country. It plays a significant role in economics ,commerce, medicine, psychology and education ...... what more?; in each and every thing in life. Innovative approaches in statistics make it an essential part of development. Present study tries to explore BCBD- the balanced complete block design: an exploration of statistics. Among the findings of the study it was found that BCBD is more desirable

Key words; BCBD, EXPLORATION and STATISTICS

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**Estimation of entropy for generalized exponential distribution based on censored data**

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**Abstract**

In this paper, estimation of entropy for generalized exponential distribution based on censored observation is considered. Maximum likelihood estimation and Bayes estimation for Shannon entropy has been considered. Bayes estimators are obtained using MCMC method. A simulation study is performed to find the performance of the estimators developed in this paper. Inferential procedures developed in this paper have also been illustrated using real data.

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**On Some Properties of Extended Generalized Yule Distribution**

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**Abstract**

Here we consider an extended version of the generalized Yule distribution and investigate some of its important properties. Various methods of estimation are employed for estimating the parameters of the distribution and certain test procedure are suggested for testing the significance of the additional parameters of the distribution. Further, a simulation study is conducted for assessing the performance of the maximum likelihood estimators. All the procedures discussed here are illustrated with the help of real data sets.

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**On Intervened Modified Alternative Hyper-Poisson Distribution And Its Applications**

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**Abstract**

Here we consider an intervened version of modified alternative hyper-Poisson distribution as a generalization of the intervened alternative hyper-Poisson distribution. Some crucial properties of the distribution are derived and discussed the estimation of its parameters by various methods of estimation.

Keywords: Confluent hyper geometric function, Method of factorial moments, Probability generating functions, Stirling numbers of the second kind.

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**On Additive Log-Inverse Weibull Distribution**

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**Abstract**

In this paper we introduce an additive form of the log-inverse Weibull distribution admitting bath-tub shaped failure rates and investigate its important theoretical properties. We discuss the estimation of its parameters by method of maximum likelihood and illustrate the flexibility and utility of the distribution with the help of certain real life data sets. A simulation study is also attempted for examining the asymptotic behaviour of the maximum likelihood estimators of the parameters of the distribution.

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**Modified Asymmetric Generalized Normal Distribution: Properties And Applications**

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**Abstract**

In this paper we investigate some important properties of the modified asymmetric generalized normal distribution and its location-scale extension. Further, we discuss the estimation of the parameters of the distribution by various method of estimation and illustrated the procedures by using real life data sets. A brief simulation study is also attempted to examine the performance of various estimators of the parameters of the distribution.

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**On Generalized Double Lindley Distribution And Its Properties**

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**Abstract**

Here first we obtain some important properties of the generalized double Lindley distribution (GDLD) and introduce a location-scale extension (EGDLD) of it. We discuss the estimation of the parameters of the EGDLD by maximum likelihood estimation method and illustrated the procedures with the help of certain real life data sets.

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**On Zero-Inflated Alternative Hyper Poisson Distribution And Its Generalization**

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**Abstract**

A zero-inflated version of the alternative hyper-Poisson distribution of Kumar and Nair (Statistica, 2012) is considered here and developed a generalized version of it for creating more flexibility in the model. Several important properties of these distributions are derived along with certain recurrence relations for their probabilities, raw moments and factorial moments. In addition, various methods of estimation are discussed for estimating the parameters of these distributions and they have been fitted to certain well known data sets.

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**Estimation of parameters of Gompertz Distribution based on Progressive Type-II Censored Data with Binomial Removals**

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**Abstract**

In this work we discuss about the problem of estimation of parameters for Gompertz distribution is considered based on a progressively type-II censored sample with binomial removals. Together with the unknown parameters, the removal probability is also estimated. The maximum likelihood estimators of the parameters and the asymptotic variance-covariance matrix of the estimates are obtained. Bayes estimators are also obtained using different loss functions such as squared error, LINEX and general entropy. A simulation study is performed for comparison between various estimators developed in this paper. A real data set is also used for illustration.

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**Application of Record Ranked Set Sampling in Estimation Problem**

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**Abstract**

Record ranked set sampling is a method of sampling in which units are identified for making measurements on the variable of interest is based on records on judgment scores or based on records of the values assigned on an easily measurable variable, which is closely associated with variable of primary interest. We have pointed out instances where this type of sampling is highly helpful, where observational economic considerations is warranted. We have proposed estimation of the unknown parameters involved in the distribution of the variable of interest based on the data obtained from the proposed sampling method. Also, we have illustrated the application of the results in estimating the unknown parameters of logistic distribution based on a real life data set

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**Process Performance Measures Using Process Capability Indices**

*Jane Luke*

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**Abstract**

Statistical techniques for analyzing process capability have been applied on a large scale by a variety of industries since the early 1980’s. The quality of a manufactured product is ultimately expressed by the level of satisfaction of the customer. In achieving quality, the production process should be capable of manufacturing products conforming to preset speciﬁcations. For normal distributions, we developed a new procedure to assess two suppliers’ capabilities using generalized pivotal quantity method. Different process capability indices are considered in this study. The performance of the proposed method is assessed using a simulation study. An example from industrial contexts is given to illustrate the result.

Keywords: Generalized conﬁdence interval, generalized pivotal quantity, normal distribution, process capability index, speciﬁcation limits.

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**Designing of Variables Single Sampling Plan through Quality Decision Region and Probabilistic Quality Region**

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**Abstract**

This paper proposes a new concept for designing Variables Single Sampling Plan through Quality Decision Region (QDR) and Probabilistic Quality Region (PQR). Usually Sampling Plans are quality levels of attributes like AQL, LQL, MAPD, Tangent Intercept, or the outgoing quality levels AOQL, MAAOQ. This paper introduces a new method of designing Sampling plan based on range of quality instead of point-wise description of quality. So this method can be adopted in the elementary production process where the stipulated quality level is advisable to fix at a later stage. The advantages of this new variables plan over conventional sampling plans are discussed. Tables are constructed for the selection of parameters of this plan indexed by acceptable quality level and limiting quality level, when the standard deviation is known or unknown. It is shown that the proposed sampling plan yield a reduction in sample size as compared with the single and double sampling plans.

Key Words: Acceptable quality level, Limiting Quality level, Operating Characteristic Curve, Probabilistic Quality Region, Quality Decision Region, Variables Single Sampling Plan.

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**Implementation Of Statistical Quality Control (S.Q.C.) In Milk Packaging Industry**

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**Abstract**

This paper examines the applications of statistical quality control in milk packaging industry. Every process and it’s output are subjected to variation.SQC involves analysis of characteristics of a output by inference from sampling the output. The analysis make ensures that the process is under control. Control charts are used to separate out the assignable cause of variation.58 raw milk samples are drawn from a selected dairy plant of Thrissur in Kerala. Statistical Quality Control tools, such as X Bar chart, R- chart, c- chart, p- chart had been utilized to measure the variability in the process. It is clearly observed that, after implementing the statistical quality control in milk packaging industries the productivity has been increased.

KEYWORDS: Raw milk, Statistical Quality Control, Control Charts, Fat, SNF

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**On the Construction of a New Bivariate Distribution with Extreme Value and Burr-Type XII Distributions as Marginals.**

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**Abstract**

In this work, we develop a new bivariate distribution by assuming a specified distribution to the concomitant of the smallest order statistic on one variable and by considering a well-known extreme value distribution forthe other marginal random variable. The unassumed form of marginal distribution of the developed bivariate distribution is proved to be a Burr-Type XII distribution. Some general characteristics of this newly generated distribution are studied. Important reliability functions of this bivariate model are also derived in this study. The method of maximum likelihood is applied in the estimation of the parameters of the proposed distribution. We have also identified the generated model as a suitable model to study some real life problems.

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**A new bathtub shaped failure rate distribution**

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**Abstract**

Most real life system exhibit bathtub shapes for their failure rate functions. Generalized Lindley, Generalized Gamma, Exponentiated Weibull and x-Exponential distributions are proposed for modeling lifetime data having bathtub shaped failure rate model. This paper considered a simple model and discusses the failure rate behavior but this proposed distribution allows only bathtub (upside down bathtub) shapes for its hazard rate function. Computation of moments requires software. Applications in reliability study are discussed.

Keywords: Bathtub failure rate, Reliability

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**A Generalization of Exponential Distribution with Bathtub**

**Shaped Failure Rate Model**

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**Abstract**

The Exponential and Weibull are the two most commonly used distributions for analyzing lifetime data. These distributions have several desirable properties and nice physical interpretations. This paper introduces a new distribution, which generalizes the well-known Exponential and Weibull distribution, which may have non-increasing, non-decreasing and bathtub hazard functions also. The component or system with high initial failure rate, which decreases rapidly and then slowly increases can be modeled using proposed distribution. The Statistical properties of this distribution are discussed. The proposed model would be use-full in survival analysis and human mortality study. An estimation procedure by the method of maximum likelihood is given. A real data set is analyzed and it is observed that the present distribution can provide a better fit than some other very well known distributions.

Key Words: Reliability, Bathtub shaped failure rate, Weibull distribution, Exponential distribution.

**A Co-median Approach to Multivariate Regression**

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**Abstract**

In Multivariate regression analysis the use of maximum likelihood method would not be appropriate in estimation problems, while the data containing outlier or extreme observations. So it is necessary to find a parameter estimation method in which the value of the estimation is not much affected by small changes in the data. This paper introduces robust method for Multivariate regression based on robust estimation location and scatter matrix of predictor and response variables. In this paper Comedian method is taken as a robust estimator of location and scatter. This estimator combines high robustness and high efficiency in estimation. Based on the simulations, the finite-sample efficiency and robustness of the estimator are investigated. The proposed method is illustrated on a real data set.

Keywords: multivariate regression, Outliers detection, Comedian approach, Finite sample efficiency.

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**Inverse Marshall-Olkin Extended Family of Distributions**

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**Abstract**

We introduce a new class of model called the inverse Marshall-Olkin extended family of distributions. We provide some special models and study the shapes of the family. We derive the quantile function and obtain explicit expressions for the moments, generating function, mean deviations, two types of entropies and order statistics. The parameters of new model are estimated by maximum likelihood method. The importance of the new family is illustrated by means of real data set.

Keywords: Inverted Distributions, Marshall-Olkin Family, Method of Maximum Likelihood, Order Statistic