

In the Name of God



Fifth seminar on
Copula Theory and its Applications
30 & 31 Jan. 2019



Abstracts of
the 5th Seminar on
Copula Theory and its Applications

Department of Statistics

and

Ordered and Spatial Data Center of Excellence, Ferdowsi
University of Mashhad, Iran,

30-31 Jan, 2019.

Preface

The series of biennial workshops on **copula theory** which took place in Ferdowsi University of Mashhad (2011 and 2013), Shahid Bahonar University of Kerman (2015) and Yazd University (2017) with an emphasis on application in engineering sciences, agricultural sciences, actuarial science, finance, reliability, survival analysis, economics and etc. is the result for the decision of the scientific committee of the Ordered and Spatial Data Center of Excellence (OSDCE) of Ferdowsi University of Mashhad (FUM) to organize workshops and seminars every two years. This seminar is sponsored by the department of statistics, OSDCE of FUM, Islamic world Science Citation database (ISC), Iranian Statistical Society and Actuarial Society of Iran to provide suitable facilities for academics to have efficient research cooperation and will be held at Faculty of Mathematical Sciences of FUM at 30 and 31 Jan. 2019. We hope all of the seminar committees provide a suitable satisfactory atmosphere for the participants.

After the first call of the seminar, 20 papers were accepted as oral presentations and 7 as poster presentations by the referees and scientific committee. The attendants and participants in the seminar are in summary 40 people which are professors, students and researchers of different institutes around Iran. Finally, we would like to extend our sincere gratitude to the Research Council of FUM, the administration of Faculty of Mathematical Sciences, the OSDCE, the Islamic world Science Citation center, the Iranian Statistical Society, Actuarial Society of Iran, the scientific committee, the organizing committee, the referees, and the students and staff of the department of statistics of FUM for their kind cooperation.

Mohammad Amini (Chair of Seminar).

Topics

The aim of the seminar is to provide a forum for presentation and discussion of scientific works covering theories and methods such as:

1. Methods of copula construction
2. Copula functions and dependence concepts
3. Dependence modelling using copula function
4. Inference based on copula
5. Application of copula in spatial, survival, reliability, engineering, hydrological, meteorological, agricultural, finance, economic data and etc.

Scientific Committee (Alphabetical order)

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5. Jabbari Nooghabi, H., Ferdowsi University of Mashhad
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6. Kazempoor, J., PhD student in Statistics, Ferdowsi University of Mashhad
7. Mohammadi, M., PhD student in Statistics, Ferdowsi University of Mashhad
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Distorted copulas: constructions, properties and some applications

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Abstract

Distortion functions aimed at converting standard distribution functions for the premium calculation was introduced by Yaari (1987) and Wang (1996) are useful tools in generalizing of standard distribution functions. Distorted copulas are one of the most popular models used in finance, economic, etc. The construction of these models are of a great importance due to their flexible dependence structure based on distortion functions. In this paper, some methods of producing distortion functions have been studied. Moreover, univariate (bivariate) distorted distributions, distorted copulas, generalized distorted distributions and some application in coherent systems presented.

Keywords: Distortion functions, Distorted distribution functions, Distorted copula.

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Analysis of bivariate binary longitudinal data using Gaussian copula

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Abstract

Analysis of bivariate binary longitudinal data using Gaussian copula is an important problem in medical, social science, economics etc. In this paper, we use a Gaussian copula approach for analysing such data. We use copula models for defining a bivariate distribution for two binary outcomes at each time point. Then, we use transition model for considering association between longitudinal measurements. The proposed approach is applied for analyzing a real data set. The data set is a longitudinal data about heart failure patients. This study is a treatment–control study, where the effect of a treatment is simultaneously investigated on readmission and referral to doctor as two binary longitudinal responses.

Keywords: Longitudinal mixed data, Copula function, Transition model.

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On stochastic comparisons of extreme order statistics from the proportional odds model of distributions

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Abstract

In this paper, we study stochastic comparison of the smallest and largest order statistics of two heterogeneous random vectors with dependent components having proportional odds marginals and Archimedean copula structure in terms of the usual stochastic order.

Keywords: Archimedean copula, Proportional odds model, Majorization, Usual stochastic order.

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The most Tsallis entropy copula

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Abstract

Maximum entropy distribution is can be estimated based on some proper intended constraints. It is unbiased and unique on some constraints and is used to find out the distribution of data. Entropy principle can be added to copula concept to approximate the distribution of the multivariate dependence data set. In this article, we would like to discuss on copula maximum Tsallis and Shannon entropy based on known Spearman's rho as an extra constraint.

Keywords: Copula entropy, Most entropic copula, Tsallis entropy, Dependence.

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Modeling ALAE data with copulas and bivariate phase-type distributions

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Abstract

Insurance products are issued to policyholders to transfer risks from the policyholders to the insurers. The insured people usually receive the amount of the claim and the insurer pays more. Any claim cost usually consists of at least two elements: the LOSS which is paid directly to the insured people and ALAE (allocated loss adjustment expenses) which covers expenses attributed to the settlement of individual claims such as claim investigation expenses. In pricing of insurance products both elements should be taken into account. In this talk, by using a real data set from car insurance industry, we will apply dependence models such as copula and bivariate phase-type distributions to model the LOSS and ALAE elements together. After a comparison between the model, we will use the quantile regression to predict the ALAE given the LOSS element.

Keywords: ALAE data, Copula, Bivariate phase-type, Dependence, Quantile regression.

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Analysis of dependent risk models based on Sarmanov copula

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Abstract

This paper extend the compound Poisson risk model to consider the distribution of the maximum surplus before failure when the claim amounts and claim inter-arrival times are dependent via a Sarmanov copula. We obtain integro-differential equation for this distribution which satisfies integro-differential equation in the state of independence and dependence via Farlie-Gumbel-Morgenstern (FGM) copula.

Keywords: Risk models, Sarmanov copula, Distribution of them maximum surplus.

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Joint modelling of longitudinal and survival data using copulas

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Abstract

In this study, joint modelling of two longitudinal and survival sub models have been considered. We utilize two student-t and Gaussian copulas for joint modelling of these submodels. The parameter of these sub models under the main joint model is estimated using maximizing likelihood estimation method. Finally, from a simulation strategy, the performance of this model is indicated.

Keywords: Copula, Joint Modelling, Longitudinal, Submodel, Survival.

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Analysis of spatial point pattern data using pair copulas

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Abstract

Copula function is a powerful tool for modelling the structural dependency of correlated continuous data. Dependent count discrete data arise in some area of spatial point pattern processes, which the counts are affected by the distance to some especial focus. For analysis of these points it is necessary to find the correlation structure of counts and the distances to the special focuses. In this talk, by implementing the introducing of some events around to the especial focuses and identifying the properties of valid spatial point pattern copulas, the count-distance based data are modelled. Next, the proposed models were applied to predict the number of rats and cockroaches in some parts of Madrid. Afterwards, based on pair copula construction, the trivariate distribution for the number of rats, cockroaches and distances to focuses was constructed to predict the counts of events given by the other variables.

Keywords: Spatial point pattern, Pair copula, Count-distance copula.

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Discrete bivariate distributions generated by copulas: DBEEW distribution

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Abstract

In this paper, we shall propose a general method of generating discrete bivariate distributions using copulas. The advantage of our method is that, contrary to the standard methods, we do not need to have the joint distribution of the base variables, we need the marginals only. In particular, we shall concentrate on generating a new discrete bivariate exponentiated extended Weibull (DBEEW) by a Cuardas-Auge copula. An advantage of this family of copulas is that they are exchangeable and, thus, can cover exchangeable random vectors which are widely used in Engineering fields.

Keywords: Cuardas-Auge copulas, Discrete bivariate distribution, Probability generating function.

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Joint modeling of correlated responses in insurance data based on Gaussian copula

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Abstract

This paper is concerned with the analysis of correlated responses in insurance data. A Gaussian copula-based regression model is proposed that accounts for associations between the number of automobile and third party claims. Our approach entails specifying underlying latent variables for the responses to indicate the latent mechanisms which generate the count variables. Full likelihood-based inference method is applied for estimation for parametric models to obtain maximum likelihood estimates of the parameters. To illustrate the utility of the models, the proposed methodology is illustrated using some simulation insurance data, with two correlated responses, the count responses of the number of automobile and third party claims. The effect of the risk factor on both responses are also investigated.

Keywords: The number of claims, Gaussian copula, Latent variable, Insurance data, Correlated responses.

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Comparison three moment methods of parameter estimation for FGM copula in presence of outlier

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Abstract

Paying attention to copulas for estimating the dependency parameters, have become popular in recent decades. Various methods of estimation for dependency parameter of copula in presence of outliers are considered in this paper. We only consider the methods based on moment, which named moment, copula moment and mixture methods. However, moment method of estimation is an ancient method, but we sometime face limitations. One of these limitations is that the boards of parameter/parameters may be changed; and this causes the obtained value of estimation to become non-suitable. Thus, two other methods of estimation are considered, which are related to moment. The results show that when we use copula moment and mixture methods for copulas in presence of outliers, the obtained MSEs are smaller. Also, copula moment is the best estimator based on MSE.

Keywords: Bivariate copula, Outlier, Moment method, Copula moment, Mixture, Estimation, Uniform distribution, FGM copula.

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