Joint PhD Colloquium in Statistics and Stochastics

University of Bremen,
Paris Lodron University of Salzburg,
Carl von Ossietzky University, Oldenburg

September 20-21, 2021

Welcome

Dear attendees!

Welcome to the sixth joint PhD Colloquium in Statistics and Stochastics of the Center for Statistics in Oldenburg and Bremen (ZeSOB). The scope of this colloquium is to bring together PhD students from the Northern German universities in the mentioned fields of study and to foster discussions among you both on topics of your research and on general PhD related questions. Moreover, the opportunity to present your results in an extended format of approximately 40 minutes (plus discussion) allows the colleagues from other places to get a deeper insight into current research of the other groups, and will hopefully give you valuable feedback for your work on top of your advisors'.
The principal investigators of the ZeSOB are grateful to the working groups of Prof. Arne Bathke and Prof. Wolfgang Trutschnig from Paris Lodron University of Salzburg who kindly agreed to our invitation to be our guests for this year's PhD Colloquium.

Speakers

Solveig Flaig, Oldenburg University
Florian Griessenberger, Paris Lodron University of Salzburg
Anh-Tuan Hoang, University of Bremen
Julian Jetses, Oldenburg University
Thimo Kasper, Paris Lodron University of Salzburg
Christina Kranzinger, Paris Lodron University of Salzburg
Jannes Tjark Rastedt, Oldenburg University
Pascal Rink, University of Bremen
Marco Tschimpke, Paris Lodron University of Salzburg
Vladimir Vutov, University of Bremen

Principal Investigators of the ZeSOB

Werner Brannath, University of Bremen
Marcus C. Christiansen, Oldenburg University
Thorsten Dickhaus, University of Bremen
Gero Junike, Oldenburg University
Angelika May, Oldenburg University
Peter Ruckdeschel, Oldenburg University

ZOOM credentials

For Monday morning (until the lunch break), September 20:

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Thema: Joint PhD Colloquium in Statistics and Stochastics, Part I
Uhrzeit: 20.Sept..2021 08:15 AM Amsterdam, Berlin, Rom, Stockholm, Wien

Zoom-Meeting beitreten
https://uni-bremen.zoom.us/j/99615686847?pwd=Rlh1ejlFZFp3N0ZWcWswSjJPZXVvQT09

Meeting-ID: 996 1568 6847
Kenncode: 862511
Schnelleinwahl mobil
+496950500952,,99615686847#,,,,*862511# Deutschland
+496950502596,,99615686847#,,,,*862511# Deutschland

Einwahl nach aktuellem Standort
        +49 69 5050 0952 Deutschland
        +49 695 050 2596 Deutschland
        +49 69 7104 9922 Deutschland
        +49 69 3807 9883 Deutschland
        +49 69 3807 9884 Deutschland
        +49 69 5050 0951 Deutschland
        +43 670 309 0165 Oesterreich
        +43 72 011 5988 Oesterreich
        +43 120 609 3072 Oesterreich
        +43 12 535 501 Oesterreich
        +43 12 535 502 Oesterreich
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Kenncode: 862511
Ortseinwahl suchen: https://uni-bremen.zoom.us/u/aejzaeSkVB

Ueber SIP beitreten
99615686847@zoomcrc.com

Ueber H.323 beitreten
162.255.37.11 (USA
 Westen)
162.255.36.11 (USA
 Osten)
213.19.144.110 (Amsterdam
 Niederlande)
213.244.140.110 (Deutschland)
Kenncode: 862511
Meeting-ID: 996 1568 6847
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For Monday afternoon (after the lunch break), September 20:

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Thema: Joint PhD Colloquium in Statistics and Stochastics, Part II
Uhrzeit: 20.Sept..2021 01:00 PM Amsterdam, Berlin, Rom, Stockholm, Wien

Zoom-Meeting beitreten
https://uni-bremen.zoom.us/j/97281231482?pwd=UW9UUnNwMlpUYk5qTnczanBnaWI3QT09

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Kenncode: 420625
Schnelleinwahl mobil
+496950502596,,97281231482#,,,,*420625# Deutschland
+496971049922,,97281231482#,,,,*420625# Deutschland

Einwahl nach aktuellem Standort
        +49 695 050 2596 Deutschland
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        +49 69 3807 9884 Deutschland
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        +49 69 5050 0952 Deutschland
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Kenncode: 420625
Ortseinwahl suchen: https://uni-bremen.zoom.us/u/auXmQytYH

Ueber SIP beitreten
97281231482@zoomcrc.com

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162.255.37.11 (USA
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 Osten)
213.19.144.110 (Amsterdam
 Niederlande)
213.244.140.110 (Deutschland)
Kenncode: 420625
Meeting-ID: 972 8123 1482
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For Tuesday, September 21:

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Thema: Joint PhD Colloquium in Statistics and Stochastics, Part III
Uhrzeit: 21.Sept..2021 08:30 AM Amsterdam, Berlin, Rom, Stockholm, Wien

Zoom-Meeting beitreten
https://uni-bremen.zoom.us/j/93690605579?pwd=NWlTSHpraUVuUUI2dEZ6c0YxZyt3UT09

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Kenncode: 168934
Schnelleinwahl mobil
+496938079884,,93690605579#,,,,*168934# Deutschland
+496950500951,,93690605579#,,,,*168934# Deutschland

Einwahl nach aktuellem Standort
        +49 69 3807 9884 Deutschland
        +49 69 5050 0951 Deutschland
        +49 69 5050 0952 Deutschland
        +49 695 050 2596 Deutschland
        +49 69 7104 9922 Deutschland
        +49 69 3807 9883 Deutschland
        +43 12 535 501 Oesterreich
        +43 12 535 502 Oesterreich
        +43 670 309 0165 Oesterreich
        +43 72 011 5988 Oesterreich
        +43 120 609 3072 Oesterreich
Meeting-ID: 936 9060 5579
Kenncode: 168934
Ortseinwahl suchen: https://uni-bremen.zoom.us/u/adYFhRYfe7

Ueber SIP beitreten
93690605579@zoomcrc.com

Ueber H.323 beitreten
162.255.37.11 (USA
 Westen)
162.255.36.11 (USA
 Osten)
213.19.144.110 (Amsterdam
 Niederlande)
213.244.140.110 (Deutschland)
Kenncode: 168934
Meeting-ID: 936 9060 5579
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Programme

Monday, September 20th, 2021

08:45 - 09:00 **Welcome**
— *Thorsten Dickhaus*, University of Bremen

Block 1: Risk Modeling
— Chair: *Arne Bathke*, Salzburg University

09:00 - 09:45 *Julian Jetses*, Oldenburg University:
Surplus participation in life insurance: A review and a look forward

09:45 - 10:30 *Solveig Flaig*, Oldenburg University:
GAN as an ESG for market risk modelling

10:30 - 10:45 Coffee Break

Block 2: Conditional Models
— Chair: *Peter Ruckdeschel*, Oldenburg University

10:45 - 11:30 *Anh-Tuan Hoang*, University of Bremen:
Multiple testing of partial conjunction null hypotheses with conditional p-values based on combination test statistics

11:30 - 12:15 *Thimo Kasper*, Salzburg University:
On weak conditional convergence of bivariate Archimedean and Extreme Value copulas, and consequences to nonparametric estimation

12:15 - 13:30 Lunch Break

Block 3: Classification
— Chair: *Wolfgang Trutschnig*, Salzburg University

13:30 - 14:15 *Christina Kranzinger*, Salzburg University:
Classification of human motion primitives in sports

14:15 - 15:00 *Pascal Rink*, University of Bremen:
MaxT Bootstrap Tilting Confidence Intervals

Tuesday, September 21st, 2021

Block 4: Dependence Estimation
— Chair: *Werner Brannath*, University of Bremen

09:00 - 09:45 *Florian Griessenberger*, Salzburg University:
Quantifying and estimating asymmetric dependence

09:45 - 10:30 *Vladimir Vutov*, University of Bremen:
Multiple two-sample testing under arbitrary correlation dependency with an application in imaging mass spectrometry

10:30 - 10:45 Coffee break

Block 5: Stochastic Processes
— Chair: *Gero Junike*, Oldenburg University

10:45 - 11:30 *Jannes Tjark Rastedt*, Oldenburg University:
Actuarial calculations for reserve-dependent payments in life insurance under information shrinkage

11:30 - 12:15 *Marco Tschimpke*, Salzburg University:
Markov product invariance in classes of bivariate copulas characterized by univariate functions

12:20 - 12:30 **Farewell**
— *Thorsten Dickhaus*, University of Bremen

Abstracts

Surplus participation in life insurance: A review and a look forward

Julian Jetses

Oldenburg University

09:00 - 09:45, Monday, September 20th, Block 1

In life and health insurance, the uncertain long-term development of economic and demographic factors (e.g. mortality rate, interest rate etc.) represents an undiversifable risk. In order to face that risk, long-term contracts include safety-loadings. As a consequence, systematic surplus arises. Due to legal restrictions (e.g. for German life annuities), this surplus has (at least partly) to be paid out to the policyholder. The talk reviews the existing literature on the calculation of surplus decompositions in multi-state models. While current concepts are largely built upon heuristic arguments, we argue for a more general surplus decomposition principle that allows for the determination of risk contributions in a broad range of models.

GAN as an ESG for market risk modelling

Solveig Flaig

Oldenburg University

09:45 - 10:30, Monday, September 20th, Block 1

Insurance companies calculating the market risk under Solvency 2 with an internal model are obliged to generate scenarios how the financial market could behave. Traditionally, this is solved by using a Monte-Carlo simulation with financial mathematical models by an economic scenario generator (ESG). We present a Generative Adversarial Networks (GANs) as an alternative solution. In particular, we

- expand the existing approaches of scenario generation by a GAN to a complete risk calculation serving for Solvency 2 purposes
- develop new performance measures
- provide a consistent, data-driven framework for the evaluation of the scenario generation
- compare the results of a GAN-based ESG to the currently used ESG approach.

Multiple testing of partial conjunction null hypotheses with conditional p-values based on combination test statistics

Anh-Tuan Hoang

University of Bremen

10:45 - 11:30, Monday, September 20th, Block 2

We propose methods for multiple testing of partial conjunction null hypotheses which make use of conditional p-values based on combination test statistics. Specific examples comprise the Fisher combination function and the Stouffer combination function. The conditional validity of the corresponding p-values is proved under Gaussian shift models. By means of computer simulations and real data analyses, we compare the proposed methodology with other recent approaches. This is joint work with Ruth Heller and Thorsten Dickhaus.

On weak conditional convergence of bivariate Archimedean and Extreme Value copulas, and consequences to nonparametric estimation

Thimo Kasper

Salzburg University

11:30 - 12:15, Monday, September 20th, Block 2

Looking at bivariate copulas from the perspective of conditional distributions and considering weak convergence of almost all conditional distributions yields the notion of weak conditional convergence. At first glance, this notion of convergence for copulas might seem far too restrictive to be of any practical importance - in fact, given samples of a copula C the corresponding empirical copulas do not converge weakly conditional to C with probability one in general. Within the class of Archimedean copulas and the class of Extreme Value copulas, however, standard pointwise convergence and weak conditional convergence can even be proved to be equivalent. After proving these two main results and pointing out some consequences we sketch some implications for two recently introduced dependence measures and for the nonparametric estimation of Archimedean and Extreme Value copulas.

Classification of human motion primitives in sports

Christina Kranzinger

Salzburg University

13:30 - 14:15, Monday, September 20th, Block 3

Classifying human motion primitives is a common task in sports performance analysis or sports injury prevention. Researchers have applied machine learning algorithms in various sports disciplines. One concrete example is the classification of ski turns into one of four different skiing style techniques based on Inertial Measurement Units (IMU). The IMU systems record acceleration and rotational rate, which are characterized by a time-dependent data structure. A scoping review of 74 articles from 2010-2020 investigated the classification methods used in the existing literature and analysed whether the time-dependent data structure is considered in the classification process of human motion data in sports. It was found that when the time-dependent data structure is considered, the dependencies are incorporated in two ways. First, rolling windows in the feature calculation account for temporal information of the basic IMU data. Second, dependencies between individual motion primitives are taken into account by the models themselves, e.g. using long-short-term memory methods. Furthermore, the scoping review showed that different classification approaches can be distinguished: first, classical machine learning methods, such as Support Vector Machines, K-nearest-neighbours or Random Forests. Second, some authors developed threshold-based algorithms to classify the motion data into predefined groups. In addition, Dynamic Time Warping and cluster based approaches have also been used. Apart from these classification approaches, there is also the possibility to use the link between statistical tests and classification and to apply nonparametric classification methods for the classification of human motion primitives.

MaxT Bootstrap Tilting Confidence Intervals

Pascal Rink

University of Bremen

14:15 - 15:00, Monday, September 20th, Block 3

In order to perform model selection and to assess the selected model's ability to predict future outcomes (conditional on the available data), data splitting is a well-established approach to avoid selection bias and to be able to estimate valid confidence bounds, e.g. for the accuracy of a classifier. Typically, a split into three parts is necessary to do so: a training set to train a (huge) number of competing models, a validation set to pick the most promising model amongst them, and an evaluation set to get an unbiased estimate of a confidence interval for the conditional prediction accuracy. Using a combination of bootstrap tilting and the maxT statistics, we are able to account for the present multiplicity and to enlarge either the training set or the validation set. This can lead to more accurate prediction models and shorter confidence intervals for the

conditional accuracy. I will present aspects of this idea for a classification problem in a $k >> n$ scenario.

Quantifying and estimating asymmetric dependence

Florian Griessenberger

Salzburg University

09:00 - 09:45, Tuesday, September 21st, Block 4

Commonly used measures of dependence considered in the literature like Pearson correlation, Spearman rank correlation or Schweitzer and Wolff's σ are symmetric, i.e. they assign each pair of random variables (X, Y) the same dependence as they assign the pair (Y, X). Since dependence structures are in general not symmetric (in contrast to independence, which is a symmetric concept), classical methods fail to detect asymmetry in dependence. In the R-package qad (short for quantification of asymmetric dependence) a strongly consistent estimator of a copula-based, directed dependence measure ζ_1, introduced in 2010, has been developed which aims at detecting asymmetries in bivariate samples.
The main objectives of the talk are to sketch the idea underlying the copula-based dependence measure, to present the most relevant mathematical properties of the underlying estimator and to illustrate its capabilities by some examples.

Multiple two-sample testing under arbitrary correlation dependency with an application in imaging mass spectrometry

Vladimir Vutov

University of Bremen

09:45 - 10:30, Tuesday, September 21st, Block 4

Large-scale hypothesis testing has become an essential problem in high-dimensional statistical inference. In imaging mass spectrometry (IMS) association studies, a large number of statistical tests are performed simultaneously in order to identify molecular masses that are associated with a particular cancer subtype. A promising technology that acquires spatially resolved mass spectral information is Matrix-assisted laser desorption/ionization (MALDI) imaging mass spectrometry, also known as MALDI Imaging. A common MALDI Imaging dataset contains a huge amount of spectra (observational units, usually 5,000-50,000), and a great number of predictors correspond to mass-to-charge (m/z) values (which refer to molecular masses). Hence, a captivating challenge is to extract biologically meaningful information out of the spectral data. We restate the biological question of the association between molecular masses and the binary outcome (two cancer subtypes) by testing multiple hypotheses. Concretely, we have developed a technique to control the false discovery proportion (FDP) under arbitrary correlation dependency among test statistics. To this end, taking explicitly into consideration the correlation effects can increase the power of the multiple test. This talk will delineate an inferential procedure for testing multiple two-sample tests under arbitrary correlation dependency.

Furthermore, a practical application of the proposed workflow to MALDI-IMS data will be demonstrated. This is joint work with Thorsten Dickhaus.

Actuarial calculations for reserve-dependent payments in life insurance under information shrinkage

Jannes Tjark Rastedt

Oldenburg University

10:45 - 11:30, Tuesday, September 21st, Block 5

In life insurance, the discounted cumulative future payments of an insurance contract are of central interest, but they are usually unknown at present. Given the available information, conditional expectations are considered instead, enabling the insurer to calculate the so-called prospective reserve.
We extend the insurance model by considering insurance payments that depend non-linearly on the prospective reserve, as well as allowing for non-monotone and restricted information structures.
In contrary to the existing literature, where a filtered probability space and application of martingale theory are central to showing existence and uniqueness of solutions to the corresponding BSDE formulation of the prospective reserve, we cannot rely on these methods under information shrinkage.
In my talk, I use the fixed-point theorem to show existence and uniqueness of the non-adapted payment process itself, before extending the results to the prospective reserve. Finally, some exemplary insurance contracts are presented.

Markov product invariance in classes of bivariate copulas characterized by univariate functions

Marco Tschimpke

Salzburg University

11:30 - 12:15, Tuesday, September 21st, Block 5

We extend and sharpen some results in the literature concerning the notion of Markov product idempotence in some well-known classes of copulas. Focusing on families of copulas which are characterized by univariate functions we show that in the class of extreme-value copulas, in the class of diagonal copulas and in some special class of copulas represented by measure-preserving transformations only the usual suspects (if contained in the class) are idempotent, namely the product copula Π and minimum copula M. Additionally, we prove a conjecture going back to Albanese and Sempi in 2016 saying that the only idempotent Archimedean copula is the product copula Π.

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Participants

Bathke, Arne	Paris Lodron University of Salzburg	Arne.Bathke@plus.ac.at
Brannath, Werner	University of Bremen, Institute for Statistics	brannath@math.uni-bremen.de
Christiansen, Marcus C.	Oldenburg University, Institute for Mathematics	marcus.christiansen@uni-oldenburg.de
Dickhaus, Thorsten	University of Bremen, Institute for Statistics	dickhaus@uni-bremen.de
Flaig, Solveig	Oldenburg University, Institute for Mathematics	solveig.flaig@deutscherueck.de
Griessenberger, Florian	Paris Lodron University of Salzburg	florian.griessenberger@plus.ac.at
Hoang, Anh-Tuan	University of Bremen, Institute for Statistics	anhtuan.hoang@uni-bremen.de
Jetses, Julian	Oldenburg University, Institute for Mathematics	julian.jetses@uni-oldenburg.de
Junike, Gero	Oldenburg University, Institute for Mathematics	gero.junike@uni-oldenburg.de
Kasper, Thimo	Paris Lodron University of Salzburg	thimo.kasper@plus.ac.at
Kranzinger, Christina	Paris Lodron University of Salzburg	christina.kranzinger@salzburgresearch.at
May, Angelika	Oldenburg University, Institute for Mathematics	angelika.may@uni-oldenburg.de
Rastedt, Jannes Tjark	Oldenburg University, Institute for Mathematics	jannes.tjark.rastedt@uni-oldenburg.de
Rink, Pascal	University of Bremen, Institute for Statistics	p.rink@uni-bremen.de
Ruckdeschel, Peter	Oldenburg University, Institute for Mathematics	peter.ruckdeschel@uni-oldenburg.de
Trutschnig, Wolfgang	Paris Lodron University of Salzburg	Wolfgang.Trutschnig@plus.ac.at
Tschimpke, Marco	Paris Lodron University of Salzburg	marco.tschimpke@plus.ac.at
Vutov, Vladimir	University of Bremen, Institute for Statistics	vladimir.vutov@uni-bremen.de