Institute of Medical Informatics, Biometry, and Epidemiology

Chair of Medical Biometry and Epidemiology

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Research focus
• Computational biostatistics
• Statistical analysis of infectious disease spread
• Dermatoepidemiology
• Cooperative epidemiological and clinical studies

Structure of the Chair

Professorships: 2
Personnel: 17
• Scientists: 10 (thereof funded externally: 5)
• Graduate students: 5

Research

The focus of the Chair's scientific activity is on three distinct areas: Methods development in the realm of machine learning (Computational Biostatistics), statistical modelling of infectious diseases, and dermato-epidemiological research, respectively. Moreover, the Chair cooperates with numerous research projects addressing different topics with different departments or institutes. Usually, the Chair is responsible for statistical aspects of study design and analysis.

Computational biostatistics
PI: PD Dr. W. Adler, Prof. Dr. O. Gefeller, Dr. B. Hofner, Dr. A. Mayr, Dr. E. Waldmann
The statistical analysis of high-dimensional data containing large numbers of features has become increasingly important in biomedical practice. Consequently, statistical methods for analyzing data with complex dependency patterns and for separating informative features from non-informative ones are needed. Boosting is a promising statistical method to address these issues. The project focuses on improving and developing boosting methodology for data structures that cannot yet be analyzed with the

help of classical boosting techniques. For example, classical boosting methods were further extended to generalized additive models for location, scale, and shape (GAMLSS). GAMLSS is a popular statistical approach for simultaneously modeling multiple parameters of a response distribution in regression models. Current fitting procedures for GAMLSS are infeasible for high-dimensional data setups and require heuristic (or potentially biased) feature selection methods. The new algorithm allows for simultaneous estimation of predictor effects and feature selection in GAMLSS. In the course of the project, boosting methods were further analyzed with regard to their general performance as optimization method for AUC-based performance criteria in classification and survival analysis. Furthermore, boosting methods are developed and evaluated which target the analysis of so-called joint models, addressing modeling of two related outcome variables, one a time-to-event-component, the other a longitudinally observed outcome, related by a parameter of association.

Statistical analysis of infectious disease spread
PI: Dr. S. Meyer
Infectious pathogens such as influenza and noro viruses cause epidemics. Public health surveillance records age-structured and spatial data on the occurrence of notifiable infectious diseases; in Germany, this is handled by the Robert Koch Institute. Based on such surveillance data, statistical models enable probabilistic forecasts of key figures relevant to public health authorities, eg. the incidence or peak week of the epidemic. A particular scientific focus was to investigate proper scoring rules for such probabilistic forecasts. Furthermore, epidemic models can support the understanding of disease spread, for example to estimate the impact of environmental or socioeconomic factors and vaccination coverage on disease dynamics. For this purpose, we have developed specialized regression models and associated statistical software, which has already been employed also by other epidemiological research groups. We are working on extensions of these methods for multidimensional time series of proportions, for example, regionally stratified consultation rates of influenza-like illness or influenza-attributable hospitalization rates in different age groups. Moreover, we evaluate statistical models for point processes, which allow for a more detailed picture of epidemic spread given individual-level surveillance data. Cooperation has been established with the Robert Koch Institute and the Bavarian Of-

fice for Health and Food Safety. All methodological developments are implemented in open-source research software to facilitate scientific progress and broad application in epidemiological research.
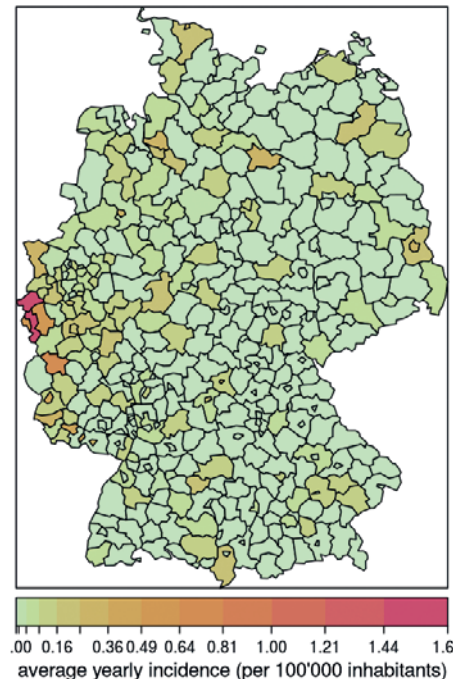
Spatial distribution of 336 cases of invasive meningococcal disease caused by the most common bacterial finetype (B:P1.7-2,4:F1-5) in Germany, 2002 - 2008 (Adapted from: Meyer S et al. J Stat Soft. 2017)

Dermatoepidemiology
PI: Prof. Dr. A. Pfahlberg, Prof. Dr. W. Uter
In clinical contact allergy research, a close cooperation with the German contact dermatitis group (DKG) e.V. and the multi-centric project information network of departments of dermatology (IVDK), maintained by an institute at the University of Göttingen, has been established. Pooled data collected in the participating allergy departments are analyzed in terms of contact allergy surveillance, i.e. early detection of trends in contact allergy (increase, possibly in particular subgroups) and for quality control purposes. Additionally, research projects prompt special analyses, for instance sensitization to common biocides and fragrances. Moreover, the network European Surveillance System on Contact Allergies – Data Centre (ESSCA-DC) has been collecting and analyzing such data on a European level since 2002, with the data center located at the Chair of Medical Biometry and Epidemiology.
The epidemiology of malignant melanoma and acquired melanocytic nevi is a further research

interest: Acquired melanocytic nevi, surrogate or potential precursor of malignant melanoma, are addressed by the current MONA-study which includes standardized assessment of student cohorts. Currently, results of two surveys ("Erlking Sun 2015", "Francis" from 2016) addressing knowledge on prevention of UV exposure in kindergarten staff and actual protective measures (shading etc.) in the institutions are being analyzed with the aim of identifying targets of improvement of primary prevention.

Cooperative epidemiological and clinical studies

This area of activity comprises diverse research topics addressed in cooperation with different departments and institutes. Usually, biometrical aspects of study design and statistical analysis have been performed by the Chair in these cooperative projects. The most important projects in the reporting period include:

- Studies in cooperation with the Chair of Psychiatry and Psychotherapy concerning non-pharmacological interventions for dementia (DeTa-MAKS, Senior-Go)
- A multi-centric European studying on "Accelerated Partial Breast Irradiation" and a controlled clinical trial on radiochemotherapy in patients with locally advanced head/neck tumors stage III and IVA-B (PACCIS) and radiochemotherapy after induction chemotherapy with gemcitabine and FOLFIRINOX, resp. (CONKO-007 study), all chaired by the Department of Radiation Oncology
- The research network PRO PRICARE (compare own report) targeting the identification of unnecessary diagnostic and therapeutic interventions, their causes, and possible strategies for a future reduction of such measures. The Chair is involved in a sub-project addressing so-called cascade effects and their causes in thyroid disease
- A European multicenter study "SCOPE" ("Screening for Chronic Kidney Disease among Older People across Europe") in cooperation with the Institute for Biomedicine of Aging
- The transsectoral TIGER Study assessing daily home support of elderly patients by "pathfinders" to reduce re-admission rates after discharge from inpatient treatment
- The ANFOLKI-36 study, which examines the effects of general anesthesia in children on their cognitive function, in cooperation with the Department of Anesthesiology and the Chair of Medical Informatics

Teaching

The Chair of Medical Biometry and Epidemiology contributes to curricular teaching in terms of mandatory and optional courses in Medicine, Molecular Medicine, medical technology and Medical Process Management. Concerning interdisciplinary teaching, the cooperation in the context of "Querschnittsbereich I" with the Chair of Medical Informatics and the Institute and Outpatient Clinic of Occupational, Social, and Environmental Medicine is of note.
The Chair supervises Bachelor's and Master's theses as well as MD and PhD doctoral theses.

Selected publications

Fiessler C, Pfahlberg AB, Keller AK, Radespiel-Tröger M, Uter W, Gefeller O. Association between month of birth and melanoma risk: fact or fiction? Int J Epidemiol. 2017, Apr 1;46(2):686-693

Meyer S, Held L, Höhle M. Spatio-Temporal Analysis of Epidemic Phenomena Using the R Package surveillance. J Stat Soft. 2017; 77: 11

Uter W et al. European Surveillance System on Contact Allergies (ESSCA): results with the European baseline series, 2013/14. J Eur Acad Dermatol Venereol. 2017 Sep;31(9): 1516-1525

Mayr A, Weinhold L, Hofner B, Titze S, Gefeller O, Schmid M. The betaboost package-a software tool for modelling bounded outcome variables in potentially high-dimensional epidemiological data. Int J Epidemiol. 2018, Oct 1;47(5):1383-1388

Schäfer R et al. Quality-of-life results for accelerated partial breast irradiation with interstitial brachytherapy versus whole-breast irradiation in early breast cancer after breast-conserving surgery (GEC-ESTRO): 5-year results of a randomized, phase 3 trial. Lancet Oncol. 2018 Jun;19(6):834-844

Uter W, Wolter J. Nickel and cobalt release from earrings and piercing jewellery - analytical results of a German survey in 2014. Contact Dermatitis. 2018 May;78(5):321-328

International cooperations

Multicentric:

Prof. C. Lidén, Prof. J.D. Johansen, Prof. C. M. Bonefeld, Dr. I. R. White, Prof. J.-P. Lepoittevin

Karolinska Institutet, Copenhagen University, Kings College London, Université de Strasbourg

Stockholm, Copenhagen, London, Strasbourg

Sweden, Denmark, UK, France