Biometry: Peter Martus works at the interface of mathematics and medicine

It’s not computer science, but it’s close to data: Prof. Dr. Peter Martus has an in-depth knowledge of how professional biotechnology and medical statistics are generated. Prof. Martus works at the University of Tübingen where he brings his know-how to clinical trials as well as working on life sciences projects where statistical issues need to be resolved.

Biometric applications are increasingly becoming part of everyday life. Biometric IDs, where personal details are stored on a chip, are a prominent example of this development. Modern passport photos provide biometric data for recognition purposes. The storage of fingerprints on the passport security chip is another example, which for the time being remains voluntary in Germany. The chips are scanned automatically at points of entry, and the details matched with information stored in a database.

In addition to digitally scanning the physiological characteristics of individuals as a means of identification, biometry can also be the application of statistical and mathematical methods in biology, i.e. biostatistics, a scientific branch that is Prof. Dr. Peter Martus’ major focus. Biostatistics should not be mistaken for bio- and medical informatics. The researcher explains the differences: “Bioinformatics is the development of methods and software tools for analysing gene expression and mass spectrometry data, for example; medical informatics deals, amongst other things, with devices and methods required for electronic health records and the analysis of images produced with imaging methods. In contrast, we apply statistical methods for the analysis of data and for designing and evaluating clinical trials.”

Prof. Dr. Peter Martus has been head of the Institute for Clinical Epidemiology and Applied Biometry at the University of Tübingen for around two years now. Although his PhD thesis on game theory and ergodic theory at the University of Erlangen involved some statistics, he became interested in the topic in more detail when medical issues came to the fore. Martus joined what is now the Institute of Medical Informatics, Biometry and Epidemiology at the University of Erlangen, where he habilitated in 1995. “I was looking for a way to carry on working with mathematical models, but did not want to continue solely focusing on theoretical mathematics,” says Martus. He soon realised that biostatistics was a field he really enjoyed, particularly due to its challenging position at the interface of medicine and mathematics. “Two different ways of thinking come together; on the one hand, the field of medicine, which is based on quite pragmatic issues, and on the other, the field of mathematics, which is more theoretical. As the two fields are so different, it is necessary to communicate and cooperate effectively. And this is something that I have enjoyed
from the word go,” says the researcher.

At the University of Erlangen, one of the projects that Martus was involved in was a DFG-sponsored ophthalmological collaborative research centre that dealt with the early detection and prognosis of glaucomas. Glaucoma is an eye disease that is very difficult to detect in its early stages, which makes the statistical evaluation of the diagnosis rather difficult.

Martus uses a simple example to show the pitfalls a statistician can be faced with: “When we collect data of paired organs such as the eye, you might think that this gives dual precision.
However, this is not the case. The interior eye pressure, for example, barely differs between an individual’s eyes. However, information about the eye pressure of two different people is able to provide a much better statistical estimate about eye pressure variability in the population.” Since there is a likelihood that every measurement series might contain mistakes, biostatisticians always need to work out the true differences between individuals or identify measurement mistakes.

Placing decisions on reliable statistical foundations

After a short professional ‘stop-over’ at the University of Mainz where Martus worked as a lecturer for six years, he moved on to the Charité Hospital in Berlin in 2001. He initially headed up a department at the Institute for Biometry and Clinical Epidemiology, and was later promoted to become institute director. Martus still works in collaboration with the team in Berlin. In Tübingen, he has gone back to ophthalmology and his cooperation partners include ophthalmology professors Prof. Marius Ueffing, Prof. Ulrich Bartz-Schmidt and Prof. Eberhart Zrenner. In addition, Martus has connections with many other medical departments in Tübingen, including the departments of virology, neurology, radiotherapy, psychiatry and occupational medicine. He is also planning to expand his network in the future. In theory, he can work with partners in all life sciences areas.

As far as his institute’s cooperations with other institutes are concerned, Martus distinguishes three stages. The first stage involves free consultations on statistical issues for all employees of the University and University Hospital of Tübingen. “For example, we can help scientists to define variables and select samples and we also provide advice on which statistical methods are best suited for a specific project,” says Martus. In stage two, we work with our partners to publish the findings obtained: “Our institute is actively involved in the analyses and our work secures the quality of the joint projects.” In stage three, the team carries out cooperative projects with its partners, for example clinical trials in which Martus’ team is involved from the very beginning.

“There is a similar process for all three stages. However, as the projects progress the workload increases and becomes more time-consuming. Clinical trials involve individual tasks, all of which are aimed at assessing the consistency of the trial. In all cases, the issue in question needs to be formulated as precisely as possible in order to make statistical evaluation possible. We ask questions and, if necessary, decide on which methods are best suited for measuring a certain parameter,” says Martus explaining how a typical cooperative project runs. Another important concern is whether a particular method is already established or whether a trial is focused on evaluating a certain method. “We always deal with the integrated consideration of several variables at any one time. This involves content-related analysis as well as the mathematical analysis of correlations,” says Martus.

Biometric challenge: the correct assessment of long-term randomised trial

Randomisation is of central importance in clinical trials and is often a major challenge. Biometricians help investigators choose the most suitable randomisation technique and sometimes provide expert help over a period of many years. At present, Martus’ team is part of an oncological trial that is aiming to identify the most suitable therapies for treating the early stages of prostate cancer. The large-scale randomised trial is sponsored by German Cancer Aid and other organisations and involves around 7,600 patients who will be monitored for a period of up to 17 years. The Department of Urology of the University Hospital of Tübingen is also participating in this trial.
Four therapy options are recommended for treating localised prostate cancer with a low and early intermediary risk: radical prostatectomy, i.e. the complete removal of the prostate, percutaneous irradiation, permanent seed implantation and active surveillance. The latter involves taking biopsies at regular intervals as the basis for deciding which of the three other therapies needs to be applied,” says Martus. Martus and his team are in charge of data management and statistical analyses. Martus is also a member of the steering committee and is involved in trial decisions.

Martus believes that the recruitment of patients who agree to be randomly placed into one of the four study groups is not the only problem faced by clinical trials. “Some patients actively support this procedure and fully understand it. They totally take on board the fact that trials need to be randomised,” says Martus. However, the long duration of the trial can make analysis somewhat difficult. Some patients might switch from one group to the other; other patients might drop out and the schedule of follow-up investigations may also need to be changed. The biostatisticians

An example of the application of biometry in the field of occupational medicine: The factor structure of the work ability index (WAI) is used to construct a self-assessment of employees and their work capacity. © Martus, University of Tübingen
need to take all these potential setbacks into account. The objective of the trials is not only to find a significant yes or no answer as to why a certain therapy is to be applied. Martus explains: “Our aim is to structure the chaos in a positive way, enabling the use of clear statistical methods which allow reliable statements to be made. We therefore also design prognostic models based on clinical data and related to patient populations.”

Further information:

Prof. Dr. Peter Martus
Institute for Clinical Epidemiology and Applied Biometry (IKEaB)
University of Tübingen
Silcherstr. 5
72076 Tübingen
E-mail: peter.martus(at)med.uni-tuebingen.de
Tel.: +49 (0)7071/29-86829

The article is part of the following dossiers

- Data mining: new opportunities for medicine and public health