TECHNISCHE UNIVERSITÄT
CHEMNITZ

Fakultät für Mathematik
Chemnitzer Mathematisches Colloquium

In der Reihe „Chemnitzer Mathematisches Colloquium“ der Fakultät für Mathematik der TU Chemnitz spricht

Herr Prof. Dr. Tim Sullivan (Freie Universität Berlin)

über das Thema

Mathematical Analysis of Statistical Inference and Why it Matters.

Der Vortrag findet am

**Donnerstag, dem 4. Mai 2017, um 16.00 Uhr im Raum B202,
Reichenhainer Straße 70**

statt.

Ich möchte Sie hiermit recht herzlich zu dieser Veranstaltung einladen. Das Kolloquium wird von Herrn Prof. Oliver Ernst geleitet.

Abstract:
Modern scientific inference rests on the three pillars of experimentation, theory, and computation — the third of which has assumed increasing prominence in the last 75 years since the invention of the programmable multi-purpose electronic computer. Data and predictions from these three sources are integrated using the mathematical procedures of statistical inference, which themselves often involve huge computational tasks far removed from the simple pen-and-paper calculations of centuries ago. Nowadays scientists are faced with huge amounts of data (the much-hyped "big data"phenomenon), though much of these data are imperfect, and often wish to make predictions about high-dimensional or continuum quantities (such as when meteorologists predict tomorrow's worldwide temperature and wind velocity fields). Statistical procedures are increasingly favoured because they promise not just single solutions but also predictions with quantified levels of uncertainty. Given the high stakes involved in many applications, ensuring the integrity of the inference procedure — all the way from data and theory to final conclusions — is essential.

However, for a thorough understanding of the validity of scientific predictions that are obtained in this way, one must consider not just the provenance and quality of data, but even the stability and well-posedness of the underlying mathematical procedures. Are they fundamentally robust, or inescapably sensitive, to mild changes in the problem setup? For example, when reconstructing a hospital patient's bone structure from a CT scan, does the reconstructed image get "better"(or at least not "worse") if one uses more pixels or voxels in the reconstruction? Without such guarantees, even with high-quality data, we run the risk of arriving at faulty conclusions because of fundamental limitations of the inference procedure as implemented.

Drawing upon the traditions of numerical analysis and robust inference, mathematical analysis has a great deal to say about these questions, especially so in the modern settings of near-continuum data and parameters. This talk will outline some of the ways in which mathematicians address the well-posedness of scientific statistical inference in terms of deterministic and Bayesian inverse problems; it will explain some of the positive results that have been established, and how they lead to the design of better computational algorithms, and also some of the negative results, which demonstrate fundamental limitations on the reach of statistical inference..

Prof. Dr. Christoph Helmberg
Dekan