Course in fall 2018:

**Algebraic Statistics**

Wednesday 10^{15} – 11^{45}, C 015 and friday 10^{15} – 11^{45}, A 1.01,
Exercises wednesday 12^{00} – 13^{30}, C 015

Algebraic statistics uses methods from algebraic geometry to solve statistical problems. This course will address mainly two such problems: How to find all possible models that can be identified using a given sample, and how to compute probabilities from contingency tables.

Most of the relevant algorithms come from computer algebra; therefore the course will start with an introduction to the relevant topics. The most important is the Gröbner base of an ideal, a technique introduced around 1965 in order to solve systems of nonlinear equations. Samples will be considered as solutions of such systems, and via Gröbner bases it will be possible to identify all models that can be estimated from the sample.

For contingency tables, the $\chi^2$ distribution can estimate probabilities, provided there are sufficiently many cases. Otherwise methods like Fisher’s exact test can be used, but they are computationally very expensive. Algebraic statistics gives a new approach based on so-called Markov bases.

**Prerequisites:** Lineare algebra, probability and statistics

**References:**

DAVID A. COX, JOHN LITTLE, DONAL O’SHEA: Ideals, Varieties, and Algorithms – An Introduction to Computational Algebraic Geometry and Commutative Algebra, *Springer* 42015 *(available also electronically inside the network of Mannheim university)*


MATHIAS DRTON, BERND STURMFELS, SETH SULLIVANT: Lectures on Algebraic Statistics, *Birkhäuser* 2009

For a first overview the following article (also available online) can be useful: