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SS 2017

Seminar
Statistics of Non-Euclidean Data

In this seminar we will discuss approaches to probability theory and statistics for data that are not Euclidean, i.e., for data that cannot be represented as elements of \mathbb{R}^n . If the data live in a metric space, a natural question is how one defines a mean. The Fréchet mean (also called barycenter) gives one possible answer: it defines the mean of elements of a metric space as the value that minimizes the sum of squared distances to these elements. Based on this notion of mean, one can try to reproduce results and statistical methods from the Euclidean case in more abstract settings. In this seminar we want to present the basic concepts needed for probability theory in metric spaces, explore some resulting propositions and implications thereof, and see how these can be used for statistics.

The seminar is directed to Master students who want to specialize in statistics. The language of the seminar will be English. The seminar will take place as a block seminar. If you are interested in participating in this seminar, please contact Christof Schötz for further information (schoetz@math.uni-heidelberg.de).

Preliminary discussion: 25.04.2017, 15:00, Mathematikon, Room 414, 4th floor

Block Seminar: 02.06.2017, 09:15 – 17:00 (with breaks), Mathematikon, Room 414, ~~4th floor~~ **2nd floor**

References:

- [1] Martial Agueh and Guillaume Carlier. Barycenters in the Wasserstein space. *SIAM J. Math. Analysis*, 43(2):904–924, 2011.
- [2] Es-Sahib Aziz and Heinrich Henri. *Barycentre canonique pour un espace métrique à courbure négative*, pages 355–370. Springer Berlin Heidelberg, 1999.

- [3] Jérémie Bigot, Raúl Gouet, Thierry Klein, and Alfredo López. Geodesic PCA in the Wasserstein space by convex PCA. *Annales de l'Institut Henri Poincaré B: Probability and Statistics*. to be published.
- [4] Sébastien Gadat, Ioana Gavra, and Laurent Risser. How to calculate the barycenter of a weighted graph. TSE Working Papers 16-652, Toulouse School of Economics (TSE), 2016.
- [5] Thibaut Le Gouic and Jean-Michel Loubes. *Barycenter in Wasserstein Spaces: Existence and Consistency*, pages 104–108. Springer International Publishing, Cham, 2015.
- [6] Jean Picard. Stochastic calculus and martingales on trees. *Annales de l'Institut Henri Poincaré (B) Probability and Statistics*, 41(4):631 – 683, 2005.
- [7] Karl-Theodor Sturm. Nonlinear martingale theory for processes with values in metric spaces of nonpositive curvature. *Ann. Probab.*, 30(3):1195–1222, 07 2002.
- [8] Karl-Theodor Sturm. Probability measures on metric spaces of nonpositive curvature. In *Heat kernels and analysis on manifolds, graphs, and metric spaces (Paris, 2002)*, volume 338 of *Contemp. Math.*, pages 357–390. Amer. Math. Soc., Providence, RI, 2003.