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THE UNIVERSITY OF BRITISH COLUMBIA

Department of Statistics
Website : www.stat.ubc.ca

3182 Earth Sciences Bldg
2207 Main Mall
Vancouver, BC V6T 1Z4

Telephone: (604)822-0570
Facsimile: (604) 822-6960

STAT 547Q, Special Topics

Gaussian and Empirical Process Theory for High-dimensional Data

2023, Term 2 (Approximate)

Instructor: Alexander Giessing, Ph.D.

Acting Assistant Professor
Department of Statistics
University of Washington

Time and Place: To be finalized. March 27, 2023 - June 9, 2023, On Zoom

Description: In this course we develop elements of the theory of Gaussian and empirical processes that have proved useful for statistical inference in high-dimensional models, i.e. statistical models in which the number of parameters is much larger than the sample size. The course consists of three parts, with the first two parts laying the foundation for the third one: an introduction to modern techniques in Gaussian processes, a recap of classical empirical process theory emphasizing weak convergence on metric spaces, and lastly, a discussion of Gaussian approximation, high-dimensional CLTs, and the conditional multiplier bootstrap. Typed lecture notes of all three parts will be provided.

Prerequisites: The course assumes that the students have taken PhD level classes in advanced theoretical statistics comparable to STAT 581, 582, 583 at University of Washington (see also https://www.washington.edu/students/crscat/stat.html). Knowledge of measure theoretic probability will be helpful, too. UBC remark: our Stat 560, 561 and 547C are necessary and likely not sufficient.

Textbook/course material:

Dudley, R. M. (2014). "Uniform Central Limit Theorems". Cambridge University Press.

Giné, E. and Nickl, R. (2016). "Mathematical Foundations of Infinite-Dimensional Statistical Models". Cambridge University Press.

van der Vaart, A. and Wellner, J. (1996). "Weak Convergence and Empirical Processes". Springer.

Typed lecture notes of all three parts will be provided**.**

Evaluation:

There will be regular homework assignments (at least 4) and an oral examination (details will be announced in class and will depend on the class size).

Topics:

1) Elements of Gaussian processes (concentration, comparison, anti-concentration, and super-concentration inequalities, Talagrand's Generic chaining bounds).

2) Elements of empirical processes (convergence of laws on separable metric spaces, Glivenko-Cantelli and Donsker theorems under metric and bracketing entropy conditions, applications to bootstrap).

3) A selection of theoretical problems in high-dimensional inference (focusing on but not limited to Gaussian approximation, high-dimensional CLTs, and multiplier bootstrap when function classes are not Donsker).