SYLLABUS FOR M7251 – HIGH-DIMENSIONAL PROBABILITY (GRADUATE)

Course Number and Name: Math 7251, graduate course in High-dimensional Probability, Spring 2024.

Course website: All the relevant information will be posted on the course webpage: https://glivshyts6.math.gatech.edu/HDP-course.html.

Lecture: MW 9:30-10:45am, Skiles 006. In extreme circumstances one may alternatively attend online: https://gatech.zoom.us/j/96455139758, but students are generally expected to attend in-person.

Instructor: Galyna Livshyts; office: Skiles 108C; e-mail: glivshyts6@math.gatech.edu.

Office hours: Friday 9-11am online via Zoom: https://gatech.zoom.us/j/96635274506 or in-person by appointment.

Prerequisite: Recommended: Math 6337 (Measure and integration theory); Math 6241 (Probability I).

Recommended textbooks and resources: the resources topic by topic are listed on the class schedule: https://glivshyts6.math.gatech.edu/HDP-schedule.pdf. Here is also a more detailed list of relevant books and lecture notes:

1. Vershynin, High-Dimensional Probability, 2018.
2. Bakry, Ledoux, Gentil, Analysis and Geometry of Markov Diffusion Operators, 2014.
3. Figalli, Glaudo, An Invitation to Optimal Transport, Wasserstein Distances, and Gradient Flows.
4. Klartag, Lecture notes in Convex Localization and Optimal Transport.
5. Van Handel, Lecture notes in High-dimensional Probability.
6. Artstein-Avidan, Giannopoulos, Milman, Asymptotic Geometric Analysis part 2, 2022.
7. Artstein-Avidan, Giannopoulos, Milman, Asymptotic Geometric Analysis part 1, 2015.
8. Bobkov, Chistyakov, Gotze, Concentration and Gaussian Approximation for randomized sums, 2023.
9. Bogachev, Gaussian measures, 1998.
10. Milman, Schechtman, Asymptotic Theory of Finite-Dimensional Normed Spaces, 1986.

11. Pisier, The Volume of Convex Bodies and Banach Space Geometry, 1989.
12. Brazitikos, Giannopoulos, Valettas, Vritsiou, Geometry of Isotropic Convex Bodies, 2014.
13. Ledoux, The Concentration of Measure Phenomenon, 2001.
14. Villani, Topics in Optimal Transportation, 2003.

Homework: The problems will appear here throughout the semester, please keep checking the file for new problems (although you will be notified when some new problems appear): https://glivshyts6.math.gatech.edu/HDP-HW.pdf.

Important dates: Last day to make schedule changes – January 12 by 4pm
Last day to withdraw with W – March 13 by 4pm

Grading: The grade for this class will be based on a) completing 7 points from the home works https://glivshyts6.math.gatech.edu/HDP-HW.pdf (therefore, the majority of the problems will be optional); b) scribing for at least 1 lecture (2 would be preferred). An additional lecture scribed will count as an extra point (and may replace a home work problem). Here is scribing sign up link.

The letter grades will be based on the standard cut offs: A 90-100%, B 80-89%, C 70-79%, D 60-69%, F 0-59%.

Attendance and electronics: You are expected to attend all the classes and to arrive on time. Please be respectful of your peers and keep your phones in silent regime and out of reach during class unless it is a serious emergency.

Academic Honesty: All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Dean of Students.

Learning outcomes: Bernstein inequality and applications, Azuma's inequality, Khinchin inequality, applications to random matrices, Concentration of measure via independence, Gaussian random processes and related inequalities for their suprema, Convex Localization method, Four function theorem and applications, Mass transport and isoperimetric-type inequality, Semigroup

method, Brunn-Minkowski inequality via localization, Prekopa-Leindler inequality via Mass transport, Isoperimetric inequality, Ehrhard inequality via Semigroups, Bobkov's inequality via semigroups, Gaussian isoperimetric inequality via Bobkov, Log-Sobolev inequality via semigroups, Concentration of measure, Poincare inequality and Payne-Weinberger's theorem, Gaussian Poincare inequality via semigroups, Rough KLS bound via localization, TBD.

Material covered: https://glivshyts6.math.gatech.edu/HDP-schedule.pdf

Remarks: This syllabus is a subject to minor changes during the semester.