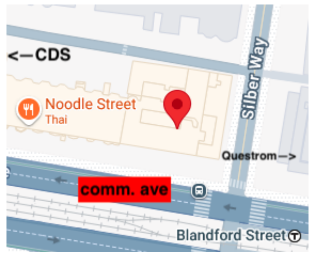
CASMA 884 topic course in

Gaussian analysis with applications (2025 Fall)
(Preliminary syllabus)

• **Instructor**: Dr. Guangqu Zheng (email: GZHENG90@bu.edu; Office: CCDS 429)

• **Basic info**: Classes on Tuesdays/Thursdays **11AM–12:15PM** at **WED-212** (2 Silber Way)



- Lecture notes will be provided before each class, while students are encouraged to read (some of) the following books/references:
  (1) D. Nualart, *The Malliavin Calculus and Related Topics*, 2nd ed., 2006
  (2) D. Nualart and E. Nualart, *Introduction to Malliavin calculus*, 2018
  (3) I. Nourdin and G. Peccati, *Normal Approximations with Malliavin Calculus*, 2012.
  (4) I. Nourdin, *Lectures on Gaussian approximations with Malliavin calculus*, arXiv:1203.4147
  (5) D. Khoshnevisan, *Analysis of Stochastic Partial Differential Equations*, CBMS book, 2014.
  (6) N. Ross, *Fundamentals of Stein's method*, arXiv:1109.1880
  (7) other research papers will be assigned for reading
- Office hours: Tuesdays **1–2:15 PM** & Thursdays **10:00-10:45 AM**;
  or email me for an appointment.

• **Course Description:** One of the course's main goals is to get students exposed to various Gaussian objects that have been central in the probability theory and its applications. For example, the Gaussian (or normal) distribution appears in the classical central limit theorem as the universal law to describe the fluctuation of sample mean statistics as the sample size tends to infinity. The Brownian motion, as the most famous example of Gaussian processes, was first used to describe the physical phenomenon of a random motion of particles suspended in a fluid (e.g., water), and later found great applications in financial mathematics, engineering, physics, etc. The space-time (Gaussian) white noises, is one of the most important noises used to model the random force posed on a system (that is described by a partial differential equation). The resulting equation is called a stochastic partial differential equation (SPDE). The course aims at familiarizing students with these standard Gaussian objects, while equipping students with several powerful tools including Wiener chaos expansion, Malliavin calculus, Stein's method, etc.

• **Course Prerequisites:** The course will be largely self-contained, accessible to a broad audience and a revision to the basic tools from probability, stochastic analysis that are needed, will be given. However, students are expected to have the knowledge equivalent to undergraduate-level analysis, probability, stochastic processes, and differential equations. Functional analysis and graduate-level probability will be helpful but NOT necessary.

• **Assessment and grading:** there would be no exams or tests for this course. After each class meeting, there would be relevant problems added into a PDF file on blackboard (preliminary name for this PDF = SolveME.pdf). Students need to find problems they find challenging to work on, and submit their solutions with enough details. (≤ 4 submissions in total)