

Matrix Analysis

with Applications in Quantum Information Theory

Bruno Nachtergaele

Course description:

The course will cover a number of fundamental topics in advanced linear algebra and matrix analysis including the following: norms on matrix spaces, positivity and order structures, convexity, matrix inequalities, and variational principles. The selection of topics will be guided by important applications in quantum information theory, quantum probability, and quantum physics, such as entropies and related inequalities, completely positive maps, quantum channel capacities, Perron-Frobenius results for quantum channels, spectral gap and log-Sobolev inequalities and more.

Prerequisites:

Basic linear algebra and finite-dimensional analysis.

Reading materials:

The textbook by Rajendra Bhatia, *Matrix Analysis* (Springer GTM 169), is a fundamental reference (pdf available from the library) supplemented by additional literature and instructor's notes. In particular, I will distribute chapters in manuscript form of the forthcoming book by Eric Carlen on *Inequalities in Matrix Algebras*.

A list of lecture topics and readings will be made available throughout the quarter.

Class schedule:

The course is scheduled for MWF 11:00-11:50am.

Homework:

Homework problem sets will be posted on Canvas (but no homework will be collected).

Grading:

Grades will be based on a written report or an oral presentation summarizing the reading of one or more research paper(s) or book chapters. Students will be asked to choose from a list of proposed topics. Alternatively, you can submit written solutions to a sufficient subset of the assigned problem sets. A final exam based on problems discussed in the courses will be given to any student who requests it.