Spectral analysis of inhomogeneous network models

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Stellingen

behorende bij het proefschrift

Spectral Analysis of Inhomogeneous Network Models

van

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1. A random matrix model can have entries that have an infinite variance, but a limiting spectral distribution that has a finite variance. In particular, the free convolution of a semicircle law and a heavy-tailed law with finite mean has finite variance.

   [Chapter 3]

2. For the scale-free percolation model in the dense regime, the underlying geometry of the graph plays no role in the limiting spectral law of its adjacency and Laplacian matrices.

   [Chapter 3, Chapter 4]

3. If an adjacency matrix can be Gaussianised without its limiting spectral distribution being affected in probability, then the limiting spectral distribution in general must be an operator-valued semicircle law.

   [Chapter 3]

4. Many different sparse random graph models have the same limiting spectral distribution independently of the connection probability. This fact is particularly useful when models that do not fall under a chosen theoretical framework can be related to those that do.

   [Chapter 2]

5. It is well-known that the sum of N i.i.d. Bernoulli random variables distributed as $\mathrm{Ber}(\lambda/N)$, for some parameter λ, scales to a Poisson random variable $\mathrm{Poi}(\lambda)$. When λ becomes large as well, the Poisson random variable after centring and scaling converges to a Gaussian random variable. This feature also manifests itself in the scaling limit of empirical measures of eigenvalues of random matrices.

   [Chapter 2]

6. Abstraction is a fundamental strength of mathematics, and opens doors to the study of complex systems. The theory of free probability abstracts from the notion of an underlying sample space and forms a framework to study random matrices and random operators.
7. Random matrix theory blends various topics in analysis, combinatorics, random graph theory, and free probability, with each approach offering new insights.
8. Linear algebra is ubiquitous in mathematics. The Hoffman-Wielandt inequality, the Perron-Frobenius theorem, and the interlacing theorem are some of the most powerful results in the analysis of limiting spectral distributions of random matrix models.
9. Maya Angelou: *"If you're always trying to be normal, you will never know how amazing you can be."* On the other hand, the Dutch saying *"doe normaal"* reminds us to stay grounded. Perhaps the sweet spot lies in between, and finding that spot is essentially finding yourself.
10. Change is inevitable, but goes hand-in-hand with adaptability. One may move halfway across the world and accept noon as lunchtime, but one may still not accept sandwiches as a proper lunch.
11. Master Oogway: *"You are too concerned with what was, and what will be."* Writing a mathematical proof involves focusing on the present step rather than worrying too much about the assumptions made or about the potential challenges one might encounter. This philosophy can be hard to implement in life, but it encourages living in the moment.

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