MA844 Advanced Data Science
Assignment 1

Due: On or before 27 March 2021, 11.59 PM

Write Answers to all questions neatly and in detail. Also do not forget to write your name and roll number.

1. State and prove Markov's inequality
2. State and prove Chebyshev's inequality
3. State and prove the law of large numbers
4. Show that most of the volume of the unit ball in $\mathbb{R}^d$ is contained in an annulus of width $O\left(\frac{1}{d}\right)$ near the boundary if d is large.
5. Derive the formulas for the volume and surface area of the unit ball in $\mathbb{R}^d$ and show that both $\to 0$ as $d \to \infty$.
6. Show that the most of the volume of the unit ball in $\mathbb{R}^d$ is near the equator if d is large.
7. State and prove Gaussian annulus theorem.
8. Explain in detail the random projection theorem
9. Explain the statement and proof of the Johnson-Lindenstrauss lemma
10. Derive in detail the algorithm for separating points from two Gaussians in $\mathbb{R}^d$ if d is large by computing the pairwise distances between the points.

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