A Word from the Editor

The editorial board of the *Mathematics Exchange* is delighted to present our latest issue, comprising nine captivating articles that explore a diverse array of mathematical topics tailored for a broad undergraduate audience. We extend our sincere appreciation to the authors for their dedicated efforts in sharing their new discoveries, inspiring, and motivating our readers to immerse themselves in the world of mathematics. We trust that you will find this collection to be a rewarding culmination of their scholarly endeavors.

The Law of Small Numbers states the convergence of the Binomial distribution to the Poisson distribution. The inaugural article vividly illustrates this law. Specifically, utilizing the programming language R, the authors delve into the total variation distance between these two distributions.

While the classification of semi-simple Lie algebras was resolved over a century ago, the challenge of categorizing solvable Lie algebras remains open, particularly in higher dimensions. The second article contributes to this ongoing discourse by delving into the classification of solvable Lie algebras in the dimension seven setting, building upon the established classifications in dimensions six and lower.

The third article offers a novel and concise proof of the well-known fact that the set of monomial matrices forms a subgroup of invertible matrices. The work not only addresses a well-known fact but also fills a gap in the literature by providing a readily available proof. In addition, the authors establish the simple yet profound result that the inverse of a nonnegative matrix is nonnegative if and only if the matrix is monomial.

Article four introduces an engaging exploration of the classic combinatorial game Cram, featuring rectangular polyominoes rather than the conventional 1×2 dominoes. This article exemplifies the discovery of innovative results by posing insightful questions, relying on elementary arguments and leveraging symmetry to articulate winning strategies. The findings may inspire further exploration of the subject with different polyominoes.

The fifth article investigates level sets of real-valued continuous functions on closed intervals, inspired by the intermediate value theorem. This inquiry delves into the behavior of functions whose endpoints converge to the same real number, providing valuable insights into the structure of these sets.

Turning to the realm of signal processing, the sixth article focuses on Independent Component Analysis (ICA) as a blind-source separation method. Specifically, it explores how ICA handles over-complete data, demonstrating its ability to consistently

group sources with similar spatial maps in the presence of three sinusoidal sources and two sensors.

The seventh article delves into the Riemann Zeta function, a captivating infinite converging sum of powers of natural numbers. The authors present various irrationality proofs, with a specific focus on demonstrating the irrationality of certain values of the Zeta function.

In the eighth article, the authors generalize a result by Mortini and Rupp, offering insights into the Cauchy transform of the complex power function. Employing limits and a contour technique, they navigate around branch cuts, introducing a novel approach utilizing hyperbolic geometric functions. This paper enriches our understanding of integrating over curves with multi-functions and establishes connections to solutions of differential equations, particularly those involving the hypergeometric function.

The final article introduces a matrix iteration framework to study the Mandelbrot set and filled Julia sets. By employing a sequence of affine transformations, the authors establish an alternate form of iteration by complex polynomials. This framework enables the verification of membership in the Mandelbrot set and filled Julia sets, demonstrating that boundedness in the operator norm corresponds to belonging to these sets.

We trust that you will find this issue of the *Mathematics Exchange* to be a source of intellectual enrichment and inspiration. As always, we eagerly welcome and encourage your ideas on how we can continue to enhance our service to our valued readers.

Yayuan Xiao

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