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Abstract

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6. Conclusions and open problems

Acknowledgements

References

Figures and tables

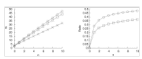


Table 1

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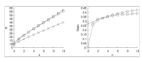
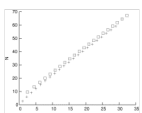
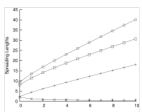
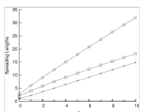


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Direct spreading measures of Laguerre polynomials

P. Sánchez-Moreno^{a, c,}, D. Manzano^{b, c,}, J.S. Dehesa^{b, c,}[Show more](#)

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Abstract

The direct spreading measures of the Laguerre polynomials $L_n^{(\alpha)}(x)$, which quantify the distribution of its Rakhmanov probability density $\rho_{n,\alpha}(x) = \frac{1}{d_n^2} x^\alpha e^{-x} [L_n^{(\alpha)}(x)]^2$ along the positive real line in various complementary and qualitatively different ways, are investigated. These measures include the familiar root-mean square or standard deviation and the information-theoretic lengths of Fisher, Renyi and Shannon types. The Fisher length is explicitly given. The Renyi length of order q (such that $2q \in \mathbb{N}$) is also found in terms of (n, α) by means of two error-free computing approaches; one makes use of the Lauricella function $F_A^{(2q+1)}\left(\frac{1}{q}, \dots, \frac{1}{q}; 1\right)$, which is based on the Srivastava–Niukkanen linearization relation of Laguerre polynomials, and another one utilizes the multivariate Bell polynomials of Combinatorics. The Shannon length cannot be exactly calculated because of its logarithmic-functional form, but its asymptotics is provided and sharp bounds are obtained by the use of an information-theoretic optimization procedure. Finally, all these spreading measures are mutually compared and computationally analyzed; in particular, it is found that the apparent quasilinear relation between the Shannon length and the standard deviation becomes rigorously linear only asymptotically (i.e. for $n \gg 1$).

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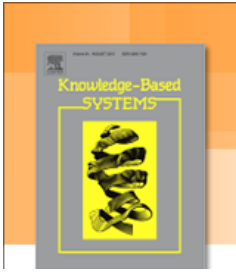
33C45; 94A17; 62B10; 65C60

Keywords

Orthogonal polynomials; Laguerre polynomials; Spreading lengths; Computation of information measures; Shannon entropy; Renyi entropy; Fisher information; Bell polynomials; Lauricella functions

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