

TOEPLITZ DETERMINANTS AND LOGARITHMIC COEFFICIENTS FOR A SUBCLASS OF STARLIKE FUNCTIONS

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ABSTRACT. The paper mainly investigates the initial coefficients for the subclasses of starlike functions defined by using the Sine function involving α ($0 \leq \alpha < 1$). We obtain upper bounds for the second and third Toeplitz determinants whose elements are the initial coefficients. Also, we obtain upper bounds of initial logarithmic coefficients for the subclass of starlike functions of order α which are connected with the sine function. Parts of the results we obtained generalized and improved previous work.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest, regarding the publication of this paper.

DATA AVAILABILITY STATEMENT

The authors declare that this research is purely theoretical and does not associate with any data.

REFERENCES

- [1] O. P. Ahuja, K. Khatter and V. Ravichandran, *Toeplitz determinants associated with Ma-Minda classes of starlike and convex functions*. Iran. J. Sci. Technol. Trans. A Sci. **45** (2021), no. 6, 2021–2027.
- [2] V. Allu, A. Lecko and D. K. Thomas, *Hankel, Toeplitz, and Hermitian-Toeplitz determinants for certain close-to-convex functions*. *Mediterr. J. Math.* **19** (2022), no. 1, Paper No. 22, 17 pp.
- [3] M. F. Ali, D. K. Thomas and A. Vasudevarao, *Toeplitz determinants whose elements are the coefficients of analytic and univalent functions*. *Bull. Aust. Math. Soc.* **97** (2018), no. 2, 253–264.
- [4] M. F. Ali and A. Vasudevarao, *On logarithmic coefficients of some close-to-convex functions*. *Proc. Amer. Math. Soc.* **146** (2018), no. 3, 1131–1142.

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- [5] N. E. Cho, B. Kowalczyk, O. S. Kwon, A. Lecko and Y. J. Sim, *On the third logarithmic coefficient in some subclasses of close-to-convex functions*. Rev. R. Acad. Cienc. Exactas Fís. Nat. Ser. A Mat. RACSAM **114** (2020), no. 2, Paper No. 52, 14 pp.
- [6] N. E. Cho, V. Kumar, S. S. Kumar and V. Ravichandran, *Radius problems for starlike functions associated with the sine function*. Bull. Iranian Math. Soc. **45** (2019), no. 1, 213–232.
- [7] P. Duren, *Univalent functions*, Springer-Verlag, New York Inc. 1983.
- [8] I. Efraimidis, *A generalization of Livingston's coefficient inequalities for functions with positive real part*. J. Math. Anal. Appl. **435** (2016), no. 1, 369–379.
- [9] A. Futa, M. Jastrzębska and P. Zaprawa, *Bounds of the third and the fourth logarithmic coefficients for close-to-convex functions*. Proc. Rom. Acad. Ser. A Math. Phys. Tech. Sci. Inf. Sci. **24** (2023), no. 3, 203–214.
- [10] S. Kazimoğlu, E. Deniz and H. M. Srivastava, *Sharp coefficients bounds for starlike functions associated with Gregory coefficients*. Complex Anal. Oper. Theory **18** (2024), no. 1, Paper No. 6, 19 pp.
- [11] B. Khan, I. Aldawish, S. Araci and M. G. Khan, *Third Hankel determinant for the logarithmic coefficients of starlike functions associated with sine function*. Fractal and Fractional **6** 2022, no. 5, 261.
- [12] B. Kowalczyk and A. Lecko, *Second Hankel determinant of logarithmic coefficients of convex and starlike functions*. Bull. Aust. Math. Soc. **105** (2022), no. 3, 458–467.
- [13] B. Kowalczyk and A. Lecko, *The second Hankel determinant of the logarithmic coefficients of strongly starlike and strongly convex functions*. Rev. R. Acad. Cienc. Exactas Fís. Nat. Ser. A Mat. RACSAM **117** (2023), no. 2, Paper No. 91, 13 pp.
- [14] R. J. Libera and E. J. Zlotkiewicz, *Coefficient bounds for the inverse of a function with derivatives in P* , Proc. Amer. Math. Soc. **87** (1983), no. 2, 251–257.
- [15] R. J. Libera and E. J. Zlotkiewicz, *Early coefficients of the inverse of a regular convex function*, Proc. Amer. Math. Soc. **85** (1982), no. 2, 225–230.
- [16] M. Obradović, S. Ponnusamy and K.-J. Wirths, *Logarithmic coefficients and a coefficient conjecture for univalent functions*. Monatsh. Math. **185** (2018), no. 3, 489–501.
- [17] C. Pommerenke, *Univalent Functions*, Vandenhoeck & Ruprecht, Gottingen, 1975.
- [18] S. Ponnusamy, N. L. Sharma and K.-J. Wirths, *Logarithmic coefficients of the inverse of univalent functions*. Results Math. **73** (2018), no. 4, Paper No. 160, 20 pp.
- [19] S. Ponnusamy and T. Sugawa, *Sharp inequalities for logarithmic coefficients and their applications*. Bull. Sci. Math. **166** (2021), Paper No. 102931, 23 pp.
- [20] H. Tang, H. M. Srivastava, S. H. Li and G. T. Deng, *Majorization results for subclasses of starlike functions based on the sine and cosine functions*. Bull. Iranian Math. Soc. **46** (2020), no. 2, 381–388.
- [21] D. K. Thomas, *On the logarithmic coefficients of close to convex functions*. Proc. Amer. Math. Soc. **144** (2016), no. 4, 1681–1687.
- [22] D. R. Wang, H. Y. Huang and B. Y. Long, *Coefficient problems for subclasses of close-to-star functions*. Iran. J. Sci. Technol. Trans. A Sci. **45** (2021), no. 3, 1071–1077.
- [23] Z. G. Wang, M. Hussain and X. Y. Wang, *On sharp solutions to majorization and Fekete-Szegő problems for starlike functions*. Miskolc Math. Notes **24** (2023), no. 2, 1003–1019.
- [24] H. Y. Zhang, R. Srivastava and H. Tang, *Third-order Hankel and Toeplitz determinants for starlike functions connected with the sine function*. Mathematics **7** 2019, no. 5, 404.
- [25] H. Y. Zhang and H. Tang, *Fourth Toeplitz determinants for starlike functions defined by using the sine function*. J. Funct. Spaces (2021), Art. ID 4103772, 7 pp.

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