

APPROXIMATION PROPERTIES OF CERTAIN BERNSTEIN–STANCU TYPE OPERATORS

ANA-MARIA ACU, OĞÜN DOĞRU, CARMEN VIOLETA MURARU AND
VOICHIȚA ADRIANA RADU

Abstract. In this paper we introduce and investigate a new operator of Bernstein-Stancu type, based on q -polynomials. We study approximation properties for these operators based on Korovkin type approximation theorem and study some direct theorems. Also, the study contains numerical considerations regarding the constructed operators based on Maple algorithms.

Mathematics subject classification (2010): 41A36, 41A25.

Keywords and phrases: Bernstein-Stancu operator, q -integers, rate of convergence, moduli of continuity.

REFERENCES

- [1] T. ACAR, A. ARAL, *On Pointwise Convergence of q -Bernstein Operators and Their q -Derivatives*, Numerical Functional Analysis and Optimization, 36(3), 2015, 287–304.
- [2] A.M. ACU, C.V. MURARU, V.A. RADU, F.D. SOFONEA, *Some approximation properties of a Durrmeyer variant of q -Bernstein-Schurer operators*, Mathematical Methods in Applied Science, 39(18), 2016, 5636–5650.
- [3] A.M. ACU, C.V. MURARU, V.A. RADU, *On the monotonicity of q -Schurer-Stancu type polynomials*, Miskolc Mathematical Notes, 19 (1), 2018, 19–28.
- [4] A.M. ACU, *Stancu-Schurer-Kantorovich operators based on q -integers*, Applied Mathematics and Computation, 259, 2015, 896–907.
- [5] A.M. ACU, D. BĂRBOSU, D.F. SOFONEA, *Note on a q -analogue of Stancu-Kantorovich operators*, Miskolc Mathematical Notes, 16 (1), 2015, 3–15.
- [6] A.M. ACU, P.N. AGRAWAL, TRAPTI NEER, *Approximation properties of the modified Stancu operators*, Numerical Functional Analysis and Optimization, 38 (3), 2017, 279–292.
- [7] O. AGRATINI, *On a q -analogue of Stancu operators*, Cent. Eur. J. Math, 8(1), 2010, 191–198.
- [8] R.P. AGARWAL, V. GUPTA, A.S. KUMAR, *On q -analogue of Bernstein-Schurer-Stancu operators*, Applied Mathematics and Computation, 219, 2013, 7754–7764.
- [9] P.N. AGRAWAL, A.M. ACU, M. SIDHARTH, *Approximation degree of a Kantorovich variant of Stancu operators based on Polya-Eggenberger distribution*, Revista de la Real Academia de Ciencias Exactas, Físicas y Naturales. Serie A. Matemáticas, 2017, <https://doi.org/10.1007/s13398-017-0461-0>
- [10] A. ARAL, V. GUPTA, R.P. AGARWAL, *Applications of q Calculus in Operator Theory*, Springer 2013, XII, 262 p.
- [11] V.A. CLECIU, *Bernstein-Stancu operators*, Studia Univ.Babes-Bolyai, Mathematica, 52 (4), 2007, 53–65.
- [12] V.A. CLECIU, *Approximation properties of a class of Bernstein-Stancu type operators*, Proceedings of the international conference NAAT, ed. O. Agratini, 2006, 171–178.
- [13] Z. DITZIAN, TOTIK, V., *Moduli of Smoothness*, Springer, New York, (1987).
- [14] O. DOĞRU, C. MURARU, *Statistical approximation by Stancu type bivariate generalization of Meyer-König and Zeller type operators*, Mathematical and Computer Modelling 48 (5), 2008, 961–968.
- [15] V. KAC, P. CHEUNG, *Quantum Calculus*, Universitext, Springer, 2002, 112 p.
- [16] A. KAJLA, N. ISPIR, P.N. AGRAWAL, M. GOYALA, *q -Bernstein -Schurer-Durrmeyer type operators for functions of one and two variables*, Applied Mathematics and Computation, 275, 2016, 372–385.

- [17] A. LUPAŞ, *A q -analogue of the Bernstein operator*, University of Cluj-Napoca, Seminar on Numerical and Statistical Calculus, Preprint 9, 1987, 85–92.
- [18] A. LUPAŞ, *q -analogue of Stancu operator*, Mathematical Analysis and Approximation Theory, 2002, 145–154.
- [19] T. NEER, A.M. ACU, P.N. AGRAWAL, *Bezier variant of genuine-Durrmeyer type operators based on Polya distribution*, Carpathian Journal of Mathematics, Vol. 33 (1), 2017, 73–86.
- [20] G. NOWAK, *Approximation properties for generalized q -Bernstein polynomials*, J. Math. Anal. Appl., 350, 2009, 50–55.
- [21] G. NOWAK, V. GUPTA, *The rate of pointwise approximation of positive linear operators based on q -integer*, Ukrainian Math. Journal, 63 (3), 2011, 403–415.
- [22] G.M. PHILLIPS, *On generalized Bernstein polynomials*, in D. F. Griffiths, G. A. Watson (Eds.), 1996, 263–269.
- [23] V.A. RADU, *Quantitative Estimates for Some Modified Bernstein-Stancu Operators*, Miskolc Math. Notes 19 (1), 2018, 517–525.
- [24] D.D. STANCU, *Approximation of functions by a new class of linear polynomial operators*, rev. Roum. Math. Pures Appl., 13, 1968, 1173–1194.