

MOVING AROUND THE SUMS OF ORTHOGONAL UNIT VECTORS

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Abstract. We discuss the extreme values of the sum of two Birkhoff orthogonal unit vectors in a normed space. In addition, we obtain some relationships between these values with some moduli of convexity and smoothness, as well as with the notions of uniform convexity or uniform non-squareness. Finally, we present some illustrative examples.

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REFERENCES

- [1] J. ALONSO, *Ortogonalidad en espacios normados*, Ph.D. thesis, Universidad de Extremadura, Badajoz, 1984.
- [2] J. ALONSO, A. ULLÁN, *Moduli in normed linear spaces and characterization of inner product spaces*, Arch. Math. **59**, 5 (1992), 487–495.
- [3] D. AMIR, *Characterizations of inner product spaces*, Operator Theory: Advances and Applications, vol. 20, Birkhäuser-Verlag, Basel, 1986.
- [4] M. BARONTI, P. L. PAPINI, *Convexity, smoothness and moduli*, Nonlinear Anal. **70**, 6 (2009), 2457–2465.
- [5] M. BARONTI, P. L. PAPINI, *Parameters in Banach spaces and orthogonality*, Constr. Math. Anal. **5**, 1 (2022), 37–45.
- [6] V. I. BERDYSHEV, *A relation between Jensen's inequality and a geometrical problem*, Math. Notes **3**, 1 (1968), 206–213.
- [7] M. M. DAY, *Reflexive Banach spaces not isomorphic to uniformly convex spaces*, Bull. Amer. Math. Soc. **47**, 1 (1941), 313–317.
- [8] D. DU, Y. LI, *Some moduli and inequalities related to Birkhoff orthogonality in Banach spaces*, Aust. J. Math. Anal. Appl. **20**, 1 (2023), Art. 2, 15 p.
- [9] K. GOEBEL, W. KIRK, *Topics in metric fixed point theory*, Cambridge Studies in Advanced Mathematics, vol. 28, Cambridge University Press, Cambridge, 1990.
- [10] G. IVANOV, H. MARTINI, *New moduli for Banach spaces*, Ann. Func. Anal. **8**, 3 (2017), 350–365.
- [11] J. L. JOLY, *Caractérisations d'espaces hilbertiens au moyen de la constante rectangle*, J. Approx. Theory **2**, 1 (1969), 301–311.
- [12] P. L. PAPINI, *Jung's constant and around*, Sem. Math. Louvain report **160**, N.S. (1989).
- [13] J. SIKORSKA, *Orthogonal stability of the Cauchy functional equation on balls in normed linear spaces*, Demonstratio Math. **37**, 3 (2004), 579–595.
- [14] A. ULLÁN DE CELIS, *Módulos de convexidad y lisura*, Ph.D. thesis, Universidad de Extremadura, Badajoz, 1991.