

## EQUIVALENCE OF THE HÖLDER–ROGERS AND MINKOWSKI INEQUALITIES

LECH MALIGRANDA

*Abstract.* It is well-known that the Hölder–Rogers inequality implies the Minkowski inequality. Infantozzi [6] observed implicitly and Royden [15] proved explicitly that the reverse implication is also true. In this note we discuss and give a new proof of this perhaps surprising fact.

*Mathematics subject classification (2000):* 26D15.

*Key words and phrases:* Hölder–Rogers inequality, Minkowski inequality, Bernoulli inequality, power means.

### REFERENCES

- [1] P. S. BULLEN, D. S. MITRINOVIĆ AND P. M. VASIĆ, *Means and Their Inequalities*, D. Reidel Publishing Company, Dordrecht, 1988.
- [2] S. B. CHAE, *Lebesgue Integration*, Springer Verlag, New York, 1995.
- [3] U. DUDLEY, *Real Analysis and Probability*, Wadsworth, 1989.
- [4] G. B. FOLLAND, *Real Analysis, Modern Techniques and Their Applications*, Wiley, New York, 1984.
- [5] G. H. HARDY, J. E. LITTLEWOOD AND G. PÓLYA, *Inequalities*, Cambridge Univ. Press, 1934.
- [6] C. A. INFANTOZZI, *An introduction to relations among inequalities*, Amer. Math. Soc. Meeting 700 Cleaveland, Ohio 1972; *Notices Amer. Math. Soc.* **14** (1972), A819–A820.
- [7] J. LINDENSTRAUSS AND L. TZAFRIRI, *Classical Banach Spaces II. Function Spaces*, Springer-Verlag, Berlin-Heidelberg-New York, 1979.
- [8] L. MALIGRANDA, *Why Hölder's inequality should be called Rogers' inequality*, *Math. Inequalities and Appl.* **1** (1998), 69–83.
- [9] L. MALIGRANDA AND L. E. PERSSON, *Generalized duality of some Banach function spaces*, *Indagationes Math.* **51** (1989), 323–338.
- [10] A. W. MARSHALL AND I. OLKIN, *Inequalities: Theory of Majorization and its Applications*, Academic Press, New York, 1979.
- [11] D. S. MITRINOVIĆ, *Analytic Inequalities*, Springer-Verlag, Berlin-Heidelberg-New York, 1970.
- [12] D. S. MITRINOVIĆ, J. E. PEČARIĆ AND A. M. FINK, *Classical and New Inequalities in Analysis*, Kluwer Academic Publ., Dordrecht, 1993.
- [13] F. RIESZ, *Untersuchungen über Systeme integrierbarer Funktionen*, *Math. Ann.* **69** (1910), 449–497.
- [14] F. RIESZ, *Les Systèmes D'équations Linéaires à Une Infinité D'inconnues*, Gauthier-Villars, Paris, 1913.
- [15] H. L. ROYDEN, *Real Analysis, Third Edition*, Macmillan Publishing Company, New York, 1988.