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Dedekind's Reciprocity Law -- The Probabilistic Way

Abstract for the Combinatorics and Number Theory Seminar 2001 May 1

The Dedekind sum is defined for relatively prime integers a and b as

$$s(a,b) = \sum_{k=1, \dots, b-1}^{(1) (2)},$$

where $(3) = x - [x] - 1/2$. This sum and its generalizations have intrigued mathematicians from various areas such as Number Theory, Topology, and Combinatorial Geometry since their introduction by Dedekind in 1892. The most fundamental theorem for the Dedekind sums was already proved by Dedekind: $s(a,b) + s(b,a) = -1/4 + 1/12 (a/b + 1/ab + b/a)$. There are several proofs of this reciprocity law in the literature. We will present one of the most recent ones, due to Dilcher and Girstmair, which is based on a certain equal distribution model. We will also show how their ideas can be generalized to a wider class of arithmetic sums.

¹⁾ ka/b

²⁾ k/b

³⁾ x

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Last update: **2020/01/29 19:03**

