The Relationship Between the Newcomb-Benford Law and the Distribution of Rational Numbers

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The Newcomb-Benford law, also known as Benford's law or the first-digit law, applies to many tabulated sets of real-world data. It states that the probability that the first significant digit is n, ($n \in \{1,2,3,4,5,6,7,8,9\}$) is given by $\log(1 + 1/n)$. The law has been verified empirically with widely differing data sets. In the present paper it is shown that it does not necessarily follow from the requirement of scale invariance alone, as has been claimed. This condition is necessary, but not sufficient. In addition, it is necessary to consider the properties of certain finite subsets of the set of rational numbers.

Key words: Newcomb; Benford; First Digit Law; Rational Numbers.