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An Introduction to Riemann Hypothesis

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Brief Report

The Riemann hypothesis is a fundamental mathematical hypothesis with far-reaching implications for the rest of mathematics. It's the foundation for many other mathematical principles, but no one knows for sure if it's correct. Its validity has become one of the most well-known open questions in mathematics. In mathematical publications, the Riemann hypothesis has a reputation for being cautiously noncommittal. Most authors that express an opinion, such as Riemann and Bombieri, imply that they believe it is accurate. Among the few authors who express real doubt about it are Ivi, who presents some reasons for scepticism, and Littlewood, who explicitly states that he feels it is false, that there is no proof for it, and that there is no possible reason it could be true.

According to the survey articles, the evidence for it is strong but not overwhelming, thus while it is probably true, there is reasonable doubt. The following are some of the arguments for and against the Riemann hypothesis, as presented by Sarnak, Conrey, and Ivi: There are various analogies to the Riemann hypothesis that have been verified. Deligne's proof of the Riemann hypothesis for varieties over finite fields is possibly the most persuasive theoretical argument in its favor. This supports the claim that all zeta functions associated with automorphic forms satisfy the Riemann hypothesis, which includes, for example, the classic Riemann hypothesis.

Selberg zeta functions, like the Riemann zeta function, fulfill the Riemann hypothesis's analogue and are similar to it in various ways, including a functional equation and an infinite product expansion equal to the Euler product expansion. However, there are several key differences, such as the fact that the Dirichlet series does not offer them. Sheats proved the Riemann hypothesis for the Goss zeta function. In contrast to these positive examples, other Epstein zeta functions do not fulfill the Riemann hypothesis despite having an infinite number of zeros on the critical line.

These functions, like the Riemann zeta function, have a Dirichlet series expansion and a functional equation, but they lack an Euler product and are unrelated to automorphic representations. The numerical verification that there are many zeros on the line looks to be important proof at first glance. However, many analytic number theory conjectures that were supported by substantial numerical data turned out to be incorrect. The first exception to a reasonable conjecture connected to the Riemann hypothesis is most likely about 10316; a counterexample to the Riemann hypothesis with an imaginary portion of this size would be far beyond anything yet computed using a direct technique.

The problem is that very slowly growing functions like log T, which go to infinity but do so slowly that computing cannot detect them, commonly impact behavior. Such functions are found in the zeta function theory, which governs the behavior of its zeros [1-5].

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