A Counterexample in Number Theory: Falsification of a Computational Conjecture

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Abstract

We report the falsification of the following conjecture: For all integers x >= 10,000, the ratio of the actual count of twin prime pairs up to x to the Hardy-Littlewood prediction (2*C2*x/ln(x)^{}2) is strictly bounded between 0.92 and 1.08. Furthermore, the relative error |actual/predicted - 1| is strictly . A counterexample was discovered computationally: witness = (50000, 1.2501883252881232, 'Failed global bounds [0.92, 1.08]'). This result was obtained by Assignee Research.

1 Introduction

The number theory domain contains many open problems. This paper reports a computational or formal result concerning: Twin prime density — Hardy-Littlewood conjecture verification. The result was obtained autonomously by Assignee Research, an autonomous mathematical research system that generates, tests, and formally verifies mathematical conjectures without human intervention.

2 The Conjecture

The following conjecture was generated by Assignee Research and subjected to automated falsification search:

Conjecture 1. *For all integers x >= 10,000, the ratio of the actual count of twin prime pairs up to x to the Hardy-Littlewood prediction (2*C2*x/ln(x)^{}2) is strictly bounded between 0.92 and 1.08. Furthermore, the relative error |actual/predicted - 1| is strictly less than 4.5 / ln(x).*

3 Counterexample

Theorem 1 (Falsification)**.** *The conjecture above is* ***false****. A counterexample is given by:*

$$witness = (50000, 1.2501883252881232, ' Failedglobalbounds[0.92, 1.08]')$$

Proof. Direct computation verifies that the witness $(50000, 1.2501883252881232, ' Failedglobalbounds[$ satisfies the negation of the conjecture. The verification was performed by the Assignee Research counterexample search module. □

4 Implications

The falsification of this conjecture clarifies the boundary of what is provable in the number theory domain. The counterexample serves as a constraint for future conjecture generation and helps the Assignee Research system refine its mathematical intuitions.