Mathematics > Number Theory

Modeling Convolutions of L-Functions

Steven J. Miller (Advisor), Ralph Morrison

(Submitted on 1 Nov 2010)

A number of mathematical methods have been shown to model the zeroes of L-functions with remarkable success, including the Ratios Conjecture and Random Matrix Theory. In order to understand the structure of convolutions of families of L-functions, we investigate how well these methods model the zeros of such functions. Our primary focus is the convolution of the L-function associated to Ramanujan's tau function with the family of quadratic Dirichlet L-functions, for which J.B. Conrey and N.C. Snaith computed the Ratios Conjecture's prediction. Our main result is performing the number theory calculations and verifying these predictions for the one-level density for suitably restricted test functions up to square-root error term. Unlike Random Matrix Theory, which only predicts the main term, the Ratios Conjecture detects the arithmetic of the family and makes detailed predictions about their dependence in the lower order terms. Interestingly, while Random Matrix Theory is frequently used to model behavior of L-functions (or at least the main terms), there has been little if any work on the analogue of convolving families of L-functions by convolving random matrix ensembles. We explore one possibility by considering Kronecker products; unfortunately, it appears that this is not the correct random matrix analogue to convolving families.

Comments: 55 Pages, 5 Figures
Subjects: **Number Theory (math.NT)**
Cite as: **arXiv:1011.0229v1 [math.NT]**

Submission history

From: Ralph Morrison [view email]
[v1] Mon, 1 Nov 2010 00:48:24 GMT (103kb,D)

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