Level Spacing and Random Matrices

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Over the summer, I got a taste of research by working on a summer project with Dr Nicholas Witte, from The University of Melbourne. The project was on random matrices, matrices where the elements are determined by an independent probability distribution.

I was looking at the probability distribution of the eigenvalues of these random matrices: if we find the eigenvalues of this matrix, how likely is it that an eigenvalue and the next highest one are a certain distance apart? My project was to try and get a better understanding of the probability curve, and hopefully come up with an equation for it in the process.

The work included a lot of scribbling on paper, finding a series solution for a rather nasty-looking differential equation, as well as some work with a computer algebra package; in my case it was Maple. Mostly it involved sitting and thinking: you have to come up with your own ideas, there are no answers in the back of the book to check any more!

This distribution turns up in a lot of other places, ranging from physics to number theory. In fact it describes the distribution of zeroes in the Riemann-Zeta function, and an accurate way of predicting where the zeroes lie could net you one of the Millennium Prizes and a cool million dollars!

The 6 weeks were very enjoyable, I got a taste of what research is like, and learnt some interesting mathematics along the way! I highly recommend it to everyone.