Log-normal distributions of neuronal responses and prime numbers through random matrix theory

During my MSc, I had an idea of using t-tests to select neurons responsive to stimuli, which would imply that neuronal responses followed a parametric distribution. The code I wrote, using t-tests, was able to select responsive neurons.

I also tried using t-tests on a small sample of prime numbers. That too returned a positive correlation. I was also able to obtain curves, showing a log-normal distribution for both these phenomena.

I am now looking to develop this further, and use Monte Carlo simulations to infer the statistical properties of neuronal responses and prime numbers. If successful, it would prove that both these are log-normal stochastic processes. The next step would be to look at both through the lens of random matrix theory.

The work on neurons relates to research carried out by Prof. Gyorgy Buzsaki, among others, who have given evidence for the log-normal distribution. Monte Carlo simulations could provide computational proof. This work could add to the growing support for the temporal coding theory. It could also contribute to our understanding of neural probe function and neural networks.

I also want to explore how the log-normal distribution of primes relates to the Erdos-Kac theorem, the prime number theorem and the work being done on gaps between primes.The distribution of prime numbers could possibly have implications for computational number theory and cryptography.

(code available here: https://github.com/sidkackar/MSc-code).