# Stochastic Analysis in Biomedical Engineering: Identifying Acute Myocardial Infarction

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Heart disease is the number one killer in the world. Every year, 720,000 heart attacks happen in the U.S. Despite medical technology advancing rapidly, medical science lags behind. This is because medical science still clings onto observational forms of analysis. The goal of this research project was to create a more accurate method of analyzing EKGs, through mathematics. Initially, Fractal Geometry, Lyapunov Exponents, t-Tests, and Fourier Series Analysis were all used, unsuccessfully, to classify EKGs. In order to make analysis faster, a roughly 600 line Computational Script was written, which calculated Amplitudes and Intervals of each EKG wave. This led to a shocking discovery. The distribution of each wave's amplitudes followed the 68-95-99.7 rule, implying a Normal Distribution. This inspired a new method of analysis, Brownian Motion. Using a Linear Stochastic Model, of the form Xt=a+dt+sBt, it was possible to calculate the exact probability of an EKG maintaining previously determined healthy parameters. It was found that any percentage value above 34.66% for the whole EKG indicated healthiness, while any value below 34.66% implied the presence of Acute Myocardial Infarction. When this new method was tested against the Traditional method, it was found to be significantly more accurate, correctly classifying a set of over 3,000 EKGs 97.5% of the time, while the Traditional Method only managed 85.3%. The new method was not only more accurate in practice, it was more precise and repeatable, as it relied on mathematics rather than observation. The new method was also much more efficient, as it was fully implanted into a Computational Script, which cut analysis time down to under 5 minutes in the longest cases.

**Awards Won:**

American Mathematical Society: First Award of $2,000