Modeling Bipolar Disorder for Clinical Purposes

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Successful treatment of bipolar disorder, an illness that affects mood, energy, and performance, has evaded psychiatrists for decades. To develop a quantitative understanding of the illness that addresses clinical questions, we constructed a mathematical model that employs a stochastic differential equation with two parameters, homing and volatility, which are patient-dependent. Collaborators at Western Psychiatric Institute supplied a decade of clinical data that monitors the moods of 175 patients over time. By analyzing patients' data using MATLAB, we determined that the noise has a Laplacian distribution, which contains jumps that are characteristic of patients' severe shifts in mood. Treatment effectiveness was assessed by comparing patterns of before and after treatment. With further testing, this model can be used to pre-select medicine and dose for a patient, to predict a next big episode, and to measure treatment effectiveness.