Project Summary: Mood prediction and Modelling for Bipolar Disorder

Introduction

The aim of this project is to use mathematical models to predict mood fluctuations in people with bipolar disorder. This illness was formerly known as manic depression and it causes an individual's mood to swing from one extreme to another, resulting in periods or 'episodes' of depression and mania. The exact cause is not fully understood, although genetic and environmental factors play a part. Models that can help predict mood episodes are potentially valuable for both understanding and managing the disorder.

The project is a collaboration between Oxford University's Department of Psychiatry and the Oxford Centre for Industrial and Applied Mathematics. I suggested the idea while employed in the Department of Psychiatry as a clinical trials programmer. My manager, Professor John Geddes, had implemented a scheme for monitoring mood using mobile phone text messages. The system is simple but effective: each week, the patient fills in a questionnaire about their mood and returns the answers by text message. In this way, the weekly mood changes of 400 patients has been monitored continually for up to 3 years. The resulting database is unique in both its quality and quantity of data. In 2008 I moved to the Mathematical Institute and started applying mathematical techniques to the mood data. Little work has been done in this field because data of sufficient frequency and quality has not hitherto been available. There is therefore plenty of scope for results which can increase quality of life for people with bipolar disorder.

Research objectives

The mood data is current displayed as a graph which allows visual detection of trends or sudden changes, as shown in Figure 1.

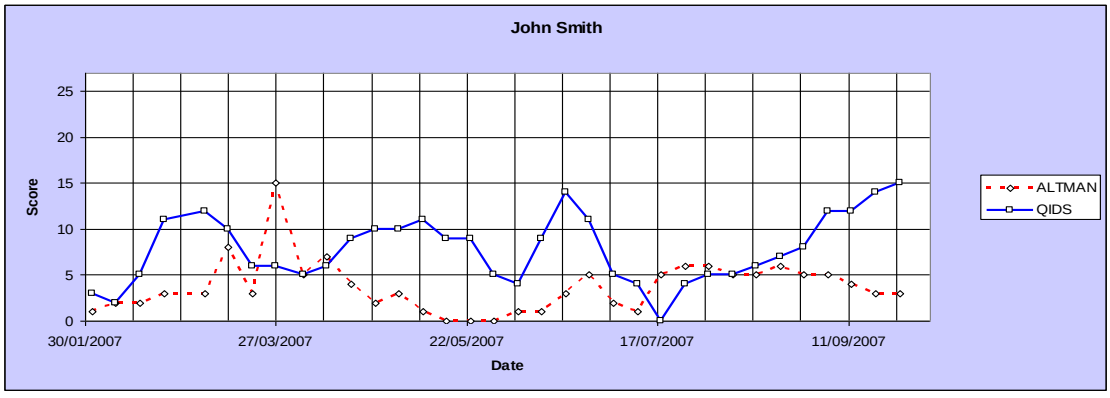

Figure 1. Graph of depression (blue) and mania (red dashed) ratings

While data can be visualised by means of a graph, further use of the data for quantitative analysis, classification and prediction requires a mathematical model. More research is needed in evaluating and selecting models that effective for predicting mood, and that can incorporate knowledge if the dynamics of the disorder. Some work has been also done in generating predictions using a regression technique, as shown in Figure 2 overleaf.

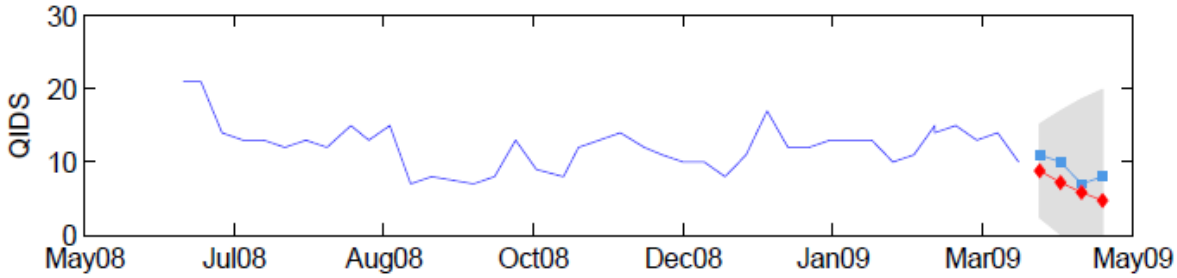

Figure 2. Prediction of depression (red diamonds) compared with the actual rating (blue squares)

The work has two specific aims

1) To use past mood and other variables to provide forecasts of future mood for patients with bipolar disorder. Forecasts can be either of a future mood level (like forecasting tomorrow's temperature) or of the probability of a mood episode occurring within a certain period (like forecasting rain for tomorrow).

2) The second aim is to derive numerical measures or 'features' that usefully summarise mood changes. Features have applications in visualisation or summarising mood, as input variables for models, and as measures in clinical trials. Visualisation has immediate clinical application to supplement the graphs that are currently used to view recent mood activity. Models describe the mood changes in mathematical terms and can provide new insights into mechanisms and factors that influence mood. In the longer term features could be applied to the evaluation of treatment effects in clinical trials. Current trials for new drugs measure the change in mood rating from the start of treatment, a method which is insensitive to signals and sensitive to noise. Using features has the potential to reduce the very high costs involved in running clinical trials for experimental treatments.

Background

After working as a software engineer for 15 years, I decided to make a career shift and pursue a career in academic research. To this end, I completed an MPhil in Speech and Language Processing at the University of Cambridge in 2006, after which I secured the post in the Psychiatry Department in Oxford. I am now in the third year of a DPhil, and will complete the project in 2012.

Further information

More information about the project is available from me, paul.moore@maths.ox.ac.uk or from my website at http://people.maths.ox.ac.uk/~moorep/.