Exercise: Calculating the period of variable light curve

Attached to this exercise you will find a light curve (lc.dat in ASCII format) from an eclipsing binary system. This light curve is taken with irregular sampling rate and there are also some gaps in the observations. We want to find the period of this binary system. In order to produce light curve in terms of orbital phase, the standard method is the folding of light curve in such a way to produce a smooth curve without any gap and dispersion in it.

Write a code to read data points from the file. The first column of data file is the number of camera (i.e C) which is useless in our study, the second column is time (i.e. t) (in Julian day), the third column is the differential magnitude of star (i.e. m) and the last column is the magnitude error bar (i.e. m_{Err}). Fold light curve in a continues way by means that if the period of folding is T, for a given data with time of "t" the new variable x is the non-integer part of t/T. In another word $x = t/T - \lfloor t/T \rfloor$.

Now calculate the dispersion of light curve in x coordinate and minimize it. In order to calculate dispersion function, first we make a straight line between point i and $i+2$ as follows:

$$m_{i+1}(x) = \frac{m_{i+2} - m_i}{x_{i+2} - x_i}(x - x_i) + m_i, \tag{1}$$

Now using equation (1), let us calculate the square of distance of data point at x_{i+1} with the value of m_{i+1} from this line

$$d_{i+1} = (m_{i+1}(x_{i+1}) - m_{i+1})^2 \tag{2}$$

The dispersion function can be defined as

$$D(T) = \sum_{1}^{N} d_{i+1}, \tag{3}$$

which is a function of period of folding.

(a) Find the minimum dispersion of D by plotting D as function of T.

(b) Plot the light curve in terms of phase of binary system for case of smallest dispersion.

(b) Estimate the transit time.

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