Based on the activity monitor's recording of several continuous days the probability of the subject of being in the lying down status for each minute of a 24h day is calculated. Standing epochs during night time (21:00pm-06:00am) that are shorter than 1 hour are removed and considered as sleeping [108, 68]. When calculating quality sleeping measures this assumption will not be taken into account and the real measured epochs of standing and sleeping considered.

For a Bernoulli distribution as the light green line in Figure 26 (i.e., 0 = the subject is not lying down, 1 = the subject is lying down) the probability distribution is equal to the sample mean (blue line in Figure 27). The standard deviation of the sample mean is considered as a measurement of uncertainty (red dashed line in Figure 27). From Figure 27 it can be seen that the probability for the subject to be lying in the bed is maximal around 01:00 am and its maximal uncertainty is around 19:50 pm and 03:00 am (red circles in Figure 27).

A model can be fitted to the data to obtain a smooth curve. In our case, a Gaussian distribution (green line in Figure 27) is fitted to the empirical probability distribution (blue line in Figure 27).

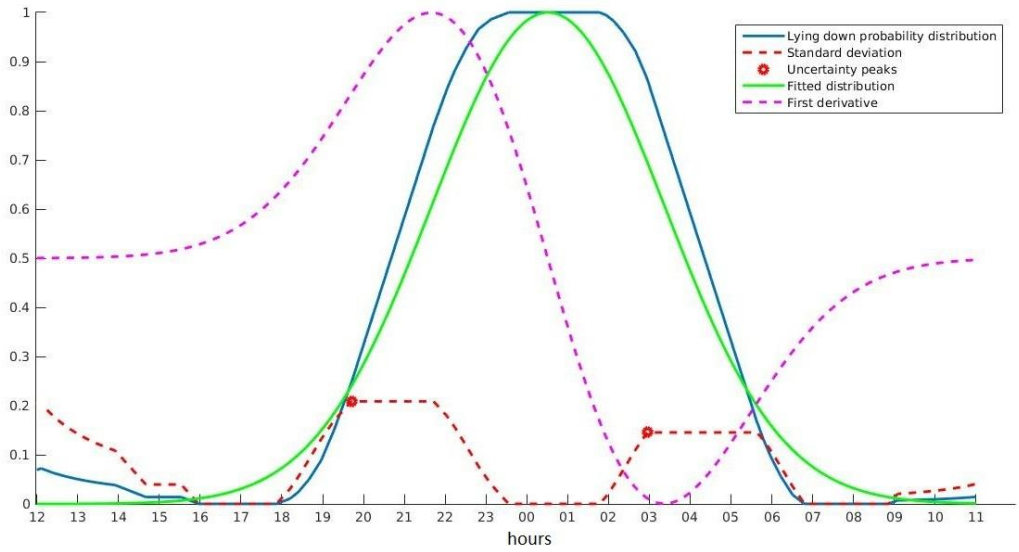

Figure 27 Lying down probability distribution over hours of the day. In blue: probability distribution of minutes classified as lying down across 24 hours. The probability estimation is calculated empirically taking into consideration all the minutes of the assessed days. In dashed red: standard deviation of sample mean taken as uncertainty measurement. In light green: Gaussian distribution fitted to the empirical distribution (blue). Red circles: uncertainty peaks that are closer to the 0·5 crossing point of the fitted Gaussian. In dashed magenta: first derivative of fitted Gaussian distribution. The derivative was rescaled to assume values between 0 and 1 for graphical inspection.

The peaks of the uncertainty distribution closest to the 0.5 crossing point of the fitted Gaussian are used to create a biphasic model that indicates when the subject is likely to be sleeping and when he is likely to be awake (blue line in Figure 28).

Alternatively the two extrema of the first derivative of the fitted Gaussian distribution could be used to create the biphasic model (magenta line in Figure 27).