Signal and background exercise: Suggested experiments

It is instructive to experiment with changing both the simulated data and the values of the parameters in the above example. Here are some suggestions.

1. Change the exposure time used to generate the data. Try values of t of 0.5, 1, 2, 10, 50, 100. You will need to adjust the range over which the posterior is calculated (`alim`, `blim`) in order to sample it adequately (i.e. to cover its full range and to sample it at high enough resolution). If you set the limits to less than 0 you will see that the posterior is correctly truncated by the prior. A larger t corresponds to more photons. You should find that this gives a more accurate and precise determination of the parameters (and a smaller t a lower accuracy and precision).

2. Vary the sampling resolution of x used to generate the data, but keeping the sampling range the same (so the number of data points will change). The samples are defined as follows.
   `xdat <- seq(from=-7*w, to=7*w, by=0.5*w)`
   In the above we have a resolution of $0.5w$, so try changing this to $0.1, 0.25, 1, 2, 3$ times w, for example. A better sampling of the spectral line will result in a more accurate and precise determination of its amplitude.

3. Vary the sampling range (keep it centred on x_0), but keep the sampling resolution the same (so the number of data points will change). I suggest values of $\pm 3w$, $\pm 10w$, $\pm 20w$, $\pm 50w$. If a larger fraction of the grid evaluations are dominated by the background, is the accuracy and precision with which we determine the amplitude reduced? What about the background? Is the covariance affected?

4. Vary the sampling range (keep it centred on x_0) between $0.5w$ and $2w$, but now with a sampling resolution of $0.1w$. In these cases we are barely sampling across the whole line. What happens to the posterior PDFs? If we set the range to $\pm 0.5w$ but have high resolution, say $0.01w$, do we improve things?

5. Change the ratio a/b used to simulate the data (keeping both positive in accordance with the prior). The smaller this is, the less prominent the line. Is the amplitude then less accurately determined?