Let and denote the step length and turning angle bins, respectively, that observation j from individual i at time segment t fall into. We assume that:

where and are the latent cluster memberships of observation j from individual i at time segment t for data type 1 and 2, respectively. Notice that we adopt the strategy of using two sets of latent variables because, once we have the aggregate data, we won’t be able to infer the joint distribution of and . We assume that these latent variables are given by:

Finally, our priors are:

In this last expression, refers to a truncated stick-breaking prior, given by:

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The FCD’s are given by:

where is the total number of bins in . Let be the number of observations across all individuals and time segments that fall in bin b and that were assigned to cluster k:

As a result, we have that:

This implies that

where is the total number of bins in . Let be the number of observations across all individuals and time segments that fall in bin b and that were assigned to cluster k:

Therefore, we have that:

This implies that

Given that the can be sampled independently, we will count the number of observations for which and sample the corresponding from a multinomial distribution.

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Let and . Therefore:

This implies that: