Code for "Sequential Monte Carlo methods for mixtures with normalized random measures with independent increment priors

J. E. Griffin*

1 Introduction

All the code uses the methods developed in the paper and assumes the following infinite mixture modesl for a sample of data $y_1, \ldots, y_n$. Either

$$y_i \sim \text{N}(\theta_i, a\sigma^2)$$

$$\theta_i \sim \text{DP}(M, H)$$

where $\text{DP}(M, H)$ represents a Dirichlet process (DP) with mass parameter M and centring measure $H = \text{N}(\mu, (1-a)\sigma^2)$ or

$$y_i \sim \text{N}(\theta_i, a\sigma^2)$$

$$\theta_i \sim \text{NGG}(\gamma, M, H)$$

*Jim Griffin is Professor, School of Mathematics, Statistics and Actuarial Science, University of Kent, Canterbury, CT2 7NF, U.K. (Email: J.E.Griffin-28@kent.ac.uk

where NGG(γ, M, H) is a Normalized Generalized Gamma process (NGGP) with shape parameter γ, mass parameter M and centring measure $H = \mathrm{N}(0, (1-a)\sigma^2)$ for which the unnormalized random measure has Lévy measure $\rho(x) = \frac{M}{\Gamma(1-\gamma)} x^{-1-\gamma} \exp\{-x\}$. All particle filter use the stratified re-sampling method (Carpenter, Clifford and Fearnhead, 1999) to re-weight particles

The file `run_code.m` contains code for running all code on the galaxy data set used in the paper.

1.1 Methods for conjugate models

```
[s] = algorithm1_DP(data, mu, sigmasq, a, M, numbofparts)
[s] = algorithm3_DP(data, mu, sigmasq, a, M, numbofparts)
[s] = algorithm3_NGG(data, mu, sigmasq, a, gamma, M, numbofparts)
```

Inputs

`data` – the sample $y_1, \ldots, y_n$.

`mu` – the value of the parameter μ

`sigmasq` – the value of the parameter σ^2.

`a` – the value of the parameter a.

`gamma` – the value of the parameter γ (for NGGP models)

`M` – the value of the parameter M.

`numbofparts` – the number of particles, N.

Outputs

`s` – a $(N \times n)$-dimensional matrix whose i-th row is the cluster configuration s for the i-th particle.

1.2 Methods for non-conjugate models

```
[s] = algorithm2_DP(data, mu, sigmasq, a, M, m, numbofparts)
[s] = algorithm4_DP(data, mu, sigmasq, a, M, m, numbofparts)
[s] = algorithm4_NGG(data, mu, sigmasq, a, gamma, M, m, numbofparts)
```

Inputs

`data` – the sample $y_1, \ldots, y_n$.

`mu` – the value of the parameter μ

`sigmasq` – the value of the parameter σ^2.

`a` – the value of the parameter a.

`gamma` – the value of the parameter γ (for NGGP models)

`M` – the value of the parameter M.

`m` – the number of empty clusters generated.

`numbofparts` – the number of particles, N.

Outputs

`s` – a $(N \times n)$-dimensional matrix whose i-th row is the cluster configuration s for the i-th particle.

1.3 Methods for conjugate models with parameter updating

```
[s, a] = algorithm3_DP_param(data, mu, sigmasq, M, numbofparts)
[s, a] = algorithm3_NGG_param(data, mu, sigmasq, gamma, M, numbofparts)
```

Inputs

`data` – the sample $y_1, \ldots, y_n$.

`mu` – the value of the parameter μ

`sigmasq` – the value of the parameter σ^2.

`gamma` – the value of the parameter γ (for NGGP models)

`M` – the value of the parameter M.

`numbofparts` – the number of particles, N.

Outputs

`s` – an $(N \times n)$-dimensional matrix whose i-th row contains the cluster configuration s for the i-th particle.

`a` – an N-dimensional vector whose i-th element contains the value of a for the i-th particle.

1.4 Methods for non-conjugate models with parameter updating

```
[s, a] = algorithm4_DP_param(data, mu, sigmasq, M, m, numbofparts)
[s, a] = algorithm4_NGG_param(data, mu, sigmasq, gamma, M, m, numbofparts)
```

Inputs

`data` – the sample $y_1, \ldots, y_n$.

`mu` – the value of the parameter μ

`sigmasq` – the value of the parameter σ^2.

`gamma` – the value of the parameter γ (for NGGP models)

`M` – the value of the parameter M.

`m` – the number of empty clusters generated.

`numbofparts` – the number of particles, N.

Outputs

`s` – a $(N \times n)$-dimensional matrix whose i-th row is the cluster configuration s for the i-th particle.

`a` – an N-dimensional vector whose i-th element contains the value of a for the i-th particle.

References

Carpenter, J., Clifford, P. and Fearnhead, P. (1999). An improved particle filter for non-linear problems. *IEE proceedings - Radar, Sonar and Navigation*, 146, 2–7.