Bayesian Age-Period-Cohort Modeling

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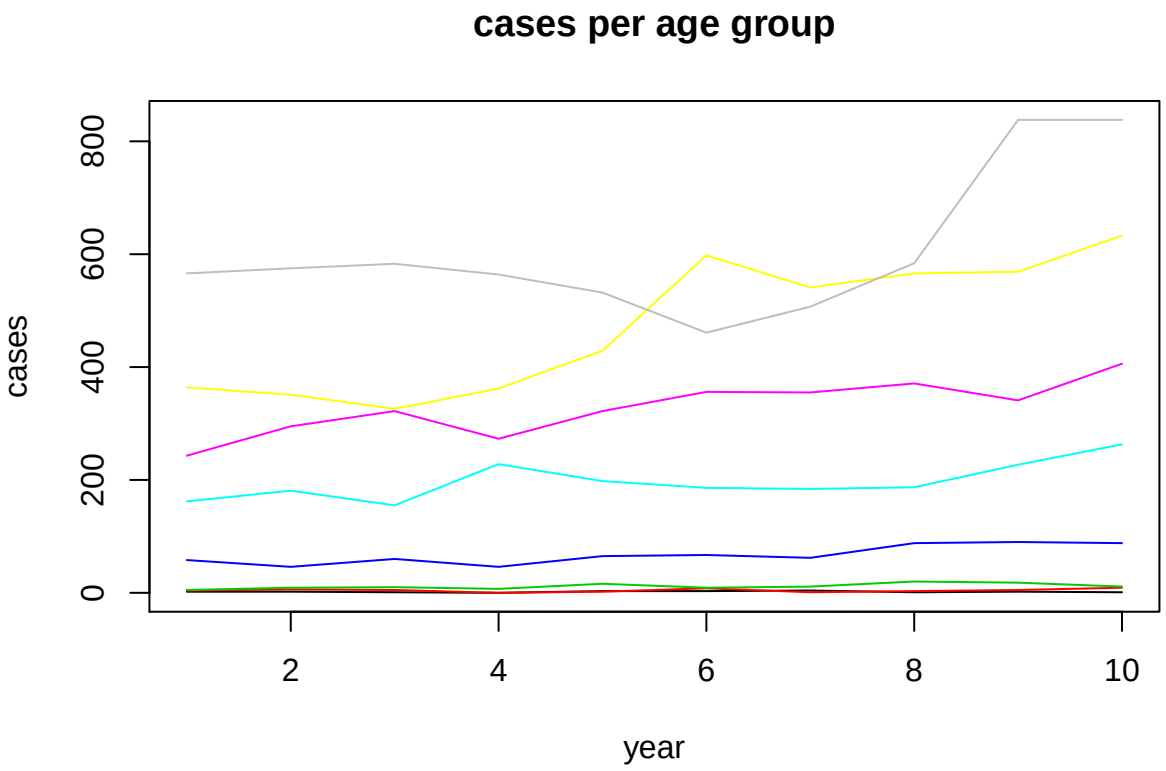
Data example

BAMP includes a data example.

```
data(apc)
plot(cases[,1],type="l",ylim=range(cases), ylab="cases", xlab="year", main="cases per age group")
for (i in 2:8)lines(cases[,i], col=i)
```



APC model with random walk first order prior

```
model1 <- bamp(cases, population, age="rw1", period="rw1", cohort="rw1",
               periods_per_agegroup = 5)
```

bamp() automatically performs a check for MCMC convergence using Gelman and Rubin's convergence diagnostic. We can manually check the convergence again:

```
checkConvergence(model1)
```

```
## [1] TRUE
```

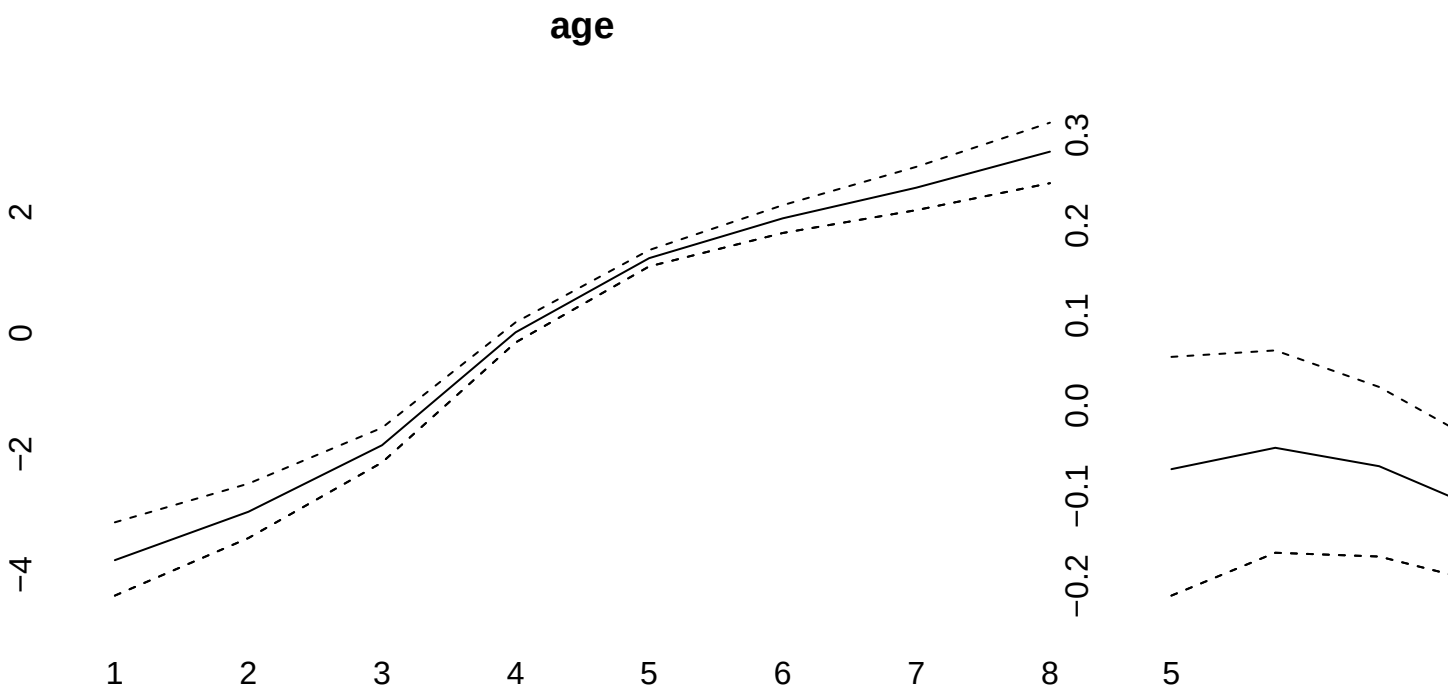
Now we have a look at the model results. This includes estimates of smoothing parameters and deviance and DIC:

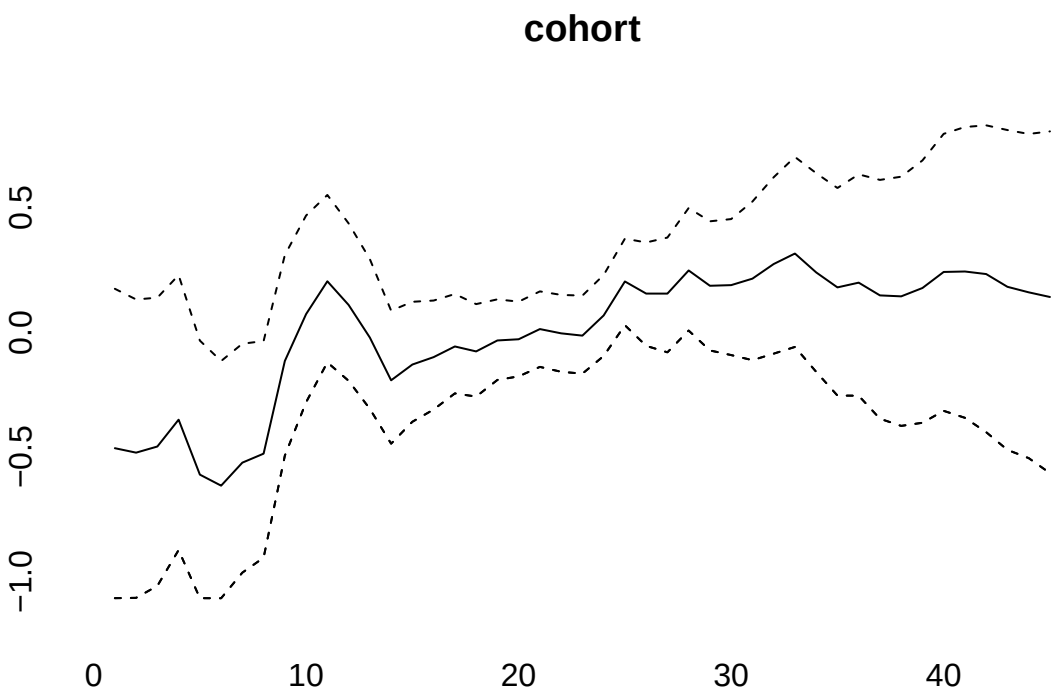
```
print(model1)
```

```
##
##  Model:
## age (rw1)  - period (rw1)  - cohort (rw1) model
## Deviance:     231.23
## pD:            36.72
## DIC:          267.95
##
##
##  Hyper parameters:                 5%           50%          95%
## age                             0.392         1.045        2.288
## period                         66.889       195.020      612.411
## cohort                         34.688        59.779       98.485
```

We can plot the main APC effects using point-wise quantiles:

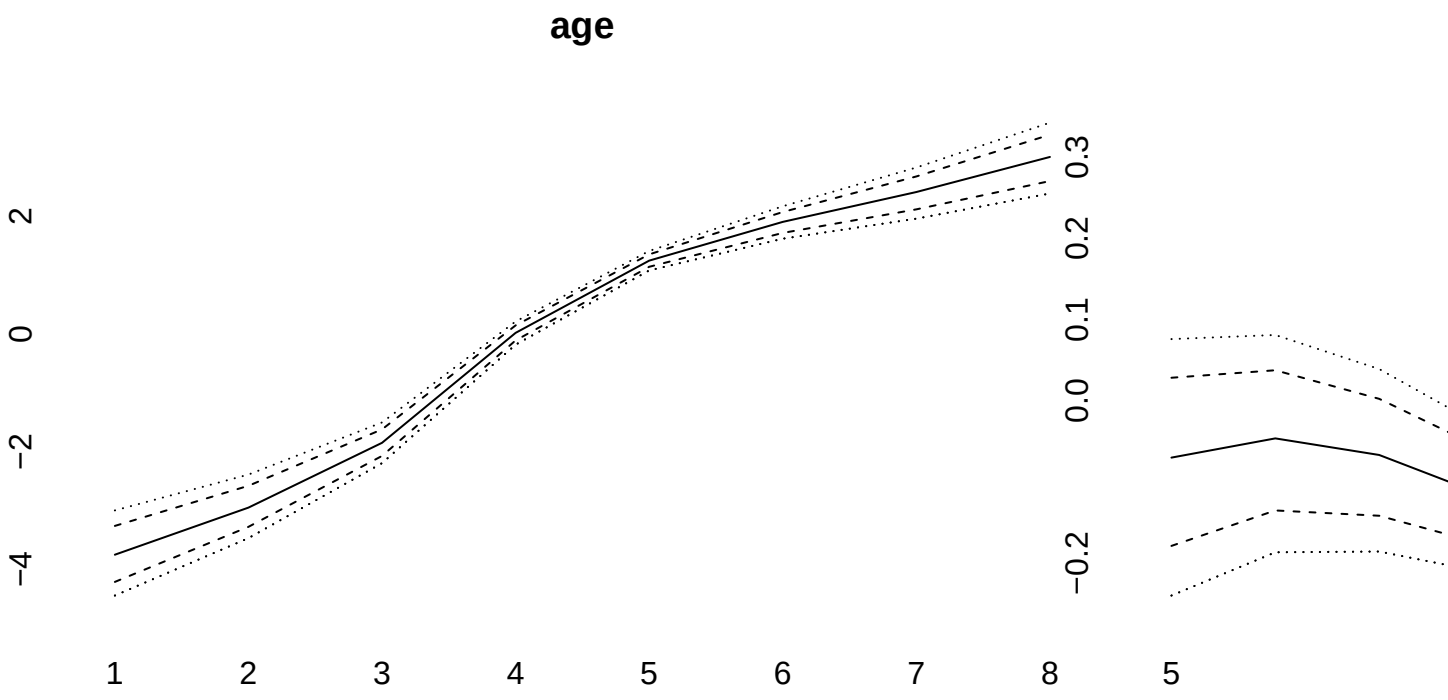
```
plot(model1)
```

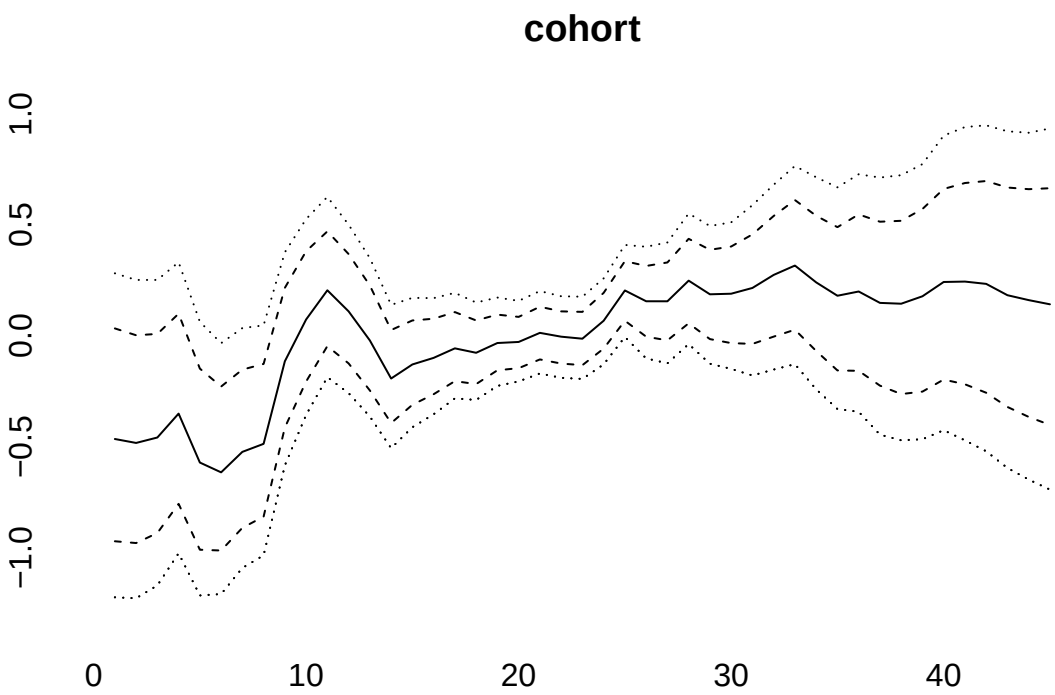




More quantiles are possible:

```
plot(model1, quantiles = c(0.025,0.1,0.5,0.9,0.975))
```






```
model2 <- bamp(cases, population, age="rw2", period="rw2", cohort="rw2",
               periods_per_agegroup = 5)
```

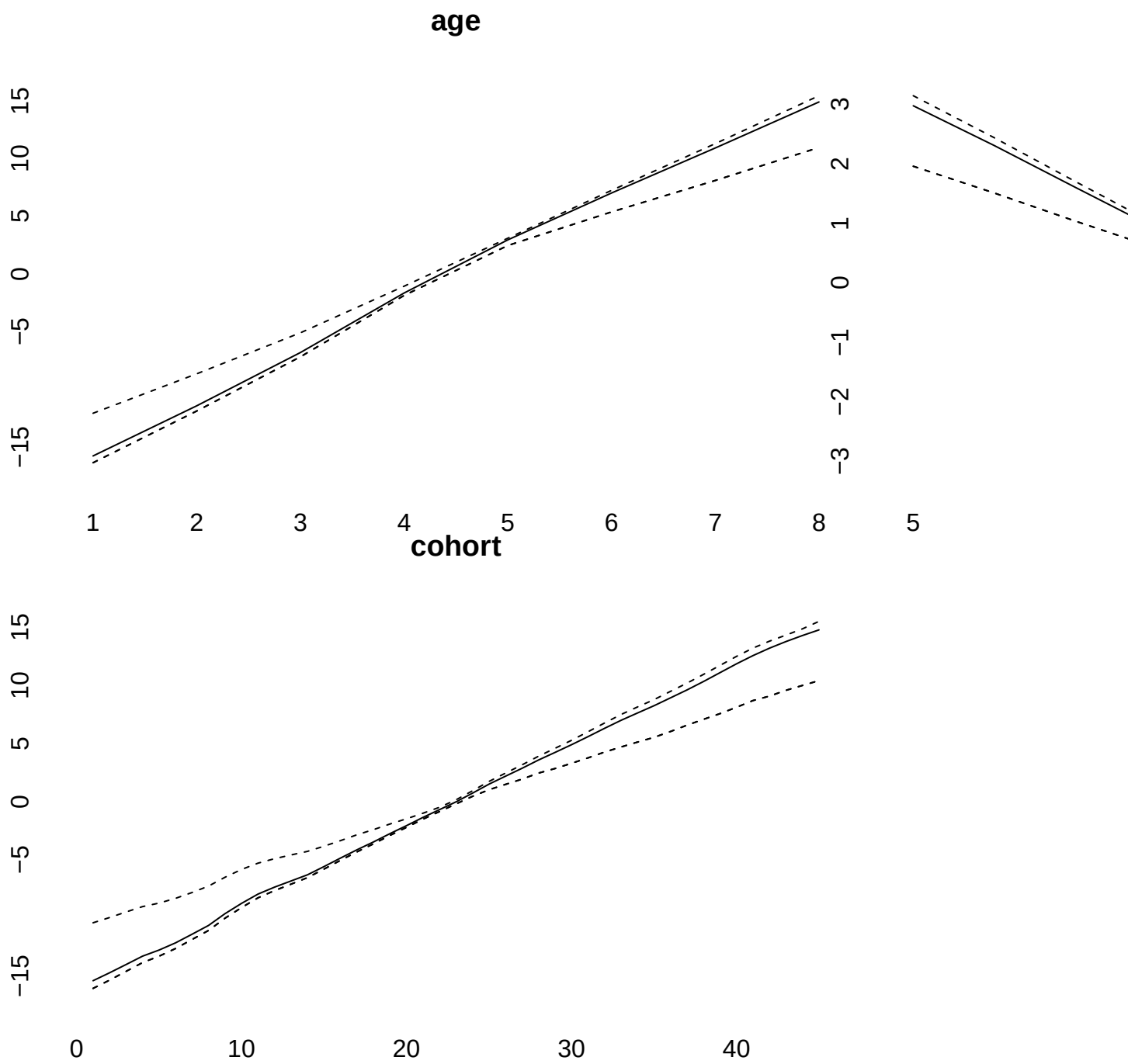
```
checkConvergence(model2)
```

```
## [1] TRUE
```

```
print(model2)
```

```
##
##  Model:
## age (rw2)  - period (rw2)  - cohort (rw2) model
## Deviance:     245.86
## pD:            33.65
## DIC:          279.51
##
##
##  Hyper parameters:                5%          50%          95%
## age                            2.011        6.410       16.952
## period                        56.214      304.855     2450.540
## cohort                        36.791       73.797      146.510
```

```
plot(model2)
```




```
model3<-bamp(cases, population, age="rw1", period=" ", cohort="rw2",
             periods_per_agegroup = 5)
checkConvergence(model3)
```

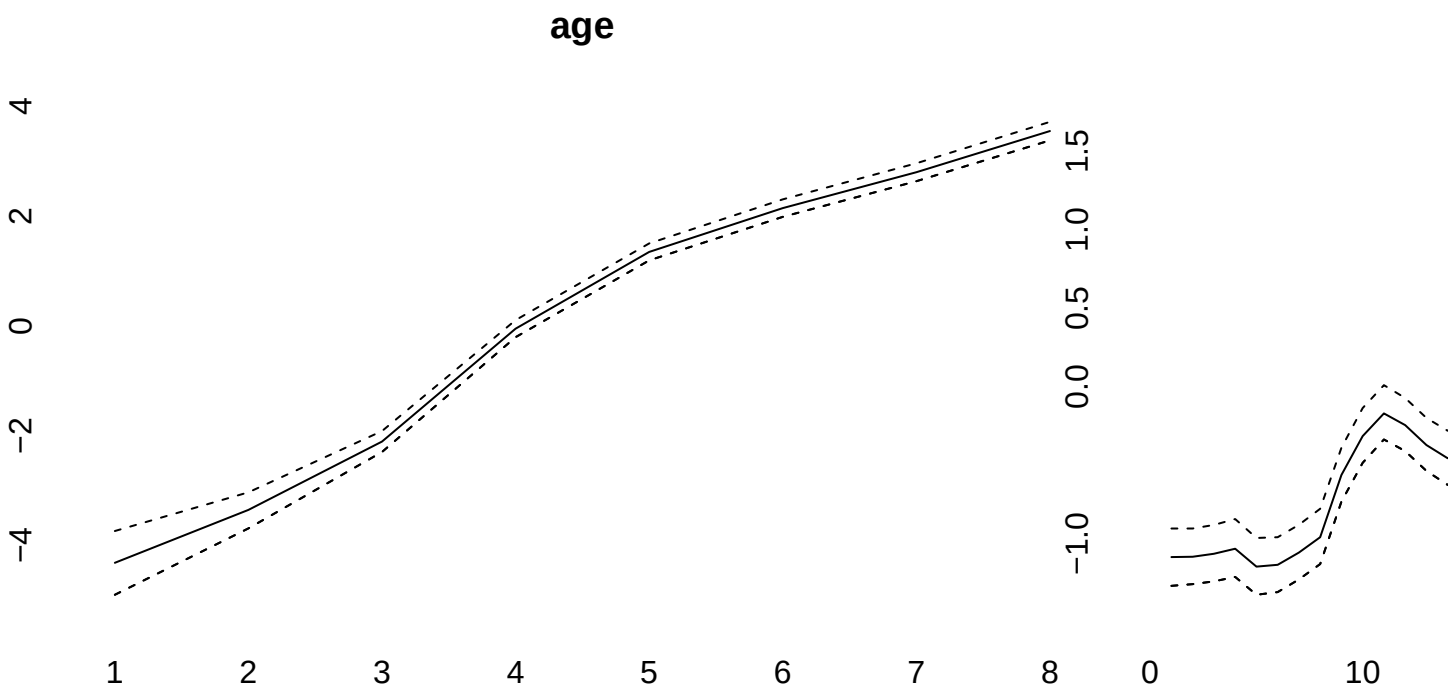
```
## [1] TRUE
```

```
print(model3)
```

```
##
##  Model:
## age (rw1) cohort (rw2) model
## Deviance:     276.57
```

```
## pD:            30.20
## DIC:          306.77
##
##
##  Hyper parameters:                5%          50%          95%
## age                            0.308        0.798        1.669
## cohort                        37.348       73.716      139.049
```

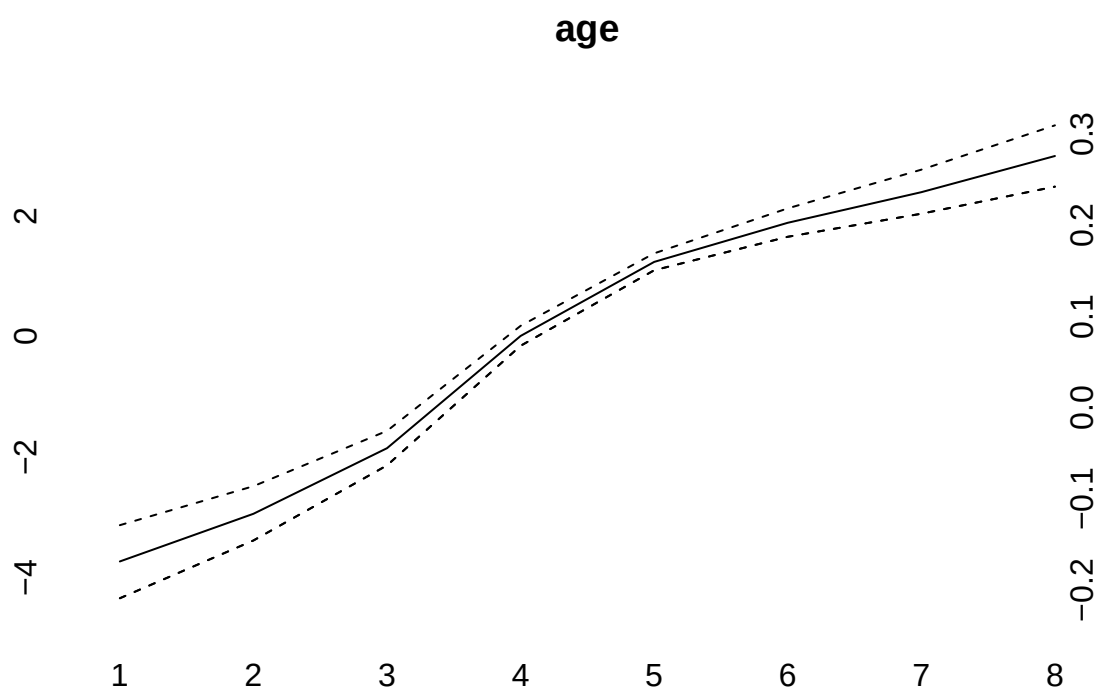
```
plot(model3)
```

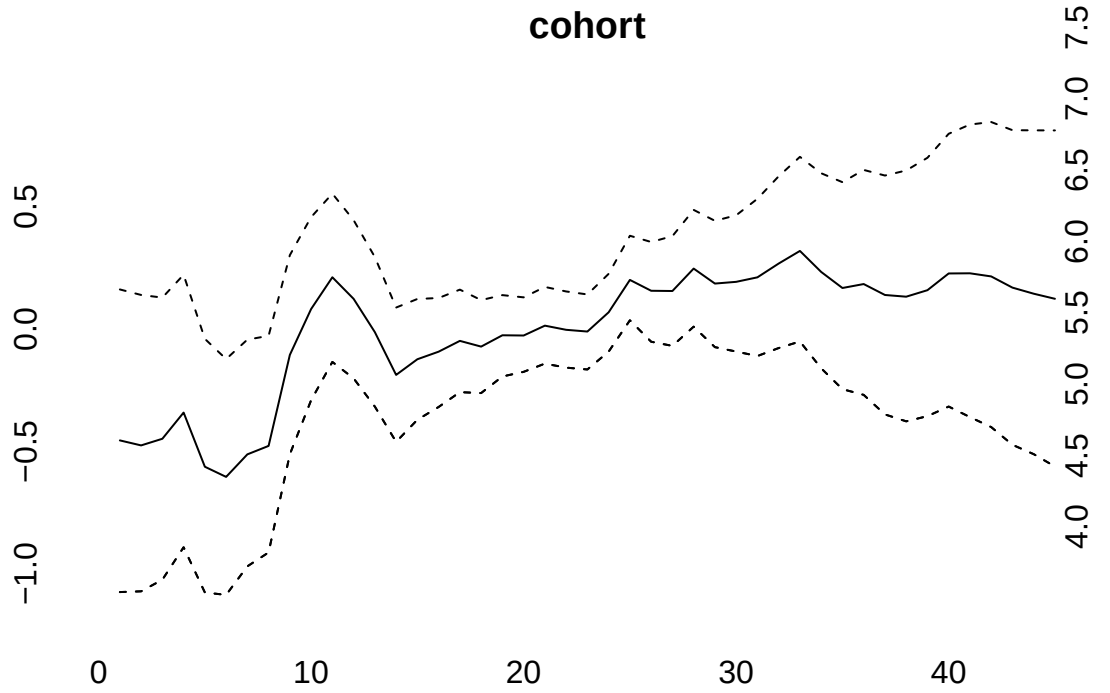



```
(model4<-bamp(cases, population, age="rw1", period="rw1", cohort="rw1",
              cohort_covariate = cov_c, periods_per_agegroup = 5))
```

```
##
##  Model:
## age (rw1)  - period (rw1)  - cohort (rw1) model
## Deviance:     231.21
## pD:            36.77
## DIC:          267.98
##
##
##  Hyper parameters:                5%          50%          95%
## age                            0.410        1.048        2.266
## period                        65.662      193.308      585.793
## cohort                        34.617       59.927       98.852
```

```
plot(model4)
```

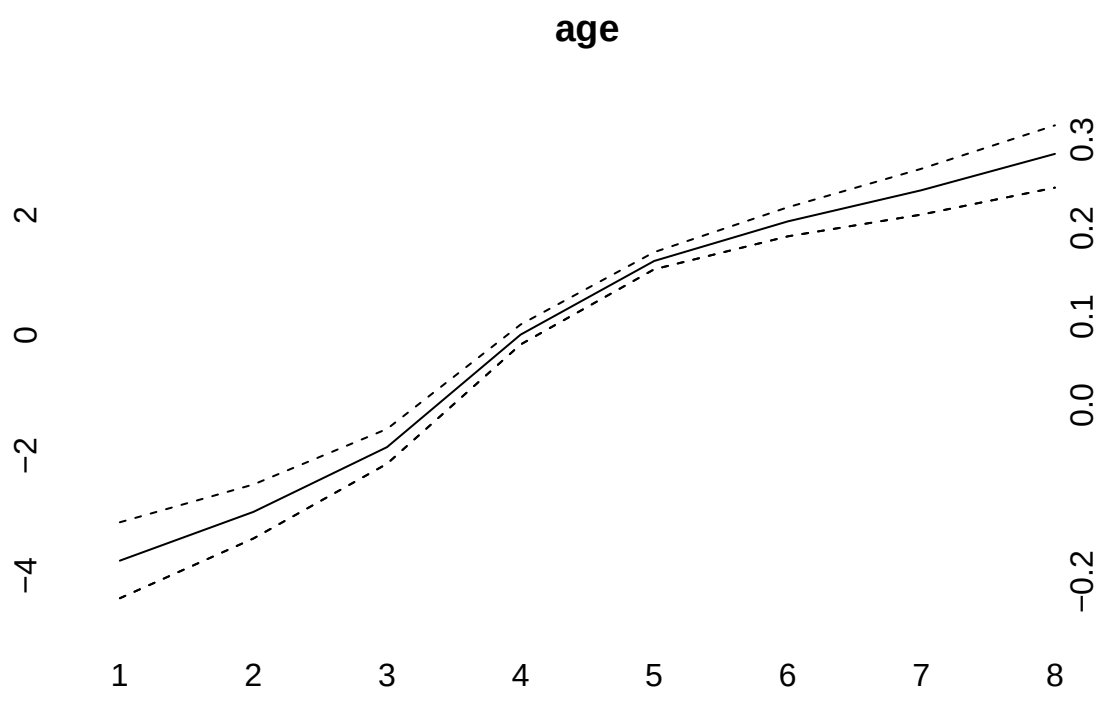

age
2
0
−2
−4
0.3
0.2
0.1
0.0
−0.1
−0.2
1
2
3
4
5
6
7
8
5

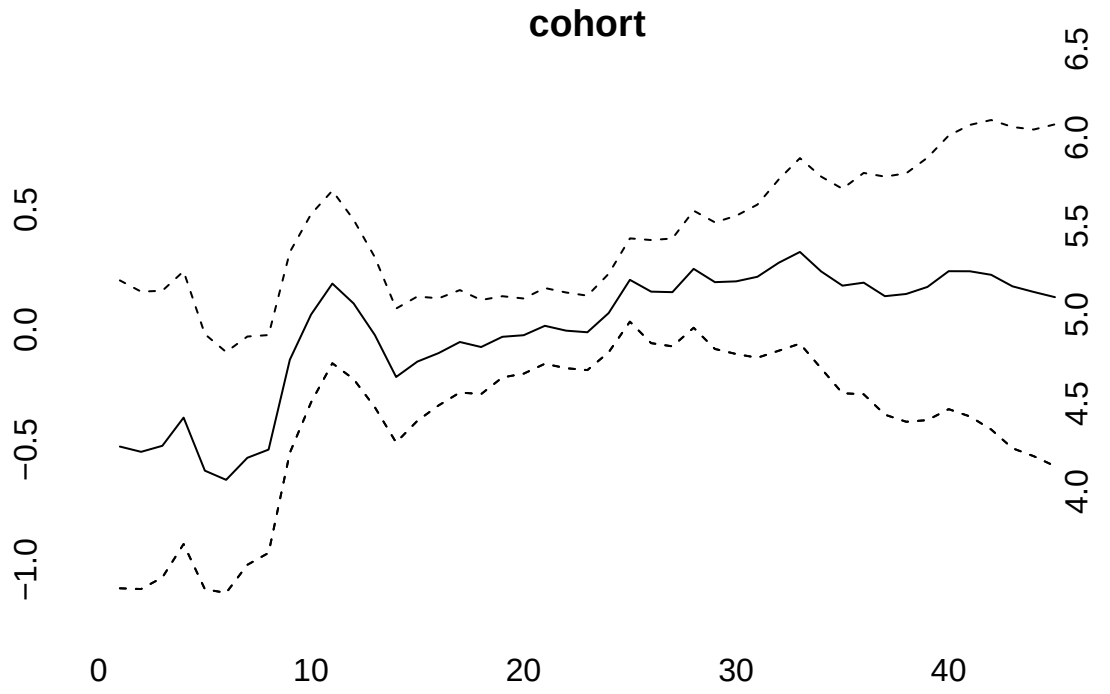

cohort
0.5
0.0
−0.5
−1.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
0
10
20
30
40
0
10

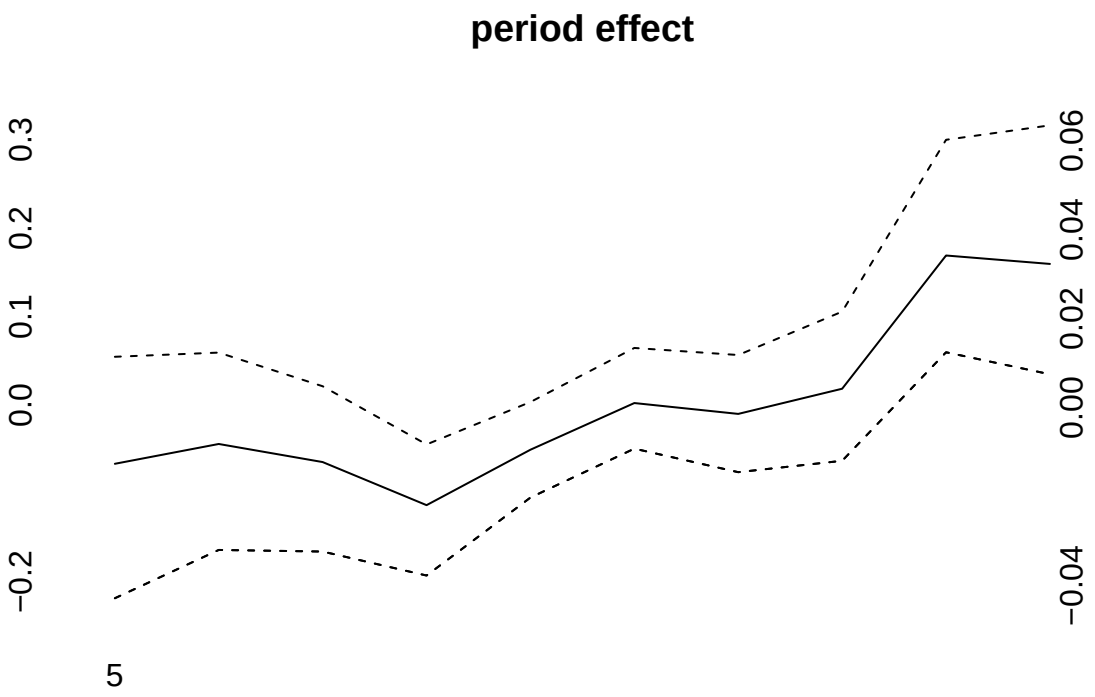

```
(model5<-bamp(cases, population, age="rw1", period="rw1", cohort="rw1",
              period_covariate = cov_p, periods_per_agegroup = 5))
```

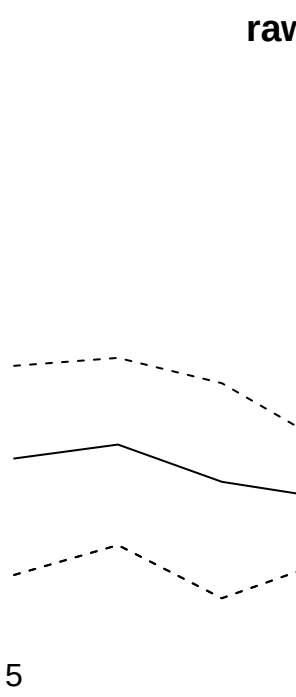
```
##
##  Model:
## age (rw1)  - period (rw1)  - cohort (rw1) model
## Deviance:     231.44
## pD:            36.77
## DIC:          268.22
##
##
##  Hyper parameters:                 5%          50%          95%
## age                             0.406        1.037        2.257
## period                         67.968      200.582      611.338
## cohort                         35.363       60.052       97.920
```

```
plot(model5)
```


age
2
0
−2
−4
0.3
0.2
0.1
0.0
−0.2
1
2
3
4
5
6
7
8
5


cohort
0.5
0.0
−0.5
−1.0
6.5
6.0
5.5
5.0
4.5
4.0
0
10
20
30
40
5


period effect
0.3
0.2
0.1
0.0
−0.2
0.06
0.04
0.02
0.00
−0.04
5


rav
5