## A time series with seasonal component: the drivers data

This example is taken from [Rue and Held, 2005, Sec 4.4.2].

The data consist in monthly counts of car drivers in Great Britain killed or seriously injured in car accidents from January 1969 to December 1984. The time series has  $n_d = 192$  data points and exhibits a strong seasonal pattern. One of our goals is to predict the pattern of counts in the 12 month following the last observation.

We assume the squared root of the counts  $y_t$  to be conditionally independent Gaussian random variables:

$$y_t|\eta_t, \lambda_y \sim \mathcal{N}(\eta_t, 1/\lambda_y), \quad t = 0, \dots, n_d - 1$$

The conditional mean  $\eta_t$  is then a sum of a smooth trend and a seasonal component:

$$\eta_t = \operatorname{season}_t + \operatorname{trend}_t, \quad t = 0, \dots, n_\eta - 1$$
(1)

We assume the vector  $\mathbf{season} = (\mathrm{season}_0, \dots, \mathrm{season}_{n_{\eta}-1})$  to follow the seasonal model in (3.58) of [Rue and Held, 2005], with length 12 and unknown precision  $\lambda_{\mathbf{season}}$ , and the vector  $\mathbf{trend} = (\mathrm{trend}_0, \dots, \mathrm{trend}_{n_{\eta}-1})$  to follow a RW2 with unknown precision  $\lambda_{\mathbf{trend}}$ .

Note that we have that  $n_{\eta} = n_d + 12 = 204$ , since no observations  $y_t$  are available for  $t = n_d, n_d + 1, \dots, n_d + 11$ . For prediction we are interested in the posterior marginals of  $(\eta_{n_d}, \dots, \eta_{n_d+11})$ .

There are three hyperparameters in the model  $\theta = (\log \lambda_y, \log \lambda_{season}, \log \lambda_{trend})$  for which we choose the following prior distributions:

$$\lambda_y \sim \text{LogGamma}(4,4)$$
  
 $\lambda_{\text{season}} \sim \text{LogGamma}(1,0.1)$   
 $\lambda_{\text{trend}} \sim \text{LogGamma}(1,0.0005)$ 

See [Rue and Held, 2005] for more details.

## References

[Rue and Held, 2005] Rue, H. and Held, L. (2005). Gaussian Markov Random Fields: Theory and Applications, volume 104 of Monographs on Statistics and Applied Probability. Chapman & Hall, London.