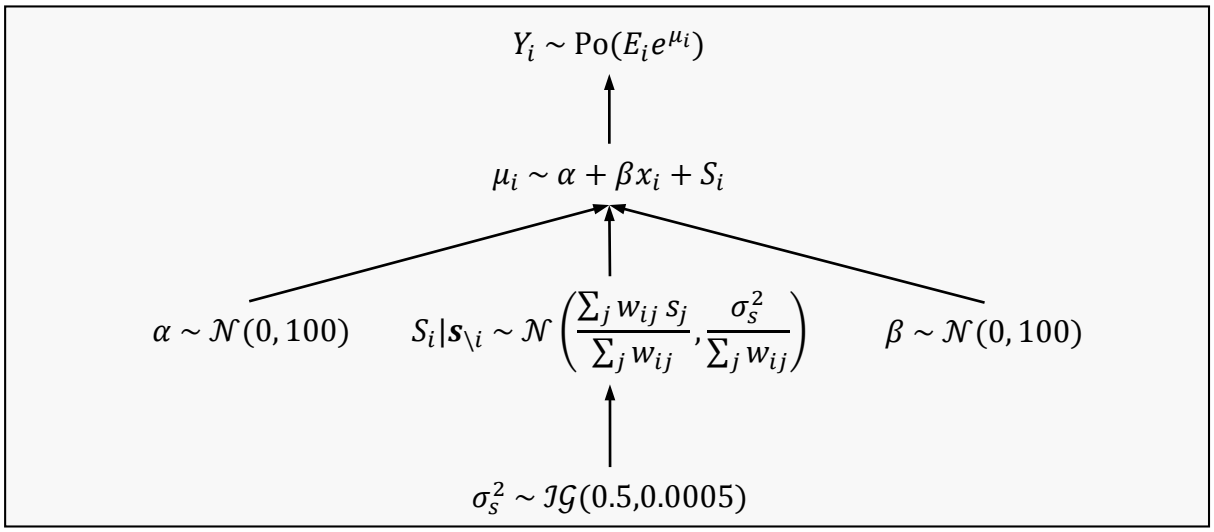
ICAR Model (Besag 1974; Besag, York, Mollié 1991)



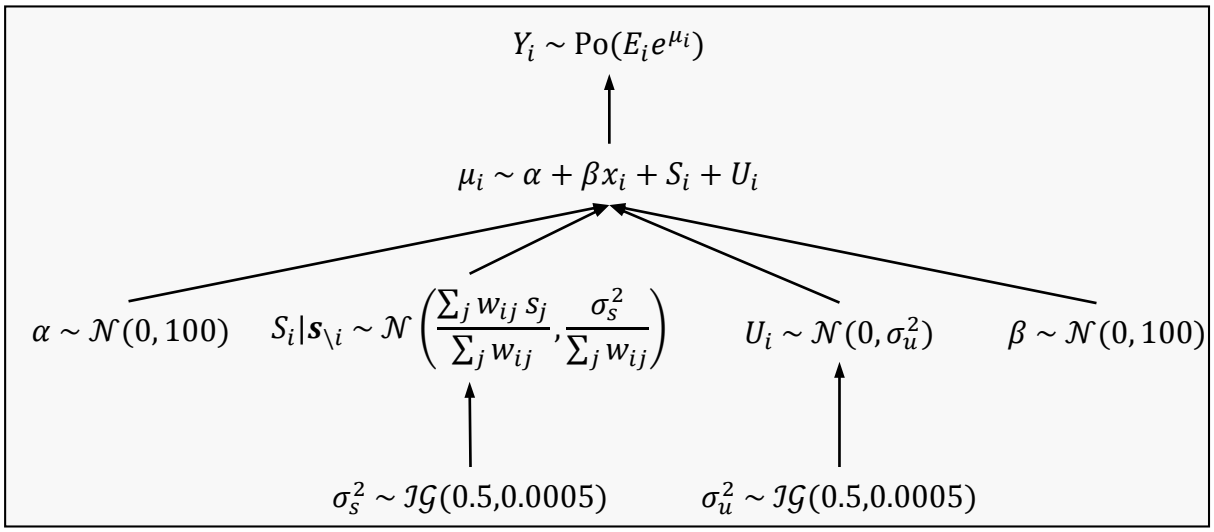
Concordance of parameter names, and values used in CARBayes to define the priors:

Model parameter		`S.CARleroux` argument	Value
Schematic	CARBayes		
S, R	ϕ	`--`	
α, β	β *	`prior.mean.beta`	`c(0, 0)`
		`prior.var.beta`	`c(100, 100)`
σ_s^2	τ^2	`prior.tau2`	`c(0.5, 2000)`
(1)	ρ **	`fix.rho`	`TRUE`
		`rho`	`1`
W	**W**	`W`	`W`

* In the CARBayes package, β includes the intercept, so the prior for both α and β must have the same *form* of distribution, but potentially different parameters.

** The ICAR model is a special case of the Leroux model when the spatial autocorrelation ρ is fixed at 1. Hence, the `S.CARleroux` R function is used.

BYM Model (Besag, York, Mollié 1991)

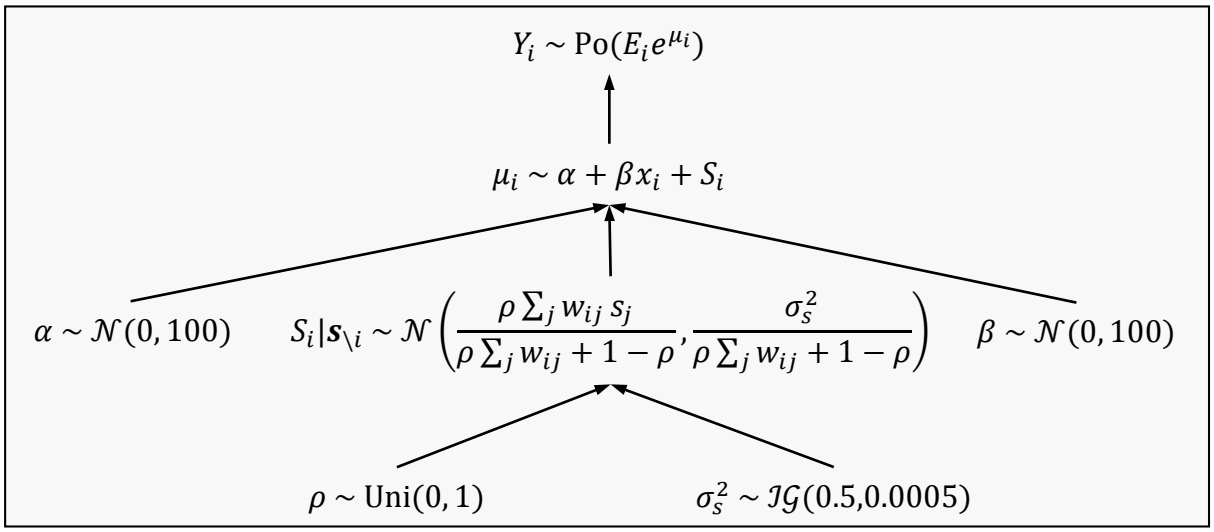


Concordance of parameter names, and values used in CARBayes to define the priors:

Model parameter		`S.CARbym` argument	Value
Schematic	CARBayes		
R	ψ	`--`	
α, β	β*	`prior.mean.beta`	`c(0, 0)`
		`prior.var.beta`	`c(100, 100)`
σ_s^2	τ^2	`prior.tau2`	`c(0.5, 2000)`
W	**W**	`W`	`W`

* In the CARBayes package, β includes the intercept, so the prior for both α and β must have the same *form* of distribution, but potentially different parameters.

Leroux Model (Leroux et al. 2000)



Concordance of parameter names, and values used in CARBayes to define the priors:

Model parameter		`S.CARleroux` argument	Value
Schematic	CARBayes		
S, R	ϕ	`--`	
α, β	β*	`prior.mean.beta`	`c(0, 0)`
		`prior.var.beta`	`c(100, 100)`
σ_s^2	τ^2	`prior.tau2`	`c(0.5, 2000)`
ρ	ρ	`fix.rho`	`FALSE`
		`rho`	`NULL`
W	**W**	`W`	`W`

* In the CARBayes package, β includes the intercept, so the prior for both α and β must have the same *form* of distribution, but potentially different parameters.

Dissimilarity Model (Lee and Mitchell 2012)

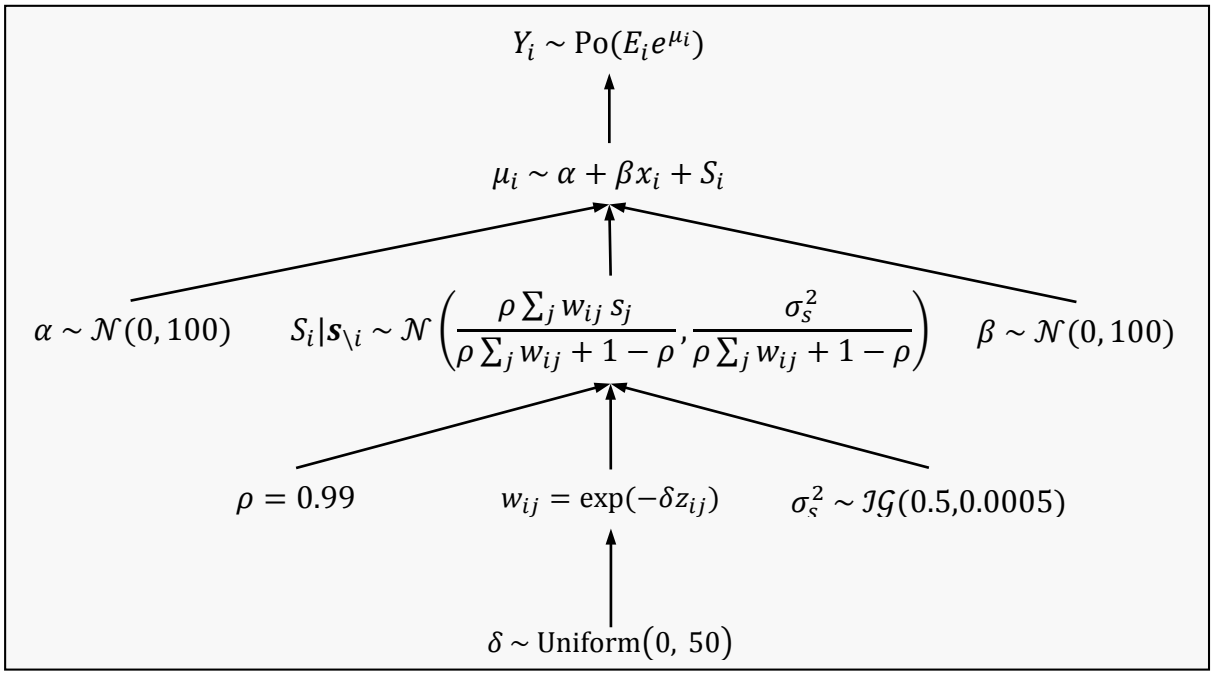
This model is based on the Leroux model, except here ρ is fixed at 0.99 to ensure strong global spatial smoothing, while the weights are estimated rather than fixed. The weights are estimated according to the dissimilarity between areas, as determined by a non-negative dissimilarity metric **Z** with elements

$$z_{ij} = \frac{|z_i - z_j|}{\sigma_z}$$

where σ_z is the standard deviation of $|z_i - z_j|$ over all pairs of contiguous areas. This metric is then treated as a regression parameter, weighted by δ. The metric can be based on geography (e.g. distance between area centroids), covariates (which would then be excluded from the stage 2 of the model), or residuals from another model. The weights can be either binary or non-binary. The non-binary formulation is given by:

$$w_{ij}(\delta, z_{ij}) = \exp(-\delta z_{ij})$$
$$\delta \sim \text{Uniform}(0, 50).$$

The larger the dissimilarity measure z_{ij}, the closer to zero the weights w_{ij} will be.



Concordance of parameter names, and values used in CARBayes to define the priors:

Model parameter		`S.CARdissimilarity` argument	Value
Schematic	CARBayes		
S, R	$\phi\ S$	`--`	
α, β	$\beta*$	`prior.mean.beta`	`c(0, 0)`
		`prior.var.beta`	`c(100, 100)`
σ_s^2	τ^2	`prior.tau2`	`c(0.5, 2000)`
ρ	ρ	`fix.rho`	`TRUE`
		`rho`	`0.99`
W	**W**	`W`	`W`
		`W.binary`	`TRUE` or `FALSE`

Z	**Z**	Z	list(Z = Z)
δ	α	--	

* In the CARBayes package, β includes the intercept, so the prior for both α and β must have the same *form* of distribution, but potentially different parameters.

References

Besag, J. 1974. Spatial interaction and the statistical analysis of lattice systems. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* **36** (2): 192-236.

Besag, J., J. York, and A. Mollié. 1991. Bayesian image restoration with application in spatial statistics. *Annals of the Institute of Statistical Mathematics* **43** (1):1-20. doi: 10.1007/BF00116466.

Leroux, B. G., X. Lei, and N. Breslow. 2000. "Estimation of disease rates in small areas: a new mixed model for spatial dependence". In *Statistial models in epidemiology, the environment and clinical trials*, edited by M. E. Halloran and D. Berry, pp. 179-191. The IMA Volumes in Mathematics and its Applications, vol 116. New York: Springer. doi: 10.1007/978-1-4612-1284-3_4.

Lee, D. and R. Mitchell. 2012. Boundary detection in disease mapping studies. *Biostatistics* **13** (3): 415-426. doi: 10.1093/biostatistics/kxr036.

See also the CARBayes paper and documentation:

Lee, D. 2013. CARBayes: An R package for Bayesian spatial modelling with conditional autoregressive priors. *Journal of Statistical Software* **55** (13): 1-24. URL: http://www.jstatsoft.org/v55/i13/.

https://cran.r-project.org/web/packages/CARBayes/CARBayes.pdf

https://cran.r-project.org/web/packages/CARBayes/vignettes/CARBayes.pdf