Visualizing priors

With great power comes great responsibility: Stan for modern ecological modelling

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2020-06-20

Bayesian models

$$
\begin{aligned}
F_i &\sim \text{Poisson}(\lambda_i) \\
\log(\lambda_i) &= \alpha + \beta x \\
\alpha &\sim \text{Normal}(??, ??) \\
\beta &\sim \text{Normal}(??, ??)
\end{aligned}
$$

Bayesian models

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F_i &\sim \text{Poisson}(\lambda_i) \\
\log(\lambda_i) &= \alpha + \beta x \\
\alpha &\sim \text{Normal}(0, 1000) \\
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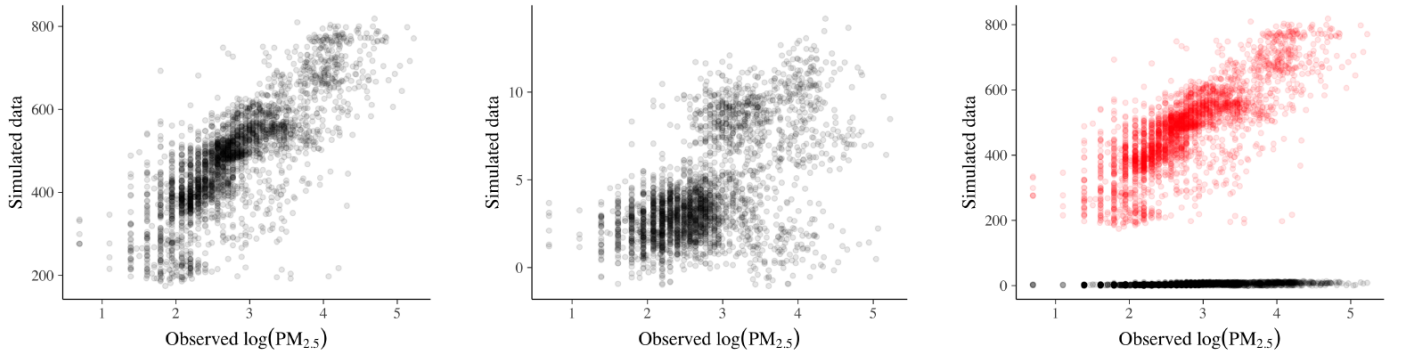
\end{aligned}
$$

as seen in Kéry & Royle 2016 p 188

So what *is* a good prior?



(a) Vague priors (b) Weakly informative priors (c) Comparison

Fig. 4: *(a) and (b) show realizations from the prior predictive distribution using vague priors and weakly informative priors. Simulated data are plotted on y-axis and observed data on x-axis. Panel (c) shows (a) and (b) in the same plot, with red points representing the realizations using vague priors and gray points using weakly informative priors.*

Gabry, Jonah, Daniel Simpson, Aki Vehtari, Michael Betancourt, and Andrew Gelman. « Visualization in Bayesian Workflow ». Journal of the Royal Statistical Society: Series A (Statistics in Society) 182 (2): 389-402. https://doi.org/10.1111/rssa.12378.

what does this prior mean?

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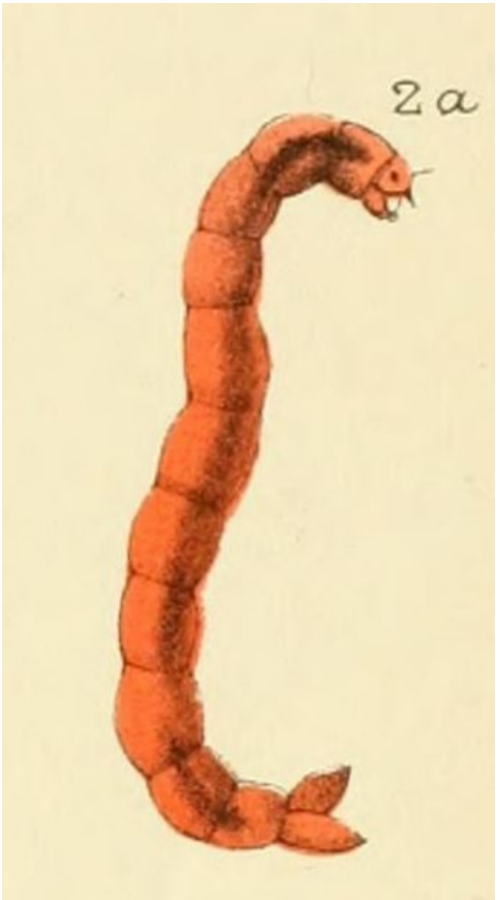
what does this prior mean?

lets do an example about my favourites: fly larvae!



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\end{aligned}
$$

where x is some kind of standardized environmental variable

A quick look at the math for those curious

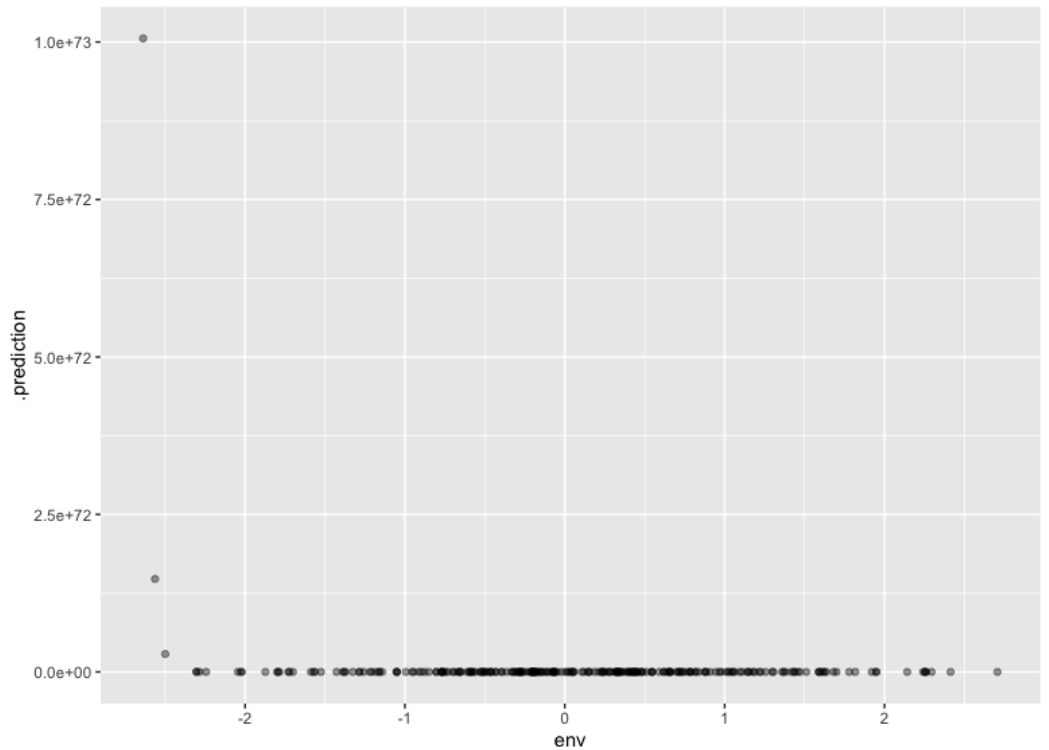
$$\log(\lambda) = \alpha + \beta x$$
$$\lambda = e^{\alpha+\beta x}$$
$$\lambda = e^{\alpha} e^{\beta x}$$

And since $N(0, 1000)$ implies that -1000 and +1000 are entirely reasonable..

- $2.72^{-1000} \times 2.72^{-1000}$
- (practically zero)

- $2.72^{1000} \times 2.72^{1000}$
- (..kind of a lot)

either no flies at all.. or a huge planet of maggots



for comparison, the planet Saturn weighs 5.7 * 10^29 grams

syntax: brms

```
# define formula

insects_bf <- bf(
abundance ~ 1 + env,
family = poisson()
)
```

syntax: setting priors

```
get_prior(insects_bf, data = insect_data)

insect_priors <- c(
  prior(normal(0,100), class = "b", coef = "env"),
  prior(normal(0,100), class = "Intercept")
)
```

syntax: sampling the model

```
insect_samples <- brm(insects_bf,
                      data = insect_data,  # does nothing
                      prior = insect_priors,
                      sample_prior = "only")
```

Exercise I -- Fly larvae

- see the file `insects.R` on github
- on your own or in a small group, experiment with setting priors for insect abundances.
- AND/OR consider an animal or plant which is more relevant to you
- or stay with insects even if that is not your specialty, and set "vague" priors!

exercises -- les poissons

using data from Kaggle, about fish

```
library(readr)
fish <- read_csv("https://raw.githubusercontent.com/aammd/ISEC_stan_c

knitr::kable(head(fish), format = 'html')
```

Species	Weight	Length1	Length2	Length3	Height	Width
Bream	242	23.2	25.4	30.0	11.5200	4.0200
Bream	290	24.0	26.3	31.2	12.4800	4.3056
Bream	340	23.9	26.5	31.1	12.3778	4.6961
Bream	363	26.3	29.0	33.5	12.7300	4.4555
Bream	430	26.5	29.0	34.0	12.4440	5.1340
Bream	450	26.8	29.7	34.7	13.6024	4.9274


THE STRIPED BASS
(ROCCUS LINEATUS.)