



On Priors

Where do Priors Come From?

- Bayesian analyses use prior distributions to represent prior knowledge
- But how do we decide what priors to use?
- Perhaps 3 approaches
 - non-informative
 - vague
 - “order of magnitude”
 - informative
- Different reasons to use each

Non-informative Priors

- Assume we know nothing
 - ignorance
- “Flat” priors
- Problem: can be flat on different scales
 - e.g. standard deviation, variance, precision
 - hence, no unique choice
- One option: Jeffrey's priors
 - minimise the effect of changing the scale over which the prior is set

An Example of Scales

- Model:

$$r \sim \text{dbin}(N, p)$$

- Non-informative prior for p : $p \sim \text{Unif}(0, 1)$

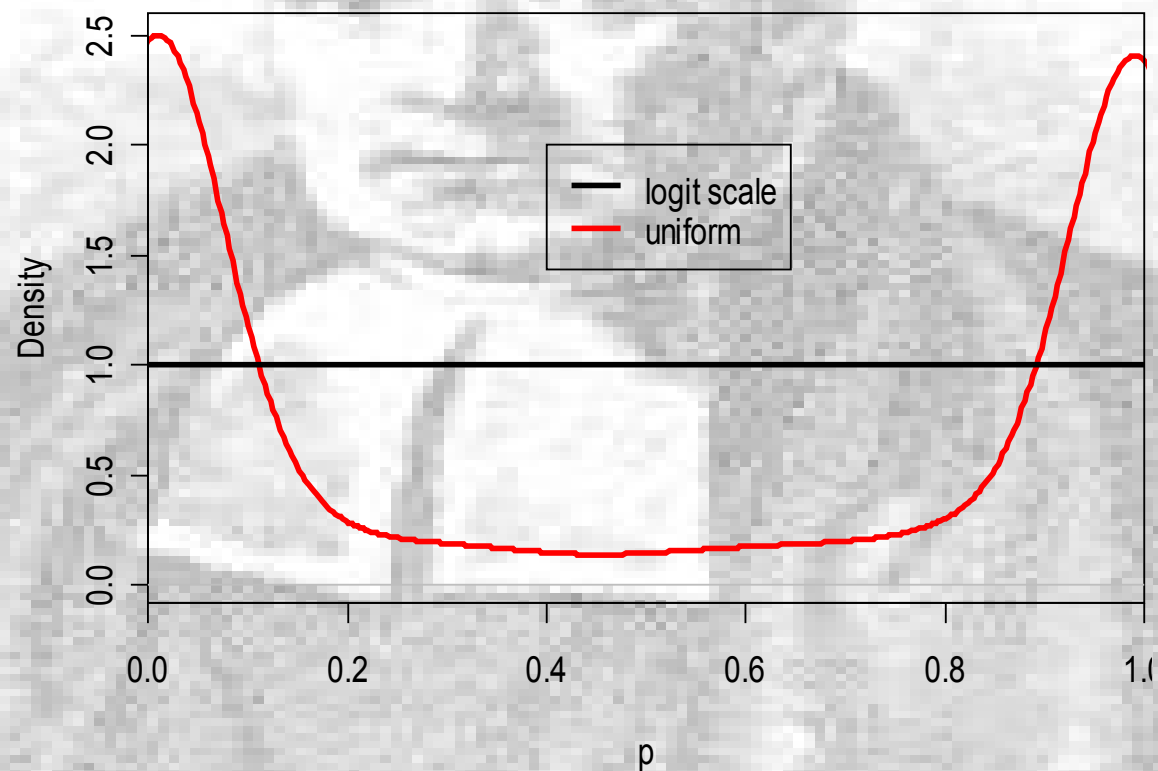
- Alternative: logistic regression

$$\text{logit}(p) \sim \text{dnorm}(0, \tau)$$

– small τ (= large variance)

- What do the priors look like?

Prior on p



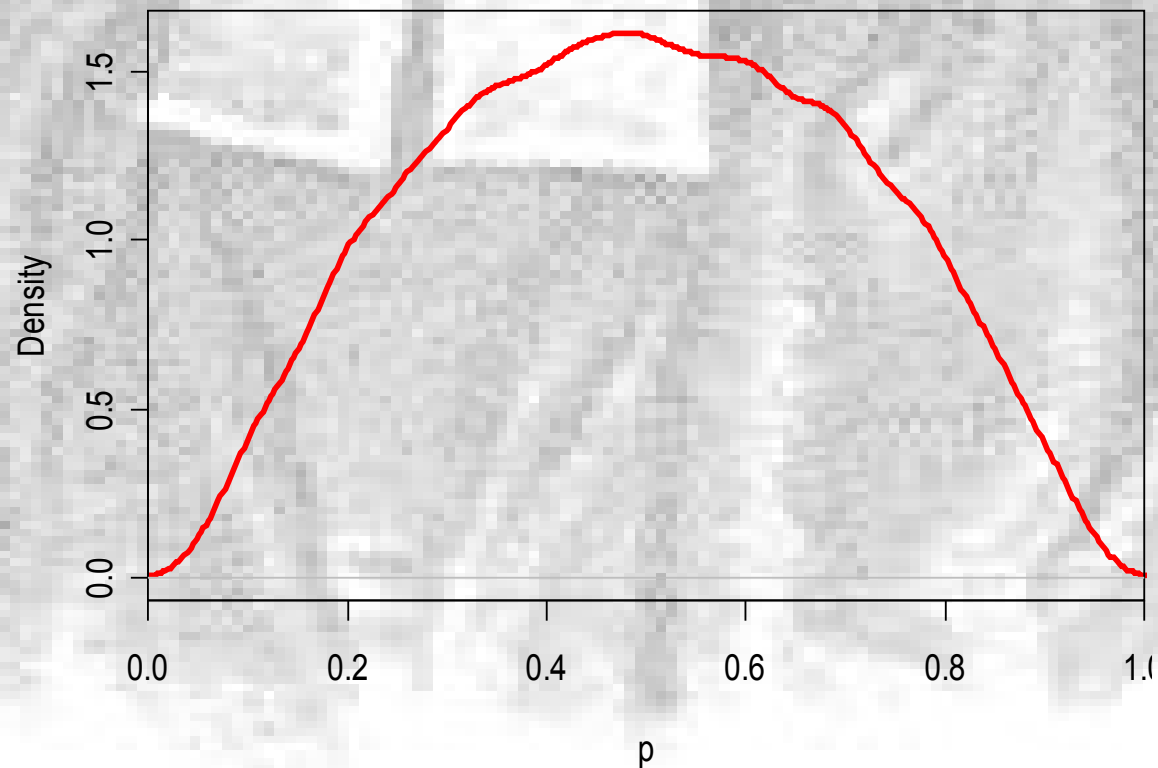
- logit prior is informative on p , but flat on $\text{logit}(p)$

Vague Priors

- Usually we have some idea about the scale of the parameters
 - in logistic regression, $p=0.0067$ is $\text{logit}(p) = -5$
 - hence, restrict the variance of $\text{logit}(p)$
- Use this in our priors
- Should be fairly flat over the range that we expect the value could take, can tail off higher and lower
 - e.g. $\text{logit}(p) \sim N(0, 1)$

Logits

- $\text{logit}(p) \sim N(0, 1)$
 - if we are interested in a probability, it is probably not close to 0 or 1
 - but can be exceptions!



Informative Priors

- If we have substantive information, we should include that in the inference
 - e.g. from previous experiments, expert knowledge
- This is subjective: different people have different opinions
- If the expert is not a Bayesian expert, how do we get out prior?

Prior Elicitation

- Need to convert intuition into a distribution
- Find something concrete
 - “what shape would you give this gamma?” is bad
- Location: ask what an “average” value would be
- Scale: hard. Ask about “limits” to the distribution
 - confidence intervals
- Get an idea about the shape: perhaps less certain
- Try plotting the prior
- May need several tries to get right