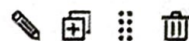



1

True or False 2 points



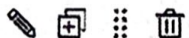
In the Bayesian linear model, the priors for the intercept and for the slope are independent. True or false: in the posterior distribution, the intercept and slope may be correlated.

- ☒ True  
☐ False

You might remember from the first example in R that when we plotted the posterior two parameters at a time we had a plot like  that shows clear correlation. It comes about because if a linear fit has a higher intercept, the slope will have to decrease in order to still go through the cloud of data.

2

Multiple Choice 2 points



In the R code

```
stan_glm(life_expectancy ~ gini, data = mini_gapminder)
```

suppose we wanted instead to use fertility as the outcome variable. Which term would you replace with fertility?

- ☒ life\_expectancy  
☐ gini  
☐ mini\_gapminder

The first term on the left, to the left of  $\sim$ , represents the outcome variable

## Info for the next 4 questions

## Instructions

Please give your answers to 3 decimal places.

Suppose

$$\text{prob}(\text{data}) = 1/8,$$

$$\text{prob}(\theta_1) = 1/4,$$

$$\text{prob}(\theta_2) = 1/2,$$

$$\text{prob}(\text{data} | \theta_1) = 1/6, \text{ and}$$

$$\text{prob}(\text{data} | \theta_2) = 1/18.$$

#3:

$$\begin{aligned} \text{Prob}(\theta_1 | \text{data}) &= \frac{P(\text{data} | \theta_1) P(\theta_1)}{P(\text{data})} \\ &= \frac{\frac{1}{6} \times \frac{1}{4}}{\frac{1}{8}} = \frac{\frac{1}{24}}{\frac{3}{24}} = \frac{1}{3} \end{aligned}$$

#4:

We do not need  $P(\theta_2 | \text{data})$ , only the numerator:

$$P(\text{data} | \theta_2) P(\theta_2) = \frac{1}{18} \times \frac{1}{2} = \frac{1}{36}$$

The probability of jumping ~~from~~ from  $\theta_1$  to a proposal of  $\theta_2$  is

$$\begin{aligned} r &= \frac{P(\theta_2 | \text{data})}{P(\theta_1 | \text{data})} = \frac{P(\text{data} | \theta_2) P(\theta_2)}{P(\text{data} | \theta_1) P(\theta_1)} \\ &\text{since the denominators cancel out} \\ &= \frac{\frac{1}{36}}{\frac{1}{24}} = \frac{2}{3} \end{aligned}$$

Numeric 2 points

What is  $\text{prob}(\theta_1 | \text{data})$ ?

0.333

4

Numeric 2 points

Suppose you are running the Metropolis algorithm to determine the **posterior distribution**. There are many possible values of  $\theta$  besides  $\theta_1$  and  $\theta_2$ . If the Metropolis algorithm is currently at  $\theta_1$  and the proposal is  $\theta_2$ , what is the probability of jumping from  $\theta_1$  to  $\theta_2$ ?

0.667

5

Multiple Choice 1 point

If  $\text{prob}(\text{data})$  had a different value, would your answer to the question about  $\text{prob}(\theta_1 | \text{data})$  be different?

☒ Yes

☐ No

The denominator would change, so the ratio would change.

6

Multiple Choice 1 point

If  $\text{prob}(\text{data})$  had a different value, would your answer to the question involving the Metropolis algorithm be different?

☐ Yes

☒ No

The denominators cancel out when calculating  $r$ .