## 1 Normal-Normal Model with known variance

### 1.1 Background

What is hippocampus?

Why do we care about hippocampus of American football players? A book on the topic

We are interested in  $\theta$  the volume of the hippocampus of American football players.

#### 1.2 Normal Prior

Let  $\theta$  be a random variable which can take any value between  $-\infty$  and  $\infty$ , ie.  $\theta \in (-\infty, \infty)$ . Then the variability in  $\theta$  might be well modeled by a Normal model with **mean parameter**  $\mu$  and standard deviation parameter  $\tau > 0$ :

$$\theta \sim \text{Normal}(\mu, \tau^2)$$

The Normal model is specified by continuous pdf

$$f(\theta) = \frac{1}{\sqrt{2\pi\tau^2}} \exp\{-\frac{1}{2}(\frac{\theta-\mu}{\tau})^2\}$$

According to Wikipedia the volume of hippocampus is about 3.0 to 3.5  $cm^{31}$ 

<sup>&</sup>lt;sup>1</sup>https://en.wikipedia.org/wiki/Hippocampus#Other\_animals

### 1.3 Normal Likelihood

 $X \sim \operatorname{Normal}(\theta, \sigma^2)$ 

Data for 50 American football players shows that the average hippocampus volume is 3.02  $cm^3$ . We will assume that  $\sigma$  is 0.4.

# 1.4 Normal-Normal Conjugacy

Exercise

Prof. Abebe recently finished his graduate school and is teaching his first statistics class. His collegaues told him that final exams are usually normally distributed with a mean of 80 and a variance of 4. Prof. Abebe conducts the final exam and observes that his students (n = 10) had an average score of 92 and he knows that the variance not for his students but for all such exams is 9 (Wow Prof. Abebe really knows a lot!). Find the posterior mean and variance.

## 2 More on Data Order Invariance