



## Normal Densities

### 1 Why

We want a density that is symmetric about some central value with some spread.

### 2 Definition

A normal density is one which can be written as a normalized

Let  $f : \mathbf{R} \rightarrow \mathbf{R}$  be a density. If there exists  $\mu \in \mathbf{R}$  and  $\sigma \in \mathbf{R}$  with  $\sigma > 0$  so that for each  $x \in \mathbf{R}$

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{1}{2} \left(\frac{x - \mu}{\sigma}\right)^2\right)$$

then  $f$  is a *normal density*. Some call a normal density a *Gaussian density*. We often drop the word density and use refer to these as *normals* or *Gaussians*, using these words as substantives.

We call the special case when  $\mu = 0$  and  $\sigma = 1$  the *standard normal density*.