1. Review: density functions as models

   (a) A function \( f \) is a density function if \( f(x) \geq 0 \) for all \( x \) and \( \int_{-\infty}^{\infty} f(x) \, dx = 1 \).

   (b) A density function computes the proportion of data in an interval \([a, b]\) by \( \int_{a}^{b} f(x) \, dx \). This is just the area under the curve defined by \( f \) between the lines \( x = a \) and \( x = b \).

   (c) A density function is a model of a distribution – a "smooth" version of a histogram.

   (d) Another way in which the density function could serve as a model – modeling the process that produced the data

2. Review: the normal density

   (a) Two parameter model: \( \mu \) (mean) and \( \sigma \) (standard deviation)

   (b) density function: \( f(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, -\infty < x < \infty \).

   (c) Computation in R:

       \( \text{pnorm(q,mu,sigma)} \) Area under density curve to left of \( x \) \( \int_{-\infty}^{q} f(x) \, dx \).

       \( \text{qnorm(p,mu,sigma)} \) \( x \) value such that area to left of \( x \) is \( p \)

       \( \text{dnorm(x,mu,sigma)} \) density at \( x \)

3. Some additional important properties

   (a) If \( y \) has a normal distribution with parameters \( \mu \) and \( \sigma \) then \( z = \frac{y - \mu}{\sigma} \) has a standard normal distribution (parameters 0 and 1).

   (b) The 68%-95%-99.7% rule.

   (c) The variable \( y \) is assumed to be continuous. Beware how you use the normal model with discrete variables (And all variables are discrete.)

       continuous possible values are all real numbers in some interval

       discrete possible values form a discrete list (like the integers)

4. Checking the model.

   (a) Is the model right?

   (b) Gross checks: unimodal, symmetric, non-heavy tails

   (c) A more sophisticated check: normal probability plot

5. Other density models.

   (a) Uniform \( \text{punif} \)

   (b) Exponential \( \text{pexp} \)

   (c) Weibull \( \text{pweibull} \)
R Functions

\begin{verbatim}
> hist(normtemp$Temp, freq=F)
> m=mean(normtemp$Temp)
> s=sd(normtemp$Temp)
> x=seq(96,101,.01)
> y=dnorm(x,m,s)
> lines(x,y)
> qqnorm(normtemp$Temp)
\end{verbatim}

Homework

1. No further homework.