Problem 1

Suppose X is a continuous normal random variable and $X \sim N(1, 2)$. Use R command `pnorm()` or `qnorm()` to find:

a. $P(X < 1.64)$

b. $P(X > 1.28)$

c. $P(-1.28 \leq X \leq 1.64)$

d. The 60th percentile of this normal distribution.

Problem 2

Suppose $X \sim Bin(20, 0.6)$. Use R command `dbinom()` or `pbinom()` to find:

a. $P(X = 15)$

b. $P(X \leq 15)$

c. $P(X \geq 15)$

d. $P(5 < X < 15)$

R Problem

Consider the data set heights collected by the famous statistician Karl Pearson in the late 1800s. Karl Pearson organized the collection of data on over 1100 families in England in the period 1893 to 1898. This particular data set gives the heights in inches of mothers and their daughters, with up to two daughters per mother. All daughters are at least age 18, and all mothers are younger than 65. The data set contain 1375 observations and for each row Mheight stands for the height for the mother and Dheight give the height of her daughter. We can import the data using the following command.

```
install.packages("alr4") #skip this line if the package is already installed.
library(alr4)
data("Heights")
```

Answer the questions below. Show your work to receive full credit.

a) Do mothers' heights follow a normal distribution? Use histogram and QQ-plot to assess normality of mother's height. How about daughters' heights?

b) Let Y be the height of an English mother younger than 65, and let X be the height of an English daughter older than 18. From (a), it looks reasonable for us to assume both Y and X are normally distributed. However, we don't know μ and σ of X and Y. We will estimate them using the data set. More specifically, we use sample mean $\bar{x}$ as an estimate for μ and sample standard deviation s as an estimate for σ. Specify the distributions of X and Y respectively.

c) Suppose there is an English mother with height 64.45 inches and her daughter's height is 65.75 inches. Who is relatively higher?

d) What is the probability that an English mother is higher than 63 inches?

e) In order to be the top 5% tallest mother, what's the lowest height must an English mother have?