

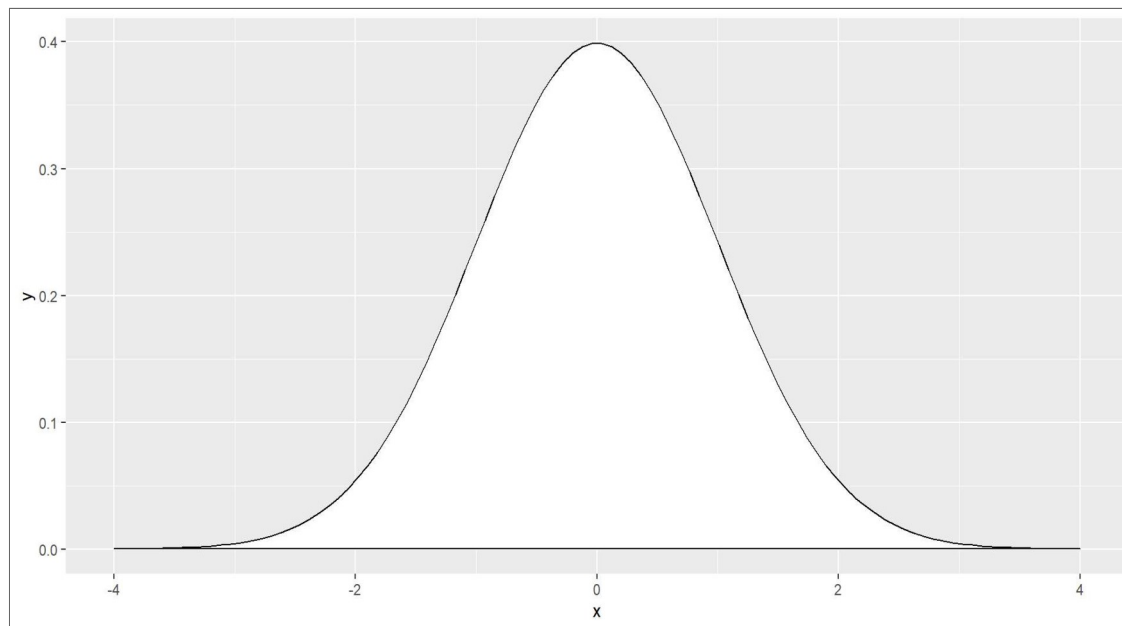
# Normal probabilities and quantiles

This program displays the standard normal curve along with various probabilities and quantiles. It was written by Steve Simon and Leroy Wheeler on 2024-09-04 and is placed in the public domain.

**Load the tidyverse library**

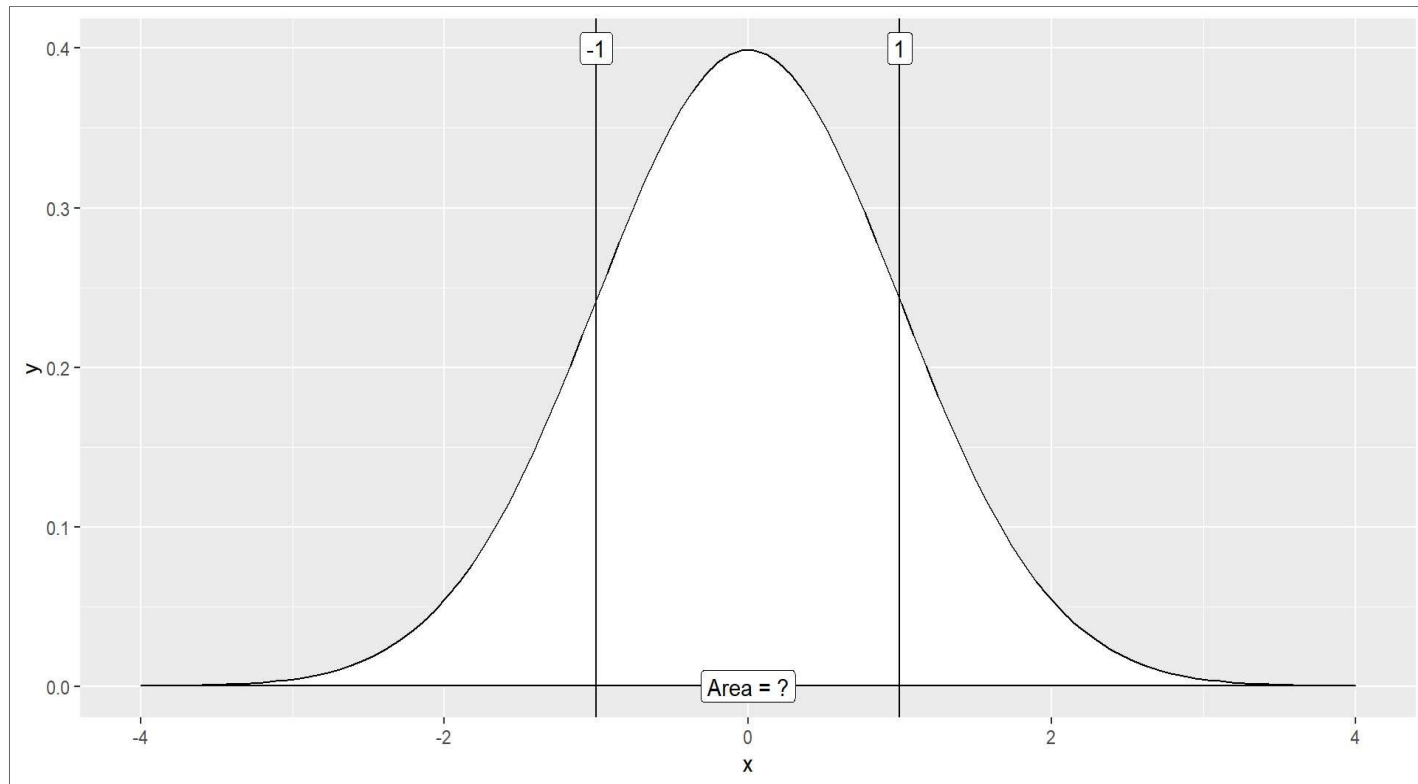
## Using R to draw the standard normal curve

use `seq` to calculate 100 evenly spaced values between -4 and +4 and `dnorm` to compute the bell curve at each point. Use `geom_polygon` to paint the area surrounded by the bell curve.



$$P[-1 < Z < 1]$$

[1] 0.6826895

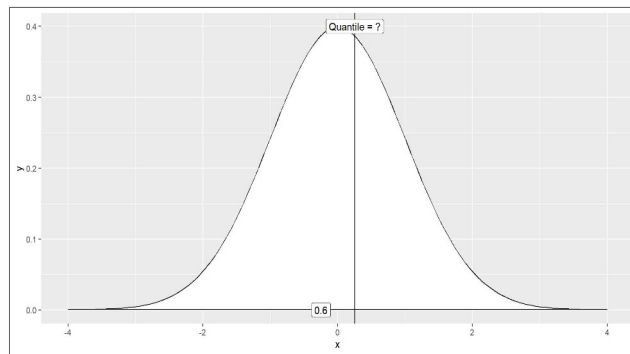


There is a 68% percent chance of getting values between 1 and -1 in the above standard normal distribution curve.

## 60th percentile of a standard normal

Use `qnorm` to calculate quantiles of the standard normal distribution.

```
[1] 0.2533471
```



The value of 0.25 on a standard normal distribution curve is the 60th percentile. This means that there is a 60% probability of getting values less than 0.25 and 40% probability of getting values greater than 0.25.

# Analysis of fev data

This program assesses the normality of variables in a study of pulmonary function in children. There is a [data dictionary](#) that provides more details about the data. The program was written by Steve Simon and Leroy Wheeler on 2024-09-04 and is placed in the public domain.

## Libraries

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The tidyverse library is the only one you need for this program.

```
library(tidyverse)
```

## List variable names

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Since the variable names are not listed in the data file itself, you need to list them here.

```
fev_names <- c(  
  "age",  
  "fev",  
  "ht",  
  "sex",  
  "smoke")
```

## Reading the data

---

Here is the code to read the data and show a glimpse.

```
fev <- read_csv(  
  file="../data/fev.csv",  
  col_names=fev_names,
```

```
col_types="nnncc")
glimpse(fev)
```

Rows: 327

Columns: 5

```
$ age    <dbl> 9, 7, 9, 6, 8, 6, 8, 8, 5, 9, 5, 4, 9, 9, 8, 5, 8, 5, 9, 8, 9, 5...
$ fev    <dbl> 1.708, 1.720, 1.895, 1.919, 1.987, 1.602, 2.193, 2.258, 1.472, 2...
$ ht     <dbl> 57.0, 54.5, 57.0, 58.0, 58.5, 53.0, 58.5, 58.0, 50.0, 59.0, 49.0...
$ sex    <chr> "F,N\n8,1.724,67.5,F", "F,N\n9,1.558,53,M", "M,N\n8,2.336,61,F",...
$ smoke  <chr> "N", "N", "N", "N", "N", "N", "N", "N", "N", "N", "N", "N", "N",...
```

## Calculate mean and standard deviation for ht

---

To orient yourself to the data, calculate a few descriptive statistics.

```
fev |>
  summarize(
    ht_mean=mean(ht),
    ht_stdv=sd(ht))
```

```
# A tibble: 1 × 2
  ht_mean ht_stdv
  <dbl>   <dbl>
1    61.1     5.72
```

The mean ht is 61 inches and the standard deviation is 5.7 inches.

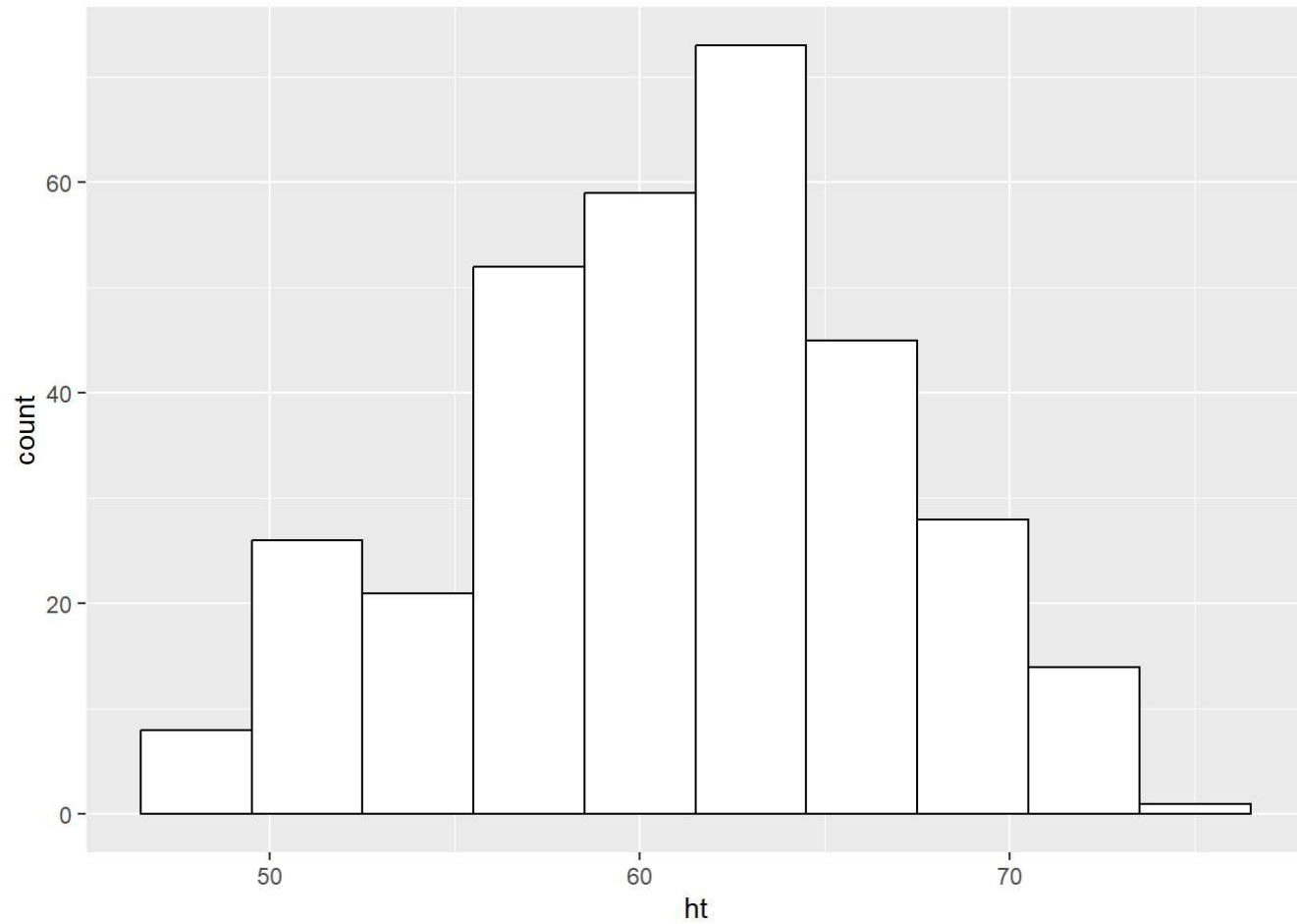
## Histogram for ht, wide bars

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The `geom_histogram` function draws a histogram. You should specify values for `color` (which is the outline of individual bars) and `fill` (which is what is inside the bars). Also be careful with your choice of `binwidth`. Don't rely on the default choice.



```
ggplot(data=fev, aes(x=ht)) +  
  geom_histogram(  
    binwidth=3,  
    color="black",  
    fill="white")
```

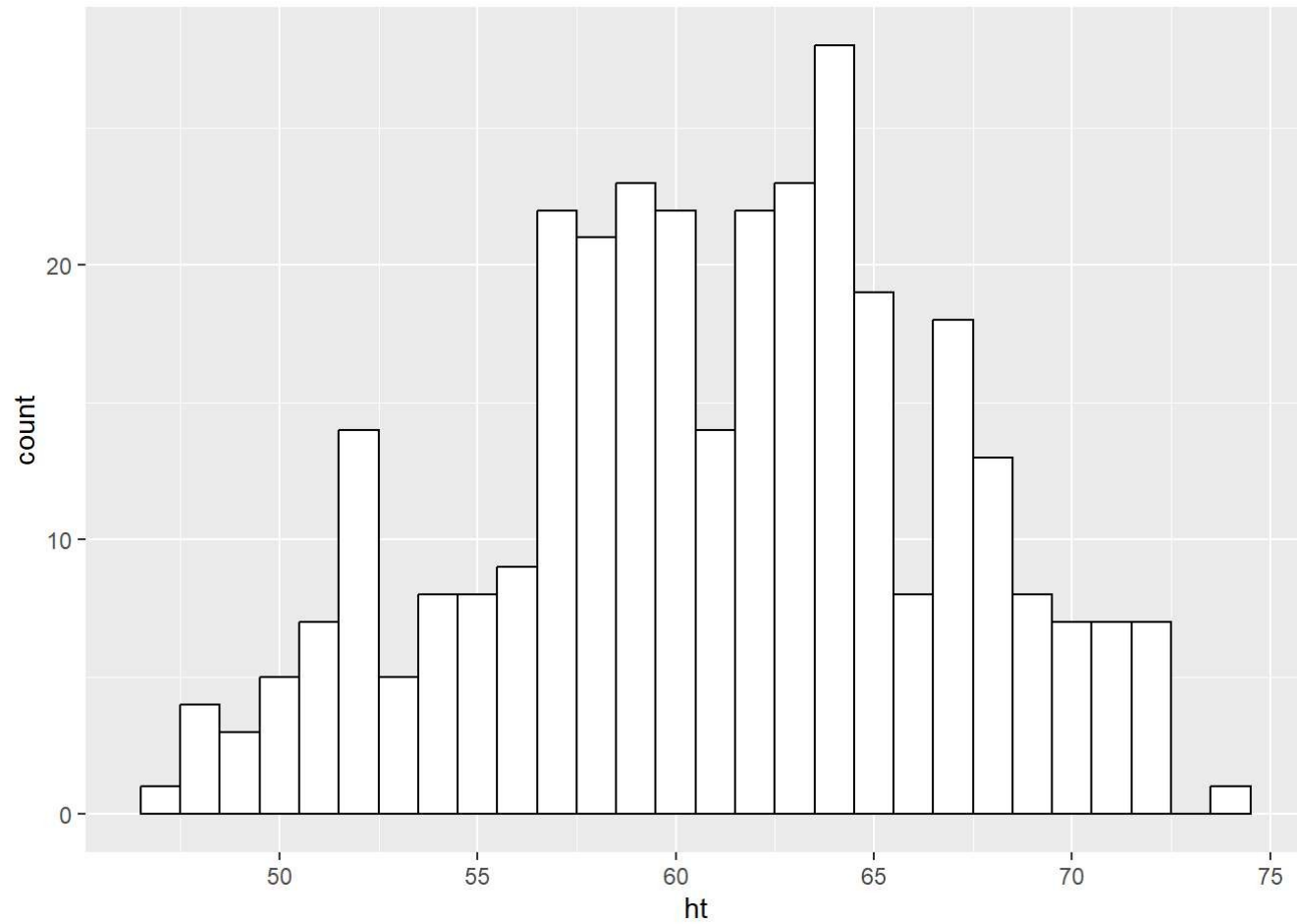


See below for interpretation

## Histogram for ht, narrow bars

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```
ggplot(data=fev, aes(x=ht)) +  
  geom_histogram(  
    binwidth=1,  
    color="black",  
    fill="white")
```



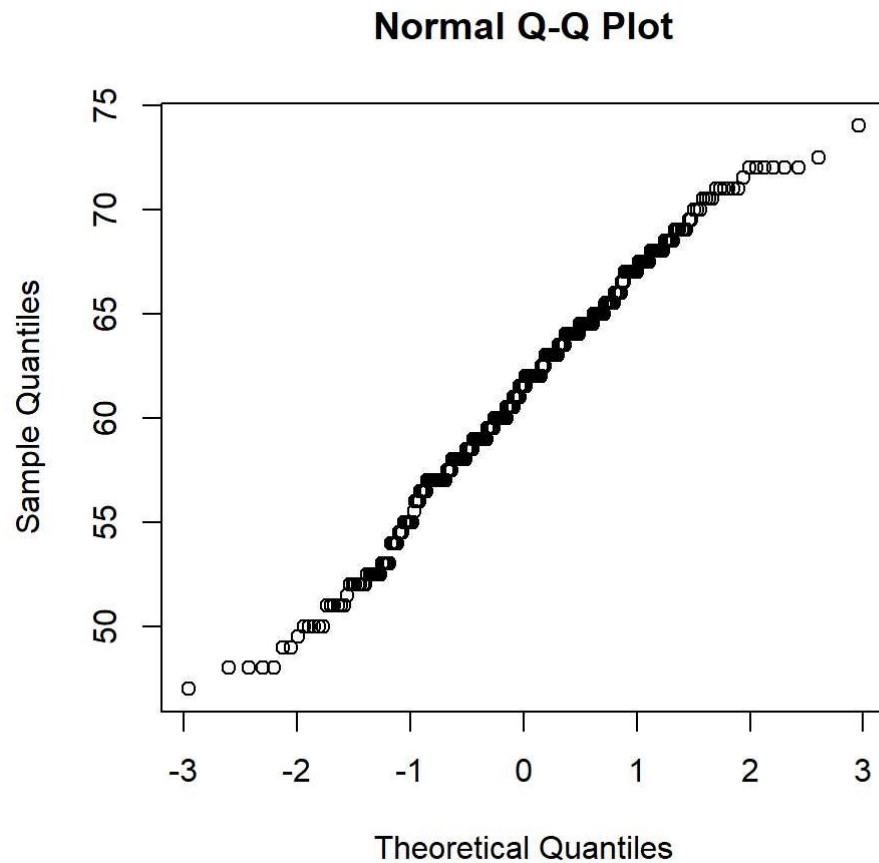
Both histograms which display the values of height in inches demonstrate an approximate normal distribution.

## Normal probability plot for ht

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The qqnorm function produces a normal probability plot. The default option for most plots is landscape orientation (the width is larger than the height). The q-q plot, however, looks best if figure width and height are equal.

```
qqnorm(fev$ht)
```



The normal probability plot is pretty close to a straight line, suggesting the data is reasonably close to a normal distribution.