Housefly wing lengths

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The data

What does the distribution of housefly wing lengths (in mm) look like? This was apparently an important question in 1955, and the data set we look at is a famous one, from Sokal & Hunter, reproduced here:

https://seattlecentral.edu/qelp/sets/057/057.html

The data set can be scanned in from the web:

```
wing.length <- scan("https://seattlecentral.edu/qelp/sets/057/s057.txt")
```

This reads the data in as a vector. To use `ggplot()`, we need the data in a data frame. The following code creates a data frame called `wings.df` that contains a variable called `Length`:

```
wings.df <- data.frame(Length = wing.length)
```

We also need to load the `ggplot2` package to use the functions in it:

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.2.3
```

Summary statistics

Find the sample mean:

```
mean(wings.df$Length)
```

```
## [1] 45.5
```

The sample mean fly wing length is 45.5 millimeters.

Find the plug-in standard deviation and the sample standard deviation:

```
# Plug-in
sqrt(mean(wings.df$Length^2) - mean(wings.df$Length)^2)
```

```
## [1] 3.9
```

```
# Sample SD
sd(wings.df$Length)
```

```
## [1] 3.919647
```

There's hardly any difference. To one decimal place, the standard deviation of fly wing lengths is 3.9 millimeters.

We can also describe the data using the five-number summary:

```
summary(wings.df)
```

```
##      Length
##  Min.   :36.0
##  1st Qu.:43.0
##  Median :45.5
##  Mean   :45.5
##  3rd Qu.:48.0
##  Max.   :55.0
```

```r
IQR(wings.df$Length)
```

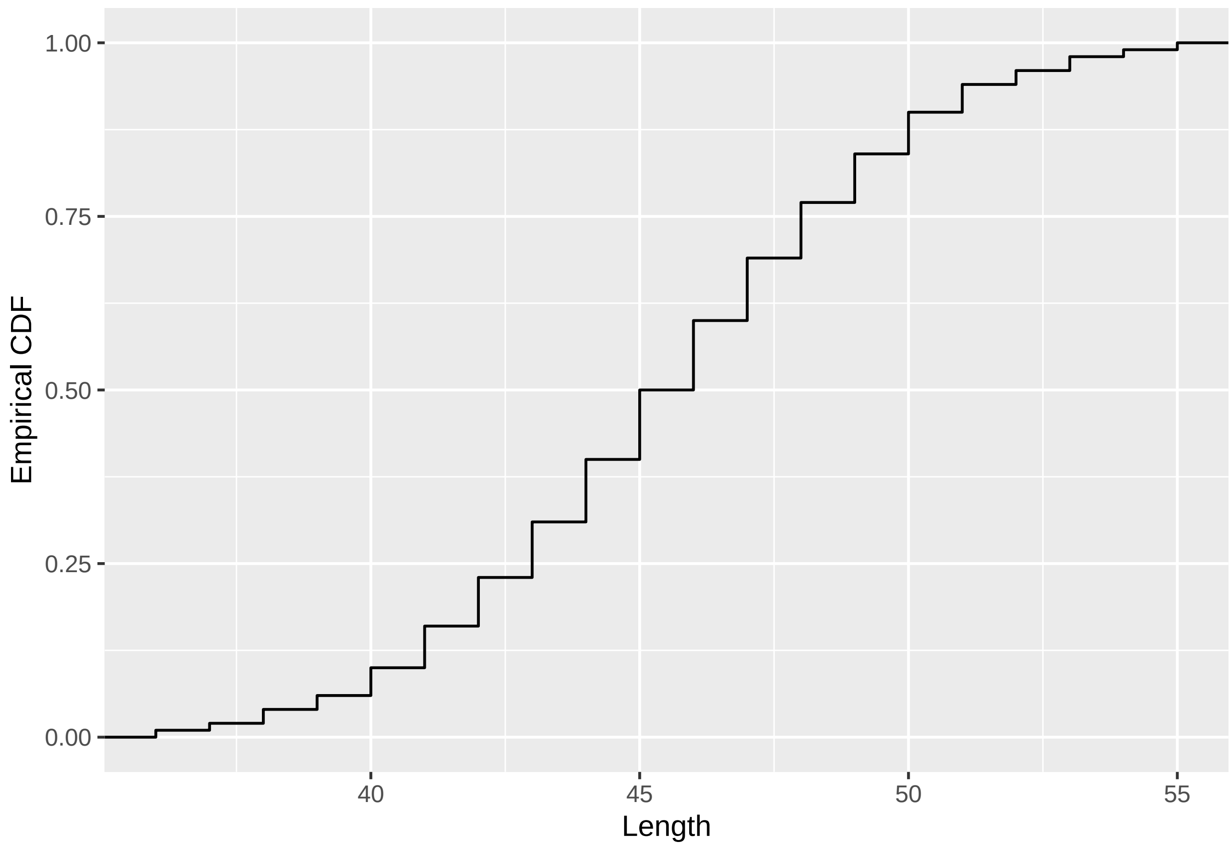
```
## [1] 5
```

The median fly wing length is 45.5 millimeters. The interquartile range is (q3-q1) = 5 millimeters.

Plot the data

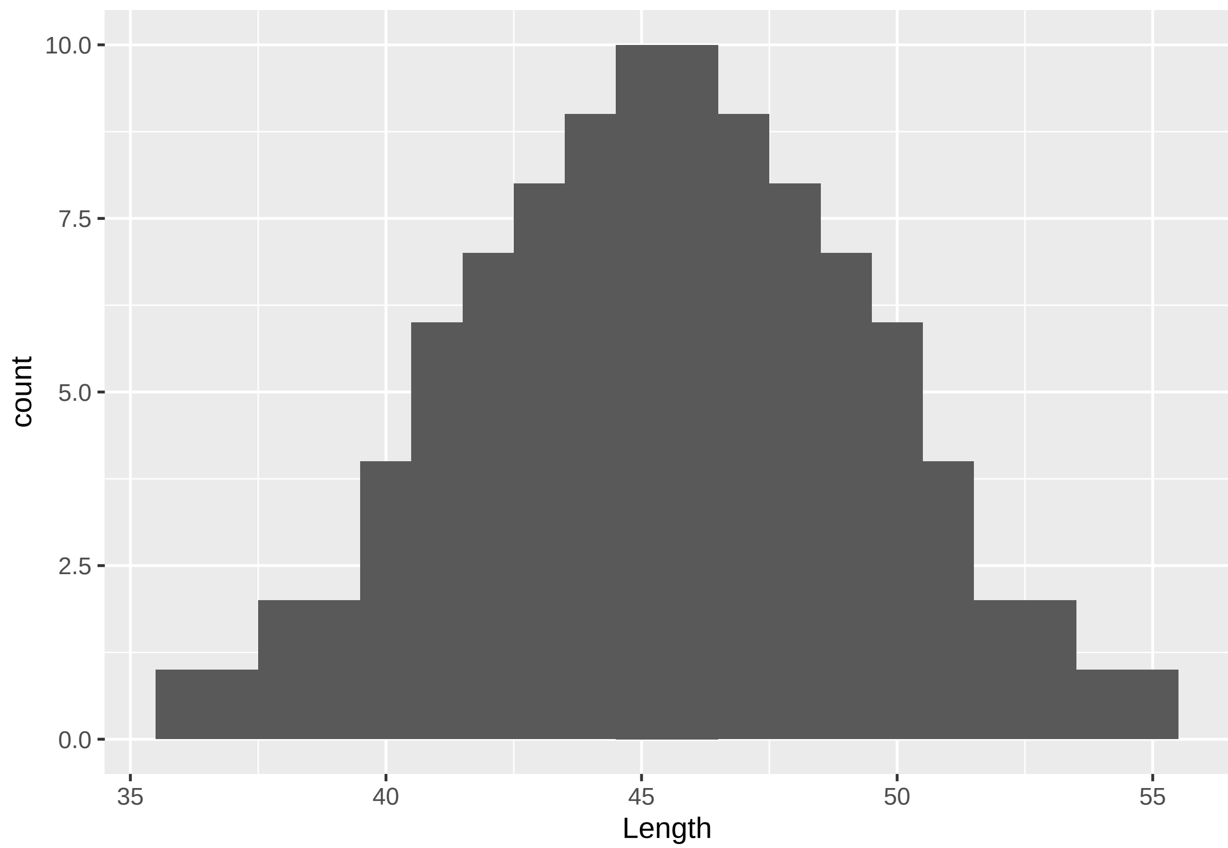
Plot the empirical CDF:

```r
ggplot(wings.df, aes(x = Length)) + stat_ecdf() + ylab("Empirical CDF")
```



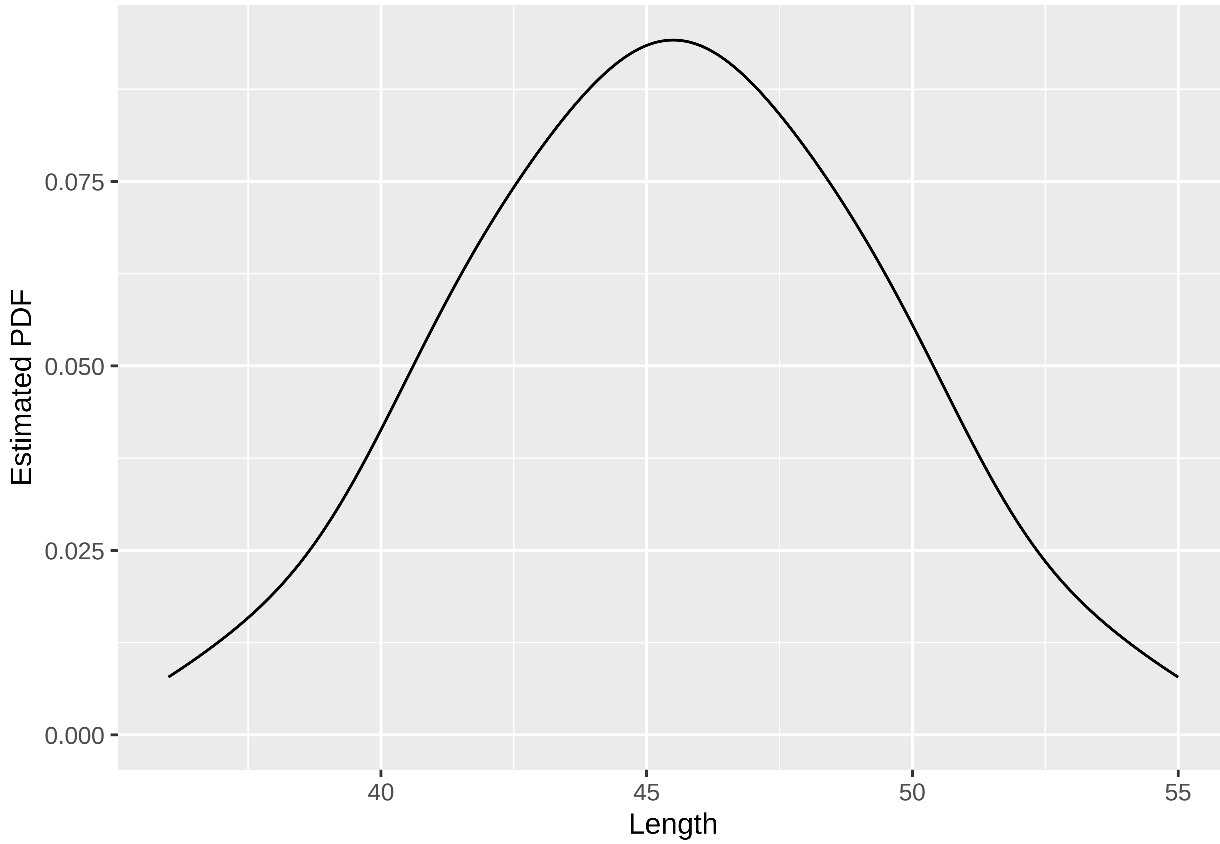
Draw a histogram:

```r
ggplot(wings.df,aes(x = Length)) + geom_histogram(breaks = seq(35.5, 55.5, 1))
```



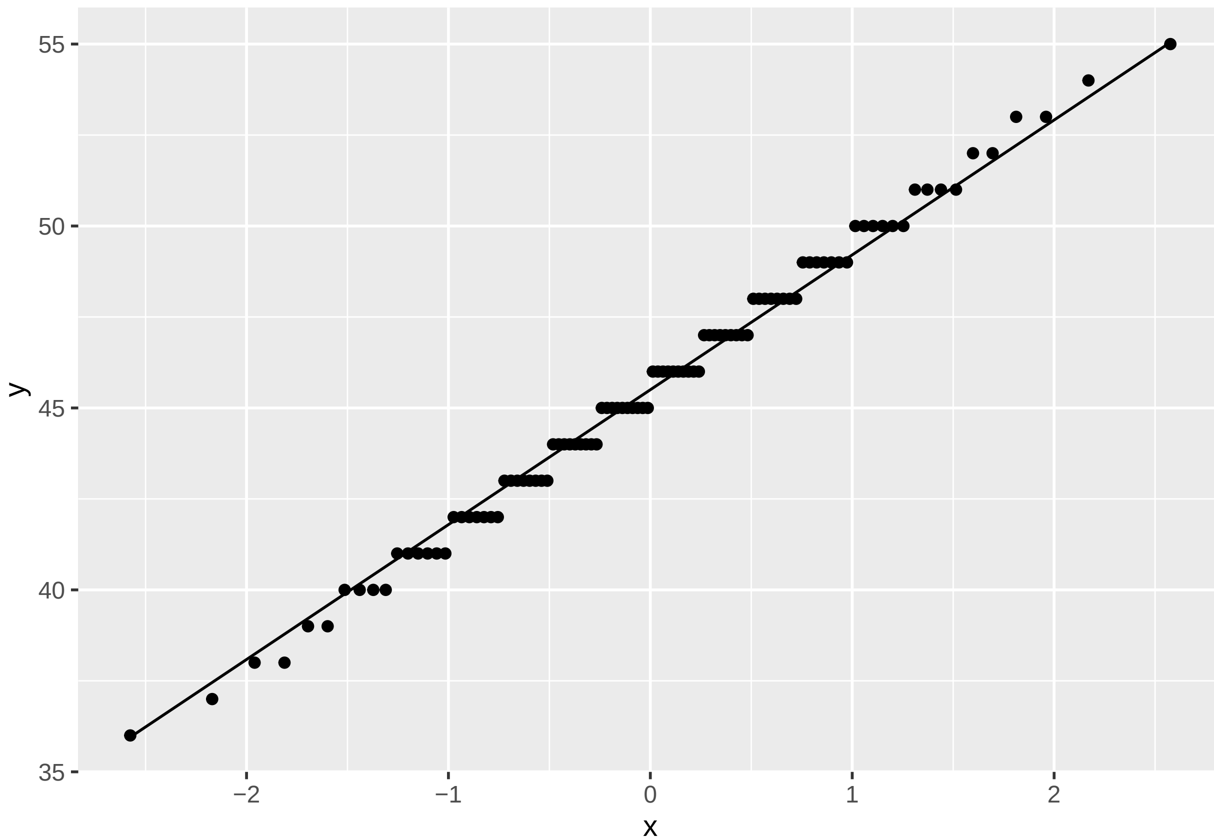
Draw a density estimate:

```
ggplot(wings.df, aes(x=Length)) + geom_density() + ylab("Estimated PDF")
```



Draw a normal quantile-quantile plot:

```
ggplot(wings.df, aes(sample = Length)) + stat_qq() + stat_qq_line()
```



Does the data look like it follows a normal distribution, apart from small discrepancies like rounding? Yes, the data does look like it follows a normal distribution. Even from the QQ line which is straight, and the fact that the points align perfectly well makes it look like its a normal distribution.

There's one thing about the data that might make one suspicious that the data is made up. The suspicious thing is: Perfection. In reality, the data is not as perfect as the data that is shown above. There will be noise, and outliers which in real practical data, which is absent in thic case.