Chapter 9

Example: The dataset **chickwts** is included in the base version of R. This dataset include 71 observations of the growth rate of chickens using a variety of feed supplements.

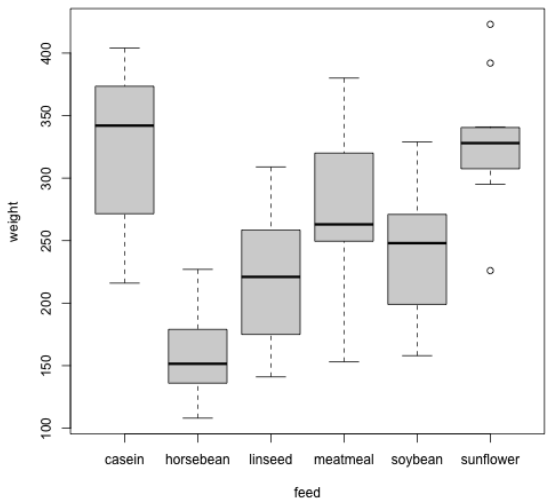
```
data(chickwts)

# pick out some random indices of the dataset and look at the elements
set.seed(2020)
chickwts[sample(x=71,size=10,replace = F),]

##    weight      feed
## 28    250   soybean
## 22    271   linseed
## 65    318    casein
## 17    148   linseed
## 36    248   soybean
## 42    226 sunflower
## 49    325  meatmeal
## 45    334 sunflower
## 56    242  meatmeal
## 8     124 horsebean
```

We can create a boxplot of the weights for the various types of feed.

```
boxplot(weight~feed,data=chickwts)
```



Based on the boxplot, there appears be a difference in weights between **casein** and **horsebean**. To test this, let's run the hypothesis test $H_0 : \mu_1 - \mu_2 = 0$ vs. $H_a : \mu_1 - \mu_2 \neq 0$, where μ_1 is the true mean weight of chicks given casein and μ_2 is the true mean weight of chicks given horsebean. We will use $\alpha = 0.05$ for the following examples.

```
# create new dataset of chicks given casein
chicks1 = chickwts[chickwts$feed=="casein",]
chicks2 = chickwts[chickwts$feed=="horsebean",]
t.test(chicks1$weight,chicks2$weight,mu=0)

##
##  Welch Two Sample t-test
##
## data:  chicks1$weight and chicks2$weight
## t = 7.3423, df = 18.36, p-value = 7.21e-07
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  116.6982 210.0685
## sample estimates:
## mean of x mean of y
##  323.5833  160.2000
```

The test statistic is $t = 7.34$ and corresponds to p-value of $7.21 \cdot 10^{-7}$. Since the p-value is less than $\alpha = 0.05$, we would reject H_0 and conclude that the true mean chick weights differ between casein and horsebean feed.

Suppose we want to test if the true mean weight of casein feed chicks is more than 200 units greater than the true mean weight of horsebean feed chicks, i.e., $H_0 : \mu_1 - \mu_2 = 200$ vs. $H_a : \mu_1 - \mu_2 > 200$.

```
t.test(chicks1$weight,chicks2$weight,mu=200,alternative = "greater")

##
##  Welch Two Sample t-test
##
## data:  chicks1$weight and chicks2$weight
## t = -1.6455, df = 18.36, p-value = 0.9416
## alternative hypothesis: true difference in means is greater than 200
## 95 percent confidence interval:
##  124.8371      Inf
## sample estimates:
## mean of x mean of y
##  323.5833  160.2000
```

The test statistic for this hypothesis test is $t = -1.6455$ with a p-value of 0.9416. At $\alpha = 0.05$, we would fail to reject $H_0 : \mu_1 - \mu_2 = 200$ and conclude there is not sufficient evidence to say that the true mean weight of casein feed chicks is more than 200 units greater than the true mean weight of horsebean feed chicks.