#Levene test prototype

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#for testing equal variances in two samples

#this test employs transformation of data values to difference values around each mean

#Assumptions:

# Observed values x1.1...x1.n are a random sample from a normal distribution.

# Observed values x2.1...x2.n are a random sample from a normal distribution.

# Both sample are independent.

## Note this test is less comprimised by deviation from normal distribution.

## Be sure to test for normal distribution before using this test!

# Hypotheses:

#1) Null: Sigma1^2 is equal to Sigma2^2

#2) Alternative: Sigma1^2 is NOT equal to Sigma2^2 (two sided case)

# Sigma1^2 < Sigma2^2 (one sided case lower tail)

# Sigma1^2 > Sigma2^2 (one sided case upper tail)

#Paperwork

#read in data

iris

#this variable will be needed in r function for Levene

iris\_sv <- iris[1:100,]

#assign variables

x1 <- iris$Sepal.Length[iris$Species=="setosa"]

x1

x2 <- iris$Sepal.Length[iris$Species=="versicolor"]

x2

#assign number of observations

n1 <- length(x1)

n1

n2 <- length(x2)

n2

#assign means

x1bar <- mean(x1)

x1bar

x2bar <- mean(x2)

x2bar

#Transformation to Absolute Difference from Mean: absolute value of each observation subtracted from the respective mean

x1t <- abs(x1-x1bar)

x1t

x2t <- abs(x2-x2bar)

x2t

#means of transformed differences from mean

x1tbar <- mean(x1t)

x1tbar

x2tbar <- mean(x2t)

x2tbar

#variances of transformed differences from mean

st1 <- var(x1t)

st1

st2 <- var(x2t)

st2

#pooled variance of transformed observations

stp <- sqrt((((n1-1)\*st1)+(n2-1)\*st2)/(n1+n2-2))

stp

#####Test Statistic#####

t <- (x1tbar-x2tbar)/sqrt((stp^2/n1)+(stp^2/n2))

t

**[1] -2.904265**

t\_sq <- t^2

t\_sq

**[1] 8.434755**

#Sampling Distribution: if assumptions hold and Null Hypothesis is true, then t~t(n1+n2-2)

#Critical Values of the Test:

alpha <- 0.05 #probability of type 1 error

#two sided case

c1 <- qt(alpha/2, n1+n2-2) #lower cv

c1

c2 <- qt(1-alpha/2, n1+n2-2) #upper cv

c2

abs\_c <- abs(c1) #cv used for two sided test

abs\_c

#one sided case

c3 <- qt(alpha, n1+n2-2) #lower cv

c3

c4 <- qt(1-alpha, n1+n2-2) #upper cv

c4

#Decision Rules:

#if abs(t) > abs\_c, then reject Null, otherwise accept (two sided case)

#if t < c3, then reject Null, " (one sided lower tail)

#if t > c4, then reject Null, " (one sided upper tail)

#Probability Values:

#two sided case

p1 <- 2\*pt(t, n1+n2-2) #if t is < or equal to 0

p1

**[1] 0.004549242**

p2 <- 2\*(1-pt(t, n1+n2-2)) #if t is > 0

p2

#one sided case

p3 <- pt(t, n1+n2-2) #lower tail

p3

p4 <- 1-pt(t, n1+n2-2) #upper tail

p4

#Test the built in R function for Levene test

library(car)

#leveneTest(data,type,center)

leveneTest(iris\_sv$Sepal.Length,iris\_sv$Species,center = mean)

**Levene's Test for Homogeneity of Variance (center = mean)**

**Df F value Pr(>F)**

**group 1 8.4348 0.004549 \*\***

**98**