#Variance Ratio F-test prototype

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#for testing equal variances in two samples

#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 seriously 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

#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

#assign variances

s1\_sq <- var(x1)

s1\_sq

s2\_sq <- var(x2)

s2\_sq

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

#two sided case:

f <- s2\_sq/s1\_sq #note: put larger variance in the numerator

f

**[1] 2.144345**

#one sided case lower tail:

f\_a <- s1\_sq/s2\_sq

f\_a

**[1] 0.4663429**

#one sided case upper tail:

f\_b <- s2\_sq/s1\_sq

f\_b

**[1] 2.144345**

#Sampling Distribution: if assumptions hold and Null Hypothesis is true, the F~F(n1-1)/(n2-1)

#Critical Values of the Test:

alpha <- 0.05 #probablility of type 1 error

cv <- qf(1-alpha/2, n1-1, n2-1) #two sided cv

cv

cv\_a <- qf(alpha, n1-1, n2-1) #one sided lower cv

cv\_a

cv\_b <- qf(1-alpha, n1-1, n2-1) #one sided upper cv

cv\_b

#Decision Rules:

#If f > cv, then reject Null, otherwise accept Null (two sided case)

#If f\_a < cv\_a, then reject Null, " (one sided lower tail)

#If f\_b > cv\_b, then reject Null, " (one sided upper tail)

#Probability Values:

#two sided case

p1 <- 2\*pf(f, n1-1, n2-1) #if f < or equal to 1

p1

p2 <- 2\*(1-pf(f, n1-1, n2-1)) #if f > 1

p2

**[1] 0.008657188**

#one sided case

p3 <- pf(f, n1-1, n2-1) #lower tail

p3

p4 <- 1-pf(f, n1-1, n2-1) #upper tail

p4

#Confidence Intervals for Variance Ratio:

#two sided case: (ci\_a ci\_b)

ci\_a <- (s2\_sq/s1\_sq)\*(1/qf(1-alpha/2, n1-1, n2-1))

ci\_a

**[1] 1.216865**

ci\_b <- (s2\_sq/s1\_sq)\*(qf(1-alpha/2, n2-1, n1-1))

ci\_b

**[1] 3.77874**

#one sided case

ci\_l <- (s2\_sq/s1\_sq)\*(qf(1-alpha, n2-1, n1-1)) #lower tail (0-ci\_l)

ci\_l

ci\_u <- (s2\_sq/s1\_sq)\*(1/qf(1-alpha, n1-1, n2-1)) #upper tail (ci\_u-infinity)

ci\_u

#Now test the built in R function:

var.test(x2,x1,alternative = "two.sided",conf.level = 0.95)

**Results of Hypothesis Test**

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**Null Hypothesis: ratio of variances = 1**

**Alternative Hypothesis: True ratio of variances is not equal to 1**

**Test Name: F test to compare two variances**

**Estimated Parameter(s): ratio of variances = 2.144345**

**Data: x2 and x1**

**Test Statistic: F = 2.144345**

**Test Statistic Parameters: num df = 49**

**denom df = 49**

**P-value: 0.008657188**

**95% Confidence Interval: LCL = 1.216865**

**UCL = 3.778740**

#one sided case lower tail

var.test(x2,x1,alternative = "less",conf.level = 0.95)

#one sided case upper tail

var.test(x2,x1,alternative = "greater",conf.level = 0.95)