**9.10 R 语言应用**

**# 陈文贤 着 《大话统计学》 清华大学出版社 2022年**

if(!require(BSDA)){install.packages("BSDA")} ; library(BSDA)

if(!require(profvis)){install.packages("profvis")} ; library(profvis)

if(!require(ggplot2)){install.packages("ggplot2")} ; library(ggplot2)

if(!require(distributions3)){install.packages("distributions3")} ; library(distributions3)

if(!require(car)){install.packages("car")} ; library(car)

x <- c(7.8, 6.6, 6.5, 7.4, 7.3, 7., 6.4, 7.1, 6.7, 7.6, 6.8)

y <- c(4.5, 5.4, 6.1, 6.1, 5.4, 5., 4.1, 5.5)

z.test(x, sigma.x=0.5, y, sigma.y=0.5, mu=2) # z 检验 x - y 均值 = 2

(ttest = t.test(x,y, var.equal = TRUE)) # t 检验 x - y 均值 = 0 , x,y 方差相等

(ttest = t.test(x,y, var.equal = F)) # t 检验 x - y 均值 = 0 , x,y 方差不相等

# 例题9.3

x1 <- c(86, 59.7, 68.6, 98.6, 87.7, 69, 80, 78.1, 69.8, 77.2)

x2 <- c(51.4,76.7,73.7,66.2,65.5,49.7,65.8,62.1,75.8,62,72,55,79.7,65.4,73.3)

qqnorm(x1) ; qqline(x1) ; pause(10) # x1 的 QQ plot 观察正态分布

qqnorm(x2) ; qqline(x2) ; pause(10) # x2 的 QQ plot 观察正态分布

test <- data.frame(score = c(x1, x2), class = c(rep("x1", length(x1)), rep("x2",

length(x2)) ) ) # x1 , x2 盒须图

ggplot(test, aes(x = class, y = score, color = class)) + geom\_boxplot() +

geom\_jitter() + scale\_color\_brewer(type = "qual", palette = 2) + theme\_minimal() +

theme(legend.position = "none")

# z 检验 x - y 均值 = 0

z.test(x1, sigma.x=12, x2, sigma.y =10, mu=0)

mu <- 0 ; v1 <- 144 ; v2 <- 100

n1 <- length(x1) ; n2 <- length(x2)

z\_stat <- (mean(x1) - mean(x2) - mu) / sqrt(v1 / n1 + v2 / n2) ; z\_stat

Z <- Normal(0, 1) # Z ~N(0,1) 标准正态分布

1 - cdf(Z, abs(z\_stat)) + cdf(Z, -abs(z\_stat)) # 计算双侧检验 p 值

cdf(Z, - abs(z\_stat)) # P(Z < - abs(z\_stat)) # 左侧检验 p 值

res <- var.test(x1, x2) ; res # F检验 x1 , x2 方差相等

t.test(x1,x2, var.equal=TRUE, alternative="greater") # t检验 x1-x2均值=0, 方差相等

# 例题9.6

y1 <- c(70,103,78,64,73,96,84,55,74,90)

y2 <- c(69,94,75,67,71,89,82,55,68,86)

res <- var.test(y1, y2) ; res # F检验 y1 , y2 方差相等

t.test(y1,y2, paired=TRUE, alternative="greater") # 配对样本 t 检验 y1 – y2 均值

t.test(y1,y2, paired=TRUE) # 配对样本 t 检验 y1 – y2 均值

wilcox.test(y1, y2, paired=TRUE) # 15.3 节 符号秩和检验 Wilcox test