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## Distribuição exponencial exponencializada

library(MASS)

# Função densidade - exponencial exponencializada
deexp <- function(x, shape, rate = 1) {
  elam <- exp(-rate * x)
  dens <- shape * rate * (1 - elam)^(shape - 1) * elam
  return(dens)
}

# Função distribuição acumulada - exponencial exponencializada
peexp <- function(x, shape, rate = 1) {
  cdf <- (1 - exp(-rate * x))^shape
  return(cdf)
}

# Amostras aleatórias - exponencial exponencializada
reexp <- function(n, shape, rate = 1) {
  raux <- runif(n)
  return(-log(1 - raux^(1 / shape)) / rate)
}

x <- scan()
17.88 28.92 33.00 41.52 42.12 45.60 48.80 51.84 51.96 54.12 55.56
67.80 68.64 68.64 68.88 84.12 93.12 98.64 105.12 105.84 127.92
128.04 173.40

n <- length(x)
cat("\n n =", n)

## Ajustes
# Exponencial
(laml <- 1 / mean(x))

fitdistr(x, "exponential")

(mgam <- fitdistr(x, "gamma"))

(mwei <- fitdistr(x, "weibull"))

(meexp <- fitdistr(x, deexp, start = list(shape = mgam$estimate[1],
rate = laml)))

# Gráficos
hist(reexp(1000, 3.5, 1), main = "", freq = FALSE)

mycolors <- c("green", "blue", "red", "black")

plot(ecdf(x), main = "", xlab = "Número de ciclos (em milhões)",
pch = 20, ylab = "Funções distribuição")
curve(pexp(x, rate = laml), add = TRUE, col = mycolors[1])
curve(pgamma(x, shape = mgam$estimate[1], rate = mgam$estimate[2]),
add = TRUE, col = mycolors[2])
curve(pweibull(x, shape = mwei$estimate[1], scale = mwei$estimate[2]), add =
TRUE, col = mycolors[3])
curve(peexp(x, shape = meexp$estimate[1], rate = meexp$estimate[2]),
add = TRUE, col = mycolors[4])
legend("bottomright", c("Exponencial", "Gama", "Weibull",
"Exponencial\n exponencializada"),

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lty = 1, col = mycolors, bty = "n")

hist(x, freq = FALSE, main = "", xlab = "Número de ciclos (em milhões)",
     pch = 20, ylab = "Funções densidade")
curve(dexp(x, rate = lam1), add = TRUE, col = mycolors[1])
curve(dgamma(x, shape = mgam$estimate[1], rate = mgam$estimate[2]),
     add = TRUE, col = mycolors[2])
curve(dweibull(x, shape = mwei$estimate[1], scale = mwei$estimate[2]),
     add = TRUE, col = mycolors[3])
curve(deexp(x, shape = meexp$estimate[1], rate = meexp$estimate[2]),
     add = TRUE, col = mycolors[4], from = 0)
legend("topright", c("Exponencial", "Gama", "Weibull",
                    "Exp. exponenc."), lty = 1, col = mycolors, bty = "n")
box()

# Bootstrap
B <- 5000
tetacs <- matrix(NA, B, 2)
for (b in 1:B) {
  xs <- sample(x, n, replace = TRUE)
  meexps <- fitdistr(xs, deexp, start =
    list(shape = meexp$estimate[1], rate = meexp$estimate[2]),
    method = "Nelder-Mead")
  tetacs[b, ] <- meexps$estimate
}

summary(tetacs)
cat("\n Erros padrão bootstrap:", apply(tetacs, 2, sd))

hist(tetacs[, 1], main = "", freq = FALSE, ylab = "Densidade",
     xlab = expression(hat(alpha)^"*"))
box()

hist(log(tetacs[, 1]), main = "", freq = FALSE, ylab = "Densidade",
     xlab = expression(log(hat(alpha)^"*")))
lines(density(log(tetacs[, 1])), col = "blue", lty = 2, lwd = 2)
box()

hist(tetacs[, 2], main = "", freq = FALSE, ylab = "Densidade",
     xlab = expression(hat(beta)^"*"))
lines(density(tetacs[, 2]), col = "blue", lty = 2, lwd = 2)
box()

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