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age=c(35,45,55,65,75)
tension=c(114,124,143,158,166)
reg=lm(tension~age)

mu=reg$coef[1] # mu = 65.1
beta=reg$coef[2] # beta = 1.38
sig=summary(reg)[[6]] # sig = 3.246
(mu = reg$coef[1]); (beta = reg$coef[2]); (sig = summary(reg)[[6]])

# exo1
# Simuler un jeu de données
y=mu+beta*age+rnorm(5,0,sig)
reg2=lm(y~age)
summary(reg2)
plot(age,tension,type="p", lwd=3) # Tracer le nuage de points des données originales
points(age,y,col="green", lwd=3) # Ajouter le nuage de points des données simulées
abline(reg,col="red", lwd=3) # Tracer la droite de régression originale
abline(reg2,col="cyan", lwd=3) # Tracer la droite de régression avec les données simulées

# exo2
# Simuler 100 jeux de données et tracer les droites de régression
for (i in 1:100){
  y=mu+beta*age+rnorm(5,0,sig)
  reg2=lm(y~age)
  points(age,y,col="green", lwd=3)
  abline(reg2,col="cyan", lwd=3)
}
# Retracer le modèle original
points(age,tension,type="p");
abline(reg,col="red",lwd=2)
# IC estimation, IC prediction
x = as.data.frame(cbind(tension,age))
p1=predict(reg,x,interval="confidence",level=0.8, se.fit=TRUE)
p2=predict(reg,x,interval="prediction",level=0.8, se.fit=TRUE)
points( p1$fit[,2]~age, type='l', lty="dotted", lwd=3)
points( p1$fit[,3]~age, type='l', lty="dotted", lwd=3)
points( p2$fit[,2]~age, type='l', lty="dashed", lwd=3 )
points( p2$fit[,3]~age, type='l', lty="dashed", lwd=3 )
legend("topleft", c("Bande de confiance","Bande de prédiction"),lwd=1, lty=c("dotted",
"dashed"),cex=0.8)

# exo3
#####
n = 10000
m = rep(0, n); b = rep(0, n); s = rep(0, n)
ms = rep(0, n); bs = rep(0, n);

for (i in 1:n){
  y = mu+beta*age+rnorm(5,0,sig)
  y = mu+beta*age+rnorm(5,0,sig)
  reg2 = lm(y~age)
  m[i] = reg2$coef[1]; b[i] = reg2$coef[2]; s[i] = summary(reg2)[[6]]
  ms[i] = summary(reg2)[[4]][3]; bs[i] = summary(reg2)[[4]][4];
}

mus = summary(reg)[[4]][3]; betas = summary(reg)[[4]][4];
hist((m-mu)/mus, freq = F, breaks = 100)
hist((b-beta)/betas, freq = F, breaks = 100)

y = seq(-4, 4, length.out = 100)
lines(y, dnorm(y), lwd=3)

hist((m-mu)/ms, freq = F, breaks = 100)
hist((b-beta)/bs, freq = F, breaks = 100)

y = seq(-20, 20, length.out = 100)
lines(y, dnorm(y), lwd=3)
lines(y, dt(y, 3), col = "red", lwd=3)

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