SIMULATION CODES FOR THE 6 PERFORMANCE MEASURES.

lm <- 186

mu <- 40

s <- 5

raw\_0\_1 <- 0.97

raw\_0\_2 <- 0.99

raw\_0\_3 <- 1.01

n1 <- c(30, 50, 100)

n2 <- c(30, 50, 100)

matmselq <- matrix(0, nrow = 3, ncol = 3)

matmselq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmapelq <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmaelq <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq90lq <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq25lq <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_3 <- matrix(0, nrow = 3, ncol = 3)

for (a in 1:3) {

for (b in 1:3) {

mselq <- 0

mselq2\_1 <- 0

mselq2\_2 <- 0

mselq2\_3 <- 0

mapelq <- 0

mapelq2\_1 <- 0

mapelq2\_2 <- 0

mapelq2\_3 <- 0

maelq <- 0

maelq2\_1 <- 0

maelq2\_2 <- 0

maelq2\_3 <- 0

meanlq <- 0

meanlq2\_1 <- 0

meanlq2\_2 <- 0

meanlq2\_3 <- 0

for (k in 1:10000) {

sx <- 0

sy <- 0

for (i in 1:n1[a]) {

random <- runif(1)

x <- log(1 - random) / (-lm)

sx <- sx + x

}

lambda <- n1[a] / sx

meanx <- sx / n1[a]

for (j in 1:n2[b]) {

random <- runif(1)

y <- log(1 - random) / (-mu)

sy <- sy + y

}

meu <- n2[b] / sy

meany <- sy / n2[b]

sum1 <- 0

for (n in 0:s) {

fact1 <- factorial(n)

x1 <- (lm / mu)^n / fact1

sum1 <- sum1 + x1

}

fact2 <- factorial(s)

p0\_1 <- 1 / sum1

sum3 <- 0

for (n in 0:s) {

fact3 <- factorial(n)

x3 <- (meany / meanx)^n / fact3

sum3 <- sum3 + x3

}

p0\_2 <- 1 / sum3

lq\_1 <- ((lm / mu)^s / fact2) \* p0\_1

lq\_2 <- ((meany / meanx)^s / fact2) \* p0\_2

e\_lq[k] <- abs(lq\_1 - lq\_2)

p\_lq <- 100 \* (e\_lq[k] / lq\_1)

mapelq <- mapelq + abs(p\_lq)

mselq <- mselq + e\_lq[k]^2

maelq <- maelq + e\_lq[k]

meanlq <- meanlq + lq\_2

if (meany <= raw\_0\_1 \* meanx \* s) {

sum3\_1 <- 0

for (n in 0:s) {

fact3\_1 <- factorial(n)

x3\_1 <- (meany / meanx)^n / fact3\_1

sum3\_1 <- sum3\_1 + x3\_1

}

p0\_2\_1 <- 1 / sum3\_1

lq\_2\_1 <- ((meany / meanx)^s / fact2) \* p0\_2\_1

} else {

sum3\_11 <- 0

for (n in 0:s) {

fact3\_11 <- factorial(n)

x3\_11 <- (s \* raw\_0\_1)^n / fact3\_11

sum3\_11 <- sum3\_11 + x3\_11

}

p0\_2\_11 <- 1 / sum3\_11

lq\_2\_1 <- ((s \* raw\_0\_1)^s / fact2) \* p0\_2\_11

}

e2\_1[k] <- abs(lq\_1 - lq\_2\_1)

p2\_1 <- 100 \* (e2\_1[k] / lq\_1)

mapelq2\_1 <- mapelq2\_1 + abs(p2\_1)

mselq2\_1 <- mselq2\_1 + e2\_1[k]^2

maelq2\_1 <- maelq2\_1 + e2\_1[k]

meanlq2\_1 <- meanlq2\_1 + lq\_2\_1

if (meany <= raw\_0\_2 \* meanx \* s) {

sum3\_2 <- 0

for (n in 0:s) {

fact3\_2 <- factorial(n)

x3\_2 <- (meany / meanx)^n / fact3\_2

sum3\_2 <- sum3\_2 + x3\_2

}

p0\_2\_2 <- 1 / sum3\_2

lq\_2\_2 <- ((meany / meanx)^s / fact2) \* p0\_2\_2

} else {

sum3\_22 <- 0

for (n in 0:s) {

fact3\_22 <- factorial(n)

x3\_22 <- (s \* raw\_0\_2)^n / fact3\_22

sum3\_22 <- sum3\_22 + x3\_22

}

p0\_2\_22 <- 1 / sum3\_22

lq\_2\_2 <- ((s \* raw\_0\_2)^s / fact2) \* p0\_2\_22

}

e2\_2[k] <- abs(lq\_1 - lq\_2\_2)

p2\_2 <- 100 \* (e2\_2[k] / lq\_1)

mapelq2\_2 <- mapelq2\_2 + abs(p2\_2)

mselq2\_2 <- mselq2\_2 + e2\_2[k]^2

maelq2\_2 <- maelq2\_2 + e2\_2[k]

meanlq2\_2 <- meanlq2\_2 + lq\_2\_2

if (meany <= raw\_0\_3 \* meanx \* s) {

sum3\_3 <- 0

for (n in 0:s) {

fact3\_3 <- factorial(n)

x3\_3 <- (meany / meanx)^n / fact3\_3

sum3\_3 <- sum3\_3 + x3\_3

}

p0\_2\_3 <- 1 / sum3\_3

lq\_2\_3 <- ((meany / meanx)^s / fact2) \* p0\_2\_3

} else {

sum3\_33 <- 0

for (n in 0:s) {

fact3\_33 <- factorial(n)

x3\_33 <- (s \* raw\_0\_3)^n / fact3\_33

sum3\_33 <- sum3\_33 + x3\_33

}

p0\_2\_33 <- 1 / sum3\_33

lq\_2\_3 <- ((s \* raw\_0\_3)^s / fact2) \* p0\_2\_33

}

e2\_3[k] <- abs(lq\_1 - lq\_2\_3)

p2\_3 <- 100 \* (e2\_3[k] / lq\_1)

mapelq2\_3 <- mapelq2\_3 + abs(p2\_3)

mselq2\_3 <- mselq2\_3 + e2\_3[k]^2

maelq2\_3 <- maelq2\_3 + e2\_3[k]

meanlq2\_3 <- meanlq2\_3 + lq\_2\_3

}

# Sorting and calculating medianaelq and q90lq

e\_lq <- sort(e\_lq)

medianaelq <- (e\_lq[4999] + e\_lq[5000]) / 2

q90lq <- (e\_lq[8999] + e\_lq[9000]) / 2

q25lq <- (e\_lq[2499] + e\_lq[2500]) / 2

# Sorting and calculating medianaelq2\_1 and q90lq2\_1

e2\_1 <- sort(e2\_1)

medianaelq2\_1 <- (e2\_1[4999] + e2\_1[5000]) / 2

q90lq2\_1 <- (e2\_1[8999] + e2\_1[9000]) / 2

q25lq2\_1 <- (e2\_1[2499] + e2\_1[2500]) / 2

# Sorting and calculating medianaelq2\_2 and q90lq2\_2

e2\_2 <- sort(e2\_2)

medianaelq2\_2 <- (e2\_2[4999] + e2\_2[5000]) / 2

q90lq2\_2 <- (e2\_2[8999] + e2\_2[9000]) / 2

q25lq2\_2 <- (e2\_2[2499] + e2\_2[2500]) / 2

# Sorting and calculating medianaelq2\_3 and q90lq2\_3

e2\_3 <- sort(e2\_3)

medianaelq2\_3 <- (e2\_3[4999] + e2\_3[5000]) / 2

q90lq2\_3 <- (e2\_3[8999] + e2\_3[9000]) / 2

q25lq2\_3 <- (e2\_3[2499] + e2\_3[2500]) / 2

matmselq[a, b] <- (mselq / 10000)

matmapelq[a, b] <- mapelq / 10000

matmaelq[a, b] <- maelq / 10000

matmeanlq[a, b] <- meanlq / 10000

matmedianlq[a,b]<- medianaelq

matq90lq[a,b]<-q90lq

matq25lq[a,b]<-q25lq

matmselq\_1[a, b] <- (mselq2\_1 / 10000)

matmapelq\_1[a, b] <- mapelq2\_1 / 10000

matmaelq\_1[a, b] <- maelq2\_1 / 10000

matmeanlq\_1[a, b] <- meanlq2\_1 / 10000

matmedianlq\_1[a,b]<- medianaelq2\_1

matq90lq\_1[a,b]<-q90lq2\_1

matq25lq\_1[a,b]<-q25lq2\_1

matmselq\_2[a, b] <- (mselq2\_2 / 10000)

matmapelq\_2[a, b] <- mapelq2\_2 / 10000

matmaelq\_2[a, b] <- maelq2\_2 / 10000

matmeanlq\_2[a, b] <- meanlq2\_2 / 10000

matmedianlq\_2[a,b]<- medianaelq2\_2

matq90lq\_2[a,b]<-q90lq2\_2

matq25lq\_2[a,b]<-q25lq2\_2

matmselq\_3[a, b] <- (mselq2\_3 / 10000)

matmapelq\_3[a, b] <- mapelq2\_3 / 10000

matmaelq\_3[a, b] <- maelq2\_3 / 10000

matmeanlq\_3[a, b] <- meanlq2\_3 / 10000

matmedianlq\_3[a,b]<- medianaelq2\_3

matq90lq\_3[a,b]<-q90lq2\_3

matq25lq\_3[a,b]<-q25lq2\_3

}

}

cat("\n\n estimates of lq for mean using substitution estimators")

cat("\t")

cat("\n\n the meanlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the meanlq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_1[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the meanlq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_2[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the meanlq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_3[a, b])

}

}

cat("\n\n estimates of lq of mse using substitution estimators")

cat("\t")

cat("\n\n the mselq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mselq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_1[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mselq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_2[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mselq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_3[a, b])

}

}

cat("\n\n estimates of lq of mape using substitution estimators")

cat("\t")

cat("\n\n the mapelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mapelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mapelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mapelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_3[a, b])

}

}

cat("\n\n estimates of lq of mae using substitution estimators")

cat("\t")

cat("\n\n the maelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the maelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the maelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the maelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_3[a, b])

}

}

cat("\n\n estimates of lq using mdae using substitution estimators")

cat("\t")

cat("\n\n the medianlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the medianlq2\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_1[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the medianlq2\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_2[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the medianlq2\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_3[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using substitution estimators")

cat("\t")

cat("\n\n the q90lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q90lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q90lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q90lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_3[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using substitution estimators")

cat("\t")

cat("\n\n the q25lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q25lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q25lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q25lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_3[a,b])

}

}

##################################################################

#### 2

lm <- 24

mu <- 10

s <- 3

raw\_0\_1 <- 0.81

raw\_0\_2 <- 0.83

raw\_0\_3 <- 0.85

n1 <- c(30, 50, 100)

n2 <- c(30, 50, 100)

matmselq <- matrix(0, nrow = 3, ncol = 3)

matmselq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmapelq <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmaelq <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq90lq <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq25lq <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_3 <- matrix(0, nrow = 3, ncol = 3)

for (a in 1:3) {

for (b in 1:3) {

mselq <- 0

mselq2\_1 <- 0

mselq2\_2 <- 0

mselq2\_3 <- 0

mapelq <- 0

mapelq2\_1 <- 0

mapelq2\_2 <- 0

mapelq2\_3 <- 0

maelq <- 0

maelq2\_1 <- 0

maelq2\_2 <- 0

maelq2\_3 <- 0

meanlq <- 0

meanlq2\_1 <- 0

meanlq2\_2 <- 0

meanlq2\_3 <- 0

for (k in 1:10000) {

sx <- 0

sy <- 0

for (i in 1:n1[a]) {

random <- runif(1)

x <- log(1 - random) / (-lm)

sx <- sx + x

}

lambda <- n1[a] / sx

meanx <- sx / n1[a]

for (j in 1:n2[b]) {

random <- runif(1)

y <- log(1 - random) / (-mu)

sy <- sy + y

}

meu <- n2[b] / sy

meany <- sy / n2[b]

sum1 <- 0

for (n in 0:s) {

fact1 <- factorial(n)

x1 <- (lm / mu)^n / fact1

sum1 <- sum1 + x1

}

fact2 <- factorial(s)

p0\_1 <- 1 / sum1

sum3 <- 0

for (n in 0:s) {

fact3 <- factorial(n)

x3 <- (meany / meanx)^n / fact3

sum3 <- sum3 + x3

}

p0\_2 <- 1 / sum3

lq\_1 <- (lm/mu)\*(1-(((lm / mu)^s / fact2) \* p0\_1))

lq\_2 <- (meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2))

e\_lq[k] <- abs(lq\_1 - lq\_2)

p\_lq <- 100 \* (e\_lq[k] / lq\_1)

mapelq <- mapelq + abs(p\_lq)

mselq <- mselq + e\_lq[k]^2

maelq <- maelq + e\_lq[k]

meanlq <- meanlq + lq\_2

if (meany <= raw\_0\_1 \* meanx \* s) {

sum3\_1 <- 0

for (n in 0:s) {

fact3\_1 <- factorial(n)

x3\_1 <- (meany / meanx)^n / fact3\_1

sum3\_1 <- sum3\_1 + x3\_1

}

p0\_2\_1 <- 1 / sum3\_1

lq\_2\_1 <- (meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_1))

} else {

sum3\_11 <- 0

for (n in 0:s) {

fact3\_11 <- factorial(n)

x3\_11 <- (s \* raw\_0\_1)^n / fact3\_11

sum3\_11 <- sum3\_11 + x3\_11

}

p0\_2\_11 <- 1 / sum3\_11

lq\_2\_1 <- (s\*raw\_0\_1)\*(1-(((s \* raw\_0\_1)^s / fact2) \* p0\_2\_11))

}

e2\_1[k] <- abs(lq\_1 - lq\_2\_1)

p2\_1 <- 100 \* (e2\_1[k] / lq\_1)

mapelq2\_1 <- mapelq2\_1 + abs(p2\_1)

mselq2\_1 <- mselq2\_1 + e2\_1[k]^2

maelq2\_1 <- maelq2\_1 + e2\_1[k]

meanlq2\_1 <- meanlq2\_1 + lq\_2\_1

if (meany <= raw\_0\_2 \* meanx \* s) {

sum3\_2 <- 0

for (n in 0:s) {

fact3\_2 <- factorial(n)

x3\_2 <- (meany / meanx)^n / fact3\_2

sum3\_2 <- sum3\_2 + x3\_2

}

p0\_2\_2 <- 1 / sum3\_2

lq\_2\_2 <- (meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_2))

} else {

sum3\_22 <- 0

for (n in 0:s) {

fact3\_22 <- factorial(n)

x3\_22 <- (s \* raw\_0\_2)^n / fact3\_22

sum3\_22 <- sum3\_22 + x3\_22

}

p0\_2\_22 <- 1 / sum3\_22

lq\_2\_2 <- (s\*raw\_0\_2)\*(1-(((s \* raw\_0\_2)^s / fact2) \* p0\_2\_22))

}

e2\_2[k] <- abs(lq\_1 - lq\_2\_2)

p2\_2 <- 100 \* (e2\_2[k] / lq\_1)

mapelq2\_2 <- mapelq2\_2 + abs(p2\_2)

mselq2\_2 <- mselq2\_2 + e2\_2[k]^2

maelq2\_2 <- maelq2\_2 + e2\_2[k]

meanlq2\_2 <- meanlq2\_2 + lq\_2\_2

if (meany <= raw\_0\_3 \* meanx \* s) {

sum3\_3 <- 0

for (n in 0:s) {

fact3\_3 <- factorial(n)

x3\_3 <- (meany / meanx)^n / fact3\_3

sum3\_3 <- sum3\_3 + x3\_3

}

p0\_2\_3 <- 1 / sum3\_3

lq\_2\_3 <- (meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_3))

} else {

sum3\_33 <- 0

for (n in 0:s) {

fact3\_33 <- factorial(n)

x3\_33 <- (s \* raw\_0\_3)^n / fact3\_33

sum3\_33 <- sum3\_33 + x3\_33

}

p0\_2\_33 <- 1 / sum3\_33

lq\_2\_3 <- (s\*raw\_0\_3)\*(1-(((s \* raw\_0\_3)^s / fact2) \* p0\_2\_33))

}

e2\_3[k] <- abs(lq\_1 - lq\_2\_3)

p2\_3 <- 100 \* (e2\_3[k] / lq\_1)

mapelq2\_3 <- mapelq2\_3 + abs(p2\_3)

mselq2\_3 <- mselq2\_3 + e2\_3[k]^2

maelq2\_3 <- maelq2\_3 + e2\_3[k]

meanlq2\_3 <- meanlq2\_3 + lq\_2\_3

}

# Sorting and calculating medianaelq and q90lq

e\_lq <- sort(e\_lq)

medianaelq <- (e\_lq[4999] + e\_lq[5000]) / 2

q90lq <- (e\_lq[8999] + e\_lq[9000]) / 2

q25lq <- (e\_lq[2499] + e\_lq[2500]) / 2

# Sorting and calculating medianaelq2\_1 and q90lq2\_1

e2\_1 <- sort(e2\_1)

medianaelq2\_1 <- (e2\_1[4999] + e2\_1[5000]) / 2

q90lq2\_1 <- (e2\_1[8999] + e2\_1[9000]) / 2

q25lq2\_1 <- (e2\_1[2499] + e2\_1[2500]) / 2

# Sorting and calculating medianaelq2\_2 and q90lq2\_2

e2\_2 <- sort(e2\_2)

medianaelq2\_2 <- (e2\_2[4999] + e2\_2[5000]) / 2

q90lq2\_2 <- (e2\_2[8999] + e2\_2[9000]) / 2

q25lq2\_2 <- (e2\_2[2499] + e2\_2[2500]) / 2

# Sorting and calculating medianaelq2\_3 and q90lq2\_3

e2\_3 <- sort(e2\_3)

medianaelq2\_3 <- (e2\_3[4999] + e2\_3[5000]) / 2

q90lq2\_3 <- (e2\_3[8999] + e2\_3[9000]) / 2

q25lq2\_3 <- (e2\_3[2499] + e2\_3[2500]) / 2

matmselq[a, b] <- (mselq / 10000)

matmapelq[a, b] <- mapelq / 10000

matmaelq[a, b] <- maelq / 10000

matmeanlq[a, b] <- meanlq / 10000

matmedianlq[a,b]<- medianaelq

matq90lq[a,b]<-q90lq

matq25lq[a,b]<-q25lq

matmselq\_1[a, b] <- (mselq2\_1 / 10000)

matmapelq\_1[a, b] <- mapelq2\_1 / 10000

matmaelq\_1[a, b] <- maelq2\_1 / 10000

matmeanlq\_1[a, b] <- meanlq2\_1 / 10000

matmedianlq\_1[a,b]<- medianaelq2\_1

matq90lq\_1[a,b]<-q90lq2\_1

matq25lq\_1[a,b]<-q25lq2\_1

matmselq\_2[a, b] <- (mselq2\_2 / 10000)

matmapelq\_2[a, b] <- mapelq2\_2 / 10000

matmaelq\_2[a, b] <- maelq2\_2 / 10000

matmeanlq\_2[a, b] <- meanlq2\_2 / 10000

matmedianlq\_2[a,b]<- medianaelq2\_2

matq90lq\_2[a,b]<-q90lq2\_2

matq25lq\_2[a,b]<-q25lq2\_2

matmselq\_3[a, b] <- (mselq2\_3 / 10000)

matmapelq\_3[a, b] <- mapelq2\_3 / 10000

matmaelq\_3[a, b] <- maelq2\_3 / 10000

matmeanlq\_3[a, b] <- meanlq2\_3 / 10000

matmedianlq\_3[a,b]<- medianaelq2\_3

matq90lq\_3[a,b]<-q90lq2\_3

matq25lq\_3[a,b]<-q25lq2\_3

}

}

cat("\n\n estimates of lq for mean using substitution estimators")

cat("\t")

cat("\n\n the meanlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the meanlq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_1[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the meanlq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_2[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the meanlq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_3[a, b])

}

}

cat("\n\n estimates of lq of mse using substitution estimators")

cat("\t")

cat("\n\n the mselq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mselq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_1[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mselq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_2[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mselq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_3[a, b])

}

}

cat("\n\n estimates of lq of mape using substitution estimators")

cat("\t")

cat("\n\n the mapelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mapelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mapelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mapelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_3[a, b])

}

}

cat("\n\n estimates of lq of mae using substitution estimators")

cat("\t")

cat("\n\n the maelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the maelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the maelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the maelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_3[a, b])

}

}

cat("\n\n estimates of lq using mdae using substitution estimators")

cat("\t")

cat("\n\n the medianlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the medianlq2\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_1[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the medianlq2\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_2[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the medianlq2\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_3[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using substitution estimators")

cat("\t")

cat("\n\n the q90lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q90lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q90lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q90lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_3[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using substitution estimators")

cat("\t")

cat("\n\n the q25lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q25lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q25lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q25lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_3[a,b])

}

}

############################################################

#### 3

lm <- 36

mu <- 6

s <- 5

raw\_0\_1 <- 1.4

raw\_0\_2 <- 1.6

raw\_0\_3 <- 1.8

n1 <- c(30, 50, 100)

n2 <- c(30, 50, 100)

matmselq <- matrix(0, nrow = 3, ncol = 3)

matmselq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmapelq <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmaelq <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq90lq <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq25lq <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_3 <- matrix(0, nrow = 3, ncol = 3)

for (a in 1:3) {

for (b in 1:3) {

mselq <- 0

mselq2\_1 <- 0

mselq2\_2 <- 0

mselq2\_3 <- 0

mapelq <- 0

mapelq2\_1 <- 0

mapelq2\_2 <- 0

mapelq2\_3 <- 0

maelq <- 0

maelq2\_1 <- 0

maelq2\_2 <- 0

maelq2\_3 <- 0

meanlq <- 0

meanlq2\_1 <- 0

meanlq2\_2 <- 0

meanlq2\_3 <- 0

for (k in 1:10000) {

sx <- 0

sy <- 0

for (i in 1:n1[a]) {

random <- runif(1)

x <- log(1 - random) / (-lm)

sx <- sx + x

}

lambda <- n1[a] / sx

meanx <- sx / n1[a]

for (j in 1:n2[b]) {

random <- runif(1)

y <- log(1 - random) / (-mu)

sy <- sy + y

}

meu <- n2[b] / sy

meany <- sy / n2[b]

sum1 <- 0

for (n in 0:s) {

fact1 <- factorial(n)

x1 <- (lm / mu)^n / fact1

sum1 <- sum1 + x1

}

fact2 <- factorial(s)

p0\_1 <- 1 / sum1

sum3 <- 0

for (n in 0:s) {

fact3 <- factorial(n)

x3 <- (meany / meanx)^n / fact3

sum3 <- sum3 + x3

}

p0\_2 <- 1 / sum3

lq\_1 <- s-((lm/mu)\*(1-(((lm / mu)^s / fact2) \* p0\_1)))

lq\_2 <- s-((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2)))

e\_lq[k] <- abs(lq\_1 - lq\_2)

p\_lq <- 100 \* (e\_lq[k] / lq\_1)

mapelq <- mapelq + abs(p\_lq)

mselq <- mselq + e\_lq[k]^2

maelq <- maelq + e\_lq[k]

meanlq <- meanlq + lq\_2

if (meany <= raw\_0\_1 \* meanx \* s) {

sum3\_1 <- 0

for (n in 0:s) {

fact3\_1 <- factorial(n)

x3\_1 <- (meany / meanx)^n / fact3\_1

sum3\_1 <- sum3\_1 + x3\_1

}

p0\_2\_1 <- 1 / sum3\_1

lq\_2\_1 <- s-((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_1)))

} else {

sum3\_11 <- 0

for (n in 0:s) {

fact3\_11 <- factorial(n)

x3\_11 <- (s \* raw\_0\_1)^n / fact3\_11

sum3\_11 <- sum3\_11 + x3\_11

}

p0\_2\_11 <- 1 / sum3\_11

lq\_2\_1 <- s-((s\*raw\_0\_1)\*(1-(((s \* raw\_0\_1)^s / fact2) \* p0\_2\_11)))

}

e2\_1[k] <- abs(lq\_1 - lq\_2\_1)

p2\_1 <- 100 \* (e2\_1[k] / lq\_1)

mapelq2\_1 <- mapelq2\_1 + abs(p2\_1)

mselq2\_1 <- mselq2\_1 + e2\_1[k]^2

maelq2\_1 <- maelq2\_1 + e2\_1[k]

meanlq2\_1 <- meanlq2\_1 + lq\_2\_1

if (meany <= raw\_0\_2 \* meanx \* s) {

sum3\_2 <- 0

for (n in 0:s) {

fact3\_2 <- factorial(n)

x3\_2 <- (meany / meanx)^n / fact3\_2

sum3\_2 <- sum3\_2 + x3\_2

}

p0\_2\_2 <- 1 / sum3\_2

lq\_2\_2 <- s-((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_2)))

} else {

sum3\_22 <- 0

for (n in 0:s) {

fact3\_22 <- factorial(n)

x3\_22 <- (s \* raw\_0\_2)^n / fact3\_22

sum3\_22 <- sum3\_22 + x3\_22

}

p0\_2\_22 <- 1 / sum3\_22

lq\_2\_2 <- s-((s\*raw\_0\_2)\*(1-(((s \* raw\_0\_2)^s / fact2) \* p0\_2\_22)))

}

e2\_2[k] <- abs(lq\_1 - lq\_2\_2)

p2\_2 <- 100 \* (e2\_2[k] / lq\_1)

mapelq2\_2 <- mapelq2\_2 + abs(p2\_2)

mselq2\_2 <- mselq2\_2 + e2\_2[k]^2

maelq2\_2 <- maelq2\_2 + e2\_2[k]

meanlq2\_2 <- meanlq2\_2 + lq\_2\_2

if (meany <= raw\_0\_3 \* meanx \* s) {

sum3\_3 <- 0

for (n in 0:s) {

fact3\_3 <- factorial(n)

x3\_3 <- (meany / meanx)^n / fact3\_3

sum3\_3 <- sum3\_3 + x3\_3

}

p0\_2\_3 <- 1 / sum3\_3

lq\_2\_3 <- s-((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_3)))

} else {

sum3\_33 <- 0

for (n in 0:s) {

fact3\_33 <- factorial(n)

x3\_33 <- (s \* raw\_0\_3)^n / fact3\_33

sum3\_33 <- sum3\_33 + x3\_33

}

p0\_2\_33 <- 1 / sum3\_33

lq\_2\_3 <- s-((s\*raw\_0\_3)\*(1-(((s \* raw\_0\_3)^s / fact2) \* p0\_2\_33)))

}

e2\_3[k] <- abs(lq\_1 - lq\_2\_3)

p2\_3 <- 100 \* (e2\_3[k] / lq\_1)

mapelq2\_3 <- mapelq2\_3 + abs(p2\_3)

mselq2\_3 <- mselq2\_3 + e2\_3[k]^2

maelq2\_3 <- maelq2\_3 + e2\_3[k]

meanlq2\_3 <- meanlq2\_3 + lq\_2\_3

}

# Sorting and calculating medianaelq and q90lq

e\_lq <- sort(e\_lq)

medianaelq <- (e\_lq[4999] + e\_lq[5000]) / 2

q90lq <- (e\_lq[8999] + e\_lq[9000]) / 2

q25lq <- (e\_lq[2499] + e\_lq[2500]) / 2

# Sorting and calculating medianaelq2\_1 and q90lq2\_1

e2\_1 <- sort(e2\_1)

medianaelq2\_1 <- (e2\_1[4999] + e2\_1[5000]) / 2

q90lq2\_1 <- (e2\_1[8999] + e2\_1[9000]) / 2

q25lq2\_1 <- (e2\_1[2499] + e2\_1[2500]) / 2

# Sorting and calculating medianaelq2\_2 and q90lq2\_2

e2\_2 <- sort(e2\_2)

medianaelq2\_2 <- (e2\_2[4999] + e2\_2[5000]) / 2

q90lq2\_2 <- (e2\_2[8999] + e2\_2[9000]) / 2

q25lq2\_2 <- (e2\_2[2499] + e2\_2[2500]) / 2

# Sorting and calculating medianaelq2\_3 and q90lq2\_3

e2\_3 <- sort(e2\_3)

medianaelq2\_3 <- (e2\_3[4999] + e2\_3[5000]) / 2

q90lq2\_3 <- (e2\_3[8999] + e2\_3[9000]) / 2

q25lq2\_3 <- (e2\_3[2499] + e2\_3[2500]) / 2

matmselq[a, b] <- (mselq / 10000)

matmapelq[a, b] <- mapelq / 10000

matmaelq[a, b] <- maelq / 10000

matmeanlq[a, b] <- meanlq / 10000

matmedianlq[a,b]<- medianaelq

matq90lq[a,b]<-q90lq

matq25lq[a,b]<-q25lq

matmselq\_1[a, b] <- (mselq2\_1 / 10000)

matmapelq\_1[a, b] <- mapelq2\_1 / 10000

matmaelq\_1[a, b] <- maelq2\_1 / 10000

matmeanlq\_1[a, b] <- meanlq2\_1 / 10000

matmedianlq\_1[a,b]<- medianaelq2\_1

matq90lq\_1[a,b]<-q90lq2\_1

matq25lq\_1[a,b]<-q25lq2\_1

matmselq\_2[a, b] <- (mselq2\_2 / 10000)

matmapelq\_2[a, b] <- mapelq2\_2 / 10000

matmaelq\_2[a, b] <- maelq2\_2 / 10000

matmeanlq\_2[a, b] <- meanlq2\_2 / 10000

matmedianlq\_2[a,b]<- medianaelq2\_2

matq90lq\_2[a,b]<-q90lq2\_2

matq25lq\_2[a,b]<-q25lq2\_2

matmselq\_3[a, b] <- (mselq2\_3 / 10000)

matmapelq\_3[a, b] <- mapelq2\_3 / 10000

matmaelq\_3[a, b] <- maelq2\_3 / 10000

matmeanlq\_3[a, b] <- meanlq2\_3 / 10000

matmedianlq\_3[a,b]<- medianaelq2\_3

matq90lq\_3[a,b]<-q90lq2\_3

matq25lq\_3[a,b]<-q25lq2\_3

}

}

cat("\n\n estimates of lq for mean using substitution estimators")

cat("\t")

cat("\n\n the meanlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the meanlq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_1[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the meanlq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_2[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the meanlq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_3[a, b])

}

}

cat("\n\n estimates of lq of mse using substitution estimators")

cat("\t")

cat("\n\n the mselq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mselq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_1[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mselq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_2[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mselq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_3[a, b])

}

}

cat("\n\n estimates of lq of mape using substitution estimators")

cat("\t")

cat("\n\n the mapelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mapelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mapelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mapelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_3[a, b])

}

}

cat("\n\n estimates of lq of mae using substitution estimators")

cat("\t")

cat("\n\n the maelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the maelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the maelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the maelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_3[a, b])

}

}

cat("\n\n estimates of lq using mdae using substitution estimators")

cat("\t")

cat("\n\n the medianlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the medianlq2\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_1[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the medianlq2\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_2[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the medianlq2\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_3[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using substitution estimators")

cat("\t")

cat("\n\n the q90lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q90lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q90lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q90lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_3[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using substitution estimators")

cat("\t")

cat("\n\n the q25lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q25lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q25lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q25lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_3[a,b])

}

}

################################################

##### 4

lm <- 19

mu <- 3

s <- 7

raw\_0\_1 <- 0.92

raw\_0\_2 <- 0.94

raw\_0\_3 <- 0.96

n1 <- c(30, 50, 100)

n2 <- c(30, 50, 100)

matmselq <- matrix(0, nrow = 3, ncol = 3)

matmselq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmapelq <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmaelq <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq90lq <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq25lq <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_3 <- matrix(0, nrow = 3, ncol = 3)

for (a in 1:3) {

for (b in 1:3) {

mselq <- 0

mselq2\_1 <- 0

mselq2\_2 <- 0

mselq2\_3 <- 0

mapelq <- 0

mapelq2\_1 <- 0

mapelq2\_2 <- 0

mapelq2\_3 <- 0

maelq <- 0

maelq2\_1 <- 0

maelq2\_2 <- 0

maelq2\_3 <- 0

meanlq <- 0

meanlq2\_1 <- 0

meanlq2\_2 <- 0

meanlq2\_3 <- 0

for (k in 1:10000) {

sx <- 0

sy <- 0

for (i in 1:n1[a]) {

random <- runif(1)

x <- log(1 - random) / (-lm)

sx <- sx + x

}

lambda <- n1[a] / sx

meanx <- sx / n1[a]

for (j in 1:n2[b]) {

random <- runif(1)

y <- log(1 - random) / (-mu)

sy <- sy + y

}

meu <- n2[b] / sy

meany <- sy / n2[b]

n=4

sum1 <- 0

for (n in 0:s) {

fact1 <- factorial(n)

x1 <- (lm / mu)^n / fact1

sum1 <- sum1 + x1

}

fact2 <- factorial(s)

p0\_1 <- 1 / sum1

sum2<-0

for(r in 0:(s-n)){

fact1\_1<-factorial(r)

x2<-(lm/mu)^r / fact1\_1

sum2<-sum2+x2

}

fact2\_2<-factorial(s-n)

p0\_11<-1/sum2

sum3 <- 0

for (n in 0:s) {

fact3 <- factorial(n)

x3 <- (meany / meanx)^n / fact3

sum3 <- sum3 + x3

}

p0\_2 <- 1 / sum3

sum4<-0

for(r in 0:(s-n)){

fact3\_3<-factorial(r)

x4<-(meany/meanx)^r / fact3\_3

sum4<-sum4 + x4

}

p0\_22<-1/sum4

lq\_1 <- (((lm / mu)^s / fact2) \* p0\_1)/(((lm/mu)^(s-n) / fact2\_2)\*p0\_11)

lq\_2 <- (((meany / meanx)^s / fact2) \* p0\_2)/(((meany/meanx)^(s-n) / fact2\_2)\*p0\_22)

e\_lq[k] <- abs(lq\_1 - lq\_2)

p\_lq <- 100 \* (e\_lq[k] / lq\_1)

mapelq <- mapelq + abs(p\_lq)

mselq <- mselq + e\_lq[k]^2

maelq <- maelq + e\_lq[k]

meanlq <- meanlq + lq\_2

if (meany <= raw\_0\_1 \* meanx \* s) {

sum3\_1 <- 0

for (n in 0:s) {

fact3\_1 <- factorial(n)

x3\_1 <- (meany / meanx)^n / fact3\_1

sum3\_1 <- sum3\_1 + x3\_1

}

p0\_2\_1 <- 1 / sum3\_1

sum4\_1<-0

for (r in 0:(s-n)) {

fact4\_1 <- factorial(r)

x4\_1 <- (meany / meanx)^r / fact4\_1

sum4\_1 <- sum4\_1 + x4\_1

}

p0\_3\_1 <- 1 / sum4\_1

lq\_2\_1 <- (((meany / meanx)^s / fact2) \* p0\_2\_1) / (((meany/meanx)^(s-n) / fact2\_2)\*p0\_3\_1)

} else {

sum3\_11 <- 0

for (n in 0:s) {

fact3\_11 <- factorial(n)

x3\_11 <- (s \* raw\_0\_1)^n / fact3\_11

sum3\_11 <- sum3\_11 + x3\_11

}

p0\_2\_11 <- 1 / sum3\_11

sum4\_11 <- 0

for (r in 0:(s-n)) {

fact4\_11 <- factorial(r)

x4\_11 <- ((s-n) \* raw\_0\_1)^r / fact4\_11

sum4\_11 <- sum4\_11 + x4\_11

}

p0\_3\_11 <- 1 / sum4\_11

lq\_2\_1 <- (((s \* raw\_0\_1)^s / fact2) \* p0\_2\_11) / ((((s-n)\*raw\_0\_1)^(s-n) / fact2\_2)\*p0\_3\_11)

}

e2\_1[k] <- abs(lq\_1 - lq\_2\_1)

p2\_1 <- 100 \* (e2\_1[k] / lq\_1)

mapelq2\_1 <- mapelq2\_1 + abs(p2\_1)

mselq2\_1 <- mselq2\_1 + e2\_1[k]^2

maelq2\_1 <- maelq2\_1 + e2\_1[k]

meanlq2\_1 <- meanlq2\_1 + lq\_2\_1

if (meany <= raw\_0\_2 \* meanx \* s) {

sum3\_2 <- 0

for (n in 0:s) {

fact3\_2 <- factorial(n)

x3\_2 <- (meany / meanx)^n / fact3\_2

sum3\_2 <- sum3\_2 + x3\_2

}

p0\_2\_2 <- 1 / sum3\_2

sum4\_2 <- 0

for (r in 0:(s-n)) {

fact4\_2 <- factorial(r)

x4\_2 <- (meany / meanx)^r / fact4\_2

sum4\_2 <- sum4\_2 + x4\_2

}

p0\_3\_2 <- 1 / sum4\_2

lq\_2\_2 <- (((meany / meanx)^s / fact2) \* p0\_2\_2) / (((meany / meanx)^(s-n) / fact2\_2) \* p0\_3\_2)

} else {

sum3\_22 <- 0

for (n in 0:s) {

fact3\_22 <- factorial(n)

x3\_22 <- (s \* raw\_0\_2)^n / fact3\_22

sum3\_22 <- sum3\_22 + x3\_22

}

p0\_2\_22 <- 1 / sum3\_22

sum4\_22 <- 0

for (r in 0:(s-n)) {

fact4\_22 <- factorial(r)

x4\_22 <- ((s-n) \* raw\_0\_2)^r / fact4\_22

sum4\_22 <- sum4\_22 + x4\_22

}

p0\_3\_22 <- 1 / sum4\_22

lq\_2\_2 <- (((s \* raw\_0\_2)^s / fact2) \* p0\_2\_22) / ((((s-n) \* raw\_0\_2)^(s-n) / fact2\_2) \* p0\_3\_22)

}

e2\_2[k] <- abs(lq\_1 - lq\_2\_2)

p2\_2 <- 100 \* (e2\_2[k] / lq\_1)

mapelq2\_2 <- mapelq2\_2 + abs(p2\_2)

mselq2\_2 <- mselq2\_2 + e2\_2[k]^2

maelq2\_2 <- maelq2\_2 + e2\_2[k]

meanlq2\_2 <- meanlq2\_2 + lq\_2\_2

if (meany <= raw\_0\_3 \* meanx \* s) {

sum3\_3 <- 0

for (n in 0:s) {

fact3\_9 <- factorial(n)

x3\_3 <- (meany / meanx)^n / fact3\_9

sum3\_3 <- sum3\_3 + x3\_3

}

p0\_2\_3 <- 1 / sum3\_3

sum4\_3 <- 0

for (r in 0:(s-n)) {

fact4\_3 <- factorial(r)

x4\_3 <- (meany / meanx)^r / fact4\_3

sum4\_3 <- sum4\_3 + x4\_3

}

p0\_3\_3 <- 1 / sum4\_3

lq\_2\_3 <- (((meany / meanx)^s / fact2) \* p0\_2\_3) / (((meany / meanx)^(s-n) / fact2\_2) \* p0\_3\_3)

} else {

sum3\_33 <- 0

for (n in 0:s) {

fact3\_33 <- factorial(n)

x3\_33 <- (s \* raw\_0\_3)^n / fact3\_33

sum3\_33 <- sum3\_33 + x3\_33

}

p0\_2\_33 <- 1 / sum3\_33

sum4\_33 <- 0

for (r in 0:(s-n)) {

fact4\_33 <- factorial(r)

x4\_33 <- ((s-n) \* raw\_0\_3)^r / fact4\_33

sum4\_33 <- sum4\_33 + x4\_33

}

p0\_3\_33 <- 1 / sum4\_33

lq\_2\_3 <- (((s \* raw\_0\_3)^s / fact2) \* p0\_2\_33) / ((((s-n) \* raw\_0\_3)^(s-n) / fact2\_2) \* p0\_3\_33)

}

e2\_3[k] <- abs(lq\_1 - lq\_2\_3)

p2\_3 <- 100 \* (e2\_3[k] / lq\_1)

mapelq2\_3 <- mapelq2\_3 + abs(p2\_3)

mselq2\_3 <- mselq2\_3 + e2\_3[k]^2

maelq2\_3 <- maelq2\_3 + e2\_3[k]

meanlq2\_3 <- meanlq2\_3 + lq\_2\_3

}

# Sorting and calculating medianaelq and q90lq

e\_lq <- sort(e\_lq)

medianaelq <- (e\_lq[4999] + e\_lq[5000]) / 2

q90lq <- (e\_lq[8999] + e\_lq[9000]) / 2

q25lq <- (e\_lq[2499] + e\_lq[2500]) / 2

# Sorting and calculating medianaelq2\_1 and q90lq2\_1

e2\_1 <- sort(e2\_1)

medianaelq2\_1 <- (e2\_1[4999] + e2\_1[5000]) / 2

q90lq2\_1 <- (e2\_1[8999] + e2\_1[9000]) / 2

q25lq2\_1 <- (e2\_1[2499] + e2\_1[2500]) / 2

# Sorting and calculating medianaelq2\_2 and q90lq2\_2

e2\_2 <- sort(e2\_2)

medianaelq2\_2 <- (e2\_2[4999] + e2\_2[5000]) / 2

q90lq2\_2 <- (e2\_2[8999] + e2\_2[9000]) / 2

q25lq2\_2 <- (e2\_2[2499] + e2\_2[2500]) / 2

# Sorting and calculating medianaelq2\_3 and q90lq2\_3

e2\_3 <- sort(e2\_3)

medianaelq2\_3 <- (e2\_3[4999] + e2\_3[5000]) / 2

q90lq2\_3 <- (e2\_3[8999] + e2\_3[9000]) / 2

q25lq2\_3 <- (e2\_3[2499] + e2\_3[2500]) / 2

matmselq[a, b] <- (mselq / 10000)

matmapelq[a, b] <- mapelq / 10000

matmaelq[a, b] <- maelq / 10000

matmeanlq[a, b] <- meanlq / 10000

matmedianlq[a,b]<- medianaelq

matq90lq[a,b]<-q90lq

matq25lq[a,b]<-q25lq

matmselq\_1[a, b] <- (mselq2\_1 / 10000)

matmapelq\_1[a, b] <- mapelq2\_1 / 10000

matmaelq\_1[a, b] <- maelq2\_1 / 10000

matmeanlq\_1[a, b] <- meanlq2\_1 / 10000

matmedianlq\_1[a,b]<- medianaelq2\_1

matq90lq\_1[a,b]<-q90lq2\_1

matq25lq\_1[a,b]<-q25lq2\_1

matmselq\_2[a, b] <- (mselq2\_2 / 10000)

matmapelq\_2[a, b] <- mapelq2\_2 / 10000

matmaelq\_2[a, b] <- maelq2\_2 / 10000

matmeanlq\_2[a, b] <- meanlq2\_2 / 10000

matmedianlq\_2[a,b]<- medianaelq2\_2

matq90lq\_2[a,b]<-q90lq2\_2

matq25lq\_2[a,b]<-q25lq2\_2

matmselq\_3[a, b] <- (mselq2\_3 / 10000)

matmapelq\_3[a, b] <- mapelq2\_3 / 10000

matmaelq\_3[a, b] <- maelq2\_3 / 10000

matmeanlq\_3[a, b] <- meanlq2\_3 / 10000

matmedianlq\_3[a,b]<- medianaelq2\_3

matq90lq\_3[a,b]<-q90lq2\_3

matq25lq\_3[a,b]<-q25lq2\_3

}

}

cat("\n\n estimates of lq for mean using substitution estimators")

cat("\t")

cat("\n\n the meanlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the meanlq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_1[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the meanlq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_2[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the meanlq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_3[a, b])

}

}

cat("\n\n estimates of lq of mse using substitution estimators")

cat("\t")

cat("\n\n the mselq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mselq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_1[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mselq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_2[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mselq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_3[a, b])

}

}

cat("\n\n estimates of lq of mape using substitution estimators")

cat("\t")

cat("\n\n the mapelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mapelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mapelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mapelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_3[a, b])

}

}

cat("\n\n estimates of lq of mae using substitution estimators")

cat("\t")

cat("\n\n the maelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the maelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the maelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the maelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_3[a, b])

}

}

cat("\n\n estimates of lq using mdae using substitution estimators")

cat("\t")

cat("\n\n the medianlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the medianlq2\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_1[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the medianlq2\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_2[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the medianlq2\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_3[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using substitution estimators")

cat("\t")

cat("\n\n the q90lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q90lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q90lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q90lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_3[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using substitution estimators")

cat("\t")

cat("\n\n the q25lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q25lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q25lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q25lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_3[a,b])

}

}

#################################

##### 5

lm <- 36

mu <- 6

s <- 5

raw\_0\_1 <- 1.4

raw\_0\_2 <- 1.6

raw\_0\_3 <- 1.8

n1 <- c(30, 50, 100)

n2 <- c(30, 50, 100)

matmselq <- matrix(0, nrow = 3, ncol = 3)

matmselq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmapelq <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmaelq <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq90lq <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq25lq <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_3 <- matrix(0, nrow = 3, ncol = 3)

for (a in 1:3) {

for (b in 1:3) {

mselq <- 0

mselq2\_1 <- 0

mselq2\_2 <- 0

mselq2\_3 <- 0

mapelq <- 0

mapelq2\_1 <- 0

mapelq2\_2 <- 0

mapelq2\_3 <- 0

maelq <- 0

maelq2\_1 <- 0

maelq2\_2 <- 0

maelq2\_3 <- 0

meanlq <- 0

meanlq2\_1 <- 0

meanlq2\_2 <- 0

meanlq2\_3 <- 0

e\_lq=numeric(10000)

e2\_1=numeric(10000)

e2\_2=numeric(10000)

e2\_3=numeric(10000)

for (k in 1:10000) {

sx <- 0

sy <- 0

for (i in 1:n1[a]) {

random <- runif(1)

x <- log(1 - random) / (-lm)

sx <- sx + x

}

lambda <- n1[a] / sx

meanx <- sx / n1[a]

for (j in 1:n2[b]) {

random <- runif(1)

y <- log(1 - random) / (-mu)

sy <- sy + y

}

meu <- n2[b] / sy

meany <- sy / n2[b]

sum1 <- 0

for (n in 0:s) {

fact1 <- factorial(n)

x1 <- (lm / mu)^n / fact1

sum1 <- sum1 + x1

}

fact2 <- factorial(s)

p0\_1 <- 1 / sum1

sum3 <- 0

for (n in 0:s) {

fact3 <- factorial(n)

x3 <- (meany / meanx)^n / fact3

sum3 <- sum3 + x3

}

p0\_2 <- 1 / sum3

lq\_1 <- ((lm/mu)\*(1-(((lm / mu)^s / fact2) \* p0\_1)))/s

lq\_2 <- ((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2)))/s

e\_lq[k] <- abs(lq\_1 - lq\_2)

p\_lq <- 100 \* (e\_lq[k] / lq\_1)

mapelq <- mapelq + abs(p\_lq)

mselq <- mselq + e\_lq[k]^2

maelq <- maelq + e\_lq[k]

meanlq <- meanlq + lq\_2

if (meany <= raw\_0\_1 \* meanx \* s) {

sum3\_1 <- 0

for (n in 0:s) {

fact3\_1 <- factorial(n)

x3\_1 <- (meany / meanx)^n / fact3\_1

sum3\_1 <- sum3\_1 + x3\_1

}

p0\_2\_1 <- 1 / sum3\_1

lq\_2\_1 <- ((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_1)))/s

} else {

sum3\_11 <- 0

for (n in 0:s) {

fact3\_11 <- factorial(n)

x3\_11 <- (s \* raw\_0\_1)^n / fact3\_11

sum3\_11 <- sum3\_11 + x3\_11

}

p0\_2\_11 <- 1 / sum3\_11

lq\_2\_1 <- ((s\*raw\_0\_1)\*(1-(((s \* raw\_0\_1)^s / fact2) \* p0\_2\_11)))/s

}

e2\_1[k] <- abs(lq\_1 - lq\_2\_1)

p2\_1 <- 100 \* (e2\_1[k] / lq\_1)

mapelq2\_1 <- mapelq2\_1 + abs(p2\_1)

mselq2\_1 <- mselq2\_1 + e2\_1[k]^2

maelq2\_1 <- maelq2\_1 + e2\_1[k]

meanlq2\_1 <- meanlq2\_1 + lq\_2\_1

if (meany <= raw\_0\_2 \* meanx \* s) {

sum3\_2 <- 0

for (n in 0:s) {

fact3\_2 <- factorial(n)

x3\_2 <- (meany / meanx)^n / fact3\_2

sum3\_2 <- sum3\_2 + x3\_2

}

p0\_2\_2 <- 1 / sum3\_2

lq\_2\_2 <- ((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_2)))/s

} else {

sum3\_22 <- 0

for (n in 0:s) {

fact3\_22 <- factorial(n)

x3\_22 <- (s \* raw\_0\_2)^n / fact3\_22

sum3\_22 <- sum3\_22 + x3\_22

}

p0\_2\_22 <- 1 / sum3\_22

lq\_2\_2 <- ((s\*raw\_0\_2)\*(1-(((s \* raw\_0\_2)^s / fact2) \* p0\_2\_22)))/s

}

e2\_2[k] <- abs(lq\_1 - lq\_2\_2)

p2\_2 <- 100 \* (e2\_2[k] / lq\_1)

mapelq2\_2 <- mapelq2\_2 + abs(p2\_2)

mselq2\_2 <- mselq2\_2 + e2\_2[k]^2

maelq2\_2 <- maelq2\_2 + e2\_2[k]

meanlq2\_2 <- meanlq2\_2 + lq\_2\_2

if (meany <= raw\_0\_3 \* meanx \* s) {

sum3\_3 <- 0

for (n in 0:s) {

fact3\_3 <- factorial(n)

x3\_3 <- (meany / meanx)^n / fact3\_3

sum3\_3 <- sum3\_3 + x3\_3

}

p0\_2\_3 <- 1 / sum3\_3

lq\_2\_3 <- ((meany/meanx)\*(1-(((meany / meanx)^s / fact2) \* p0\_2\_3)))/s

} else {

sum3\_33 <- 0

for (n in 0:s) {

fact3\_33 <- factorial(n)

x3\_33 <- (s \* raw\_0\_3)^n / fact3\_33

sum3\_33 <- sum3\_33 + x3\_33

}

p0\_2\_33 <- 1 / sum3\_33

lq\_2\_3 <- ((s\*raw\_0\_3)\*(1-(((s \* raw\_0\_3)^s / fact2) \* p0\_2\_33)))/s

}

e2\_3[k] <- abs(lq\_1 - lq\_2\_3)

p2\_3 <- 100 \* (e2\_3[k] / lq\_1)

mapelq2\_3 <- mapelq2\_3 + abs(p2\_3)

mselq2\_3 <- mselq2\_3 + e2\_3[k]^2

maelq2\_3 <- maelq2\_3 + e2\_3[k]

meanlq2\_3 <- meanlq2\_3 + lq\_2\_3

}

# Sorting and calculating medianaelq and q90lq

e\_lq <- sort(e\_lq)

medianaelq <- (e\_lq[4999] + e\_lq[5000]) / 2

q90lq <- (e\_lq[8999] + e\_lq[9000]) / 2

q25lq <- (e\_lq[2499] + e\_lq[2500]) / 2

# Sorting and calculating medianaelq2\_1 and q90lq2\_1

e2\_1 <- sort(e2\_1)

medianaelq2\_1 <- (e2\_1[4999] + e2\_1[5000]) / 2

q90lq2\_1 <- (e2\_1[8999] + e2\_1[9000]) / 2

q25lq2\_1 <- (e2\_1[2499] + e2\_1[2500]) / 2

# Sorting and calculating medianaelq2\_2 and q90lq2\_2

e2\_2 <- sort(e2\_2)

medianaelq2\_2 <- (e2\_2[4999] + e2\_2[5000]) / 2

q90lq2\_2 <- (e2\_2[8999] + e2\_2[9000]) / 2

q25lq2\_2 <- (e2\_2[2499] + e2\_2[2500]) / 2

# Sorting and calculating medianaelq2\_3 and q90lq2\_3

e2\_3 <- sort(e2\_3)

medianaelq2\_3 <- (e2\_3[4999] + e2\_3[5000]) / 2

q90lq2\_3 <- (e2\_3[8999] + e2\_3[9000]) / 2

q25lq2\_3 <- (e2\_3[2499] + e2\_3[2500]) / 2

matmselq[a, b] <- (mselq / 10000)

matmapelq[a, b] <- mapelq / 10000

matmaelq[a, b] <- maelq / 10000

matmeanlq[a, b] <- meanlq / 10000

matmedianlq[a,b]<- medianaelq

matq90lq[a,b]<-q90lq

matq25lq[a,b]<-q25lq

matmselq\_1[a, b] <- (mselq2\_1 / 10000)

matmapelq\_1[a, b] <- mapelq2\_1 / 10000

matmaelq\_1[a, b] <- maelq2\_1 / 10000

matmeanlq\_1[a, b] <- meanlq2\_1 / 10000

matmedianlq\_1[a,b]<- medianaelq2\_1

matq90lq\_1[a,b]<-q90lq2\_1

matq25lq\_1[a,b]<-q25lq2\_1

matmselq\_2[a, b] <- (mselq2\_2 / 10000)

matmapelq\_2[a, b] <- mapelq2\_2 / 10000

matmaelq\_2[a, b] <- maelq2\_2 / 10000

matmeanlq\_2[a, b] <- meanlq2\_2 / 10000

matmedianlq\_2[a,b]<- medianaelq2\_2

matq90lq\_2[a,b]<-q90lq2\_2

matq25lq\_2[a,b]<-q25lq2\_2

matmselq\_3[a, b] <- (mselq2\_3 / 10000)

matmapelq\_3[a, b] <- mapelq2\_3 / 10000

matmaelq\_3[a, b] <- maelq2\_3 / 10000

matmeanlq\_3[a, b] <- meanlq2\_3 / 10000

matmedianlq\_3[a,b]<- medianaelq2\_3

matq90lq\_3[a,b]<-q90lq2\_3

matq25lq\_3[a,b]<-q25lq2\_3

}

}

cat("\n\n estimates of lq for mean using substitution estimators")

cat("\t")

cat("\n\n the meanlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the meanlq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_1[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the meanlq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_2[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the meanlq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmeanlq\_3[a, b])

}

}

cat("\n\n estimates of lq of mse using substitution estimators")

cat("\t")

cat("\n\n the mselq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mselq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_1[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mselq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_2[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mselq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmselq\_3[a, b])

}

}

cat("\n\n estimates of lq of mape using substitution estimators")

cat("\t")

cat("\n\n the mapelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mapelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mapelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mapelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmapelq\_3[a, b])

}

}

cat("\n\n estimates of lq of mae using substitution estimators")

cat("\t")

cat("\n\n the maelq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the maelq\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the maelq\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the maelq\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmaelq\_3[a, b])

}

}

cat("\n\n estimates of lq using mdae using substitution estimators")

cat("\t")

cat("\n\n the medianlq matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the medianlq2\_1 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_1[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the medianlq2\_2 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_2[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the medianlq2\_3 matrix is")

for(a in 0:3){

cat("\n\n")

for(b in 0:3){

cat("\t", matmedianlq\_3[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using substitution estimators")

cat("\t")

cat("\n\n the q90lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q90lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q90lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q90lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_3[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using substitution estimators")

cat("\t")

cat("\n\n the q25lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q25lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q25lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q25lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_3[a,b])

}

}

#####################

#### 6

lm <- 15

mu <- 4

s <- 7

raw\_0\_1 <- 1.27

raw\_0\_2 <- 1.29

raw\_0\_3 <- 1.31

n1 <- c(30, 50, 100)

n2 <- c(30, 50, 100)

matmselq <- matrix(0, nrow = 3, ncol = 3)

matmselq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmselq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmapelq <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmapelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmaelq <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmaelq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmedianlq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq90lq <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq90lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matq25lq <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_1 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_2 <- matrix(0, nrow = 3, ncol = 3)

matq25lq\_3 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_1 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_2 <- matrix(0, nrow = 3, ncol = 3)

matmeanlq\_3 <- matrix(0, nrow = 3, ncol = 3)

for (a in 1:3) {

for (b in 1:3) {

mselq <- 0

mselq2\_1 <- 0

mselq2\_2 <- 0

mselq2\_3 <- 0

mapelq <- 0

mapelq2\_1 <- 0

mapelq2\_2 <- 0

mapelq2\_3 <- 0

maelq <- 0

maelq2\_1 <- 0

maelq2\_2 <- 0

maelq2\_3 <- 0

meanlq <- 0

meanlq2\_1 <- 0

meanlq2\_2 <- 0

meanlq2\_3 <- 0

e\_lq=numeric(10000)

e2\_1=numeric(10000)

e2\_2=numeric(10000)

e2\_3=numeric(10000)

for (k in 1:10000) {

sx <- 0

sy <- 0

for (i in 1:n1[a]) {

random <- runif(1)

x <- log(1 - random) / (-lm)

sx <- sx + x

}

lambda <- n1[a] / sx

meanx <- sx / n1[a]

for (j in 1:n2[b]) {

random <- runif(1)

y <- log(1 - random) / (-mu)

sy <- sy + y

}

meu <- n2[b] / sy

meany <- sy / n2[b]

n=4

sum1 <- 0

for (r in 0:(s-n)) {

fact1 <- factorial(r)

x1 <- ((lm / mu)^r) / fact1

sum1 <- sum1 + x1

}

fact2 <- factorial(s-n)

p0\_1 <- 1 / sum1

sum3 <- 0

for (r in 0:(s-n)) {

fact3 <- factorial(r)

x3 <- ((meany / meanx)^r) / fact3

sum3 <- sum3 + x3

}

p0\_2 <- 1 / sum3

lq\_1 <- ((lm/mu)\*(1-((((lm / mu)^(s-n)) / fact2) \* p0\_1)))/(s-n)

lq\_2 <- ((meany/meanx)\*(1-((((meany / meanx)^(s-n)) / fact2) \* p0\_2)))/(s-n)

e\_lq[k] <- abs(lq\_1 - lq\_2)

p\_lq <- 100 \* (e\_lq[k] / lq\_1)

mapelq <- mapelq + abs(p\_lq)

mselq <- mselq + e\_lq[k]^2

maelq <- maelq + e\_lq[k]

meanlq <- meanlq + lq\_2

if (meany <= raw\_0\_1 \* meanx \* (s-n)) {

sum3\_1 <- 0

for (r in 0:(s-n)) {

fact3\_1 <- factorial(r)

x3\_1 <- ((meany / meanx)^r) / fact3\_1

sum3\_1 <- sum3\_1 + x3\_1

}

p0\_2\_1 <- 1 / sum3\_1

lq\_2\_1 <- ((meany/meanx)\*(1-((((meany / meanx)^(s-n)) / fact2) \* p0\_2\_1)))/(s-n)

} else {

sum3\_11 <- 0

for (r in 0:(s-n)) {

fact3\_11 <- factorial(r)

x3\_11 <- (((s-n) \* raw\_0\_1)^r) / fact3\_11

sum3\_11 <- sum3\_11 + x3\_11

}

p0\_2\_11 <- 1 / sum3\_11

lq\_2\_1 <- (((s-n)\*raw\_0\_1)\*(1-(((((s-n) \* raw\_0\_1)^(s-n)) / fact2) \* p0\_2\_11)))/(s-n)

}

e2\_1[k] <- abs(lq\_1 - lq\_2\_1)

p2\_1 <- 100 \* (e2\_1[k] / lq\_1)

mapelq2\_1 <- mapelq2\_1 + abs(p2\_1)

mselq2\_1 <- mselq2\_1 + e2\_1[k]^2

maelq2\_1 <- maelq2\_1 + e2\_1[k]

meanlq2\_1 <- meanlq2\_1 + lq\_2\_1

if (meany <= raw\_0\_2 \* meanx \* (s-n)) {

sum3\_2 <- 0

for (r in 0:(s-n)) {

fact3\_2 <- factorial(r)

x3\_2 <- ((meany / meanx)^r) / fact3\_2

sum3\_2 <- sum3\_2 + x3\_2

}

p0\_2\_2 <- 1 / sum3\_2

lq\_2\_2 <- ((meany/meanx)\*(1-((((meany / meanx)^(s-n)) / fact2) \* p0\_2\_2)))/(s-n)

} else {

sum3\_22 <- 0

for (r in 0:(s-n)) {

fact3\_22 <- factorial(r)

x3\_22 <- (((s-n) \* raw\_0\_2)^r) / fact3\_22

sum3\_22 <- sum3\_22 + x3\_22

}

p0\_2\_22 <- 1 / sum3\_22

lq\_2\_2 <- (((s-n)\*raw\_0\_2)\*(1-(((((s-n) \* raw\_0\_2)^(s-n)) / fact2) \* p0\_2\_22)))/(s-n)

}

e2\_2[k] <- abs(lq\_1 - lq\_2\_2)

p2\_2 <- 100 \* (e2\_2[k] / lq\_1)

mapelq2\_2 <- mapelq2\_2 + abs(p2\_2)

mselq2\_2 <- mselq2\_2 + e2\_2[k]^2

maelq2\_2 <- maelq2\_2 + e2\_2[k]

meanlq2\_2 <- meanlq2\_2 + lq\_2\_2

if (meany <= raw\_0\_3 \* meanx \* (s-n)) {

sum3\_3 <- 0

for (r in 0:(s-n)) {

fact3\_3 <- factorial(r)

x3\_3 <- ((meany / meanx)^r) / fact3\_3

sum3\_3 <- sum3\_3 + x3\_3

}

p0\_2\_3 <- 1 / sum3\_3

lq\_2\_3 <- ((meany/meanx)\*(1-((((meany / meanx)^(s-n)) / fact2) \* p0\_2\_3)))/(s-n)

} else {

sum3\_33 <- 0

for (r in 0:(s-n)) {

fact3\_33 <- factorial(r)

x3\_33 <- (((s-n) \* raw\_0\_3)^r) / fact3\_33

sum3\_33 <- sum3\_33 + x3\_33

}

p0\_2\_33 <- 1 / sum3\_33

lq\_2\_3 <- (((s-n)\*raw\_0\_3)\*(1-(((((s-n) \* raw\_0\_3)^(s-n)) / fact2) \* p0\_2\_33)))/(s-n)

}

e2\_3[k] <- abs(lq\_1 - lq\_2\_3)

p2\_3 <- 100 \* (e2\_3[k] / lq\_1)

mapelq2\_3 <- mapelq2\_3 + abs(p2\_3)

mselq2\_3 <- mselq2\_3 + e2\_3[k]^2

maelq2\_3 <- maelq2\_3 + e2\_3[k]

meanlq2\_3 <- meanlq2\_3 + lq\_2\_3

}

# Sorting and calculating medianaelq and q90lq

e\_lq <- sort(e\_lq)

medianaelq <- (e\_lq[4999] + e\_lq[5000]) / 2

q90lq <- (e\_lq[8999] + e\_lq[9000]) / 2

q25lq <- (e\_lq[2499] + e\_lq[2500]) / 2

# Sorting and calculating medianaelq2\_1 and q90lq2\_1

e2\_1 <- sort(e2\_1)

medianaelq2\_1 <- (e2\_1[4999] + e2\_1[5000]) / 2

q90lq2\_1 <- (e2\_1[8999] + e2\_1[9000]) / 2

q25lq2\_1 <- (e2\_1[2499] + e2\_1[2500]) / 2

# Sorting and calculating medianaelq2\_2 and q90lq2\_2

e2\_2 <- sort(e2\_2)

medianaelq2\_2 <- (e2\_2[4999] + e2\_2[5000]) / 2

q90lq2\_2 <- (e2\_2[8999] + e2\_2[9000]) / 2

q25lq2\_2 <- (e2\_2[2499] + e2\_2[2500]) / 2

# Sorting and calculating medianaelq2\_3 and q90lq2\_3

e2\_3 <- sort(e2\_3)

medianaelq2\_3 <- (e2\_3[4999] + e2\_3[5000]) / 2

q90lq2\_3 <- (e2\_3[8999] + e2\_3[9000]) / 2

q25lq2\_3 <- (e2\_3[2499] + e2\_3[2500]) / 2

matmselq[a, b] <- (mselq / 10000)

matmapelq[a, b] <- mapelq / 10000

matmaelq[a, b] <- maelq / 10000

matmeanlq[a, b] <- meanlq / 10000

matmedianlq[a,b]<- medianaelq

matq90lq[a,b]<-q90lq

matq25lq[a,b]<-q25lq

matmselq\_1[a, b] <- (mselq2\_1 / 10000)

matmapelq\_1[a, b] <- mapelq2\_1 / 10000

matmaelq\_1[a, b] <- maelq2\_1 / 10000

matmeanlq\_1[a, b] <- meanlq2\_1 / 10000

matmedianlq\_1[a,b]<- medianaelq2\_1

matq90lq\_1[a,b]<-q90lq2\_1

matq25lq\_1[a,b]<-q25lq2\_1

matmselq\_2[a, b] <- (mselq2\_2 / 10000)

matmapelq\_2[a, b] <- mapelq2\_2 / 10000

matmaelq\_2[a, b] <- maelq2\_2 / 10000

matmeanlq\_2[a, b] <- meanlq2\_2 / 10000

matmedianlq\_2[a,b]<- medianaelq2\_2

matq90lq\_2[a,b]<-q90lq2\_2

matq25lq\_2[a,b]<-q25lq2\_2

matmselq\_3[a, b] <- (mselq2\_3 / 10000)

matmapelq\_3[a, b] <- mapelq2\_3 / 10000

matmaelq\_3[a, b] <- maelq2\_3 / 10000

matmeanlq\_3[a, b] <- meanlq2\_3 / 10000

matmedianlq\_3[a,b]<- medianaelq2\_3

matq90lq\_3[a,b]<-q90lq2\_3

matq25lq\_3[a,b]<-q25lq2\_3

}

}

cat("\n\n estimates of lq for mean using substitution estimators")

cat("\t")

cat("\n\n the meanlq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmeanlq[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the meanlq\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmeanlq\_1[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the meanlq\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmeanlq\_2[a, b])

}

}

cat("\n\n estimates of lq for mean using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the meanlq\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmeanlq\_3[a, b])

}

}

cat("\n\n estimates of lq of mse using substitution estimators")

cat("\t")

cat("\n\n the mselq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmselq[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mselq\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmselq\_1[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mselq\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmselq\_2[a, b])

}

}

cat("\n\n estimates of lq of mse using alternative estimators estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mselq\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmselq\_3[a, b])

}

}

cat("\n\n estimates of lq of mape using substitution estimators")

cat("\t")

cat("\n\n the mapelq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmapelq[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the mapelq\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmapelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the mapelq\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmapelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mape using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the mapelq\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmapelq\_3[a, b])

}

}

cat("\n\n estimates of lq of mae using substitution estimators")

cat("\t")

cat("\n\n the maelq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmaelq[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_1")

cat("\t")

cat("\n\n the maelq\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmaelq\_1[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_2")

cat("\t")

cat("\n\n the maelq\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmaelq\_2[a, b])

}

}

cat("\n\n estimates of lq of mae using alternative estimators for rho\_0\_3")

cat("\t")

cat("\n\n the maelq\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmaelq\_3[a, b])

}

}

cat("\n\n estimates of lq using mdae using substitution estimators")

cat("\t")

cat("\n\n the medianlq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmedianlq[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the medianlq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmedianlq\_1[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the medianlq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmedianlq\_2[a,b])

}

}

cat("\n\n estimates of lq using mdae using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the medianlq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matmedianlq\_3[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using substitution estimators")

cat("\t")

cat("\n\n the q90lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q90lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q90lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 90th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q90lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq90lq\_3[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using substitution estimators")

cat("\t")

cat("\n\n the q25lq matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_1")

cat("\t")

cat("\n\n the q25lq2\_1 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_1[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_2")

cat("\t")

cat("\n\n the q25lq2\_2 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_2[a,b])

}

}

cat("\n\n estimates of lq using 25th percentile using alt estimators for rho\_0\_3")

cat("\t")

cat("\n\n the q25lq2\_3 matrix is")

for(a in 1:3){

cat("\n\n")

for(b in 1:3){

cat("\t", matq25lq\_3[a,b])

}

}

CODES FOR THE NON PARAMETRIC TEST

lm <- 186

> mu <- 40

> s <- 5

> raw\_0\_1 <- 0.97

> raw\_0\_2 <- 0.99

> raw\_0\_3 <- 1.01

>

> n1 <- c(30, 50, 100)

> n2 <- c(30, 50, 100)

>

> t12\_pval <- matrix(NA, 3, 3)

> t13\_pval <- matrix(NA, 3, 3)

> t14\_pval <- matrix(NA, 3, 3)

>

> # ---------- Non-parametric test function (Mann–Whitney U / Wilcoxon rank-sum) ----------

> mann\_whitney\_test <- function(a, b) {

+ test <- wilcox.test(a, b, paired = FALSE, exact = FALSE)

+ return(test$p.value)

+ }

>

> # ---------- Function to simulate ONE estimator ----------

> simulate\_estimator <- function(estimator, n1, n2, lm, mu, s, raw\_const, reps = 10000) {

+ se <- numeric(reps)

+ fact2 <- factorial(s)

+

+ for (k in 1:reps) {

+ # sample X

+ sx <- 0

+ for (i in 1:n1) {

+ random <- runif(1)

+ x <- log(1 - random) / (-lm)

+ sx <- sx + x

+ }

+ meanx <- sx / n1

+

+ # sample Y

+ sy <- 0

+ for (j in 1:n2) {

+ random <- runif(1)

+ y <- log(1 - random) / (-mu)

+ sy <- sy + y

+ }

+ meany <- sy / n2

+

+ # true reference (common across estimators)

+ sum1 <- 0

+ for (n in 0:s) {

+ sum1 <- sum1 + (lm / mu)^n / factorial(n)

+ }

+ p0\_1 <- 1 / sum1

+ lq\_1 <- ((lm / mu)^s / fact2) \* p0\_1

+

+ # estimator logic

+ if (estimator == 1) {

+ sum3 <- 0

+ for (n in 0:s) {

+ sum3 <- sum3 + (meany / meanx)^n / factorial(n)

+ }

+ p0\_2 <- 1 / sum3

+ lq\_2 <- ((meany / meanx)^s / fact2) \* p0\_2

+ se[k] <- (lq\_1 - lq\_2)^2

+

+ } else {

+ # thresholded versions

+ threshold <- raw\_const \* meanx \* s

+ if (meany <= threshold) {

+ sum3 <- 0

+ for (n in 0:s) {

+ sum3 <- sum3 + (meany / meanx)^n / factorial(n)

+ }

+ p0\_2 <- 1 / sum3

+ lq\_2 <- ((meany / meanx)^s / fact2) \* p0\_2

+ } else {

+ sum3 <- 0

+ for (n in 0:s) {

+ sum3 <- sum3 + (s \* raw\_const)^n / factorial(n)

+ }

+ p0\_2 <- 1 / sum3

+ lq\_2 <- ((s \* raw\_const)^s / fact2) \* p0\_2

+ }

+ se[k] <- (lq\_1 - lq\_2)^2

+ }

+ }

+ return(se)

+ }

>

> # ---------- Main loops ----------

> for (a in 1:3) {

+ for (b in 1:3) {

+

+ # simulate each estimator INDEPENDENTLY

+ se1 <- simulate\_estimator(1, n1[a], n2[b], lm, mu, s, NA, reps = 10000)

+ se2 <- simulate\_estimator(2, n1[a], n2[b], lm, mu, s, raw\_0\_1, reps = 10000)

+ se3 <- simulate\_estimator(3, n1[a], n2[b], lm, mu, s, raw\_0\_2, reps = 10000)

+ se4 <- simulate\_estimator(4, n1[a], n2[b], lm, mu, s, raw\_0\_3, reps = 10000)

+

+ # --- Apply Mann–Whitney U test ---

+ t12\_pval[a,b] <- mann\_whitney\_test(se1, se2)

+ t13\_pval[a,b] <- mann\_whitney\_test(se1, se3)

+ t14\_pval[a,b] <- mann\_whitney\_test(se1, se4)

+

+ }

+ }