**DIAGRAM KENDALI TEWMA-MAX UNTUK MEMANTAU RATA-RATA DAN VARIABILITAS PROSES PADA PROSES *SPINNING* BENANG PT X**

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**R Code**

library(readxl)

View(dataspinning)

#Mencari rata-rata setiap sub grup

ratarata <- rowMeans(dataspinning[-1])

dataspinning$ratarata <- ratarata

#Mencari simpangan baku setiap sub grup

simpanganbaku <- apply(dataspinning[2:6], 1, sd)

dataspinning$simpanganbaku <- simpanganbaku

#Mencari Ui dan Vi

n = nrow(dataspinning)

rataratatarget = 640

simpanganbakutarget = 27.328

for (i in 1:n) {

 #nilai Ui

 nilaiU <- (dataspinning$ratarata[i]-rataratatarget)/(simpanganbakutarget/sqrt(5))

 #nilai Vi

 q <- ((5-1)\*(dataspinning$simpanganbaku[i]^2))/(simpanganbakutarget^2)

 nilaiV <- qnorm(pchisq(q,4))

 #menyimpan ke data frame

 dataspinning[i,c("Ui", "Vi")] <- list(nilaiU, nilaiV)

}

#Mencari Gi

for (i in 1:n){

 nilaiG <- max(c(abs(dataspinning$Ui[i]), abs(dataspinning$Vi[i])))

 dataspinning[i,"Gi"] <- list(nilaiG)

}

#Mencari Yi1

lambda <- 0.2

hasilYi1 <- numeric(length(dataspinning$Gi) + 1)

hasilYi1[1] = 1.128379

for (i in 2:(length(dataspinning$Gi) + 1)) {

 hasilYi1[i] <- lambda \* dataspinning$Gi[i - 1] + (1 - lambda) \* hasilYi1[i - 1]

}

dataspinning$Yi1 <- hasilYi1[-1]

#Mencari Yi2

lambda <- 0.2

hasilYi2 <- numeric(length(dataspinning$Yi1) + 1)

hasilYi2[1] = 1.128379

for (i in 2:(length(dataspinning$Yi1) + 1)) {

 hasilYi2[i] <- lambda \* dataspinning$Yi1[i - 1] + (1 - lambda) \* hasilYi2[i - 1]

}

dataspinning$Yi2 <- hasilYi2[-1]

#Mencari Yi3

lambda <- 0.2

hasilYi3 <- numeric(length(dataspinning$Yi2) + 1)

hasilYi3[1] = 1.128379

for (i in 2:(length(dataspinning$Yi2) + 1)) {

 hasilYi3[i] <- lambda \* dataspinning$Yi2[i - 1] + (1 - lambda) \* hasilYi3[i - 1]

}

dataspinning$Yi3 <- hasilYi3[-1]

#Mencari Mi3 dan ni3

hasilmi3 <- numeric(length(dataspinning$Yi3))

hasilni3 <- numeric(length(dataspinning$Yi3))

for(i in 1:length(dataspinning$Yi3)) {

 hasilmi3[i] <- lambda^3\*abs(dataspinning$Ui[i])+lambda^2\*(1-lambda)\*hasilYi1[i]+lambda\*(1-lambda)\*hasilYi2[i]+(1-lambda)\*hasilYi3[i]

 hasilni3[i] <- lambda^3\*abs(dataspinning$Vi[i])+lambda^2\*(1-lambda)\*hasilYi1[i]+lambda\*(1-lambda)\*hasilYi2[i]+(1-lambda)\*hasilYi3[i]

 dataspinning[c("mi3", "ni3")] <- list(hasilmi3, hasilni3)

}

#Mencari nilai UCL

theta <- (1 - lambda)^2

c31 <- (6 \* (1 - lambda)^6 \* lambda) / (2 - lambda)^5 + (12 \* (1 - lambda)^4 \* lambda^2) / (2 - lambda)^4 +

 (7 \* (1 - lambda)^2 \* lambda^3) / (2 - lambda)^3 + lambda^4 / (2 - lambda)^2

#C32

AL <- numeric(length(dataspinning$X1))

AN <- numeric(length(dataspinning$X1))

AP <- numeric(length(dataspinning$X1))

AR <- numeric(length(dataspinning$X1))

AM <- numeric(length(dataspinning$X1))

AO <- numeric(length(dataspinning$X1))

AQ <- numeric(length(dataspinning$X1))

AS <- numeric(length(dataspinning$X1))

c32 <- numeric(length(dataspinning$X1))

for(i in 1:length(dataspinning$X1)){

 AL[i] <- ((theta^3)\*(lambda^6))/(4)

 AN[i] <- 2\*(theta^2)\*(lambda^6)

 AP[i] <- ((7\*theta\*(lambda^6))/(2))

 AR[i] <- lambda^6

 AM[i] <- ((i\*((i^2)-1)\*(i-2)\*(theta^(i-3)))/(1-theta))+((4\*i\*((i^2)-1)\*(theta^(i-2)))/((1-theta)^2))+((12\*i\*(i+1)\*(theta^(i-1)))/((1-theta)^3))+((24\*(i+1)\*(theta^i))/((1-theta)^4))+((24\*(theta^(i+1)))/((1-theta)^5))

 AO[i] <- ((i\*((i^2)-1)\*(theta^(i-2)))/(1-theta))+((3\*i\*(i+1)\*(theta^(i-1)))/((1-theta)^2))+((6\*(i+1)\*(theta^i))/((1-theta)^3))+((6\*(theta^(i+1)))/((1-theta)^4))

 AQ[i] <- ((i\*(i+1)\*(theta^(i-1)))/(1-theta))+((2\*(i+1)\*(theta^i))/((1-theta)^2))+((2\*(theta^(i+1)))/((1-theta)^3))

 AS[i] <- ((theta^(i+1)))/((1-theta)^2)+(((i+1)\*(theta^i))/(1-theta))

 c32[i] <- (AL[i]\*AM[i])+(AN[i]\*AO[i])+(AP[i]\*AQ[i])+(AR[i]\*AS[i])

}

#NILAI UCL

K3 <- 2.121

UCL <- numeric(length(dataspinning$X1))

for(i in 1:length(dataspinning$X1)) {

 UCL[i] <- 1.128379+0.60281\*K3\*sqrt(c31-c32[i])

}

dataspinning$UCL <- UCL

#Membuat Plot TEWMA-Max

plot(dataspinning$`Hari ke-`, dataspinning$Yi3,col = "blue", type = "b", xlab = "Sub Grup ke-", ylab = "Nilai Yi(3)", main = "Diagram Kendali TEWMA-Max pada Proses Spinning Benang PT X")

lines(dataspinning$`Hari ke-`,dataspinning$UCL, type = "l", col = "red")

legend("bottomright", legend=c("Yi3", "Batas Kendali Atas", "Penurunan Rata-rata Proses", "Penurunan Rata-rata Proses dan Kenaikan Variabilitas Proses", "Kenaikan Rata-rata Proses dan Penurunan Variabilitas Proses", "Kenaikan Rata-rata dan Variabilitas Proses", "Penurunan Rata-rata dan Variabilitas Proses"), lty = c(1,1,0,0,0,0,0,0), pch = c(NA, NA, NA, NA, NA, NA, NA, NA), col=c("blue", "red", "black", "black", "black", "black","black","black"), cex = 0.8)

legend\_x <- c(NA, NA, 26.4, 26.5, 26.5, 26.5, 26.7) #koordinat legend

legend\_y <- c(NA, NA, 1.206, 1.184, 1.16, 1.137, 1.119) #koordinat legend

text(legend\_x[3], legend\_y[3], labels="m-", col="black", cex=0.8, pos=4)

text(legend\_x[4], legend\_y[4], labels="-+", col="black", cex=0.8, pos=4)

text(legend\_x[5], legend\_y[5], labels="+-", col="black", cex=0.8, pos=4)

text(legend\_x[6], legend\_y[6], labels="++", col="black", cex=0.8, pos=4)

text(legend\_x[7], legend\_y[7], labels="--", col="black", cex=0.8, pos=4)